HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Skookum Hatchery Coho
Species or Hatchery Stock:	Coho Salmon (*Oncorhynchus kisutch*) Nooksack Hatchery Stock
Agency/Operator:	Lummi Natural Resources Department
Watershed and Region:	WRIA 1 South Fork Nooksack River
Date Submitted:	August 27,2015
Date Last Updated:	November 25,2015

Executive Summary

Development of land and resources in the Nooksack River Basin has reduced its capacity to provide a sustainable salmon harvest required to meet the treaty reserved right to take fish. Natural production of salmon has been greatly reduced by the deleterious effects of land use practices on the quantity and quality of properly functioning habitat and salmon hatchery production was established to mitigate for these losses. The coho hatchery programs are, and will continue to be, an integral component of salmon management until the Nooksack watershed has been restored to provide naturally sustaining salmon at harvestable levels to meet the Treaty Right and the needs of the Lummi community. The program also provides harvest opportunity to local non-tribal, recreational and commercial fisheries.

The Lummi Nation's Skookum Creek Hatchery Coho Program, the subject of this HGMP, and the Lummi Bay Coho hatchery program are expected to contribute to annual average terminal area harvests comparable to levels experienced in the mid 1980s, without impeding the recovery of listed Chinook and steelhead populations. Specifically, Lummi's initial objective is to attain an average annual total Nooksack/Samish region terminal area harvest of 171,000 coho salmon, comparable to the average annual harvest from all directed fisheries in the mid-1980s. It is anticipated that 80% of the terminal harvest will be from hatchery production. Recent 12-year (2002-2013) average terminal catch has been approximately 49,000 coho salmon, well below harvest objectives.

The Nooksack-Samish Terminal Area, by co-manager agreement, has been managed for hatchery production since the 1980s. The WDFW Kendall Creek hatchery also produced coho until recently. Natural spawning escapement objectives have not been established. Two naturally spawning coho populations have been identified in the Nooksack-Samish region.

1. A Samish population, currently with a *Primary* designation, is descended from the WDFW hatchery population originating from a composite stock. Spawning escapement has averaged around 10,000 in recent years.
2. A Nooksack population is designated as *Stabilizing*, and is dominated by descendents of the WDFW hatchery population originating from a composite stock.

Lummi Bay and Skookum Creek hatcheries comprise two rearing and release locations and utilize a single hatchery stock of mixed origin that is localized to the tribal hatchery release sites. Two HGMPs have been developed to continue the Skookum Creek program and explore the potential for the Lummi Bay Hatchery to become an independent segregated hatchery. Hatchery releases, smolt to adult returns (SARs), and terminal harvest are summarized in the table below.

Table 1. Hatchery production, SARs, and terminal harvest from 1980-2013.

Brood Years	Annual Release (by release year)			Average Hatchery SAR		Average Terminal Catch (BY +3)
	Skookum Creek	Lummi Bay	Kendall Creek	Skookum Creek	Lummi Bay	
1980-1989	1,511,583	769,106	1,167,561	8.2%	8.6%	139,074
1990-2001	1,482,313	1,218,215	638,134	2.9%	2.0%	53,582
2002-2013	1,106,823	972,147	95,962	2.3%	1.0%	52,496

In recent years, reduced hatchery production and poor post-release survival of hatchery fish have substantially reduced abundance and harvest of Nooksack-Samish coho. Current coho smolt production targets are 1,000,000 from Skookum Creek and 750,000 from Lummi Bay. Production is planned to increase in three phases.

The key management issues affecting the expected benefits and risks of the program are related to the performance of hatchery coho in terms of:

1. Utilization, i.e. survival and contribution to terminal fisheries.
   Solutions:
   i. Hatchery strategies (release size, location and numbers) are designed to maximize the number of adults available for terminal harvest.
   ii. Management strategies will achieve a 75% or greater harvest rate on hatchery returns in the Nooksack River.
   iii. Monitor survival of hatchery returns (SAR) and catch contributions to all fisheries.
2. Genetic and ecological interactions, i.e. destination and volume of hatchery origin fish not harvested or trapped at hatchery facilities.
   Solutions:
   i. Operate adult trapping facilities at Skookum Creek and Lummi Bay efficiently.
   ii. Release smolts at times and locations that maximize homing fidelity and minimize straying.
   iii. In coordination with Co-managers, review and evaluate the contribution of hatchery adults to natural spawning within the Samish coho population, and straying of adult hatchery-origin coho into Early Chinook salmon spawning areas.
   iv. Periodic genetic monitoring of natural origin coho in the harvest and escapement to confirm population identity.
3. Design and implement predation studies to monitor rate of predation of coho hatchery smolts on listed Chinook.

Table 2. Proposed stages for the Skookum Creek and Lummi Bay hatchery programs.

Stage	Smolt Release Targets		Expected % Return to Terminal Area	Criteria for moving to next Phase*	Expected Terminal Harvest Contribution
	Skookum Creek	Lummi Bay			
1	1,000,000	750,000	4%	River Harvest Rate > 75%; SAR > 4%	60,000
2	1,500,000	1,500,000	4%	Terminal Harvest Rate > 75%; SAR > 4%	90,000
3	2,000,000	2,000,000	4%		150,000

*The criteria represent guidelines as averaged over multiple years

Results of research, monitoring, and evaluation activities will be reviewed at annual program review workshops where hatchery program adjustments will be considered in coordination with habitat and harvest management. The purpose of adaptively managing the program is to improve

harvest benefits and reduce identified risks to ESA listed populations. The criteria for changing between stages of the program will base on averages evaluated over 3-5 years and will be addressed in annual staff workshops.

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Skookum Hatchery Coho

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

Coho Salmon (*Oncorhynchus kisutch*)

A Puget Sound/Strait of Georgia ESU was identified in a status review of all coho from Washington, Oregon and California. The Biological Review Team was concerned that the ESU was likely to become endangered in the foreseeable future and widespread habitat degradation and hatchery production concerns were noted. The status was determined to be "Not presently in danger of extinction, but likely to become so." (Weitcamp, et al. 1995). Though not listed, the ESU is identified by NOAA as a Species of Concern.

In the Nooksack Watershed, naturally spawning coho in the upper North Fork Nooksack River are genetically distinct from hatchery coho in the Nooksack River and from naturally spawning coho in the lower Nooksack River (Small et al., 2004. A distinct non-hatchery coho stock has not been identified outside of the Upper North Fork Nooksack River.

Nooksack Hatchery Coho

The Nooksack hatchery coho production is intended to have no stray impacts on the reported genetically distinct North Fork coho group that has existed though extensive hatchery production and high fisheries exploitation rates. The co-managers have given a stabilizing designation to the Upper North Fork Nooksack coho.

1.3) Responsible organization and individuals

Name (and title):	Merle Jefferson -Natural Resources Director
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Name (and title):	Bill Finkbonner, Skookum Creek Hatchery Manager
Agency or Tribe:	Lummi Natural Resources Department
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Agency	Involvement
WA Dept. Fish & Wildlife (WDFW)	Co-manager
Nooksack Tribe	Co-manager
US Department of Interior	Primary funding agency

This hatchery is a component of the Equilibrium Brood Document for the Nooksack-Samish Terminal Area mentioned in the Puget Sound Salmon Management Plan (US v. Washington No. 9213 (85-2) (PSSMP).

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

This program is funded by the Lummi Indian Nation Natural Resources Department which receives its funding from the US Department of Interior.

Five full-time employees operate Skookum Creek Hatchery. Three employees and their families live on the hatchery site. The hatchery is staffed and monitored 24 hours a day, 7 days a week. Annual operational cost for coho production at Skookum Creek Hatchery is approximately $215,000.

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

South Fork Nooksack River, RM 14.3, Nooksack River Basin, WRIA 1, just downstream of the confluence with Skookum Creek

1.6) Type of program.

Harvest Augmentation

1.7) Purpose (Goal) of program.

The goal of this hatchery program is to meet the 1855 Point Elliott treaty obligation for a treaty reserved right to take fish at usual fishing grounds and stations. Specifically, this program is to contribute to a minimum terminal area annual average harvest of 171,000 coho salmon with 80% of the catch being of hatchery origin. The program is required to mitigate for habitat loss associated with forestry, industrial, agriculture, and rural and urban development affecting coho abundance in the terminal area. The program will support terminal area non-treaty fisheries and sport fisheries under co-manager and PFMC management. The program will buffer the impact of harvests of natural production of the Puget Sound Coho ESU in Southern US and Canadian fisheries and support obligations under the Pacific Salmon Treaty to ensure equity in harvest and preserve essential Fraser Panel Fisheries.

1.8) Justification for the program.

The harvest of hatchery fish under this program is part of the Lummi nation's Federally recognized Treaty Rights. The role of hatcheries associated with our Treaty-reserved fishing Rights is to support four basic values recognized by the Federal courts: (1) conservation of the resource, (2) ceremonial, religious, and spiritual values, (3) subsistence values, and (4) commercial values. Until listed wild stocks are fully recovered, Lummi Nation fisheries will continue to depend on harvestable surplus of hatchery coho. This program mitigates for lost natural-origin fish production by producing coho salmon for meaningful commercial, ceremonial and subsistence harvest and provides important population monitoring in marine and fresh waters while minimizing adverse genetic, demographic, or ecological effects on listed fish and other natural populations. This hatchery program is indispensable in the implementation of the Treaty Right to fish in the face of continuing loss of salmon habitat by degradation and climate change. As long as the Nooksack River and adjacent watersheds within the tribe's U&A fishing area are unable to maintain naturally self-sustaining levels of salmon that ensure that the Lummi Nation is able to harvest salmon in traditional areas in sufficient numbers to carry out the promises of the Treaties fully, and the requirements of United States vs. Washington, this hatchery program will be an integral and indispensable component of our salmon management.

