HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Lower Nooksack Fall Chinook
Species or Hatchery Stock:	Chinook (*Oncorhynchus tshawytscha*) Samish Fall Chinook Hatchery Stock
Agency/Operator:	Lummi Natural Resources Department
Watershed and Region:	WRIA 1 –Nooksack River/Lummi Bay
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 as mitigation for these losses. Conservation concerns have resulted in a listing of the Puget Sound Chinook Evolutionarily Significant Unit (ESU) as threatened under the Endangered Species Act (ESA). The implementation of Section 4 (d) protections has severely impacted Lummi treaty right fisheries. The Fall Chinook hatchery program will continue to be an integral component of salmon management until the Nooksack watershed has been restored to natural salmon production at levels to sustain harvest that will 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 Tribe's Lower Nooksack Fall Chinook hatchery program, at the tribe's Lummi Bay facility, is expected to contribute to annual average terminal area harvests comparable to that experienced in the mid 1980s, without impeding the recovery of listed Chinook, bull trout and steelhead populations. Specifically, Lummi's initial objective is to attain an average annual total terminal area harvest of 81,000 Chinook comparable to the average annual harvest in the mid-1980s. It is anticipated that 90% of the terminal harvest will be from hatchery production. Recent 12-year (2002-2013) average terminal catch has been 22,000, well below harvest objectives. The Fall Chinook program HGMP evaluates and addresses the risks of the program on salmon stocks of concern.

Two naturally spawning Chinook populations have been identified in the Nooksack-Samish region.

1. A North Fork/Middle Fork Nooksack early timed (spring) population. Spawning escapement has averaged 210 from 1998 to 2013 (NORs only). The NF Chinook population is in a preservation phase of recovery.
2. A South Fork Nooksack population. Spawning escapement has averaged only 67 adults (NOR) from 1999 to 2013. The SF Chinook population is in a preservation phase of recovery.

Both early timed Chinook populations in the Nooksack basin have been determined to be "critical" in ESA status by the co-managers. A "low abundance threshold" of 1,000 adults has been developed for both populations. (*Puget Sound Indian Tribes and WDFW. 2010. Revised Comprehensive management plan for Puget Sound Chinook: harvest management component).* Populations below this threshold require the initiation of additional harvest management strategies to protect the population from excess harvest.

There are also two fall Chinook hatchery stocks, the Lummi Bay and Samish hatchery stocks. These populations are not part of the listed ESU. This HGMP addresses the Lummi Bay program

Hatchery production--background. The Lummi Tribe releases fall Chinook at the Lummi Bay hatchery and Bertrand Creek Acclimation Facility. Juveniles currently originate from WDFW's Samish hatchery program. Use of the Bertrand Creek Watershed pond began in 2008 as a way to

reduce potential straying of unharvested hatchery fall Chinook into the Nooksack Forks; previous releases were into the tidal Nooksack River at the Marine Drive Bridge, without acclimation.

Catch objectives were being met when the total hatchery fall Chinook fingerling release in the terminal area was between 16 and 20 million annually, with more than 8 million released in the Nooksack watershed. Kendall Creek Hatchery (located on the North Fork Nooksack) operated by WDFW once produced fall Chinook, but the program was terminated in 2000, as a precautionary measure to reduce interactions with the ESA-listed Chinook. In addition, a few years later, fall Chinook production in the terminal area was reduced to 500,000 in the Lower Nooksack, 500,000 into Lummi Bay and five million Chinook into the Samish as a precautionary measure to reduce interactions with the ESA-listed Chinook.
Reduced hatchery production, combined with poor post-release survival of hatchery fish has resulted in substantially reduced abundance and harvest of Nooksack-Samish fall Chinook.

Planned hatchery program. Lummi fall Chinook production is planned to increase in three stages, characterized by: 1) transition to local broodstock, 2) increased survival, and 3) increased production.

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

1. Utilization, i.e. survival and contribution to terminal fisheries.
   Solutions:
   - i. Hatchery strategies (release size, release location, rearing and acclimation, and release goals) are designed to maximize the number of adults available for terminal harvest.
   - ii. Management strategies will adjust the river harvest rate on hatchery chinook in an adaptive manner to limit the opportunity for straying.
   - iii. Improve program survival rates (e.g. vaccinate for *vibriosis* to reduce threat of outbreak and mortality).
   - iv. Monitor survival of hatchery returns (SAR) and catch contributions to all fisheries with a particular emphasis on the terminal fisheries.
     - a. Unique otolith code for each release location and year
     - b. Sample terminal fisheries and spawning grounds for otoliths.
     - c. Samish CWT marked hatchery fish will be used as an indicator of contributions of the Lummi programs to pre-terminal fisheries.
2. Genetic and ecological interactions (e.g., destination and volume of adult hatchery origin fish not harvested or trapped at hatchery facilities).
   Solutions:
   - i. Operate adult trapping facilities at Lummi Bay efficiently.
     - a. Adjust river harvest rates to reduce escapement into the watershed.
   - ii. Release smolts at times, life stages, and locations that maximize homing fidelity and minimize straying.

iii. Monitor and evaluate the contribution of program adults to natural spawning within the Nooksack early timed Chinook populations (North Fork and South Fork) populations.

Additional key management issues affecting risks of this program to listed fish populations are:

1. Environmental risks
   - Water withdrawal impact on streams minimized
   - Intakes screened to avoid blockage of adults and entrapment of juveniles
   - Hatchery effluent discharges according to permit standards

   Solution: Monitor withdrawals, screens and discharges and ensure they are operated according to permits.

2. Fish Culture Risks
   - Best fish culture operational standards are met
   - Co-Manager Fish health standards are observed

   Solution: Document hatchery practices and file annual report.

3. Ecological Risks
   - All fish are released as seawater-ready subyearling smolts at sizes, during times, and in areas that reduce risks of interactions with listed fish, and predation and competition effects.
   - Release timed for rapid downstream migration (Bertrand Creek)

   Solution: best release practices, record time of release, and monitor appearance and span of occurrence at the Lower Nooksack Trap

4. Genetic Risk
   - DNA analysis of listed Early Chinook genomes do not diverge significantly from baseline
   - Stray rate monitoring via spawner surveys indicate low escapement levels and unsubstantial spatial and temporal overlap with early Chinook spawners.
   - Stray hatchery fall Chinook and adult superimposition effects in SF and NF Chinook Populations
   - All hatchery-origin fall Chinook are marked.

   Solution: Spawning ground surveys and sample tissues from natural origin spawners and migrants to evaluate through DNA analysis.

Table 1: Stages of Broodstock Development

Stage	Brood stock
1. Brood Stock	720 assuming 1:1 Male/Female. Relying on Samish Fry/Brood as available to meet shortfalls
2. Increase Survival	720 assuming 1:1 Male/Female, returning to facilities
3. Increase Production	1440 assuming 1:1 Male/Female, returning to facilities

Table 2: Proposed stages for the Bertrand Creek Pond and Lummi Bay fall Chinook hatchery programs.

Stage	Smolt Release Targets		Expected % Return to Terminal Area*	Criteria for moving to next Stage*	Expected Terminal Harvest Contribution*
	Bertrand Creek Pond	Lummi Bay			
1 Broodstock	500,000	500,000	0.3%	Terminal Harvest Rate > 75%; Stray estimates less than 5% of the SF and NF population spawners SAR > 0.3%	2,000
2 Improved Survival	500,000	500,000	>0.5%	Terminal Harvest Rate > 75%; Stray estimates less than 5% of the SF and NF population spawners SAR > 0.5%	3,500
3 Increased production	1,000,000	1,000,000	1.0%		15,000

*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.

Lummi Lower Nooksack Fall Chinook

1.2) Species and population (or stock) under propagation, and ESA status.
Chinook, Samish Hatchery Stock, (*Oncorhynchus tshawytscha*)

The status of this stock is unclear. Two independent Chinook populations were identified in the Nooksack Basin, a North Fork Nooksack River population and a South Fork Nooksack River population. A later-returning spawning aggregation of Nooksack River naturally-produced Chinook was considered to be part of the historical diversity of Chinook within the basin, however because the Green River Chinook stock was introduced to the Nooksack basin, genetic evidence of historical population structure in the current late spawning aggregations has been obscured. DNA Microsatellite analyses of the current late spawning aggregations in the Nooksack basin demonstrate that they closely resemble the Green River stock and are reproducing naturally in the River ((Ruckelshaus et. al. 2006). The hatchery stock that will be propagated through the program is not considered to be part of the Puget Sound Chinook ESU or included in NOAA Fisheries Hatchery Listing Policy (70FR37160, 78FR38270).

