HATCHERY AND GENETIC MANAGEMENT PLAN

(HGMP)

Hatchery Program:	**Big Creek Coho Salmon Program**
Species or Hatchery Stock:	**Big Creek Hatchery Coho (stock 13)**
Agency/Operator:	**Oregon Department of Fish and Wildlife**
Watershed and Region:	**Lower Columbia River and Estuary**
Date Submitted: **First Update Submitted:**	**August 19, 2005** **May 10, 2016**
Date Last Updated:	**May 10, 2016**

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of Program.

Big Creek Hatchery Coho Salmon Program

1.2) Population (or stock) and species.

The Big Creek Hatchery coho salmon program utilizes lower Columbia River coho salmon, *Oncorhynchus kisutch*. Hatchery produced coho salmon (stock 13) are used in this propagation program. The wild population of coho salmon in the Lower Columbia River is part of the lower Columbia River Coho Evolutionarily Significant Unit (ESU). This ESU was listed by NOAA Fisheries as threatened on June 28, 2005. The hatchery population is not considered part of the Lower Columbia River coho ESU. Naturally produced wild coho were listed as an endangered species by the Oregon Fish and Wildlife Commission in July 1999.

1.3) Responsible organization and individual.

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

NOAA Fisheries is involved through Mitchell Act funding, and WDFW is involved as fishery co-manager through the Columbia River Compact.

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

Funding Sources:
NOAA: 70% funding through Mitchell Act
STATE: 30% funding through Columbia River and Ocean Salmon Policy

Operational Information:
Full time equivalent staff: 8 FTE (6 at BC and 2 stationed at Klaskanine Hatchery)
Annual hatchery operating cost: $987,322
Estimated coho salmon program cost: $394,929

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

1) Big Creek Hatchery (regional mark location code: 5F33202 H2 21) is located at RM 3.3 on Big Creek in the Columbia Estuary Watershed, Clatsop County, Oregon.

Coho program functions include:
Broodstock collection
Adult holding
Spawning
Egg incubation
Egg Transfer
Juvenile rearing

2) Salmon and Trout Enhancement Program (STEP): Astoria High School (Astoria, OR) receives 5,000 eyed coho eggs, and Warrenton High School (Astoria, OR) receives 6,000 from Big Creek Hatchery for educational purposes. Fingerlings are released into Youngs Bay and Skipanon River. Other area high school programs (Knappa, Seaside) may request eggs for educational purposes in the future.

1.6) Type of program.

Harvest mitigation.

1.7) Purpose (Goal) of program.

The goal of Big Creek Hatchery coho salmon program is to supplement harvest by producing 15,000 adult coho salmon through releases of 535,000 yearling smolts annually into Big Creek (see Figure 1). This could be attained through an effective smolt-to-adult return of 2.8%. Specifically, this program aims to provide coho salmon for harvest in lower Columbia River commercial and recreational fisheries, as well as supplement harvest to ocean commercial troll and recreational fisheries. The harvest goal is 10,000 adults to the combined fisheries and the harvests will be managed in a way that impact to listed natural salmon is minimal or within allowable limit.

Another goal of this hatchery program is to provide 5,000 eyed eggs to Astoria High School

and 6,000 eyed eggs to Warrenton High School in December of each year for educational purposes using classroom incubators. The resulting fish are released into Youngs Bay and Skipanon River in May as 100% adipose fin-clipped fingerlings (40 fish/lb) (Figure 1). Other area high schools may also request eggs in the future.

This program is also responsible to produce about 1.4 million green eggs for the SAFE coho program and that has been covered in the SAFE coho HGMP.

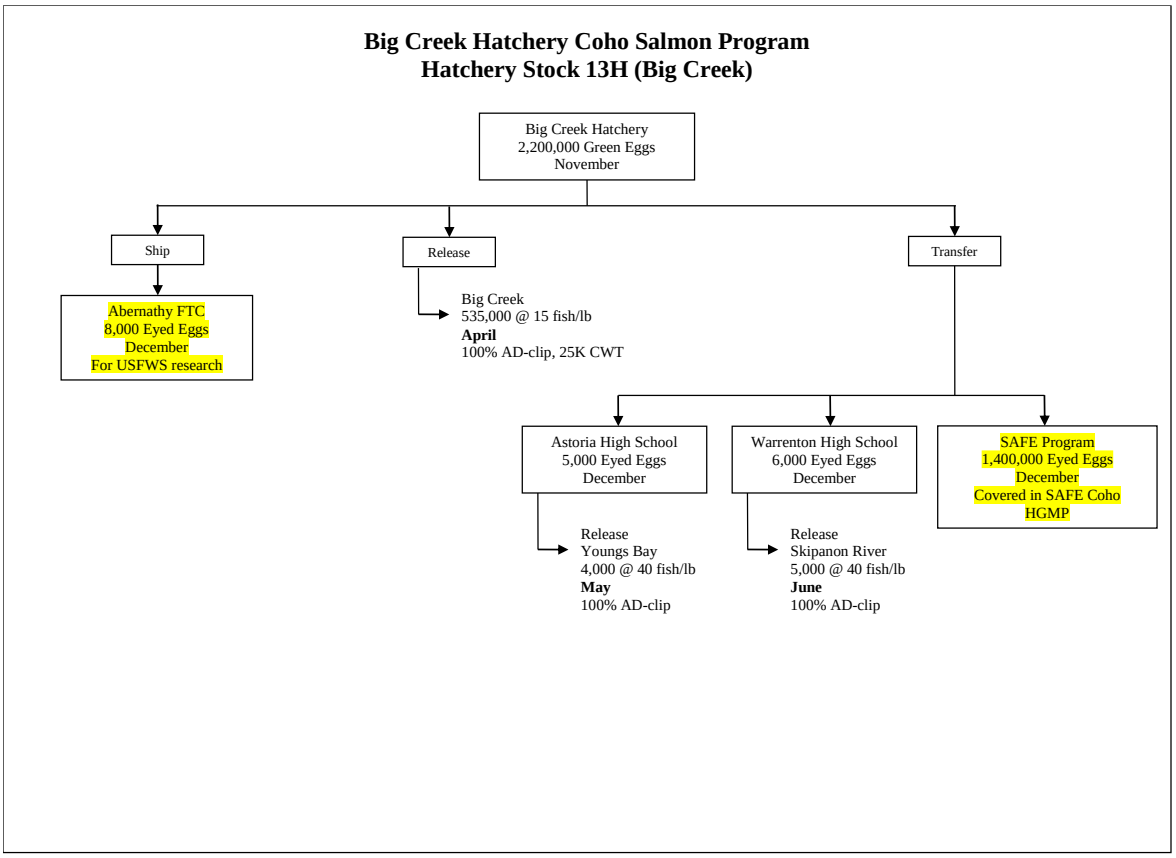

Figure 1. Big Creek Hatchery coho salmon smolt production flow chart with release locations.

1.8) Justification for the program.

This program mitigates for the loss of coho salmon catch in Oregon commercial troll, Oregon Ocean recreational, and Columbia River mainstem commercial and recreational fisheries due to habitat and passage loss or degradation in the Columbia River Basin. All (100%) smolts are mass-marked with an adipose fin clip for easy identification as hatchery origin fish. Approximately 25,000 smolts of each release are also coded-wire tagged to enable evaluation of program performance and contributions to fisheries. The marking and CWT tagging of release groups also provides information on straying and spawning escapement. The mass marking of program fish facilitates selective harvest of hatchery fish while minimizing impacts to listed natural fish populations.

Fishing effort for Big Creek Hatchery coho is concentrated prior to the arrival of most wild

chum and late stock wild coho in the local tributary streams. The intensive harvest of Big Creek Hatchery coho in ocean and freshwater fisheries reduces the number that may escape to potentially spawn in Big Creek and other lower Columbia tributaries. Specific release strategies are implemented to minimize potential biological and ecological effects to wild juveniles including size of smolts and time of release. Juveniles are reared to full term smolts and released on-site during late April or early May, which facilitates rapid emigration and minimizes interaction with the listed late-run wild coho. On-site release of smolts may also reduce the potentials for straying as most fish will return to hatchery traps. The STEP component is designed primarily to educate the high school students on salmon biology, and habitat requirements to complete their life cycle.

1.9) Performance Standards.

See Section 1.10

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

1.10.1) "Performance Indicators" addressing benefits.

BENEFITS Performance Standards	Performance Indicators	Monitoring & Evaluation
Contribute to harvest mitigation for loss of coho catch in sport and commercial fisheries due to habitat and passage degradation in the Columbia River Basin.	Achieve a smolt to adult survival rate adequate to collect sufficient adult broodstock to produce 535,000 yearling smolts for release.	Monitor adult returns, smolt production, and survival rates. Perform best rearing strategies to meet spawning and production goals.
Successfully maintain a broodstock of Big Creek coho salmon.	Achieve smolt to adult survival goal adequate to collect and spawn a minimum of 750 females and 750 males (preferred F:M ratio 1:1) to achieve production goal (including egg production for SAFE coho program).	Smolt to adult survival rates are estimated for each brood year release.
Contribution of hatchery coho to lower Columbia River commercial fisheries.	Number of Big Creek coho harvested in lower Columbia River commercial fisheries.	Fish buyer monitoring, and recovery of CWT marked fish from commercial sampling programs.
Contribution of hatchery coho to lower Columbia River recreational fisheries.	Angler success rates (catch per angler trip), and angler total catch of coho in the lower Columbia estuary (Buoy 10) and mainstem Columbia recreational fishery.	Dock-side creels and effort counts in Buoy 10 and lower Columbia recreational fisheries, recoveries of CWT marked fish from recreational sampling programs.
Contribution of hatchery coho to ocean commercial and recreational fisheries.	Big Creek coho contribute to Oregon and Washington ocean troll and ocean recreational fisheries.	Fish buyer and dock-side creels, recoveries of CWT marked fish in coastal port sampling programs.
Contribution of hatchery coho to ocean and freshwater selective fisheries.	Big Creek coho 100% adipose fin-clip marked to contribute to mark-selective fisheries	Long-term commitment in resources necessary to adipose fin-clip Big Creek hatchery coho each year.

BENEFITS Performance Standards	Performance Indicators	Monitoring & Evaluation
Design and implementation of projects that improve the survival of Big Creek coho.	Projects are identified, implemented and reviewed, to determine best rearing practices to increase survival of program fish.	Research and monitoring programs are incorporated into project designs. Examples of projects include: rearing/release studies and feeding studies.
Release groups are sufficiently marked and tagged to track survival and distribution.	A minimum of 25,000 of program fish are both adipose fin-clipped and coded-wire-tagged.	Representative Ad-CWT level to monitor catch distribution and harvest rates.
Program hatcheries will be operated in compliance with ODFW's Fish Health Management Policy and Fish Hatchery Management Policy, and the Integrated Hatchery Operations Team (IHOT) fish health guidelines.	Number of broodstock sampled and pathogens observed. Rearing survival rates, egg to fry, and fry to smolt. Number of juveniles sampled and pathogens observed during rearing and immediately prior to release.	Juvenile fish health is monitored on at least a monthly basis at the rearing hatchery. A fish health specialist will examine affected fish and recommend remedial or preventative measures. Disposal of affected eggs or fish follows ODFW Fish Health and IHOT policies.
Contribution to ecosystem function (e.g. through nutrient enhancement, food web effects, etc.)	Hatchery fish in excess of broodstock requirements may be placed in streams for nutrient enhancement.	Ability to consistently respond to planned nutrient enhancement needs as appropriate for Oregon watersheds.

1.10.2) "Performance Indicators" addressing risks.

RISKS Performance Standards	Performance Indicators	Monitoring & Evaluation
Fisheries conducted to harvest hatchery produced coho are consistent with conservation requirements.	Fishery impacts to ESA listed salmon and steelhead do not exceed federal and state ESA limits.	In-season monitoring of catch by species is conducted in the ocean, and catch and stock composition in the Columbia River. Post-season analysis of fisheries estimates impacts to listed fish based on sampling of the landed catch (sport and commercial) for species, marks, and CWTs.
Columbia River coho fisheries are consistent with Indian and non-Indian harvest allocation agreements.	Harvest of upriver origin coho concurrently with Big Creek Hatchery coho in non-Indian fisheries is within allocation provisions of *U.S. v. Oregon* Agreements.	In-season monitoring of catch in ocean and lower Columbia River fisheries. Upriver coho run reconstruction, and post-season harvest estimates using the Columbia River coho Technical model.
Juvenile hatchery releases minimize interactions with wild fish species.	Release timing, location, condition of juveniles, and emigration patterns.	Effective rearing studies and monitoring of juvenile health. Smolts are reared full-term to facilitate rapid emigration.

RISKS Performance Standards	Performance Indicators	Monitoring & Evaluation
Minimize disease risk to wild fish.	Program complies with all state and federal health monitoring, transfer, and release guidelines (e.g. ODFW Fish Health Policy and Implementation Guidelines; IHOT fish policy).	Juvenile fish health is monitored on at least a monthly basis at the rearing hatchery. A fish health specialist will examine affected fish and recommend remedial or preventative measures. Disposal of affected eggs or fish follows IHOT policy.
Straying of hatchery fish to lower Columbia watersheds.	Recovery of program fish in watersheds other than Big Creek.	CWT recoveries throughout the Columbia Basin are recorded and summarized annually in order to estimate stray rates
Natural spawning of program fish documented to enable extent hatchery and wild coho spawning.	Ability to estimate the number of hatchery and wild coho naturally spawning in lower Columbia River tributaries.	Estimates of hatchery coho spawning naturally can be made with high confidence in Lower Columbia streams where spawning ground surveys are conducted because 100% of the Big Creek hatchery coho are adipose fin-clipped.

1.11) Expected size of program.

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

The program needs an adequate number of adult broodstock collected to meet the egg production goals for both Big Creek Hatchery coho and SAFE coho programs (Figure 1). Assuming 1:1 sex ratio, the annual broodstock collection level would be 750 females and 750 males; however, additional brood stock may be collected as a back-up to other SAFE coho releases. All hatchery brood are hatchery origin.

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

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling	Youngs Bay Skipanon River	4,000 5,000
Yearling	Big Creek	535,000

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

The purpose of this hatchery program is to provide coho salmon for harvest mitigation. The Program performance is measured by total adult production, smolt to adult survival rate, and adult returns to the hatchery. The total hatchery returns of this stock are provided in Table 1.12a. The average survival for brood years 2001-2011 has been 1.7%. Smolt-to-adult survival rates and adult production is provided in Table 1.12b. Harvest levels and fishery proportions are described in Section 3.3., and coded-wire tag release groups and associated recovery numbers are reported in Table 11.1.1.

