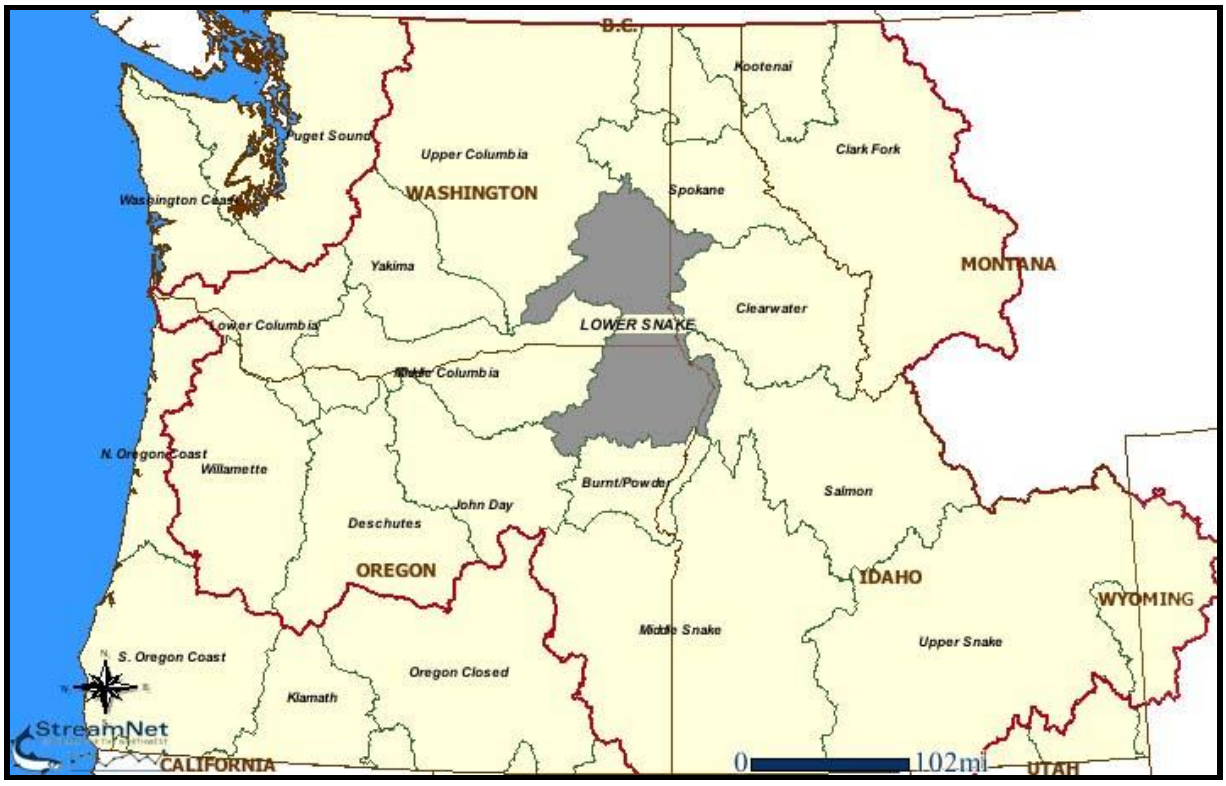
U.S. Fish & Wildlife Service - Pacific Region

Columbia Basin Hatchery Review Team

Columbia River Basin, Lower Snake River Region

Grande Ronde and Imnaha River Watersheds



Oregon Lower Snake River Compensation Plan State Operated Hatcheries

Irrigon, Lookingglass, and Wallowa Fish Hatcheries

Assessments and Recommendations

Final Report

April 2011

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Preface

The assessments and recommendations presented in this report represent the independent evaluations of the Hatchery Review Team and do not necessarily represent the conclusions of the U.S. Fish and Wildlife Service (Service). The Review Team used the most current scientific information available and the collective knowledge of its members to develop the recommendations presented in this report. The Service will respect existing agreements with comanagers when considering the recommendations presented in this report. The Review Team and Service acknowledge that the *U.S. v Oregon* process is the appropriate forum for defining or modifying hatchery programs in the Columbia River Basin. The Service looks forward to working with comanagers to advance forward the principles of hatchery reform and sustainable fisheries management.

Summary

Long-term conservation needs of natural salmonid populations and their inherent genetic resources require a reexamination of the role of hatcheries in basin-wide management and conservation strategies. Hatcheries must be viewed as part of the environmental and ecological landscape to help achieve both conservation and harvest goals. These goals need to be part of a holistic and integrated strategy that combines habitat, hydropower and harvest needs for conserving and managing fishery resources. These strategies must establish short- and long-term goals for both hatchery-propagated and naturally-spawning populations.

To ensure that its hatchery programs are best meeting conservation and harvest goals, the U.S. Fish & Wildlife Service (Service) began, in October 2005, a five-year review of 21 salmon and steelhead hatcheries that the Service owns or operates in the Columbia River Basin. The goal of this review is to ensure that Service hatcheries are operated in accordance with best scientific principles, and contribute to sustainable fisheries and the conservation of naturally-spawning populations of salmon, steelhead and other aquatic species. The Service's review process is modeled after the Puget Sound and Coastal Washington Hatchery Reform Project[1].