1.3) Responsible organization and individuals

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Name (and title):	Linda Delgado, Salmon Enhancement Manager
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

The program is part of the Nooksack Samish Terminal Area Co-manager agreed Equilibrium Brood Document required under the Puget Sound Salmon Management Plan. The Washington Department of Fish and Wildlife Samish Hatchery currently provides the fry for the Lummi program pending the development of a locally adapted hatchery stock, and Whatcom Creek Hatchery is involved with the rearing of juveniles for the

Bertrand Creek/Lower Nooksack program due to capacity limitations at Lummi Bay Hatchery.

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

These programs are funded through Lummi Nation self-governance programs supported with Bureau of Indian Affairs and tribal revenue. Four permanent employees operate these programs on a combined operational budget of approximately $145,000.

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

Lummi Bay Hatchery

Lummi Bay Hatchery, Southeast Georgia Strait, Whatcom County, Washington
WRIA 1

Whatcom Creek Hatchery

Maritime Heritage Park, Bellingham, Washington
RM 0.5, WRIA 01.0566
Association: Rearing juveniles for Bertrand Creek/Lower Nooksack River program.

Samish Hatchery

Samish River, WRIA 03.0005.
Association: Broodstock and egg collection, early fry rearing. For information on the facilities, broodstock collection, spawning, incubation and rearing of fry to be transferred to the Lummi program, please consult the HGMP for the Samish Hatchery Summer/Fall Chinook Fingerling Program

1.6) Type of program.

Isolated Harvest

1.7) Purpose (Goal) of program.

This hatchery program will be operated to mitigate for lost natural-origin Chinook salmon production by producing adult fall Chinook salmon for harvest in Nooksack Basin and regional fisheries. The program will contribute, in three successive stages up to 15,000 fall Chinook for a minimum terminal area harvest (annual average 81,000 adults, 90% hatchery-origin, in three stages to 20,000 or 25% of the total) to meet the Point Elliott treaty obligation for a treaty reserved right to take fish at usual and accustomed fishing grounds and stations. In addition, this program will mitigate for the loss of essential and critical habitat and ecosystem processes resulting from forestry, agricultural, industrial, rural and urban development and the infrastructure required to support these developmental activities. This program will also buffer impacts of non-terminal fisheries in the US and Canada and meet production objectives under the Pacific Salmon Treaty.

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 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 Chinook. This program mitigates for lost natural-origin fish production by producing Chinook 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."

In addition to helping to meet treaty-reserved fishing rights and co-management responsibilities, this program will be managed to avoid impeding the recovery of ESA-listed Chinook in the Nooksack River basin through the development of a local hatchery brood stock and the acclimation of juveniles to areas that will reduce straying into the watershed areas critical to the ESA-listed Chinook while providing provide harvestable surplus in the area of the Lummi reservation.

Catch objectives were being met when the total hatchery fall Chinook fingerling release in the watershed was between 16 and 20 million annually, with more than 8 million released in the Nooksack Watershed. This production was reduced to one million in the Nooksack watershed and a total of five Million Chinook in the terminal area as a precautionary measure to reduce interactions with the ESA-listed Chinook. While the reduced production resulted in a significant decline in terminal area harvestable Chinook for Lummi, Nooksack and non-tribal fishers, it did not provide a quantifiable positive response (in productivity and abundance) of the listed Chinook populations as expected.

1.9) List of program "Performance Standards".

The performance standards for this program will be related to the provision of Chinook to satisfy legally mandated harvest in a manner that minimizes the risk of adverse effects to

listed wild populations.

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 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 (WDFW/WWTIT, 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	All applicable fish disease	Disposition of carcasses

spawner products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines, including state, tribal and federal carcass distribution guidelines.	policies are followed.	reported in Annual Hatchery Report.
The stray rate will not cause a significant change in the genome of the listed Chinook.	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 supports rapid out migration.	Records from hatchery operations contained in 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 supports 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.

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

Up to 1,440 adult fall Chinook salmon returning to program broodstock collection sites will be collected for spawning each year.

Table 1.11.1.1: Stages of Broodstock Development

Stage	Broodstock Goals
1. Broodstock	720 assuming 1:1 Male/Female. Relying on Samish Fry/Brood as available to meet shortfalls
2. Improved Survival	720 assuming 1:1 Male/Female, returning to facilities
3. Increase Production	1440 assuming 1:1 Male/Female, returning to facilities

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

Up to 2,000,000 fall Chinook salmon subyearling smolts will be released each year at the Lummi Bay (up to 1,000,000 fish) and Bertrand Creek (up to 1,000,000 fish) sites (Table 1.11.2.1.

Table 1.11.2.1: Proposed stages for the Bertrand Creek Pond and Lummi Bay fall Chinook hatchery programs.

Stage	Smolt Release Targets		Expected % Return to Terminal Area*	Criteria for moving to next Stage*	Expected Terminal Harvest Contribution*
	Bertrand Creek Pond	Lummi Bay			
1 Broodstock	500,000	500,000	0.3%	Terminal Harvest Rate > 75%; Stray estimates less than 5% of the SF and NF population spawners SAR > 0.3%	2,000
2 Improved Survival	500,000	500,000	>0.5%	Terminal Harvest Rate > 75%; Stray estimates less than 5% of the SF and NF population spawners SAR > 0.5%	3,500
3 Increased production	1,000,000	1,000,000	1.0%		15,000

*The criteria represent guidelines as averaged over multiple years.

In stage 1, the development of the hatchery brood stock from returns of program fish supplemented by fry from the Samish Hatchery, the target release will be 500,000 sub-yearling smolts from each program location. In stage 2, the full adaptation of the brood stock to hatchery conditions and acclimation with stage return targets attained, the target release will be 500,000 sub-yearling smolts from each program location. In final stage, with an increased return target, the target release will be 1,000,000 sub-yearling smolts from each program location.

Table 1.11.2.2: Program Objectives by Phase and Location for Lower Nooksack Chinook

Stage	Age Class	Maximum Number	Size Objective (fpp)	Release Date	Location
1. Brood Stock	Fingerling Smolt	500,000	65-80	Mid-April - Early May	Lummi Bay Hatchery
	Fingerling Smolt	500,000	75-85	Late May - Early June	Bertrand Creek Acclimation Pond
2. Improved Survival	Fingerling Smolt	500,000	65-80	Mid-April - Early May	Lummi Bay Hatchery
	Fingerling Smolt	500,000	75-85	Late May - Early June	Bertrand Creek Acclimation Pond
3. Increase Production	Fingerling Smolt	1,000,000	65-80	Mid-April - Early May	Lummi Bay Hatchery
	Fingerling Smolt	1,000,000	75-85	Late May - Early June	Bertrand Creek Acclimation Pond

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

The program is in a developmental stage, and there have not been sufficient returns to develop solid estimates of production performance. Few otolith samples from the Lummi fishery have been collected, and samples that have been collected remain to be analyzed. The co-managers are working on a process to coordinate otolith reads from hatcheries and spawning grounds.

1.13) Date program started (years in operation), or is expected to start.
Lummi Bay – Initiated release year 1977
Lower Nooksack
Marine Drive Bridge: 2004-2007
Bertrand Creek – Initiated release year 2008, various sites

1.14) Expected duration of program.
These programs are 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 harvest objectives and may be modified as justified by regularly evaluated monitoring information.

1.15) Watersheds targeted by program.
The Nooksack River basin (WRIA 1) includes Lummi Bay and the Nooksack River and its tributaries. Fisheries that would primarily benefit from the program are in Lummi Bay, Bellingham Bay and in the lower Nooksack River around the Lummi Nation reservation. The target adult return sites are Lummi Bay Hatchery and facilities on a Lower Nooksack tributary off of the main stem. The current location in the Lower Nooksack is a farm impoundment in McClellan Creek drainage in the Bertrand Creek Watershed.

1.16) Indicate alternative actions considered for attaining program goals, and reasons

why those actions are not being proposed.