Table 1.12a. Total returns of coho salmon to Big Creek Hatchery, 1992-2015.

Return Year	Hatchery Returns	Return Year	Hatchery Returns
1992	5,768	2004	5,040
1993	740	2005	7,259
1994	4,646	2006	7,403
1995	3,374	2007	4,635
1996	2,926	2008	5,953
1997	4,110	2009	6,550
1998	2,032	2010	4,832
1999	2,108	2011	2,436
2000	6,462	2012	3,349
2001	11,313	2013	7,890
2002	10,302	2014	20,113
2003	8,919	2015	2,555

Data from ODFW HMS

Table 1.12b. Smolt to adult survival (SAR) rates and estimated numbers of adults from releases of Big Creek Hatchery stock coho released at Big Creek Hatchery, brood years 1992-2015. Data from RMIS.

Brood Year	Number Released	SAR (%)	Adult Production
1992	465,990	0.9	3,444
1993	533,857	0.8	4,109
1994	543,566	0.7	4,987
1995	535,702	0.7	3,042
1996	501194	0.6	2,596
1997	525,342	1.6	8,255
1998	567,459	3.8	22,089
1999	537,185	3.6	19,949
2000	540,898	4.0	23,049
2001	537,086	1.2	6,634
2002	516,942	1.7	8,358
2003	549,967	1.9	12,040

2004	527,631	1.1	7,842
2005	529,697	0.9	5,450
2006	559,718	1.7	12,116
2007	540,170	0.9	4,985
2008	516,206	0.7	3,710
2009	538,402	0.6	3,311
2010	532,082	1.3	8,237
2011	571,616	6.7	37,991
2012	537,811	-	-
2013	537,661	-	-
2014	526,229	-	-
2015	593,107	-	-

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

Coho program at Big Creek Hatchery began in 1938.

1.14) Expected duration of program.

The program is ongoing with no planned termination.

1.15) Watersheds targeted by program.

Columbia River Estuary (location code: 5F33213 H13 22), Big Creek (location code: 5F33202 H2 21), and Youngs Bay (location code: 5F33236 R36 27).

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

1.16.1) Brief Overview of Key Issues.

Issue 1. Maintain current coho production at Big Creek Hatchery.
Approximately 535,000 coho are released annually from Big Creek Hatchery to provide sport and commercial harvest opportunities as mitigation for fishing opportunities lost due to hydropower development in the Columbia River Basin. Hatchery-origin fish are identified by an adipose fin-clip and adults are spawned using random mating of fish throughout the entire run. Releases are 100% adipose fin-clipped to support harvest in selective sport fisheries and for differentiation of hatchery (adipose fin-clipped) and wild (unmarked) adults upon return to hatcheries and escapement areas. Additionally, a component of the releases is coded-wire tagged to evaluate survival, harvest distribution, and straying. The program receives widespread support because fish survive well and contribute substantially to various freshwater and ocean fisheries. Few alternatives to this program have been identified.

Issue 2. Passage of coho salmon above Big Creek Hatchery.
Wild Coho Salmon destined for lower Columbia River tributaries, including Big Creek, are depressed at this time and wild coho destined for Oregon tributaries have been listed as endangered under Oregon state law since July 1999. Lower Columbia River coho were listed as a federally-threatened species by NOAA Fisheries in 2005. Improving access of wild fish to historical production areas that are currently blocked (i.e. passage above hatcheries) is a part of the ODFW plan to recover listed coho.

Significant habitat exists in the Big Creek watershed above Big Creek Hatchery, especially for coho salmon, chum Salmon, and winter steelhead. Until recently, access to habitat was blocked at Big Creek Hatchery due to disease concerns. Providing access to the upper Big Creek watershed has the potential to significantly improve the status of anadromous salmonids utilizing the Big Creek watershed. Habitat above Big Creek Hatchery is best suited for coho and winter steelhead, but chum salmon and fall Chinook may also benefit from access to this portion of the watershed. Passage of anadromous salmonids (fall Chinook, coho, chum or steelhead) above the hatchery intake weir will require modifications to the hatchery facilities. Facility improvements are facilitating treatment of water source for disease agents. The hatchery intake screening system was updated June 2012 to meet NOAA Fisheries requirements and improve adult fish handling capabilities. Sampling of downstream migrants could provide data necessary to evaluate the effect of increased access to spawning and rearing areas above the hatchery intake.

Adult returns to Big Creek Hatchery are trapped and sorted by hand. Since the 2001-2002 return year, all unmarked adult coho and steelhead returns have been passed upstream of the hatchery weir to utilize the available upstream habitat. The current sorting facility does not allow direct return of unmarked fish back to the stream; therefore, unmarked adults are loaded into a portable tank and truck and transported upstream for release back into Big Creek. Chum salmon collected in conjunction with coho trapping are loaded into a tanker truck for transport to Stewart Creek where habitat that is better suited for chum salmon.

1.16.2) Potential Alternatives to the Current Program.

Issue 1. Maintain current coho production at Big Creek Hatchery.

Alternative 1: Maintain current coho production at Big Creek Hatchery. Coho production at Big Creek Hatchery was established as mitigation for the loss of fishing opportunities due to hydropower development in the Columbia River Basin. Current coho production provides significant support to important selective recreational fisheries in the ocean and the Columbia River. Additionally, this stock provides significant contributions to ocean and Columbia River commercial fisheries.

Alternative 2: Discontinue releases of coho from Big Creek Hatchery. The Big Creek Hatchery coho program was established as mitigation for the loss of fishing opportunities due to hydroelectric development in the Columbia River basin. The current program functions very well since Big Creek stock hatchery coho contribute to a variety of ocean and freshwater commercial and sport fisheries. Also, it produces more 1.4 million eyed

eggs for the SAFE coho program. Additionally, no other facility currently exists to replace production that would be lost if this program is discontinued. For these reasons, ODFW and industry do not support this alternative.

Issue 2. Passage of coho salmon above Big Creek Hatchery.

Alternative 1: Maintain current program of manually sorting and passing unmarked coho to spawning areas above Big Creek Hatchery. Currently coho are not allowed to freely pass above Big Creek Hatchery. All unmarked coho returning to Big Creek Hatchery are currently being passed above the hatchery but this requires all fish to be manually handled and sorted at the existing Big Creek adult fish trap. Fish identified for passage above the hatchery are manually loaded into a fish transportation vehicle and driven to at least river mile 8.0 above the hatchery intake structure. Release back into the stream currently occurs through a suspended 18" aluminum pipe from a portable tank. Releasing fish to other locations in the drainage will require fish be manually carried from the transportation vehicle to the stream for release. This method of trapping, transportation, and release is labor intensive and causes handling stress to adult fish.

Increased passage of anadromous salmonids (fall Chinook, chum, coho, and steelhead) above the hatchery will require facility improvements. First and foremost the hatchery intake weir was upgraded in June 2012 with screens to meet standards set forth by the NMFS. In conjunction with the access-road to the intake weir it would also require construction of a retaining wall. Additionally, the water supply for Big Creek Hatchery would require treatments to eliminate pathogens that severely affects hatchery productions. Water supply modifications will include new pump stations and a settling pond plus filtration, UV, aeration, and ozone treatments of the water prior to its use for incubation and early rearing.

Alternative 2: Improve current methods of passing adult coho to spawning areas above Big Creek Hatchery. The current passage method causes significant handling stress of returning adults. Improved passage and/or sorting facilities would allow adults to continue their upstream migration with minimal handling and no transportation. Fish could be sorted and returned to the stream via a release pipe that would deliver adult fish back into the stream above the adult trap to continue their upstream migration.

Passage of anadromous salmonids (fall Chinook, chum, coho, and steelhead) under this alternative would require all the improvements listed under Alternative 1 plus additional improvements at the adult trap and the hatchery intake structure. The adult trap would require the addition of a hoist to sort and load fish, platforms, tighter net pens, and a pipe to transport adults back to the stream. Improvements to the hatchery intake will require construction of a pool and a 6-step fishway to allow passage over the intake structure. Additionally, a pump station will be required to pump water from the adult trap to the hatchery intake for the purpose of maintaining adequate flows through the stream between the hatchery intake and the adult trap to allow fish passage through this stretch of Big Creek.

Alternative 3: Construct an outmigrant counting facility at the hatchery intake weir. The effectiveness of providing passage to upstream areas would best be measured by resultant smolt production. Screening improvements mentioned in Alternatives 1 and 2 will allow smolts to pass the hatchery intake and adult trap structures without harm; however, the number of coho smolts produced in upstream areas cannot be documented at this time. Smolt enumeration would require a collection device that could either be associated with the hatchery intake screening modifications or independent of the intake structure (i.e. a screw trap). Either option would provide a count of outmigrant production. The trap associated with the intake structure would likely document total outmigration while the screw trap would provide index counts of outmigration. Either method would be adequate for determining relative annual juvenile production. An evaluation of natural production in the drainage was initiated in 2005 by ODFW and Columbia River Estuary Study Taskforce (CREST). Preliminary results from snorkeling surveys and outmigrant collections (screw trap) indicate significant production is occurring upstream of the hatchery.

1.16.3) Potential Reforms and Investments.

Reform/Investment 1: Establish an alternate egg source for this coho program. Currently, coho releases from Klaskanine (priority) and Bonneville hatcheries may be used as back up egg source for the Big Creek Hatchery coho program. Since no additional cost is associated with this reform, this reform is being considered appropriate.

Reform/Investment 2: Provide funding for modifications to the current hatchery facility that are required due to the presence of listed anadromous salmonids (fall Chinook, chum, coho, or steelhead) upstream of the hatchery. Treatment of water supply to eliminate pathogens (see Alternative 2). Costs of these modifications would be moderate and would not exceed $1 million.

Reform/Investment 3: Provide funding for modifications to the current adult trap and intake structure to allow anadromous salmonids (fall Chinook, coho, chum or steelhead) to pass upstream of Big Creek Hatchery with minimal handling stress. Modifications would include improved trapping equipment, an adult passage ladder at the hatchery intake structure, and a pump station to maintain adequate flows from the intake structure to the adult trap. Total cost associated with reform/investments 2 and 3 combined is $2-4 million.

Reform/Investment 4: Fund a method of enumerating anadromous salmonid (fall Chinook, coho, chum, or steelhead) outmigrants. Collection method could be included as part of the required juvenile screening modifications or with a screw trap operated just downstream of the intake structure. Cost of collection associated with the intake structure would be moderate while costs of the screw trap would be low.

SECTION 2. PROGRAM EFFECTS ON 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.

Fish production activities conducted by the Big Creek coho program are covered by a Biological Opinion received from NMFS in 1998. Re-initiation of consultation regarding Big Creek Hatchery coho production was planned to begin in spring 2004 with a new production Biological Assessment. The HGMP for Big Creek Hatchery coho program was submitted to NMFS 8/19/2005 for ESA take authorization. This is an updated version of the previously submitted HGMP.

2.2) List Federally ESA-listed natural populations in the target area.

All natural populations of Columbia River salmonids that successfully return to spawn must migrate through the lower Columbia River and estuary twice during their life cycle. Thus, hatchery programs in the lower Columbia have the potential to affect the 13 listed ESUs in the Columbia River Basin. However, it is more probable that the program would affect those ESA listed natural salmonid populations that occur in the subbasin where the program fish are collected and released, including:

The Lower Columbia River Chinook salmon (*Oncorhynchus tshawytscha*) ESU is federally listed as threatened under the Endangered Species Act, effective May 24, 1999.

The Columbia River chum salmon (*Oncorhynchus keta*) ESU is federally listed as threatened, effective May 24, 1999.

The Lower Columbia River coho salmon (*Oncorhynchus kisutch*) ESU is federally listed as threatened in 2005.

The Lower Columbia River Steelhead (*Oncorhynchus mykiss*) is a federally listed threatened species.

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.

Only hatchery-origin coho are used as broodstock for the Big Creek Hatchery coho program. Therefore, no direct take of ESA-listed coho or other listed species shall occur due to this program. In times of hatchery return shortfalls, additional broodstock have been transferred from other coho salmon hatcheries in the lower Columbia, including the Klaskanine, Sandy, and Bonneville hatcheries. Only four stock transfers are on record since the broodstock was established in 1938. Hatchery-origin coho salmon at the Big Creek Hatchery trap can be identified based on adipose fin clip marks. Although naturally

spawning adult coho and Chinook salmon may be present and affected while broodstock are collected, only adipose fin clipped coho are collected for broodstock. During release of hatchery smolts, naturally-spawned coho, chum and Chinook smolts may be present within the area and be indirectly affected through competitive interactions for food and space.

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

The Big Creek coho salmon program may incidentally or indirectly affect the following listed populations through competitive interactions and the extent of such adverse impacts is not measurable and expected to be minimal.

The fall component of the Lower Columbia River Chinook ESU is comprised of two groups: 'tules' and 'brights'. Native fall Chinook in Oregon tributaries of the lower Columbia River are almost all tule fall Chinook, with the exception of bright fall Chinook in the Sandy River. Sscattered naturally spawning populations are still observed in small Oregon tributaries (primarily Big, Plympton, and Gnat creeks and the Clatskanie River). Tule fall Chinook generally arrive at the mouth of the Columbia River beginning in August, with peak migration generally in September; bright fall Chinook return timing generally is later than tules. Tule fall Chinook are sexually mature upon river entry and spawn soon after arrival to the spawning grounds, while bright fall Chinook are sexually immature and may hold in freshwater for months prior to spawning. Populations in the lower Columbia have short migrations, which are more characteristic of coastal populations than upper Columbia populations. Depending on spawn timing and water temperature, tule fall Chinook juveniles in the lower Columbia River generally emerge beginning in March-April and follow an ocean-type life history, emigrating in late spring/early summer of their first year as subyearlings. Meanwhile, bright fall Chinook juveniles in the lower Columbia River generally emerge from March-June and emigrate in early/late summer. Ocean distribution of lower Columbia fall Chinook extends from the coast of Washington to Southeast Alaska; bright fall Chinook salmon are generally more northerly distributed.