The report presented here is one of three reports for federally-owned hatcheries that are operated by state agencies in the Snake River basin under the auspices of the Lower Snake River Compensation Plan (LSRCP), a federally-funded program to mitigate for fish losses resulting from the construction and operation of four hydroelectric and transportation dams on the lower Snake River in Washington State. The report here provides benefit-risk assessments and recommendations for hatchery programs at Irrigon, Lookingglass, and Wallowa Fish Hatcheries (FH) in Oregon. Irrigon FH is located along the south shore of the Columbia River, upstream of John Day Dam, three miles west of Irrigon, Oregon. Lookingglass FH is located 19 miles north of Elgin, Oregon adjacent to Lookingglass Creek, 2.2 miles upstream of its confluence with the Grande Ronde River (at river mile 86). Wallowa FH is located along Spring Creek, a tributary of the Wallowa River (Grande Ronde River Subbasin), one mile west of Enterprise, Oregon. All three hatcheries are operated by Oregon Department of Fish and Wildlife (ODFG). Counterpart reports exist for LSRCP hatcheries in Washington and Idaho.

The Review Team considered, as a foundation for its assessments, four characteristics of each salmonid stock in watersheds where fish are released as part of the LSRCP in Oregon: *biological significance*, *population viability*, *habitat* conditions, and *harvest* goals. The Review Team attempted to use both short- (15 years) and long-term (50–75 years) goals for each salmonid stock, as identified by the fishery comanagers[2], as a foundation for assessing the benefits and risks of the reviewed hatchery programs. Source documents not readily available to the general public, including appendices and background documents for this report, are accessible via the Service's hatchery review website.[3]

Lookingglass Fish Hatchery

Facility overview: Lookingglass FH is located on 22.5 acres 19 miles north of the town of Elgin, Oregon, adjacent to Lookingglass Creek, 2.2 miles upstream from the confluence with the Grande

[1] *www.lltk.org/HRP.html. See also www.hatcheryreform.us/.*

[2] *LSRCP comanagers in Oregon are the U.S. Fish and Wildlife Service, ODFW, Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Confederated Tribes of the Warm Springs Reservation (CTWSR), with comanaging input from the National Marine Fisheries Service (NOAA Fisheries).*

[3] *www.fws.gov/Pacific/fisheries/HatcheryReview/*

Ronde River (river mile 86). The hatchery was constructed in 1982 as part of the LSRCP program to mitigate for the reduced abundance of spring Chinook and summer steelhead caused by the construction and operation of four federal dams on the lower Snake River. Lookingglass Hatchery is operated by ODFW and raises spring Chinook for the Grande Ronde and Imnaha rivers as part of the LSRCP.[4]

Lookingglass Creek Spring Chinook

Program overview: The Lookingglass Creek Spring Chinook program currently operates as a reintroduction program to restore spring Chinook to Lookingglass Creek. The native population of spring Chinook in Lookingglass Creek is considered extirpated. In 2001, comanagers selected spring Chinook from Catherine Creek as the appropriate stock for reintroduction into Lookingglass Creek. Juvenile spring Chinook from the Catherine Creek hatchery program (see below) were first released into Lookingglass Creek in 2001 and adult spring Chinook from Catherine Creek were first released in 2004. The program is intended to ultimately operate as an integrated-harvest program with both hatchery and natural origin adults returning to Lookingglass Creek used for broodstock. The long-term goal of the program is to support harvest of spring Chinook within the Grande Ronde River watershed and contribute to the LSRCP mitigation goal of returning 5,860 hatchery-origin adult spring/summer Chinook from the Grande Ronde River basin to upstream of Lower Granite Dam. A directed harvest in Lookingglass Creek is allowed if escapement predictions to Lookingglass Creek exceed 620 adults. The broodstock goal is to annually collect 170 adult spring Chinook (85 females and 85 males) to yield approximately 286,000 green eggs and 250,000 yearling smolts for release into Lookingglass Creek. A maximum of 150,000 juvenile spring Chinook are reared at Lookingglass Hatchery and up 100,000 juveniles are transferred and reared at Irrigon FH. The proportion of the broodstock composed of hatchery and natural-origin fish follows a sliding scale that is a function of the predicted total number of adult Chinook expected to return to Lookingglass Creek. Based on that sliding scale, up to 450 hatchery-origin adults are passed annually upstream of the hatchery weir to spawn naturally in Lookingglass Creek.

Benefits: The number of hatchery-origin spring Chinook adults trapped at Lookingglass FH has increased continuously since 2004, from a low of n = 45 adults in 2005 to a high of n = 305 adults in 2009. The number of natural-origin spring Chinook increased from n = 50 adult recruits in 2008 to approximately n = 101 adult recruits in 2009. Unmarked adult spring Chinook (age 4 years), considered to be the natural-origin progeny of introduced Catherine Creek fish, first returned to Lookingglass Creek during the late spring and summer of 2008.