Besides providing fish for harvest, this hatchery program also supports natural resource management responsibilities consistent with Treaty Rights (e.g. US v Washington, PSSMP). The legal basis for Co-management of salmon in Puget Sound is based on the Puget Sound Salmon Management Plan (PSSMP), which was developed by the Co-managers and adopted as an order of the Federal court in 1985 (United States v. Washington, No. 9213 Phase 1 (sub no. 85-2) 1985). This program provides important monitoring, and supplementation of local salmon abundances, and integrates efforts and strategies of the WRIA 1 watershed recovery plan.

Hatchery production of coho salmon in the terminal area was reduced by 65% in the early 2000s as a precautionary matter to reduce potential ecological interactions with ESA-listed Chinook in the watershed. While reduced production coincided with a significant decline in terminal area harvestable Coho, it has not resulted in a quantifiable positive response from the listed Chinook populations.

The program is managed to produce a diversity of coho to ensure that returning adults that might stray would be able to reproduce in any underutilized coho habitat as the ecosystem processes that create and maintain properly functioning coho habitat are protected and restored.

The program is structured to minimize any potential risk to ESA-listed species. Juveniles will be released as fully smolted yearlings; therefore, minimal duration of interaction is expected with any co-occurring ESA-listed juvenile Chinook salmon and steelhead in freshwater (HSRG, 2014). No adverse fisheries-related effects resulting from implementation of the coho program are expected. ESA-listed Chinook and steelhead are past peak spawning by the time the hatchery coho enter the fishery. Program fish return

as adults to the terminal area at a time when ESA-listed Chinook have already spawned and prior to the migration of the ESA-listed Steelhead. Effects of fisheries for Skookum Hatchery coho on ESA listed salmon and steelhead have been previously reviewed and authorized by NMFS through a separate ESA consultation (NMFS 2015).

1.9) List of program "Performance Standards".

The performance standards for this program will be related to the provision of coho to satisfy legally mandated harvest in a manner which minimizes the risk of adverse effects to ESA-listed species.

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

Table 1.10.1: "Performance Indicators" addressing benefits.

Standard	Indicator	Monitor
Identification of hatchery production in the hatchery, harvests and spawning grounds.	Absence of adipose fin, otolith mark, CWT, or genetic stock identification.	Sample harvest, hatchery and spawning grounds to provide statistically valid estimates of hatchery fish.
Significant contributions to terminal area harvest.	Proportion in of identified hatchery fish in harvest samples.	Sample at rates to provide statistically valid estimates of contributions to all fisheries.
Effectiveness of program operations	Hatchery operations use the best available science to maximize survival and prevent disease Survival rates recorded at each stage of culture.	Annual report of hatchery activities.
Release survival meets standards.	Proportion of released production that contributes to escapement and fisheries.	Analysis of program contributions to spawning grounds, hatchery return, and all fisheries.

Table 1.10.2: "Performance Indicators" addressing risks.

Standard	Performance Indicator	Monitor
Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols (WWIT/WDFW 2006).	Hatchery records document compliance with applicable standards and criteria.	Annual report of hatchery fish health; guidelines and standards met.
Effluent from hatchery facility will not Adversely affect the ecosystem.	Discharge water quality meets NPDES permit standards.	Reports as required by NPDES permit in annual hatchery report.
Water withdrawals and in-stream water diversion structures for hatchery operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.	Water withdrawals are compliant with water rights. Facility operates in compliance with applicable passage and screening criteria for juveniles and adults.	Annual record of water withdrawal and status of passage and screening include in annual hatchery report.
Releases do not introduce new pathogens and do not increase the levels of existing pathogens in local populations	All State and co-manager fish health policies and standards are followed. Certification of fish health during rearing and release.	Report of compliance with fish health policies and fish health certifications contained in the annual hatchery report.
Any distribution of carcasses or other spawner 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.	Disposition of carcasses reported in annual hatchery report.
Stray hatchery coho spawning in the wild will not lead to substantial interactions or adverse effect on listed salmon and steelhead, including redd superimposition.	Spawning ground surveys in Early Chinook spawning areas during the hatchery coho salmon adult return period.	Spawner survey reports showing species counts by origin in Nooksack watershed Early Chinook spawning areas.
Competition by hatchery origin releases on natural origin salmonids does not significantly reduce numbers of listed natural origin salmonids.	Dates, size and location of release supporting rapid out migration.	Records from hatchery operations contained in an annual hatchery report. Supplemental information from lower river smolt trap as available.
Predation by hatchery origin releases on natural origin salmonids does not significantly reduce numbers of listed natural origin salmonids.	Dates, size and location of release supporting rapid out migration.	Records from hatchery operations contained in Annual Hatchery Report. Supplemental information from lower river smolt trap as available.

1.11) Expected size of program.

Table 1.11.1: Implementation stages of the Skookum Creek coho program.

Phase	Terminal Harvest	Release Goal	SAR	Criteria[1]
1	40,000	1,000,000	0.04	Current, meet standards
2	60,000	1,500,000	0.04	Resources, facilities available; standards
3	80,000	2,000,000	0.04	Resources, facilities available; standards

[1] The standards are adequate facilities and resources to ensure achievement of documented return per smolt released and targeted return to fisheries

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

Up to 2,400 adult coho salmon per year (Table 1.11.1.1).

Table 1.11.1.1: Proposed annual broodstock collection levels.

Phase	Brood Stock	Egg Take Goal	Criteria
1	Up to 900 F – 900 M	Up to 1,800,000	As needed, if Lummi Bay shortfall
2	600 F - 600 M	1,200,000	No longer required for Lummi Bay
3	750 F – 750 M	1,875,000	4 year avg harvest phase 1 goal met
4	1,200 F- 1,200 M	2,200,000	4 year avg harvest phase 2 goal met

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

Up to 2,000,000 yearling smolts per year released at RM 14.3 on the South fork Nooksack River, left bank tributary to the mainstem Nooksack River at RM 36.6 (Table 1.11.1.2).

Table 1.11.1.2: Proposed annual fish release levels (maximum number) by life stage and location.

Phase	Life Stage	Release Location	Annual Release Level
1	Yearling Smolt	RM 14.3 South Fork Nooksack	1,000,000
2	Yearling Smolt	RM 14.3 South Fork Nooksack	1,500,000
3	Yearling Smolt	RM 14.3 South Fork Nooksack	2,000,000

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

Table 1.12.1: Skookum Creek Coho Program Estimated Smolt to Adult Survival Rates.

		Hatchery Escapement		
Return Year	**Brood Year***	**Adults**	**Jacks**	**Estimated SAR†**
2001	1998	32,048	1,146	4.42%
2002	1999	32,348	645	5.31%
2003	2000	26,577	381	2.86%
2004	2001	21,230	530	4.47%
2005	2002	20,131	548	2.55%
2006	2003	3,911	722	1.35%
2007	2004	10,976	667	2.40%
2008	2005	5,026	400	2.10%
2009	2006	7,528	1,038	2.30%
2010	2007	6,823	252	2.99%
2011	2008	14,452	534	4.60%
2012	2009	15,068	356	3.77%
2013	2010	14,848	926	4.43%
Average		**16,228**	**627**	**3.35%**

Data Source: Lummi Natural Resources, 2014

*Brood year applies only to adults for any particular year row.

† Smolt-to-adult survival rates (SAR) applies only to age-3 adults and reflect total contribution to fisheries and escapement..

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

The Skookum Creek Coho Program began in 1977 and has operated continually since.

1.14) Expected duration of program.

This program is expected to last as long as necessary to meet the treaty right to take fish not met by natural production. The program will be managed to meet mitigation objectives for the loss of natural coho production and may be modified as justified by regular evaluation of monitoring information.

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1.15) Watersheds targeted by program.

WRIA 1

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

The alternative to hatchery production to meet the needs of the treaty reserved fishing right is to restore the basin and marine habitat to the condition that would support natural production to meet that harvest need.

The Lummi Nation's harvest objectives for the species were being met when the total annual hatchery coho smolt release in the terminal area exceeded 5,600,000 fish. This production was reduced to two million in the terminal area as a precautionary measure to reduce interactions with the ESA-listed Chinook. The reduction resulted in a significant decline in terminal area harvestable coho, however no quantifiable positive response from the listed Chinook populations has been observed.

The WDFW Kendall Creek Hatchery program discontinued a 1,300,000 coho smolt release program because no financial resources had been allocated by the State of Washington to sustain it. If the Kendall Creek Hatchery coho program were re-initiated, the release goals for the two Lummi hatchery programs would be reviewed.

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.

There are currently no ESA permits or authorizations for this hatchery program. This HGMP is submitted for ESA authorization of this program under ESA 4(d) Rule, limit 6 and NEPA.

Harvest management of coho populations within Puget Sound is implemented through the North of Falcon process of the Pacific Fisheries Management Council to regulate the ocean and inside fisheries to ensure compliance with the sharing and conservation principles of the Boldt decision. The ESA authorization for the effects of harvest of Skookum Hatchery-origin coho salmon on listed fish species was completed through a separate consultation (NMFS 2015).

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.

Puget Sound Chinook (*Oncorhynchus tshawytscha*): The Puget Sound Chinook ESU was 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 38 historically quasi-independent populations, of which 22 have been identified although they may not represent the population that used to be there

historically (Ruckelshaus et al. 2006). 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 populations in the North/Middle Fork Nooksack and South Fork Nooksack River (Ruckelshaus et al. 2006).