Lower Columbia River chum salmon are occasionally observed in the Klaskanine River and Big Creek. Also, ODFW has taken a recovery effort of chum salmon using hatchery as a tool along the lower Columbia. Hatchery chum being outplanted in a few tributaries which have been observed spawning naturally and producing outmigrating chum fry. Chum salmon in the lower Columbia generally arrive at the mouth of the Columbia River beginning in mid-late October, with peak migration generally in November. Chum salmon are sexually mature upon river entry and spawn soon after arrival to the spawning grounds. Depending on spawn timing and water temperature, chum fry begin emerging in early spring (March) and emigrate shortly after emergence; peak emigration is usually late April. Current chum salmon ocean distribution is not well documented but is expected to extend along the coast from Washington to Alaska.

Lower Columbia River coho salmon are present in numerous Oregon tributaries to the lower Columbia; evidence suggests that most coho observed in these subbasins are hatchery stocks and few wild fish are present. Lower Columbia River coho are categorized

as either Type S or Type N, based on their general ocean distribution either south or north of the Columbia River. Managers also refer to Type S as early stock coho and Type N as late stock. Early stock coho salmon in the lower Columbia generally enter the Columbia River beginning in August, with peak spawn timing generally in late October- early November. Late stock coho salmon in the lower Columbia generally enter the Columbia River beginning in September, with peak spawn timing generally in late November and December. Depending on spawn timing and water temperature, coho fry begin emerging in the spring and rear for a year in freshwater; emigration begins the following spring.

Listed populations that may be incidentally affected by the Big Creek coho salmon program include species utilizing habitat in Big Creek and the Columbia River and estuary downstream of Big Creek. All NMFS ESA-listed salmonids use the lower Columbia River as a migratory route, although effects of the Big Creek coho salmon program are expected to be minimal. Impacts associated with the Big Creek coho program are more likely to occur in populations of threatened Chinook, coho and chum salmon that spawn in Big Creek. Estimates of total natural spawning escapement have not been quantified for coho salmon; however, fish per mile estimates have been made for Big Creek (Table 2.2.2b). The 2000-2003 fish per mile data represents only wild coho as marked hatchery fish could be accounted for and removed from the data.

Lower river hatchery (LRH) tule fall Chinook stock abundance increased between 2001-2004 and then decreased to the lowest level since 1990 in 2006 (Table 2.2.2a). From 2008-2011 the LRH tules rebounded back but not completely to the levels seen in the early 2000's. Other Columbia River Chinook stocks (e.g. Lower River Wild (LRW), Lower River Bright, etc.) have not been observed spawning in Big Creek. Rogue River bright (RRB) stock Chinook are occasionally found in Big Creek as a result of straying from the SAFE SAB fall Chinook program. Chinook in Plympton Creek and Big Creek are comprised primarily of LRH stock (Table 2.2.2a). Chum salmon are periodically observed in the Big Creek Hatchery trap, although abundance is quite low (Table 2.2.2b).

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 (see definitions in "Attachment 1").

The Willamette/Lower Columbia Technical Review Team (WLC-TRT) has not calculated critical and viable population thresholds for the Oregon lower Columbia fall Chinook, chum, or coho populations in the vicinity of the Big Creek Hatchery coho program. However, the TRT has established "default value" minimum population viability criteria of 1,400 for Chinook and 1,100 for chum for use as a general value for lower Columbia fall Chinook and chum populations. A default minimum viable population criterion has not been identified by the TRT for coho, although the Lower Columbia Recovery Board (LCFRB) has assumed a value of 600 for Washington lower Columbia coho populations, which is the same criterion identified by the TRT for lower Columbia steelhead.

The WLC-TRT has completed a draft assessment of the current viability status of salmon and steelhead populations in the lower Columbia and Willamette ESUs. This assessment

used a persistence probability criterion to estimate extinction risk for each population. To estimate the extinction risk, four key attributes were evaluated: 1) abundance and productivity, 2) diversity, 3) spatial structure, and 4) habitat. The populations were ranked from 0-4, with category 0 representing a 0-40% chance of persistence in the next 100 years and category 4 representing a 99 percent chance of persistence in the next 100 years. A population was considered viable with a category 3 score. The status assessment includes fall chinook, coho, and chum populations in Youngs Bay tributaries, Big Creek, Scappoose Creek, and the Clatskanie River. The persistence probability scores of both the WLC-TRT and ODFW are reflected as a range (Figure 1). The scores for fall chinook are generally low ranging from 1-2, for chum very low at less than 1, and for coho low from 1 to 2. However, it should be noted that ODFW, working in cooperation with the WLC-TRT, has not yet finalized this assessment and subsequent refinement of the methods and analyses may yield different results.

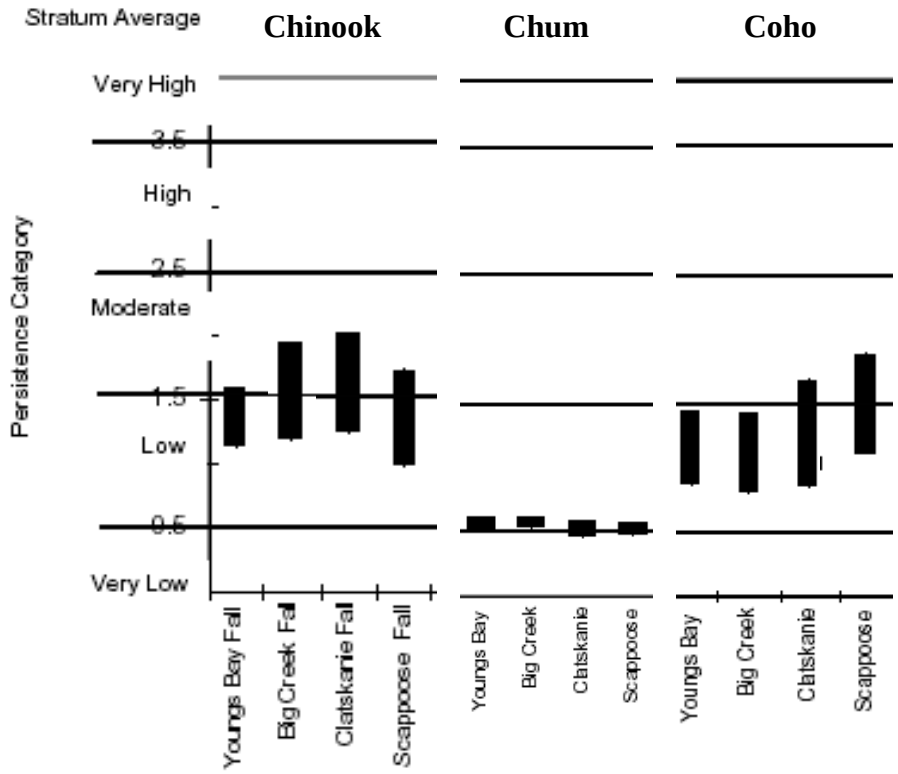

Figure 1. Current viability status of fall Chinook, chum and coho salmon populations in Youngs Bay, Big Creek, Clatskanie River, and Scapoose Creek. Figure adapted from McElhany et al. 2004.

- 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. Indicate the source of these data.

These data are not available.

- 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. (Include estimates of juvenile habitat seeding relative to capacity or natural fish densities, if available).

Natural Chinook spawning escapements in Oregon tributaries of the lower Columbia River have been separated by stock components since 1998 (Table 2.2.2a). No LWR bright fall chinook have been observed during that time; the primary stock components are LRH (includes hatchery and wild produced tule stock fall Chinook) and SAB. Although the proportions of hatchery and wild produced LRH stock are unknown, it is assumed that these tributaries are similar to other lower Columbia tributary fall chinook populations with the majority of LRH spawning returns including a mixture of first generation hatchery-produced fish and domesticated naturally-produced fish.

Natural spawning escapement estimates for fall Chinook in Big Creek and Plympton Creek are shown in Table 2.2.2a, Total returns to Big Creek Hatchery and natural spawner escapement (in Big Creek) is shown in Table 2.2.2b and Fall Chinook abundance indicators for coho and chum in Big Creek is shown in Table 2.2.2c.

Table 2.2.2a. Fall Chinook aggregate natural spawning escapement estimates for select lower Columbia River subbasins (1990-2003), as well as Plympton Creek and Big Creek (1998-2015).

Run Year	Lower Columbia Tributaries [a]	Plympton Creek			Big Creek	
		LRH [b]	BUB [c]		LRH [b]	SAB[d]
1990	2,545	na	na		na	na
1991	1,712	na	na		na	na
1992	2,230	na	na		na	na
1993	2,225	na	na		na	na
1994	5,189	na	na		na	na
1995	3,906	na	na		na	na
1996	2,307	na	na		na	na
1997	2,175	na	na		na	na
1998	1,206	545	0		461	8
1999	2,057	1,085	44		725	6
2000	2,843	1,158	0		1,197	61
2001	11,651	3,908	0		7,227	7
2002	22,685	10,071	0		11,677	0
2003	30,036	9,393	0		19,308	0
2004	12,225	5,060	0		5,970	0
2005	7,464	2,620	0		4,220	0
2006	1,140	391	0		153	0
2007	1,341	451	0		304	0
2008	6,593	1,108	0		4,772	0

2009	5,326	2,118	0		2,028	0
2010	10,895	3,430	0		6,574	87
2011	8,090	3,289	0		2,682	0
2012	7,038	1,819	2 (SAB)		1,396	0
2013	4,818	1,591	12 (SAB)		664	130
2014	6,931	2,745	2 (SAB)		1,442	9
2015	4,325	2,038	0		749	0

[a] Expanded spawning ground surveys for nine Oregon lower Columbia River tributaries; South Fork Klaskanine, North Fork Klaskanine, Lewis and Clark River, Youngs River, Bear Creek, Big Creek, Plympton Creek, Gnat Creek, and Clatskanie River. Numbers include jacks (Source: WDFW Fall Chinook Big Sheets).
[b] LRH = Lower River Hatchery stock.
[c] BUB = Bonneville Upriver Bright stock.
[d] SAB = Select Area Bright stock.

Table 2.2.2b. Total returns to Big Creek Hatchery and natural spawner escapement (in Big Creek) of Big Creek Hatchery tule fall Chinook, 1992-2015.

Return Year	Big Creek Hatchery Returns	Big Creek Spawner Escapement[a]	Klaskanine Hatchery Returns[b]	Klaskanine Spawner Escapement[a]
1992	4,622	NA	8	
1993	3,478	NA	35	
1994	7,918	NA	12	
1995	6,173	NA	8	
1996	7,987	NA	0	
1997	5,028	NA	0	
1998	3,991	461	0	
1999	6,467	725	17	na
2000	2,363	1,197	12	2
2001	16,596	7,227	7	0
2002	20,278	11,677	0	0
2003	16,785	19,308	10	0
2004	8,578	5,970	6	0
2005	5,262	4,220	129	71
2006	2,125	153	0	0
2007	3,392	304	0	0
2008	8,792	4,772	0	0
2009	5,392	2,028	0	101
2010	8,141	6,574	0	0
2011	8,031	2,682	137	185
2012	5,621	1,396	2575	1,347
2013	2,810	664	726	323
2014	6,627	1,442	75	412

2015	5,556	749	647	328

[a] Prior to 1998, estimates of natural spawner escapements were not made. Escapement estimates are primarily comprised of hatchery fish, but may include some naturally produced fish, including jacks (source: WDFW Big Sheets). Klaskanine includes both North and South Forks.

[b]2010 was the first release of tule fall Chinook from Klaskanine Hatchery. Chinook that returned to Klaskanine Hatchery during 1992-2010 may have been stray fish of either natural- or hatchery-origin fish or combination of both. Returns to Klaskanine Hatchery include both Big Creek and Klaskanine stock tule Chinook (source: ODFW HMIS).

Table 2.2.2c. Chum and coho salmon escapement estimates in Big Creek, 1990-2011.

Run Year	Chum Big Creek Hatchery Trap	Coho Big Creek[a] (fish/mile)
1990	10	0.0
1991	3	0.0
1992	2	0.7
1993	1	0.7
1994	6	1.4
1995	0	0.0
1996	0	0.0
1997	3	0.0
1998	3	0.0
1999	0	0.0
2000	0	0.0
2001	4	0.0
2002	0	10.0
2003	27	1.4
2004	24	0.0
2005	9	Not available
2006	192	4.3
2007	1	0.0
2008	3	0.0
2009	22	0.0
2010	23	0.0
2011	4	Not available

[a]Escapement estimates represent standard survey fish per mile peak counts; estimates from 2002-2011 represent primarily wild fish (some unmarked hatchery fish included) while pre-2000 estimates include both hatchery and wild fish, of which, many are hatchery fish. Source: OASIS

- 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.

Proportions of hatchery coho in natural spawning escapements in lower Columbia tributaries are summarized in Table 2.2.2d. It is likely that naturally-produced coho in the Youngs River and Big Creek are very similar to the hatchery-produced fish due to many years of coho hatchery production in the area. Although the ODFW chum introduction program at Big Creek began with a fry release into Big Creek in 2011, the release groups

were not adipose fin clipped until 2015. Returns from the 2015 brood year will begin in the Fall 2018. A small number of hatchery chum salmon are expected to be present in Oregon tributaries of the lower Columbia because of the new reintroduction program and the ongoing Lewis and Grays River hatchery chum programs on the Washington side of the Columbia River. Proportions of hatchery origin and wild origin chum are not currently available.

Table 2.2.2d. Estimated percent of hatchery coho in the natural spawning escapement for select Oregon lower Columbia tributaries, 1999-2015 run years.

Year	Youngs River	Big Creek	Clatskanie River	Scappoose River
1999				7%
2000	49%	49%		9%
2001	99%	92%	17%	20%
2002	86%	90%	55%	0%
2003	86%	40%	0%	10%
2004	86%	70%	0%	8%
2005	75%	36%	1%	0%
2006	84%	n.a.	10%	5%
2007	40%	50%	48%	0%
2008	22%	15%	0%	0%
2009	92%	54%	15%	0%
2010	61%	30%	9%	0%
2011	66%	52%	3%	0%
2012	47%	22%	10%	0%
2013	n.s.	n.s.	37%	0%
2014	n.s.	n.s.	12%	0%
2015 [a]	*n.s.*	*n.s.*	*9%*	*0%*

[a] = Preliminary results.
n.a. = Not available. Due to stream and/or weather conditions, no spawning surveys met criteria for inclusion in abundance and pHOS estimate.
n.s. = Starting in 2013 this population is no longer sampled for abundance and pHOS estimation.

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 (see "Attachment 1" for definition of "take").

