HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	North/Middle Fork Nooksack Native Chinook Hatchery Restoration Program
Species or Hatchery Stock:	North/Middle Fork Nooksack River Chinook (*Oncorhynchus tshawytscha*)
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Nooksack River/Puget Sound
Date Submitted:	May 1, 2013 Resubmitted September 23, 2014
Date Last Updated:	September 23, 2014

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

North/Middle Fork Nooksack Native Spring Chinook Restoration Program

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

North Fork Nooksack Spring Chinook (*Oncorhynchus tshawytscha*) – Re-affirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448).

1.3) Responsible organization and individuals

Hatchery Operations Staff Lead Contact

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

Nooksack Tribe and Lummi Natural Resources

Nooksack Salmon Enhancement Association (NSEA) - volunteers feed fish at the acclimation ponds (when in operation).

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

Funding Sources	Operational Information
General Fund – State	Full time equivalent staff – 4.29
DJ – Federal	Annual operating cost (dollars) - $676,144
Federal Restoration program	
ALEA	
Local Restoration program	

The above information for annual operating cost applies cumulatively to the Kendall Creek Hatchery Fish Programs and cannot be broken out specifically by program.

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

Broodstock Collection; Incubation Locations:

Kendall Creek Hatchery: Located at the mouth of Kendall Creek (WRIA 01.0406), tributary to the NF Nooksack River (WRIA 01.0120) at RM 46, Puget Sound, Washington.

Rearing and Release Locations:

Kendall Creek Hatchery

McKinnon pond: Located at RM 4.4, Middle Fork Nooksack (WRIA 01.0339).

Also see HGMP section 10 for all additional non-facility release sites.

1.6) Type of program.

Integrated recovery.

1.7) Purpose (Goal) of program.

Restoration. This program is to help restore indigenous spring Chinook salmon in the North Fork and Middle Fork population to 3,680 annual natural-origin spawners, and a productivity rate of 3.4 recruits per spawner (WRIA 1 SRB 2005).

1.8) Justification for the program.

Driven by chronically-low natural escapements, a restoration program for this locally-indigenous stock was developed using a strategy of increasing the numbers of smolts released and subsequently increasing the number of returning spawners. Natural-origin spawners in recent decades have been extremely low which emphasizes the importance of the hatchery component of this program as a reservoir for the genome while habitat limiting factors are being addressed.

WDFW and the tribes shall conduct the proposed program in such a way as to assure that the genetic, ecological and demographic effects on the listed Chinook salmon in the Puget Sound region do not appreciably reduce the likelihood of the survival and recovery of the Puget Sound Chinook ESU.

To minimize impacts on listed fish by WDFW facilities operation and the Kendall Creek spring Chinook program, the following Risk Aversions are included in this HGMP:

Table 1.8.1: Summary of risk aversion measures for the Kendall Creek spring Chinook program.

Potential Hazard	HGMP Reference	Risk Aversion Measures
Water Withdrawal	4.2	Well water rights are formalized through trust water right permit # G1-10562c & G1-23261c. Surface water right permit# is S1-00317. Monitoring and measurement of water usage is reported in monthly NPDES reports.
Intake Screening	4.2	The Kendall Creek gravity water intake screens are not in compliance with state and NOAA Fisheries screening criteria (NMFS 2011). These screens are identified for replacement but are a lower priority than others since listed Chinook do not occur above the rack on Kendall Creek. In most years, the creek is very low or dry during the time of spring Chinook spawning. Kendall Creek is not considered to support spawning and early rearing of bull trout due to the low elevation setting (USFWS 2004).
Effluent Discharge	4.2	This facility operates under the "Upland Fin-Fish Hatching and Rearing" National Pollution Discharge Elimination System administered by the Washington Department of Ecology (DOE) - WAG 13-3007.

Broodstock Collection & Adult Passage	5.1, 7.9, 2.2.3	The weir spanning Kendall Creek directs fish into a ladder leading into the holding pond. All returning hatchery-origin adult fish are trapped and held at the Kendall Creek Hatchery weir and trap during the entire run period to maintain the proper genetic diversity of the restored stock.
Disease Transmission	9.2.7	Co-Managers Fish Disease Policy (WDFW and WWTIT 1998, updated 2006). Details hatchery practices and operations designed to stop the introduction and/or spread of any diseases.
Competition & Predation	2.2.3, 10.11	Fish are released at times, size, life-history stage (smolts), and locations to foster rapid downstream migration to marine waters.

1.9) List of program "Performance Standards".

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

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

1.10.1) "Performance Indicators" addressing benefits.

Table 1.10.1.1: "Performance Indicators" addressing benefits.

Benefits		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
3.1.1 Program contributes to fulfilling tribal trust responsibility mandate and treaty rights as described in US v WA.	Contributes to co-manager harvest.	Participate in annual coordination between co-managers to identify and report on issues of interest, coordinate management, and review programs (FBD process, North of Falcon, HAIPs).
3.1.2 Program contributes to mitigation requirements.	This program provides mitigation for lost fish production due to impaired habitats within the Nooksack system.	Survival and contribution to fisheries will be estimated for each brood year released.
3.1.3 Program addresses ESA responsibilities.	Program complies with Federal ESA-listed fish take authorizations for harvest and hatchery actions.	HGMP updated and re-submitted to NOAA with significant changes or under permit agreement.
3.3.1 Hatchery program contributes to an increasing number of spawners returning to natural spawning areas.	Increasing total annual abundance of natural origin spawners.	Annual estimates of total spawner and origin.
3.3.2 Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production, and to evaluate effects of the program on the local natural population.	Percentage of total hatchery releases are identifiable as hatchery-origin fish. Mass-mark (fin-clips, otoliths, tags, etc.) production fish to allow for their differentiation from naturally-produced fish.	Monitor size, number, date of release and mass mark quality. Annual estimates of mass-mark rate (ad-clip + otolith, ad-clip/otolith + CWT, unclipped/otolith + CWT) of all hatchery releases. pHOS goal<0.30.

		This stock is designated as an escapement indicator stock used to evaluate the escapement of North Puget Sound natural spring Chinook annually per the Pacific Salmon Treaty (2009-2018).
3.4.1 Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of population from which broodstock is taken.	Collection of broodstock is done from hatchery returns throughout entire run period. Adhere to WDFW spawning guidelines. (Seidel 1983).	Annual run timing, age and sex composition and spawning escapement timing data are collected.
3.6.1 The hatchery program uses standard scientific procedures to evaluate various aspects of artificial propagation.	Adhere to HSRG (2004) and WDFW spawning guidelines (Seidel 1983). Apply minimal monitoring standards in the hatchery: food conversion rates, growth trajectories, mark/tag rate error, weight distribution (CV).	Annual run timing, age and sex composition data are collected upon adult return. Growth rates, mark rate and size at release and release dates are recorded annually.
3.8.3 Non-monetary societal benefits for which the program is designed are achieved.	Program is designed to help achieve the end goal of conserving and stabilizing natural salmon populations. Hatchery-produced fish contribute significant benefits to numerous directed and incidental Treaty and non-Treaty fisheries from Alaska, BC, the Washington coast, Puget Sound pre-terminal and terminal area fisheries.	Annual estimates of total stock abundance and productivity monitored towards recovery objective.

1.10.2) "Performance Indicators" addressing risks.

Table 1.10.2.1: "Performance Indicators" addressing risks.

Risks		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
3.1.3 Program addresses ESA responsibilities.	This HGMP has been submitted for program authorization under auspices of the ESA. Risks have been addressed through best available science hatchery management actions.	HGMP is updated to reflect any major changes in program and resubmitted to NOAA fisheries. Monitor juvenile hatchery fish size, number, date of release and mass-mark quality; monitor contribution of hatchery adult fish to fisheries and escapement.
3.2.2 Release groups are sufficiently marked in a manner consistent with information needs and protocols to enable determination of impacts to natural- and hatchery-origin fish in fisheries.	Percentage of total hatchery releases are identifiable as hatchery-origin fish. Mass-mark (adipose-fin clip, CWT, otolith-mark, etc., depending on species) produced fish to allow for their differentiation from	100% mass-marking as of brood year 2004. Annual harvest of mass-marked hatchery fish assessed based on CWT recovery estimates, mass marks, and reading otoliths. and creel surveys.

	naturally produced fish for selective fisheries.	CWTs and otoliths provide data on catch contributions, run timing, total survival, migration patterns, straying, in-stream evaluations of juvenile and adult behaviors, NOR/HOR ratio on the spawning grounds Because harvest of natural-origin Nooksack Chinook is tightly controlled to meet the objectives of the co-managers' Chinook harvest management plan, directed harvest of hatchery production must be conducted in a manner that will minimize impacts to natural-origin stocks.
3.3.1 Hatchery program contributes to an increasing number of spawners returning to natural spawning areas.	Total number of spawners, categorized by origin, are monitored (pHOS, spawner-recruit ratios).	Annual natural spawning estimates are total escapement estimates based on carcass and redd counts in the North Fork and Middle Fork drainages. Fish origin determined from expanded mark/tag recovery estimates and otolith data. pHOS goal <0.30.
3.3.2 Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production and to evaluate effects of the program on the local natural population.	All hatchery production is identifiable in some manner (fin-marks, tags, otolith, etc.) consistent with information needs.	Annual estimates of mass-mark (ad-clip) rate of all hatchery releases. Returning fish encountered are examined for the fin-mark and sampled for otoliths upon hatchery return and on the spawning ground. Numbers of estimated hatchery (marked) and natural (unmarked) are recorded annually. pHOS goal <0.30.
3.4.1 Fish collected for broodstock are taken throughout the return or spawning period in proportions approximating the timing and age distribution of population from which broodstock is taken.	Collection of broodstock is done randomly throughout the entire return period.	Annual run timing, age and sex composition and return timing data are collected.
3.4.2 Broodstock collection does not significantly reduce potential juvenile production in natural rearing areas.	Integrated harvest – collection of NOB does not significantly reduce potential juvenile production in the system.	Trap is checked daily. Short term PNI goal of >0.05, Long term PNI goal of >0.70.
3.4.3 Life history characteristics of the natural population do not change as a result of this hatchery program.	Life history patterns of juvenile and adult NORs are stable.	Otolith and scales are collected from adults upon return.
3.5.1 Patterns of genetic variation within and among natural	Within and between hatchery and natural-origin populations,	Currently not monitored.