Risks: The current productivity and capacity of Lookingglass Creek upstream of the hatchery may not be sufficient to provide the desired number of natural-origin adults for a genetically integrated broodstock consisting of 170 adult spring Chinook. This latter limitation coupled with the existing sliding scale for passing hatchery-origin fish upstream to spawn naturally poses a long-term domestication risk to a future naturalized population in Lookingglass Creek, largely because hatchery-origin fish are expected to dominate natural-origin fish numerically on the spawning

[4] *Spring Chinook native to the Grand Ronde and Imnaha rivers, including their hatchery-origin descendants, are included with the Snake River Spring-Summer Chinook Salmon Evolutionarily Significant Unit (ESU) by NOAA Fisheries. These fish exhibit a range of return times to freshwater that ranges from early spring (March) to mid-summer (August). Collectively, these fish are characterized by both their return timing to freshwater and their smolting as yearling fish, as opposed to the subyearling smolting of fall Chinook salmon. The terms "spring Chinook" and "spring/summer Chinook" are used somewhat synonymously in the report presented here and, in general, refer to the same stocks (populations) of fish; for example, "Imnaha River spring Chinook" and " Imnaha River spring/summer Chinook" refer to the same population.*

grounds under the current sliding scale and management scheme. Low stream flows and high water temperatures in Lookingglass Creek during the late summer and early fall pose fish health risks to adult spring Chinook adults held on station. The passage of hatchery-origin spring Chinook upstream of the weir poses disease risks to other stocks of spring Chinook reared at Lookingglass Hatchery (see below) because Lookingglass Creek is the water source for the hatchery. The short-term rearing of Lookingglass spring Chinook fingerlings at Irrigon FH and subsequent transfer back to Lookingglass FH increases fish health risks at both facilities.

Recommendations for current program: The Review Team identified 31 program specific recommendations to reduce risks and/or improve benefits of the current Lookingglass Creek Spring Chinook program at Lookingglass FH. These recommendations include: (a) modification of the current sliding scale so that it includes contingencies for not passing hatchery-origin fish upstream when the number of natural-origin adults achieves a threshold level of abundance, thus promoting establishment of a self-sustaining naturalized population; (b) improve treatment of the water supply at Lookingglass Hatchery to reduce disease risks to juvenile spring Chinook reared on station; (c) reduce juvenile rearing densities (DI) and water flow indices (FI) to maximum values of DI $\leq$ 0.2 and FI $\leq$ 1.0 to reduce fish health risks; (d) reduce the size of one or more programs at Lookingglass FH (see below) to preclude the need to transfer Lookingglass Creek spring Chinook juveniles to Irrigon FH for rearing; (e) investigate different types of shade covers used at other facilities and consider installing shade covers over the raceways at Lookingglass FH; and (f) replace the water intake screen at Lookingglass FH so that it complies with the screening criteria of NOAA Fisheries.

Alternatives to current program: The Review Team considered the pros and cons of six alternatives to the existing Lookingglass Creek Spring Chinook program at Lookingglass FH, ranging from (a) the current program with full implementation of all program specific recommendations (Alternative 1) to (b) termination of all programs at Lookingglass FH and decommissioning the facility (Alternative 6). The Review Team recommends Alternative 4: expansion of the current Lookingglass Spring Chinook program from 250,000 to 325,000 smolts. Implementation of this recommendation requires concurrent reductions in the sizes of the upper Grande Ronde and Imnaha River spring Chinook programs to accommodate the expanded Lookingglass Creek program. Implementation of these recommendations is intended to increase harvest mitigation benefits in Lookingglass Creek and the Grande Ronde River with little or no reductions in harvest elsewhere. Alternative 4 is intended to be implemented with all the recommendations for the current program (Alternative 1) but could be implemented with development of a stepping-stone program (Alternative 2) or a segregated broodstock management strategy (Alternative 3) depending on comanager goals and priorities.

Upper Grande Ronde River Spring Chinook

Program overview: The program currently operates as a conservation program to prevent extirpation of the endemic spring Chinook population in the upper Grande Ronde River. Under current conditions, the naturally spawning population would most likely become functionally extinct without hatchery intervention. The hatchery program is intended to eventually contribute to recreational and tribal harvests and the overall LSRCP mitigation goal to return 5,860 hatchery-origin adult spring/summer Chinook from the Grande Ronde River basin upstream of Lower Granite Dam. Currently, the program consists of both "conventional" and "captive" components. The broodstock goal for the conventional program is to annually capture 170 adult spring Chinook (85 males and 85 females) to produce 250,000 yearling smolts for release into the upper Grande Ronde River. Adults are trapped for broodstock at the Upper Grande Ronde River Adult

Collection Facility, located at river mile 153 of the Grande Ronde River. Adult spring Chinook retained for broodstock are transported to the Lookingglass FH where they are held until sexually mature. Spawning of adults, egg incubation, hatching, and rearing of progeny fish to the yearling smolt stage occur at Lookingglass FH. Yearling smolts are transported to the upper Grande Ronde River acclimation facility (located at river mile 170 of the Grande Ronde River) for acclimation and release. For the captive component, three to five (3-5) eyed eggs from each female parent of the conventional program are removed from the incubators at Lookingglass FH and transported to Wallowa FH (see below) for incubation and hatching. The resulting fry are reared to the yearling stage at Wallowa FH and then transported to Bonneville FH[5] (ODFW) for captive rearing to sexual maturity. The program attempts to raise a total of 300 captively-reared adults each brood year. Captively-reared adults are crossed and spawned between brood years to yield progeny that can be used as a "safety net" to backfill" progeny shortages of the conventional program. Natural-origin adults from this stock are incorporated within the broodstock annually, and hatchery origin adults are allowed to spawn naturally in the upper Grande Ronde River each year. All adults returning from the captive portion of the program are allowed to spawn naturally.

Benefits: The principle benefit of the program is maintenance of spring Chinook salmon in the upper Grande Ronde River and prevention of functional extirpation of the endemic, naturally spawning population. The program also confers research benefits for captive rearing technologies.