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

Incidental take of naturally-produced lower Columbia River Chinook, Columbia River chum, or Columbia River coho may occur through activities associated with adult broodstock collection for the Big Creek coho salmon program. Broodstock are collected via volitional return of adults to the fish trap at the Big Creek Hatchery. Listed fish may enter the trap while the trap is open to receiving fish. However, the presence of listed

salmonids at the point of collection during the timing of annual broodstock collection is low, thereby minimizing incidental take of listed species. Furthermore, any incidental take is expected to be minimized as a result of the broodstock collection methods described in Sections 6 and 7.

Only adipose fin clipped coho are retained for broodstock. Any wild or listed fish are transported upstream of the hatchery and returned to Big Creek to spawn naturally. Additionally, any adult hatchery coho salmon collected in excess of annual broodstock needs are used for one of the following purposes: stream enrichment, sold to a fish buyer, donated to a food bank, or processed into fish food or fertilizer. No excess broodstock are returned to the river and allowed to spawn naturally.

Chum salmon enter the hatchery facility periodically during coho broodstock collection. The chum are transported to Little Big Creek where habitat is most suitable for chum production.

Incidental take of juvenile lower Columbia River Chinook, Columbia River chum, or Columbia River coho is not expected to occur through activities associated with rearing, acclimation, and release at the Big Creek Hatchery. There may be competition between hatchery released smolts and naturally-produced smolts in Big Creek, or predation, however, these effects have not been quantified. Interaction between hatchery coho smolts and wild juveniles is minimized by release strategies which promote rapid emigration.

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

Wild coho need to enter the hatchery trap for passage to natural spawning areas in Big Creek upstream of the hatchery. Handling (i.e. capture, transport and release) of wild coho at the hatchery from 2006-2015 has ranged from 168 to 644 adults. Not all of the wild coho were handled during the time when hatchery coho broodstock were collected. Some were handled and passed after the hatchery broodstock collection period had ended.

Wild chum enter the hatchery in the late fall and early winter in some years. The number of chum handled (i.e. capture, transport and release) has ranged from 1 to 192 during 2006-2015. Only a portion of the chum run enters the hatchery while coho broodstock is being collected.

Table 2.2.3. Number of unmarked coho, steelhead, and chum captured at Big Creek Hatchery

Return Year	Tule Chinook	Unmarked Coho	Unmarked Steelhead	Chum
2006-07	-	252	84	192
2007-08	-	225	65	1
2008-09	-	246	57	3
2009-10	-	515	17	22
2010-11	8	275	85	23
2011-12	15	168	94	4
2012-13	-	215	79	37
2013-14	-	251	25	15
2014-15	-	644	26	135
Data Source: HMS; hatchery files				

- 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).

Projected annual take estimates for Lower Columbia ESUs are provided in Table 2.2.3.

Table 2.2.3. Estimated annual take of lower Columbia River listed salmonid ESUs based on typical hatchery operations[a].

Action	Lower Columbia Chinook		Columbia Chum		Lower Columbia Coho	
	Life stage[b]	Estimated Annual take	Life stage[b]	Estimated Annual take	Life stage[b]	Estimated Annual take
Observe or harass	A	0	A	0	A	0
Collect for transport	A	0	A	0	A	0
Capture, handle, and release	A	100	A	50	A	250
Capture, handle, tag/mark/tissue sample, and release	A	0	A	0	A	0
Capture and remove (e.g., brookstock)	A	0	A	0	A	0
Intentional lethal take	A	0	A	0	A	0

Unintentional lethal take	A, J	0	A, J	0	A, J	0
Other take (specify)	A, J	0	A, J	0	A, J	0

[a] Data includes values for Big Creek Hatchery only.
[b] A = Adult, J = Juvenile.

- 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.

All of Big Creek Hatchery coho are marked with an adipose fin clip, thus allowing for easy identification of wild fish. Only marked coho are retained for broodstock. Any unmarked fish entering the trap are loaded into a tanker truck and transported upstream and released. In the future, if the handling of wild fish is considered above the take levels, wild fish passage and handling alternatives should be implemented, as identified in Issue 2 and detailed in Alternative 2 and Reform/Investment 3 of this HGMP.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

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

The Big Creek coho salmon program operates in accordance with the ODFW Hatchery Management Policy, the Northwest Power and Conservation Council Annual Production Review Report (NPPC document 99-15), the Lower Columbia Salmon and Steelhead Recovery and Subbasin Plan (LCFRB 2004), the Lower Columbia River and Estuary Bi-State Subbasin Plan (LCREP 2004), and ODFW Native Fish Conservation Policy. The conservation plans developed under the Native Conservation Policy will provide guidance for hatchery programs within the associated Species Management Unit (SMU).

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

Mitchell Act
US v. Oregon
Oregon Division of State Lands submerged land lease(s)

3.3) Relationship to harvest objectives.

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve run years (2003-2014), if available. Also provide estimated future harvest rates on fish propagated by the program, and on listed fish that may be taken while harvesting program fish.

This program is managed to provide coho salmon to supplement harvest in ocean and Columbia River commercial and sport fisheries. The program serves to help mitigate for lost salmon production due to habitat loss and degradation in the Columbia River Basin. Analysis of recoveries of coded-wire tagged Big Creek Hatchery coho salmon indicates fishery contribution by this program is greatest in Oregon recreational and commercial fisheries (Table 3.3.1a).

Big Creek coho are harvested in fall commercial and recreational Columbia River fisheries. Based on coded-wire tag recoveries for the coho released on station, the estimated harvest of Big Creek coho for the 2000-2011 brood year releases has ranged from 1,073 (2001 brood year) to 15,153 (2011 brood year) in the commercial fisheries and 312 (2008 brood year) to 8,873 (2011 brood year) in the recreational fisheries. The estimated number returning to the hatchery ranged from a low of 1,558 for the 2009 brood year to a high of 13,852 for the returns from 2011 brood year.

Twenty-four production CWT groups were released directly from Big Creek Hatchery between 2002 and 2013. The smolt-to-adult survival averaged 1.88% (Table 1.12b and Table 11.1.1) with commercial fisheries, recreational fisheries, and escapement accounting for 33%, 21%, and 46% of all adult returns, respectively (Table 3.3.1b).

Table 3.3.1a. Percent distribution of coded-wire tagged Big Creek coho recoveries in fisheries, 2000-2011 brood years. Escapement is not included in the percentages.

Fishery Type		BC	WA	OR	CA	Total
COMMERCIAL	Ocean	0.00%	0.95%	0.86%	0.00%	1.82%
	Freshwater	0.00%	0.00%	58.68%	0.01%	58.69%
	Total	0.00%	0.95%	59.54%	0.01%	60.51%
RECREATIONAL	Ocean	0.16%	10.20%	15.23%	0.60%	26.19%
	Freshwater	0.00%	3.63%	9.67%	0.00%	13.30%
	Total	0.16%	13.83%	24.90%	0.60%	39.49%

Source: Regional Mark Information System database (RMIS)

Table 3.3.1b Average annual harvest or return and percent contribution in regional fisheries of Big Creek Hatchery coho (24 CWT release groups), 2000-2011 brood years.

Recovery Area	Harvest	Percent
Commercial Fishery		
Ocean	379	1.0%
Freshwater	3,504	31.8%
Total	3,883	**32.8%**
Recreational Fishery		
Ocean	1,639	14.2%
Freshwater	834	7.2%
Total	2,473	**21.4%**
Escapement		
Total	5,424	45.7%

Source: Regional Mark Information System database (RMIS)

3.4) Relationship to habitat protection and recovery strategies.

Natural production in Big Creek is likely to be limited by factors such as: water quantity, water quality, sedimentation, stream substrate, cover, and barriers to fish passage. No single entity is responsible for habitat protection and recovery in the Lower Columbia Basin and its tributaries. Oregon Department of Fish and Wildlife, Oregon Department of Forestry, the Lower Columbia River Estuary Partnership, and numerous regional, state, and local organizations have interest in habitat protection in the region. Habitat conditions in Big Creek are considered to be fair to good. Habitat protection and recovery strategies were developed in the draft Lower Columbia River and Estuary Bi-State Subbasin Plan (LCREP 2004). The Big Creek coho salmon program is consistent with these habitat protection and recovery strategies.

3.5) Ecological interactions.

(1) Species that could negatively impact the program include:

- Avian predators, such as great blue herons, Caspian terns, cormorants, and gulls,
- Mammalian predators such as river otters, harbor seals, or sea lions,
- Introduced fish species such as American Shad, Walleye, Smallmouth Bass, and Channel Catfish,
- Northern Pikeminnow,
- Out-of-basin hatchery salmonid releases,
- Known or unknown aquatic non-indigenous animals and plants.

The majority of the preceding species list can be characterized as predators of juvenile salmonids, which may negatively affect Big Creek coho salmon juvenile survival after release. In recent years, Caspian terns (*Sterna caspia*) have colonized the Columbia River estuary; the colony currently represents the largest in North America. Recent estimates of

annual Caspian tern predation on salmonid smolts have been as high as about 25 million (Roby et al. 1998). Caspian tern predation is highest on large smolts, such as steelhead or coho that spend 1-2 years rearing in freshwater; predation is lower on ocean-type salmonids such as fall Chinook and chum salmon that emigrate as sub-yearlings. Northern Pikeminnow (*Ptychocheilus oregonensis*) have been estimated to annually consume millions of juvenile salmonids in the lower Columbia River; most Northern Pikeminnow predation is thought to occur downstream of dams. Pikeminnow abundance in the Columbia River estuary is likely low; therefore, Pikeminnow effects are expected to be minimal. Walleye (*Sander vitreus*), Smallmouth Bass (*Micropterus dolomeiui*), and Channel Catfish (*Ictalurus punctatus*) have been estimated to consume substantial numbers of emigrating juvenile salmonids; effects of these species is thought to be highest around dams and throughout impounded reaches of the Columbia River. Like Pikeminnow, their abundance in the Columbia River estuary is thought to be low; thus, their predation effects in the lower Columbia River and the estuary should be minimal.

River otters (*Lutra canadensis*) are present in the lower Columbia region and may represent a substantial predation source on juvenile salmonids. Harbor seals (*Phoca vitulina*), Steller sea lions (*Eumetopias jubatus*), and California sea lions (*Zalophus californianus*) are commonly observed in the Columbia River estuary. Seals and sea lions reportedly prey on adult salmonids, although diet studies indicate that other fish species generally comprise the majority of their food. These mammals are often attracted to concentrated fishing effort and can be troublesome to both sport and commercial fishers by taking hooked or net-caught fish before they can be landed.

American Shad (*Alosa sapidissima*) and large out-of-basin hatchery salmonid releases represent potential competitors of juvenile Big Creek coho and may decrease juvenile survival through density dependent competition effects. In the Columbia River estuary, juvenile American shad were described as year-round residents in all areas of the estuary (Bottom et al. 1984). Multiple studies have found overlap in both habitat use and diet items in juvenile American shad and both sub-yearling and yearling salmonids (McCabe et al. 1983, Bottom et al. 1984), suggesting competition for food and space. Additionally, other hatchery fish may be a source of competition for Big Creek coho salmon. The potential exists for large-scale hatchery releases of fry and fingerling ocean-type Chinook salmon to overwhelm the production capacity of estuaries (Lichatowich and McIntyre 1987). Estuaries may be "overgrazed" when large numbers of ocean-type juveniles enter the estuary en masse (Reimers 1973, Healey 1991). Food availability may be negatively affected by the temporal and spatial overlap of juvenile salmonids from different locations; competition for prey may develop when large releases of hatchery salmonids enter the estuary (Bisbal and McConnaha 1998), although this issue remains unresolved (Lichatowich 1993 as cited in Williams et al. 2000).

Aquatic non-indigenous species introductions in the lower Columbia River represent permanent alterations of the biological integrity of the ecosystem for numerous reasons: impacts of introduced species are unpredictable, introduced species alter food web dynamics, and introduced species are a conduit for diseases and parasites (Waldeck et al. 2003). Significant changes in estuary faunal and floral communities have occurred through species introductions, but, for the most part, the effects of these species introductions have

not been assessed. Several nonnative invertebrate species have expanded their populations dramatically since introduction, particularly the Asian bivalve, *Corbicula fluminea*. Additionally, ecosystem effects of non-indigenous aquatic plants are a concern for many resource managers. Of particular interest in the Columbia River estuary and lower mainstem are four plants considered noxious weeds: purple loosestrife (*Lythrum salicaria*), Eurasian water milfoil (*Myriophyllum spicatum*), parrot feather (*Myriophyllum aquaticum*), and Brazilian elodea (*Egeria densa*). Effects of these non-indigenous species on Big Creek Coho Salmon are unknown.

(2) Species that could be negatively impacted by the program include:

- Lower Columbia River Chinook,
- Lower Columbia River Chum,
- Lower Columbia River Coho,
- Out-of-basin wild salmonids using the Columbia River estuary,

Wild juvenile salmonids using the Columbia River estuary may be affected by releases of Big Creek coho salmon smolts. However, the hatchery coho are released as yearling smolts that are expected to promptly out-migrate through Big Creek and the lower Columbia River estuary with a minimum of ecological interaction with other species. The influence of these hatchery juveniles on predatory behavior in the lower Columbia is unknown. Some researchers purport that releases of hatchery juveniles in general attract predators, thereby increasing predation on wild juvenile salmonids, while other researchers maintain that releases of hatchery fish may overwhelm predators, thereby providing a competitive advantage to wild juvenile salmonids that have better predator avoidance capability than hatchery fish.

As adults, Big Creek coho salmon return at a time of the year when adult chum are not usually present but overlap the run timing of other lower Columbia River fall Chinook and coho salmon. However, as discussed in Section 2, the abundance of wild fall Chinook, chum, and coho in Big Creek is thought to be low and thus ecological interactions with wild adult salmonids should be minimal. And all hatchery-origin coho adults are captured in hatchery traps and can't migrate to natural spawning ground above the hatchery barrier.

(3) Species that could positively impact the program: This include any hatchery or wild salmonid that dies or is deposited within the subbasin since decaying carcasses maintain productivity in freshwater stream systems. Passage of unmarked coho above Big Creek Hatchery may help maintain some of the nutrient load historically recycled to the basin by returning adults.