Natural-origin North Fork Spring Chinook, South Fork Nooksack Spring Chinook, Nooksack basin bull trout and Nooksack basin steelhead may be incidentally affected by the program. Incidental effects may include: redd superimposition, competition, predation and, hatchery screening-related effects. The extent to which listed Chinook salmon, steelhead and bull trout will be incidentally affected through these mechanisms by the hatchery program is not well understood.

Nooksack System Steelhead (*Oncorhynchus mykiss*): Puget Sound steelhead 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 2013). Incidental effects of the program are not well understood.

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

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

Puget Sound (Nooksack System) Chinook (*Oncorhynchus tshawytscha*): All Puget Sound Chinook salmon populations are well below escapement abundance levels identified, as required for recovery to low extinction risk in the recovery plan (NMFS 2006). In addition, most populations are consistently below the productivity goals identified in the recovery plan as necessary for recovery. Although trends vary for individual populations across the ESU, most populations have declined in total natural origin recruit abundance since the last status review; and natural origin recruit escapement trends since 1995 are mostly stable. Several of the risk factors identified in the previous status review (Good et al. 2005) are still present, including high fractions of hatchery fish in many populations and widespread loss and degradation of habitat.

NMFS (1999) considered the Kendall Creek 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 (NMFS 2004; 70 FR 37160). 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 dramatically increased hatchery-origin Chinook natural spawner abundances, but natural-origin spawners have not steadily increased. A reasonable conclusion is that the main limiting factor for this population is poor habitat.

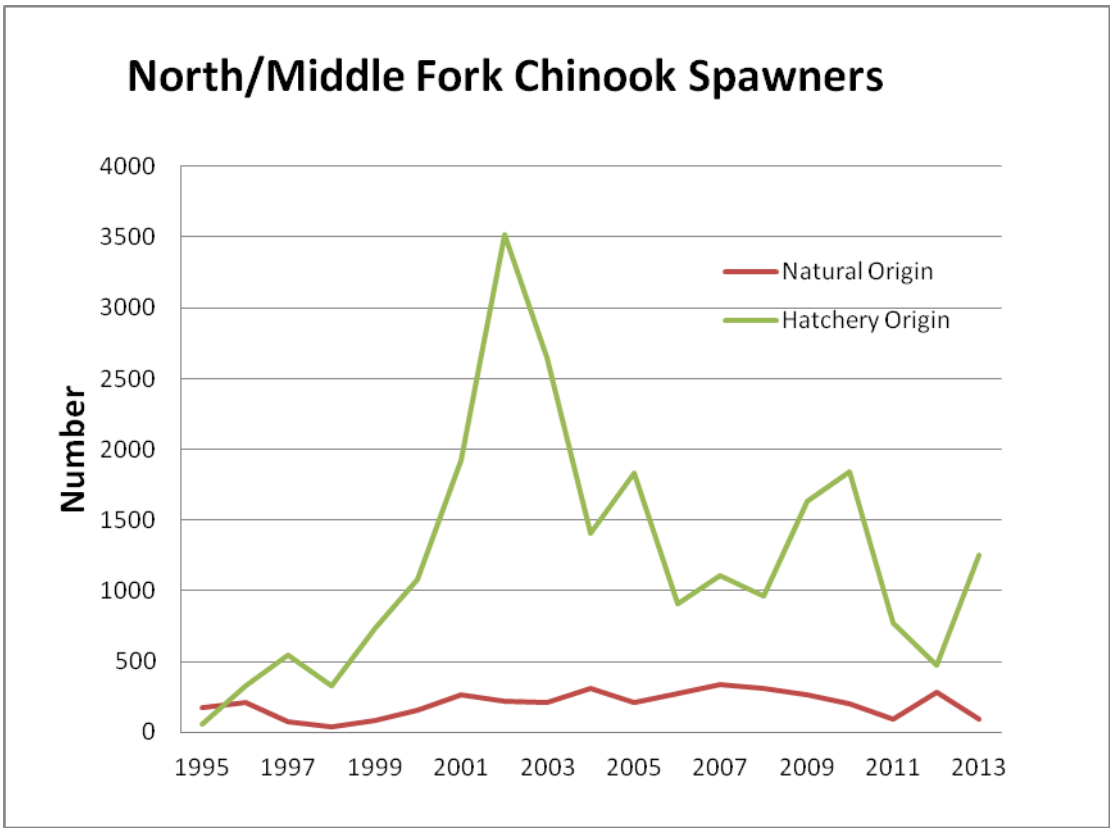

Figure 2.2.2.1: Natural origin spawners and hatchery origin spawners 1995-2013.

Driven by chronically low natural escapements, a restoration program for this locally indigenous North/Middle Fork population 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. The Kendall 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 North/Middle Fork 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). Recent escapement levels (1999-2013) have averaged 1,659 natural spawners in the North/Middle Fork Nooksack River Population.

The South Fork Nooksack early Chinook population has averaged 52 (2003 – 2013 range 10-114) in recent years.

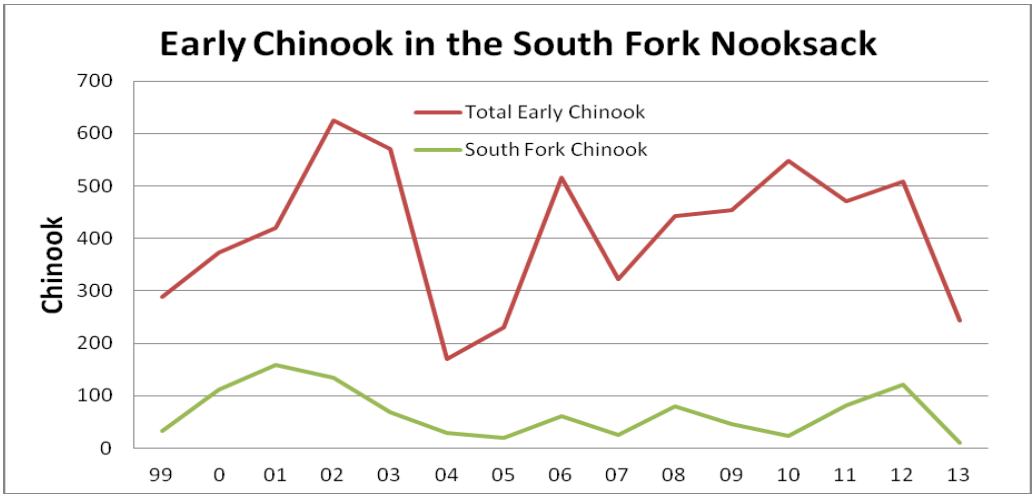

Figure 2.2.2.2: Natural origin South Fork Chinook relative to total early Chinook 1999-2013.

The Puget Sound Technical Review Team (Ruckelshaus 2006) assigned preliminary critical thresholds of 1,000 for both the NF and SF populations. WDFW recently determined that the NF and SF Chinook populations are "critical" in status (WDFW 2002).

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. 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 2013, WDFW 2002; 2012).

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

Puget Sound (Nooksack System) Chinook (*Oncorhynchus tshawytscha*):

Table 2.2.2.1: Nooksack early 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***

[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.

Brood year 1992 to 2000 recruit/spawner levels for natural-origin North Fork/MF Nooksack spring Chinook salmon (Co-managers, unpublished data):

Table 2.2.2.2: Estimated Productivity of North/Middle Fork Natural Spawners

Brood Year	Spawners	Adult Returns	Recruits/Spawner
1992	493	174	0.37
1993	445	77	0.16
1994	45	25	0.56
1995	230	18	0.08
1996	535	248	0.46
1997	617	344	0.56
1998	370	119	0.32
1999	823	196	0.24
2000*	823	325	0.26

*- Age 3 & 4 returns only, Co-Manager data

Table 2.2.2.3: South Fork Chinook Productivity Estimates.

Year	Escapement*	Brood Escapement (RY-4)	Recruits/ Spawner
2003	69	32	2.16
2004	29	111	0.26
2005	19	159	0.12
2006	61	135	0.45
2007	26	69	0.38
2008	80	29	2.76
2009	45	19	2.37
2010	24	61	0.39
2011	81	26	3.12
2012	121	80	1.51
2013	10	45	0.22
Avg	51.4	69.6	1.36

- Minimum estimate

Nooksack System Steelhead (*Oncorhynchus mykiss*): The glacial hydrology in this system makes it difficult to monitor data for steelhead stocks in this system. In 1996, 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). Expanded surveys conducted in this basin in 2003-2004 indicated that a substantial winter steelhead population may exist (see escapement below). Summer steelhead spawn in the upper South Fork Nooksack River

including upstream from RM 30.4, and are native with wild production and an unknown status, but the run has been historically small.

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

Table 2.2.2.4: Early Chinook Escapement 1999- 2013

	Escapement	
Return Year	**S.F. Nooksack [b]**	**N. F./MF Nooksack (NOR+HOR)**
1999	32	823
2000	111	1,242
2001	159	2,185[a]
2002	135	3,741
2003	69	2,857
2004	29	1,719
2005	19	2,047
2006	61	1,184
2007	26	1,438
2008	80	1,266
2009	45	1,903
2010	24	2035
2011	81	865
2012	121	758
2013	10*	1347
Average	**67**	**1,659**

- Minimum estimate

Source: Lummi Compilation of Co-manager Data

[a] Additionally, 4,765 hatchery Chinook were returned to the N.F. Nooksack River.

[b] Represents S.F. native NORs only

Since 1999 the escapement of Chinook to the South Fork Nooksack River has included, in addition to the South Fork population, natural origin and hatchery origin North Fork Chinook and later timed fall Chinook

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 2004-2014.