populations do not change significantly as a result of artificial production.	no genetic structure differences are detected.	
3.5.2 Collection of broodstock does not adversely impact the genetic diversity of the naturally-spawning population.	Collection of broodstock is done randomly throughout the entire return period.	Annual run timing, age and sex composition and return timing data are collected. DIT groups allow evaluation of straying, in-stream evaluations of juvenile and adult behaviors, NOR/HOR ratio on the spawning grounds. This stock is designated as an escapement indicator stock used to evaluate the escapement of North Puget Sound natural spring Chinook annually per the Pacific Salmon Treaty (2009-2018).
3.5.3 Hatchery-origin adults in natural production areas do not exceed appropriate proportion of the total natural spawning population.	At recovery, the ratio of observed and/or estimated total numbers of artificially-produced fish on natural spawning grounds, to total number of naturally-produced fish (pHOS).	pHOS goal of <0.30.
3.5.4 Juveniles are released on-station, or after sufficient acclimation to maximize homing ability to intended return locations.	Fish are released in lower river locations after acclimation.	Annual release information, including location, method (forced) and age class (sub-yearlings) are recorded in hatchery data systems.
3.5.5 Juveniles are released at fully-smolted stage.	Level of smoltification at release. Forced release type.	Monitor size, number, date of release.
3.5.6 The number of adults returning to the hatchery that exceeds broodstock needs is declining.	Program is sized appropriately for recovery goals.	Numbers of adults returning to the hatchery, broodstock collected, and surplus returns are recorded annually.
3.7.1 Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols (IHOT, PNFHPC, WDFW Fish Health Policy, INAD, MDFWP).	Annual reports indicating levels of compliance with applicable standards and criteria. Periodic audits indicating level of compliance with applicable standards and criteria.	Pathologists from WDFW's Fish Health Section monitor program monthly. Exams performed at each life stage may include tests for virus, bacteria, parasites and/or pathological changes, as needed.
3.7.2 Effluent from hatchery facility will not detrimentally affect natural populations.	Discharge water quality compared to applicable water quality standards by NPDES permit. WDOE water right permit. compliance.	Flow and discharge reported in monthly NPDES reports.
3.7.3 Water withdrawals and in-stream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural	Water withdrawals compared to NMFS, USFWS and WDFW applicable passage and screening criteria for juveniles and adults.	Barrier and intake structure compliance assessed and needed fixes are prioritized.

populations, or impact juvenile rearing environment.		
3.7.4 Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens. Follow Co-managers Fish Health Disease Policy (WDFW and WWTIT 1998, revised 2006).	Necropsies of fish to assess health, nutritional status, and culture conditions.	WDFW Fish Health Section inspects adult broodstock yearly for pathogens and monitor juvenile fish on a monthly basis to assess health and detect potential disease problems. As necessary, WDFW's Fish Health Section recommends remedial or preventative measures to prevent or treat disease, with administration of therapeutic and prophylactic treatments as deemed necessary. A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings.
	Release and/or transfer exams for pathogens and parasites.	1 to 6 weeks prior to transfer or release, fish are examined in accordance with the Co-managers Fish Health Policy.
	Inspection of adult broodstock for pathogens and parasites.	At spawning, lots of 60 adult broodstock are examined for pathogens.
	Inspection of off-station fish/eggs prior to transfer to hatchery for pathogens and parasites.	Controls of specific fish pathogens through eggs/fish movements are conducted in accordance to Co-managers Fish Health Disease Policy.
3.7.5 Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines, including state, tribal and federal carcass distribution guidelines.	All applicable fish disease policies are followed. See HGMP sections 7.5 and 7.8.	Controls of specific fish pathogens through eggs/fish movements are conducted in accordance to Co-managers Fish Health Disease Policy. Disposition of carcasses are recorded in the WDFW Hatchery Adult Data.
3.7.6 Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally-produced population.	Spatial and temporal spawning distribution of natural populations above and below weir/trap currently compared to historic distribution.	Broodstock is collected throughout the entire run period. Annual run timing, age and sex composition and return timing data are collected.
3.7.7 Weir/trap operations do not result in significant stress, injury or mortality in natural populations.	All observations of natural-origin fish at hatchery facilities are recorded and reported annually.	Trap checked daily. Natural- and hatchery-origin fish abundances recorded and reported annually.
3.8.1 Cost of program operation does not exceed the net economic value of fisheries in dollars per fish for all fisheries targeting this population.	Recovery program, not applicable.	Not applicable.

1.11) Expected size of program.

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

Up to 520 adults collected annually.

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

Table 1.11.2.1: Annual Release Levels.

Life Stage	Release Location	Annual Release Level*
Sub-yearling	Kendall Creek (01.0406)	200,000
	North Fork Nooksack River (01.0120)	400,000
	Middle Fork Nooksack River (01.0339)	200,000

Data Source: WDFW, Future Brood Document 2011.

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

Based on the average smolt-to-adult survival rate of 0.30% for broodyears 2000-2004 (RMIS 2012) and a programmed release goal of 800,000 sub-yearlings, the estimated adult production (goal) level would be 2,200 fish (see table in HGMP section 3.3.1).

Table 1.12.1: Kendall Creek Hatchery spring Chinook rack escapement 2000-2011.

Year	Escapement
2000	2,095
2001	5,817
2002	5,694
2003	5,311
2004	3,529
2005	1,549
2006	743
2007	529
2008	1,194
2009	769
2010	1,252
2011	1,331
Average	**2,484**

Data Source: WDFW Hatchery Headquarter Database *2012.*

Additionally, program fish contribute to total spawning ground abundance. For annual pHOS estimates (see HGMP section 2.2.2).

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

Spring Chinook program began in 1980.

1.14) Expected duration of program.

This program was established to help recover the indigenous spring Chinook salmon in the North Fork and Middle Fork population to 3,680 natural-origin spawners annually, and a productivity rate of 3.4 recruits per spawner (WRIA 1 SRB 2005).

1.15) Watersheds targeted by program.

NF Nooksack River (WRIA 01.0120) and MF Nooksack River (WRIA 01.0339).

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

The Chinook recovery Plan (WRIA 1 SRB 2005) identified factors limiting the survival (in the freshwater environment) of natural-origin spawners in the NF and SF Nooksack River. Starting with 2002 brood, the hatchery component of this program was scaled back to reduce the number of NF Nooksack spring Chinook straying into the SF Nooksack River that were a threat to the genetic integrity of the SF stock. The co-managers will consult with NOAA Fisheries to determine the protocols for utilizing the hatchery production in a manner that most efficiently promotes the recovery of the natural spawning population. This will be done while maintaining sufficient reserves of hatchery broodstock to ensure protection against sudden reversals in natural spawning population survival.

Since the inception of the NF Nooksack spring Chinook restoration program, alternative actions to attain program goals have been a constant consideration by WDFW and the tribes. The Puget Sound Salmon Management Plan (PSSMP 1985), which is a federal court order, explicitly states that "no change may be made to the Equilibrium Brood Document (program production goals) without prior agreement of the affected parties."

SECTION 2. PROGRAM EFFECTS ON NMFS ESA-LISTED SALMONID POPULATIONS. (USFWS ESA-Listed Salmonid Species and Non-Salmonid Species are addressed in Addendum A)

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

None currently. This HGMP is submitted to 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 NMFS ESA-listed population(s) that will be directly affected by the program.

Puget Sound Chinook (*Oncorhynchus tshawytscha*): Listed as *Threatened* on March 24, 1999 (64FR14308); *Threatened* status reaffirmed on June 28, 2005 (70FR37160); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448). The Puget Sound Chinook salmon ESU is composed of 31 historically quasi-independent populations, of which 22 are believed to be extant currently. The ESU includes all naturally-spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Strait of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington, as well as twenty-six artificial propagation programs (Ford 2011). In the Nooksack basin, the TRT has identified demographically independent populations (DIPs) in the North/Middle Fork Nooksack and South Fork Nooksack River (Ruckelshaus et al. 2006).

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

Puget Sound steelhead (*Oncorhynchus mykiss*): Were listed as *Threatened* under the ESA on May 11, 2007 (72FR26722); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448). The DPS includes all naturally spawned anadromous winter-run and summer-run *O. mykiss* (steelhead) populations, below natural migration barriers in the river

basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington (Ford 2011). This DPS is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), and also includes the Green River natural and Hood Canal winter-run steelhead hatchery stocks. In the Nooksack Basin, the TRT has preliminarily delineated one DIP of winter steelhead in the Nooksack River and one DIP of summer steelhead in the South Fork Nooksack River (PSSTRT 2011).

2.2.2) Status of NMFS ESA-listed salmonid population(s) affected by the program.

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

Kendall Creek hatchery spring Chinook in Puget Sound Chinook ESU. NMFS (1999) considered this hatchery stock to be part of the ESU, and listed with natural-origin Chinook salmon that are part of the North/Middle Fork Nooksack population (70 FR 37160, June 28, 2005; NMFS SHIEER 2004). The stock designation has been assigned to the Primary category by the Co-managers, with a short term PNI benchmark goal of >.05, and a long term PNI goal of > .70 (WDFW, Nooksack and Lummi Tribes 2010). The hatchery program was started with natural-origin fish from the North Fork Nooksack River. The Kendall Creek Hatchery North/Middle Fork early Chinook supplementation program has increased abundances and largely maintains the North Fork population. Because the hatchery program has dramatically increased hatchery-origin Chinook, but natural-origin fish are only slowly increasing, a reasonable conclusion is that the main limiting factor for this population is poor habitat. Driven by chronically low natural escapements, a restoration program for this locally indigenous stock was developed using a strategy of increasing the numbers of juveniles released and subsequently increasing the number of returning spawners. Recent numbers of natural-origin spawners have been extremely low which emphasizes the importance of the hatchery component of this program as a reservoir for the genome while limiting factors are being addressed. Since that time, the program has relied totally on volunteer returns to the hatchery. In the past, hatchery and wild fish were not entirely differentiated with distinguishing marks, so it was possible that wild fish contributed to the broodstock at some level. Most spring Chinook salmon spawned in recent years have been of hatchery-origin. The proportion of natural-origin fish typically used in the broodstock is low and averaged 3.2 Chinook per brood year (WDFW unpublished otolith data).

Nooksack spring Chinook in Puget Sound Chinook ESU. Recent escapement levels (2000-2011) have averaged 1,793 natural spawners in the North/Middle Fork Nooksack River DIP and 66 (2000-2010) for the South Fork Nooksack River DIP. Both populations have shown decreasing population trends during this same period (SaSI, WDFW 2012; Natasha Geiger WDFW 2012).

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

Table 2.2.2.1: Nooksack Chinook, minimum viability spawning abundance and abundance at equilibrium or replacement, and spawning A/P at MSY for a recovered state as determined by EDT analyses of properly functioning conditions and expressed as a Beverton-Holt function. The

TRT minimum viability abundance was the equilibrium abundance or 17,000, whichever was less.

Region and population	TRT minimum viability abundance	Under properly functioning conditions (PFC)			NMFS Escapement Thresholds	
		Equilibrium abundance	Spawners at MSY	Productivity at MSY	Critical[a]	Rebuilding[b]
Strait of Georgia					400	500
NF Nooksack	16,000	16,400	3,680	3.4	200[c]	-
SF Nooksack	9,100	9,100	2,000	3.6	200[c]	-
ESU	**261,300**	**307,500**	**70,948**	**3.2**	**3,875**	**2,785**

Source: Ford 2011; NMFS 2011.

[a]Critical natural-origin escapement thresholds under current habitat and environmental conditions (McElhaney et al. 2000; NMFS 2000a).

[b]Rebuilding natural-origin escapement thresholds under current habitat and environmental conditions (McElhaney et al. 2000; NMFS 2000a).

[c]Based on generic VSP guidance (McElhaney et al. 2000; NMFS 2000a).

Nooksack River steelhead in Puget Sound steelhead DPS: The glacial hydrology and landslide prone areas in this system make it difficult to monitor data sufficiently for steelhead escapement estimates in this system. As such, data has only been collected for Nooksack winter steelhead in recent years and when conditions allow. The Nooksack has one proposed winter run steelhead population and one proposed summer run population. There are no abundance trend data for the South Fork Nooksack summer steelhead DIP and it is not currently monitored.