The Lummi Nation's Treaty-reserved catch objectives were being met when the total hatchery fall Chinook fingerling release in the watershed was between 16 and 20 million annually, with more than 8 million released in the Nooksack Watershed. The co-managers reduced annual juvenile Chinook salmon release levels to one million in the Nooksack watershed and a total of five million Chinook in the terminal area (includes WDFW's Samish River Hatchery) as a precautionary measure to reduce interactions with the ESA-listed Chinook. While the reduced production resulted in a significant decline in terminal area harvestable Chinook to Lummi and non-tribal fishers, it did not provide the expected quantifiable positive response to abundance and productivity from the listed Chinook populations.

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 to obtain an ESA take authorization for this program under ESA 4(d) Rule, limit 6 (CFR 50 223.203)

Harvest management of Chinook populations within Puget Sound is implemented through the draft Puget Sound Comprehensive Chinook Management Plan (PSCCMP) - Harvest Management Component (WDFW/PSIT, 2010).

2.2) Provide descriptions, status, and projected take actions and levels for NMFS ESA-listed natural populations in the target area.

2.2.1) Description of NMFS ESA-listed salmonid population(s) affected by the program.

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

It is not anticipated that this program will directly affect ESA listed Chinook, Steelhead or Bull Trout

- Identify the NMFS ESA-listed population(s) that may be incidentally 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: competition and predation after release of Chinook from the lower Nooksack acclimation facility; and, enhanced potential for fish disease transfer from hatchery to natural-origin fish. The extent to which listed Chinook salmon, steelhead and bull trout will be incidentally affected by the hatchery program is unknown. The release of sub-yearling migrant smolts in a lower river tributary and a marine location reduces fresh water rearing conflicts and conditions the return of adults to the release locations to minimize straying to basin areas used by the listed Chinook. Because the returning adults enter the terminal fishing areas later than the listed early migrating stocks, harvest is managed to avoid interception of early migrating listed Chinook and to maximize the river fishery harvest of returning fall Chinook to minimize straying to areas of listed early Chinook spawning. Southern US Fisheries are managed to a 7% exploitation rate on ESA listed Nooksack Early Chinook to protect the spawning population, with 9% acceptable once every five years.

To the extent that the increased recruitment of adults on the returning ocean migration provides an addition to the potential food supply of the listed Killer Whales (*Orcinus orca*) it should the program should be beneficial and buffer predation on the remaining natural-origin recruits. Similarly, increases in program smolts may provide forage to the benefit of sub-adult and adult bull trout as they out-migrate or rear in estuarine or nearshore areas and buffer natural origin listed Chinook from that predation. Since all bull trout spawning occurs higher in the watershed (USFWS 2004), predation of bull trout juveniles that are small enough to be eaten by sub-yearling Chinook smolts in the lower river tributary and nearshore is very unlikely due to the geographic separation, as Bertrand Creek enters the mainstem at river mile 12.6, which is more than 25 miles downstream from the most downstream bull trout spawning grounds located in the forks (USFWS, 2004).

The Puget Sound Chinook TRT identified 20 Chinook populations outside of the Strait Of Georgia Biological Region, they include the following:

Lower Skagit River
Upper Skagit River
Cascade River
Lower Sauk River
Upper Sauk River

Suiattle River
North Fork Stillaguamish River
South Fork Stillaguamish River
Skykomish River
Snoqualmie River
Sammamish River
Cedar River
Duwamish/Green River
White River
Puyallup River
Nisqually River
Skokomish River
Mid-Hood Canal Rivers
Dungeness River
Elwha River.

Nooksack System Steelhead (*Oncorhynchus mykiss*): Were listed as Threatened under the ESA on May 11, 2007 (72FR26722); reaffirmed Threatened by five-year status review, completed August 15, 2011 (76FR50448). The DPS includes all naturally spawned anadromous winter-run and summer-run *O. mykiss* (steelhead) populations, below natural migration barriers in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington (Ford 2011). This DPS is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), and also includes the Green River natural and Hood Canal winter-run steelhead hatchery stocks. In the Nooksack Basin, the TRT has preliminarily delineated one DIP of winter steelhead in the Nooksack River and one DIP of summer steelhead in the South Fork Nooksack River (PSSTRT 2013). Information on the potential interaction between program fish and listed steelhead are not well known at present. The volitional release of the sub-yearling Chinook is to ensure rapid emigration to the marine area. The bulk of the young of the year steelhead appear in Bertrand Creek area after the Chinook have left the facility. Predation on steelhead is not expected to be significant.

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 (WRIA 1 SRB 2005). 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 increased abundances and largely maintains the North Fork population. Because the hatchery program has dramatically increased hatchery-origin Chinook, but natural-origin fish are only slowly increasing, a reasonable conclusion is that the main limiting factor for this population is poor habitat.

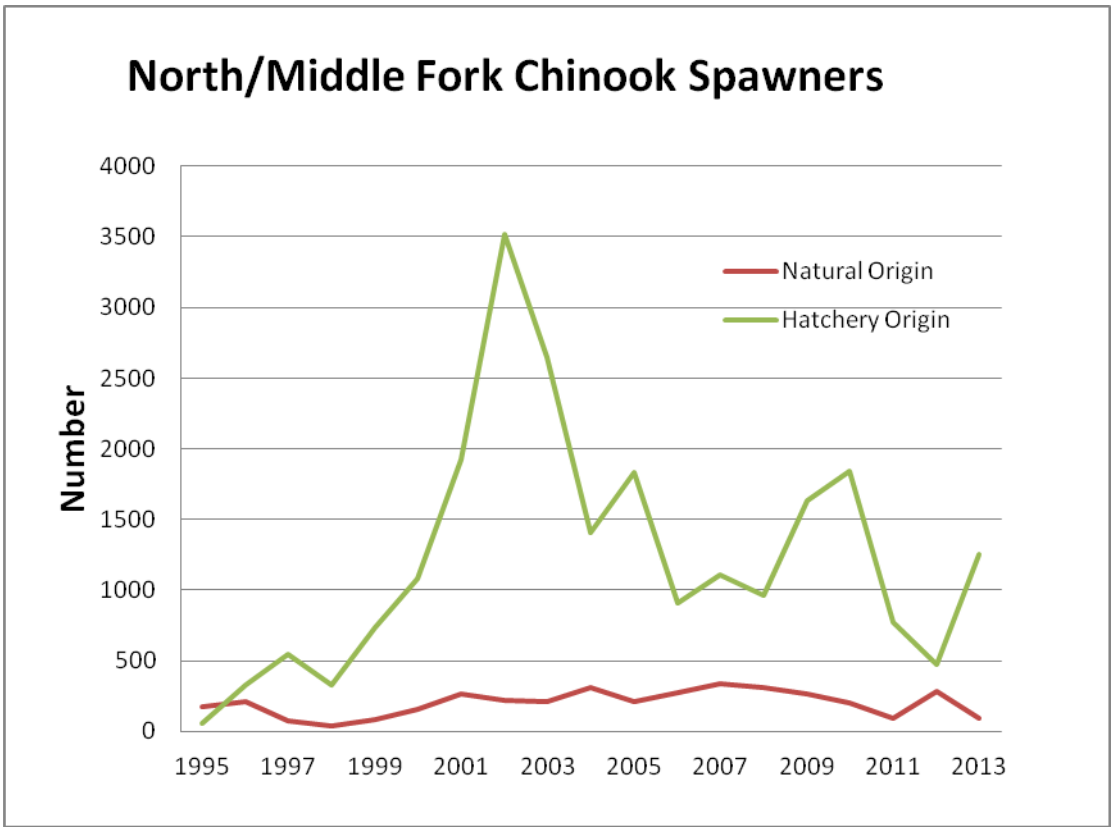

Figure 2.2.2.1: Natural origin spawners and hatchery origin spawners 1995-2011

Driven by chronically low natural escapements, a restoration program for this locally indigenous stock was developed using a strategy of increasing the numbers of smolts released to increase 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.