Risks: The program poses genetic, ecological, and demographic risks to the upper Grande Ronde River population of spring Chinook salmon. However, those risks are considered to be significantly lower than the demographic risk of extinction resulting from degraded habitat conditions in the upper Grande Ronde River.

Recommendations for current program: The Review Team identified nine specific recommendations to reduce risks and/or improve benefits of the current Upper Grande Ronde River Spring Chinook program at Lookingglass FH. These recommendations include: (a) evaluate and improve the efficiency of the adult weir in the upper Grande Ronde River, and (b) evaluate post-release survivals and smolt-to-adult return rates (SARs) of direct stream-released yearlings versus acclimated smolts to determine whether the former strategy is a viable alternative to acclimating two release groups over a protracted release period.

Alternatives to current program: The Review Team considered the pros and cons of four alternatives to the existing Upper Grande Ronde River Spring Chinook program at Lookingglass FH, ranging from (a) the current program with full implementation of all program specific recommendations (Alternative 1) to (b) termination of the program and decommissioning the adult trap and juvenile acclimation facilities in the upper Grande Ronde River (Alternative 4). The Review Team recommends Alternative 2 in the near term: reduce the size of the upper Grande Ronde River program, focusing exclusively on conservation and maintaining the endemic spring Chinook population in the upper Grande Ronde River. Under this alternative, the desired size of the program would be reduced from an annual release of 250,000 smolts to 130,000 smolts with an annual broodstock size of 60 females and 60 males. The Team recommends continuation of the captive program as a "safety net" for the population. The recommended alternative would "free up" two raceways at Lookingglass FH that could be used to increase the size of the Lookingglass Creek Spring Chinook program. This recommended alternative implicitly assumes that aggressive actions to restore habitat and increase natural population viability would also occur. Over the long

[5] *Bonneville Fish Hatchery is located along the lower Columbia River immediately downstream of Bonneville Dam.*

term, the size of the program could be increased in response to improved habitats, increased smolt-to-adult survivals, and restored harvest opportunities.

Catherine Creek Spring Chinook

Program overview: The program currently operates primarily as a conservation program to maintain the endemic spring Chinook population in Catherine Creek, a major tributary to the Grande Ronde River. The immediate goal of the program is to maintain a naturally spawning population in Catherine Creek and ensure a high probability of population persistence into the future. The program is also intended to assist with restoration of spring Chinook salmon in the Grande Ronde River basin, including the reintroduction of spring Chinook to Lookingglass Creek. The program is intended to eventually contribute to recreational and tribal harvests and the overall LSRCP mitigation goal to return 5,860 hatchery-origin adult spring/summer Chinook from the Grande Ronde River basin upstream of Lower Granite Dam. The broodstock goal is to annually capture 82 adult spring Chinook (41 males and 41 females) to produce 130,000 yearling smolts for release into Catherine Creek. Adults are trapped for broodstock at the Catherine Creek weir, located at river mile 43 of Catherine Creek. Natural-origin adult Chinook from Catherine Creek are included with the broodstock annually, and hatchery-origin adults are allowed to spawn naturally in Catherine Creek each year. A sliding scale has been developed to help determine the proportion of the broodstock and natural spawners composed of hatchery and natural-origin fish annually, based on the estimated adult escapement to Catherine Creek. Adult spring Chinook retained for broodstock are transported to the Lookingglass FH where they are held until sexually mature. Spawning of adults, egg incubation, hatching, and rearing of progeny fish to the yearling smolt stage occur at Lookingglass FH. Yearling smolts are transported to the Catherine Creek Acclimation Facility (located at river mile 52 of Catherine Creek) for acclimation and release.

Benefits: The program is reducing the demographic risk of extinction and helping to maintain a naturally spawning population of spring Chinook in Catherine Creek. The program is providing fish for the reintroduction of "endemic" Grande Ronde River spring Chinook into Lookingglass Creek.

Risks: The high proportion of naturally-spawning spring Chinook composed of hatchery-origin fish in Catherine Creek poses a genetic domestication risk to the natural population. The current sliding scale used to determine the proportion of natural and hatchery-origin adults passed upstream of the Catherine Creek weir results in upstream passage of hatchery-origin fish even when the number of natural-origin fish exceeds the natural spawning escapement objective. Icy water conditions at the acclimation site in March and early April pose demographic risks (icing of water intake) and physiologic risks (cold shock) to juvenile spring Chinook prior to release. Continued outplanting of Catherine Creek spring Chinook adults into Lookingglass and Indian creeks poses fish health and competition risks (i.e., ecological risks) to naturally spawning populations in those streams.

Recommendations for current program: The Review Team identified nine specific recommendations to reduce risks and/or improve benefits of the current Catherine Creek Spring Chinook program at Lookingglass FH. These recommendations include: (a) modify the current sliding scale used for determining the proportion of hatchery and natural-origin fish passed upstream so that upstream passage of hatchery-origin fish is precluded when the number of natural-origin fish exceeds the natural spawning escapement objective (n = 750 natural-origin adults); (b) discontinue outplanting adult spring Chinook into Indian Creek unless the activity can be justified and evaluated based upon specific goals for the program; (c) evaluate post-release

survivals and smolt-to-adult return rates (SARs) of direct stream-released yearlings versus acclimated smolts to determine whether the former strategy is a viable alternative to acclimating two release groups over a protracted release period susceptible to icing.

