HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Photo: Courtesy of Marblemount Hatchery Staff

Hatchery Program:	Skagit River Spring Chinook Hatchery Program (Segregated)
Species or Hatchery Stock:	Skagit River Spring Chinook (*Oncorhynchus tshawytscha*)
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Skagit River/Puget Sound
Date Submitted:	Original: October 30, 2015 Resubmission: June 22, 2016
Date Last Updated:	June 22, 2016

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Executive Summary

The previous version of this HGMP was submitted to NOAA fisheries on August 23, 2002. This version of the HGMP has been updated to reflect changes in the program and is being resubmitted to NOAA fisheries. The spring Chinook program is co-managed with the Sauk-Suiattle Tribe and Swinomish Indian Tribal Community (represented by Skagit River System Cooperative, SRSC), and Upper Skagit Indian Tribe. The Skagit River System Cooperative (SRSC) provides natural resource management services for the Sauk-Suiattle Indian Tribe and the Swinomish Indian Tribal Community.

Anthropogenic influences have resulted in decreased and degraded aquatic and terrestrial habitat which has resulted in the decreased production of Chinook salmon in the Skagit basin. This decreased production has, in part, resulted in the listing of the Puget Sound Chinook Evolutionarily Significant Unit (ESU) as threatened under the Endangered Species Act (ESA). Under Section 4(d) of the ESA, all fisheries (directed and indirect impacts) have been severely restricted, including those guaranteed under Tribal Treaty Rights.

The ESA-listed salmonid populations within the Skagit watershed are comprised of Skagit River Chinook (6 stocks, including both spring and summer/fall populations; one of these stocks, Cascade spring Chinook, is native to the Cascade River) and Skagit River Steelhead (5 stocks, including both summer and winter). There are two hatchery Chinook populations; Skagit hatchery springs and Skagit hatchery summer/falls.

NMFS (1999) considered Marblemount Hatchery (Skagit River) spring Chinook stock to be part of the Puget Sound Chinook ESU, but not essential for recovery. This stock is a Category 2c. This stock was founded from within the ESU and is native to the basin in which it is released. However, most of the broodstock was trapped in the Suiattle River, a downstream tributary of the Skagit River below the confluence of the Cascade River where this program operates. The Suiattle and Cascade River spring-run populations are recognized as distinct (SSHAG 2003). Genetic analyses indicate that although this stock was founded by native spring-run Chinook salmon, there has been moderate divergence between the hatchery broodstock and other spring run populations in the Skagit River Basin (Marshall et al. 1995).

This is a segregated, terminal harvest program and supplements the return as mitigation for lost production and also serves as an indicator group designed to support domestic and international management objectives. The purpose of the indicator program is to track fishery interception rates as they relate to the Pacific Salmon Treaty (Annex IV, Chapter 3), and the ESA Recovery goals for Skagit Chinook through use of double index tag groups (AD+ CWT and CWT only). Due to lack of achievement of harvest and productivity goals (Skagit Chinook Recovery Plan, 2005), this program provides harvest mitigation. The spring Chinook program was originally designed as an indicator stock to provide information on exploitation rates as well as to monitor and evaluate migration patterns, timing and distribution representative of the natural spring Chinook stock. The mitigation component addresses lost spring Chinook production due to habitat and productivity losses, with a long-term minimum terminal harvest goal of 1,000 wild spring Chinook (Skagit Chinook Recovery Plan, 2005).

Returns of Spring Chinook to the Marblemount Hatchery trap have averaged 1,710 between 2002 and 2013. Average SAR is 0.55% and total exploitation rate for fish from this program has averaged 51.8% (brood years 20002-2007). No data on the exploitation of double index tagged fish was provided. Up to 400 adults are required to achieve current smolt release numbers. The annual terminal freshwater sport catch is estimated to be 158 fish at the current release level. The annual treaty terminal harvest (2009 – 2014) has been 484 Marblemount Hatchery spring Chinook.

1 SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1 Name of hatchery or program.

Skagit River spring Chinook program – Marblemount Hatchery.

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

Skagit River spring Chinook (*Oncorhynchus tshawytscha*).

ESA Status: *Threatened*. Puget Sound Chinook was listed as *threatened* on March 24, 1999 (64FR14308); *Threatened* status was reaffirmed on June 28, 2005 (70FR37160); and August 15, 2011 (76FR50448), and May 26, 2016 (81FR33468). Spring Chinook salmon from the artificial propagation through the Marblemount hatchery program is included in Puget Sound Chinook Evolutionary Significant Unit (ESU) listing (78FR38270).

1.3 Responsible organization and individuals

Hatchery Operations Staff Lead Contact

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

The spring Chinook program is co-managed with the Sauk-Suiattle Tribe and Swinomish Indian Tribal Community (represented by Skagit River System Cooperative, SRSC), and Upper Skagit Indian Tribe. The Skagit River System Cooperative (SRSC) provides natural resource management services for the Sauk-Suiattle Indian Tribe and the Swinomish Indian Tribal Community.

In 2014 Tacoma Power and Skokomish Tribe initiated a reintroduction program of spring Chinook into Skokomish River. Until this program can be self-supported from adults returning to the Skokomish River, eyed eggs for the production will be provided by Marblemount Hatchery. Initially 150,000 eyed eggs were transferred (2015) to and incubated at Long Live the Kings' (LLTK) Lilliwaup Hatchery until the final destination for program operation, the North Fork Skokomish River Hatchery, is operational. Post hatchery construction, program will be supported with 470,000 eyed eggs. Eggs provided for the Skokomish program will be collected from the surplus fish to Marblemount Hatchery spring Chinook program.

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

Funding Sources	Operational Information (for FY 2015)
General Fund - State DJ - Federal	Full time equivalent staff – 3.48 Annual operating cost - $395,844
Upper Skagit Indian Tribe	$31,290 Annually for DIT production

The General Fund and DJ funding information applies cumulatively to annual operating cost of the Marblemount Hatchery and cannot be broken out specifically by program.

1.5 Location(s) of hatchery and associated facilities.

Table 1.5.1: Location of culturing phases, by facility.

Facility	Culturing Phase	Location
Marblemount Hatchery	Broodstock collection, incubation, rearing, acclimation, release.	Clark Creek (WRIA 04.1421) at RM 0.5; tributary to the Cascade River (WRIA 04.1411) at RM 1.05; tributary to the Skagit River (WRIA 03.0176) at RM 78.1

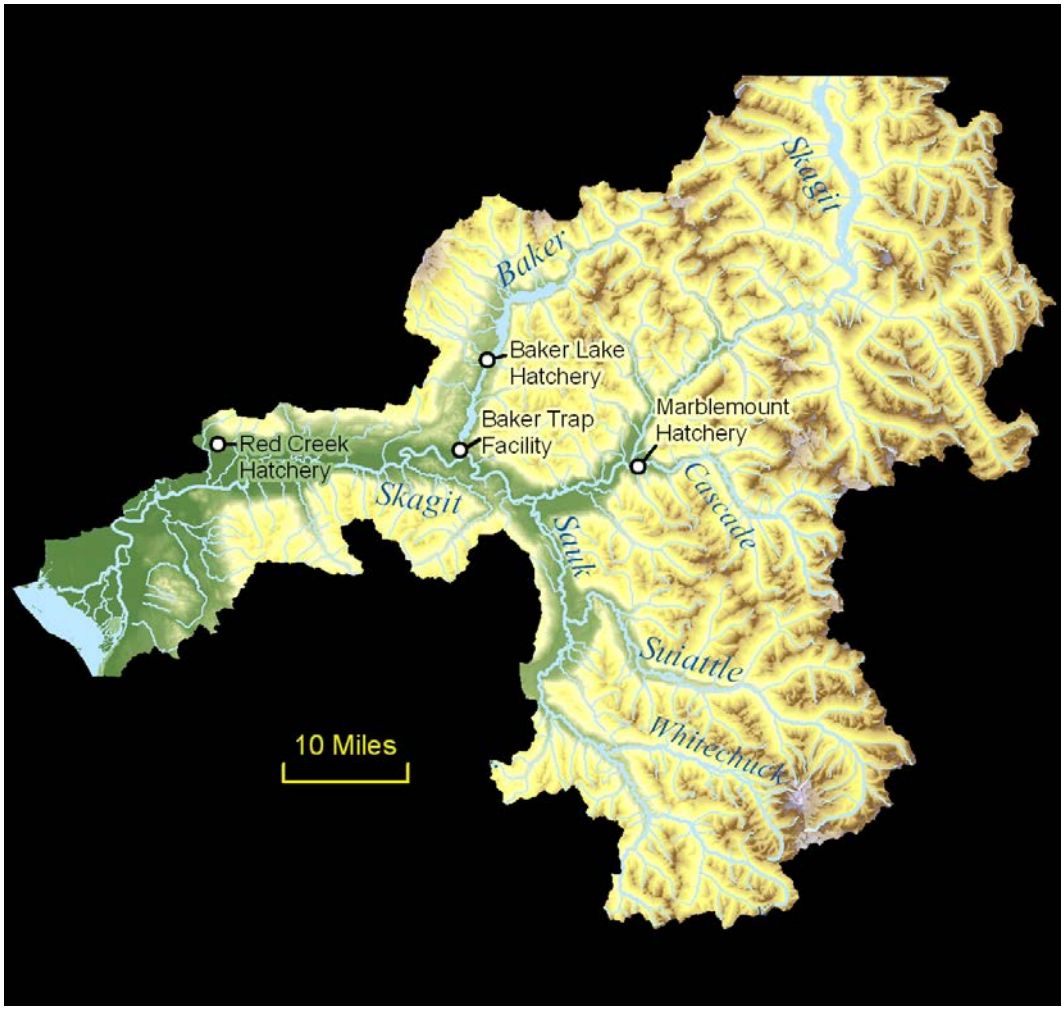

Figure 1.5.1: Map of the Skagit Basin hatchery and trapping facilities. Source: WDFW GIS Staff.

1.6 Type of program.

This is a segregated harvest program with a management indicator stock component.

1.7 Purpose (Goal) of program.

The purpose of this program is (1) to provide harvest opportunity for spring Chinook in mitigation for lost production (Skagit Chinook Recovery Plan, 2005) and (2) to track fishery interception rates as they relate to the Pacific Salmon Treaty (Annex IV, Chapter 3), and ESA Recovery goals for Skagit Chinook.

1.8 Justification for the program.

The spring Chinook program was originally designed as an indicator stock to provide information on exploitation rates as well as to monitor and evaluate migration patterns, timing and distribution that represents the natural spring Chinook stock. The harvest component addresses lost spring Chinook production due to habitat and productivity losses, with a long-term minimum terminal harvest goal of 1,000 wild spring Chinook (Skagit Chinook Recovery Plan, 2005). Under the current habitat and environmental conditions, this goal is not being achieved and hatchery production mitigates, in part, for this unrealized production.

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

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

Potential Hazard	HGMP Reference	Risk Aversion Measures
Water Withdrawal	4.1	Water rights are formalized through permits obtained from Washington Department of Ecology (WDOE). Monitoring and measurement of water usage is reported in monthly NPDES reports.
Intake Screening	4.2	The water intakes are in compliance with state and federal guidelines (NMFS 1995, 1996), but do not meet the current *Anadromous Salmonid Passage Facility Design* criteria (NMFS 2011). The current intakes on Clark and Jordan Creeks do not allow fish passage. The Jordan Creek intake project, designed to allow fish passage, is currently scheduled to begin construction in 2016.
Effluent Discharge	4.2	The facility operates under the *Upland Fin-Fish Hatching and Rearing,* National Pollution Discharge Elimination System (NPDES) administered by WDOE and is regulated through NPDES permit #WAG 13-3015.
Broodstock Collection & Adult Passage	2.2.3, 6.2.3, 6.3, 7.2, 7.9	Adult broodstock is collected from volunteers returning to the hatchery trap, located on Clark Creek, between May and September. Hatchery-origin spring Chinook are held for broodstock, and all unmarked Chinook and all other species, when encountered, are passed directly into Cascade River. No fish are released into Clark Creek above the trapping weir or Jordan Creek. Cascade River has no blockage and all fish (including hatchery fish), can by-pass hatchery and spawn naturally. Collection facilities are operated nearly all year, to increase capture and removal of hatchery fish and reduce pHOS.
Disease Transmission	9.2.7, 10.9	The *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006) details hatchery practices and operations designed to stop the introduction and/or spread of any diseases.
Competition & Predation	2.2.3, 10.11	Fish are released at a time, size, life-history stage (smolts), and location to foster rapid downstream migration to marine waters.

1.9 List of program "Performance Standards".

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

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

1.10.1 "Performance Indicators" addressing benefits.