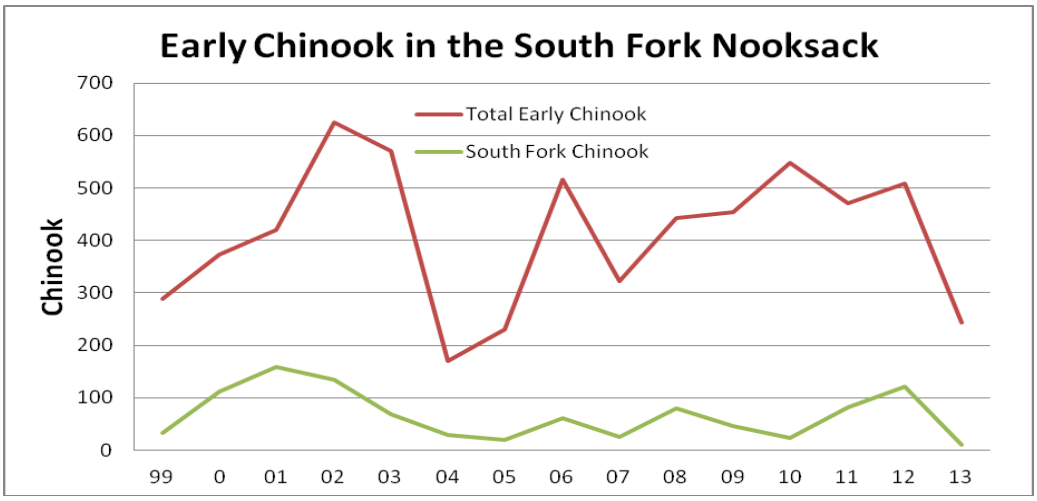

Figure 2.2.2.2: Natural origin South Fork Chinook relative to total early Chinook 1999-2013.

The Co-manager's 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).

These low average abundance levels are in the range of "critical" levels for an independent Pacific salmonid population below which: 1) depensatory processes are likely to reduce it below replacement; 2) short term effects of inbreeding depression or loss of rare alleles cannot be avoided; and 3) productivity variation due to demographic stochasticity becomes a substantial source of risk.

NMFS (2003) reported a short-term (1990-2002) median population growth rate for the composite (hatchery and natural Chinook) North Fork Nooksack population of 0.75. In developing this estimate, NMFS assumed that the reproductive success of naturally spawning hatchery fish was equivalent to that of natural fish. The composite North Fork Nooksack naturally spawning population is not replacing itself in the short term, despite decades of high contributions of hatchery-origin spawners on the spawning grounds. Long-and short-term population trends estimated for all spawners were 1.16 and 1.42, respectively (NMFS 2003).

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.

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 (unpublished data, Co-managers):

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

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.

North/Middle Fork and South Fork Chinook: Conditions in the spawning areas the North/Middle Fork and South Fork Chinook Spawning Grounds make precise and accurate spawning ground estimates difficult. The co-managers have developed protocols to provide an estimate that may provide an annual index of the spawning ground abundance of each population. There are continuing efforts to identify new methodologies to relate the current estimates to a more accurate estimate of the spawning populations.

Table 2.2.2.4: Nooksack River Early Chinook escapement -2013.

Return Year	Escapement	
	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**

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

Table 2.2.2.5: Lummi Trap Catch of Natural Origin Chinook 2006-2014

Year	Effort (min)	Zero	Yearling
2006	44,386	1,297	24
2007	58,724	365	23
2008	53,634	1,324	2
2009	43,006	877	64
2010	53,683	517	35
2011	60,522	1,659	15
2012	101,874	3,956	44
2013	106,104	2,415	92
2014	172,670	1,118	51

Lummi Internal Records

Nooksack System Steelhead (*Oncorhynchus mykiss*): Glacial conditions and lack of adequate funding 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 1998-2010.

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 Fk Native	North Fk 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

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>.

- 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.

The program may lead to the take of listed Chinook salmon in the Nooksack River watershed through straying of hatchery-origin fall Chinook into early Chinook salmon population spawning areas, potentially leading to interbreeding and consequent among population genetic diversity reduction effects on the native populations. South Fork Early Chinook and fall Chinook remain highly differentiated despite co-occurrence on the spawning grounds. Baseline collections used to assign population of origin have Fst estimates of 3.5% between SF Spring and fall in the 1980s, and 5.3% between SF spring and fall in the 1990s (NWIFC, WDFW unpublished data). These pairwise estimates of genetic diversity are among the highest observed within the Puget Sound ESU of Chinook salmon (NWIFC unpublished data) and is remarkable considering that fall Chinook outnumber spring Chinook in the South Fork Nooksack by at least 2:1.(Adrian Spidel, NWIFC) personnel communication)"

DNA Microsatellite analyses of the current late spawning aggregations in the basin closely resemble the Green River stock and they are reproducing naturally in the River ((Ruckelshaus et. al. 2006). The hatchery stock is not considered to be part of the Puget Sound Chinook ESU or included in NOAA Fisheries Hatchery Listing Policy (70FR37160, 78FR38270).

Natural origin fall Chinook will not be taken into the program, therefore there are no ESA-listed Chinook under propagation through the program. The location of the hatchery acclimation and release sites in lower river or estuarine areas removed from primary ESA-listed Chinook salmon and steelhead spawning areas in the watershed reduces the potential for straying and incidental takes through genetic introgression (Chinook salmon) or redd superimposition (Chinook salmon and steelhead)

Juvenile fish released through the program may compete with listed juvenile Chinook salmon and steelhead in lower river and nearshore marine areas where they co-occur. After release, the hatchery-origin juveniles may also prey on listed Chinook salmon and steelhead of sizes vulnerable to predation in areas and at times when they co-occur. Ecological interactions between the program fish and the ESA-listed species are primarily theoretical. Every precaution has been taken to minimize the effect of this program on the ESA-listed species. The volitional release of program chinook as smolting sub-yearlings will ensure rapid movement downstream and limit opportunity to prey on juvenile steelhead.

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 migrating smolts markedly reduces the potential for hatchery and wild fish to compete for resources in the freshwater rearing environment (HSRG, 2014). 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) also stated “It is unclear whether or not hatchery and wild Chinook salmon utilize similar or different resources in the estuarine environment”.

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

Unknown

- **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).**

Information not currently available to estimate the impact on listed Chinook and Steelhead from potential takes through ecological interaction. Tools will be developed through monitoring and adaptive management

- 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.

Not Applicable

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) provides for an agreed Equilibrium Brood Document.

This program is aligned with The Tribal Policy Statement for Salmon Hatcheries in the Face of Treaty Rights at Risk by the Northwest Indian Fish Commission contains a fundamental principle that "…Changes to hatchery programs in response to scientific recommendations cannot be successfully implemented without integrating many non-technical factors and risks, including but not limited to: (1) legally authorized and mandated mitigation obligations, (2) tribal treaty-reserved fishing rights under *United States* vs. *Washington* and *Hoh* vs. *Baldrige* , (3) logistical challenges and infrastructure constraints, and (4) funding and operating budgets for implementing the changes and monitoring their effectiveness"

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates. *Indicate whether this HGMP is consistent with these plans and commitments, and explain any discrepancies.*

This hatchery program and all other Lummi anadromous salmon hatchery programs within the Puget Sound Chinook ESU, operates under *U.S v Washington* (1974) and the *Puget Sound Salmon Management Plan* (PSSMP 1985), which provides the legal framework for coordinating these programs, defining artificial production objectives, and maintaining treaty-fishing rights. The elements of the last agreed equilibrium document are contained in draft white paper for Hatchery Action Implementation Program for the Nooksack-Samish Terminal Area and the agreed summary glossy

This program is also integrated into the Pacific Salmon Treaty process for cooperative management of fisheries and enhancement programs to provide optimum production and to receive benefits equal to production originating in its waters.

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.

The effects on listed Chinook salmon and steelhead of harvests of Chinook salmon adults produced through the Lower Nooksack Hatchery program in all fisheries have been previously evaluated and authorized 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.

The primary beneficiaries from this program area expected to be the tribal fishers in and around the Lummi Reservation. Because hatchery Chinook salmon released from each hatchery site in the Nooksack/Samish Basin are differentially otolith-marked, terminal area fisheries have been sampled for otoliths to allow estimation of the contributions from each hatchery release location and brood year to the terminal area.

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

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.

3.4) Relationship to habitat protection and recovery strategies.

The purpose of this program is to mitigate for lost natural production due to habitat degradation 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 harvest 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 Chinook to meet the treaty reserved right to take fish seem unlikely in the foreseeable future. Hatchery production, including this program will 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.