Alternatives to current program: The Review Team considered the pros and cons of four alternatives to the existing Catherine Creek Spring Chinook program at Lookingglass FH, ranging from (a) the current program with full implementation of all program specific recommendations (Alternative 1) to (b) termination of the program and decommissioning the adult trap and juvenile acclimation facilities in Catherine Creek (Alternative 4). The Review Team recommends Alternative 1: continuation of the current program with implementation of all program-specific recommendations.

Lostine-Wallowa River Spring Chinook

Program overview: The program currently operates primarily as a conservation program to maintain the endemic spring Chinook population in the Lostine River, a tributary to the Wallowa River which – in turn - is a major tributary to the Grande Ronde River. The immediate goal of the program is to maintain a naturally spawning population in the Lostine River and ensure a high probability of population persistence into the future. The program is intended to eventually contribute to recreational and tribal harvests and the overall LSRCP mitigation goal to return 5,860 hatchery-origin adult spring/summer Chinook from the Grande Ronde River basin upstream of Lower Granite Dam. The broodstock goal is to annually capture 140 adult spring Chinook (70 males and 70 females) to produce 250,000 yearling smolts for release into the Lostine River, with jacks composing up to 10% of the male spawning contribution of the broodstock. Adults are trapped for broodstock at the Lostine River weir, located at river mile 1.0 of the Lostine River. Natural-origin adults from the Lostine River are included within the broodstock annually. In addition, hatchery-origin adults are allowed to spawn naturally in the Lostine River. A sliding scale has been developed to help determine the proportion of the broodstock and natural spawners composed of hatchery and natural-origin fish annually based on the estimated adult escapement to the Lostine River. Up to 250, 100, and 100 hatchery-origin adults are outplanted annually into the Wallowa River, Bear Creek, and Prairie Creek, respectively. Adult spring Chinook retained for broodstock are transported to Lookingglass FH where they are held until sexually mature. Spawning of adults, egg incubation, hatching, and rearing of progeny fish to the yearling smolt stage occur at Lookingglass FH. Yearling smolts are transported to the Lostine River Acclimation Facility (river mile 12) for acclimation and release.

Benefits: The program provides very limited harvest benefit in the Wallowa River. The program is reducing the demographic risk of extinction and is helping to maintain a naturally spawning population of spring Chinook in the Lostine River.

Risks: The high proportion of naturally spawning spring Chinook composed of hatchery-origin fish in the Lostine River poses a genetic domestication risk to the natural population. The current sliding scale used to determine the proportion of hatchery and natural-origin adults passed upstream of the weir in the Lostine River results in passage of hatchery-origin fish when the number of natural-origin fish exceeds the natural spawning escapement objective. The inefficiency of the temporary adult weir can also result in uncontrolled numbers of spring Chinook passing upstream during higher water flows, further increasing genetic domestication risks. Icy water conditions at the acclimation site in March and early April pose demographic and physiologic risks to juvenile spring Chinook prior to release. Outplanting Lostine River spring Chinook adults into the Wallowa River, Bear Creek, and Prairie Creek poses fish health and competition risks to

naturally spawning populations in those recipient streams. Outplanting subyearling parr poses competition risks to natural-origin parr and may confer few or no benefits.

Recommendations for current program: The Review Team identified 11 specific recommendations to reduce risks and/or improve benefits of the current Lostine-Wallowa River Spring Chinook program at Lookingglass FH. These recommendations include: (a) modify the current sliding scale used to adjust the proportion of hatchery and natural-origin fish passed upstream to exclude passage of hatchery-origin fish when the number of natural-origin fish exceeds the natural spawning escapement objective (n = 1,000 natural-origin adults); (b) discontinue outplanting adult spring Chinook into the Wallowa River, Bear Creek, and Prairie Creek unless the activity can be justified and evaluated based upon specific goals for the program; (c) construct a new permanent weir in the Lostine River; (d) evaluate post-release survivals and smolt-to-adult return rates (SARs) of direct stream-released yearlings versus acclimated smolts to determine whether the former strategy is a viable alternative to acclimating two release groups over a protracted release period when icing occurs; and (e) terminate the outplanting of subyearling parr unless the activity can be justified based upon specific goals for the program.

Alternatives to current program: The Review Team considered the pros and cons of seven alternatives to the existing Lostine-Wallowa River Spring Chinook program at Lookingglass FH, ranging from (a) the current program with full implementation of all program specific recommendations (Alternative 1) to (b) termination of the program and decommissioning the adult trap and juvenile acclimation facilities in the Lostine River (Alternative 7). The Review Team recommends, in the short term, Alternative 1: continuation of the current program with implementation of all program-specific recommendations. These recommendations include construction of a new weir in the Lostine River. Over the long term, the Team supports development of the Northeast Oregon Hatchery (NEOH) on the Lostine River. The NEOH facility and a new weir would allow comanagers to increase the size of the Lostine-Wallowa River Spring Chinook program to provide harvest benefits. The NEOH would also relieve facility constraints at Lookingglass FH. If NEOH and a new weir are constructed, then the Team further recommends that comanagers consider converting the Lostine-Wallowa Spring Chinook program to a two-broodstock, stepping-stone program (Alternative 3). Absent a new NEOH facility, the comanagers may wish to reassess other programs at Lookingglass FH to determine whether they should be reduced and the Lostine-Wallowa Spring Chinook program increased (alternative 5).