Table 1.10.1.1: "Performance indicators" addressing benefits.

Benefits		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
3.2.1 Program contributes to fulfilling tribal trust responsibility mandates and treaty rights as described in *U.S. v WA*.	Total number of fish harvested in tribal fisheries targeting this program.	Tribal fisheries are monitored and marked and unmarked fish are evaluated for hatchery origin. Reports are produced annually.
3.2.2 Release groups are sufficiently marked in a manner consistent with information needs and protocols to enable determination of impacts to natural- and hatchery-origin fish in fisheries.	Number of marks of this program observed in fishery samples, and estimated total contribution of this population to fisheries, by fishery.	All juveniles released through this program are marked with adipose fin clip, and/or coded wire tags. Mark retention rates are monitored. Commercial, test and recreational fisheries are annually sampled for presence of CWT and presence or absence of adipose fin. Number and codes of recovered CWT's are continually reported to RMIS database and available through their web site. WDFW and Tribes annually monitors returning Chinook by preforming spawning and carcass ground and air surveys and observing numbers of built redds, live fish count and collecting biological data from encountered carcasses. The data collection includes fish length, sex, scales, snouts, when coded-wire tags (CWTs) are present, Collected data are used to estimate fisheries contribution, distribution and survival. DIT group provides ability to estimate impacts of pre-terminal and terminal, directed, mark-selective fisheries. Estimated total fisheries contribution of this population is presented in **Table 3.3.1.1**.
	Recreational angler days, by fishery.	WDFW uses Catch Record Cards and creel surveys as a tool to estimate recreational catch of salmon.
	Annual escapement of natural	WDFW annually monitors

	populations that are affected by fisheries targeting program fish.	returning Chinook by preforming spawning and carcass ground and air surveys, observing numbers of built redds, live fish presence, and sampling carcasses for biological data including length, sex, scales, otoliths and DNA. Fish are also monitored for presence of external and internal marks. Data collected during fishery monitoring are used to estimate contribution and distribution, escapement, survival, diversity and origin.
3.3.2 Releases are sufficiently marked to allow statistically significant evaluation of program contribution to natural production, and to evaluate effects of the program on the local natural population.	Number of marks and estimated total proportion of this population in juvenile dispersal and in adults on natural spawning grounds.	All juveniles released through this program are marked with adipose fin clip, and/or coded wire tags. Fish released that are only coded-wire tagged and not adipose fin-clipped are part of the double index tag (DIT) group used to estimate non-retention mortality in mark selective sport fisheries. Size, number, date of release and mass-mark quality (AD rate) and tag rate of all hatchery releases are annually monitored and recorded in WDFW Hatcheries Headquarters Database. Juvenile release numbers, size, date and condition are monitored at the hatchery and migration patterns are monitored at the smolt traps. Returning adults are annually sampled for the adipose fin and CWT presence and absence at the hatchery and on natural spawning grounds.
3.5.4 Juveniles are released on-station, or after sufficient acclimation to maximize homing ability to intended return locations.	Location of juvenile releases. Length of acclimation period. Release type, whether forced, volitional, or direct stream release.	Release information including location, method, and age is annually recorded in WDFW Hatcheries Headquarters Database.
	Proportion of adult returns to program's intended return location, compared to returns to unintended dams, fisheries, and artificial or natural production areas.	Returning fish are annually sampled for the CWT presence and absence at the hatchery, from fisheries, and natural spawning grounds. Retrieved coded wire tags enable evaluation of fish origin versus escapement location. CWT data releases and recaptured are annually reported to RMIS.

3.6.1 The hatchery program uses standard scientific procedures to evaluate various aspects of artificial propagation.	Scientifically based experimental design, with measurable objectives and hypotheses.	The program is operated consistent with *the Co-Manager's Fish Health Policy* (WDFW and WWTIT 1998, updated 2006) and WDFW rearing standards. Data in regards of hatchery population growth, development, and return, including annual size and run timing, age and sex composition is collected and recorded in WDFW Hatcheries Headquarters Database.
3.6.2 The artificial propagation program is monitored and evaluated on an appropriate schedule and scale to address progress towards achieving the experimental objective and evaluate beneficial and adverse effects on natural populations.	Monitoring and evaluation framework including detailed time line.	As an indicator stock, survival and contribution to fisheries and escapement will be estimated for natural-origin fish each brood year released.
3.8.2 Juvenile production costs are comparable to or less than other regional programs designed for similar objectives.	Average total cost of activities with similar objectives.	Annual operational cost is recorded and can be compared to calculated fishery contribution value estimated be Wegge, (2009).

1.10.2 "Performance Indicators" addressing risks.

Table 1.10.1.1: "Performance indicators" addressing risks.

Risks		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
3.1.3 Program addresses ESA responsibilities	ESA consultation(s) under Section 7 have been completed, Section 10 permits have been issued, or HGMP has been determined sufficient under Section 4(d), as applicable.	First HGMP for this program was submitted to NOAA fisheries in August 2002. This HGMP has been updated to reflect changes in the program and resubmitted to NOAA fisheries
3.5.1 Patterns of genetic variation within and among natural populations do not change significantly as a result of artificial production.	Genetic composition of naturally produced adults and co-occurring adults of this program measured annually.	Currently not monitored.
3.5.2 Collection of broodstock does not adversely impact the genetic diversity of the naturally-spawning population.	Total number of spawners estimated to pass the collection facility to spawning areas compared to minimum effective population size (when established) required for those natural populations.	This is a segregated program maintained exclusively with returning hatchery adults.
3.5.3 Hatchery-origin adults in natural production areas do not exceed appropriate proportion of the total natural spawning population.	The ratio of observed and/or estimated total numbers of artificially-produced fish on natural spawning grounds, to total number of naturally- and artificially-produced fish	Natural production areas are monitored for returning fish and their markings (fin-clips and CWT presence and absence), and pHOS is calculated (see **Table 2.2.3.1**).

	(pHOS). The appropriate proportion for the segregated program has been set for less than 5%.	
3.7.1 Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols (IHOT, PNFHPC, the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (WDFW and WWTIT 1998, updated 2006), INAD, MDFWP).	Annual reports indicating levels of compliance with applicable standards and criteria. Periodic audits indicating level of compliance with applicable standards and criteria.	The program is operated consistent with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). Fish health and condition are monitored monthly by WDFW pathologist. Examination procedures performed at each life stage may include virus, bacteria and parasites testing and pathological changes observation.
3.7.2 Effluent from hatchery facility will not detrimentally affect natural populations.	Discharge water quality compared to applicable water quality standards by NPDES permit.	Flow and discharge are monitored and reported monthly in NPDES reports.
	WDOE water right permit compliance.	Usage of water at Marblemount Hatchery is regulated and compliant with trust water right permit.
3.7.3 Water withdrawals and in-stream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.	Water withdrawals compared to NMFS, USFWS and WDFW applicable passage and screening criteria for juveniles and adults.	The current barriers and intake structures have been evaluated and needed changes has been recommended and prioritized (see **Table 5.8.1**).
3.7.4 Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens. Follow the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).	Necropsies of fish to assess health, nutritional status, and culture conditions.	All fish present at the hatchery are inspected for pathogens by WDFW pathologists. Juvenile fish health assessments are performed monthly. As necessary remedial or preventive measures are taken to prevent or treat diseases, with administration of therapeutic or prophylactic treatments. Fish health dataare maintained to identify trends in fish health, diseases and treatments.
	Release and/or transfer exams for pathogens and parasites.	Fish to be releases are examined 1 to 6 weeks prior to transfer or release, in accordance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
	Inspection of adult broodstock for pathogens and parasites.	Adult broodstock are examined for pathogens at spawning.

	Inspection of off-station fish/eggs prior to transfer to hatchery for pathogens and parasites.	Specific fish pathogens are tested prior to transfers in accordance to the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
3.7.5 Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines, including state, tribal and federal carcass distribution guidelines.	All applicable fish disease policies are followed.	Carcass distribution is performed in accordance to the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (WDFW and WWTIT 1998, updated 2006). Disposition of carcasses is reported in the WDFW Hatcheries Headquarter Database.
3.7.6 Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally-produced population.	Spatial and temporal spawning distribution of natural populations above and below weir/trap currently compared to historic distribution.	Run timing and spawning areas are monitored annually. Segregated program utilizes only hatchery origin broodstock.
3.7.8 Predation by artificially produced fish on naturally produced fish does not significantly reduce numbers of natural fish.	Hatchery juveniles are raised to smolt-size and released from the hatchery at a time that fosters rapid migration downstream.	Hatchery smolt release size and time are monitored to quantify/minimize predation effects on naturally produced Chinook (Seiler et al., 2002, 2003).

1.11 Expected size of program.

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

Up to 400 adults collected annually, changes to this program may be implemented, based on co-manager review and agreement and revision of this program HGMP.

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

Table 1.11.2.1: Annual release levels.

Life Stage	Release Location	Annual Release Level
Sub-yearling	Cascade River (WRIA 04.1411)	587,500

Source: Future Brood Document 2014.

Until 2011, both sub-yearlings (250,000) and yearlings (150,000) were released through this hatchery program. Due to funding constrains, yearling releases were discontinued in 2012 but per contract with Upper Skagit Indian Tribe, sub-yearling releases were elevated to 587,500 fish dependent on funding availability.

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

Based on the average smolt-to-adult survival of 0.55% for brood years 2000-2007 (RMIS 2013, see also **Table 3.3.1.1**), and a program release goal of 587,500 sub-yearlings, the estimated adult production (goal) level would be 3,231 fish.

Table 1.12.1: Spring Chinook escapement to Marblemount Hatchery, 2002-2013.

Year	Escapement
2002	1,667
2003	1,558
2004	3,223
2005	2,352
2006	1,591
2007	2,014
2008	1,482
2009	959
2010	1,496
2011	1,324
2012	1,583
2013	1,274
Average	**1,710**

Source: WDFW Hatcheries Headquarters Database 2014.

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

This program was initiated in 1974.

1.14 Expected duration of program.

The program is expected to be ongoing.

1.15 Watersheds targeted by program.

The program targets the Skagit River watershed (WRIA 03 and 04).

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

In order for any alternative actions to be considered for attaining program goals, the affected parties (co-managers) must approve any changes. The *Puget Sound Salmon Management Plan* (PSSMP 1985), a federal court order, describes the co-management responsibilities of WDFW and the tribes with regard to fishery management and artificial production. The *PSSMP* explicitly states that "no change may be made to the Equilibrium Brood Document (program production goals) without prior agreement of the affected parties." In the Skagit watershed, any changes in the production at the Marblemount Hatchery have to be reviewed and approved by WDFW and the Sauk-Suiattle Tribe, Swinomish Indian Tribal Community and Upper Skagit Indian Tribe.

Alternative 1: *Reduce Chinook release numbers as a measure to decrease genetic and ecological risks to natural-origin Chinook salmonids*. The Co-managers did not pursue this alternative because it would not meet research objectives for the program. The program is justified to meet the monitoring standards set by PSC technical committee for indicator stocks. In order to meet both mark and harvest sharing needs and treaty harvest obligations, additional fish were added as part of a DIT mark group.

Alternative 2: Increase fishing effort on hatchery (marked) fish. Additional fishing effort is not being proposed out of concern for adequate escapement of unmarked, naturally-spawning fish. As natural abundance and escapement increase fishing effort, targeted on hatchery fish, will be increased.

2 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.

The Marblemount spring Chinook HGMP was previously submitted to NOAA in August of 2002; however it was not acted on by NOAA. This HGMP is submitted to NOAA Fisheries for ESA consultation, and determination regarding compliance of the plan with ESA Limit 6 of the 4(d) rule criteria for joint state/tribal hatchery resource management plans affecting listed species.

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

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

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

Puget Sound Chinook (*Oncorhynchus tshawytscha*): Listed as *Threatened* on March 24, 1999 (64FR14308); *Threatened* status reaffirmed on June 28, 2005 (70FR37160); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448); reaffirmed *Threatened* by five-year status review, completed May 26, 2016 (81FR33468). The Puget Sound Chinook salmon ESU is composed of 31 historically quasi-independent populations, of which 22 are believed to be extant currently. The ESU includes all naturally-spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Strait of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington (Ford 2011), as well as twenty-seven artificial propagation programs (NMFS 2013 78FR38270). In the Skagit basin, the Technical Recovery Team (TRT) has identified demographically independent populations (DIPs) in the Lower Skagit River, Upper Skagit River, Upper Cascade River, Lower Sauk River, Upper Sauk River and Suiattle River (Ruckelshaus et al. 2006).