ESA-listed Chinook populations in the North and South Forks of the Nooksack River are the focus of salmon recovery in WRIA 1, but habitat restoration actions are directed toward 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 hatchery program activities will not impede the recovery of ESA-listed Chinook.

3.5) Ecological interactions.

Ecological interactions between the program fish and the ESA-listed species are primarily theoretical. Every precaution has been taken to minimize the effect of this program on the ESA-listed species. The volitional release of program chinook as smolting sub-yearlings will ensure rapid movement downstream and limit opportunity to prey on juvenile steelhead.

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. 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). Flagg et al (2000) also stated "It is unclear whether or not hatchery and wild Chinook salmon utilize similar or different resources in the estuarine environment.

To the extent that resources are limited there may be ecological interactions between program fish and ESA-listed species, but the 75% reduction in hatchery Chinook in 2000 has show no noticeable increase in the natural origin ESA-listed early Chinook.

The production of adult Chinook from this program will add to the prey base of the ESA listed endangered Southern Resident Killer Whale (SRKW). Chinook salmon, which appear to be the preferred prey of this population are also in decline, and their decline has been suggested as a factor in the decline of the SRKW. Recent work by NWFSC scientists evaluated the whales' likely daily energy requirements. Together, these studies suggest that Chinook salmon abundance is likely a critical factor for whale survival. An Independent Science Panel participated in three workshops convened by the Pacific Salmon Commission to evaluate the effects of salmon fisheries on Southern Resident Killer Whales (SRKW) populations. A key point of their review was that the evidence for strong reliance by the SRKW on Chinook salmon in the summer was convincing (Hilborn, R. et. al. 2012).

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.

Samish Hatchery
Samish Hatchery uses Friday Creek surface water for incubation of fall Chinook prior to transfer to the Lummi Lower Nooksack Program.

Lummi Bay Hatchery
Nooksack River surface water is pumped directly from the river below the Marine Drive bridge through a pipeline to a reservoir and settling pond (100' x 100' x 5') on Chief Martin Road and then fed to the Lummi Bay facility through a gravity line. The current water supply is limited to approximately 1,050 gpm.

Salt water is used at Lummi Bay Hatchery to condition and acclimate juvenile Chinook prior to release. Salt water is supplied from within the Sea Pond with electric water pumps at volumes of up to 500 gpm.

Eggs are incubated at an auxiliary facility at Sandy Point on the Lummi Reservation. Water delivered at approximately 100 gpm is provided from a well and gravity fed to the incubation facility. The incubation facility is on a 450 gpm partial reuse system operated with filters, pumps and UV sterilizers.

Lummi Bay Hatchery operates under the NPDES permit WAG130018.

Bertrand Creek Rearing Site
The current rearing facility is a seasonal agricultural impoundment of McClellan Creek near its junction with lower Bertrand Creek above its junction with the Nooksack River. There is a fish ladder in the impounding structure. The gravity fed water supply is a sourced from springs and local run-off.

Whatcom Creek Hatchery
The hatchery is supplied with surface water gravity-fed to the ponds. Hatchery operations are limited by high water temperatures during summer and early fall months, and an excessive silt load during high flows. Water temperatures range from 34°-74°F.

The water right permit (S1-28591C) for Whatcom Creek Hatchery surface water is formalized through the Washington Department of Ecology, was obtained by Bellingham Technical College in 2008, and grants water withdrawal volumes up to 5.8 cfs.

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.

Lummi Bay Hatchery
The water intake structure is located in the tidal area of the lower Nooksack river area

removed from the predominant smolt migration corridor and contacts with listed fish are unsubstantial. Regular observations by hatchery personnel have not identified juvenile salmon in the area of the intake. A buildup of large woody debris on the bridge piling just upstream of the pump station has created problems at the intake. Modifications are being developed to remedy this situation and ensure a more dependable water supply to the Lummi Bay Hatchery. The intake is currently screened with a 4' by 13" cylindrical screen attached to a suction hose that meets NOAA screening criteria (NMFS 1997). The restoration of a more normal flow of water by intake will include upgrading the intake and screens to meet additional NOAA criteria (NMFS 2011) by 2018.

Lummi Bay Hatchery operates under the NPDES permit WAG130018 to ensure effluent discharge does not adversely affect the ecosystem.

Bertrand Creek Rearing Site

The current rearing facility is a seasonal agricultural impoundment of McClellan Creek near its junction with lower Bertrand Creek above its junction with the Nooksack River. There is a fish ladder in the impounding structure. The gravity fed water supply is not screened and is sourced from springs and local run-off. There are no reports of steelhead in the small tributary system and it is not identified in the draft critical habitat proposal for steelhead, NMFS 2013).

Whatcom Creek Hatchery

The gravity water intake structure is in compliance with state and federal guidelines, but does not meet the current Anadromous Salmonid Facility Design Criteria (NMFS 2011).

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Lummi Bay

Chinook collected for brood stock are selected from adults that voluntarily enter a fish ladder located on the south east side of the Sea Pond complex that is connected to a 10' x 80' concrete pond. Brood are sorted to isolated gender-specific holding ponds and held until maturation.

Bertrand Creek/Lower Nooksack

As fall Chinook return to the acclimation area, they will be collected and moved to Lummi Bay for maturation. Techniques are under development for accessing returns as the numbers increase.

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

Fry are transported from incubation facilities to Lummi Bay Hatchery and Bertrand Creek in a tanker truck with a 1,000 gallon capacity. Pure oxygen is diffused into the tank during loading and transport.

5.3) Broodstock holding and spawning facilities.

Broodstock are held in four 9-foot X 80-foot linear raceways or up to 4 40-foot X 4-foot circular ponds depending on capacity requirements.

5.4) Incubation facilities.

Eggs collected from brood at Lummi Bay Hatchery are incubated and hatched at the Sandy Point Incubation Facility. This facility serves as the incubation and hatching facility for all programs operated out of Lummi Bay Hatchery due to a lack of water suitable for incubating and hatching at the latter.

Water for the Sandy Point facility is sourced from a well at a rate of 110 gpm. A partial reuse system in the facility produces system volumes of up to 450 gpm. Reused water is filtered and treated with UV-sterilizers at a power of approximately 60-micro joules per cm^2.

Once fully funded, a thermal otolith marking chiller will be installed at Sandy Point Incubation Facility providing the ability to mark all eggs collected for this program. The anticipated completion of this system is spring of 2016.

5.5) Rearing facilities.

In initial years, when fish will be transferred from Samish Hatchery, fry are reared in four 40-foot X 4-foot circular ponds at Lummi Bay Hatchery until release.

Fry from Samish Hatchery destined for acclimation and release in the Bertrand Creek watershed are transported to the Whatcom Creek Hatchery where they are reared to mass marking size. Fry are reared in 2 60-foot by 4-foot circular ponds until they are transferred to Bertrand Creek for release as smolts.

5.6) Acclimation/release facilities.

Currently, juveniles are transferred soon after mass marking, typically the first week in May to an agricultural irrigation impoundment on McClellan Creek a small tributary low in the Bertrand drainage that is equipped with a fish ladder, outlet screen, and dam boards for controlling the water level in the pond. This pond measures approximately 60 feet at its widest point, is approximately 200 feet in length and has a maximum depth of 5 feet.

The option of portable rearing and acclimation tanks supplied by creek water is being considered to improve fry growth rates and provide additional control over the program.

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

Not Applicable

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.

Lummi Bay Hatchery, Sandy Point Facility

Currently no listed natural fish are taken into the hatchery where they would be subject to take through equipment failure, water loss, flooding, disease transmission or other events that could lead to injury or mortality. Rearing is conducted in compliance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* to minimize the likelihood of the take of listed natural fish that may result from disease transmission.

Whatcom Creek Hatchery

Currently no listed natural fish are taken in the Whatcom Creek Hatchery as part of the Lummi Lower Nooksack Fall Chinook Program. Rearing is conducted in compliance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* to minimize the likelihood of the take of listed natural fish that may result from disease transmission. All hatchery ponds are supplied with gravity-fed water and are not dependent on electricity.

Bertrand Watershed Acclimation Site

No listed fish are taken into the facility. The water supply to the pond is gravity fed and the level is controlled with dam boards. Rearing is conducted in compliance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* to minimize the likelihood of the take of listed natural fish that may result from disease transmission.