(4) Species that may be positively impacted through the program: include any freshwater or marine species that depend on salmonids as a nutrient or food base. Pacific salmon carcasses are important for nutrient input back to freshwater streams (Cederholm et al. 1999). Many species are known to utilize juvenile and adult salmon as a nutrient food base (Groot and Margolis 1991; McNeil and Himsworth 1980). Declines in wild salmonid populations during the last few decades could reduce overall ecosystem productivity. Hatchery production, passage of unmarked fish above hatcheries, and carcass placement in the upper watershed areas of other regional area streams without hatcheries has the

potential for maintaining the population dynamics of predator-prey relationships and community ecology during low productivity and shifting climatic cycles when natural returns are reduced. This program likely provides a net gain in nutrient load to Big Creek downstream of Big Creek Hatchery and a net reduction for areas upstream. The nutrient load in other area streams may be maintained by carcass placement of Big Creek Hatchery coho.

SECTION 4. WATER SOURCE

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

The water source at Big Creek Hatchery comes from Big Creek, Mill Creek, and upper and lower natural springs. The facility has water right permits to withdraw water from these sources. The water meets or exceeds the recommended IHOT water quality guidelines for temperature, ammonia, carbon dioxide, chlorine, pH, copper, dissolved oxygen, hydrogen sulfide, dissolved nitrogen, iron, and zinc. The water supply is protected by flow alarms at the intake(s) and the head box. At Big Creek Hatchery, seasonal flows limit production during July-September.

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 facility operates within the limitations established in its National Pollution Discharge Elimination System (NPDES) 300J permit. Water Intake screening at Big Creek Hatchery comply with the NOAA Fisheries screening criteria.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Hatchery-origin adult coho salmon are collected in a trap on Big Creek at river mile 3.3 at Big Creek Hatchery. The adult holding area consists of a large upper pond and a lower pond divided into 7 sections with a total capacity of about 10,000 fish depending on the species. Coho are held only in the lower pond.

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

The transfer of fish on station is conducted using a distribution box, irrigation pipe and a gas powered pump. All off-station transfers are done with the use of a large liberation truck. Additional information is provided in Table 5.2.

Table 5.2. Fish transportation facilities used at Big Creek Hatchery.

Equipment type	Capacity (gallons)	Supplemental Oxygen (y/n)	Normal transit time	Chemicals used
Tank	250-1000	Y	Varied	None

5.3) Broodstock holding and spawning facilities.

The adult holding area consists of a large upper pond and a lower pond at Big Creek Hatchery divided into 7 sections with a total capacity of about 10,000 fish depending on the species. Coho are held only in the lower pond. The dimensions of the lower pond are 80' x 29.5' x 3', with a working volume of 6,301 cubic feet. Flow through the lower pond is 15-20 cfs.

5.4) Incubation facilities.

Egg incubation at Big Creek Hatchery is done in one deep trough for eyeing, and six vertical incubation trays for hatching. Additional information is provided in Table 5.4. At Big Creek Hatchery, incubation water can be heated or chilled to approximate natural water temperature profiles. Temperature is checked daily using a digital thermometer and held constant at 47° F until the eyed stage. Dissolved oxygen is not monitored, but remains between 10-7 ppm.

Table 5.4. Incubation facilities for coho at Big Creek Hatchery.

Incubator Type	Units (number)	Flow (gpm)	Loading-Eyeing (eggs/unit)	Loading-Hatching (eggs/unit)
Deep Troughs	1	10/12	100,000 eggs/section 8-10 sections/trough	NA (verticals used for hatching)
Vertical Stack Incubators	6	5	NA (deeps used for hatching)	8,000 eggs/tray 15 trays/stack

5.5) Rearing facilities.

For Big Creek Hatchery coho, initial rearing (prior to mass marking) is done in three concrete raceways. After mass marking, rearing is distributed among five concrete raceways and one pond (pond 31). Additional information is provided in Table 5.5.

Table 5.5. Rearing facilities for coho at Big Creek Hatchery.

Number of ponds	Pond type	Volume (cu.ft)	Length (ft)	Width (ft)	Depth (ft)	Max flow index	Max density index
5	Concrete Raceways	4,800	80	20	3	400-750 gpm	72,000 fish/raceway
1	Concrete Pond	11,400	76	30	5	400-750 gpm	175,000 fish

5.6) Acclimation/release facilities.

Acclimation facilities at Big Creek Hatchery are the same as those used for rearing, as described in Section 5.5.

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

No incidences of this nature have occurred in the past 15 years.

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

No listed natural fish is reared under this coho program. Therefore, it is unlikely that system failure will affect the ESA-listed species. However, to prevent the transmission of diseases, adult fish, eggs and fry are treated as per prescriptions written by ODFW pathologists. Culled eggs and dead fry are frozen and disposed of in a manner that prevents transmission of disease to the receiving watershed. To prevent the loss of any fish of this program, alarms are installed in all functions critical to the operations. The alarm system will notify the staff of any emergency situations at the facility. Also, the facility is staffed full-time to assure the security of fish stocks on-site.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source.

Broodstock for the Big Creek Hatchery coho program are collected from hatchery adult returns trapped at Big Creek Hatchery.

6.2) Supporting information.

6.2.1) History.

The broodstock was founded in 1938 from adult coho trapped at Big Creek. Transfers into this stock occurred in 1994 and 1951 from the Klaskanine Hatchery; in 1970 from Sandy Hatchery; and in 1984 from the Bonneville Hatchery. Otherwise all broodstock collection occurred at Big Creek. Historically hatchery fish were not marked so it is not certain how many wild fish may have been retained as broodstock. Very little natural spawning currently occurs in Big Creek and it is likely that few, if any wild fish have been included in the broodstock since the 1970s. Currently, all hatchery-origin coho are mass marked and only hatchery-origin fish are collected for broodstock.

6.2.2) Annual size.

The annual broodstock collection size is 1,500 adults (750 females and 750 males). These adult numbers are required for the 2.2 million program egg production for both Big Creek coho and SAFE coho programs.

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

No natural fish are incorporated into broodstock, and there is no future plan to include natural fish in the broodstock. All unmarked fish are released back into Big Creek.

6.2.4) Genetic or ecological differences.

Any genetic or ecological differences between Big Creek hatchery coho stock and naturally produced wild coho is assumed to be due to stock transfers and mixing and domestication since the program started. These differences are likely to be minimal since coho transfers have been rare occurrences at Big Creek Hatchery.

6.2.5) Reasons for choosing.

This broodstock was selected because it originated from the local stream, and thus maintaining the biological characteristics of the local coho population.

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

No listed natural fish are selected for broodstock. Any unmarked coho collected in adult traps are transported and released upstream of the hatchery.

SECTION 7. BROODSTOCK COLLECTION

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

Returning adults are collected for broodstock.

7.2) Collection or sampling design.

All marked adults that volitionally enter the trap at Big Creek Hatchery are collected throughout the run period. Adults are selected randomly from the available fish at a 1:1 ratio (female : male) for broodstock. Beginning and ending dates of collection and spawning are listed in Table 7.2.

Table 7.2. Big Creek Hatchery coho salmon program adult collection and spawning dates.

Run Year	Collection		Spawning	
	Beginning	Ending	Beginning	Ending
1990	31-Aug	27-Nov	16-Nov	26-Nov
1991	03-Sep	02-Dec	24-Oct	07-Nov
1992	08-Sep	14-Dec	16-Nov	30-Nov
1993	03-Sep	09-Dec	25-Oct	03-Dec
1994	30-Aug	14-Dec	02-Nov	10-Nov
1995	21-Aug	12-Dec	24-Oct	22-Nov
1996	03-Sep	14-Nov	23-Oct	05-Nov
1997	13-Aug	03-Dec	21-Oct	28-Oct
1998	04-Sep	23-Nov	27-Oct	10-Nov
1999	03-Sep	19-Nov	27-Oct	09-Nov
2000	14-Aug	27-Dec	25-Oct	07-Nov
2001	29-Aug	16-Nov	23-Oct	30-Oct
2002	09-Sep	09-Jan	22-Oct	29-Oct
2003	05-Sep	18-Dec	18-Sep	04-Dec
2004	03-Sep	28-Dec	04-Oct	14-Dec
2005	09-Sep	21-Dec	07-Oct	06-Dec
2006	07-Sep	18-Dec	09-Oct	18-Dec
2007	06-Sep	11-Dec	09-Oct	11-Dec
2008	03-Sep	30-Dec	24-Oct	05-Dec
2009	03-Sep	02-Dec	21-Oct	20-Nov
2010	02-Sep	20-Dec	17-Oct	17-Nov
2011	02-Sep	29-Nov	17-Oct	22-Nov
2012	05-Sep	26-Nov	17-Oct	26-Nov
2013	09-Sep	24-Dec	12-Sep	21-Nov
2014	08-Sep	08-Jan	22-Sep	24-Nov
2015	08-Sep	02-Dec	14-Oct	13-Nov

Source: ODFW HMS database.

7.3) Identity.

Big Creek Hatchery coho are 100% mass marked with an adipose fin clip that allows them to be easily identified from listed natural coho. CWT recovery data indicates the majority (on average, 79%) of hatchery coho used for broodstock originated from Big Creek Hatchery on-station releases. About 20% are from Select Area releases of Big Creek stock and <1% are from Tanner Creek and upriver hatchery coho stocks.

7.4) Proposed number to be collected:

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

The proposed number of maximum broodstock collection is 750 females and 750 males (including broodstock for SAFE coho program). Beginning with brood year 2016, the preferred spawning ratio will be 1:1 (female to male). All marked coho entering the trap

are collected and scanned for CWT's to maximize the recovery of CWT information for this stock.

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

Broodstock collection levels for 1992-2015 are included in Table 7.4.2 on the next page.

Table 7.4.2. Disposition of coho collected in the Big Creek Hatchery trap, brood years 1992-2015.

Brood Year	Collected			Retained for Broodstock		Spawned		Released			Surplus			Mortality		
	Females	Males	Jacks	Females	Males	Females	Males	Females	Males	Jacks	Females	Males	Jacks	Females	Males	Jacks
1992	2,682	3,009	77	2,214	N/A	2,207	N/A	0	0	0	130	2,825	65	338	179	1
1993	302	393	45	216	163	216	163	0	0	0	48	190	43	38	40	2
1994	2,150	2,464	32	298	186	295	183	0	0	0	1,654	2,234	24	198	44	8
1995	1,511	1,697	166	826	302	1,045	396	0	0	0	331	1,249	159	354	146	7
1996	1,359	1,429	138	743	371	742	369	0	0	0	296	860	125	320	198	13
1997	1,954	2,044	112	578	319	567	310	0	0	0	1,071	1,604	102	305	121	10
1998	1,002	945	85	292	161	292	151	0	0	0	668	774	64	42	10	21
1999	750	934	424	611	353	612	306	0	0	0	113	556	392	26	25	32
2000	2,091	1,943	2,428	431	226	416	208	6	11	1	1,475	1,615	2,419	179	91	8
2001	5,121	4,926	1,266	309	190	276	136	37	59	3	4,519	4,552	1,260	256	125	3
2002	3,486	4,879	1,938	262	131	243	118	20	26	27	2,580	4,152	1,897	624	570	14
2003	4,273	3,673	972	279	170	278	168	161	152	18	3,521	3,125	919	312	226	35
2004	1,848	1,694	1,498	277	140	259	132	44	68	17	1,337	1,328	1,460	190	158	21
2005	3,382	3,173	704	244	142	242	139	91	89	21	2,742	2,769	675	305	173	8
2006	3,108	3,067	1,228	705	402	669	337	105	120	27	1,944	2,239	1,197	354	306	4
2007	2,006	1,932	697	624	326	618	307	113	99	13	1,166	1,426	677	103	82	7
2008	2,168	1,922	1,863	1,250	752	575	72	106	123	17	666	958	1,863	146	89	0
2009	2,846	2,973	731	683	352	675	337	222	265	28	1,901	2,309	689	40	47	14
2010	2,383	1,878	571	901	428	882	419	125	144	6	1,195	1,197	563	162	109	2
2011	1,194	793	657	666	379	604	268	73	72	23	428	302	657	27	40	0
2012	916	703	1,772	592	235	633	262	83	105	27	182	316	1,688	59	47	57
2013	2,657	2,002	3,235	892	546	611	306	106	116	29	1,391	1,157	3,202	268	183	1
2014	10,704	8,036	1,376	1,876	1,329	771	398	292	314	38	7,455	5,898	1,323	1,081	494	16
2015	1,428	1,047	281	1,076	554	991	395	35	53	0	186	258	281	131	182	0

Source: ODFW HMS database.

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

All hatchery fish that enter the hatchery trap are collected and are either selected for broodstock or killed as surplus (Table 7.4.2). Fish in excess of what is needed for broodstock are sold to a competitive bidder if quality is good for human consumption. Some are also donated to Oregon food banks. Fish unsuitable for these programs will be used for stream enrichment, buried or taken to landfill for disposal. All hatchery coho carcasses that are used for stream enrichment are marked to prevent any confusion with naturally spawned fish during spawning ground surveys. Specific criteria and guidelines for operation of the stream enrichment program are identified in an MOU between ODFW and DEQ. Currently, excess Big Creek Hatchery coho are being used for stream enrichment in many streams without hatcheries. Carcass placement is not currently being conducted in Big Creek or the North Fork Klaskanine River since unmarked coho and steelhead are being passed upstream which will provide some enrichment to the upper sections of these habitats. Broodstock mortalities are transported to the Clatsop County landfill for disposal.

7.6) Fish transportation and holding methods.

The fish transportation equipment used at Big Creek Hatchery is described in Section 5.2, and holding ponds in Section 5.3. IHOT guidelines for transportation and holding flows are followed in this program. Big Creek coho eggs are incubated, reared and released on site. Eggs are also shipped to another facility for the SAFE coho program.

7.7) Describe fish health maintenance and sanitation procedures applied.

ODFW Fish Health Management Policy, Integrated Hatchery Operations Team (IHOT), Pacific Northwest Fish Health Protection committee (PNFHPC) guidelines are followed for broodstock fish health inspection, treatment, transfer of eggs or adults, broodstock holding, and disposal of carcasses.

7.8) Disposition of carcasses.

Fish in excess of what is needed for broodstock are sold to a competitive bidder if in suitable condition. Some will also go to the food bank if fit for human consumption. Those fish not suitable for these programs will be used for stream enrichment in other area streams, buried, or landfill. All hatchery coho carcasses used for stream enrichment in spawning survey streams are marked to prevent confusion with naturally spawned fish. Specific criteria and guidelines for operation of the stream enrichment program are identified in an MOU between ODFW and DEQ. All mortality is transported to the Clatsop County landfill for disposal.

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.

Hatchery-produced coho salmon are not listed under the federal ESA. The collection trap

is checked daily and any listed fish trapped are released back into Big Creek with minimum stress. No listed natural fish are taken for Big Creek Hatchery coho salmon program.