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

Puget Sound steelhead *(Oncorhynchus mykis*s): Listed as *Threatened* under the ESA on May 11, 2007 (72FR26722); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448); reaffirmed *Threatened* by five-year status review, completed May 26, 2016 (81FR33468). 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. This DPS is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive, Ford 2011). Also includes steelhead from six artificial propagation programs: Green River Natural; White River Winter Steelhead Supplementation; Hood Canal Steelhead Supplementation Off-station Projects in the Dewatto, Skokomish, and Duckabush Rivers; and the Lower Elwha Fish Hatchery Wild Steelhead Recovery (NMFS 2013 78FR38270). In the Skagit Basin, the TRT has preliminarily delineated one winter steelhead DIP in Nookachamps Creek and three DIPs of combined winter/summer steelhead (mainstem Skagit River, Baker River and Sauk River) (PSSTRT 2013).

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.

Marblemount Hatchery (Skagit River) spring Chinook in the Puget Sound Chinook ESU. NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery. This stock is a Category 2c. This stock was founded from within the ESU and is native to the basin in which it is released. However, most of the broodstock was trapped in the Suiattle River and the program operates in the Cascade River. The Suiattle and Cascade River spring-run populations are recognized as distinct (SSHAG 2003). Genetic analyses indicate that although this stock was founded by native spring-run Chinook salmon, there has been moderate divergence between the hatchery broodstock and other spring run population in the Skagit River Basin (Marshall et al. 1995).

Marblemount Hatchery (Skagit River) summer Chinook in the Puget Sound Chinook ESU. NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery. SSHAG (2003) designated this stock as Category 1a, due to recent founding from native natural-origin fish. Allozyme analysis has shown that Upper Skagit Chinook are not significantly different from Lower Skagit fall Chinook stock or from Upper Sauk spring Chinook (Marshall et al. 1995). The current program was established in 1995 using native Skagit River summer Chinook stock collected in the Upper Skagit River above Marblemount (between RM 80 and RM 84).

Skagit River spring Chinook in the Puget Sound Chinook ESU. Recent escapement levels (2000-2011) have averaged 540 for natural spawners in the Upper Sauk River DPS, 343 for the Suiattle River DPS and 353 for the Cascade River DPS. During this same period, the Upper Sauk DPS has shown and increasing population trend, while the Suiattle has decreased and the Cascade has remained relatively flat (SaSI, WDFW 2013).

Skagit Summer/ Fall Chinook in the Puget Sound Chinook ESU. Recent escapement levels (2000-2011) have averaged 10,969 for natural spawners in the Upper Skagit River DPS, 688 for the Lower Sauk River DPS and 2,401 for the Lower Skagit River DPS. All populations have shown declining population trends during this same period (SaSI, WDFW 2013).

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

Table 2.2.2.1: Extant populations of Chinook salmon in the Skagit (Whidbey) Basin, Puget Sound Chinook ESU, grouped by geographic region, their minimum viability spawning abundance and abundance at equilibrium or replacement, and spawning A/P at MSY for a recovered state as determined by EDT analyses of properly functioning conditions and expressed as a Beverton-Holt function. The TRT minimum viability abundance was the equilibrium abundance or 17,000, whichever was less.

Region and population	TRT minimum viability abundance	Under properly functioning conditions (PFC)			NMFS Escapement Thresholds	
		Equilibrium abundance	Spawners at MSY	Productivity at MSY	Critical[a]	Rebuilding[b]
Skagit Summer/ Fall MU						
Upper Skagit	17,000	26,000	5,368	3.8	967	7,454
Lower Sauk	5,600	5,600	1,400	3	200	681
Lower Skagit	16,000	15,800	3,900	3	251	2,182
Skagit Spring MU						
Upper Sauk	3,000	3,000	750	3	130	330
Suiattle	600	600	160	2.8	170	400
Cascade	1,200	1,200	290	3	170	1,250[c]
ESU	**261,300**	**307,500**	**70,948**	**3.2**	3,875	**2,785**

Source: Ford 2011; NMFS 2011b.

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

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

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

Skagit River summer and winter-run steelhead in the Puget Sound Steelhead DPS. The number of natural-origin winter steelhead has substantially increased in the last five years. From a low point in 2008-2009 of 2,502 spawners, the number of spawners increased to 3,981 in 2009-2010, 5462 in 2010-2011, to 6,182 in 2011-2012, and to 8,272 in 2012-2013. Ford (2011) used spawner data collected through 2008 and concluded the following: "Steelhead counts in the Skagit River have declined steadily since the 1980s. The estimated probability that this steelhead population would decline to 10% of its current estimated abundance (i.e., to 504 fish) is high—about 80% within 75 years. With an estimated mean population growth rate of −0.037 ($\lambda = 0.964$) and process variance of 0.005, NOAA was confident ($P < 0.05$) that a 90% decline in this population will not occur within the next 30 years, and that a 99% decline will not occur within the next 60 years. However, beyond the next 50 years NOAA was uncertain about the precise level of risk ". Based on a habitat-based intrinsic potential (IP) estimate by the PSSTRT (2013), the capacity for summer and winter steelhead in Skagit system ranges from 6,478 to 129,551 for the mainstem Skagit DIP, 2,323 to 46,460 for the Sauk DIP, 503 to 10,056 for the Baker River DIP and between 123 and 2,462 for the Nookachamps Creek winter steelhead DIP (**Table 2.2.2.2**).

Table 2.2.2.2. Estimated DIP abundance thresholds of wild steelhead in the Skagit basin. Abundance goals for summer-run fish (*italics*) are still under review. QET, quasi extinction threshold; SAS, smolt to adult survival. Minimum abundance = 100 (Low Abundance), 250 (Viable).

Population Basin				Quasi Extinction Threshold	Low Abundance	Viable	Capacity
Population Name	Area km^2	Mean Elevation (m)	Total Stream Length (m)		1% SAS	5% SAS	20% SAS
Nookachamps Creek	183	252	159,503	27	123	616	2,462
Skagit River	5,543	1,098	2,815,113	157	6,478	32,388	129,551
Sauk River	1,897	1,132	1,079,263	103	2,323	11,615	46,460
Baker River	771	999	421,859	36	503	2,514	10,056
Puget DPS Total				**1,462**	**30,449**	**153,194**	**613,662**

Source: Hard et al. 2014.

***Puget Sound steelhead: Updated Risk Summary*.** The number of winter steelhead spawners has increased for many populations in Puget Sound since 2009. The number of spawners for 16 Puget Sound winter steelhead populations, relative to the average number of spawners for each population in the four year period up to the listing in 2007, increased from an average of 51% in 2009 to 141% in 2013 (Figure 2.2.2.1).

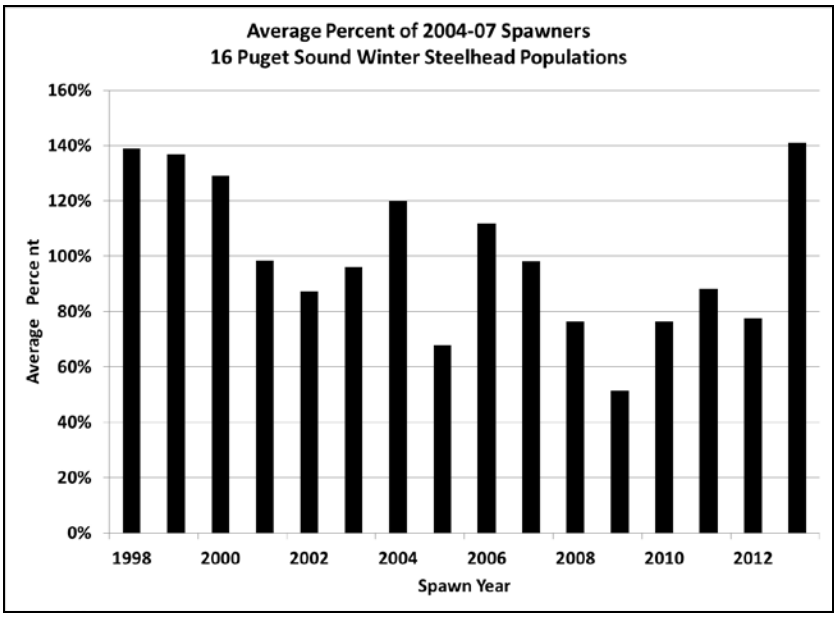

Figure 2.2.2.1: Relative to average percent of 2004-2007 spawners for 16 Puget Sound winter steelhead populations.

These recent, short-term increases in spawners are a positive development, but do not negate the long term risks facing Puget Sound steelhead DPS. Using spawner data collected through 2008 or 2009, Ford (2011) concluded that the status of the listed Puget Sound steelhead DPS has not changed substantially since the 2007 listing, and that steelhead in the Puget Sound DPS remain at risk of extinction throughout all or a significant portion of their range in the foreseeable future but are not currently in danger of imminent extinction.

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

Table 2.2.2.3: Chinook smolts caught in Skagit River scoop (Scp) and screw (Scr) traps 1998-2007.

Species	1998		1999		2000		2001		2002	
	Scp	Scr	Scp	Scr	Scp	Scr	Scp	Scr	Scp	Scr
Chinook 1+ Natural	876	350	198	87	129	105	32	26	199	228
Hatchery	24	12	201	41	511	360	26	50	177	161
Chinook 0+ Natural	33,698	20,001	55,254	41,492	23,289	14,944	54,762	40,180	35,332	24,908
Hatchery	5,837	2,127	3,449	2,213	2,554	2,152	1,667	1,354	3,310	2,726

Species	2003		2004		2005		2006		2007	
	Scp	Scr	Scp	Scr	Scp	Scr	Scp	Scr	Scp	Scr
Chinook 1+ Natural	95	94	342	205	59	57	51	42	364	296
Hatchery	170	122	172	212	33	24	158	108	604	390
Chinook 0+ Natural	51,316	34,498	13,009	6,694	44,737	34,470	61,493	39,767	32,058	17,213
Hatchery	2,033	1,611	[a]12,874	[b]6,600	657	440	8,294	8,129	8,202	5,410

Source: Kinsel et al. 2008.

[a] Includes 690 unmarked hatchery Chinook.

[b] Includes 341 unmarked hatchery Chinook.

Table 2.2.2.4: Puget Sound Chinook population average productivity for five-year intervals measured as recruits per spawner (R/S) and spawners per spawner (S/S) 1982-2006. Trend over the intervals is also given.

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**
Lower Skagit	*5.34*	*1.08*	*1.55*	*0.39*	*3.33*	*1.58*	*4.8*	*3.03*	*0.9*	*0.66*	*-0.56*	*0.18*
Upper Skagit	*4.93*	*0.96*	*2.8*	*0.79*	*3.88*	*1.48*	*2.81*	*1.85*	*1.08*	*0.68*	*-0.77*	*0.05*
Upper Cascade	*8.02*	*1.49*	*2.88*	*1.08*	*2.41*	*1.31*	*3.21*	*1.73*	*1.76*	*0.86*	*-1.22*	*-0.06*
Lower Sauk	*5.45*	*1.28*	*1.54*	*0.4*	*4.04*	*1.82*	*3.69*	*2.35*	*1.43*	*1.12*	*-0.59*	*0.16*
Upper Sauk	*14.8*	*1.98*	*1.52*	*0.51*	*1.98*	*1.07*	*3.13*	*1.47*	*2.56*	*1.1*	*-2.29*	*-0.08*
Suiattle	*8.12*	*1.34*	*1.57*	*0.62*	*2.7*	*1.45*	*2.49*	*1.18*	*1.44*	*0.63*	*-1.24*	*-0.09*
ESU	***9.57***	***2.19***	***5.05***	***0.96***	***3.01***	***1.24***	***2.70***	***1.19***	***1.67***	***0.67***	***-1.81***	***-0.28***

Source: This is copied from analyses reported by Ford (2011). These analyses incorporate assumptions for years where escapements were not sampled for hatchery: natural-origin ratios that are not necessarily agreed to by WDFW, the Sauk-Suiattle Tribe, Swinomish Indian Tribal Community, and the Upper Skagit Indian Tribe. Trend over the intervals is also given.

Table 2.2.2.5: Short and long term population trend and growth rate estimates for the Puget Sound Chinook ESU populations.