Imnaha River Spring Chinook

Program overview: The program currently operates as an *integrated harvest and conservation* program to support recreational and tribal fisheries in the Imnaha River while assisting with the conservation of the endemic Imnaha River population of spring/summer Chinook. The program is intended to contribute to recreational and tribal harvests and the overall LSRCP mitigation goal to return 3,210 hatchery-origin adult spring/summer Chinook from the Imnaha River to upstream of Lower Granite Dam on the mainstem Snake River. The current broodstock goal is to annually capture 216 adult spring/summer Chinook (108 males and 108 females) to yield 360,000 smolts for release in the Imnaha River, with jacks composing up to 10% of the male spawning contribution of the broodstock. Adults are trapped for broodstock at the Imnaha River weir and satellite facility, located at river mile 49 of Imnaha River. Natural-origin adults from the Imnaha River are included with the broodstock annually, and hatchery-origin adults are allowed to spawn naturally in the Imnaha River each year. A sliding scale has been developed to help determine the proportion of the broodstock and natural spawners composed of hatchery and natural-origin fish annually based on the estimated adult escapement to the Imnaha River. Up to 500 hatchery-origin

adults trapped in the Imnaha River are outplanted annually into Big Sheep Creek and Lick Creek in the Big Sheep Creek watershed. Adult spring/summer Chinook retained for broodstock are transported to the Lookingglass FH where they are held until sexually mature. Spawning of adults, egg incubation, hatching, and rearing of progeny fish to the yearling smolt stage occur at Lookingglass FH. Yearling smolts are transported to the Imnaha River Acclimation Facility (river mile 49) for acclimation and release.

Benefits: The Imnaha River Spring Chinook program provides recreational and tribal harvest in the Imnaha River basin. ODFW opened spring/summer Chinook sport fishing in the Imnaha River from 2001-2005 and in 2008. Estimated sport harvest of spring/summer Chinook in the Imnaha River during those years averaged 164 fish (range = 22-302 fish) per year. Estimated tribal harvest in the Imnaha River from 2001 through 2007 averaged 160 fish (range = 33-316 fish) per year. The total number of hatchery-origin spring/summer Chinook adults trapped at the Imnaha River weir for the years 2000-2009 has ranged from 660 fish (2006) to 3,254 fish (2009). During that same time period, the number of natural-origin adults trapped at the weir has ranged from 131 fish (2006) to 1,390 fish (2001). The hatchery program has significantly increased the total number of spring/summer Chinook returning to the Imnaha River since the early 1990's, thereby reducing demographic risks of extirpation.

Risks: The high proportion of hatchery-origin spring Chinook spawning in the Imnaha River poses a genetic domestication risk to the natural population. Approximately 40% of the total number of adults returning to the weir site are able to migrate upstream before installation of a temporary weir because of high water flows. The mean and range of return dates for natural-origin fish are shifting to later dates, thus providing evidence of genetic effects of the hatchery program on the natural population. In addition, hatchery-origin adults pass upstream of the weir during periods of high flow in some years. The comparatively large number of hatchery-origin fish spawning naturally also poses competition risks to the productivity (number of adult progeny recruits per adult spawner) of natural-origin fish. The current sliding scale used to determine the proportion of hatchery and natural-origin adults passed upstream of the weir in the Imnaha River results in passage of hatchery-origin fish even when the number of natural-origin fish meets or exceeds the natural spawning escapement objective. Outplanting hatchery-origin spring/summer Chinook adults into Big Sheep and Lick creeks poses genetic and ecological risks to the natural populations in those streams. Those risks are a concern because the status of the natural populations are largely unknown, and desired benefits or intended goals of those outplants have not been clearly identified.

Recommendations for current program: The Review Team identified 17 specific recommendations to reduce risks and/or improve benefits of the current Imnaha River Spring Chinook program. These recommendations include: (a) modify the current sliding scale used to adjust the proportion of hatchery and natural-origin fish passed upstream so that hatchery-origin fish are excluded from passage when the predicted number of natural-origin fish returning to the Imnaha River exceeds the natural spawning escapement objective (n = 1,000 natural-origin adults); (b) discontinue outplanting adult Chinook into the Big Sheep and Lick creeks unless the activity can be justified and evaluated based upon specific goals for that portion of the program; (c) design and construct a new weir in the Imnaha River; (d) identify beneficial uses for trapped, hatchery-origin Chinook that exceed broodstock and natural spawning needs (e.g., direct subsistence to tribes, food banks, etc.); (e) maintain rearing and acclimation densities within desired guidelines for spring Chinook; (f) increase the capacity of the adult trap and holding pond at the Imnaha River weir and satellite facility; (g) develop a monitoring program for Big Sheep

and Lick creeks to evaluate whether the desired benefits from outplanting adults are achieved; and (h) increase public outreach opportunities at the Imnaha River satellite facility.

Alternatives to current program: The Review Team considered the pros and cons of eight alternatives to the existing Imnaha River Spring Chinook program at Lookingglass FH, ranging from (a) the current program with full implementation of all program specific recommendations (Alternative 1) to (b) termination of the program and decommissioning the Imnaha River satellite facility (Alternative 8). The Review Team recommends Alternative 2: reduce the size of the program to 325,000 smolts and modify the existing sliding scale for adult escapement and broodstock collection to reduce hatchery influence on the natural population upstream of the weir. The recommendation to reduce the size of the program from 360,000 to 325,000 smolts annually is intended to address facility constraints at Lookingglass FH and to meet the Team's recommended alternatives for the spring Chinook programs for the Grande Ronde River Basin. This small reduction in the size of the program should not significantly affect the ability of the program to achieve harvest and conservation goals. Alternative 2 also includes implementation of Alternative 1 recommendations, including construction of a new weir on the Imnaha River to better meet broodstock management and natural spawning objectives.