Puget Sound Steelhead: Updated Risk Summary. The status of the listed Puget Sound steelhead DPS has not changed substantially since the 2007 listing. Most populations within the DPS are showing continued downward trends in estimated abundance, a few sharply so (Ford 2011). For all but a few putative demographically independent populations of steelhead in Puget Sound, estimates of mean population growth rates obtained from observed spawner or redd counts are declining—typically 3 to 10% annually—and extinction risk within 100 years for most populations in the DPS is estimated to be moderate to high. Collectively, these analyses indicate that steelhead in the Puget Sound DPS remain at risk of extinction throughout all or a significant portion of their range in the foreseeable future, but are not currently in danger of imminent extinction.

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population.

Table 2.2.2.2: Nooksack River smolt trap catches and total out-migrant estimates 2004-2010.

Trap Year[a]	Sub-yearling Chinook[b]		% of Hatchery Chinook Mass-Marked	Steelhead[c]
	Wild	Hatchery		
2010	502 (114,236)	4,794	99.60%	277
2009	853 (206,231)	5,151	99.60%	570
2008	1,323 (420,194)	5,851	99.30%	351
2007	365 (63,088)	3,688	99.70%	149
2006	1,299 (275,975)	4,215	99.40%	NA
2005	885 (151,832)	3,618	100.00%	NA
2004	2,444 (59,216)	2,524	76.80%	NA
2003	5,708 (666,424)	2,120	80.90%	NA

Source: Lummi Tribe; Dolphin 2011.

[a]Corresponds with the brood year from the preceeding year (i.e. trap year 2010 = brood year 2009 Chinook).
[b]The number caught in the trap, plus (wild only) the estimated total number of migrants to pass the trap location.
[c]Field crews did not actively differentiate hatchery and wild steelhead caught in the trap.

Table 2.2.2.3: Puget Sound Chinook population average productivity for five-year intervals measured as recruits per spawner (R/S) and spawners per spawner (S/S). Trend over the intervals is also given. [a]

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**
North + Middle Fork Nooksack	*5.56*	*2.52*	*2.83*	*1.28*	*0.61*	*0.39*	*0.55*	*0.31*	*0.32*	*0.11*	*-1.28*	*-0.58*
South Fork Nooksack	*2.01*	*0.93*	*1.3*	*0.62*	*1.6*	*0.99*	*1.66*	*0.94*	*2.99*	*0.92*	*0.23*	*0.03*
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 2011.
[a] This is from analyses reported by Ford (2011). These analyses incorporate assumptions for years where escapements were not sampled for hatchery: natural-origin ratios, and are not necessarily agreed to by WDFW and Co-managers.

Table 2.2.2.4: Short and long term population trend and growth rate estimates for the Puget Sound Chinook ESU populations. [a]

Regions and Populations	Years	Trend Natural Spawners w/CI	Hatchery Fish Success = 0 Lambda w/CI	p>1	Hatchery Fish Success = 1 Lambda w/CI	p>1
Lower-North Fork-Middle Fork Nooksack Spring Run	1995-2009	1.092 (1.023 - 1.165)	1.082 (0.622 - 1.884)	0.84	0.607 (0.232 - 1.589)	0.05
	1984-2009	1.049 (0.995 - 1.106)	1.032 (0.909 - 1.172)	0.74	0.729 (0.571 - 0.93)	0.01
South Fork Nooksack River Spring Run	1995-2009	1.05 (0.995 - 1.107)	1.068 (0.507 - 2.251)	0.77	0.938 (0.388 - 2.269)	0.26
	1984-2009	1.006 (0.976 - 1.038)	1.009 (0.883 - 1.154)	0.57	0.927 (0.825 - 1.041)	0.07

Source Data: Ford 2011.
[a] This is from analyses reported by Ford (2011). These are based on analyses reported by Ford (2011) that are not necessarily agreed to by WDFW and the Co-managers. "Lambda" is a measure of population growth rate. See Ford (2011) for explanation of the meaning of the columns.

Nooksack System Steelhead: (*Oncorhynchus mykiss*) In 1996, the National Marine Fisheries Service (NMFS) listed a declining trend in the Nooksack River system of total escapement of –11.6 to –7.0, where trend is defined as percent annual change in total escapement or an index of total escapement (Busby et al. 1996). More recent expanded surveys conducted in this basin in 2003-2004, 2009/2010 & 2010/2011 indicated that a comparatively strong winter steelhead population exists (see escapement below). Summer steelhead spawn in the upper SF Nooksack River including upstream from RM 30.4, and are native with wild production and an unknown status(PSSTRT 2012 and SaSI, WDFW 2012). The level of hatchery winter run steelhead spawners in the Nooksack River is unknown, but thought to be low, as the program is modestly sized and there are no off station releases. Due to spawn timing differences between early Chambers stock steelhead and a majority of the existing wild winter population (being later February – June), interaction on the spawning grounds is unclear. Due to temporal and spatial separation from South Fork summer run steelhead, the potential for spawning ground interactions is even lower.

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

Table 2.2.2.5: Nooksack River Chinook (early) escapement from 1999-2011 (SaSI 2012).

Return Year	Escapement	
	S.F. Nooksack	N. F./MF Nooksack
1999	166	823
2000	284	1,242
2001	267	6,950[a] (2,185)
2002	289	3,741
2003	204	2,857
2004	130	1,719
2005	120	2,047
2006	355	1,184
2007	29[b]	1,438
2008	83[b]	1,266
2009	45[b]	1,903
2010	24[b]	2044
2011	NA	865
Average	**166**	**1,760**

Source: WDFW SaSI 2012 and Natasha Geiger WDFW 2012.
[a] Additionally, 4,765 hatchery Chinook were returned to the N.F. Nooksack River.
[b] Represents S.F. native NORs only, everything else is NOR and HOR combined.

Nooksack System Steelhead (*Oncorhynchus mykiss*): Glacial conditions have limited past spawner surveys throughout the Nooksack watershed. A combination of aerial and ground survey have been conducted during clear water conditions to track abundance.

Table 2.2.2.6: Nooksack River winter steelhead escapement 2004-2011.

Return Year	Escapement
2004	1,574
2005	NA
2006	NA
2007	NA
2008	NA
2009	NA
2010	1,897
2011	1,774
Average	**1,748**

Source: SaSI (WDFW 2012).

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

Table 2.2.2.7: Nooksack early Chinook spawners (*Oncorhynchus tshawytscha*) from 1998-2010.

Year	NF Nooksack River		
	Natural-Origin	Hatchery-Origin	% of Natural Origin
1998	37	333	10

1999	85	738	10.3
2000	160	1,082	12.8
2001	240	2,185*	10
2002	224	3,517	5.9
2003	210	2,647	7.3
2004	318	1,746	15.4
2005	210	1,837	10.3
2006	275	909	23.2
2007	334	1,104	23.2
2008	307	959	24.2
2009	269	1,634	14.1
2010	204	1804	10.2
Average	**221**	**1,577**	**13.6**

Source: SaSI, WDFW 2012 and Natasha Geiger WDFW 2012.
* - Does not include the 4,765 hatchery "putbacks" to the NF Nooksack.

Table 2.2.2.8[a]: Puget Sound Chinook average natural (natural origin and hatchery) and natural origin only spawners and percent hatchery contributions for five year intervals.

Return Years	1990-1994			1995-1999			2000-2004			2005-2009		
Populations	**Nat**	**%**	**NOR**	**Nat**	**%**	**NOR**	**Nat**	**%**	**NOR**	**Nat**	**%**	**NOR**
North + Middle Fork Nooksack	101	47%	52	471	71%	96	3,464	93%	229	1,666	82%	276
South Fork Nooksack	171	24%	126	217	37%	133	398	38%	235	388	37%	244
ESU	**23,938**	**75%**	**17,905**	**27,392**	**63%**	**17,245**	**43,192**	**72%**	**31,294**	**34,486**	**69%**	**23,938**

Data Source: Ford 2011. Spawning abundance averages are geometric means and hatchery contribution averages are arithmetic.
[a] This is from analyses reported by Ford (2011). These are based on analyses reported by Ford (2011) that are not necessarily agreed to by WDFW and the Co-managers.

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

- 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: All listed returning hatchery-origin adult fish are trapped and held at the Kendall Creek Hatchery weir and trap (a "run-of-the-river" operation) during the entire run period. It is necessary to block Kendall Creek and trap fish during the entire spring Chinook run to maintain the genetic diversity of the population. Take effects on all listed hatchery-origin fish collected at Kendall Creek include capture and handling. Effects will also include intentional lethal take for all adult fish retained as broodstock. To date, little natural-origin adult spring Chinook return to the hatchery weir (average 3.2 per year over last 11 years. In the past, all returning hatchery-origin adults were killed and spawned to meet the program goals for the restoration program. Currently, excess hatchery adults are surplused.

Disease effects: The risk of disease transmission to wild Chinook in the area (Puget Sound) is low. Transmission of hatchery-origin diseases from the hatchery to wild fish in areas where they co-occur is an unlikely event. Although hatchery populations can be considered to be reservoirs

for disease pathogens because of their elevated exposure to high rearing densities and stress, there is little evidence to suggest that diseases are routinely transmitted from hatchery to wild fish (Steward and Bjornn 1990). Any potential impacts are addressed by rearing the Chinook at lower densities, within widely recognized guidelines, continuing well-developed monitoring, diagnostic, and treatment programs already in place (WDFW and WWTIT 1998, updated 2006).

Juvenile releases (predation/competition): Potential take issues associated with hatchery juvenile Chinook released into the Nooksack River basin each year may include competition with and predation on naturally produced juvenile Chinook salmon. The extent of any take is unknown, however, juvenile spring Chinook salmon are released through the program at life stages and sizes that are very similar to co-occurring wild smolt out-migrants (see HGMP section 2.2.1), decreasing the likelihood for predation. Salmonid predators are generally thought to prey on fish 1/3 or less their length (USFWS 1994). Chinook salmon are released, beginning in April as smolts to foster rapid migration to minimize freshwater residence time and potential competition with listed fish (Steward and Bjornn 1990).

Facility issues: The hatchery weir spans Kendall Creek and no Chinook salmon are passed upstream. The stream has very low to no flow in the spring and summer and is not suitable for Chinook spawning and rearing. Screens on the Kendall Creek intake are currently not in compliance with state and federal standards. Since there is no Chinook production above the rack on Kendall Creek, there is no associated take.

Genetic effects: Straying of Kendall Creek Hatchery-origin adult Chinook salmon into the South Fork has been identified as a significant concern by the co-managers (Kirby 2002; Castle et al. 2002; Young and Shaklee 2002, WRIA 1 SRB, 2005). The genetic diversity of the South Fork population may be adversely affected by hatchery fish straying, and by straying of non-indigenous fall Chinook that interbreed with the native stock. Effective with the 2002 brood year, the size of the Kendall Creek Hatchery program was reduced, from 600,000 fish to150,000 fish, to reduce North Fork spring Chinook stray levels into the South Fork. Acclimation ponds have been eliminated from the current strategy in favor of releases to natural pools in the upper reaches to improve natural selection and distribution of returning adults throughout the system.

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

To date, there have been a few natural-origin volunteers trapped at hatchery and spawned for broodstock. Past takes of natural-origin spring Chinook have included capture, handling, and release of adults (up to three per year), ecological effects on the supplemented natural-origin population at unknown levels, and ecological and genetic effects on SF Nooksack spring Chinook at unknown levels. Take associated with listed Kendall Creek hatchery-origin spring Chinook has included: capture, handling, spawning, incubation and rearing of the listed species (see also HGMP section 7.4.2).

- 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).