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.

Lummi Natural Resource fall Chinook programs have sourced eyed eggs and fry from Samish Hatchery for the programs at Lummi Bay Hatchery and Bertrand Creek.

As the program develops into a self-sustaining program by meeting broodstock collection goals at Lummi Bay Hatchery, the offspring of brood will be incorporated into the program and the Samish Hatchery fry transfers will be reduced in a manner that meets program objectives.

6.2) Supporting information.

6.2.1) History.

Lummi Nation has been sourcing eggs and fry from Samish Hatchery since 1978.

Green River-origin Chinook eggs were first transferred to the Samish Hatchery in 1929, supplanting Columbia River-origin eggs (Kalama River and Wind River) as a source of fall Chinook production for the facility (WDFG1932), which were first transferred in by the Feds in 1914 (WDFG 1916). A consistent year-to-year Chinook salmon egg transfer program from Green River to Samish began in 1938, in an attempt to "create a return to the Samish River that could be self-sustaining" (WDF 1938). No Chinook eggs were taken from broodstock returning to Samish prior to 1937, after which time, the Chinook return was built to a sufficient level to provide egg takes (WDF 1939; 1941). GSI analysis identifies this stock as typical of Puget Sound fall Chinook (especially Soos Creek origin) and different than lower Columbia Tule stocks. This stock has been propagated with no new introductions for the last four generations without significant input of genetic material from other sources, including Soos Creek (Green River).

6.2.2) Annual size.

Up to 1,440 adult fall Chinook per year. It is unlikely that any ESA-listed Chinook will be included into the brood stock because the adult fish collection locations are distant from the spawning areas for ESA Listed Early Chinook, and the time of brood stock collection is well after the migration and peak spawn timing of the ESA listed Early Chinook

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

We have no information to indicate that natural fall Chinook were incorporated in the annual brood stock collection or expectation that they will be included in the future brood stock collections.

6.2.4) Genetic or ecological differences.

There are natural origin fall Chinook aggregations in the terminal area (Nooksack-Samish) watersheds. South Fork Early Chinook and fall Chinook remain highly differentiated despite co-occurrence on the spawning grounds. Baseline collections used to assign population of origin have Fst estimates of 3.5% between SF Spring and fall in the 1980s, and 5.3% between SF spring and fall in the 1990s (NWIFC, WDFW unpublished data). These pairwise estimates of genetic diversity are among the highest observed within the Puget Sound ESU of Chinook salmon (NWIFC unpublished data) and is remarkable considering that fall Chinook outnumber spring Chinook in the South Fork Nooksack by at least 2:1.(Adrian Spidel, NWIFC) personnel communication)

Genetic population analysis of natural origin fall Chinook in the terminal area consistently assigns all samples to the GAPS 2 group known as South Sound Fall/Hood Canal group, which is identical to the Samish Hatchery stock genetic profile (Ken Warheit, Personal Communication). The temporal and spatial distribution of the naturalized fall Chinook is not well understood, but they are behaviorally and genetically distinct from the two stocks of ESA-listed early Chinook.

6.2.5) Reasons for choosing.

The Samish Hatchery fall Chinook stock has been utilized by hatchery programs in the Nooksack River and Samish River watersheds since the 1920s. Lummi Nation has been sourcing eggs and fry for its fall chinook programs from the Kendall Creek (now discontinued) and Samish Hatcheries since 1978. The stock was selected for use to provide a harvestable adult Chinook salmon returns to meet the treaty reserved right to take fish because natural production due to habitat loss was not able to meet the requirement of the treaty right. Hatchery production was recognized as mitigation for the habitat loss.

Because of the selected stock's later adult return and spawn timings, (terminal area return timing of August, early October; spawn timing of September-October) relative to the Early Chinook populations (river entry February-July, and spawn timing August-early September), respectively), the Samish Hatchery stock provides the ability to have a substantial Chinook harvest after the ESA-listed early Chinook have migrated to areas higher in the Nooksack basin. The late timing of this stock provides a Chinook fishery that does not impede the recovery of the listed early timed Chinook populations.

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.

No natural origin Chinook will be incorporated into the program.

Straying of returning fall Chinook into Early Chinook spawning areas is minimized by applying a high terminal area harvest rate to remove the majority of the total adult return. Weirs are maintained open during the entire adult return period to remove escaping Chinook salmon at the Lummi Bay and Bertrand Creek facilities, to further limit the number of adult fish that may stray.

The later migration timing of the Samish Hatchery Stock, the location of Samish Hatchery (the initial broodstock source) in a watershed that does not have a chinook population, the use of acclimation sites outside of the mouth of the Nooksack River (Lummi Bay) and in the lowest portion of the river (Bertrand Creek) away from the main Nooksack River, and the continued development of a localized brood stock that will home to the Lummi Bay and Bertrand Creek juvenile fish release sites will minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from brood stock selection practices.

SECTION 7. BROODSTOCK COLLECTION

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

Adults

7.2) Collection or sampling design.

Broodstock for the program at Lummi Bay Hatchery are currently collected from adult fish returns to WDFW's Samish River Hatchery. Broodstock are also collected from returns to the adult trap located on the Lummi Bay Hatchery facility grounds. The long term goal is to produce sufficient adult returns to the Lummi Bay and Bertrand Creek juvenile fish release sites to sustain the program without the need for broodstock transfers from Samish River Hatchery. Adults may return from late August to early October and are sorted on an as-needed basis.

Broodstock may be collected in Bertrand Creek if necessary to supplement the initial stages of a Lower Nooksack Chinook Program stock by accessing returning program fish with a temporary weir operated by LNR staff from early August to mid-October depending on water flows and returning adults. Any non-target species, and natural origin chinook encountered will be passed above the weir. The weir site will be located as low in the Bertrand Creek drainage as possible to maximize collection and removal levels.

As the returning program fish exceed program broodstock requirements fisheries operated by LNR staff harvest rates will be increased and program fish reaching the weir will be collected and prevented from entering the drainage.

7.3) Identity.

Fall Chinook salmon stock originating from adult returns of Green River/Hoodsport hatchery lineage fish established at Samish River Hatchery that have been localized through transfers to the Lummi Bay and Bertrand Creek release sites.

The ESA-listed Chinook stocks have not been encountered at the Lummi Bay Hatchery trap and there are no reports of ESA-listed early Chinook in the Bertrand Creek basin. All hatchery Chinook will be indentified by an adipose fin clip to distinguish them from any natural origin fall Chinook.

7.4) Proposed number to be collected:

Up to 1,440 adult fish per year, assuming a 1:1 sex ratio (Table 7.4.1.1).

Table 7.4.1.1: Program goal (assuming 1:1 sex ratio for adults).

Stage	Broodstock Goals
1. Broodstock	720 assuming 1:1 Male/Female. Relying on Samish Fry/Brood as available to meet shortfalls
2. Improved Survival	720 assuming 1:1 Male/Female, returning to facilities
3. Increase Production	1440 assuming 1:1 Male/Female, returning to facilities

Table 7.4.2) Broodstock collection levels at Lummi Bay Hatchery for the last twelve years (e.g. 1988-99), or for most recent years available.

Year	Adults	Jacks
2001	0	0
2002	111	0
2003	54	0
2004	62	6
2005	23	0
2006	375	0
2007	147	85
2008	36	0
2009	0	0
2010	220	0
2011	2	0
2012	3	0
2013	0	0
Average	**79**	**7**

Data source: Lummi Natural Resources Data

No fall Chinook have been collected as yet for use as broodstock from the Bertrand Creek Hatchery site. See the WDFW Samish River Hatchery HGMP for broodstock collection levels for the most recent twelve years.

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

At present there are no hatchery origin fish collected in surplus of broodstock needs. The program will be evaluated and adjusted if the hatchery origin fish escape to the Lummi Bay and Bertrand Creek hatchery release sites in-excess of 100% of brood stock requirements in four consecutive years. Excess Chinook may be sold for human consumption or crab bait, or as carcasses for distribution in the upper watershed as marine derived nutrient sources.

7.6) Fish transportation and holding methods.