Summary of recommended alternatives for spring Chinook programs at Lookingglass FH. The rearing capacity of Lookingglass FH is constrained by a total of 18 raceways. Each raceway can rear a maximum of 65,000 yearling spring Chinook smolts consistent with fish health guidelines.

Program	Proposed Short Term Size of Program: No. of smolts	No. of raceways required at Lookingglass FH	Recommended Alternative
Lookingglass Creek Spring Chinook	325,000	5	Increase from 250,000 smolts to increase harvest and mitigation benefits in Lookingglass Creek and Grande Ronde River
Upper Grande Ronde River Spring Chinook	130,000	2	Reduce from 250,000 smolts, with focus on maintaining the endemic population. Continue captive rearing program.
Catherine Creek Spring Chinook	130,000	2	Maintain current program size.
Lostine River Spring Chinook	250,000	4	Maintain current program size and construct a new weir. Increase size of program if proposed NEOH facility is constructed.
Imnaha River Spring Chinook	325, 000	5	Reduce from 360,000 smolts, and construct a new weir.

Irrigon and Wallowa Fish Hatcheries

Irrigon FH

Facility overview: Irrigon FH is located three miles west of Irrigon, Oregon, adjacent to the Columbia River and the reservoir pool behind John Day Dam. The hatchery was constructed under the LSRCP Program to offset fish losses caused by the construction and operation of four hydropower dams on the lower Snake River. The hatchery was completed in 1985 and is the primary LSRCP steelhead rearing facility in Oregon. The facility was designed to rear steelhead smolts for release into the Grande Ronde and Imnaha River systems. Irrigon FH receives eyed steelhead eggs from Wallowa FH and rears them prior to transfer for release or acclimation.

Wallowa FH

Facility overview: Wallowa FH is located on 11 acres along Spring Creek (river mile 0.5), a spring-fed tributary to the Wallowa River approximately one mile west of the town of Enterprise, Oregon. Wallowa FH began operation in 1920 as a resident trout hatchery. In 1985, the U.S. Army Corps of Engineers renovated the hatchery for rearing summer steelhead under the LSRCP. The main hatchery building includes an egg incubation area, office, bunkhouse, and storage area. The facility also includes a weir and fish ladder, a concrete adult holding pond, adult spawning facility, water diversion structure, two smolt acclimation ponds, a fish release pipeline, and domestic water system. Water rights for the entire hatchery total 23,813 gpm from several sources. The acclimation ponds receive water from Spring Creek.

Wallowa River Summer Steelhead

Program overview: The program currently operates as a *segregated-harvest* program to support recreational and tribal fisheries in the Grande Ronde and Wallowa rivers. The LSRCP mitigation goal for the program is to return 9,184 hatchery-origin summer steelhead adults to the Snake River upstream of Ice Harbor Dam. The Wallowa hatchery steelhead stock was developed from adult steelhead trapped at Ice Harbor Dam in 1976 and Little Goose Dam in 1977-1978, while eyed eggs imported from Pahsimeroi Fish Hatchery (Idaho Department of Fish and Game) were the source of fish in 1979. Since 1979, the Wallow hatchery steelhead stock has been maintained from hatchery-origin adults trapped at the Wallowa FH, Big Canyon satellite facility – located at the confluence of Deer Creek and the Wallowa River just east of the town of Minam, Oregon, - and the Cottonwood Creek satellite facility in the lower Grande Ronde River (Washington Department of Fish and Wildlife). The current broodstock goal is to annually capture 450 adult summer steelhead (225 males and 225 females) to yield 800,000 smolts for release in the Wallowa River. The broodstock goal includes 90 fish trapped in the fall (45 males and 45 females) to yield 160,000 smolts and 360 adults trapped in the spring (180 males and 180 females) to yield 640,000 smolts. The two broodstocks and their resulting progeny are managed separately. Fall-returning fish are the descendants of fish originally caught by hook-and-line from the Lower Grande Ronde River during the early fall, 2002-2006. All offspring of fall-caught fish (160,000 smolts) and 50% of the offspring of spring-trapped fish (320,000 smolts) are acclimated and released at Wallowa FH. The remaining 320,000 smolt offspring of spring-trapped fish are acclimated and released from the Big Canyon facility. Currently, all broodstock are collected at Wallowa FH. Hatchery-origin adult steelhead trapped at the Big Canyon facility are stocked in local fishing ponds, released downstream in the Wallowa River ("recycled") to increase harvest opportunities for anglers (100 fish total over several weeks), or transferred to Wallowa FH to supplement the program's broodstock if needed. However, "backfills" from Big Canyon have not occurred since the early 1990's. Spawning of adults and initial incubation of eggs occurs at Wallowa FH. Eyed

eggs from all spawned adults (≈ 1.02 M eggs) are transferred to Irrigon FH for hatching and rearing to the yearling smolt stage. Smolts are transferred from Irrigon FH to Wallowa FH and the Big Canyon facility for acclimation and release.