Return Year	Escapement
2004	1,574
2005	NA
2006	NA
2007	772
2008	NA
2009	NA
2010	1901
2011	1774
2012	1747
2013	1805
2014	1521
Average	**1585**

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

Table 2.2.2.7: Short and long-term population trend and growth rate estimates for the Nooksack Early Chinook populations.

Regions and Populations	Years	Trend Natural Spawners w/Cl	Hatchery Fish Success = 0 Lambda w/Cl	p>1	Hatchery Fish Success = 1 Lambda w/Cl	p>1
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.

Table 2.2.2.8: NF/MF Nooksack early Chinook spawners (*Oncorhynchus tshawytscha*) from 1998-2013.

Year	NF/MF Nooksack River		
	Natural-Origin	**Hatchery-Origin**	**% of Natural Origin**
1998	37	333	10%
1999	85	738	10%
2000	160	1,082	13%
2001	240	2,185*	12%
2002	224	3,517	6%
2003	210	2,647	7%
2004	318	1,746	18%
2005	210	1,837	10%
2006	275	909	23%
2007	334	1,104	23%
2008	307	959	24%
2009	269	1,634	14%
2010	204	1,840	10%
2011	96	769	11%
2012	281	477	37%
2013	91	1254	7%
Average	**210**	**1402**	**11.7**

Source: (WDFW 2002; WDFW 2012 and Natasha Geiger WDFW 2012).
* - Does not include the 4,765 hatchery "put backs" to the NF Nooksack.

There are three Chinook Stocks encountered during spawning ground surveys in the South Fork Nooksack River. The estimates are broken into hatchery and natural origin based on CWT and/or adipose fin clip, and the natural origin Chinook are further estimated by stock by DNA microsatellite tissue assignment.

Table 2.2.2.9: Estimated Escapement of Chinook into the South Fork Nooksack by Origin and Stock

Return Year	South Fork Native	North Fork NOR	Fall NOR	Kendall Cr Hatchery	Other Hatchery	Total Natural
1999	32	0	127	90	39	288
2000	111	42	132	74	15	373
2001	159	51	65	138	8	420
2002	135	55	98	289	47	625
2003	69	0	150	210	162	591
2004	29	29	88	14	12	172
2005	19	56	56	32	70	233
2006	62	104	192	84	90	532
2007	29	44	128	112	35	348
2008	83	106	126	109	23	447
2009	45	58	187	128	38	456
2010	24	49	123	299	58	552
2011	81	82	114	172	32	481
2012	121	165	93	97	38	514
2013	10*	30	22	162	19	243

* Minimum estimate

- Preliminary co-manager data

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

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

Adult coho salmon produced by the program that stray into Nooksack River basin areas where Early Chinook salmon spawn may effect listed Chinook through redd superimposition. The risk of this effect is low, due to differences in spawn timings and areas, and the tendency for most returning hatchery fish that aren't harvested to return to the hatchery release site. After their release from Skookum Creek Hatchery, yearling coho smolts may compete with any listed fish juveniles downstream of the release site for food and space. The expected effects of competition are unsubstantial, because all yearling coho will be released as smolts that have been shown through juvenile outmigrant trapping data to emigrate rapidly seaward, limiting the duration of any interactions to just a few days. The hatchery yearlings may also prey on any co-occurring listed juvenile fish of small enough sizes vulnerable to predation. Effects are expected to be low, as demonstrated by stomach content analysis data collected at the Nooksack river

juvenile outmigrant trapping site, which shows that newly released coho yearlings are not consuming listed juvenile listed fish. Water intake screening at Skookum Hatchery that is out of compliance with current NMFS screening criteria (NMFS 2011) may pose risks of entrainment and injury to migrating and rearing listed fish. The magnitude of any risk is unknown, and the Lummi Nation plans to replace screening so that it complies with NMFS criteria by 2018.

There is a risk that ESA-listed natural-origin South Fork Nooksack Chinook will enter the hatchery complex from the river and ascend the fish ladder to the broodstock holding area during the hatchery coho return period. Potential take associated with listed Chinook adult returns to the hatchery are addressed in the HGMP for the Skookum Creek South Fork Chinook Gene Bank and Supplementation program.

Coho program fish may attempt to enter the brood stock program during the later part of the Chinook entry into the facility. Protocols are being developed to separate early arriving coho from the Chinook broodstock and hold them in a separate holding area. There are no records of steelhead or bull trout entering the hatchery facility

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

There is no data available on the take of ESA-listed Chinook and steelhead resulting from the Skookum Hatchery coho program.

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).

There is currently no information available from which to estimate annual take levels for ESA-listed species resulting from this program. Protocols are being developed to ensure a minimum exposure of ESA-listed species from activities associated with the coho program.

Monitoring and adaptive management will be used to ensure that hatchery practices meet the WRIA 1 Salmonid Recovery Plan (WRIA 1 SRB 2005) objectives of 1) “use hatcheries to sustain treaty-reserved fisheries and non-treaty fishing opportunities, in a manner consistent with salmon recovery” and 2) “hatchery production of Chinook and other salmon will neither cause further decline nor inhibit recovery of WRIA 1 naturally spawning Chinook populations”.

- 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.

Hatchery monitoring practices will record all interactions with ESA-listed species information will be included in the annual report. The report is available to the National

Marine Fisheries Service and the U. S. Fish and Wildlife Service for consultation to determine whether modifications in the program plan are needed.

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.

There is currently no Puget Sound regional hatchery program. Co-manager hatchery plans are developed under U. S. v. Washington (US District Court Western District of Washington No. 9213), the Boldt Decision. The Puget Sound Salmon Management Plan (PSSMP) (1985) (US v. Washington No. 9213 (85-2) provides for an agreed Equilibrium Brood Document.

The Equilibrium Brood Document for the Nooksack Samish terminal area was originally approved by the co-managers in 1993. The elements of the plan have been modified as necessary over the years, and the Skookum coho program is consistent with the plan.

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

This program operates under the applicable orders of U. S. v. Washington (US District Court Western District of Washington No. 9213), the Boldt Decision. The Puget Sound Salmon Management Plan (US v. Washington No. 9213 (85-2) (PSSMP) provides for an agreed Equilibrium Brood Document. The Equilibrium Brood Document for the Nooksack Samish terminal area was originally approved by the co-managers in 1993. The elements of the plan have been modified as necessary over the years, and the Lower Nooksack Fall Chinook program is consistent with the plan.

This program was contained in the WRIA 1 Salmonid Recovery Plan and was incorporated into the Shared Strategy Puget Sound Chinook Recovery Plan adopted by NOAA in 2007. WRIA 1 Salmonid Recovery Plan stated that hatchery practices meet the WRIA 1 Salmonid Recovery Plan (2005) objectives of 1) “use hatcheries to sustain treaty-reserved fisheries and non-treaty fishing opportunities, in a manner consistent with salmon recovery” and 2) “hatchery production of Chinook and other salmon will neither cause further decline nor inhibit recovery of WRIA 1 naturally spawning Chinook populations”.

3.3) Relationship to harvest objectives.

The primary purpose of this program is to provide harvest to the Nooksack Samish Terminal Area fisheries, particularly to those around the boundaries of the Lummi

Reservation. The harvest of program fish is a component of the annual co-manager List of Agreed Fisheries (LOAF) for fisheries in Washington Coastal and Puget Sound Areas by the WDFW and treaty tribes. The list is developed during the Pacific Fisheries Management Council process establishing ocean salmon fisheries to ensure that Chinook escaping the ocean fisheries meet the requirements of U.S. V. Washington with respect to sharing and conservation.

Harvest effects on listed fish resulting from implementation of the Skookum Hatchery coho program were previously addressed through a separate ESA consultation process (NMFS 2015).

3.3.1) Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years, if available. *Also provide estimated future harvest rates on fish propagated by the program, and on listed fish that may be taken while harvesting program fish.*

The primary beneficiaries from this program area expected to be the tribal fishers in and around the Lummi Reservation. Terminal area fisheries have been sampled for missing adipose fins to allow estimation of the contributions of hatchery production to the catch.

Table 3.3.1.1: Nooksack Samish terminal area coho catch

Year	Coho Harvest
2002	57,755
2003	56,997
2004	86,492
2005	40,486
2006	22,435
2007	27,455
2008	24,725
2009	44,628
2010	72,115
2011	55,508
2012	44,116
2013	53,895
Average	**48,884**

The ultimate goal of the program will be to have a terminal area catch annually averaging 171,000 coho, which was the average annual catch from 1983 to 1987. The combined Lummi programs are projected to contribute 136,000 or 80 percent of the terminal area catch.

The harvest rates on program fish in the extreme terminal area fisheries will be adjusted to ensure minimum escapement into the watershed from late August to late September after the river migration period of the ESA-listed early Chinook and summer Steelhead and well before the migration of the Winter Steelhead.

Program fish will contribute to mark selective recreational fisheries in the ocean and Strait of Juan de Fuca to support the economic return of those fisheries.

Contributions to Pacific Salmon Treaty fisheries will be based on the analysis of the CWT recovery analyses prepared by the PSC Coho Technical Committee.

3.4) Relationship to habitat protection and recovery strategies.

The Skookum Hatchery coho program is part of and consistent with the WRIA 1 Salmonid Recovery Plan (WRIA 1 SRB 2005) that was incorporated into the Shared Strategy Puget Sound Chinook Recovery Plan adopted by NOAA (NFMS 2007). The purpose of this program is to mitigate for lost natural production and provide a harvest opportunity to meet the treaty reserved right to take fish consistent with primary management strategy and recovery objectives. Habitat protection and restoration strategies are essential to the recovery of self-sustaining, natural populations. If land use decisions are made consistent with sufficient habitat protection and restoration, and harvest goals are being met, the hatchery program will be the remaining focus to meet management criteria. The impacts of development in the watershed may be moderated and even reversed, but the conditions required to provide natural origin harvestable surplus coho to meet the treaty reserved right to take fish seem unlikely in the foreseeable future.