Annual take levels for listed fish are estimated where feasible in Take table at the end of HGMP.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

Any projected take that will exceed the estimates given in this HGMP from this operation on a yearly basis would be communicated to co-managers and NOAA Fisheries 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.

WDFW hatchery programs in Puget Sound operate under and adhere to *U.S. v Washington* which provides the legal framework for coordinating these programs, defining artificial production; objectives *Comprehensive Management Plan for Puget Sound Chinook* (2004); and the Hatchery Action Implementation Plan (HAIP) for the watershed.

Resource Management Plan: Puget Sound Chinook Salmon Hatcheries- (a component of the Comprehensive Chinook Salmon Management Plan). This plan describes the operating procedures for Chinook salmon hatcheries in Puget Sound, their role in achieving the Co-managers' resource management goals, and their consistency with the protection given to Puget Sound Chinook salmon by the Endangered Species Act (ESA). The plan describes both Tribal and WDFW hatcheries, as they often operate in the same watersheds, exchange eggs, and share rearing space to maximize the effectiveness of the programs (WDFW and PSTT 2004).

Hatchery Reform- Principles and Recommendations of the Hatchery Scientific Review Group. WDFW programs have incorporated suggestions this report provided, in a detailed description of the HSRG's scientific framework, tools and resources developed for evaluating hatchery programs, the processes used to apply these tools, and the resulting principles, system-wide recommendations, and program-specific recommendations to reform (HSRG 2004) (see also HGMP section 6.2.3).

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 hatchery program, and all other WDFW anadromous salmon hatchery programs within the Puget Sound Chinook ESU, operates under *U.S v Washington* (1974) and the *Puget Sound Salmon Management Plan* (PSSMP 1985), which provides the legal framework for coordinating these programs, defining artificial production objectives, and maintaining treaty-fishing rights.

Hatchery salmon and steelhead production levels are detailed in the annual Future Brood Document. The Future Brood Document (FBD) is a pre-season planning document for fish hatchery production in Washington State for the upcoming brood stock collection and fish rearing season (July 1 – June 30). The FBD is coordinated between WDFW, the Northwest Indian Fisheries Commission (NWIFC) representing Puget Sound and coastal treaty tribes, eastern Washington treaty tribes, and Federal fish hatcheries. Hatchery production by volunteers, schools, and Regional Fisheries Enhancement Groups are represented by WDFW.

See also HGMP section 3.1.

3.3) Relationship to harvest objectives.

Tribal and non-Tribal fisheries directed at Chinook and other species produced through WDFW hatchery releases will be managed to minimize incidental effects to listed Chinook salmon. There is no directed harvest on the North Fork Chinook salmon population in the terminal area; however, there is a restricted sport fishery in mixed stock areas.

Table 3.3.1: Estimates of total exploitation rates for Nooksack early Chinook by calendar year (post-season FRAM validation estimates). The exploitation rate ceiling for Nooksack spring Chinook in Southern U.S. fisheries is currently set at 7%[a] and exploitation has averaged 1% to 4% in Southern U.S. fisheries (WDFW & PSTT 2010).

Year	Total	North	Pre-Terminal Southern US	Terminal Southern US
2001	22%	17%	2%	2%
2002	19%	17%	2%	0%
2003	19%	16%	2%	2%
2004	20%	16%	2%	2%
2005	21%	17%	2%	2%
2006	16%	11%	2%	2%
2007	20%	15%	2%	2%
2008	14%	11%	1%	2%
Average	**19%**	**15%**	**2%**	**2%**

Data Source: WDFW and PSTT 2010.

[a]Once in five years the Southern US exploitation rate ceiling identified in planning may increase from 7% to 9%.

Each year, state, federal and tribal fishery managers plan the Northwest's recreational and commercial salmon fisheries. The pre-season planning process, known as the North of Falcon (NoF) process involves a series of public meetings between federal, state, tribal and industry representatives and other concerned citizens. NoF coincides with meetings of the Pacific Fishery Management Council, which sets the ocean salmon seasons at these meetings based on needs for internal fisheries and escapements.

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

Although there is no directed commercial harvest in the terminal area, there are fisheries (below) that benefit from the program. The long-term objective of the program is to recover the stock to the extent that sustainable tribal and non-Indian fisheries harvesting NF/MF Chinook salmon can occur. The current fisheries management objective is to minimize the impact of incidental harvest to a level that does not impede recovery. Catch is incidental in the Puget Sound sport fishery (<4%), net fishery (<2%), Canadian fisheries (<10%) and Alaska fisheries.

Table 3.3.1.1: Kendall Creek Hatchery Sub-yearling Spring Chinook Fishery Contributions.

Brood Years: 2000-2004 Fishery Years: 2004-2008		
	Average SAR%[a]	**0.30**
Agency	***Non-WA Fishery***	***% of total Survival***
ADFG	All	*2.9*
CDFO	All	*45.6*
NMFS	All	*0.0*
Agency	***WA Fishery***	***% of total Survival***
WDFW	10- Ocean Troll	*0.1*
WDFW	15- Treaty Troll	*1.1*
WDFW	23- PS Net	*1.4*
WDFW	42- Ocean Sport- Private	*0.3*

WDFW	45- PS Sport	*2.5*
WDFW	46- Out of Basin Freshwater Sport (Strays)[b]	*0.2*
WDFW	50- Hatchery Escapement	*26.2*
WDFW	50- Out of Basin Hatchery Escapement (Strays)[c]	*0.1*
WDFW	52- Out of Basin Fish Trap (Strays)[d]	*0.1*
LUMM	54- Spawning Grounds	*0.4*
WDFW	54- Spawning Grounds	*18.9*
WDFW	54- Out of Basin Spawning Grounds (Strays)[e]	*0.3*
	Total	***100.0***

Source: RMIS 2012. ; based off of expanded CWT data

[a] Average SAR% = (tags recovered/tags released)

[b] Freshwater Sport based on RMIS CWT data and is unlikely to fully represent the contribution to this fishery. Strays recovered in the Skagit River.

[c] Strays recovered at Marblemount and Wallace River Hatcheries.

[d] Strays recovered at the Baker River Trap.

[e] Strays recovered on spawning grounds in WRIA 4.

3.4) Relationship to habitat protection and recovery strategies.

Puget Sound Chinook Salmon Resource Management Plan. – The hatchery component of the comprehensive Chinook salmon management plan for the region (WDFW and PSTT 2004). The Kendall Creek Hatchery program is among the WDFW-managed HGMPs included within the Co-Manager's resource management plan (RMP). The RMP is the over-arching scientific framework for joint state/tribal implementation of Chinook salmon hatchery programs in the Puget Sound region.

The WRIA 1 Salmon Recovery Plan -The WRIA 1 Salmon Recovery Board was identified as the Lead Entity in the Nooksack River basin, with the passage of resolutions by the Nooksack Tribe, Lummi Nation, Cities of Ferndale, Everson, Lynden, Sumas, Nooksack, Blaine and Bellingham; and Skagit and Whatcom counties. The WR1A 1 SRFB has developed a long-term strategy to ensure the protection and restoration of healthy salmon populations. The WRIA 1 Salmon Recovery Plan (WRIA 1 SRB, 2005) is integrated into the regional salmon recovery plan (Shared Strategy for Salmon Recovery). This "Shared Strategy" is the official ESA recovery plan. This plan provides hypotheses on what is limiting our Chinook population productivity and abundances, identifies restoration actions to address these (with emphasis on near term improvements given small population sizes) and identifies the need for regulations for proposed projects to hold our existing environmental baseline.

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 Kendall Creek Hatchery fingerling NF/MF Chinook 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 Chinook 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 Chinook 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 Chinook through predation include the following:

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

- Bull Trout

Holding and migrating adult Chinook originating from the program may also serve as prey for large, mammalian predators in marine areas, nearshore marine areas and in the Nooksack River to the detriment of population abundance and the program's success in recovery. Species that may negatively impact program fish through predation may include:

- Orcas
- Sea lions
- Harbor seals
- River otters

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

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

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

Many watersheds in the Pacific Northwest appear to be nutrient-limited (Gregory et al. 1987; Kline et al. 1997) and salmonid carcasses can be an important source of marine derived nutrients (Levy 1997). Carcasses from returning adult salmon have been found to elevate stream productivity through several pathways, including: 1) the releases of nutrients from decaying carcasses has been observed to stimulate primary productivity (Wipfli et al. 1998); 2) the decaying carcasses have been found to enrich the food base of aquatic invertebrates (Mathisen et al. 1988); and 3) juvenile salmonids have been observed to feed directly on the carcasses (Bilby et al. 1996). Addition of nutrients has been observed to increase the production of salmonids (Slaney and Ward 1993; Slaney et al. 2003; Ward et al. 2003). With integrated spawning and any carcass seeding efforts, 2,000 adult Chinook carcasses (escapement goal) could contribute, assuming average size of adult Chinook is 18 pounds, approximately 36,000 pounds of marine derived nutrients to organisms in the river.

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

- Southern Resident Killer Whale
- Northern pikeminnow
- Cutthroat trout
- Bull trout
- Steelhead
- Coho salmon
- Pacific staghorn sculpin
- Numerous marine pelagic fish species

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Table 4.1.1: Water sources available at Kendall Creek Hatchery.

Facility	Water Source	Available Water Flow (gpm)	Water Temp (F)	Usage	Limitations
Kendall Creek Hatchery	Wells (5)	Up to 12,200	47	All	No limitations
	Kendall Creek (surface)	Up to 10,700	30-50	Broodstook holding, rearing, acclimation.	Limited summer usage.
McKinnon Acclimation Pond	Unnamed stream (surface)	800-900	38-45	acclimation	No limitations

*Kendall Creek Hatchery***:** Surface and well water are both used in the production of Nooksack Chinook. Water from the (5) wells is of excellent quality, pathogen free, and has a constant year round temperature of 47°F. It is passed through a de-nitro tower to improve dissolved oxygen content.

Kendall Creek surface water levels can be very low in the summer time. During dry summers water from the wells is used to help attract adults. When available, creek water is mixed with well water and used for adult holding, rearing and on-station acclimation.

The water right permit #s are G1-10562c and G1-2361c. The WDOE surface water right permit number is S1-00317.

McKinnon Pond: Is a single pond gravity-fed by surface water from stream (01.0352) known locally as "Peat Bog Creek." Water temperatures range from 38°-45°F. The intake to McKinnon Pond consists of six intake pipes, which are deadheaded into a screened section of the creek. The water travels down to a screened collection box that removes debris. The 8-inch supply line then travels down to a 4-inch manifold that supplies the 300-ft pond. Flow to this pond has been normally 450 gpm, but recently has been upgraded through some effort to 800-900 gpm.

Water supply is affected by stream flow, which is relatively consistent, but is reduced in late summer. The outflow from the pond consists of a settling box and about 100 yards of heavily vegetated stream channel that returns directly into Peat Bog Creek. Smolting Chinook from this program are released from this facility into the Middle Fork, until such time as anadromous fish access is anticipated to be restored at the city of Bellingham's Diversion Dam.

The WDOE surface water right permit number is S1-27351.

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.

Kendall Creek Hatchery: Gravity water intake structure is in compliance with state and federal guidelines (NMFS 1995, 1996), but does not meet the current Anadromous Salmonid Passage Facility Design criteria (NMFS 2011). These screens are identified for replacement but are a lower priority than others since listed Chinook do not occur above the rack on Kendall Creek. In most years, the creek is very low or dry during the time of adult spring Chinook spawning. Wells supply most of the water needed for incubation and rearing. It is also discharged into Kendall Creek as attraction water.