Regions and Populations	Years	Trend Natural Spawners w/CI	Hatchery Fish Success = 0 Lambda w/CI	p>1	Hatchery Fish Success = 1 Lambda w/CI	p>1
Lower Skagit River Late Run	1995-2009	1.064 (0.976 - 1.158)	1.051 (0.404 - 2.733)	0.69	1.041 (0.394 - 2.748)	0.65
	1952-2009	0.987 (0.978 - 0.996)	1.003 (0.926 - 1.086)	0.53	0.993 (0.916 - 1.076)	0.42
Upper Skagit River Late Run	1995-2009	1.033 (0.968 - 1.103)	1.022 (0.59 - 1.77)	0.65	1.013 (0.574 - 1.787)	0.59
	1952-2009	1.004 (0.997 - 1.01)	1.004 (0.953 - 1.059)	0.57	0.996 (0.945 - 1.051)	0.44
Lower Sauk River Late Run	1995-2009	1.054 (0.981 - 1.133)	1.044 (0.443 - 2.458)	0.68	1.033 (0.437 - 2.441)	0.64
	1952-2009	0.994 (0.984 - 1.004)	1.007 (0.929 - 1.09)	0.57	0.999 (0.922 - 1.083)	0.49
Upper Sauk River Early Run	1995-2009	1.061 (0.995 - 1.131)	1.076	?	1.066	?
	1952-2009	0.977 (0.966 - 0.99)	0.991 (0.909 - 1.081)	0.41	0.984 (0.903 - 1.073)	0.35
Cascade River Early Run	1995-2009	1.035 (0.977 - 1.095)	1.02 (0.63 - 1.653)	0.66	1.015 (0.622 - 1.658)	0.62
	1981-2009	1.029 (1.01 - 1.049)	1.023 (0.968 - 1.082)	0.84	1.018 (0.962 - 1.077)	0.79
Suiattle River Early Run	1995-2009	0.955 (0.903 - 1.01)	0.946 (0.584 - 1.533)	0.19	0.939 (0.572 - 1.54)	0.18
	1952-2009	0.981 (0.974 - 0.989)	0.988 (0.926 - 1.055)	0.35	0.982 (0.919 - 1.048)	0.27

Source: Ford 2011. These are based on analyses reported by Ford (2011) that are not necessarily agreed to by WDFW, the Sauk-Suiattle Tribe, Swinomish Indian Tribal Community, and the Upper Skagit Indian Tribe. "Lambda" is a measure of population growth rate. See Ford (2011) for explanation of the columns.

Skagit System Steelhead (*Oncorhynchus mykiss*): Smolt monitoring traps utilized in larger river systems cannot successfully trap steelhead smolts. Smolt monitoring for Chinook and coho salmon in the Skagit River system indicates low numbers of wild steelhead smolts incidentally caught (Kinsel et al. 2008).

Table 2.2.2.6: Steelhead smolts and adults caught in Skagit River scoop (Scp) and screw (Scr) traps 1998-2007.

Species	1998		1999		2000		2001		2002	
	Scp	Scr	Scp	Scr	Scp	Scr	Scp	Scr	Scp	Scr
Steelhead 1+ Natural	389	1,100	99	334	95	597	32	317	118	437
Hatchery	446	2,325	122	511	75	736	23	465	75	534
Steelhead Adult	1	3	11	1	1	2	0	0	1	2

Species	2003		2004		2005		2006		2007	
	Scp	Scr	Scp	Scr	Scp	Scr	Scp	Scr	Scp	Scr
Steelhead 1+ Natural	32	366	337	1,287	45	289	36	293	179	746
Hatchery	26	474	213	2,401	16	183	17	624	114	1,932
Steelhead Adult	0	0	0	0	2	0	0	0	0	3

Source: Kinsel et al. 2008.

Table 2.2.2.7: Steelhead population exponential trend ln(nat. spawners) (95% CI)

Population	1985-2009	1995-2009
Skagit River winter-run	0.969 (0.954 - 0.985)	0.978 (0.931 - 1.029)

Source: Ford 2011. These are based on analyses reported by Ford (2011) that are not necessarily agreed to by WDFW, the Sauk-Suiattle Tribe, Swinomish Indian Tribal Community, and the Upper Skagit Indian Tribe.

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

Table 2.2.2.8: Skagit River Chinook Escapement 2001-2012.

Return Year	Upper Sauk Spring	Suiattle Spring	Upper Cascade Spring[1/]	Upper Skagit Summer	Lower Sauk Summer	Lower Skagit Fall
2001	543	688	625	10,084	1,103	2,606
2002	460	265	340	13,815	910	4,866
2003	298	353	278	7,123	1,493	1,161
2004	700	495	380	20,040	443	3,070
2005	308	518	420	16,608	875	3,320
2006	1,043	375	478	16,165	1,095	3,508
2007	282	108	223	9,845	383	1,053
2008	983	203	284	8,441	538	2,685
2009	367	273	338	5,290	250	1,439
2010	768	263	330	6,644	356	1,017
2011	345	215	265	4,480	237	820
2012	1,826	460	488	9,808	715	3,295
Avg.	**660**	**351**	**371**	**10,695**	**700**	**2,403**

Source: SaSI (WDFW 2014).
[1/] Includes hatchery and natural-origin spawners.

Table 2.2.2.9: Wild Skagit River steelhead escapement 2001-2012

Return Year	Winter Run*	Summer Run
2000/2001	4,584	NA
2001/2002	5,394	NA
2002/2003	6,818	NA
2003/2004	7,332	NA
2004/2005	6,382	NA
2005/2006	6,757	NA
2006/2007	4,242	NA
2007/2008	4,887	NA
2008/2009	2,502	NA
2009/2010	3,981	NA
2010/2011	5,462	NA
2011/2012	6,185	NA
Average	**5,377**	**NA**

Source: SaSI (WDFW 2014)

* Total Escapement Data are total escapement estimates for all Skagit winter steelhead based on cumulative redd counts in the mainstem Skagit River from RM 22.5 to 94.1 and in Alder, Diobsud, Rocky, O'Toole, Cumberland, Day, Sorenson, Hansen and Jones creeks. Estimates include winter steelhead in the Sauk and Cascade Rivers.

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

Spring Chinook salmon originating from Marblemount Hatchery are known to spawn with two natural populations of Chinook salmon, Cascade River and Upper Skagit River.

Cascade River Population. The Cascade River population consists of spawners in the Cascade River upstream of RM 8.1. The population is segregated spatially from the Upper Skagit River population, which spawns in the lower Cascade River, by a high gradient canyon from around RM 3.4 to 8.1.

The co-managers annually conduct spawner surveys in the upper Cascade River to count redds and check carcasses for fish with a CWT. However, relatively few carcasses are found, the incidence of CWTs is low, and the annual estimates of pHOS are imprecise. Therefore, adaptive management relative to the 5% pHOS level will be based upon an average for the previous ten years. Annual estimates of spawners, pHOS, and the nine-year average of these statistics are provided in **Table 2.2.2.10**.

The relatively low level of pHOS observed in the Cascade River population may be partially attributed to the source of broodstock. The current Marblemount spring Chinook program was established with broodstock collected from the Suiattle River, a tributary to the Sauk River, rather than the Cascade River (see HGMP section 6.2.1). The creation of this program t originated from a lower Skagit River tributary may reduce the likelihood that returning Marblemount adults continue past the hatchery and ascend past the swift water of the canyon to the upper Cascade River.

Table 2.2.2.10. Proportion hatchery spawners (census pHOS) from the Marblemount spring Chinook program into the Cascade River spring Chinook population.

Year	Spawners (NOS + HOS)	Carcasses Sampled	Estimated Marblemount Hatchery Strays[a]	Census pHOS[b]
2006	478	23	83	17.4%
2007	223	0	-	-
2008	284	5	0	0.0%
2009	338	12	0	0.0%
2010	330	9	0	0.0%
2011	265	1	0	0.0%
2012	488	24	0	0.0%
2013	310	10	31	10.0%
2014	225	4	0	0.0%
Average	**327**	**9.8**	**14.2**	**3.4%**[c]

[a] Not adjusted for bad mark rate which averages ~1%.
[b] Effective pHOS is less than census pHOS by the relative fitness factor.
[c] Average pHOS weighted by sample sizes is 5.2%.

Upper Skagit River Population. The Upper Skagit River population consists of spawners in the Skagit River from the mouth of Sauk River to Newhalem, tributaries Illabot, Diobsud, Bacon, Fall and Goodell Creeks, and spawners in the lower Cascade River.

Spring Chinook originating from the Marblemount Hatchery have an earlier spawn timing than Upper Skagit River summer Chinook salmon, but the extent of the overlap was not known until a 2006 study by WDFW and the Skagit River System Cooperative (SRSC). Surveys were conducted in the Lower Cascade River (RM 0.0 - 3.4), Boulder Creek (tributary to the Cascade River), upper Skagit tributaries Bacon, Illabot and Diobsud creeks. Encountered carcasses were sampled for CWT to ascertain origin. The data demonstrated that there was a two week window of overlap from approximately the last week of August through the first week of September and that roughly 50% of the redds during that window were built by hatchery origin Spring chinook strays and 50% by wild Upper Skagit summer chinook. Thus, in subsequent years, 50% of the number of redds surveyed in that two week window have been attributed to the spring Chinook strays from the Marblemount Hatchery (**Table 2.2.2.11**). Annual reports of strays are generated and reviewed by comanagers.

Table 2.2.2.11. Proportion hatchery spawners (census pHOS) from the Marblemount spring chinook program into the Upper Skagit River population.

Year	Upper Skagit Summer Escapement (NOS + HOS) [a]	Marblemount Spring Chinook Strays into Upper Skagit Summer during overlap[b,c]	Marblemount Spring Chinook Census pHOS[d]	Hatchery Strays Prior to Summer Chinook Period[2/]
2006	16,165	114	0.70%	411
2007	9,845	54	0.55%	294
2008	8,441	64	0.75%	514
2009	5,290	26	0.49%	289
2010	6,644	60	0.90%	520
2011	4,480	43	0.94%	457
2012	9,808	146	1.46%	757
2013	8,801	80	0.90%	358
2014	8,308	124	1.47%	656
Average	**8,642**	**72**	**0.83%**	**473**

[a] Excludes hatchery-origin spawners originating from the Marblemount Hatchery Spring Chinook program.
[b] Not adjusted for bad mark rate which averages ~1%.
[c] Total hatchery strays within the Upper Skagit summer chinook spawning grounds in the two week spawn timing overlap (late August to early September).
[d] Effective pHOS is less than census pHOS by the relative fitness factor.

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

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

Broodstock Collection: The Marblemount hatchery trap is usually operated from May 1 (May 15 at the latest) through middle of March (or later if necessary and possible) to accommodate Chinook, coho and steelhead broodstock collection and removal of hatchery-origin fish from the system. Spring Chinook program at Marblemout Hatchery is managed as segregated and no natural origin fish are targeted for the broodstock. However, any fish during brood collecting season can enter hatchery trap including unmarked and untagged fish. If it happens, any unmarked Chinook are returned to the Cascade River, which is not blocked by weir and allows unobstructed fish movement. Unmarked steelhead have not been encountered at the hatchery trap for past 12 years. Although trapping and handling process may pose injury or death, the risk is minimal and little or no mortality has been documented.

Adult passage: The Jordan Creek Intake, one of four water sources that supply hatchery, may pose a low to moderate risk of take to listed fish by delaying passage or restricting access to the upper creek, though, potential Chinook utilization of Jordan Creek above the hatchery intake is limited by its very steep gradient. A new Jordan Creek intake project, designed to allow fish passage, is currently scheduled to begin construction in 2016. A permanent weir on Clark Creek blocks access to approximately one river mile between hatchery and spring that feeds the creek. There is no obstruction to fish movement on Cascade River. Unmarked fish that volunteer to the hatchery trap are released into Cascade River.

Operation of Hatchery Facilities: Potential facility operation impacts on listed fish include: water withdrawal, hatchery effluent, and intake compliance. Monitoring and maintenance are conducted along with staff observations. Effluent at outfall areas is rapidly diluted with mainstem flows and operation is within permitted guidelines (see HGMP sections 4.1 and 4.2). All permit requirements are followed in order to minimize the potential indirect 'Take" associated with the operations of these facilities. No take of listed fish have been reported by staff during the normal operation of the hatchery.

Disease Transmission: Interactions between hatchery-reared and naturally-produced populations may be a source of pathogen and disease transmission although there is little evidence showing that diseases are transmitted from hatchery fish to natural-origin fish (Steward and Bjornn 1990). WDFW conducts fish disease examinations to ensure minimal disease transmission and to prevent the introduction and/or spread of any fish diseases. Fish health monitoring efforts include fish health examinations and virus sampling, abnormal fish loss investigations, virus sampling, and pre-transfer and pre-liberation inspections. All activities are done in accordance with guidelines developed under the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (*WDFW and WWTIT 1998, updated 2006).

Hatchery Production/Density-Dependent Effects: Hatcheries can release numbers of fish that can exceed the density of the natural productivity in a limited area for a short period of time and can compete with listed fish. Fish are released as active smolts that will emigrate in order to minimize the effect of the release. Indirect take from density-dependent effects is unknown.