Recovery activities in WRIA 1 are focused on the recovery of the ESA-listed Chinook populations in the North and South Forks of the Nooksack River, with habitat restoration directed at the recovery of those populations benefitting all salmon in the area. To the extent possible the effort to restore more natural ecosystem processes required to create and maintain properly functioning Chinook habitat will be supported, and program activities will not impede the recovery of ESA-listed Chinook. The WRIA 1 Salmonid Recovery Plan (WRIA 1 SRB 2005) was incorporated into the Shared Strategy Puget Sound Chinook Recovery Plan adopted by NOAA (NFMS 2007). As stated in the Recovery Plan hatchery practices will meet the objectives of 1) “use hatcheries to sustain treaty-reserved fisheries and non-treaty fishing opportunities, in a manner consistent with salmon recovery” and 2) “hatchery production of Chinook and other salmon will neither cause further decline nor inhibit recovery of WRIA 1 naturally spawning Chinook populations”.

3.5) Ecological interactions.

Ecological interactions between the program fish and the ESA-listed species are primarily theoretical. Among the potential ecological interactions with listed species and program fish may include indirect resource competition and predation. Coho smolts from the program are volitionally released into South Fork Nooksack River in May as they show signs of smolting. Catch in the Lower Nooksack Smolt Trap indicates a rapid movement down river. The rate of passage through the 44 miles from Skookum Creek Hatchery to the Lummi smolt trap at river mile 4.6 is indicated by the catch of adipose clipped coho. Table 10.11.1 indicates the proportion of the season’s catch of adipose

clipped coho taken in each statistical week. Between 80% and 90% of the catch of adipose clipped coho at the smolt trap takes place within two weeks release from the Skookum Creek Hatchery.

Table 3.5.1 Percentage of Skookum Coho Catch by Release Week and Sample Week

Release Year	Release Week	Statistical Week						
		19	20	21	22	23	24	Total
2014	21			89%	8%			97%
2013	19	46%	36%	8%				90%
2012	22				93%			93%
2011	22				9%	75%	9%	93%

There is a short period of overlap between the program smolts and listed Chinook and steelhead as demonstrated by beach seine data in the 4.3 miles of the South Fork Nooksack 1.4 miles below the Skookum Creek release point in 2005 (Dunphy, 2005). Many factors may limit the vulnerability of small salmonids to predation by larger salmonids. In a special case of coho preying on recently emerged sockeye in Chignik Lake Alaska, Ruggerone found that shore dwelling (non smolted) coho could consume sockeye up to 45% of their length, that 95% of the fry consumed were between 31 and 34 mm long or 28% of the 120 mm coho released from Skookum Creek (Ruggerone, 1991). The juvenile Chinook as indicated by the 2005 sampling in the South Fork range from 36% to 56% of the 120 mm Coho released and are not likely subject to predation. While the YOY steelhead (32 mm-35 mm) fall within this range (26%-29%) of the 120 mm average Skookum coho release, the abundance of steelhead during this period is low at 2.83 fish per set. During fieldwork in 2003, the average steelhead catch per set was 55.8 mm supporting the conclusion that the coho smolts are gone before the peak of the steelhead emergence (Dunphy, 2005).The bulk of the steelhead spawning is well above the Skookum Creek Release (Brett Barkdull, personal communication)

Table 3.5.2 2005 South Fork Nooksack Young of the Year Chinook and Coho Catch and Size Statistics

Species	2005 Statistical Week						
	19	20	21	22	23	24	25
Chinook							
Catch per Set	1.5	0	0.4	0.75	1	2.14	5.5
Average FL (mm)	50		62	43	58	65	67
Steelhead							
Catch per Set	0	0.17	1.4	0.75	2.83	2.57	1.25
Average FL (mm)		35	35	32	34	34	33

Dunphy (2005)

Lavage of fish caught in beach seines on 2003 showed the sampled YOY Chinook, and steelhead and coho were feeding on insects. Of 19 adipose clipped coho examined 16 had fed on insects and 2 had unidentifiable fish remains in their stomachs (Dunphy, 2005).

The short period of overlap in time and space in the Nooksack watershed between migration oriented program smolts would appear to limit significant ecological interactions with listed Chinook and steelhead. While there has been no concerted effort to analyze the feeding habits of salmonids captured in the Lummi Smolt Trap, there is occasional lavageing of fish of interest. During periods of high abundance Steelhead migrants have consumed chum and pink fry, but we have had no reports of hatchery coho consuming the abundant pink and chum. This would seem to confirm that the hatchery coho are moving rather than feeding (Kruse, personal communication).

Once leaving the river, there appears to be little chance for ecological interaction between program coho and migrating steelhead, which move rapidly through Puget Sound on their way to the open ocean. Studies in Puget Sound indicate some spatial distribution and diet similarities between coho and Chinook, but coho tend to be less abundant in the nearshore and feed more heavily on plankton. (Duffy et. al. 2005, Duffy et.al.2010, Brennen et al 2004). The major prey of juvenile coho and Chinook off of the Washington and Oregon Coast is larval and juvenile fishes though a substantial proportion of the diet of coho salmon consisted of invertebrates (Brodeur and Pearcy 1990 and Schabetsberger et. al. 2002) This lower reliance on larval and juvenile fish would reduce competitive interaction between coho and Chinook.

Catch objectives were being met when the total annual hatchery coho smolt release in the terminal area exceeded 5,600,000. This production was reduced to two million in the terminal area by 2003 as a precautionary measure to address the speculation of negative ecological interactions between hatchery produced coho and ESA-listed species. The reduced production resulted in a significant decline in terminal area harvestable coho, however no quantifiable positive response from the listed Chinook populations was observed.

Studies conducted in other areas indicate that this program is likely to pose a minimal risk of competition. By definition, hatchery and wild salmonids will not compete unless they require the same limiting resource. Thus, the modern enhancement strategy of releasing salmon and steelhead trout as smolts markedly reduces the potential for hatchery and wild fish to compete for resources in the freshwater rearing environment. The HSRG (2014), among others, have noted that this potential for competition is further reduced by the fact that many hatchery salmonids have developed different habitat and dietary behavior than wild salmonids (Flagg et al 2000).

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.

Skookum Creek Hatchery derives its water from two sources: Skookum Creek and ground water. Skookum Creek is the primary source of water, and is drawn into the hatchery by a screened diversion intake approximately 1,000 feet above the creek's confluence with the South Fork. A Washington State water right permit (WDOE #22899, 1983) allows the withdrawal of 40cfs from the Creek. Under the permit, minimum flows

for Skookum Creek are 26cfs. Water flows from the diversion structure by gravity to a settling pond through 36-inch underground pipe and then into the hatchery facility.

Water quality of Skookum Creek is variable through the year. The temperature of Skookum Creek water flowing to the hatchery typically ranges from 32°-65°F. High turbidity and low temperatures during the spring and fall months may limit use for incubation and early rearing purposes.

Four operational groundwater wells provide a secondary source of water to Skookum Creek hatchery. Total available ground water flow is limited to 480 gpm, which is far below the optimal level required by the hatchery. Ground water is used primarily for incubation and secondarily for early rearing.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Skookum Creek where surface water is withdrawn does not harbor any listed fish populations, and no effects on listed fish associated with water withdrawal activities are expected. Regardless, screens at the intake at Skookum Creek are designed to avoid entrainment of juvenile fish. By 2018, new NOAA-approved fish screens will be installed once a funding source has been identified.

Waste water generated during pond cleaning and drawdown is routed to a series of pollution abatement ponds. Hatchery effluent is monitored according to current NPDES regulation and conforms to all permit requirements.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Broodstock are trapped and collected from the Skookum Creek Hatchery's brood pond. Brood voluntarily enter the hatchery outflow channel from the river and ascend a short fish ladder to enter the brood pond. Brood are contained within a 90-foot long by 9-foot 6-inch wide pen until they are manually crowded and sorted into gender specific pens.

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

There is currently no transportation of coho to or from this facility except for eyed eggs. Eyed eggs are transported from Skookum Creek Hatchery to Kendall Creek Hatchery on an as-needed basis to supplement egg take shortfalls at Lummi Bay Hatchery. In this event, eyed eggs are transported in sanitized 5-gallon buckets individually covered with sanitized, water saturated burlap bags. Upon arriving to Kendall Creek Hatchery, eggs undergo standard disinfection protocol and are placed in incubators for hatching.

5.3) Broodstock holding and spawning facilities.

Gamete collection occurs adjacent to the broodstock collection pond inside the spawning building. This building is located on the top end of the brood pond and allows access to brood pond through a series of overhead rolling doors. The building is approximately 65-feet by 20-feet in dimensions and is entirely enclosed from the elements.

Broodstock are manually crowded weekly for spawning sorts. Despite final disposition, all fish are lifted in an aluminum box with a winch and deposited in a plastic tote for killing by carbon-dioxide asphyxiation and sent through an NMT R-9500 coded-wire tag detector. Blood and spilled eggs and milt are contained by a floor drain which runs the entire width of the building and leads to an approved septic system.

5.4) Incubation facilities.

The incubation facility is located within the main hatchery facility; it has two rooms with independent plumbing and equipment. Coho are incubated in NoPad™ incubators. The coho incubation room has eighteen NoPad™ incubating trays that have a combined capacity of 2.5 million eggs.

5.5) Rearing facilities.

Upon absorption of yolk sacs during incubation, coho are transferred to fifteen 10-foot by 4-foot by 90-foot linear concrete raceways for initial rearing. Each raceway has rearing capacity of approximately 175,000 fry. Each linear raceway is plumbed to accept ground water or Skookum Creek water at variable flow volumes depending on water quality requirements.