Adults entering the Lummi Bay Hatchery are not transported. Broodstock collected in Bertrand Creek will be transported to Lummi Bay for holding and spawning. These adults are transported in insulated totes with diffused oxygen to Lummi Bay Hatchery and held until maturation in brood ponds.

7.7) Describe fish health maintenance and sanitation procedures applied.

Fish health during broodstock collection operations will be regularly monitored by co-manager Fish Health Professionals, and any disease management measures will be applied based on their recommendations.

At this time, no antibiotics or formalin are administered to broodstock. The use of oxytetracycline injections may be evaluated for decreasing the incidence of brood mortality cause by bacterial infections.

Fish health maintenance and sanitation procedures are consistent with the consistent with *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State, 2006* guidelines.

7.8) Disposition of carcasses.

Spawned and unspawned carcasses are donated for crab bait or deposited in upland landfills.

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.

Any natural-origin (unmarked) Chinook salmon encountered during broodstock collection operations at Lummi Bay and Bertrand Creek trapping sites will be immediately released back into the natural environment, after minimal holding and handling.

The later migration timing of the Samish Hatchery stock, the use of acclimation sites in the lowest portion (Bertrand Creek) or outside of (Lummi Bay) the mainstem Nooksack River, the development of a hatchery adapted brood stock with expected high return fidelity to release locations removed from Early Chinook spawning areas, and exclusion of natural origin Chinook from the broodstock will minimize the likelihood for capture, handling, and inadvertent retention of non-target Chinook populations, and adverse demographic, genetic or ecological effects to listed early Chinook resulting from brood stock collection practices.

The risk of fish disease amplification will be minimized by following co-manager *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State, 2006* guidelines.

SECTION 8. MATING

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

8.1) Selection method.

Spawners are selected from available ripe fish once a week during spawning season.

8.2) Males.

When possible males will be pooled in groups of 5 from ripe fish on spawning day from the available brood stock. A spawning ratio of 1:1 will be implemented during fertilization.

8.3) Fertilization.

When possible, females will be pooled into groups of 5 and spawned with 5-pooled males. Eggs are pooled at the time of egg take, but milt is collected individually in plastic containers. Fertilization takes place at Sandy Point Incubation Facility. After fertilization, eggs are immediately loaded into incubators for water hardening for one hour with a buffered iodophore at a concentration of 100ppm.

8.4) Cryopreserved gametes.

Cryopreserved gametes are not used.

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

ESA Listed Early Chinook are not encountered or used for broodstock 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.

Reference the Samish Hatchery Fall Chinook HGMP for information related to operations at that hatchery for fry that are used in this program.

9.1) Incubation:

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

Not available

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

There have been no surplus egg takes.

9.1.3) Loading densities applied during incubation.

Eggs collected from program brood stock are loaded into Heath® incubators at 3.5 lbs per tray. In the event a large egg take occurs, eggs may be placed in Nopad® incubators at a rate of 70 pounds for green eggs and for hatching. At this time, no marks are applied during incubation at Lummi facilities (see section 5.4).

9.1.4) Incubation conditions.

All eggs are incubated on pathogen-free ground water. Eggs incubated in Heath® trays are provided 3.5 gpm flow rates until shocking and picking, and then 4.0 gpm for hatching. Eggs incubated in Nopad® incubators are provided 8gpm until shocking and picking and up to 12gpm for hatching. The partial reuse system in the facility filters and treats return water with UV-sterilizers at a power of approximately 60-micro joules/cm^2. Water quality is monitored on a daily basis by hatchery personnel. Electronic monitoring equipment and alarms provide constant security for head box water level, low oxygen, and abnormal temperature changes.

9.1.5) Ponding.

Ponding is forced when fry are at least 95% buttoned-up in incubators at Sandy Point Incubation Facility, which occurs in January and February. Unfed fry are transported to Lummi Bay Hatchery in insulated fish totes supplied with bottled oxygen. Fry are ponded either into raceways or circular ponds supplied with Nooksack River water, depending on capacity requirements for other Lummi Bay Hatchery programs.

9.1.6) Fish health maintenance and monitoring.

All eggs are hardened in a 100ppm iodophor solution and treated daily with an iodophor flush at a rate of 55ml for Heath stacks and 300ml for Nopads to control *Saprolegnia*. Egg mortalities are initially removed at the time of shocking, followed by an as-needed basis using handheld egg picking tongs. The incidence of yolk-sac malformation is low. Fish behavior is monitored daily by hatchery personnel.

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.

No ESA-listed fish are propagated in this program or the hatchery facilities.

9.2) Rearing:

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

Data not currently available.

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

Loading density goals for Lummi Bay Hatchery and the Bertrand Creek acclimation pond are determined from published standard guidelines, such as Wedemeyer 2001 and Piper et. al.1982. By the time of release, observed densities may reach 4lbs fish/gpm or 0.375lbs/ft^3.

9.2.3) Fish rearing conditions

Fish are reared in 40-foot x 4-foot concrete circular ponds, but may also be reared in 80-foot x 9-foot x 3-foot concrete raceways if ideal loading densities in the circular ponds are not available. All ponds or raceways at Lummi Bay Hatchery containing fish are vacuumed once a week minimum or more frequently if needed. Fish behavior is monitored daily by hatchery personnel.

Freshwater temperature at Lummi Bay Hatchery rarely exceeds 46°F by the time of release, but saltwater temperature pump from within the Sea Pond used for acclimation purposes may reach 55°F by the time of release. Water temperature in the Bertrand Creek acclimation pond may reach 60°F at the time of release. Water quality (temperature, dissolved oxygen, salinity) is monitored daily and recorded at both locations.

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.

Data not currently available.

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

Data not currently available.

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

Fry are ideally fed at a rate of 2.0% B/W per day by the time they are fully adept at feeding (2-3 weeks). Unfed fry are started on #0 crumble and quickly transitioned to #1 crumble. Feed size does not exceed #2 crumble. Feed size is determined by the feed manufacturer's recommend guidelines. An FCR of 1.2 is considered acceptable. Feed rates may be increased or decreased in order to meet size objectives.

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

Fish health is monitored bi-monthly by a fish health professional from the NWIFC. Fish behavior and health is inspected daily by hatchery staff. All fish health procedures

conform to the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW/WWTIT, 2006) Disease outbreaks in juvenile fish at Lummi Bay Hatchery have historically been very low. The requirement to use chemical treatments for bacterial disease in the juvenile ponds has not been warranted within the last 10 years. A *Vibrio spp*. vaccine bath is used annually at the time of mass-marking due to the relatively high risk of *Vibrio spp*. outbreaks due to exposure to saltwater near the time of release (see section 10.4 for additional information).

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. Premature release before fish have met their release size objective may be required at Lummi Bay Hatchery due to the threat of Vibrio spp. outbreaks, despite the use of a vaccine.

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

Not applicable

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.

No ESA-listed fish are propagated in this program or the hatchery facilities.

SECTION 10. RELEASE

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

Table 10.1: Program Objectives by Phase and Location for Lower Nooksack Chinook

Stage	Age Class	Maximum Number	Size Objective (fpp)	Release Date	Location
1. Brood Stock	Fingerling Smolt	500,000	65-80	Mid-April - Early May	Lummi Bay Hatchery
	Fingerling Smolt	500,000	75-85	Late May - Early June	Bertrand Creek Acclimation Pond
2. Improve Survival	Fingerling Smolt	500,000	65-80	Mid-April - Early May	Lummi Bay Hatchery
	Fingerling Smolt	500,000	75-85	Late May - Early June	Bertrand Creek Acclimation Pond
3. Increase Production	Fingerling Smolt	1,000,000	65-80	Mid-April - Early May	Lummi Bay Hatchery
	Fingerling Smolt	1,000,000	75-85	Late May - Early June	Bertrand Creek Acclimation Pond

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

Lummi Bay Hatchery Program

Stream, river, or watercourse: Lummi Bay, Lummi Reservation
Release point: Lummi Bay Hatchery (88.8001)
Major watershed: None
Basin or Region: Southern Strait of Georgia, WRIA 1

Bertrand Acclimation Program
Stream, river, or watercourse: Bertrand Creek, Lower Nooksack River basin
Release point: Bertrand Creek (WRIA 1 0203)
Major watershed: Nooksack River
Basin or Region: WRIA 1, Whatcom County

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

Table 10.3.1: Actual numbers and sizes of fish released by age class at Lummi Bay 2002-2014.