SECTION 8. MATING

8.1) Selection method.

Only hatchery-origin fish are used for the broodstock. Males and females that are ripe on a given day are randomly selected for mating.

8.2) Males.

The preferred sex ratio for this program is currently 1:1 (female to male). In the past, the ratio was 2:1 or 3:1. The ratio may change if situation warrants.

8.3) Fertilization.

The preferred fertilization protocol is to take eggs from one female and combine with the milt from a single male. To prevent transmission of diseases, fertilized eggs are disinfected with 1:100 parts of Argentine for 10 minutes prior to incubation.

8.4) Cryopreserved gametes.

Cryopreserved gametes are not used as part of this program.

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

All (100%) broodstock used in this program are hatchery-produced fish and are not listed under the ESA, therefore the mating scheme poses no risk to listed natural fish.

Big Creek Hatchery coho is an isolated harvest program using hatchery stock only, and therefore, it is unlikely that the mating scheme will have any adverse genetic or ecological impacts to listed natural fish. However, to maintain within hatchery-population genetic diversity, adults used for brood are mixed and randomly selected (throughout entire run). Pairs of males and females are mated randomly with a conscious effort made to avoid any bias for size or other external characteristics. Since broodstock is collected throughout the temporal duration of the run, it is believed that this method is sufficiently random to avoid genetic bias within the hatchery program.

SECTION 9. INCUBATION AND REARING

9.1) Incubation:

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

Number eggs taken in the past (1993-2015), egg to fry survival, and fry to smolt survival data are provided in Table 9.1.1.

Table 9.1.1. Egg to fry and fry to smolt survivals of Big Creek Hatchery coho salmon, brood years 1993-2015.

Brood Year	Egg Take	Egg-to-fry survival (%)	Fry-to-Smolt survival (%)
1993	452,336	89.1	96.9
1994	1,483,457	NA	93.6
1995	4,956,110	NA	89.4
1996	1,922,202	85.2	97.6
1997	1,791,467	92.9	98.2
1998	845,949	91.8	97.8
1999	2,101,379	95.8	96.7
2000	1,599,420	91.9	97.8
2001	869,021	84.8	98.2
2002	779,788	86.2	95.9
2003	829,371	85.0	93.8
2004	918,072	86.3	85.7
2005	776,900	86.8	88.6
2006	2,084,385	82.0	90.1
2007	1,794,468	81.7	95.8
2008	2,000,432	77.1	92.5
2009	1,888,292	78.2	98.0
2010	3,138,800	63.3	95.3
2011	1,954,515	77.7	97.0
2012	1,681,800	84.0	96.2
2013	1,677,500	88.5	97.7
2014	2,154,300	86.5	NA
2015	1,744,450	78.4	NA

Source: ODFW Hatchery Management System Database.

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

If eggs are found to be in excess of production goals, it is first determined if any other hatcheries have egg deficits (of stock-13). If not, surplus eggs are destroyed, frozen and disposed of in a manner compliant with the ODFW Fish Health Management Policy and IHOT guidelines.

9.1.3) Loading densities applied during incubation.

IHOT species-specific incubation recommendations are followed for water quality, flows and temperature. Eggs are incubated under conditions that result in equal survival of all segments of the population to ponding. Loading densities during egg incubation are as follows:

Table 9.1.3. Egg incubation facility, flows, and loading density for coho salmon at Big Creek Hatchery.

Incubator Type	Units (number)	Flow (gpm)	Loading-Eyeing (eggs/unit)	Loading-Hatching (eggs/unit)
Deep Troughs	1	10/12	100,000 eggs/section 8-10 sections/trough	NA (verticals used for hatching)
Vertical Stack Incubators	6	5	NA (deeps used for hatching)	8,000 eggs/tray 15 trays/stack

9.1.4) Incubation conditions.

Egg incubation at Big Creek Hatchery is done in one deep trough for eyeing, and six vertical incubation trays for hatching. Eggs are incubated using natal or home stream water. Temperature is checked daily using a digital thermometer and held constant at 47° F until the eyed stage. Dissolved oxygen is not monitored, but remains between 10-7 ppm. Disinfection procedures are implemented during incubation that prevents pathogen transmission between stocks of fish on site and in the receiving stream. Following eye-up stage, eggs are inventoried, and dead or undeveloped eggs removed and disposed of as described in the disease control guidelines.

IHOT species-specific incubation recommendations are followed for water quality, flows and temperature. Eggs are monitored when needed to determine fertilization efficiency and embryonic development. Eggs are incubated under conditions that result in equal survival of all segments of the population to ponding. Families are not incubated individually, but rather may be mixed with other families from the same spawn group. Families among spawning groups are mixed randomly at ponding so that any unintentional rearing differences affect all families equally.

9.1.5) Ponding.

Rearing facilities are described in Section 5.5. Fry are ponded when they are nearly 100% button-up. The procedures used for determining when fry are ponded include visual inspection of the amount of yolk remaining and based on fry reaching a specified number of accumulated temperature units. Prior to ponding, family groups are mixed so that rearing protocols affect all families equally. At Big Creek Hatchery ponding of coho is forced.

9.1.6) Fish health maintenance and monitoring.

Disinfection procedures are implemented during incubation, preventing pathogen

transmission between stocks of fish. Eggs are monitored to determine fertilization efficiency and embryonic development. Following eyed-up stage, eggs are inventoried, and dead or undeveloped eggs are removed and disposed of as described in the disease control guidelines. Dead or culled eggs are discarded in a manner that prevents transmission of diseases to the receiving watershed. ODFW Fish Health Management Policy, IHOT, Pacific Northwest Fish Health Protection committee (PNFHPC) guidelines are followed for fish health inspections.

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

No ESA listed fish are involved in the incubation process of this program. Disinfection procedures are implemented to ensure prevention of disease transfer between stocks. Dead or culled eggs are discarded in a manner that prevents transmission of disease to the receiving watershed.

9.2) Rearing:

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

See Table 9.1.1 for egg to fry, and fry to smolt survival rates of Big Creek Hatchery coho salmon for brood years 1993-2015.

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

For Big Creek Hatchery coho, initial rearing (prior to mass marking) is done in three concrete raceways. The juvenile rearing density and loading guidelines used at the facility are based on: standardized agency guidelines, life-stage specific survival studies conducted at other facilities, staff experience (e.g. trial and error) and other criteria. IHOT standards are followed for: water quality, alarm systems, predator control measures to provide the necessary security for the cultured stock, loading and density.

See Table 5.5 for description of rearing facilities at Big Creek Hatchery. Usually, the rearing density is 72,000 fish per raceway, and 175,000 fish in concrete pond. Flows are normally 400-750 gpm. For Big Creek Hatchery coho, initial rearing (prior to mass marking) is done in three concrete raceways. After mass marking, juveniles are distributed amongst five concrete raceways and one pond (pond 31).

9.2.3) Fish rearing conditions.

At Big Creek Hatchery, rearing temperatures are monitored daily via remote site digital thermometer and computer. Temperatures follow the natural thermograph and range from 33-70 degrees F. Dissolved oxygen is not actively monitored, but remains between 7-10 ppm. Flow through the rearing ponds is 15-20cfs. Settleable solids, unused feed and feces are removed weekly to ensure proper cleanliness of rearing containers. Mortalities are

removed daily. The juvenile rearing density and loading criteria used at the facility are based on standardized agency guidelines, life-stage specific survival studies conducted at other facilities, staff experience (e.g. trial and error) and other criteria.

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.

Feeding rates are followed so that fish size is within 10% of program goal each year. Operator conducts periodic feed quality analysis. Feed is stored under proper conditions as described by IHOT guidelines. The available data on fish growth information is provided below in Table 9.2.4.

Table 9.2.4. Average growth information (fpp) of coho salmon during rearing at Big Creek Hatchery (brood years 2010-2014).

Month	Weight (fpp)
January	909
February	455
March	221
April	134
May	95
June	72
July	51
August	38
September	29
October	26
November	22
December	21
January	19
February	17
March	15
April	14

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

Average monthly fish growth data (fpp) are provided in Table 9.2.4. Energy reserve data are not available.

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

Feeding rates are manipulated so that fish size stay within 10% of the program goal each year. Operator conducts periodic feed quality analysis. Feed is stored under proper conditions as described by IHOT guidelines. The correct amount and type of food is provided to achieve the desired growth rate for the species and life stages being reared. Food type, feeding protocols, and total food conversion efficiency are provided in Table

9.2.6.

Table 9.2.6. Food type, feeding schedule and food conversion of coho salmon reared at Big Creek Hatchery.

Rearing period	Food type	Application schedule (no. feedings/day)	Food Conversion
Jan.-Feb	#0 BVS	8	0.57 – 0.65
Mar.-Apr.	#0,#1,#2 BVS	1	0.66 – 0.74
May-July	#2 BVS, 1.2,1.5 BCF	1	0.77 – 1.48
Aug.-Oct.	1.5,2,2.5 BCF	1	0.64 – 1.68
Nov.-Mar.	2.5 BCF	1	0.86 – 1.13
Apr.-May	2.5,3.0 BCF	1	0.60 – 0.78

BVS = BioVita Starter BCF = BioClark's Fry

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

ODFW Fish Health Management Policy and IHOT fish health guidelines treatment protocols are followed to prevent transmission of diseases between lots of fish on site or transmission or amplification to or within the watershed. Vaccines are NOT used to minimize the use of antimicrobial compounds. The juvenile rearing density and loading criteria at this facility are maintained per standardized agency guidelines, life-stage specific survival studies conducted at other facilities, staff experience (e.g. trial and error) and other criteria. Settleable solids, unused feed and feces are removed from rearing containers weekly to ensure proper cleanliness of rearing containers. Mortalities are removed daily. All equipment is properly disinfected with iodine. Fish health is monitored on regular basis by ODFW fish pathologists, and if requires, fish are treated as per prescriptions written by pathologists.

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

The migratory state of smolts is determined by age, size, behavior, physical appearance and condition factors of smolts. No ATPase studies are conducted.

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

Fish are reared entirely in the hatchery environment using natural waters from Big Creek.

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

The Big Creek hatchery coho salmon (stock 13) is not a part of the ESA listed population, and no listed natural coho is used as broodstock in this program.

SECTION 10. RELEASE

10.1) Proposed fish release levels.

The Big Creek Hatchery coho program currently releases (and plans to release in subsequent years) 535,000 yearling smolts annually at approximately 15 fish/lb into Big Creek. Actual annual on-station releases since 1990 are presented in Table 10.3.

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

Big Creek Hatchery coho smolts are released into Big Creek (regional mark location code: 5F33202 H2 21) at river mile 3.3. Big Creek is a tributary of the Lower Columbia River at approximately river mile 27.

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

The total numbers of Big Creek coho released into Big Creek since 1994 are presented in Table 10.3. Big Creek coho smolts are released as yearling smolts from April 14-May 1 each year.

Table 10.3. Releases of Coho salmon from Big Creek Hatchery.

Release year	Yearling	Avg size (fpp)
1994	526,229	12
1995	593,107	11
1996	603,485	13
1997	595,702	12
1998	561,346	12
1999	525,342	12
2000	543,459	12
2001	537,185	12
2002	540,898	12
2003	537,086	12
2004	516,492	11
2005	506,172	12
2006	527,631	12
2007	529,607	12
2008	559,718	12
2009	540,170	12
2010	516,206	12
2011	538,402	11
2012	532,082	12
2013	571,616	14
2014	537,811	14
2015	537,661	15

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

Approximately 535,000 Big Creek Hatchery coho are volitionally released as yearling smolts each year from April 14 to May 1. After the two week volitional release period (May 1), any remaining smolts are forcibly released. Release dates, tag codes, weights and numbers of tagged fish representing each release group are shown in Table 10.4. For brood years 2012 and 2013, the on-station release group has been represented by one 25k group of ad-CWT fish due to funding constraints.

Table 10.4. Dates, weights, tag codes and numbers of Big Creek stock coho tagged and released, brood years 2000-2011.

Brood Year	Release Date	Tag code	Weight (g)	# CWT Tagged	Total Released
2000	4/1/2002	093242	35.4	26,833	144,690
	5/1/2002	093243	36.8	27,141	396,208
2001	4/1/2003	091929	35.1	27,165	143,574
	5/1/2003	091930	36.8	27,052	393,511
2002	4/1/2004	093724	38.4	26,720	144,839
	5/1/2004	093725	39.0	26,752	372,103
2003	4/1/2005	094125	37.3	26,158	142,898
	5/1/2005	094126	38.5	27,084	363,274
2004	4/11/2006	093703	35.8	28,588	142,120
	5/1/2006	093704	38.2	27,231	385,511
2005	4/15/2007	094431	38.1	26,817	144,007
	5/8/2007	094430	36.8	26,539	385,690
2006	4/15/2008	094555	38.3	26,093	141,789
	5/10/2008	094554	37.8	25,969	417,928
2007	4/15/2009	094648	37.2	26,579	145,738
	5/2/2009	094530	36.9	26,803	394,431
2008	4/1/2010	090252	37.7	25,478	144,188
	4/27/2010	090253	37.3	25,180	372,018
2009	4/12/2011	094131	39.6	26,929	160,512
	4/30/2011	094130	39.2	27,195	377,890
2010	4/13/2012	094203	35.6	27,247	148,082
	4/30/2012	094204	37.7	27,264	384,000
2011	3/27/2013	094311	30.0	28,015	166,100
	4/23/2013	094310	32.2	27,981	405,516
2012	4/24/2014	090369	33.6	26,612	537,811
2013	4/13/2015	090370	30.1	25,534	537,661

10.5) Fish transportation procedures, if applicable.

Big Creek Hatchery coho are released at the hatchery where they are reared; no additional transportation is used.

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

No acclimation; all fish are reared using natural water from Big Creek from hatching to smolt stage. Fish are released on site.

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

All (100%) of Big Creek Hatchery coho are marked with an adipose fin clip. A component of each release is also marked with coded wire tags.

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

Any culling in this program occurs when the fish are at the eyed egg stage or during mass marking. The culled eggs/fish are either donated to other programs or destroyed. See Section 9.1.2.

10.9) Fish health certification procedures applied pre-release.

All fish are examined to determine the presence of any "reportable pathogens" as defined in the PNFHPC disease control guidelines, within three weeks prior to release. Only healthy and certified fish are released and no diseased fish are released into the state's water.

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

Since these are a local stock of Big Creek, all fish will be released on site during 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.