Predation/Competition: Juvenile spring Chinook salmon produced through the program may interact with emigrating natural-origin Chinook salmon in the Skagit River basin freshwater and estuarine areas, after the hatchery fish are released in June. The release of hatchery juveniles coincides near the end of the annual natural Chinook salmon emigration period in the Skagit

River Basin. The sub-yearlings average size at release of 77fpp for years 2003-14 correlates with fish length of between 88mm and 92mm, while the length of natural-origin Chinook salmon is ~60mm (Seiler et al., 1999-2001). The USFWS (1994) suggested that juvenile salmonids can consume fish which are one-third or less their own body length. Based on this suggestion natural-origin Chinook are larger than the predation susceptibility size. Hatchery juveniles are also released as smolts, a practice to foster rapid seaward migration and reduce the duration of interaction with natural-origin Chinook present in the river. Juvenile Chinook trapping data from Seiler et al. (2000, 2001, 2002), indicated rapid fish exit. The degree to which the hatchery-origin Chinook salmon may compete with natural-origin Chinook salmon for food resources in the Skagit River basin is unknown.

Genetic Effects: The Marblemount hatchery spring chinook program produces some strays that may impact the Upper Skagit summer population or the Upper Cascade spring chinook population (SRSC 2015). Fish that stray may interbreed with native fish if there is overlap in spawn timing and location.

Overlap in spawn timing between the hatchery program and the Upper Skagit summer Chinook population is about two weeks spanning late-August to early-September. However, the estimated pHOS has averaged less than 1% (**Table 2.2.2.11**).

Spawn timing overlap between the hatchery program and the Upper Cascade spring chinook population is assumed to be 100%. However, the location of the hatchery is well separated from the Upper Cascade spring chinook habitat, so although some hatchery fish may stray to that habitat, few have been found there (**Table 2.2.2.10**).

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

Listed fish are not targeted for broodstock collection at the hatchery trap. However during broodstocking season any fish can enter hatchery trap. Any unmarked and untagged Chinook arriving at the trap throughout the season are transported and immediately released into Cascade River. Unmarked steelhead has not been encountered at the hatchery trap for past 12 years. See also “Take” Tables at the end of this document.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

See “Take” Tables at the end of this document.

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

In case when take levels will exceed or will be projected to exceed the take levels in this plan, NOAA Fisheries will be consulted to develop a contingency plan.

3 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.

This HGMP is a component of the co-managers comprehensive resource management plan for Puget Sound Chinook.

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

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

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

3.3 Relationship to harvest objectives.

The spring Chinook program was initially designed for use as an indicator stock to provide information on exploitation rate as well as to monitor and evaluate migration patterns, timing and distribution that represents natural spring Chinook stock. The long-term objectives would be for a minimum annual harvest of 1,000 wild spring Chinook (WDFW, 2005). This hatchery production also provides mitigation to supplement treaty commercial fisheries, non-treaty sport fisheries, and treaty ceremonial and subsistence fisheries targeting hatchery spring chinook from this program, until such time as natural production provides the capacity for the natural harvest goal. Currently, the production goal is not being consistently met (**Table 3.3.2**).

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.

Table 3.3.1.1: Marblemount Hatchery Spring Chinook sub-yearling fishery contributions.

Brood Years: 2000-2007 Fishery Years: 2004-2011		
	Average SAR%[a]	**0.55**
Agency	***Non-WA Fishery***	***% of total Survival***
ADFG	All	*0.5*
CDFO	All	*18.6*
NMFS	All	*0.0*
ODFW	All	*0.0*
Agency	***WA Fishery***	***% of total Survival***
WDFW	10- Ocean Troll	*0.0*
MAKA	15- Treaty Troll	*0.3*
WDFW	15- Treaty Troll	*0.5*
WDFW	23- PS Net	*8.5*
WDFW	41- Ocean Sport- Charter	---
WDFW	42- Ocean Sport- Private	---
WDFW	45- PS Sport	*0.4*
WDFW	45- PS Sport - Winter Blackmouth[b]	*2.6*
WDFW	46- Freshwater Sport[c]	*4.9*
WDFW	46- Freshwater Sport (Strays)[d]	*0.0*
FWS	50- Hatchery Escapement (Strays)[e]	*0.0*
WDFW	50- Hatchery Escapement	*48.2*
WDFW	50- Out of Basin Hatchery Escapement (Strays)[f]	*0.2*
STIL	53- Wild Broodstock Collection (Strays)[g]	*0.2*
NIFC	54- Spawning Grounds[h]	*0.1*
SSC	54- Spawning Grounds[h]	*1.6*
STIL	54- Spawning Grounds (Strays)[g]	*0.3*
WDFW	54- Spawning Grounds[h]	*13.2*
WDFW	62- Test Fishery Seine	---
	Total	*100.0*

Source: RMIS 2013.

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

[b] Winter Blackmouth fishery occurs between October and April.

[c] Freshwater Sport based on WDFW Catch Record Card (CRC) data; no CRC data for BY 2000.

[d] Based on tag recoveries from strays in the Samish River (WRIA 3).

[e] Based on tag recoveries at Winthrop National Fish Hatchery (WRIA 3).

[f] Based on tag recoveries at Kendall Creek, Wallace River and George Adams Hatcheries (WRIA 1, 7 and 16).

[g] Based on tag recoveries in the Stillaguamish River (WRIA 5).

[h] Based on tag recoveries in the Skagit Basin (WRIA 3 and 4).

Table 3.3.2. Skagit River spring Chinook: historical harvest. Run years 2000-2012.

Run Year	Escapement - Natural	Total Harvest		Terminal Harvest		Total (H+W)	
		Natural	Hatchery	Natural	Hatchery	Catch	Terminal Catch
2000	1192	427	460	16	33	936	49
2001	1309	561	936	13	34	1544	47
2002	289	280	692	10	32	1014	42
2003	926	243	541	9	18	81	27
2004	1668	354	842	29	67	1292	96
2005	1329	333	1035	23	342	1733	365
2006	1884	337	940	45	524	1846	569
2007	659	231	1745	23	555	2554	578
2008	1494	553	1885	89	785	3312	874
2009	1030	346	961	105	454	1866	559
2010	1401	375	1535	79	757	2746	836
2011	816	368	1714	65	598	2745	663
2012	3011	952	1788	251	813	3804	1064

Source: FRAM validation runs (may include rounding error).

3.4 Relationship to habitat protection and recovery strategies.

Habitat protection and restoration strategies are paramount to the recovery of self-sustaining, natural populations. Habitat protection and recovery strategies are addressed in documents developed for the Puget Sound area and individual watersheds. Different groups are involved in planning, funding and realizing restoration projects through the region as listed below.

Puget Sound Salmon Recovery Plan (2005): Describes habitat related challenges (http://www.govlink.org/watersheds/9/plan-implementation/HabitatPlan.aspx). Based on this recovery plan, a number of habitat actions have been implemented, with additional improvements identified to be considered in the future.

Puget Sound Partnership Action Plan: An ESU-wide recovery planning effort is being undertaken by the Puget Sound Partnership, a collaborative group dedicated to restoring salmon and steelhead throughout Puget Sound (online at http://www.pugetsoundpartnership.org).

State of Our Watershed: Individual member Tribes have worked with the NWIFC and SSHIAP to create the State of Our Watersheds report. This document examines key indicators of habitat quality and quantity across more than 20 watersheds in western Washington that lie within tribal Usual and Accustomed fishing areas as defined by *U.S. vs. Washington* (1974 Boldt Decision).

Salmon Recovery Funding Board (SRFB). Created by the Legislature in 1999, the SRFB is composed of five citizens appointed by the Governor and five state agency directors, the Board provides grant funds to protect or restore salmon habitat and assist related activities. It works closely with local watershed groups known as lead entities (see below). The Board supports salmon recovery by funding habitat protection and restoration projects, and related programs and activities that produce sustainable and measurable benefits for fish and their habitat.

Lead Entities - The Skagit Watershed Council is the Lead Entity for the Skagit basin that includes the lower and upper Skagit River (WRIAs 3 & 4). The Skagit basin is the largest watershed in Puget Sound. The land use in the lower portion is 64% forestry, 22% agriculture, 5% urban, 4% range and 5% other. In the uplands, land use is 73% forestry, 12% range and 15% other. (See also http://www.rco.wa.gov/salmon_recovery/lead_entities.shtml**)**

Regional Fisheries Enhancement Groups (RFEGs). **S**everal citizen-based groups work in conjunction with local governments on habitat actions that benefit both listed and non-listed

stocks in the system. In the Skagit River system, this includes the Skagit Fisheries Enhancement Group.

3.5 Ecological interactions.

(1) *Salmonid and non-salmonid fishes or other species that could negatively impact the program.* Negative impacts by fishes and other species on the Marblemount Hatchery spring Chinook program could occur directly through predation on program fish, or indirectly through food resource competition, genetic effects, or other ecological interactions. In particular, fishes and other species could negatively impact Chinook survival rates through predation on newly released, emigrating juvenile fish in the freshwater and marine areas. Certain avian and mammalian species may also prey on juvenile Chinook while the fish are rearing at the hatchery site, if these species are not excluded from the rearing areas. Species that could negatively impact juvenile hatchery Chinook through predation include the following:

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

Rearing and migrating adult Chinook originating through the program may also serve as prey for large, mammalian predators in marine areas, nearshore marine areas and in the Skagit River. This would act toward the detriment of population abundance, as well as the program's success in monitoring and evaluating the wild stock and harvest augmentation. Species that may negatively impact program fish through predation may include:

- Orcas
- Sea lions
- Harbor seals
- River otters

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

- Puget Sound Chinook
- Puget Sound steelhead
- Bull trout

(3) *Salmonid and non-salmonid fishes or other species that could positively impact the program.* Fish species that could positively impact the program may include other natural and hatchery origin salmonid species and trout present in the Skagit River watershed. Juvenile fish of these species may serve as prey items for the Chinook during their downstream migration in freshwater and into the marine area. Decaying carcasses of spawned adult fish may contribute nutrients that increase productivity in the watershed, providing food resources for the emigrating Chinook. Many watersheds in the Pacific Northwest appear to be nutrient-limited (Gregory et al. 1987; Kline et al. 1997) and salmonid carcasses can be an important source of marine derived nutrients (Levy 1997). Carcasses from returning adult salmon have been found to elevate stream productivity in several ways, including 1) stimulation of primary productivity through the release of nutrients from decaying carcasses (Wipfli et al. 1998); 2) enrichment of the aquatic invertebrate food base from decaying carcasses (Mathisen et al. 1988); and 3) direct consumption of carcasses by juvenile salmonids (Bilby et al. 1996). The addition of nutrients has been observed to increase the production of salmonids (Slaney and Ward 1993; Slaney et al. 2003; Ward et al. 2003).

(4) *Salmonid and non-salmonid fishes or other species that could be positively impacted by the program.* The Chinook program could positively impact freshwater and marine fish species

that prey on adult and juvenile fish. Nutrients provided by decaying Chinook carcasses may also benefit fish in freshwater. These species include:

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

4 SECTION 4. WATER SOURCE

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

Table 4.1.1: Water sources available at Marblemount Hatchery.

Water Source	Water Right		Available Water Flow	Water Temp. (F°)	Usage	Limitations
	Record/Cert. No.	Permit No.				
Wells (5)	G1-23230C WRIS	-----	10 cfs	46	Incubation, rearing	Wells are sanding in and needs to be redeveloped
Clark Creek (surface)	S1-*06773C WRIS/ 03506	06152	10 cfs	40-45	Broodstock collection rearing, acclimation	Low flow in summer
	S1-*21701C WRIS/ 10939	15832	5 cfs			
	S1-20241C WRIS	----	10 cfs			
Cascade River (surface)	S1-00419C WRIS	16698	30 cfs	38-58	Rearing,	No limitations
Jordan Creek (surface)	S1-*06774C WRIS/ 03507	06153	15 cfs	38-65	Rearing	High winter flows and high summer temperatures

Source: Phinney 2006, WDOE Water Resources Explorer 2014, WDFW hatchery data.

Water to the hatchery is supplied from five wells, gravity flow from Jordan Creek, and pumped water from Clark Creek and Cascade River (Fuss and Ashbrook, 1995). Wells supply hatchery with stable temperature, pathogen free water that is used for incubation and rearing. Spring fed Clark Creek provides stable flow of water used for broodstock collection (fish attraction) and holding, and juveniles rearing and acclimation. Cascade River is the most utilized water source and is used for rearing, however heavy bed loads movement in the river cause channel shifts and increased silt loads (Fuss and Ashbrook, 1995), resulting in necessity to use settling pond before water is pumped to the hatchery. Gravity-fed water from Jordan Creek is also used for rearing. The utilization of this water source however is limited by creeks high water temperatures in summer and high flows in winter. Also land management practices in the area have exacerbated an on-going-problem with historically unstable watershed conditions; transportation of huge rocks during high flow events that pose a large threat of damaging capital structures at the hatchery (Fuss and Ashbrook 1995).