At 150 to 200 fish per pound, juvenile coho are adipose marked and/or coded-wire tagged and immediately transferred to up to four 80-foot by 280-foot asphalt lined rearing and acclimation ponds which hold approximately 550,390 gallons of water each with a maximum capacity of 650,000 juveniles at an average weight of 20fpp. The four large rearing ponds operate with Skookum Creek water at variable flow volumes.

5.6) Acclimation/release facilities.

Coho are acclimated on Skookum Creek water in the large rearing ponds. Fish are volitionally released from the ponds after the outlet screens have been pulled.

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

There have not been any unintentional mortalities resulting from operational difficulties.

The destruction of the 1989 and 1990 brood year production after a detection of a VHS virus was an intentional precautionary action before it was understood that this virus was naturally occurring and not a significant cause of mortality in Pacific salmon.

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.

No listed natural-origin fish are native to, or are present in Skookum Creek. Coho salmon are not listed, so the issue of their take associated with hatchery facility failure is not a take concern.

The Skookum Creek hatchery is staffed full-time with four full-time permanent and one half-time employees. Two permanent employees reside on-station in employee housing. All significant electrical water pumps, including well pumps and reuse pumps, are connected to failure alarms. Low water alarm probes tied to the central alarm panel are located in all head boxes and reuse sumps. Oxygen concentration and temperature alarms are currently operating in the partial reuse system with plans to expand monitoring capabilities to all rearing ponds and raceways. 24-hour temperature, pH and dissolved oxygen monitoring and data logging is located in incubation and early rearing and the partial reuse sections.

All incubators, raceways, tanks, and rearing ponds at the hatchery have been designed to operate with either ground water or gravity-fed Skookum Creek water allowing full operation of the hatchery in the event of a power outage. An 80kW backup diesel generator supplies power for all necessary electrical demand in the event of power outages.

Facilities on the hatchery complex are not located in areas not subjected to flood events.

In addition to observations by the hatchery crew, a NWIFC fish health specialist regularly monitors the health of fish in held in the 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.

The coho salmon stock under propagation is of mixed origin, but primarily from Soos Creek (Green River) Hatchery lineage that has through years of planting become localized to the Skookum Creek Hatchery release site. Broodstock have been selected from hatchery and natural origin coho voluntarily entering the brood pond on the hatchery complex since 1990.

6.2) Supporting information.

6.2.1) History.

Historically the stock has been derived from the Soos Creek, Green River Hatchery Stock

received from a variety of hatcheries culturing that stock. The extant Skookum Creek Hatchery coho salmon stock is not part of any listed natural population. The 1989 and 1990 brood year Lummi Coho production was intentionally destroyed as a precautionary action after a detection of a VHS virus before it was understood that this virus was not a significant cause of mortality in Pacific salmon. The hatchery broodstock was rebuilt from contributions of the Soos Creek hatchery stock from WDFW Kendall Creek, Marblemount, and Skykomish hatcheries.

6.2.2) Annual size.

The program will be phased and adjusted as criteria are met.

Table 6.2.2.1: Proposed Stages for the Skookum Hatchery coho program.

Phase	Brood Stock	Egg Take Goal	Criteria
1	Up to 900 F – 900 M	Up to 1,800,000	As needed, if Lummi Bay shortfall
2	600 F - 600 M	1,200,000	No longer required for Lummi Bay
3	750 F – 750 M	1,875,000	4 year avg harvest phase 1 goal met
4	1,200 F- 1,200 M	2,200,000	4 year avg harvest phase 2 goal met

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

Stray natural origin coho entering the hatchery and incorporated into the broodstock have typically ranged from 1-5% of the total broodstock composition. Since this program is isolated from the native population identified in the upper North Fork Nooksack River, volunteers will be recorded and incorporated in the brood stock to enhance the ability of hatchery strays to successfully occupy restored habitat as it becomes available.

6.2.4) Genetic or ecological differences.

Microsatellite DNA analysis suggests that naturally spawning coho in all areas of the Nooksack River basin are genetically indistinguishable from the Hatchery Coho stock regardless of location sampled, with the exception of naturally spawning coho in the areas upriver of Kendall Creek Hatchery. At this time, there are no known differences in genotype, phenotype, or behavior between hatchery stocks and naturally spawning coho, except for a small group of coho in the upper North Fork Nooksack. (Small et. al. 2004)

6.2.5) Reasons for choosing.

The current coho hatchery stock has been proven to do well under the conditions at Skookum Creek Hatchery. There has been no difficulty in achieving broodstock goals with the stock that was re-established replacing the 1989-1990 brood year destroyed as a precautionary action (see section 5.7).

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.

There are no ESA-listed species that would be at risk from broodstock selection processes.

SECTION 7. BROODSTOCK COLLECTION

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

Adults.

7.2) Collection or sampling design.

All fish encountered in the trap are scanned for coded wire tags and inspected for physical health. Those considered for broodstock are selected over the entire duration of the returning run to maintain diverse temporal distribution and maximize genetic diversity. Male and female coho selected for broodstock are separated and held in separate areas in the partitioned collection pond.

Males less than 12" in length are typically not reserved for broodstock.

7.3) Identity.

Hatchery origin coho are identified by the lack of an adipose fin, and/or the presence of a CWT. Natural origin coho are identified by an intact adipose fin without the presence of a CWT.

7.4) Proposed number to be collected:

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

The program will be phased and adjusted as criteria are met

Table 7.4.1.1: Proposed Stages for the Skookum Creek Hatchery coho program.

Phase	Brood Stock	Egg Take Goal	Criteria
1	Up to 900 F – 900 M	Up to 1,800,000	As needed, if Lummi Bay shortfall
2	600 F - 600 M	1,200,000	No longer required for Lummi Bay
3	750 F – 750 M	1,875,000	4 year avg harvest phase 1 goal met
4	1,200 F- 1,200 M	2,200,000	4 year avg harvest phase 2 goal met

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

Table 7.4.2.1 Skookum Creek Hatchery Coho Broodstock Collection

Year	Males Spawned	Females Spawned	Eggs* Taken
2002	880	880	2,000,000
2003	990	990	1,980,000
2004	1144	1144	2,530,000
2005	970	970	2,100,000
2006	665	665	1,820,000
2007	770	770	1,606,000
2008	825	440	1,416,000
2009	840	840	1,708,000
2010	660	660	1,896,000
2011	540	540	1,440,000
2012	725	725	2,364,494
2013	600	600	1,500,000
2014	752	752	1,620,000
Average	**797**	**767**	**1,844,653**

*Including supplementation of Lummi Bay Brood

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

Per the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State 2006* guidelines, surpluses of adults may be used for nutrient enhancement within the South Fork sub-basin after culling. Carcasses may also be sold or donated for animal feed or sold or donated as bait to tribal crab fishers.

7.6) Fish transportation and holding methods.

Adult coho are not transported.

7.7) Describe fish health maintenance and sanitation procedures applied.

Broodstock are not intentionally treated with medication except for incidental exposure to formalin treatment for mature South Fork Chinook broodstock as part of the Skookum South Fork Chinook Gene Bank and Supplementation program.

7.8) Disposition of carcasses.

Pre-spawn mortalities are disposed of in an approved septic system or used for bait in saltwater fisheries. According to the *Salmonid Disease Control Policy of the Fisheries*

Co-Managers of Washington State 2006, surpluses of adults may be used for nutrient enhancement within the South Fork sub-basin after culling. Carcasses may also be sold or donated for animal feed or sold or donated as bait to tribal crab fishers.

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 are collected in an off-channel pond in a creek lacking any listed fish populations. Takes resulting from listed fish capture, handling, injury and mortality during broodstock collection at Skookum Hatchery are therefore unlikely to occur. The risk of fish disease amplification will be minimized by following the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State 2006* guidelines. This will minimize the likelihood for adverse genetic or ecological affects to ESA-listed species.

SECTION 8. MATING

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

8.1) Selection method.

Broodstock are selected randomly during pre-spawn sorts, with an emphasis on the runtime distribution which reflects the entire adult entry to the hatchery. Adults selected for brood are spawned as they become ripe.

8.2) Males.

Males are chosen randomly to match the number of ripe females on any spawning day. Milt from each male is stored individually in plastic containers until fertilization.

8.3) Fertilization.

The eggs from 10 females are placed in a 5-gallon bucket. The mixture is then equally distributed between 5 one-gallon buckets. Each bucket is then fertilized with the milt from 2 males.

8.4) Cryopreserved gametes.

Cryopreserved gametes are not used in the program

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.

ESA-listed species are not included in this program

SECTION 9. INCUBATION AND REARING -

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

9.1) Incubation:

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

Accurate data for egg survival during incubation has not been recorded. Available evidence indicates that survival from fertilization to ponding has likely averaged 97%. Steps are currently being taken to record necessary data in the future.

Table 9.1.1.1: Skookum Creek Hatchery Egg Takes 2002-2014

Year	Females Spawned	Males Spawned	Eggs Taken	Pounds of Eggs	Estimated Egg/Pound
2002	880	880	2,000,000	960	2083
2003	990	990	1,980,000	990	2000
2004	1144	1144	2,530,000	1259	2010
2005	970	970	2,100,000	1050	2000
2006	665	665	1,820,000	910	2000
2007	770	770	1,606,000	700	2294
2008	825	440	1,416,000	720	1967
2009	840	840	1,708,000	854	2000
2010	660	660	1,896,000	948	2000
2011	540	540	1,440,000	720	2000
2012	725	725	2,364,494	1053	2245
2013	600	600	1,500,000	750	2000
2014	752	752	1,620,000	810	2000
Average	**797**	**767**	**1,844,653**	**902**	**2046**

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

Surplus egg takes occur for three primary reasons: 1.) Preventative measure against catastrophic loss at Skookum Creek Hatchery; 2.) supplementing egg take shortfalls at Lummi Bay Hatchery; and 3.) providing eggs for educational purposes in Whatcom County schools or local rehabilitation programs.