To minimize interaction with wild species, the hatchery coho are released as active smolts that will promptly out-migrate to the sea.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

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

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

Many policies within the hatchery program are already in place to minimize and avoid risks to ESA listed species. Thus, much of the monitoring and evaluation of the Big Creek

Hatchery program are incorporated into routine ODFW operations within the Hatchery, Fish Pathology, and Fish Management programs. See Section 1.10 for a listing of monitoring and evaluation efforts associated with each of the performance indicators for the Big Creek Hatchery coho program.

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 (NOAA) and staffing (ODFW) are adequately provided to allow implementation of the monitoring and evaluation program.

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.

No adverse effects to listed stocks are anticipated from monitoring of the landed catch and analysis of CWT data.

Table 11.1.1. Number of estimated coded-wire tags and recovery percentages (SAR's) for coded-wire tag releases of coho from Big Creek Hatchery, 2000-2012 brood years.

Brood Year	Tag Code	Number Ad + CWT	Number Released	Number of Coded-Wire Tag Recoveries					Smolt-to-Adult Survival (S		
				Ocean Harvest		Freshwater Harvest					
				COMM	SPORT	COMM	SPORT	ESCAPEMENT	Ocean Harvest	Freshwater Harvest	ESC
2000	093242	26,833	144,690	10	192	303	71	317	0.8	1.4	1.2
	093243	27,141	396,208	16	332	324	104	473	1.3	1.6	1.7
2001	091929	27,165	143,574	2	58	60	8	159	0.2	0.3	0.6
	091930	27,052	393,511	8	106	43	8	186	0.4	0.2	0.7
2002	093724	26,720	144,839		13	99	1	349	0.0	0.4	1.3
	093725	26,752	372,103	2	30	110	3	276	0.1	0.4	1.0
2003	094125	26,158	142,898	4	20	97		84	0.1	0.4	0.3
	094126	27,084	363,274	2	91	325	11	384	0.3	1.2	1.4
2004	093703	28,588	142,120		12	21		35	0.0	0.1	0.1
	093704	27,231	385,511	8	123	73	14	312	0.5	0.3	1.1
2005	094430	26,539	385,690		5	85	20	212	0.0	0.4	0.8
	094431	26,817	144,007			45	6	94	0.0	0.2	0.4
2006	094554	25,969	417,928	11	118	188	69	299	0.5	1.0	1.1
	094555	26,093	141,789	7	48	41	27	76	0.2	0.3	0.3
2007	094530	26,803	394,431		13	64	14	165	0.0	0.3	0.6
	094648	26,579	145,738	5	21	43	3	141	0.1	0.2	0.5
2008	090252	25,478	144,188			123	3	59	0.0	0.5	0.2
	090253	25,180	372,018		6	72	14	88	0.0	0.3	0.4
2009	094130	27,195	377,890	4	24	59	13	85	0.1	0.3	0.3
	094131	26,929	160,512		8	37	16	64	0.0	0.2	0.2
2010	094203	27,247	148,082		4	110	5	109	0.0	0.4	0.4
	094204	27,264	384,000	1	35	183	45	233	0.1	0.8	0.9
2011	094310	27,981	405,516	17	204	732	228	651	0.8	3.4	2.3
	094311	28,015	166,100	26	250	700	190	765	1.0	3.2	2.7
2012	090369	26,612	537,811		62	38	28	86	0.2	0.2	0.3

Source: Regional Mark Information System database (RMIS)

SECTION 12. RESEARCH

Research is not currently being conducted at Big Creek Hatchery although an evaluation of natural production upstream of the hatchery was initiated in 2005 (see Section 1.16.2; Alternative 3). While ODFW determined that hatchery operations will not adversely affect listed species, additional research at the hatchery and in the stream before and after release may be undertaken to gather more information. Potential projects may include observation of juvenile and adult fish behavior, documenting ecological interactions, assessing ecological and genetic risks, and determining reproductive success of hatchery fish in the stream. Sampling techniques may include snorkeling, underwater video, trapping, spawning surveys, genetic analysis, and radio telemetry.

12.1) Objective or purpose.

NA

12.2) Cooperating and funding agencies.

NA

12.3) Principle investigator or project supervisor and staff.

NA

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

NA

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

NA

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

NA

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

NA

12.8) Level of take of listed fish: number of range or fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2.

NA

12.9) Alternative methods to achieve project objects.

NA

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

NA

12.11) 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.

NA

SECTION 13. ATTACHMENTS AND CITATIONS

Lewis, M. A., C. Mallette, W.M Murray, L.R. Funston, K.E. Taylor. 2002. Oregon Department of Fish and Wildlife, 2002, Annual Stock Assessment- Coded Wire Tag Program (ODFW) 2001 Annual Report. Report to Bonneville Power Administration, Contract No. 00004345, Project No. 198201302.

McElhany, P., T. Backman, C. Busack, S. Kolmes, J. Myers, D. Rawding, A. Steel, C. Steward, T. Whitesel, and C. Willis. 2004. Status evaluation of salmon and steelhead populations in the Willamette and lower Columbia River basins. Willamette/Lower Columbia Technical Recovery Team. NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA.

Waldeck, R.D., M. Sytsma, J. Cordell, and J. Chapman. 2003. Preliminary results from the lower Columbia River aquatic nonindigenous species survey (LCRANS) 2001-2003. Portland State University, 30 pp.

Washington Department of Fish and Wildlife. 2002. Status Report. Columbia River Fish Runs and Fisheries, 1938-2000. July 2002.

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 and Title of Applicant: Scott Patterson, Fish Propagation Program Manager, ODFW

Signature: _____ Date: _____

Table1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: _Coho___ ESU/Population:_____Lower Columbia_____ Activity:_Hatchery Trap_____				
Location of hatchery activity:_Big Creek __ Dates of activity:__Aug-Dec_____ Hatchery program operator:_Alan Meyer_____				
	Annual Take of Listed Fish By Life Stage (Number of Fish)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			≤ 200	
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)				
Listed species affected: _Chum_____ ESU/Population:_____Columbia River_____ Activity:__Hatchery Trap_____				
Location of hatchery activity:___Big Creek __ Dates of activity:___Oct-Dec____ Hatchery program operator:_ Alan Meyer_____				
	Annual Take of Listed Fish By Life Stage (Number of Fish)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			≤ 10	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

[a.] Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.

[b.] Take associated with weir or trapping operations where listed fish are captured and transported for release.

[c.] Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.

[d.] Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.

[e.] Listed fish removed from the wild and collected for use as broodstock.

[f.]. Intentional mortality of listed fish, usually as a result of spawning as broodstock.

[g] Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.

[h] Other takes not identified above as a category.

ATTACHMENT 1.

DEFINITION OF TERMS REFERENCED IN THE HGMP TEMPLATE.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Natural origin recruit (NOR) - See natural fish.

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

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

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

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

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

Stock - (see “Population”).

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

ATTACHMENT 2.

AGE CLASS DESIGNATIONS BY FISH SIZE AND SPECIES FOR SALMONIDS RELEASED FROM HATCHERY FACILITIES.

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

SPECIES/AGE CLASS	SIZE CRITERIA Number of fish/pound	Grams/fish
Chinook Yearling	<=20	>=23
Chinook (Zero) Fingerling	>20 to 150	3 to <23
Chinook Fry	>150 to 900	0.5 to <3
Chinook Unfed Fry	>900	<0.5
Coho Yearling 1/	<20	>=23
Coho Fingerling	>20 to 200	2.3 to <23
Coho Fry	>200 to 900	0.5 to <2.3
Coho Unfed Fry	>900	<0.5
Chum Fed Fry	<=1000	>=0.45
Chum Unfed Fry	>1000	<0.45
Sockeye Yearling 2/	<=20	>=23
Sockeye Fingerling	>20 to 800	0.6 to <23
Sockeye Fall Releases	<150	>2.9
Sockeye Fry	> 800 to 1500	0.3 to <0.6
Sockeye Unfed Fry	>1500	<0.3
Pink Fed Fry	<=1000	>=0.45
Pink Unfed Fry	>1000	<0.45
Steelhead Smolt	<=10	>=45
Steelhead Yearling	<=20	>=23
Steelhead Fingerling	>20 to 150	3 to <23
Steelhead Fry	>150	<3
Cutthroat Trout Yearling	<=20	>=23
Cutthroat Trout Fingerling	>20 to 150	3 to <23
Cutthroat Trout Fry	>150	<3
Trout Legals	<=10	>=45
Trout Fry	>10	<45

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

2/ Sockeye yearlings defined as meeting size criteria and 1 year old.

ADDENDUM A.

PROGRAM EFFECTS ON OTHER (AQUATIC OR TERRESTRIAL) ESA-LISTED POPULATIONS. (ANADROMOUS SALMONID EFFECTS ARE ADDRESSED IN SECTION 2)

A. 1) List all ESA permits or authorizations for USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species associated with the hatchery program.

Section 7 biological opinions, Section 10 permits, 4(d) rules, etc.

A. 2) Describe USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species and habitat that may be affected by hatchery program.

General species description and habitat requirements.
Local population status and habitat use.
Site-specific inventories, surveys, etc.

Columbian White-tailed Deer (*Odocoileus virginianus leucurus*, Endangered Species Delisting Proposed)

Currently, there are 38 Recognized subspecies on *O. virginianus*, The Columbian white-tailed deer (*Odocoileus virginianus leucurus*) is one of the largest terrestrial mammals associated with the Columbia River estuary (NPPC 2002). Preferred habitats on the mainland and on islands exist in the upper Columbia River estuary and within the river corridor (LCFRB 2004).

Status: Declines in the Columbia white-tailed deer populations led to its listing under the Endangered Species Act in 1967. The floodplain and riparian habitat from the Cascade Mountains to the ocean and from the Puget Sound south to the Umpqua River Basin. Once ranged from the western slopes of the Cascade Mountains to the ocean and Puget Sound in Washington southward to the Umpqua River Basin. Habitat modification (farming, logging and commercial and residential development) and over hunting are thought to be the cause of the decline in white-tailed deer numbers (ODFW 2003). The few scattered populations now number 300-500 in the Lower Columbia and 5,000 in Douglas County (LCFRB 2004).

Recent reintroduction of deer has taken place on Crims and Lord Island in the Columbia River. The Crims Island population has become established and 2003 deer were released on Lord Island (LCFRB 2004).

Habitat: The Columbian white-tailed deer are linked closely with riparian habitats. Historically, deer were found throughout the woodlands and bottomlands of the lower Columbia, Cowlitz, Willamette, and Umpqua river basins in Oregon and Washington (LCFRB 2004). Tall shrubs and scattered spruce, alder cottonwood and willows dominated the densely forested habitats associated with white-tailed deer (ODFW 2003). Large numbers of lakes, sloughs, ponds, backwaters, overflow channels and wetlands scattered the habitat.

Columbian White tailed Deer are resident in suitable habitat and show little tendency to wander outside the home range. Preferred habitat in the lower Columbia Subbasin is limiting. Extensive losses of habitat have occurred in the lower Columbia and estuary provinces as a results of dredging, filling, diking, and channelization. The floodplain and lowlands likely were much more heavily forested and historically there were many more lakes, ponds, sloughs, overflow channels, backwaters and wetlands. Between 1850 and 1999, 20,000 acres of tidal swamps (with woody vegetation, 10,000 acres of tidal marshes (with non woody vegetation), and 3,000 acres of tidal flats have been lost along the lower Columbia River (BPA unpub. data).

Conservation Measures: Population numbers have increased due to land acquisition, and protection and improvement of habitat. Protection under the Endangered Species Act has resulted in acquisition, protection, and improvement of habitat, which has allowed the two populations to increase in size. A Recovery Plan was developed for the two populations of Columbian white-tailed deer in 1983. Many of the tasks identified in the Recovery Plan have been implemented. In 1972, the Julia Butler Hansen Refuge for the Columbian White-tailed Deer was established in Wahkiakum County, Washington. In Douglas County, the Bureau of Land Management acquired a large parcel of habitat (the North Bank Habitat Management Area) through a land exchange specifically to benefit the Columbian white-tailed deer; this parcel alone provides over 6000 acres of good habitat for the deer.

Fisher (*Martes pennanti*, Candidate Species)

Status: The west coast population of the fisher was accorded federal candidate status on April 8, 2004. Fishers, found only in North America, occur in the northern coniferous and the mixed forests of Canada and the northern United States. Their range extends from the mountainous areas in the southern Yukon and Labrador Provinces southward to central California and Wyoming, the Great Lakes and Appalachian regions, and New England.

In Oregon, fishers occurred historically throughout the Coastal and Cascade mountains. Currently, the range of the fisher is severely reduced. Despite extensive surveys conducted in forested regions of Oregon, records dating from 1954 to 2001 show that the remaining populations of fishers are restricted to two separate and genetically isolated populations in southwestern Oregon; one in the northern Siskiyou Mountains and one in the southern Cascade Range. The population in the southern Cascades descended from reintroduced fishers that were translocated to Oregon from British Columbia and Minnesota.

The west coast population of the fisher is endangered mainly due to the loss and fragmentation of habitat due to timber harvest, roads, urban development, recreation, and wildfires. Other threats include small population sizes and isolation, predation, and human-caused mortality from vehicle collisions, poaching, and incidental capture and injury.

Habitat: Fishers select forests with high canopy closure, large trees, and a high percentage of conifers. The physical structure of this type of forest provides the fisher with reduced vulnerability to predation and an abundance of prey. The distribution of the fisher is likely limited by elevation and snow depth.

Conservation Measures: In December 2000, the Fish and Wildlife Service (Service) received a petition to list the west coast population of the fisher as an endangered species in Washington, Oregon, and California. The Service concluded that the west coast fisher population was a distinct population segment and was warranted for listing, but precluded by other higher priority listing action, and subsequently placed the species on the federal list of candidates. Now the Service will begin conducting an annual review of the species status and may propose to list the species at a later date. The Service encourages state and federal agencies proposing activities within the historic range of the fisher to give consideration to the fisher during the environmental planning process, especially activities which alter or destroy mature and old growth forests.

Bald Eagle (*Haliaeetus leucocephalus*, Threatened Species – Delisting Proposed)

Status: Bald Eagles were listed as endangered in the conterminous United States under the ESA on March 6, 1967 (32 FR 4001). The population in the Pacific Northwest was later downlisted on February 14, 1978 to threatened. Eagles in the remaining states were subsequently downlisted to threatened on July 12, 1995 (60 FR 36000). Bald eagle populations have rebounded considerably within the last few years, with nearly all recovery goals met for Oregon, Washington, and other regions of the country. On July 6, 1999 the USFWS proposed delisting bald eagles from the ESA. Bald eagles and golden eagles are, and will continue to, be protected under the Bald Eagle and Golden Eagle Protection Act of 1940 (as amended) and the Migratory Bird Treaty.