This facility operates under the "Upland Fin-Fish Hatching and Rearing" National Pollution Discharge Elimination System (NPDES) general permit, which conducts effluent monitoring and

reporting and operates within the limitations established in its permit administered by the Washington DOE, WAG 13-3007. Monthly and annual reports on water quality sampling, use of chemicals at this facility, compliance records are available from DOE.

Discharges from the cleaning treatment system are monitored as follows:

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

Table 4.2.1: Record of NPDES permit compliance at Kendall Creek Hatchery.

Facility/ Permit #	Reports Submitted Y/N			Last Inspection Date	Violations Last 5 yrs (see Table 4.2.2)	Corrective Actions Y/N	Meets Compliance Y/N
	Monthly	Qtrly	Annual				
Kendall Cr WAG13-3007	Y	Y	Y	5/23/2005	1	N	Y

Source: Ann West, WDFW Hatchery Data Unit.

Table 4.2.2: List of NPDES violations at Kendall Creek Hatchery over the last five years (2008-2012).

Monitoring Month	Parameter	Sample Type	Result/ Violation	Permit Limit	Comment	Action
September 2011	N/A	N/A	DMR due to Ecology by July 30, 2011	N/A	Late DMR to Ecology	Explanation to personnel to correct procedures

Source: Ann West, WDFW Hatchery Data Unit.
Note: These violations did not result in non-compliance with NPDES permit.

McKinnon Pond: Gravity water intake screens at McKinnon ponds meet the current "Anadromous Salmonid Passage Facility Design criteria" (NMFS 2011).

Fish production is relatively small, well under the 20,000 pounds limit set by WDOE for concern regarding hatchery effluent discharge effects and for the requirement of an NPDES permit. The outflow from the pond consists of a settling box and about 100 yards of heavily vegetated stream channel that returns directly into Peat Bog Creek.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Adult collected for broodstock return as volunteers to the trap at Kendall Creek Hatchery. The weir spanning Kendall Creek directs fish into a ladder leading into the holding pond.

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

Live adults are not transported.

5.3) Broodstock holding and spawning facilities.

Broodstock is held in the center channel of the asphalt lined ½-acre adult pond. Ripe adults are killed and transported in chilled water-filled totes into the hatchery building to spawn.

5.4) Incubation facilities.

Eggs are incubated in vertical "Heath"-style incubators using pathogen-free well water that is a constant 47°F. There are 24 stacks of vertical tray with 14 usable trays each, a total of 336 trays.

The facility also has 12 freestyles available for incubation. The freestyles are capable of incubating 500,000 eggs per freestyle. In addition, there are also 34 aluminum and fiberglass shallow troughs, typically used for trout egg incubation and rearing.

Table 5.4.1: Incubation vessels available at Kendall Creek Hatchery.

Type	Number	Size
Vertical stack incubators	336 trays	24" x 25" x 3"
Troughs	24	24" x 31" x 17"

5.5) Rearing facilities.

Table 5.5.1: Rearing ponds available at Kendall Creek Hatchery.

Type	Number	Size
Asphalt-lined rearing ponds	3	Half-acre
Standard raceways	12	10' x 100' x 4'
Super-raceways	3	21’ x 130’ x 6’
Fiberglass circular ponds	2	20' diameter x 4'deep
Fiberglass circular ponds	8	16' diameter x 4'deep
Fiberglass circular ponds	6	6' diameter x 4'deep
Aluminum Capilano troughs	8	20' x 3' x 2'
Fiberglass intermediate troughs	6	11' x 3' x 36'
Fiberglass shallow troughs	34	14' x 12" x 7.5"
Fiberglass “ugly trough”	1	15' x 5' x 42'

5.6) Acclimation/release facilities.

Table 5.6.1: Fish Release Sites.

Release Site	Location
North Fork Nooksack (WRIA 01.0120)	Near Boyd Creek (WRIA 01.0492), tributary to the NF Nooksack River at RM 63.
Kendall Creek (WRIA 01.0406) (Kendall Creek Hatchery)	At the mouth of Kendall Creek; tributary to the NF Nooksack River at RM 46.
Middle Fork Nooksack (WRIA 01.0339) (McKinnon Pond)	At RM 4.4; tributary to the Nooksack River at RM 40.5.

Off-station releases to the Middle Fork and upper North Fork may need to be adjusted as necessary when conditions change due to access issues, flood damage, etc.

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

No operational difficulties have led to significant fish loss.

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.

Kendall Creek Hatchery: A hatchery employee is on stand-by at the hatchery at all times to monitor hatchery operations and respond to any unexpected events. The facility is equipped with low water alarms and a back-up generator in case of power loss, gas powered pumps in case of pump failure. Gravity-fed creek water, when available, can be used as a backup in the event of power loss.

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.

The 2012, the Legislature passed a jobs creation bill that provided WDFW with funding for hatchery capital improvements in addition to our capital budget request. At Kendall Creek Hatchery, this allowed for the following improvements:

Table 5.8.1: Hatcheries Capital Improvement Projects Funded Under the "Jobs Now Act" (2012).

Projects
Re-design and renovate current water distribution system.
Construct new two-bay pollution abatement ponds.
Renovate the current fish handling facilities

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

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

6.1) Source.

Adult Chinook salmon collected from Kendall Creek and used as broodstock are part of the extant NF Nooksack native population delineated by the Puget Sound TRT (Ruckelshaus et al. 2006).

6.2) Supporting information.

6.2.1) History.

The present program was initiated in 1980 for the purpose of preserving and increasing the abundance of the native early Chinook salmon population in the North Fork Nooksack River, which had declined to critically low abundance levels (SaSI, WDFW 2012). Fish collected for broodstock to establish the program were native spring Chinook gill-netted in Wick's Slough, a right bank side channel of the North Fork Nooksack River, just upstream of the hatchery (WRIA 1 SRB 2005). Collected adults (1980, 1981 and 1982 brood years) were transferred to the hatchery for spawning and production of predominately sub-yearling fish for release at the hatchery (WRIA 1 SRB 2005). Established spring Chinook salmon adult return to the Kendall Creek Hatchery is now the source of fish collected for broodstock.

The co-managers agreed to decrease on-station production levels and to adjust program release strategies effective 2003 to address excess adult return levels to Kendall Creek Hatchery and to decrease stray levels to the South Fork Nooksack River see Table 10.3.1).

Yearling releases were discontinued in 1998 (1996 brood year).

6.2.2) Annual size.

Up to 520 adults collected annually.

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

The past proportion of natural-origin fish incorporated as broodstock is unknown; before mass-marking hatchery fish were indistinguishable from natural-origin fish. (see HGMP section 7.3). Recent data from marked (otolith, CWT) hatchery-origin adult returns indicate that hatchery-origin fish compose the majority of the present Chinook salmon population. Current levels of natural-origin adults in the broodstock are passively attained. All trapped fish are held for broodstock consideration and unmarked fish are incorporated at the level available (Table 7.4.2).

6.2.4) Genetic or ecological differences.

Genetic analysis of natural-origin and Kendall Creek hatchery-origin spring Chinook indicate that there are no significant differences between the natural and hatchery populations, and that they are one distinct stock (Young and Shaklee 2002, SaSI 2003,SHIEER 2004).

6.2.5) Reasons for choosing.

This program artificially propagates the indigenous NF/MF spring Chinook stock for conservation purposes.

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

Broodstock is selected randomly from adults representing endemic stock through otolith analysis. Natural-origin fish are also included, to keep the hatchery and naturally-produced fish genetically similar and reduce the risk of divergence of the populations.

SECTION 7. BROODSTOCK COLLECTION

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

Adults.

7.2) Collection or sampling design.

A weir placed along Kendall Creek diverts fish into the ladder and following holding pond. Collection starts during last week of May and lasts the entire run time through September.

7.3) Identity.

Beginning with the 1983 releases a portion of the fish from this program have received an adipose fin-clip or coded-wire tag. As 2005of all fish released through this hatchery program have been consistently 100% mass marked (adipose fin-clipped and/ or coded-wire tagged). Since 1992 released fish were also otolith marked.

Coded-wire tag retrieval allows for evaluation of fishery contribution, survival rates, possible straying to other watersheds, and identification to release site.

7.4) Proposed number to be collected:

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

Up to 520 adults collected annually.

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

Table 7.4.2: Fish origin and sex composition of broodstock spawned at Kendall Creek Hatchery for spring Chinook program.

Brood Year	Spawned Total			Included in Spawned	
	Male	Female	Jack	Natural-Origin[a]	Unknown
2000	588	585	3	NA	NA
2001	486	491	4	1	8
2002	489	216	0	0	2
2003	388	213	3	5	NA
2004	488	203	0	8	NA
2005	236	218	0	0	NA
2006	197	170	3	1	17[b]

2007	280	237	3	10	5 [b]
2008	240	210	1	6	8 [b]
2009	248	225	6	3	1 [b]
2010	228	208	4	2	25 [b]
2011	218	199	8	1	0
2012	194	179	3	Unavailable	Unavailable
Avg.	**341**	**265**	**3**	**3.3**	

Source: WDFW Hatchery Headquarters Database 2013.

[a] Natural-origin fish included in the table were determined using otolith data.

[b] Otoliths were too damaged to be analyzed for origin

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

Hatchery-origin Chinook returning to the Kendall Hatchery trap in excess of broodstock needs are surplussed to the fish buyer or utilized for nutrient enhancement.

7.6) Fish transportation and holding methods.

Adults are not transported.

7.7) Describe fish health maintenance and sanitation procedures applied.

Broodstock is handled consistent with Co-Managers Fish Health Policy (1998, updated 2006). Minimized handling has greatly reduced mortality of fish and needs for medical and chemical treatment. Adults collected for broodstock at Kendall are not treated with erythromycin or formalin.

7.8) Disposition of carcasses.

Carcasses are sold to contracted fish buyer or used for nutrient enhancement.

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.

Broodstock collection is random but constrained by return timing and confirmed presence of otolith marks to ensure selection of endemic spring Chinook fish.

The risk of fish disease amplification at the hatchery is minimized by following the sanitation and fish heath maintenance and monitoring guidelines in the Co-managers Fish Health Policy (WDFW and WWTIT 1998, updated 2006).

SECTION 8. MATING

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

8.1) Selection method.

Spawners are chosen weekly based on ripeness before August 24, and ripeness confirmed identity (otolith mark) after that to exclude out of basin fall Chinook strays.

8.2) Males.

All males collected, including up to 2% jacks, are considered for spawning and chosen randomly on any spawning day.

8.3) Fertilization.

Eggs from each female are collected in separate container, mixed with milt from one male and allowed 30-60 seconds for fertilization. Then milt from a second, back up male is added in case

of poor quality milt of the primary male. The second male used was a primary male to fertilize eggs of previous female (overlapping pairwise spawning). Fertilized eggs are placed into incubators and water hardened for 1 hour in an iodophor solution of 100ppm.

8.4) Cryopreserved gametes.

Cryopreserved gametes are not used.

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

The annual collection of 520 adult fish ensures retention of an adequate effective spawning population size for the program, decreasing the likelihood for within population diversity loss. Adults to be spawned are chosen from the available gene pool. The goal is to positively identify NF Nooksack spring Chinook before they are included in the broodstock.

In an effort to minimize directed, artificial selection of traits that could negatively affect this listed population, proper spawning protocols are implemented to maximize the representation of each individual adult into the entire brood.