9.1.3) Loading densities applied during incubation.

Green eggs, historically weighing an average of 2,046epp are loaded at the rate of approximately 250,000 eggs per incubator. After the eggs are eyed, shocked, picked and enumerated, they are reloaded for hatching at approximately 160,000 eggs per Nopad™ tray. For the green to eyed stage, incubator flow is 8gpm. After shocking and picking, incubators are supplied 12gpm.

9.1.4) Incubation conditions.

Eggs are reared and hatched on pathogen-free ground water with a near constant temperature of 48°F and a dissolved oxygen content averaging 10.5 mg/L.

Water quality is constantly monitored and data logged with a YSI-5200A multi parameter water quality monitor. When eggs are sufficiently eyed, they are shocked and reloaded into incubators for hatching. Eggs required for Lummi Bay Hatchery's coho program are transferred to WDFW's Kendall Creek Hatchery after eying for hatching and rearing.

9.1.5) Ponding.

Fry are force-ponded when all of the fry in incubators are buttoned up, which occurs through the month of February. Ground water is used for early rearing with a gradual transition to Skookum Creek surface water.

9.1.6) Fish health maintenance and monitoring.

Eggs are water-hardened and treated on a daily basis to within 7 days of hatching with buffered PVP iodine.

Coldwater disease, which may cause fish health issues on most years, is effectively prevented by providing medicated feed containing florofenicol. Fry are fed medicated treatment of 10mg of florofenicol per kilogram of fish typically 14-21 days after ponding. Treatment lasts for 20 days, but is divided into two 10-day treatments separated by one week of non-medicated feed.

Water quality is monitored constantly with a real-time water quality monitor and also with handheld monitors on a daily basis. Any indications of health-related threats are immediately alerted to fish pathologists. Bi-monthly health inspections by NWIFC fish health professionals are regularly scheduled.

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 and hatched exclusively on pathogen and sediment free ground water.

9.2) <u>Rearing</u>:

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

98- 99% survival has been the typical survival rate from the fry to fingerling stages since 1992. Fingerling to smolt survival has typically ranged from 98.5-99.5% since 1992.

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

The density target for 150 fpp in the raceways is 0.2 lbs/ft^3. Densities are adjusted if

weight discrepancies become apparent. Immediately after marking and tagging, sub-yearlings are transferred to the large ponds and loaded to a maximum density of approximately 0.37 lbs/ft^3 assuming 2 of the 4 large ponds are used for rearing.

9.2.3) Fish rearing conditions

When fry are initially ponded in raceways, low temperature and high turbidity from Skookum Creek water may cause impediments to starting fry on feed. To compensate for this, ground water is almost exclusively used until fish are adequately competent to feed in turbid conditions without pin-heading.

Water quality monitoring occurs on a daily basis. The minimum acceptable dissolved oxygen concentration during any stage of rearing is 8.5 mg/L. Raceway and pond outlet screens are cleaned on a daily basis and raceways floors are completely vacuumed a minimum of once weekly. All mortalities are removed on a daily basis and disposed into the septic system.

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.

Not available at this time

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

Table 9.2.5.1: Average Monthly Fish Growth Rate for Program.

Month	Average Size (fpp)
February	1900
March	800
April	450
May	300
June	200
July	150
August	125
September	100
October	85
November	75
December	65
January	55
February	45
March	33
April	25
May	22
June	19

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*).

EWOS semi-dry pellet food is fed at generally 2.0% of body weight per day. This rate is adjusted to meet growth goals and to mimic natural growth curves. From initial feedings to release, fish transition from #0 crumble to 1.5mm pellets. An FCR of 1.2 is considered acceptable.

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

Fish health monitoring and disease treatment is follows the *Disease Control Policy of the Fisheries Co-Managers of Washington State 2006* guidelines. A WDFW or NWIFC fish health specialist visits bi-monthly for pathology sampling. Fish health and behavior is inspected by hatchery staff at multiple occurrences throughout the day.

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

Not applicable. Smoltification is determined by physical appearance and behavior of the fish. Visual indications of smoltification include crowding the pond outlet screens, reduced or no appetite and a silver appearance.

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

There are currently no intentional natural rearing methods applied in this 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.

The coho program is completely isolated from the South Fork Chinook program at the Skookum Creek hatchery, except for the initial overlap in migration timing into the facility.

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 by program phase.

Phase	Age Class	Maximum Number	Size (fpp)	Release Date	Location
1	Yearling Smolt	1,000,000	17-22	Late-May-Early June	South-Fork Nooksack River
2	Yearling Smolt	1,500,000	17-22	Late-May-Early June	South-Fork Nooksack River
3	Yearling Smolt	2,000,000	17-22	Late-May-Early June	South-Fork Nooksack River

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

Release Site

Stream, river, or watercourse: South Fork Nooksack River (WRIA 1)
Release point: Skookum Creek Hatchery, RM 14.3, tributary to the mainstem Nooksack River at RM 36.6
Major watershed: Nooksack River
Basin or Region: Strait of Georgia

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

Table 10.3.1: Skookum Hatchery Coho Yearling Smolt Releases

Release	Yearling Smolts	Size at Release	Release Date(s)
2003	991,005	18.0	May 19-25
2004	947,468	18.0	May 20-25
2005	982,578	18.0	May 13-17
2006	1,083,472	17.0	May 17-22
2007	973,642	17.0	May 18-25
2008	1,090,541	17.0	May 21-30
2009	1,019,613	17.0	May 22-28
2010	985,420	16.0	June 4-9
2011	849,479	15.0	May 25-June 3
2012	895,628	19.0	May 25-May 31
2013	1,085,244	16.0	May 9-May 13
2014	1,740,000	17.0	May 19-May 25
Average	**1,053,674**	**17.1**	

Lummi data

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

Over the last 12 years, actual release dates have ranged from mid-May to early June (Table 10.3.1).
Yearling coho are released volitionally. Release begins when fish stop feeding, begin to circle the edges of the rearing pond, and crowd the exit flume screen. After two to three pulses of volitional exit, the remaining fish (about 1-2%) are forced out the exit flume. An electronic fish counter is used to count the release. Refer to Table 10.3.1 for release dates.

10.5) Fish transportation procedures, if applicable.

Juvenile coho are not currently transferred from Skookum Creek Hatchery to other locations. In the event the rearing of Lummi Bay Hatchery coho is transferred back to Skookum Creek Hatchery from Kendal Creek Hatchery, transportation of juvenile pre-

smolts will occur. Transport will be conducted with Lummi Nation's tanker truck that has a water capacity of 1,000 gallons. Up to 1,000 pounds of juveniles will be transported at a time and transport times average 55 minutes. Pure oxygen is diffused into the tanks and dissolved oxygen levels average 9.0 mg/L at maximum loading density.

10.6) Acclimation procedures

Coho volitionally propagated for release from Skookum Creek Hatchery are reared and acclimated on Skookum Creek water.

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

Skookum Creek coho are a Pacific Salmon Commission indicator stock. Each year, in mid June a target of 50,000 of the coho sub-yearlings are coded-wire tagged. All Skookum Creek coho are 100% mass-marked and quality control of mark rates is conducted several times per day mass-marking is occurring.

Thermal otolith marks may be applied in the future for an additional method to determine contributions to terminal harvest.

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

Every effort will be made to ensure that the coho smolt release is within 10% of the release goal. If monitoring data during rearing indicate a number significantly greater than the release goal error margin, the excess will be culled to reflect the release goal and minimize wastage of resources. The cull, if implemented, will be noted in the hatchery records. Co-managers will be consulted if release estimates are or may be 10% or greater over the release goal.

10.9) Fish health certification procedures applied pre-release.

The release group receives a fish health determination within one week of release by an NWIFC fish pathologist.

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

Emergency release of pre-mark/CWT sub-yearlings from the raceways will be avoided at all cost with the maintenance of emergency backup generators.

Depending on the rearing location in the hatchery, during the event of a catastrophic emergency where generators fail and the Skookum Creek intake is destroyed, coho may be released by pulling screens or removed from ponds with a fish pump within 15 minutes to 1 hour from decision.

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.

All yearling Coho salmon are volitionally released from Skookum hatchery as actively migrating smolts from mid-May to early June during high river flows to facilitate rapid out-migration and reduce the potential for in-river interaction with listed stocks. The rate of passage through the 44 miles from Skookum Creek Hatchery to the Lummi smolt trap at river mile 4.6 is indicated by the catch of adipose clipped coho. Table 10.11.1 indicates the proportion of the season's catch of adipose clipped coho taken in each statistical week. Between 80% and 90% of the catch of adipose clipped coho at the smolt trap takes place within two weeks release from the Skookum Creek Hatchery.