The northern bald eagle is closely associated with freshwater, estuarine, and marine ecosystems that provide abundant prey and suitable habitat for nesting and communal roosting (Watson et al. 1991). Breeding territories are typically located within one mile of permanent water in predominantly coniferous, uneven-aged stands with old-growth structural components (Anthony et al. 1982, Stalmaster 1987, Anthony and Isaac 1989). Bald eagles winter along ice-free lakes, streams, and rivers where food and perch sites are abundant and the level of human disturbance is low (USFS 1977, Steenhof 1978, Stalmaster 1980). Communal night roosts are used by bald eagles primarily during the winter months. In the Pacific Northwest, communal roosts generally occur in multi-layered mature or old-growth conifer stands that provide protection from weather and human disturbance (Stalmaster and Newman 1979).

Home range size varies greatly according to food abundance and the availability of suitable nest and perch trees (Stalmaster 1987). Favored nest trees are usually the largest tree or snag in a stand that provides an unobstructed view of the surrounding area and a clear flight to and from the nest (Stalmaster 1987). Nest are usually built on limbs just below the crown, with the canopy above providing cover (USFS 1977). Nesting behaviors typically begin in January, followed by egg laying and incubation in February and March (Isaac et al. 1983). Young are reared throughout April, May, and June. Fledging occurs in July and August. Bald eagles are primarily predators but also opportunistic scavengers that feed on a variety of prey including salmon, other fish, small mammals, waterfowl, seabirds, and carrion (Snow 1981). Bald eagles usually forage in large open areas with a wide visual field and suitable perch trees near the food source (USFS 1985).

The bald eagle occurs throughout the United States and Canada. It winters primarily along rivers south of the Canadian border. The historic decline of the bald eagle has been attributed to the loss of feeding and nesting habitat, organochloride pesticide residues, shooting, poisoning, and

electrocution (Snow 1981, USFWS 1986). Human interference has been shown to adversely affect the distribution and behavior of wintering bald eagles (Stalmaster and Newman 1978).
Critical Habitat: Critical habitat for bald eagles has not been formally designated by USFWS.

Northern Spotted Owl (*Strix occidentalis caurina*, Threatened Species)

Status: The northern spotted owl was listed as a threatened species throughout its entire range in June 1990 (55 FR 26114). It ranges from southern British Columbia south to Marion County, California and east to the shrub steppe of the Great Basin in Oregon and California. In the Western Cascades, the northern spotted owl can be found from approximately sea level to 4000 feet in elevation (USFWS 1992). Most observations of spotted owl habitat use have been made in forests with a component of old-growth and mature forests consisting of western hemlock, Douglas-fir and western red cedar. However, the northern spotted owl has been observed to use a wide variety of habitat types and forest stand conditions, including managed stands, for nesting, feeding or roosting (USFWS 1992). In general, northern spotted owls preferentially use forests with greater complexity and structure. In the Western cascades, the home range of northern spotted owl pairs ranges in size from approximately 1,450 acres to 9,750 acres with a median home range size of 2,950 acres (USFWS 1992). Spotted owls do not build their own nests. They depend on suitable naturally occurring nest sites such as broken-top trees and cavities in older-age forests, abandoned raptor nests, squirrels nests and debris accumulations. Most northern spotted owl nest sites observed on public lands have been located in old-growth or mature forests (USFWS 1992). However, spotted owls are known to nest in managed stands, especially if residual old-growth characteristics are present. Owlets remain in the nest for three to five weeks and generally leave the nest before they can fly. They usually remain near the nest in nearby branches or on the ground where they are fed and tendered by both adults before dispersing in early fall (late September to early October) (USFWS 1992). Roosting habitat are typically areas of relatively dense vegetation (high canopy closure dominated by large-diameter trees). Spotted owls respond to variations in temperature and move within the canopy to find favorable microclimate conditions which are facilitated by multistoried stand structure of roost sites (USFWS 1992). Spotted owl foraging habitat is more varied but is generally characterized by high canopy closure and complex structure. Spotted owls are primarily nocturnal and eat small mammals, birds and insects. Both the woodrat (*Neotoma fuscipes* and *N. cinerea*) and the northern flying squirrel (*Glaucomys sabrinus*) compose the majority of the prey base of the spotted owl (USFWS 1992).

Habitat: Critical habitat is designated for the northern spotted owl solely on 6.9 million acres of federal lands (57 FR 1796). Areas managed by the U.S. Forest Service (USFS) in upper Eagle Creek watershed are part of the critical habitat designation for northern spotted owl. Northern spotted owls live in forests characterized by dense canopy closure of mature and old-growth trees, abundant logs, standing snags, and live trees with broken tops. Although they are known to nest, roost, and feed in a wide variety of habitat types, these owls prefer older forest stands with variety: multi-layered canopies of several tree species of varying size and age, both standing and fallen dead trees, and open space among the lower branches to allow flight under the canopy. Typically, forests do not attain these characteristics until they are at least 150 to 200 years old.

Conservation measures: The listing of the northern spotted owl as threatened and the designation of critical habitat are helping to reduce habitat loss on federal lands. Although the need for timber

necessitates continued harvesting, new forest management practices now stress restricted harvesting in old-growth forests and suggest alternate areas for harvest which are less preferred by spotted owls. Careful planning of timber sales and wise use of forest resources is necessary to halt the decline of the northern spotted owl and other old growth-associated species. The Northwest Forest Plan, created in 1994, creates a system of late-successional reserves (LSR) across the range of the species that are designed to provide suitable nesting habitat over the long term. The federal forest lands outside these reserves are managed to allow dispersal between the LSRs through riparian reserves and other land allocations.

Marbled Murrelet (*Brachyramphus marmoratus,* Threatened Species)

Status: The North American subspecies of marbled murrelet ranges from the Aleutian Islands and Southern Alaska south to central California, the largest portion of the population occurs in Alaska and British Columbia. Due to loss of older forests used for nesting sites, the species in declining. For example, current estimates indicate that the population has declined by 50% to 82%. Along the Oregon coast, recent surveys have shown a decline in murrelet numbers during the 1990's. Loss of viable nesting habitat is thought to be a primary factor responsible for an estimated annual 4% to 7% decline in marbled murrelet populations in Washington, Oregon, and California. It is unlikely that population numbers will increase rapidly due to the naturally low reproductive rate and the continued loss of nesting habitat indicates that the recovery of the species is likely to take decades.

Habitat: The marbled murrelet is a small robin-sized diving seabird that feeds primarily of fish and invertebrates in near-shore marine waters. It spends the majority of its time on the ocean roosting and feeding, but comes inland up to 80 kilometers (50 miles) to nest in forest stands with old growth forest characteristics. These dense shady forests are generally characterized by large trees with large branches or deformities for use as nest platforms. The listed population nests in stands varying in size from several acres to thousands of acres. However, larger, unfragmented stands of old growth appear to be the highest quality habitat for marbled murrelet nesting. Nesting stands are dominated by Douglas fir in Oregon and Washington and by old growth redwoods in California.

Conservation measures: Although most murrelet nesting habitat on private lands has been decimated by logging, suitable habitat remains on Federal and State owned lands. Areas of critical habitat have been designated within the three-state area to protect habitat and promote the recovery of the species. Over the next 50 to 100 years, the protected areas on Federal lands should provide for an increase in suitable nesting habitat. Although timber continues to be harvested, timber sale programs on Federal lands require consultation with the U.S. Fish and Wildlife Service to review and assess the potential impacts of the timber harvests on the marbled murrelet. In 1997, the Fish and Wildlife Service approved a recovery plan for the marbled murrelet that specified actions necessary to halt the decline of the species in the three-state area.

Western Snowy Plover (*Charadrius alexandrinus nivosus*, Threatened Species)

The western snowy plover is a small shorebird distinguished from other plovers by its small size, pal brown upper parts, dark patches on either side of the upper breast, and dark gray to blackish

legs. Snowy plovers weigh between 1.2 and 2 ounces and are about 5.9 to 6. inches long. The western snowy plover is listed as threatened. Critical habitat has been designated at 28 areas along the coasts of California, Oregon and Washington. A recovery plan is being prepared.
Status: The Pacific coast population of the western snowy plover is defined as those individuals that nest beside or near tidal waters, and includes all nesting colonies on the mainland coasts, peninsulas, offshore islands, adjacent bays and estuaries form southern Washington to southern Baja California, Mexico. Historic records indicate that western snowy plovers nested at 29 locations on the Oregon coast. Currently, only nine locations in Oregon support nesting western snowy plovers, a 69 percent reduction in active breeding locations.

As early as the 1970's, observers suspected a decline in plover numbers. The primary cause of decline is loss and degradation of habitat. The introduced European beachgrass (*Ammophila arenaria*) contributes to habitat loss by reducing the amount of open, sandy habitat and contributing to steepened beaches and increased habitat for predators. Urban development has reduced the available habitat for western snowy plovers while increasing the intensity of human use, resulting in increased disturbance to nesting plovers.

Habitat: The Pacific coast population of western snowy plovers breeds on coastal beaches from southern Washington to southern Baja California, Mexico. Plovers lay their eggs in shallow depressions in sandy or salty areas that generally do not have much vegetation. Because the sites they choose are in loose sand or soil, nesting habitat is constantly changing under the influence of wind, waves, storms and encroaching plants.

Conservation measures: In the nine areas of the Oregon coast that are currently used for nesting by the snowy plover, seasonal restrictions on beach use are implemented in an effort to reduce disturbance to breeding plovers. Activities that may adversely affect plovers include sand deposition, spreading or leveling; beach cleaning; construction of breakwaters and jetties; dune stabilization/restoration using native and nonnative vegetation or fencing; driving of off-road vehicles in nesting areas or at night. Recreational activities near western snowy plover nests, such as picnicking or dog walking, may also result in abandonment of the nest by adult plovers. Trash or food left on the beach may attract predators.

Brown Pelican (*Pelecanus occidenta*, Endangered species)

Status: There are two geographically and genetically distinct regional populations or subspecies of brown pelican that occur in North America. They are the California brown pelican (*P. o. californicus*), ranging from California to Chile, and the eastern brown pelican (*P. o. carolinensis*), which occurs along the Atlantic and Gulf coasts, the Caribbean, and the Central and South American coasts. Consumption of pesticide-laden fish, lack of food, and disturbances by humans were responsible for a marked decline in reproductive success, and consequently a decline in numbers of both brown pelican subspecies in the 1960s and 1970s. The eastern brown pelican remains endangered. Current information indicates that the California brown pelican has sufficiently recovered as a result of restrictions on the use of certain types of pesticides (organochlorines), and this news has prompted a proposal to delist this subspecies. A final ruling on this action is pending.

Habitat: The brown pelican is a warm weather species that thrives near coasts and on islands. The California brown pelican generally uses the rocky islands along the California coast for their group or "colonial" nest sites. These islands typically feature steep, rocky slopes and little vegetation, and they must be without terrestrial predators or human disturbances. Nearby high-quality marine habitat is also essential. Brown pelicans rely in part on the actions of marine predators such as sharks, salmon, and dolphins to force schools of fish to the surface where they can catch them. Pelicans will only breed in areas and at times with enough food to support the breeding colony. Roosting and resting or "loafing" sites where brown pelicans can dry their feathers and rest without disturbance are also important.

Conservation measures: In the early 1970s, the use of DDT was banned, and restrictions controlling the use of other pesticides were imposed in the United States. As a result, pelican reproduction improved. Sanctuaries, reserves, and natural areas have been established to protect nesting habitat and fledging areas from human disturbances and to preserve nearby marine resources. Reduction of contaminant levels, habitat protection, and conservation of food resources have led to the successful recovery of the California brown pelican population to self-sustaining levels, warranting the current proposal for delisting of this subspecies.

Oregon Silverspot Butterfly (*Speyeria zerene hippolyta*, Threatened Species)

The Oregon silverspot is a medium-sized, orange and brown butterfly with black veins and spots on the dorsal (upper) wing surface, and a yellowish submarginal band and bright metallic silver spots on the ventral (under-side) wing surface. This subspecies is distinguished from other subspecies of silverspot butterflies be a somewhat smaller size and darker coloration at the base of the wings. These are morphological adaptations for survival in a persistently wind and foggy environment.

Status: The historical range of this subspecies extends from the Long Beach Peninsula, Pacific County, Washington, south to Del Norte Count, California. All of these populations were restricted to the immediate coast, centered around salt-spray meadows, or within a few miles of the coastline in similar meadow-type habitat. At the time of listing the only viable population known was on the Siuslaw National Forest in Tillamook County, Oregon. Additional populations have since been discovered ant Cascade Head, Bray Point and Clatsop Plains in Oregon, on the Long Beach Peninsula in Washington and in Del Norte County in California.

Habitat: The Oregon silverspot occupies three types of grassland habitat. One type consists of marine terrace and coastal headland salt-spray meadows (e.g., Cascade Head, Bray Point Rock Creek-Big Creek and portions of Del Norte sites). The second consists of stabilized dunes as found at the Long Beach Peninsula, Clatsop Plains, and the remainder of Del Norte. Both these habitats are strongly influenced by proximity to the ocean, mild temperatures, high rainfall, and persistent fog. The third habitat type consists on montane grasslands found on Mount Hebo and Fairview Mountains. Conditions at these sites include colder temperatures significant snow accumulations, less coastal fog, and no salt spray.

The most important feature of the habitat of the Oregon silverspot is the presence of the early blue violet. This plant is normally the only species on which the Oregon silverspot can successfully feed and develop as larva. This plant is apart of the salt-spray meadow vegetation and is an

obligatory component of the butterfly's habitat. Other features of optimum habitat include moderate grass cover, and a mixture of herbaceous plants used for nectaring by adults. Adults generally move out of the meadows into the fringe of conifers or brush for shelter, courtship and mating.

A. 3) Analyze effects.

No take of USFWS trust species is expected to occur or be adversely affected by operation of Big Creek Hatchery.

Adult hatchery fish in Big Creek could potentially serve as a forage base for bald eagles. Adult hatchery carcasses distributed in tributary streams can also enhance nutrients and ecosystem productivity of the stream (Cederholm et al. 1999).

A. **4) Actions taken to minimize potential effects.**

No actions are necessary to address effects for USFWS ESA trust species.

A. 5) References

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