SECTION 9. INCUBATION AND REARING -

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

9.1) Incubation:

Current egg-take goal (FBD 2012) for spring Chinook program at Kendall Creek Hatchery is 900,000.

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

Table 9.1.1.1: Survival rates from egg-take to ponding, spring Chinook collected at Kendall Creek Hatchery, 2000-2011.

Brood Year	Eggs Collected	Green-to-Eye-Up	Eye-Up-to-Ponding
2000	2,303,000	85.2	89.4
2001	1,956,000	93.5	97.3
2002	878,000	92.7	96.7
2003	870,000	95.3	98.6
2004	808,000	95.6	98.0
2005	832,000	97.9	98.0
2006	767,000	95.2	94.2
2007	792,000	97.3	98.0
2008	778,700	95.6	98.0
2009	839,800	94.9	98.1
2010	832,000	97.5	98.7
2011	839,960	98.3	99.0
Average	**1,041,372**	**94.9**	**97.0**

Data Source: Hatchery Records, 2012.

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

Current management approach does not allow for the taking of eggs in surplus of program goal.

9.1.3) Loading densities applied during incubation.

Fertilized eggs are placed in vertical trays up to 7,000 eggs per tray.

9.1.4 Incubation conditions.

All eggs are incubated in trays on high-quality, pathogen-free well water at constant temperature of 47°F and water flow of 3.5 gpm. Dissolved oxygen levels are monitored. Vexar™ layers are placed in trays as a substrate substitute. Chillers are used to lower water temperature to create otolith marks.

9.1.5) Ponding.

When 100% buttoned up, (December, January, condition factor (KD) ranges from 1.97 to 2.04 and corresponds to approximately 1,800TU) fish are moved to standard raceways.

9.1.6) Fish health maintenance and monitoring.

All eggs are fertilized and water hardened in an iodophor solution. Fungus in incubators is controlled by a formalin drip, (15-minute injection per day at a target dose of 1,667-ppm formalin), throughout incubation to just prior to hatching. At approximately 600 TUs eggs are shocked and dead eggs are removed. Fry loss is picked at the time of ponding and then daily.

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

Eggs are incubated on high quality, pathogen-free well water. Chinook eggs retained in the Heath stacks are held at relatively low loading densities. Mortality due to fungus infection is controlled and water temperatures and dissolved oxygen levels are monitored.

All systems are alarmed with 24-hr/day monitoring and an emergency backup generator.

9.2) Rearing:

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

Table 9.2.1.1: Survival rates from ponding to release, spring Chinook sub-yearlings reared at Kendall Creek Hatchery, 2000-2011.

Brood Year	Survival Rates (%)
2000	93.9
2001	98.1
2002	98.9
2003	97.6
2004	99.8
2005	99.7
2006	97.1
2007	99.5
2008	99.8
2009	99.7
2010	99.8

2011	99.8
Average	**98.6**

Data Source: Hatchery Records 2012.

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

Loading and density levels at WDFW hatcheries conform to standards and guidelines set forth in Fish Hatchery Management (Piper et al. 1982) and co-managers Fish Health Policy (WDFW and WWTIT 1998, updated 2006). Fish rearing densities are maintained at maximum less than 3 lbs of fish /gpm at release and under 0.35 lbs/ft^3.

Actual levels reached were 1.90lbs/gpm and a density index of less than 0.2 lbs/ft^3.

9.2.3) Fish rearing conditions.

All spring Chinook are reared on well water; per FBD, fish released to the MF Nooksack are held on pathogen-free water. The portion of fish released on-station may be reared on well/creek water mix if creek water is available. Fish are marked in February at 100-200 fpp.

9.2.4) Indicate biweekly or monthly fish growth information (average program performance), including length, weight, and condition factor data collected during rearing, if available.

Table 9.2.4: Average size (fpp), by month, of juvenile spring Chinook reared at Kendall Creek Hatchery.

Month	Average Size (fpp)
January	1,200
February	500
March	250
April	100
May	80

Data Source: Hatchery Records 2012.

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).

Spring Chinook are fed a variety of diet formulations including starter, crumbles and pellets of Bio-Oregon brand. Feeding frequencies vary depending on the fish size and water temperature and usually begin at 4 feedings/7 days a week and end at 1 feeding/7 days a week. Feed rates vary from 1.5% to 3.0% B.W./day. An overall season food conversion rate is approximately 0.6:1.

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

Fish health is monitored on a daily basis by hatchery staff and at least monthly by a state Fish Health Specialist. Hatchery personnel carry out treatments prescribed by the FHS. Procedures are consistent with the Co-Manager's Fish Health Policy (WDFW and WWTIT 1998, updated 2006).

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

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

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

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

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

All reasonable and prudent measures are employed to minimize rearing and incubation losses. These include the use of high quality well water for incubation, use of high quality feeds for rearing, rearing densities and loadings that conform to best management practices and frequent fish health inspections.

SECTION 10. RELEASE

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

10.1) Proposed fish release levels.

Table 10.1.1: Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Sub-yearling	200,000	100	April 15	Nooksack River (see Table 10.3.1)
	200,000	100	May	
	400,000	80		

Data Source: WDFW, Future Brood Document 2012.

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

Off-station releases to the Middle Fork and upper North Fork may need to be adjusted as necessary when conditions change due to access issues, flood damage, etc.

Stream, river, or watercourse:
1. Kendall Creek (WRIA 01.0406)
2. NF Nooksack River (WRIA 01.0120)
3. MF Nooksack River (WRIA 01.0339)

Release point:
1. RM 0.25 (Kendall Creek Hatchery), tributary to the NF Nooksack River at RM 45.9
2. In the vicinity of Boyd Creek (WRIA 01.0490) , tributary to the NF Nooksack River at RM 63
3. McKinnon Pond, located at on an unnamed outlet creek (01.0352), tributary to MF Nooksack River at RM 4.75

Major watershed: Nooksack River

Basin or Region: Puget Sound

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

Table 10.3.1: Numbers released, by year, age and size.

Release Year	MF Nooksack		NF Nooksack		Kendall Creek	
	Sub-yearling	Avg. Size (fpp)	Sub-yearling	Avg. Size (fpp)	Sub-yearling	Avg. Size (fpp)
2000	----	----	1,081,800	86	631,000	79
2001	203,900	70	1,018,900	73	424,500	66
2002	222,500	93	1,079,800	84	443,000	78
2003	197,500	92	422,200	92	158,700	93

2004	217,000	91	432,600	91	148,000	88
2005	208,000	88	442,000	71	114,000	78
2006	210,000	69	537,000	69	107,500	82
2007	167,000	90	349,100	81	158,900	81
2008	220,000	100	446,700	86	193,500	86
2009	215,000	83	369,500	83	170,000	84
2010	222,000	100	438,028	80	162,350	86
2011	205,650	94	438,472	77	166,920	88
Average	**208,050**	**88**	**588,008**	**81**	**239,864**	**82**

Data Source: WDFW Hatchery Plants database, 2011, FishBooks 2011.

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

Table 10.4.1: Release dates, by year, and location.

Release Year	Date(s)		
	MF Nooksack	**NF Nooksack**	**Kendall Creek**
2000	-----	5/1-31	5/15, 6/2
2001	5/15	5/5-6/13	6/3
2002	5/5-8, 5/6-7	3/4-5/31	4/19, 6/1
2003	5/7	5/9-12, 16-19, 23-27	4/14, 30, 5/27
2004	5/5	5/6, 12, 18	4/15, 5/1, 24
2005	5/5	5/4, 12, 17, 26	4/14, 5/1
2006	5/17-18	5/8, 16, 22, 31	4/14, 5/1
2007	5/16	5/8, 15, 22	4/16, 5/1, 31
2008	5/12	5/8, 13, 20	5/3, 14
2009	5/12	5/7, 13, 14	4/15, 5/4, 15
2010	5/12	5/13, 18, 25	4/15, 5/3, 25
2011	5/18	5/11, 19, 23	4/15, 5/1, 24

Data Source: WDFW Hatchery Plants database, 2011, FishBooks 2011.

Fish released from Kendall Creek Hatchery and into Boyd Creek are forced released. Fish at McKinnon are released volitionally for couple of weeks and then forced.

10.5) Fish transportation procedures, if applicable.

Juveniles are transported to release sites in 400 and 850-gallon tanks (250 and 675 pounds of fish, respectively), equipped with aerators and oxygen tanks. Transportation time to the acclimation sites is approximately half an hour.

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

Portion of on-station releases can be reared on well/creek water mix if creek water is available. If not they are reared on well water only. The remaining fish are reared on well water only.

Fish transferred to McKinnon can leave without restrictions; there are no structures in the pond to hold them in. Fish that stay for more than two weeks are eventually forced from the pond.

There is no holding pond at Boyd Creek. Fish are released directly into the creek.

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

Table 10.7.1. Marks Applied to Kendall Creek spring Chinook Releases.

Brood Year	Sub-yearling	Marking
2012	400,000	AD+OT
	200,000	AD+CWT+OT
	200,000	CWT+OT

Data Source: WDFW, Future Brood Document 2012.

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

No program surplus exists in this recovery program at time of release.

10.9) Fish health certification procedures applied pre-release.

Prior to release, fish health is monitored and the fish health status of the population is certified by a WDFW Fish Health Specialist.

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

Flooding has not caused major fish losses in the past at Kendall Creek. Staff is on duty 24 hours a day to respond to alarms. Generators and creek water back up water supply system failure.

Hatcheries Standby Procedures (revised in March 2012), a guideline developed by WDFW, includes information regarding proper actions to follow by hatchery employees in the case of an emergency.

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

The production and release of only smolts through fish culture and volitional release practices fosters rapid seaward migration with minimal delay in the rivers, limiting interactions with listed Chinook. Fish are visually monitored for smolting activities to ensure that they are released fully smolted to ensure actively downstream migration. In addition, a coefficient of variation (CV) for length at release of 10.0% or less is desirable in order to increase the likelihood that most of the fish are ready to migrate (Fuss and Ashbrook 1995).

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

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

The purpose of monitoring is to identify and evaluate the benefits and risks from this hatchery program, elements of which are identified in HGMP section 1.10.

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

Each production group is identified with distinct otolith marks, adipose clips, coded-wire tags, or other identification methods as they become available. This allows selective harvest on hatchery stocks when appropriate, and monitoring hatchery and wild Chinook abundances of the target population. Through extensive annual spawning ground surveys, co-managers will monitor the Chinook salmon escapement into the target and non-target Chinook populations to estimate the number of tagged, un-marked and marked fish escaping into the North, Middle and South Fork sub-basins each year. Escapement reports by the co-managers provide adult return and stray rate monitoring and evaluation results for the hatchery program.

In addition, another important aspect of hatchery management is the monitoring and evaluation of the genetic profile of hatchery stock(s) and of nearby natural stock(s). This is an ongoing monitoring need to evaluate changes in the genetic structure of both hatchery and natural populations and the amount, in geographic extent, of gene flow between them. A recent technical report by WDFW (Young and Shaklee 2002) evaluates the genetic profiles of extant Chinook salmon stocks in the Nooksack River basin, producing a baseline for on-going, future evaluations of Kendall Creek Hatchery program effects.