Table 10.11.1 Percentage of Skookum Coho Catch by Release Week and Sample Week

Release Year	Release Week	Statistical Week						
		19	20	21	22	23	24	Total
2014	21			89%	8%			97%
2013	19	46%	36%	8%				90%
2012	22				93%			93%
2011	22				9%	75%	9%	93%

There is a short period of overlap between the program smolts and listed Chinook and steelhead as demonstrated by beach seine data in the 4.3 miles of the South Fork Nooksack 1.4 miles below the Skookum Creek release point in 2005 (Dunphy, 2005). Many factors may limit the vulnerability of small salmonids to predation by larger salmonids. In a special case of coho preying on recently emerged sockeye in Chignik Lake Alaska, Ruggerone found that shore dwelling (non smolted) coho could consume sockeye up to 45% of their length, that 95% of the fry consumed were between 31 and 34 mm long or 28% of the 120 mm coho released from Skookum Creek (Ruggerone, 1991). The juvenile Chinook as indicated by the 2005 sampling in the South Fork range from 36% to 56% of the 120 mm Coho released and are not likely subject to predation. While the YOY steelhead (32 mm-35 mm) fall within this range (26%-29%) of the 120 mm average Skookum coho release, the abundance of steelhead during this period is low at 2.83 fish per set. During fieldwork in 2003, the average steelhead catch per set was 55.8 mm supporting the conclusion that the coho smolts are gone before the peak of the steelhead emergence (Dunphy, 2005).The bulk of the steelhead spawning is well above the Skookum Creek Release (Brett Barkdull, personal communication)

Table 10.11.2 2005 South Fork Nooksack Young of the Year Chinook and Coho Catch and Size Statistics

	2005 Statistical Week						
Species	19	20	21	22	23	24	25
Chinook							
Catch per Set	1.5	0	0.4	0.75	1	2.14	5.5
Average FL (mm)	50		62	43	58	65	67
Steelhead							
Catch per Set	0	0.17	1.4	0.75	2.83	2.57	1.25
Average FL (mm)		35	35	32	34	34	33

Dunphy (2005)

Lavage of fish caught in beach seines on 2003 showed the sampled YOY Chinook, and steelhead and coho were feeding on insects. Of 19 adipose clipped coho examined 16 had fed on insects and 2 had unidentifiable fish remains in their stomachs (Dunphy, 2005).

The short period of overlap in time and space in the Nooksack watershed between migration oriented program smolts would appear to limit significant ecological interactions with listed Chinook and steelhead. While there has been no concerted effort to analyze the feeding habits of salmonids captured in the Lummi Smolt Trap, there is occasional lavageing of fish of interest. During periods of high abundance Steelhead migrants have consumed chum and pink fry, but we have had no reports of hatchery coho consuming the abundant pink and chum. This would seem to confirm that the hatchery coho are moving rather than feeding (Kruse, personal communication).

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

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

The purpose of the monitoring program is to identify and evaluate the benefits and risks that may derive from the hatchery program. The monitoring program is designed to answer questions of whether the hatchery is providing the benefits intended, while also minimizing or eliminating the risks inherent in the program. A key tool in any monitoring program is having a mechanism to identify each hatchery production group.

Hatchery coho are identified with adipose clips, coded wire tags, or other identification methods as they become available. This will allow for selective harvest on hatchery stocks when appropriate, monitoring of interactions of hatchery and wild fish wherever they co-mingle in riverine, estuarine and marine habitats and assessment of the status of the target population. Through annual spawning ground surveys, the co-managers will sample the coho salmon escapement within the watershed to develop an estimate of the number of tagged, un-tagged and marked fish escaping into the river each year and the rates of hatchery Chinook into the rivers. The sample of the harvest of coho taken in the Nooksack River fisheries to estimate the proportion of natural origin and hatchery coho

can provide an alternate minimum estimated stray rate when compared with the total return to Skookum Creek Hatchery

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.

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

Continue to coded-wire tag and remove adipose fins on all coho to allow identification at the hatchery rack and on the spawning grounds.

The co-managers will monitor coho escapement in the Nooksack basin to estimate the number of tagged, untagged and marked fish present on the spawning grounds each year and contributions by hatchery release as appropriate and resources are available. The returns to the hatchery will be identified by origin (adipose clip) and coded wire tag. This information will provide an estimate of the year and location of release.

The co-managers will sample the terminal areas fisheries for sufficient CWTs to allow estimation of the total catch of coho by hatchery origin and year of release. Fisheries beyond the terminal area will be sampled according to the PSC coast wide protocols for CWTs to allow the estimation to the total CWTs in the each fishery. The CWT recoveries estimated in all non-terminal fisheries plus the terminal area estimates, spawning ground estimates and hatchery returns of stock, origin, release year and location will allow the evaluation of the program success and the fisheries that benefitted. The development of Parental Based Tagging might provide better estimates of fisheries contributions by hatchery and stock and better estimates of natural spawning ground populations by stock.

The basic information on the hatchery release numbers, mark status, release location and date will be reviewed by the Co-managers and posted with RMIS within a year. The CWT information collected in the terminal area will be prepared by and reviewed by the co-managers to meet the requirements of the PST. Estimates of the composition of the terminal area catch, the hatchery return and the spawning ground abundance by stock, origin and release strategy will be available within 18 months, and the basis for the estimates of the stock composition by origin from coast wide fisheries that will allow a complete evaluation of adult production from each release is dependent on international teams and may take more than 2 years. Best management practices will be followed in hatchery operations and records will be kept to monitor performance. Results will be reported annually. The co-managers will regularly meet to evaluate monitoring results and develop action plans where necessary to ensure programs are producing the expected outcomes, or to evaluate whether we are able to move up to the next level.

Table 11.1.1.1: "Performance Indicators" addressing benefits.

Standard	Indicator	Monitor
Identification of hatchery origin coho in the hatchery, harvests and spawning grounds	Ad Clip, otolith mark or CWT	Sample harvest, hatchery and spawning grounds to provide statistically valid estimates of hatchery fish
Significant contributions to terminal area harvest	Proportion in of identified hatchery fish in harvest samples	Sample at rates to provide statistically valid estimates of contributions to all fisheries.
Effectiveness of program operations	Survival rates recorded at each stage of culture	Annual report of hatchery activities
Release survival meets Standards	Proportion of released production that contributes to escapement and fisheries	Analysis of program contributions to spawning grounds, hatchery return and all fisheries

Table 11.1.1.2: "Performance Indicators" addressing risks.

Standard	Performance Indicator	Monitor
Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols (WWIT/WDFW 2006))	Hatchery records document compliance with applicable standards and criteria.	Annual report of hatchery fish health guidelines and standards met
Effluent from hatchery facility will not adversely affect the ecosystem.	Discharge water quality meets NPDES permit standards.	Reports as required by NPDES permit in annual hatchery report
Water withdrawals and in-stream water diversion structures for hatchery operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.	Water withdrawals are compliant with water rights. Facility operates in compliance with applicable passage and screening criteria for juveniles and adults.	Annual record of water withdrawal and status of passage and screening include in annual hatchery report
Releases do not introduce new pathogens and do not increase the levels of existing pathogens in local populations	All State and co-manager fish health policies and standards are followed. Certification of fish health during rearing and release.	Report of compliance with fish health policies and fish health certifications contained in the annual hatchery report
Any distribution of carcasses or other spawner products for nutrient enhancement is accomplished in compliance with appropriate state, tribal and federal disease control regulations and guidelines	All applicable fish disease policies are followed.	Disposition of carcasses reported in Annual Hatchery Report.

The stray rate will not cause a significant genetic change in North Fork coho	DNA stock identification compared to the baseline	Statistics comparing stock genomes will not show a significant change
Competition by hatchery origin releases on natural origin salmonids does not significantly reduce numbers of listed natural origin salmonids.	Dates, size and location of release supporting rapid out migration	Records from hatchery operations contained in annual hatchery report. Supplemental information from lower river smolt trap as available.

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

The standard of the monitoring is related to the resources available to it. Basic status quo monitoring is available for hatchery operations. Basic tagging, fin clipping, and otolith marking are funded. The spawning ground characterization requires substantial additional funding to identify the total abundance and the proportion from different stocks, origins, and the date and release strategies. The resources for timely analysis of sample data from the spawning grounds and fisheries is not steady and may delay analyses for up to a year.

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.

Coho are not a listed fish and the preponderance of coho, natural and hatchery origin in the Nooksack Watershed is indistinguishable from the program fish.

The operation of the Lummi smolt trap in the lower river is monitored in variable time periods related to the expected abundance of juveniles passing the site to minimize the duration of holding and risk of harm ESA listed Chinook and Steelhead as it samples the migrations to provide estimates of salmon abundance by species, origin, and age to provide a baseline for evaluation to the production per spawner, and marine survival.

SECTION 12. RESEARCH

There are currently no research programs directly related to this program. If a research plan is developed that would provide insight into modifications of the program to improve efficiencies and modify or inform the identification of genetic or ecological impacts of program fish on ESA-listed species, the Co-managers will consult with the listing services.

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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:_____

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

Listed species affected: _____ ESU/Population:_____ Activity:_____				
Location of hatchery activity:_____ Dates of activity:_____ Hatchery program operator:_____				
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)				
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

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

Instructions:

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

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	SIZE CRITERIA Number of fish/pound	SIZE CRITERIA Grams/fish
X	Chinook Yearling	<=20	>=23
X	Chinook (Zero) Fingerling	>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 Fingerling	>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 Fed Fry	<=1000	>=0.45
X	Chum Unfed Fry	>1000	<0.45
X	Sockeye Yearling 2/	<=20	>=23
X	Sockeye Fingerling	>20 to 800	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 Fed Fry	<=1000	>=0.45
X	Pink Unfed Fry	>1000	<0.45
X	Steelhead Smolt	<=10	>=45
X	Steelhead Yearling	<=20	>=23
X	Steelhead Fingerling	>20 to 150	3 to <23
X	Steelhead Fry	>150	<3
X	Cutthroat Trout Yearling	<=20	>=23
X	Cutthroat Trout Fingerling	>20 to 150	3 to <23
X	Cutthroat Trout Fry	>150	<3
X	Trout Legals	<=10	>=45
X	Trout Fry	>10	<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.