Lummi Bay Hatchery					
Release Year	**Life Stage**	**Number Released**	**Fish Per Pound**	**Release Type**	**Release Date**
2002	Fingerling	493,905	80	Forced	5/17/2002
2003	Fingerling	398,678	90	Forced	5/19/2003
2004	Fingerling	574,439	90	Forced	5/11/2004
2005	Fingerling	435,915	88	Forced	5/2/2005
2006	Fingerling	334,750	105	Forced	4/26/2006
2007	Fingerling	246,070	88	Forced	4/18/2007
2008	Fingerling	476,282	83	Forced	5/8/2008
2009	Fingerling	444,188	115	Forced	5/4/2009
2010	Fingerling	271,488	82	Forced	5/3/2010
2011	Fingerling	450,000	84	Forced	5/16/2011
2012	Fingerling	402,370	64	Forced	6/11/2012
2013	Fingerling	379,000	95	Forced	6/3/2013
2014	Fingerling	323,400	86	Forced	5/24/2014
Average		**402,345**	**88**		

Table 10.3.2: Actual numbers and sizes of fish released by age class at Bertrand Creek 2008-2014.

Bertrand Creek Acclimation Pond					
Release Year	**Life Stage**	**Number Released**	**Fish Per Pound**	**Release Type**	**Release Date**
2008	Fingerling	504,280	148	Volitional	4/30/2008
2009	Fingerling	460,018	112	Volitional	5/6/2009
2010	Fingerling	451,000	240	Volitional	6/11/2010
2011	Fingerling	421,209	115	Volitional	6/9/2011
2012	Fingerling	402,370	64	Volitional	6/11/2012
2013	Fingerling	379,000	95	Volitional	6/3/2013
2014	Fingerling	417,000	200	Volitional	6/9/2014
Average		**433,554**	**139**		

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

See section 10.3 for information on release dates and release type. At Lummi Bay Hatchery, the date of release may be dependent on the anticipation of *Vibrio spp*.

outbreaks caused by warming sea water temperatures. Significant mortality may arise from *Vibrio* infections if action to release fish in anticipation of outbreaks is not taken. Due to the shallow depth within the Sea Pond (average depth of approximately 4 feet), rapid temperature increases from warm air temperatures and clear skies and the subsequent *Vibrio* outbreaks may occur in less than 3 days. For this reason, early releases are taken as a precautionary measure to avoid significant mortality. Additional release protocols are being evaluated to reduce risks from *Vibrio*.
Fish are allowed to leave the Bertrand Creek acclimation pond when they have acclimated for a minimum of 14 days. Procedures will be developed to ensure that all migrants leave the acclimation facility.

10.5) Fish transportation procedures, if applicable.

Juvenile Chinook are transported from Samish Hatchery to Whatcom Creek Hatchery and Lummi Bay Hatchery. From Whatcom Creek Hatchery, fingerlings are transferred to the Bertrand Creek acclimation pond shortly after mass-marking. All transport is conducted with Lummi Nation's tanker truck which has a water capacity of 1,000 gallons. Up to 120,000 juveniles are transported at a time and transport times range from 35-60 minutes depending on the transport destination. Pure oxygen is diffused into the tanks and dissolved oxygen levels average 9.0 mg/L at maximum loading density.

10.6) Acclimation procedures

For the Bertrand Creek program, the acclimation duration objective is a minimum of 14 days. Fish are fed at least 6 days a week at a rate of 1.4% B/W per day. They are in an open water body where all of the fish predators may not have been removed, and they are open to other predators It is assumed that acclimating juveniles are also consuming natural food sources while in the pond.

The fish released from Lummi Bay Hatchery are acclimated to the hatchery facility.

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

Juveniles from both releases are 100% fin clipped.

The release from Lummi Bay hatchery has an otolith mark identifying the location, stock and date of release.

The release from the Bertrand acclimation site also has a unique otolith mark identifying the location, stock and date of release.

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 take only enough eggs to meet program needs. As the program progresses, it is expected that occasional variations in the survival rate will

provide an excess of fish at the time of release that may provide an additional release of up to 10% of the release target.

10.9) Fish health certification procedures applied pre-release.

For both programs, fish receive a fish health determination within 2 weeks of release by a fish health specialist from NWIFC.

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

A backup generator is available during power outages at Lummi Bay Hatchery.

Flooding is not a concern at this facility.

Flooding is not a concern in the Bertrand Creek acclimation pond. The water source for the pond is an impounded natural stream flows; therefore a backup is not required.

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.

Fish are released as actively migrating smolts at sizes and during times which minimize risk of ecological impacts to listed Chinook salmon and steelhead. The Lummi Bay release site is well removed from the freshwater and marine migration pathway for Nooksack salmonids, including ESA listed species. The volitional release of smolting program fish at a size and physiological state intended to ensure rapid migration to the marine area reduces the opportunity for substantial interactions with listed species that could lead to competition or predation.

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.

South Fork Early Chinook and fall Chinook remain highly differentiated despite co-occurrence on the spawning grounds. Baseline collections used to assign population of origin have Fst estimates of 3.5% between SF Spring and fall in the 1980s, and 5.3% between SF spring and fall in the 1990s (NWIFC, WDFW unpublished data). These pairwise estimates of genetic diversity are among the highest observed within the Puget Sound ESU of Chinook salmon (NWIFC unpublished data) and is remarkable considering that fall Chinook outnumber spring Chinook in the South Fork Nooksack by at least 2:1.(Adrian Spidel, NWIFC, personnel communication)"

Each production group is currently identified with distinct otolith marks and adipose clips. In the future, coded wire tags, blank wire tags or other identification methods may be used as they become available. This will allow for 1) selective harvest on hatchery stocks when appropriate; 2) monitoring of interactions of hatchery and wild fish wherever they co-mingle in riverine, estuarine and marine habitats; and 3) assessment of the status of the target population. Through annual spawning ground surveys, the co-managers will monitor the Chinook salmon escapement into the listed early Chinook populations to estimate the number of tagged, un-tagged and marked fish escaping into the river each year and the stray rates of fall hatchery Chinook into the spawning areas.

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 otolith mark fish to allow identification at the hatchery rack and on the spawning grounds.

The co-managers will continue to monitor Chinook escapement to the North Fork, Middle Fork, and South Fork to estimate the number of tagged, untagged and marked fish present on the Early Chinook spawning grounds each year by stock, origin and release location and strategy as appropriate. The returns to the hatchery will identified by origin (adipose clip) and otolith mark. This information will provide the year and location of release.

The co-managers will sample the terminal areas fisheries for sufficient otoliths and CWTs to allow estimation of the total catch by species, stock and year and 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 Parent 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 production in the hatchery, harvests and spawning grounds	Ad Clip, Otolith Mark or CWT	Sample harvest, hatchery and spawning grounds, with emphasis on early chinook populations, 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 (WDFW/WWTIT, 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	Water withdrawals are compliant with water rights. Facility operates in compliance with applicable passage and screening	Annual record of water withdrawal and status of passage and screening include in Annual Hatchery Report

populations, or impact juvenile rearing environment.	criteria for juveniles and adults.	
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.
The stray rate will not cause a significant change in the genome of the Early Chinook populations.	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 operation since 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, 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.

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.

Spawning ground surveys will employ measures to ensure that effects on the survival of the listed Chinook salmon population are insignificant. Salmon redds and live spawning fish will not be disturbed during surveys and sampling.

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 to ESA listed Chinook and steelhead. It samples the out-migrations of juveniles to provide estimates of salmon abundance by species, origin, and age to provide a baseline for evaluation of the production per spawner, and marine

survival.

SECTION 12. RESEARCH

There are currently no research programs directly related to this program.

SECTION 13. ATTACHMENTS AND CITATIONS

Include all references cited in the HGMP. In particular, indicate hatchery databases used to provide data for each section. Include electronic links to the hatchery databases used (if feasible), or to the staff person responsible for maintaining the hatchery database referenced (indicate email address). Attach or cite (where commonly available) relevant reports that describe the hatchery operation and impacts on the listed species or its critical habitat. Include any EISs, EAs, Biological Assessments, benefit/risk assessments, or other analysis or plans that provide pertinent background information to facilitate evaluation of the HGMP.

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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	 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.