The water right permits at the Marblemount Hatchery are formalized through the Washington Department of Ecology (WDOE), and were obtained for Clark Creek in 1945, 1969 and 1972; for Jordan Creek in 1945; for the Cascade River in 1971; and for the wells in 1978.

NPDES Permit:

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

reporting and operates within the limitations established in its permit administered by the Washington Department of Ecology (DOE), WAG 13-1015. Monthly and annual reports on water quality sampling, use of chemicals at this facility, compliance records are available from DOE.

Discharges from the cleaning treatment system are monitored as follows:

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

No listed fish are passed above Clark Creek. Jordan Creek is utilized only from April through November.

Table 4.1.2: Record of NPDES permit compliance at Marblemount Hatchery.

Facility/ Permit #	Reports Submitted Y/N			Last Inspection Date	Violations Last 5 yrs (see Table 4.1.3)	Corrective Actions Y/N	Meets Compliance Y/N
	Monthly	Qtrly	Annual				
Marblemount WAG13-1015	Y	Y	Y	5/23/2005	1	N	Y

Source: Ann West, WDFW Hatcheries Headquarters Database 2014.

Table 4.1.3: List of NPDES violations at Marblemount Hatchery, over the last five years (2009-2013).

Monitoring Month	Parameter	Sample Type	Result/ Violation	Permit Limit	Comment	Action
September 2011	N/A	N/A	N/A	DMR due to Ecology by July 30, 2010	Late DMR to Ecology	Explanation to personnel to correct procedures

Source: Ann West, WDFW Hatcheries Headquarters Database 2014.
Note: These violations did not result in non-compliance with NPDES permit.

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

The surface water intakes at Marblemount Hatchery are in compliance with state and federal guidelines (NMFS 1995, 1996), but do not meet current *Anadromous Salmonid Passage Facility Design* criteria (NMFS 2011a). Improvements have been identified as a high-priority project and are on the WDFW's 20-year Capital Plan to bring into compliance. The 2012 Legislature passed the "Jobs Now" bill, which provided WDFW with funding for hatchery capital improvements in addition to our Capital Budget request (see **Table 5.8.1**). This included bringing the intake into compliance and improvements to the Jordan Creek water supply line. The pipeline project was completed in 2013. The new intake project is currently scheduled to begin construction in 2016.

5 SECTION 5. FACILITIES

5.1 Broodstock collection facilities (or methods).

The facility has one trap located on Clark Creek, typically operated from May 1 (May 15 at the latest) through middle of March (or later if necessary and possible) to accommodate Chinook andcoho broodstock collection and removal of hatchery-origin fish from the system. During that time a weir spanned across the creek blocks passage and directs fish through a four-step ladder

and the “V”-trap into the separated 200'x10'x48" section of the adult pond supplied with Clark Creek water.

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

Two tanker trucks (1,000 and 300-gallons), equipped with aerators and oxygen tanks, are available at the facility for transportation needs.

5.3 Broodstock holding and spawning facilities.

Table 5.3.1: Adult holding facilities at Marblemount Hatchery.

Type	Number	Size (ft)
Adult pond (Pond-22)	1	200x10x4
Concrete raceways	3	100x10x3

Depending on the species, broodstock are held in either the 10'x100'x36" concrete ponds or a separated section of the adult pond.

Spring Chinook broodstock is held in the 10'x100'x36" concrete raceway, supplied with Clark Creek water. Spawning takes place at the end of the raceway.

5.4 Incubation facilities.

Table 5.4.1: Incubation vessels available at Marblemount Hatchery

Type	Number	Size
Vertical stack incubators	1,056 Trays	24"x25"x3"
Removable Shallow troughs	8	16'x11"x6"

5.5 Rearing facilities.

Table 5.5.1: Rearing ponds available at Marblemount Hatchery

Type	Number	Dimensions
Indoor Fiberglass Starter Tanks	16	16'x3'x28"
Gravel bottom pond	1	273'x53'x36"
Asphalt bottom adult pond	1	249'x89'x48"
Asphalt bottom pond	4	37'x350'x54"
Concrete ponds	21	10'x100'x36"

5.6 Acclimation/release facilities.

All fish are primarily reared on mix of well/surface water (a mix of Jordan/Clark/Cascade water), and exclusively on Clark Creek water for the last three weeks before release. Fish are released directly into Clark Creek, 10 feet above the confluence with Cascade River.

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

During the power outage in winter of 1996, water level at the water-head tower went down and after power was restored, never returned to a level elevated enough for water to flow through all of double stack incubators. It resulted in a 75% fry loss. After the incident investigation revealed that water-head tower was built too low. The problem has since been rectified by raising the water-head level.

5.8 Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

The following risk aversion measures are in place at Marblemount Hatchery:

- A crew member is on stand-by at the facility at all times to monitor hatchery operations and respond to any unexpected events.
- The facility is equipped with low water alarms, a back-up generator in case of power loss, and gas powered pumps in case of pump failure.
- Fish rearing is conducted in compliance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (1998, updated 2006). Adherence to artificial propagation, sanitation and disease control practices defined in the policy should reduce the risk of fish disease pathogen transfers.

In 2012, the Washington State Legislature passed a jobs creation bill, which provided WDFW with funding for hatchery capital improvements in addition to our Capital Budget request. At Marblemount Hatchery, this allowed the following improvements:

Table 5.8.1: Hatcheries capital improvement projects, funded under the "Jobs Now Act" (2012).

Projects	Completion Date
Replace or renovate Jordan Creek intake to meet current fish passage and screening requirements.	Construction to begin 2016.
Replace Jordan Creek pipeline – completed fall 2013.	Completed
Bring water intakes to compliance with current Anadromous Salmonid Passage Facility Design criteria (NMFS 2011).	Estimated 2017-2019*

*Estimated completion dates due to acquiring legislative funding.

6 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.

Hatchery broodstock is collected from adult hatchery-origin spring Chinook returning to the Marblemount hatchery trap.

6.2 Supporting information.

6.2.1 History.

References to Skagit spring Chinook were found in WDFW planting records in 1952. The releases from 1953 to 1963 are documented in RMIS (2012). Released fish may have originated from the Cascade River (SHAGG, 2003). Native Suiattle River spring Chinook broodstock was used to establish the new program in 1974, through adult fish collections from Buck Creek (a Suiattle tributary) and later from other tributaries to the Suiattle River (WDFW 2003e). In 1981, the first returns of Buck Creek stock returned to Marblemount Hatchery. These progeny, along with the other tributary broods were combined through spawning and rearing, and released to create an adult return to Marblemount Hatchery (SHEER, NMFS, 2004). Hatchery stock has been maintained with adults returning to the hatchery since 1995.

6.2.2 Annual size.

Up to 400 adults are collected annually for broodstock. Any changes to this program would require approval of the comanagers and modification of this HGMP.

6.2.3 Past and proposed level of natural fish in broodstock.

Levels of natural-origin fish included in the broodstock are unknown prior to the start of 100% mass-marking of released fish. Spring Chinook releases through the Marblemount Hatchery program has been consistently marked since the 1995 release (1994 brood). This program is managed as segregated with no intent to use natural-origin fish in the hatchery broodstock.

6.2.4 Genetic or ecological differences.

Allozyme analysis of the hatchery spring-run indicated that it had diverged from its founding Suiattle River population (Marshall et al. 1995). This is possibly due to hybridization with wild Cascade River spring Chinook collected from the river, and summer–run Chinook salmon also reared at the hatchery. Monitoring and evaluation of the genetic and ecological effects of the program are ongoing (WDFW 2003g; and for e.g., Seiler et al., 2002), and the data will be used to adjust the hatchery program to meet its fish production and research objectives (WDFW 2003g) (SHEER, NOAA, 2004).

6.2.5 Reasons for choosing.

The native Suiattle River spring Chinook was chosen to found hatchery stock based on its indigenous origin.

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.

The production is managed as segregated program, and only hatchery-origin fish are randomly selected from spring Chinook adults returning to the hatchery trap. Broodstock collection is concluded before August 15, to maintain temporal difference in return and spawn time of hatchery and natural-origin fish and keep both populations genetically segregated and prevents inclusion of summer and fall Chinook into the hatchery broodstock.

7 SECTION 7. BROODSTOCK COLLECTION

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

Adults.

7.2 Collection or sampling design.

Spring Chinook broodstock is collected randomly from hatchery-origin volunteers returning to the hatchery trap through August 15th, and marked with CWT (regardless of presence or absence of adipose fin clip). The cutoff date was set to maintain temporal difference in return and spawn timing between hatchery and natural populations and keep them genetically segregated. Presence of a CWT ensures fish have a spring run identity. Fish returning after August 15 are surplused.

7.3 Identity.

All fish released through this hatchery program have been consistently 100% mass-marked with an adipose fin-clipped (AD) and/or coded-wire tag (CWT) since brood year 1994. Yearling releases were 50% AD+CWT and 50% CWT-only from 2000 (brood year 1998) until the yearling program was eliminated, with last release in 2012 (RMIS 2012). Beginning in 2013, 277,500 sub-yearlings are released with AD+CWT, 200,000 sub-yearlings are CWT-only, and 110,000 are released AD-only (FBD 2013) (see also HGMP section 10.7).

7.4 Proposed number to be collected:

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

To achieve program releases goal up to 400 adults are collected annually for broodstock needs.

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

Table 7.4.2.1: Sex composition of spring Chinook spawned at Marblemount Hatchery.

Brood Year	Females	Males	Jacks
2002	169	173	0
2003	138	134	0
2004	166	166	0
2005	195	194	0
2006	143	143	0
2007	138	138	0
2008	160	157	3
2009	147	143	4
2010	173	173	0
2011	120	119	1
2012	170	170	0
2013	168	168	0
Average	**157**	**157**	**1**

Source: WDFW Hatchery Headquarters Database 2014.

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

Hatchery-origin adults entering the trap in excess of broodstock needs (surplus) can be donated to the local Tribes or local food bank and/or used for nutrient enhancement. Surplus fish in good condition also may be sold to food processor.

Between 1999 and 2006, fish in excess of broodstock needs were transported and released into Baker Lake, where they could spawn in its tributaries. With the concern of possible significant predation risk posed to sockeye in the system, this practice was discontinued in 2006.

7.6 Fish transportation and holding methods.

Adults selected for spawning are transported about 500-ft from holding pond to the concrete raceway. Fish are transported in a 1,000-gallon tanker truck equipped with aerators and oxygen. Fish are loaded at about 50 per load and are in the tank for about 20 minutes. The 10'x100'x3' concrete raceway is supplied with well water and fish are held there till spawned.

Unmarked Chinook encountered in the trap are netted for transportation (tanker truck) and release into Cascade River above the hatchery intake.

7.7 Describe fish health maintenance and sanitation procedures applied.

Standard fish health protocols are adhered to, as defined in the *Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State* (WDFW and WWTIT 1998, updated 2006).

Adult broodstock is treated with formalin (1:10,000) every other day as precaution against fungus infection and females receive erythromycin injection (20 mg/kg of fish), as a prevention for BKD outbreak at the time of transfer to the holding pond and again three weeks later. Mortalities are removed daily and buried on station.

7.8 Disposition of carcasses.

Male carcasses which are not treated for BKD are used for nutrient enhancement. Females are buried on-station.

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.

This program is managed as segregated and natural origin fish are not targeted for broodstock. However, any fish during broodstock collecting can enter hatchery trap including unmarked and untagged fish. If it happens, any unmarked Chinook are return to the Cascade River that is not blocked by weir and allows unobstructed fish movement. Unmarked steelhead has not been encountered at the hatchery trap for past 12 years. Trapping methods do not generally pose lethal risks to the fish health.

8 SECTION 8. MATING

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

8.1 Selection method.

Broodstock is selected randomly from ripe fish that return to the hatchery before August 15. To maintain run timing similar to original broodstock, egg-take is scheduled throughout the spawning season (**Table 8.1.1**).

Table 8.1.1: Egg-take schedule to maintain run-timing, Marblemount Hatchery spring Chinook program.

Percent of Total Egg-take	Period
45%	August 1 -15
50%	August 15-31
5%	September

8.2 Males.

All males collected, regardless of size, are considered for spawning and selected randomly on spawn days.