Continued coded-wire tagging and otolith marking of fish will allow identification at the hatchery rack and on the spawning grounds. All broodstock returning to the hatchery will have their coded-wire tags and otoliths read to maintain separation between spring and fall Chinook stocks. Co-managers shall continue to monitor Chinook escapement to the NF, MF and SF Nooksack River to estimate the number of tagged, untagged and marked fish escaping or straying to the river each year. That, coupled with the revised development of a baseline microsatellite DNA profile, will allow a more precise evaluation of the natural-origin spawner production from the watersheds. This monitoring will allow for assessment of the status of the target population and the success of the program in achieving restoration objectives.

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

Funding and resources are currently committed to monitor and evaluate this program as detailed in the Resource Management Plan for Puget Sound Chinook Salmon Hatcheries (2004). Additional funding and resources are needed to monitor and evaluate this program as well as to analyze samples for DNA profiles.

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

Monitoring and evaluation has/will be undertaken, with consultation with NOAA Fisheries, in a manner which does not result in an unauthorized take of listed Chinook.

SECTION 12. RESEARCH

12.1) Objective or purpose.

No current research is directly associated with the program.

12.2) Cooperating and funding agencies.

Not applicable

12.3) Principle investigator or project supervisor and staff.

Not applicable

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

Not applicable

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

Not applicable

12.6) Dates or time period in which research activity occurs.

Not applicable

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

Not applicable

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

Not applicable

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

Not applicable

12.10) Alternative methods to achieve project objectives.

Not applicable

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

Not applicable

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

Not applicable

SECTION 13. ATTACHMENTS AND CITATIONS

Bilby R.E., B.R. Fransen, and P.A. Bisson. 1996. Incorporation of nitrogen and carbon from spawning coho salmon into the trophic system of small streams: evidence from stable isotopes. Canadian Journal of Fisheries and Aquatic Sciences 53:164–173.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L. Leirheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. 1996. U.S. Dep. Commerce NOAA Tech. Memo. NMFS-NWFSC-27, 261 pp.

Castle, P., N. Currence, A. Chapman, D. Huddle, and D. Griggs. 2002. Potential modifications to the Kendall hatchery Chinook program. Lummi Fisheries. Lummi Indian Nation. Technical Report. Bellingham, Washington. 8 pp.

Ford, M.J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-113, 281 p.

Fuss, H. and C. Ashbrook. 1995. Hatchery operation plan and performance summaries (HOPPS). Washington Department of Fish and Wildlife. Olympia, Washington.

Good, T.P., R.S. Waples, and P. Adams, (editors). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Department Commerce. NOAA Tech. Memo. NMFS-NWFSC-66.

Gregory, S.V., G.A. Lamberti, D.C. Erman, K.V. Koski, M.L. Murphy, and J.R. Sedell. 1987. Influence of forest practices on aquatic production. *In* Salo, EO and Cundy TW. (editors), Streamside management: forestry and fishery interactions. Institute of Forest Resources, University of Washington. Seattle, Washington.

HSRG (Hatchery Scientific Review Group). 2002. Nooksack/Samish Briefing Book.

HSRG (Hatchery Scientific Review Group). 2004. Hatchery reform; principles and recommendations of the Hatchery Scientific Review Group. Long Live the Kings. Seattle, Washington. Available from: http://hatcheryreform.us/hrp_downloads/reports/hsrg_princ_recs_report_full_apr04.pdf

Kirby, G. 2002. Assessment of release strategies for Nooksack River Chinook supplementation program. Northwest Indian Fisheries Commission. Mount Vernon, Washington. 26 pp.

Kline, T.C. Jr., J.J. Goring, Q.A. Mathisen, and P.H. Poe. 1997. Recycling of elements transported upstream by runs of Pacific salmon: I _^{15}N and _^{13}C evidence in Sashin Creek, southeastern Alaska. Canadian Journal of Fisheries and Aquatic Sciences 47(1): 136-144.

Levy, S. 1997. Pacific salmon bring it all back home: Even in death these fish fuel life in their natal streams. Bio Science 47(10): 657-660.

Mathisen, O.A., P.L. Parker, J.J. Goering, T.C. Kline, P.H. Poe and R.S. Scalan. 1988. Recycling of marine elements transported into freshwater systems by anadromous salmon. International Association of Theoretical and Applied Limnology 23: 2249-2258.

McElhaney, P., M. H. Ruckelshaus, M. J. Ford, and T. C. Wainwright. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-42, 156 pp.

NMFS (National Marine Fisheries Service). 1999. Endangered and threatened species: Threatened status for three Chinook salmon Evolutionarily Significant Units in Washington and Oregon, and Endangered status for one Chinook salmon ESU in Washington; final rule. Partial 6-month extension on final listing determinations for four Evolutionarily Significant Units of West Coast Chinook salmon; proposed rule. Federal Register 64:14308-14328.

NMFS (National Marine Fisheries Service). 2000a. A risk assessment procedure for evaluating harvest mortality of Pacific salmonids. National Marine Fisheries Service, Sustainable Fisheries Division, Northwest Region. May 30. 33pp.

NMFS (National Marine Fisheries Service). 2007. Endangered and threatened species: final listing determination for Puget Sound steelhead. Federal Register 72FR26722.

NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.

NMFS (National Marine Fisheries Service). 2011. Evaluation of and recommended determination on a Resource Management Plan (RMP), pursuant to the salmon and steelhead 4(d) rule: Comprehensive management plan for Puget Sound Chinook: harvest management component. U.S. Department of Commerce, NOAA. FINWRI2010/06051.

NMFS SHIEER 2004, 70 FR 37160. June 28, 2005 - Final ESA listing determinations for 16 ESUs of West Coast salmon, and final 4(d) protective regulations for threatened salmonid ESUs; NMFS 2004. Salmonid Hatchery Inventory and Effects Evaluation Report (SHIEER). An evaluation of the effects of artificial propagation on the status and likelihood of extinction of west coast salmon and steelhead under the Federal Endangered Species Act. May 28, 2004. Technical Memorandum NMFS-NWR/SWR. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Portland, Oregon. 557p.

NPPC (Northwest Power Planning Council). 2001. Performance standards and indicators for the use of artificial production for anadromous and resident fish populations in the Pacific Northwest. Portland, Oregon. 19 pp.

Piper, R., I.B. McElwain, L.E. Orme, J.P. McCraren, L.G. Fowler, J.R. Leonard, A.J. Trandahl, and V. Adriance. 1982. Fish Hatchery Management. United States Dept of Interior, Fish and Wildlife Service. Washington, D.C.

PSSTRT (Puget Sound Steelhead Technical Recovery Team). 2011. (Review Draft) Identifying historical populations of steelhead within the Puget Sound distinct population segment. U.S Department of Commerce National Oceanic and Atmospheric Administration, Northwest Fisheries Science Center. Seattle, Washington. 112 pp.

Puget Sound Salmon Management Plan. 1985. United States vs. Washington (1606 F.Supp. 1405).

RMIS (Regional Mark Information System). 2012. Retrieved February 6th 2012. Available from: http://www.rmpc.org/

Ruckelshaus, M.H., K.P. Currens, W.H. Graeber, R.R. Fuerstenberg, K. Rawson, N.J. Sands, and J.B. Scott. 2006. Independent populations of Chinook salmon in Puget Sound. United States Department of Commerce, NOAA. Technical Memo. NMFS-NWFSC-78, Seattle, Washington. 125 pp.

Seidel, P. 1983. Spawning guidelines for Washington Department of Fish and Wildlife hatcheries. Washington Department of Fish and Wildlife. Olympia, Washington.

Shared Strategy for Puget Sound. 2005. Puget Sound salmon recovery plan. Volumes I and II. Plan adopted by the National Marine Fisheries Service January 19, 2007. Submitted by the Shared Strategy Development Committee. Shared Strategy for Puget Sound. Seattle, Washington.

Slaney, P.A. and B.R. Ward. 1993. Experimental fertilization of nutrient deficient streams in British Columbia. *In* Schooner, G. and S. Asselin, (editors). Le developpmente du saumon Atlantique au Quebec: connaitre les regles du jeu pour reussir. Colloque international e la Federation quebecoise pour le saumon atlantique, p. 128-141. Quebec, decembre 1992. Collection *Salmo salar* n°1.

Slaney, P.A., B.R. Ward and J.C. Wightman. 2003. Experimental nutrient addition to the Keogh River and application to the Salmon River in coastal British Columbia. *In* Stockner J.G. (editor). Nutrients in salmonid ecosystems: sustaining production and biodiversity. American Fisheries Society, Symposium 34(1): 111-126.

SSHAG (Salmon and Steelhead Hatchery Assessment Group). 2003. Hatchery broodstock summaries and assessments for chum, coho, and Chinook salmon and steelhead stocks within evolutionarily significant units listed under the Endangered Species Act. NOAA Fisheries, Northwest Fisheries Science Center, Seattle, Washington and Southwest Fisheries Science Center, La Jolla, California. 326pp.

Steward, C. and T.C. Bjornn. 1990. Supplementation of salmon and steelhead stocks with hatchery fish; a synthesis of published literature. Idaho Cooperative Fish and Wildlife Research Unit. University of Idaho. Tech. Rpt. 90-1. Moscow, Idaho.

U.S. District Court of Western Washington. 1974. United States v. Washington, 384 F, Supp. 312.

United States v. Washington, No. 9213 Phase 1 (sub no. 85-2) Order Adopting Puget Sound Management Plan, 1985.

USFWS (U.S. Fish and Wildlife Service). 1994. Biological assessment for operation of U.S. Fish and Wildlife Service operated or funded hatcheries in the Columbia River Basin in 1995-1998. Submitted to National Marine Fisheries Service under cover letter, dated August 2, 1994, from William F. Shake, Acting USFWS Regional Director, to Brian Brown, NMFS.

Ward, B.R., D.J.F. McCubbing and P.A. Slaney. 2003. Evaluation of the addition of inorganic nutrients and stream habitat structures in the Keogh River watershed for steelhead trout and coho salmon. *In* Stockner J.G. (editor). Nutrients in salmonid ecosystems: sustaining production and biodiversity. American Fisheries Society, Symposium 34(1): 127-147.

WDFW (Washington Department of Fish and Wildlife) and WWTIT (Western Washington Treaty Indian Tribes). 1998 (Updated 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.

WDFW (Washington Department of Fish and Wildlife) and PNPTT (Point No Point Treaty Tribes). 2000. Summer Chum Salmon Conservation Initiative - An Implementation Plan to Recover Summer Chum in the Hood Canal and Strait of Juan de Fuca Region. Wash. Dept. Fish and Wildlife. Olympia, WA. 800 p. Available at http://wdfw.wa.gov/conservation/fisheries/chum/

WDFW (Washington Department of Fish and Wildlife) and PSTT (Puget Sound Treaty Tribes). 2004. Puget Sound Chinook salmon hatcheries, resource management plan: a component of Comprehensive Chinook salmon management plan, Olympia, Washington. 103 pp.

WDFW (Washington Department of Fish and Wildlife) Nooksack and Lummi Tribes. 2010. Final Draft Nooksack-Samish Basin Glossy Briefing Document. Washington Department of Fish and Wildlife. Olympia, Washington. 11 pp.

WDFW (Washington Department of Fish and Wildlife) and PSTT (Puget Sound Treaty Tribes). 2010. Comprehensive management plan for Puget Sound Chinook: harvest management component. Olympia, Washington. 230 pp.

WDFW (Washington Department of Fish and Wildlife). 2012. Fishbooks hatchery database. Hatcheries Data Unit, Washington Department of Fish and Wildlife. Olympia, Washington.