8.3 Fertilization.

Until 2011, pair-wise spawning method (one male and one female) was used to mate spring Chinook. Starting in 2012, matrix spawning is used for mating. Eggs from five females are pooled into one bucket and milt from each male is collected separately. Eggs from one bucket are then equally spread into five buckets and each bucket is fertilized with milt from one male using a total of 5 males. After 60 seconds of fertilization time, milt from a second male is added, as a back-up to ensure fertilization in case of poor quality milt used. The second male used was a primary male to fertilize eggs from previous batch.

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.

Adults to be spawned are chosen at random from the available gene pool and attempt is made to ensure that the egg-take is representative of the entire summer run. To minimize directed, artificial selection of traits that could have negative effects, proper spawning protocols are implemented to maximize the representation of each individual adult into the entire brood.

9 SECTION 9. INCUBATION AND REARING -

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

9.1 Incubation:

The current egg-take goal for spring Chinook program is to collect up to 750,000 eggs (FBD 2014). In addition, starting with brood year 2014, Marblemount Hatchery will provide up to 470,000 eyed eggs for the North Fork Skokomish River Hatchery spring Chinook program until the program is self-supporting (see also HGMP section 1.3).

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

Table 9.1.1.1: Egg-to-ponding survival of spring Chinook eggs collected at Marblemount Hatchery, 2002-2013.

Brood Year	Eggs Collected	Survival Rates (%)	
		Green-to-Eyed Up	Eyed-Up-to-Ponding
2002	689,700	88.3	98.0
2003	585,700	91.6	98.0
2004	631,400	89.0	98.0
2005	757,500	87.8	98.0
2006	647,700	87.4	98.0
2007	545,400	89.6	98.0
2008	527,000	85.6	98.0
2009	525,700	87.2	98.0
2010	507,000	89.3	98.0
2011	554,200	86.1	98.0
2012	859,000	82.9	98.0
2013	873,075	89.0	98.0
Average	**641,075**	**87.8**	**98.0**

Source: Hatchery Records 2014.

9.1.2 Cause for, and disposition of surplus egg takes.

In some years additional eggs are collected after egg take goal is fulfilled to maintain return and spawn timing and adjust for BKD losses. The eggs collected earlier are replaced based with eggs collected later and eggs detected with high BKD levels are destroyed at the eyed-egg stage. Culled eggs are buried on-station.

9.1.3 Loading densities applied during incubation.

Fertilized eggs are placed in vertical trays at 5,000 per tray.

9.1.4 Incubation conditions.

All eggs are incubated in trays supplied with well water flowing at the rate of at 3.5gpm. Well water has constant temperature of 46°F. Dissolved oxygen levels remain constant at 12 mg/l in water flowing in and 9.5 mg/l in water flowing out. Vexar® layers are placed in trays as a substrate substitute.

Eyed eggs destined to support North Fork Skokomish River Hatchery spring Chinook program will be transported in October for the years that support is needed.

9.1.5 Ponding.

When approximately 95%+ buttoned up, (December/January), fish are moved from trays into 16'x3'x28' starter tankstroughs supplied with well water. Troughs are located in hatchery building.

9.1.6 Fish health maintenance and monitoring.

All fertilized eggs are water-hardened in an iodophor solution. Fungus in incubators is controlled by formalin drip, (15-minute injection per day at a target dose of 1,667-ppm formalin), throughout incubation to just prior to hatching. Once eyed (~ 500 TU's), eggs are shocked and dead eggs are removed. Fry loss is picked at the time of ponding and then daily.

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

To maximize survival Chinook eggs are retained in the trays at relatively low loading densities. Trays are supplied with pathogen free water, which limits pathogen problems. Mortality due to fungal infection is controlled and water temperatures and dissolved oxygen levels are monitored. All water systems are connected to 24-hr/day low water alarms and an emergency backup generator.

9.2 Rearing:

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

Table 9.2.1.1: Fry-to-sub-yearling and sub-yearling-to-yearling survival of spring Chinook produced at Marblemount Hatchery; 2002-2013.

Brood Year	Survival Rates (%)	
	Fry-to-Subyearling	Subyearling-to-Smolt
2002	99.9	77.8
2003	96.7	98.6
2004	99.6	94.4
2005	98.6	76.6
2006	90.0	90.9
2007	87.8	77.0
2008	98.5	89.2
2009	97.3	91.4
2010	99.1	96.5
2011	99.6	Discontinued
2012	87.5	
2013	89.2	
Average	**95.3**	**88.0**

Source: Hatchery Records 2014.

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

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

9.2.3 Fish rearing conditions

Buttoned up fish are initially reared in troughs for as long as possible. When fry reach weight of 400-800 fpp (January, February) they are moved to the 10'x100'x3' concrete ponds supplied with a mix of Jordan Creek/Clark Creek/Cascade River water. Marking and tagging starts when fish reach the size of 200 fpp, (May).

Table 9.2.3.1: Monthly average surface water temperature (°F) at Clark, Jordan Creeks and Cascade River .

Month	Average Water Temperature (ºF)		
	Clark Creek	Jordan Creek	Cascade River
January	45	33	40
February	45	34	38
March	46	40	48
April	47	45	48
May	47	48	50
June	48	50	50
July	48	55	50
August	49	60	52
September	50	55	52
October	48	50	50
November	47	46	50
December	46	36	45

Source: Hatchery Records 2012.

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

Table 9.2.4.1: Average size (fpp), by month, of juvenile spring Chinook reared at Marblemount Hatchery.

Month	Average Size (fpp)	
	Subyearlings	Yearlings
January	1,200	1,200
February	780	780
March	410	410
April	250	250
May	130	130
June	80	80
July		60
August		40
September		50
October		30
November		28
December		22
January		17
February		14
March		12
April		10

Source: Hatchery Records 2012.

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

See **Table 9.2.4** for growth information. No energy reserve data is available.

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

Chinook are fed a variety of diet formulations including crumbles and pellets; the food brand used may vary, depending on cost and vendor contracts. Feeding regimes vary, depending on the fish size, water temperature and other environmental factors, from eight feedings/7 days a week,

to two feedings/7days a week. Feeding rates vary from 2.07% to 3.5% B.W./day. The overall feed conversion rate (feed fed/weight gained) for the season approximately 0.8:1.

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

Fish health is monitored on a daily basis by hatchery staff and at least monthly by a WDFW Fish Health Specialist. Hatchery personnel carry out treatments prescribed by the Fish Health Specialist. Procedures are consistent with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). See also HGMP section 10.9 for WDFW Standard Fish Health Procedures.

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

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

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

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

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

All reasonable and prudent measures are employed to minimize rearing and incubation losses. These include the use of high quality well water for incubation, use of high quality feeds for rearing, rearing densities and loadings that conform to best management practices and frequent fish health inspections and the presence of professionally trained personnel to operate the facilities. Hatcheries are designed to provide safe and secure rearing environment through the use of alarm systems, backup generators, and water re-use pumping systems to prevent catastrophic fish losses.

10 SECTION 10. RELEASE

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

10.1 Proposed fish release levels.

Table 10.1.1: Proposed number and size at release.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Sub-yearling	587,500	70	June	Skagit River

Source: Future Brood Document 2014.

Both sub-yearlings (250,000) and yearlings (150,000) were released through this hatchery program until 2011. In 2012 yearling releases were discontinued and sub-yearling release goal was elevated to 587,500 (see also HGMP section 1.11.2).

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

Stream, river, or watercourse: Cascade River (WRIA 03.1411)

Release point: Cascade River at RM 1.0

Major watershed: Skagit River

Basin or Region: Puget Sound

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

Table 10.3.1: Actual number and size at release, 2003-2014.

Release Year	Sub-yearling				Yearlings			
	Number	Avg. size (fpp)	CV	Date(s)	Number	Avg. size (fpp)	CV	Date(s)
2003	252,335	68	5.5	6/3-4	150,728	13.0	7.3	4/25
2004	267,248	66	6.0	6/8	120,000	12.0	10.2	4/5-23
2005	256,190	69	6.0	6/6	151,000	11.9	11.2	4/29-30
2006	252,195	90	12.1	6/15	146,753	9.7	6.5	4/14-16
2007	255,685	75	6.0	6/15	275,546	12.0	10.6	4/4-5
2008	221,225	70	5.8	6/5	139,111	10.0	8.1	4/11-13
2009	256,041	80	5.4	6/11	117,346	10.0	9.7	4/1-2
2010	268,617	90	7.2	6/7-8	153,200	10.0	8.0	4/14-16
2011	253,841	79	5.2	6/13	161,000	10.5	7.2	4/4-11
2012	475,326	80	3.0	6/15	140,019	10.0	7.5	4/16-26
2013	580,985	73	3.8	6/10	Discontinued			
2014	577,524	80	3.9	6/12				
Average	**326,434**	**77**	**5.8**		**155,470**	**10.9**	**8.6**	

Source: WDFW Hatcheries Headquarters Database 2014.
Note: 70 fpp = 92 mm fork length (fl); 80 fpp = 88 mm fl; 90 fpp = 84 mm fl
10 fpp = 176 mm fl; 12 fpp = 166 mm fl; 15 fpp = 154 mm fl.

10.4 Actual dates of release and description of release protocols.

Spring Chinook juveniles are forced-released due to construction of the ponds they are reared at. Fish are scheduled to be released in June (FBD, 2014). Actual release dates are summarized in **Table 10.3.1.**

10.5 Fish transportation procedures, if applicable.

No applicable. Fish are released on station.

10.6 Acclimation procedures.

Spring Chinook are acclimated on Clark Creek water for three weeks prior to release.

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

All spring Chinook released through this program are intended to be mass-marked and/or coded wire tagged. For mark/tag combinations specific to this program see **Table 10.7.1**.

Due to regeneration of a partially-clipped or unclipped adipose fin (missed-clip), and rejected coded wire tags, some hatchery adults may return with an intact adipose fin and/or no tags. WDFW monitors clipping and tagging rates during the marking process and records partial or missed-clips as “bad clip” and missed-tags as “no tag”.

Table 10.7.1: Marks applied and numbers of fish marked, by brood year and age.

Brood Year	Release		Marks
	Sub-yearlings	Yearlings	
Through 2011	250,000	75,000	AD+CWT
	-----	75,000	CWT only
2012	387,500	Discontinued	AD+CWT
	200,000		CWT only
2013 to date	110,000		AD-only
	277,500		AD+CWT
	200,000		CWT only

Source: Future Brood Document 2011-2014.

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

Egg-take is carefully managed to minimize the likelihood of collecting surplus eggs or raising surplus fry. Annual fluctuation in survival rates may result in higher-than-expected production levels. Regional staff and NOAA Fisheries will be informed and consulted if actual fish production will results in excess of 10% of the proposed level.

10.9 Fish health certification procedures applied pre-release.

Standard Fish Health Procedures performed at the facility:

- *All fish health monitoring is conducted by a qualified WDFW fish health specialist.*
- *Juvenile fish examinations are conducted at least monthly and more often if necessary.* A representative sample (at the discretion of the fish health specialist) of healthy and moribund fish from each lot is examined.
- *Abnormal levels of fish loss are investigated if they occur*.
- *Fish health status is determined prior to release or transfer to another facility*. The exam may occur during the regular monthly monitoring visit, i.e. within 1 month of release or transfer.
- *Appropriate actions, including drug or chemical treatments are recommended as necessary*. If a bacterial pathogen requires treatment with antibiotics a drug sensitivity profile is be generated when possible.
- *Findings and results of fish health monitoring are recorded on a standard Fish Health reporting form and maintained in a Fish Health database*.
- *Fish culture practices are reviewed, as necessary, with facility personnel*. Where pertinent, nutrition, water flow and chemistry, loading and density indices, handling, disinfecting procedures and treatments are discussed.

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

In the case of a catastrophic event, conditions critical to the fish's health will be monitored and if necessary to prevent loss, fish may be released prematurely.

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

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

Production and release of only smolts and volitional release practices foster rapid seaward migration with minimal delays in the rivers, limiting interactions with listed species.

Due to construction constraints, spring Chinook are forced-released, but are closely visually monitored for smolting activities to ensure they are released fully-smolted. Coefficient of variation (CV) for length at release is also monitored. An average CV value of 10.0% or less is desirable to confirm the likelihood that most fish are ready to migrate (Fuss and Ashbrook 1995). The average CV, for release years 2003-2014 was 5.8% (**Table 10.3.1**), indicating fish were released in migratory stage. Juvenile Chinook trapping data from Seiler et al. (2000, 2001, 2002), indicated rapid downstream migration of hatchery program fish.

The release of juveniles coincides near the end of the annual natural Chinook salmon emigration period in the Skagit River Basin. The size at release for Marblement Hatchery sub-yearling Chinook average 77 fpp (2003-2014), around 88 mm to 92mm fork length, while natural-origin Chinook salmon averages around 60 mm fork length (Seiler et al., 1999-2001). The USFWS

(1994) suggested that juvenile salmonids can consume fish which are one-third or less their own body length. Based on this suggestion natural-origin Chinook are larger than the predation susceptibility size. The degree to which the hatchery-origin Chinook salmon may compete with natural-origin Chinook salmon for food resources in the Skagit River basin is unknown.