WDFW (Washington Department of Fish and Wildlife). 2012. 2012 Future brood document. Washington Department of Fish and Wildlife. Olympia, Washington. Available from: http://wdfw.wa.gov/publications/01356/

WDFW (Washington Department of Fish and Wildlife). 2012. Salmonid stock inventory (SaSI). Fish Program, Science Division. Washington Department of Fish and Wildlife. Olympia, Washington. Available from: http://wdfw.wa.gov/conservation/fisheries/sasi/

Wipfli, M.S., J. Hudson, and J. Caouette. 1998. Influence of salmon carcasses on stream productivity: Response of biofilm and benthic macroinvertebrates in southeastern Alaska, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences. 55(6): 1503-1511.

WRIA 1 Salmon Recovery Board. 2005. WRIA 1 Salmonid Recovery Plan. Bellingham, WA. Pages 151-166.

Young, S. and J.B. Shaklee, 2002. DNA characterization of Nooksack River Chinook salmon stocks and stock-origin assignments of out-migrating smolts from 1999 and 2000. Genetics Laboratory, Washington Department of Fish and Wildlife. Olympia, Washington. 34 pp.

SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the information provided is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____ Date:_____

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

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

The WDFW and the USFWS have a Cooperative Agreement pursuant to section 6(c) of the Endangered Species Act that covers the majority of the WDFW actions, including hatchery operations.

> "*The department is authorized by the USFWS for certain activities that may result in the take of bull trout, including salmon/steelhead hatchery broodstocking, hatchery monitoring and evaluation activities and conservation activities such as adult traps, juvenile monitoring, spawning ground surveys...*"

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

Nooksack 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). Ten local populations have been identified in the Nooksack Core Area, based the distribution of suitable spawning and rearing habitat: Lower, Middle and Upper North Fork, Lower and Upper Middle Fork, Lower and Upper South Fork, Glacier Creek, Lower Canyon Creek and Wanlick Creek. The anadromous form is known to be present and it is possible that the fluvial and resident life history forms are also present in the core area. Anadromous out-migrants have caught in the lower mainstem from early April through mid-July (USFWS 2004). Bull trout spawning is known to occur throughout much of the upper watershed and is mainly confined to non-glacier tributary streams. Little, if any, comprehensive information exists concerning escapement levels, population size, or past harvest levels and as such the current status of the Nooksack bull trout is unknown (WDFW Bull Trout **SaSI** 2004). The recovered abundance level for bull trout in the Snohomish /Skykomish Core Area has been set at 2000 adult spawners, based on current habitat capacity (USFWS 2004).

Table 15.2.1: Summary table of core area rankings for population abundance, distribution, trend, threat, and final rank.

Core Area Population	Abundance Category (individuals)	Distribution Range Rank (stream length miles)	Short-term Trend Rank	Threat Rank	Final Rank
Nooksack River	Unknown	620-3000	Unknown	Moderate, imminent	Potential Risk

Source Data: USFWS 2008.

Habitat— Past forest practices and related road networks and mass wasting have had some of the most significant impacts to bull trout habitat within this core area. These have resulted in the loss or degradation of a number of spawning and rearing areas within local populations, as well as foraging, migration, and overwintering habitats. Bellingham Diversion has significantly reduced if not precluded connectivity of the Upper Middle Fork Nooksack local population with the rest of the core area. Bellingham Diversion currently prevents most anadromous and fluvial bull trout returning to the Middle Fork Nooksack River from reaching spawning and rearing habitats in the upper watershed. Agriculture practices, residential development, the transportation network and related stream channel and bank modifications have resulted in the loss and degradation of foraging, migration, and overwintering habitats in mainstem reaches of the major forks, as well as in a number of tributaries. Marine foraging habitats for this core area have and continue to be

greatly impacted by urbanization along nearshore habitats in Bellingham Bay and Strait of Georgia. The presence of brook trout in many parts of the Nooksack core area and their potential to further increase in distribution is of significant concern given the level of habitat degradation that has occurred within the core area. The detection of brook trout/Dolly Varden hybrids further emphasizes this threat to bull trout. The absence of established spawner index areas or other repeatable means of monitoring bull trout population abundance and distribution within the core area, continues to hinder the identification, conservation, and restoration of remaining spawning and rearing reaches within the core area (USFWS 2004).

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

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

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

15.3) Analyze effects.

Hatchery activities, including in-river broodstock collection, hatchery trap, and water intake structures may pose a risk to system bull trout populations. Annual estimates of bull trout encounters through the hatchery activities are recorded and reported.

15.4 Actions taken to minimize potential effects.

Trap is checked at least daily. Any bull trout encountered at the trap are immediately returned to the stream. Bull trout may be encountered in other hatchery programs during broodstock collection activities (steelhead or coho) that would directly impact or create potential effects on bull trout in this system based on the current understanding of the status of these fish.

15.5 References

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

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

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

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

Listed species affected: Chinook *(Oncorhynchus tshawytscha)*	**ESU/Population:** Puget Sound/ North Fork Nooksack Chinook		**Activity:** Kendall Creek Spring Chinook Sub-yearling Program
Location of hatchery activity: Kendall Creek Hatchery, Kendall Creek (01.0406)	**Dates of activity:** April-June		**Hatchery program operator:** WDFW
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***		
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass a)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	-	
Capture, handle, tag/mark/tissue sample, and release d)	-	-	-	-
Removal (e.g. broodstock) e)	-	-	Up to 534	-
Intentional lethal take f)	-	-	Up to 520	-
Unintentional lethal take g)	78,000	12,000	Up to 14	-
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 *(Oncorhynchus mykiss)*	**ESU/Population:** Nooksack System Steelhead		**Activity:** Kendall Creek Spring Chinook Sub-yearling Program
Location of hatchery activity: Kendall Creek Hatchery, Kendall Creek (01.0406)	**Dates of activity:** April-June		**Hatchery program operator:** WDFW
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***		
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass a)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	-	-
Capture, handle, tag/mark/tissue sample, and release d)	-	-	-	-
Removal (e.g. broodstock) e)	-	-	-	-
Intentional lethal take f)	-	-	-	-
Unintentional lethal take g)			-	-
Other Take (specify) h)	-	-	-	-

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Attachment 1. Definition of terms referenced in the HGMP template.

Augmentation - The use of artificial production to increase harvestable numbers of fish in areas where the natural freshwater production capacity is limited, but the capacity of other salmonid habitat areas will support increased production. Also referred to as "fishery enhancement".

Critical population threshold - An abundance level for an independent Pacific salmonid population below which: depensatory processes are likely to reduce it below replacement; short-term effects of inbreeding depression or loss of rare alleles cannot be avoided; and productivity variation due to demographic stochasticity becomes a substantial source of risk.

Direct take - The intentional take of a listed species. Direct takes may be authorized under the ESA for the purpose of propagation to enhance the species or research.

Evolutionarily Significant Unit (ESU) - NMFS definition of a distinct population segment (the smallest biological unit that will be considered to be a species under the Endangered Species Act). A population will be/is considered to be an ESU if 1) it is substantially reproductively isolated from other conspecific population units, and 2) it represents an important component in the evolutionary legacy of the species.

Harvest project - Projects designed for the production of fish that are primarily intended to be caught in fisheries.

Hatchery fish - A fish that has spent some part of its life-cycle in an artificial environment and whose parents were spawned in an artificial environment.

Hatchery population - A population that depends on spawning, incubation, hatching or rearing in a hatchery or other artificial propagation facility.

Hazard - Hazards are undesirable events that a hatchery program is attempting to avoid.

Incidental take - The unintentional take of a listed species as a result of the conduct of an otherwise lawful activity.

Integrated harvest program - Project in which artificially propagated fish produced primarily for harvest are intended to spawn in the wild and are fully reproductively integrated with a particular natural population.

Integrated recovery program - An artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), and fish produced are intended to spawn in the wild or be genetically integrated with the targeted natural population(s). Sometimes referred to as "supplementation".

Isolated harvest program - Project in which artificially propagated fish produced primarily for harvest are not intended to spawn in the wild or be genetically integrated with any specific natural population.

Isolated recovery program - An artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), but the fish produced are not intended to spawn in the wild or be genetically integrated with any specific natural population.

Mitigation - The use of artificial propagation to produce fish to replace or compensate for loss of fish or fish production capacity resulting from the permanent blockage or alteration of habitat by human activities.

Natural fish - A fish that has spent essentially all of its life-cycle in the wild and whose parents spawned in the wild. Synonymous with *natural origin recruit (NOR).*

Natural origin recruit (NOR) - See *natural fish* .

Natural population - A population that is sustained by natural spawning and rearing in the natural habitat.

Population - A group of historically interbreeding salmonids of the same species of hatchery, natural, or unknown parentage that have developed a unique gene pool, that breed in approximately the same place and time, and whose progeny tend to return and breed in approximately the same place and time. They often, but not always, can be separated from another population by genotypic or demographic characteristics. This term is synonymous with stock.

Preservation (Conservation) - The use of artificial propagation to conserve genetic resources of a fish population at extremely low population abundance, and potential for extinction, using methods such as captive propagation and cryopreservation.

Research - The study of critical uncertainties regarding the application and effectiveness of artificial propagation for augmentation, mitigation, conservation, and restoration purposes, and identification of how to effectively use artificial propagation to address those purposes.

Restoration - The use of artificial propagation to hasten rebuilding or reintroduction of a fish population to harvestable levels in areas where there is low, or no natural production, but potential for increase or reintroduction exists because sufficient habitat for sustainable natural production exists or is being restored.

Stock - (see “Population”).

Take - To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Viable population threshold - An abundance level above which an independent Pacific salmonid population has a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame.

Attachment 2. Age class designations by fish size and species for salmonids released from hatchery facilities.

(generally from Washington Department of Fish and Wildlife, November, 1999).

	SPECIES/AGE CLASS	Number of fish/pound	SIZE/CRITERIA Grams/fish
X	Chinook Yearling	<=20	>=23
X	Chinook (Zero) Yearling	>20 to 150	3 to <23
X	Chinook Fry	>150 to 900	0.5 to <3
X	Chinook Unfed Fry	>900	<0.5
X	Coho Yearling 1/	<20	>=23
X	Coho Sub-yearling	>20 to 200	2.3 to <23
X	Coho Fry	>200 to 900	0.5 to <2.3
X	Coho Unfed Fry	>900	<0.5
X	Chum Fry	<=1000	>=0.45
X	Chum Unfed Fry	>1000	<0.45
X	Sockeye Yearling 2/	<=20	>=23
X	Sockeye Fingerling	>20 to 8000	0.6 to <23
X	Sockeye Fall Releases	>150	>2.9
X	Sockeye Fry	>800 to 1500	0.3 to <0.6
X	Sockeye Unfed Fry	>1500	<0.3
X	Pink Fry	<=1000	>=0.45
X	Pink Unfed Fry	>1000	<0.45
X	Steelhead Smolt	<=10	>=0.45
X	Steelhead Yearling	<=20	>=23
X	Steelhead Fry	>20 to 150	3 to <23
X	Steelhead Unfed Fry	>150	<3
X	Cutthroat Yearling	<=20	>=23
X	Cutthroat Fingerling	>20 to 150	3 to <23
X	Cutthroat Fry	>150	<3
X	Trout Legals	<=10	>=0.45
X	Trout Fry	>10	<0.45

1/ Coho yearlings defined as meeting size criteria and 1 year old at release, and released prior to June 1st.
2/ Sockeye yearlings defined as meeting size criteria and 1 year old.