For monitoring and evaluation purposes fish are released properly marked to allow identification.

11 SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

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

The monitoring process is used to verify if program goals are achieved and weight the program benefits against risks posed to wild populations (see HGMP section 1.10). This spring Chinook program was designed to be used as an indicator stock with an objective to collect representative harvest and marine survival data of spring Chinook that conclude effects on wild Chinook population as well as stock migration patterns, timing and distribution information. The goal was to be achieved by monitoring 587,500 sub-yearling summer Chinook smolts, marked with adipose fin-clip and/or coded wire tag, released annually from the Marblemount Hatchery.

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

Annually a statistically significant number of spring Chinook releases from the hatchery are both marked and tagged with CWTs to allow monitoring and evaluation of juvenile out-migrants (Seiler et al., 1998-2002) and adult returns. CWTs are also used to assess temporal separation during hatchery spawning between springs, summer and fall Chinook stocks. As production increases, the number of CWT fish will need to be increased to maintain statistical significance.

Chinook escapement (see HGMP section 11.1.2) to the Marblemount Hatchery and the Skagit River natural spawning areas will also be monitored to estimate the number of tagged, untagged and marked fish escaping to the river each year. This monitoring will allow for assessment of the status of the target population and the success of the program in achieving restoration objectives. The Co-managers annually monitor returning Chinook by preforming basin-wide spawners' surveys. Mainstem Skagit and Sauk Rivers are generally surveyed from the air, while tributaries are surveyed on foot and by boat. Surveys are conducted from late July until late October or early November each year in standardized river sections. Aerial surveys are limited to redd count. Ground surveys include redd and life fish counts and collection of data from sampled carcasses that include fish length, sex, CWTs, marks, scales (and for specific studies otoliths and DNA), all of which are shared and reviewed annually to assess both natural production and physical presence of hatchery and non-Skagit fish. Ground surveys are conducted for spring chinook in the Cascade River mainstem, Sauk River, North Fork Sauk and South Fork Sauk and the Tributaries of the Suiattle River. Ground surveys for Summer/Fall chinook occur on the Skagit River and selected tributaries in the accessible reaches.

WDFW's Wild Salmonid Production/Evaluation Unit (WSP/E) has been annually monitoring juvenile migration since the spring of 1990 when Skagit River juvenile salmon trapping project was initiated. Since then two juvenile migrant traps are operated annually in the mainstem Skagit River, 17-miles upstream of the river mouth from late-January through late-July. The project started with the goal to estimate natural-origin coho smolt production, but was later expanded to include estimates of natural-origin juvenile Chinook production. Supplemental data is collected which includes enumeration of all juvenile salmonids trapped, as well as collection of data to determine fish size, age and origin. Collected data has been used to estimate migrant abundance, survival and diversity.

This monitoring and research will be regularly evaluated by the co-managers with the intent of adjusting as appropriate the HGMPs consistent with stock recovery and fishing objectives.

Mark-Selective monitoring of recreational Chinook fisheries in the marine catch areas of Puget Sound: WDFW' Puget Sound Sampling Unit (PSSU) has been implementing sampling and monitoring program to collect data needed to evaluate each mark-selective Chinook fishery and its impact on unmarked salmon. As per state-tribal agreement (e.g., WDFW and NWIFC 2009), WDFW have developed area-specific sampling plans consisting of several comprehensive and complementary sampling components, including dockside creel sampling, test fishing, on-water or aerial effort surveys, and angler-completed voluntary trip reports (VTRs).

Annually, all commercial salmon fisheries conducted in Skagit Bay and River are sampled and monitored, and the catch is reported on Fish Receiving Tickets. Treaty, or Non-treaty.
Catch from recreational fisheries are reported on Catch Record Cards (CRC), or from creel surveys. Electronic sampling is required for all commercial Chinook fisheries (goal 20% of Chinook catch) to detect CWTs from marked and tagged and DIT groups enabling managers to estimate the total selective fishery release mortality.. Commercial Chinook encounters in a non-retention fishery are estimated either by commercial fishery monitoring, or test fishery catches used as surrogate for commercial fishery encounter rates.

Skagit River test fishery: SRSC annually perform Chinook (Blake's Drift), coho at Blake's, and chum (Jetty and in Skagit Bay) test fisheries. Upper Skagit Indian Tribe annually perform a sockeye test fishery in Area 78D3, as well as coho test fisheries form coho at Spudhouse drift 78C and in the middle Skagit in aread 78D3. Data collected during test fisheries are used to estimate run timing distribution and its wild and hatchery components, including CWT groups. CWT recoveries contribute to estimates of terminal run size, exploitation rate, and total CWT recruitment.

In river recreational fisheries monitoring: WDFW annually estimates recreational harvest on salmon and selected other species using Catch Record Cards and creel surveys as needed. All recreational fishermen are required to fill and submit CRC to WDFW with information regarding their catch.

Comanagers annually review all Skagit hatchery programs to assess goals, plans, performance indicators and to make adjustments to the programs as needed to comply with HGMP guidelines.

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

Funding and resources are currently committed to monitor and evaluate this program as detailed in the *Resource Management Plan for Puget Sound Chinook Salmon Hatcheries* (PSTT and WDFW 2004, revised 2010).

Changes to production will only be initiated when capacity for monitoring and assessment of that production is available, and with agreement of co-managers.

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

Monitoring and evaluation will be undertaken, with consultation with NOAA Fisheries, in a manner that does not result in an unauthorized take of listed species.

12 SECTION 12. RESEARCH

12.1 Objective or purpose.

Not applicable.

12.2 Cooperating and funding agencies.

Not applicable

12.3 Principle investigator or project supervisor and staff.

Not applicable

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

Not applicable

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

Not applicable

12.6 Dates or time period in which research activity occurs.

Not applicable

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

Not applicable

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

Not applicable

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

Not applicable

12.10 Alternative methods to achieve project objectives.

Not applicable

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

Not applicable

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

Not applicable

13 SECTION 13. ATTACHMENTS AND CITATIONS

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14 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:_____

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

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

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

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

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

Skagit Bull Trout *(Salvelinus confluentus):* Bull trout were listed as a threatened species in the Coastal-Puget Sound Distinct Population Segment on November 1, 1999 (64 FR 58910). The USFSW identified the Lower Skagit River below Diablo Dam as a core area with 19 local populations and two potential local populations (USFWS 2004). This core area supports all four life forms of bull trout: resident, fluvial, adfluvial, and anadromous. The adfluvial form is only found in the Baker River system in both Lake Shannon and Baker Lake. While spawning has been documented in the Baker River and its tributaries above Baker Lake, it is believed that bull trout in Lake Shannon originate from fish spilling over the upper Baker dam and that any natural spawning is extremely limited. Anadromous bull trout are found throughout the system and also make extensive use of the estuarine and nearshore waters foraging on juvenile salmon, smelt, sandlance and herring. Resident and fluvial forms are also found throughout the anadromous zones of the Lower Skagit core area. Primarily spawning areas are found in the upper portions of the watershed at an elevation of 1,000 to 3,000 feet. The Lower Skagit core area is thought to represent the largest population of bull trout in Washington State and the status of this stock is considered to be healthy (WDFW 2004). The recovered population level for the Lower Skagit core area has been set at 3,800.

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

Core Area Population	Abundance Category (individuals)	Distribution Range Rank (stream length miles)	Short-term Trend Rank	Threat Rank	Final Rank
Lower Skagit River	2,500-10,000	620-3,000	Increasing	Slightly	Low Risk

Source: USFWS 2008

Table 15.2.2: Bull trout redd counts in the South Fork Sauk River spawning index area, and bull trout smolt counts at the lower Skagit River trap (representing entire core area), 1998 to 2009.

Year	Number of Redds	Smolts Captured
1998	62	358
1999	---	199
2000	---	246
2001	163	142
2002	318	189
2003	287	149
2004	433	186
2005	104	31
2006	143	90
2007	110	228
2008	208	146
2009	77	72
Average	**191**	**170**

Source: Zimmerman and Kinsel 2010

Habitat - Large portions of this core area fall within areas under National Park and Wilderness designation, so these areas have generally avoided many of the impacts from more intensive land management. Gorge Dam currently restricts connectivity between the Stetattle Creek local population and the majority of the core area. This has put the Stetattle Creek local population at increased risk, however this break in connectivity may be less significant to the core area as a whole due to the large number of connected local populations that exist below this barrier. The Baker Dams also restrict connectivity between the Baker Lake local population and Sulphur Creek potential local population and the rest of the core area. Operations of the Lower Baker Dam have at times significantly impacted water quantity in the lower Baker and Skagit Rivers. Agriculture practices, residential development, the transportation network and related stream channel and bank modifications have resulted in the loss and degradation of foraging, migration, and overwintering habitats in mainstem reaches of the major forks, as well as in a number of tributaries. Nearshore foraging habitats have and continue to be impacted by agricultural practices and development activities. Bull trout within this system were overharvested in the past, but the implementation of more restrictive regulations in the early 1990's have helped allow the population to increase in abundance from the low levels of the late 1980's. Recent spawning index area counts strongly indicate that this population is rebounding near or to recovered levels. (USFWS 2004).

Competition and Predation **–** Given the life history of bull trout and release strategies used in this hatchery program (see also HGMP section 10), predation and competitive interactions between hatchery fish and bull trout are likely to be limited (USFWS 2004). However with the listing of Puget Sound Chinook and steelhead hatchery fish may provide an important addition to the forage base for bull trout (see also HGMP section 3.5).

Several other listed and candidate species are found in Skagit County; however the hatchery operations and facilities for this program do not fall within the critical habitat for any of these species. As such there are no effects anticipated for these species.

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

Gray Wolf (*Canis lupus*) –Threatened
Grizzly bear (*Ursus arctos horribilis*) –Threatened

Canada Lynx (*Lynx canadensis*) –Threatened [critical habitat designated]
Marbled murrelet (*Brachyramphus marmoratus*) –Threatened [critical habitat designated]
Northern Spotted owl (*Strix occidentalis caurina*) –Threatened [critical habitat designated]

Proposed
Dolly Varden (*Salvelinus malma*) due to similarity of appearance

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

15.3 Analyze effects.

There are no activities associated with this hatchery program that would directly impact the Skagit bull trout population. There is the possibility for indirect "take" associated with hatchery program operations—up to and including unintentional lethal take. Any observations of bull trout encountered during any hatchery activity, up to and including lethal take associated with hatchery activities, are reported annually by WDFW to USFWS under the ESA section 6 operating agreement. See also HGMP section 15.1.

15.4 Actions taken to minimize potential effects.

All adult trapping facilities are regularly checked at consistent short intervals while actively trapping. All efforts are made to minimize any holding time listed fish remain in any traps.

All off-station collection activities attempt to minimize interaction with and effects to listed bull trout.

15.5 References

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"Take" Tables

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

Listed species affected: Spring Chinook *(Oncorhynchus tshawytscha)*	**ESU/Population:** Lower Skagit River Puget Sound Chinook		**Activity:** Marblemount Spring Chinook Program	
Location of hatchery activity: Marblemount Hatchery, RM 0.5 Cascade River (04.1411).	**Dates of activity:** Sub-yearlings- July-June Yearlings- June-April		**Hatchery program operator:** WDFW	
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass a)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	Up to 79	-
Capture, handle, tag/mark/tissue sample, and release d)	-	-	-	-
Removal (e.g. broodstock) e)	-	-	-	-
Intentional lethal take f)	-	-	-	-
Unintentional lethal take g)	-	-	Up to 6	-
Other Take (specify) h)	-	-	-	-

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

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

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

Listed species affected: Summer Chinook *(Oncorhynchus tshawytscha)*	**ESU/Population:** Lower Skagit River Puget Sound Chinook		**Activity:** Marblemount Spring Chinook Program	
Location of hatchery activity: Marblemount Hatchery, RM 0.5 Cascade River (04.1411).	**Dates of activity:** Sub-yearlings- July-June Yearlings- June-April		**Hatchery program operator:** WDFW	
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass a)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	0	-
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.

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

Listed species affected: Steelhead *(Oncorhynchus mykiss)*	**ESU/Population:** Skagit River / Puget Sound Steelhead	**Activity:** Marblemount Spring Chinook Program
Location of hatchery activity: Marblemount Hatchery, RM0.5 Clark Creek (04.1421)	**Dates of activity:** December-May	**Hatchery program operator:** WDFW

Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass a)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	0	-
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.