Benefits: The Wallowa River Summer Steelhead program provides significant recreational and tribal harvests in the Grande Ronde River basin. Estimates of harvest of Wallowa steelhead in the Grande Ronde River basin for 1993/1994 through 2004/2005 averaged 2,381 fish (range 760-4,820) per year. Estimates of sport harvest (1993/1994-2004/2005) of Wallowa steelhead within the project area (outside the Grande Ronde River Basin) averaged 2,352 fish per year (759-3,874 fish/year). Annual estimated harvest (expanded from CWT recoveries) of Wallowa stock steelhead (for both release locations) within the project area for return years 2003-2005 averaged 6,724 fish per year (range = 4,394 to 8,694 fish/year). Approximately 9.3% of the total estimated harvest on Wallowa hatchery steelhead occurred outside the Snake River basin, 2003-2005.

Risks: The water alarm system at Irrigon FH is antiquated, thus posing demographic risks to the Wallowa hatchery stock reared there. The continued propagation and release of an introduced hatchery stock in the Grande Ronde River basin poses genetic and ecological risks to ESA-listed natural populations, although tagging data indicate very high homing fidelity of Wallowa steelhead back to release locations within the Grande Ronde River basin (Wallow FH and Big Canyon facility). On the other hand, significant "out-of-basin" straying of Wallowa steelhead into the Deschutes and John Day rivers poses genetic and ecological risks to natural populations in those watersheds; approximately 6% of all returning Wallowa hatchery steelhead for return years 1993/94 through 2004/05 were recovered as "out-of-basin strays".

Recommendations for current program: The Review Team identified 23 specific recommendations to reduce risks and/or improve benefits of the current Wallowa River Summer Steelhead program. These recommendations include: (a) continue to investigate alternative broodstocks and broodstock strategies to reduce straying risks outside the Grande Ronde River basin; (b) monitor escapement of steelhead into Joseph Creek and the Wenaha River within the Grande Ronde River basin to ensure that Wallowa hatchery steelhead compose less than 5% of the naturally-spawning steelhead in those two "refuge" streams; (c) discontinue the practice of "recycling" adult steelhead in the Wallowa River at the Big Canyon facility and find alternative benefits for those fish; (d) institute more stringent fish health protocols at Irrigon and Wallowa hatcheries to better control bacterial coldwater disease (e.g., by adopting the protocols used to control bacterial kidney disease); (e) update the water alarm systems at Irrigon FH; and (f) investigate options for de-icing the water intake, head, and tail screens at the Big Canyon satellite facility to reduce demographic risks to acclimated fish prior to release.

Alternatives to current program: The Review Team considered the pros and cons of five alternatives for the existing Wallowa River Summer Steelhead program, ranging from (a) the current program with full implementation of all program specific recommendations (Alternative 1) to (b) termination of the program and decommissioning the Wallowa FH and Big Canyon satellite facility (Alternative 5). The Review Team recommends Alternative 1: continuation of the current program with implementation of all program-specific recommendations. The current program provides significant harvest benefits and is currently meeting the mitigation requirements of the LSRCP. Consequently, the Team's recommendations largely reflect the need to control and reduce risks rather than change a program that is fundamentally meeting its intended benefits. The Team did discuss, at some length, the potential desirability of replacing the Wallowa hatchery stock with another stock (Alternatives 2 and 3), largely because other hatchery stocks of steelhead in the Snake River basin – including the Little Sheep Creek stock (see below), exhibit very low out-of-

basin stray rates compared to the Wallowa hatchery stock. In the end, the Team favored investigation and evaluation of additional measures to monitor, control, and reduce straying risks of the current program rather that recommend replacement of the Wallowa hatchery stock at this time. However, some Team members strongly favored the latter alternative to phase out the Wallowa hatchery stock and replace it with either (a) the Little Sheep Creek stock (Alternative 2) or (b) an endemic Grande Ronde River steelhead stock (Alternative 3).

Little Sheep Creek Summer Steelhead

Program overview: The program currently operates as an *integrated-harvest* program to support recreational and tribal fisheries in the Imnaha River basin. The LSRCP mitigation goal for the program is to return 2,000 hatchery-origin summer steelhead adults to the Snake River upstream of Ice Harbor Dam. The Little Sheep Creek hatchery steelhead stock was developed from natural-origin adult steelhead trapped in Little Sheep Creek beginning in 1982. The current broodstock goal is to annually capture and spawn 134 adult summer steelhead (67 males and 67 females) in Little Sheep Creek to yield 215,000 smolts for release in the Imnaha River watershed. Adults are trapped and spawned at the Little Sheep Creek satellite facility, located at river mile 5.2. Hatchery-origin adults in excess of broodstock needs are either (a) passed upstream of the weir in Little Sheep Creek to supplement natural-origin spawners (via a sliding scale) with the objective of achieving a total spawning escapement of 250 fish or (b) outplanted into Big Sheep Creek. ODFW and NOAA Fisheries are currently conducting a genetic evaluation of the relative reproductive success of hatchery and natural-origin steelhead upstream of the weir in Little Sheep Creek. From 1999 through 2008, an average of 1,186 hatchery-origin steelhead adults per year (range = 42-2,030 fish/year) from Little Sheep Creek were outplanted into Big Sheep Creek. Unfertilized gametes collected at the Little Sheep Creek satellite facility are transported to Wallowa FH for fertilization and incubation to the eyed stage. Eyed eggs are transferred to Irrigon FH for final incubation, hatching, and rearing to the yearling smolt stage. Two groups of yearling steelhead are transferred from Irrigon FH and released in the Imnaha River basin: (1) 165,000 yearling smolts are acclimated and released at the Little Sheep Creek satellite facility and (2) 50,000 yearling smolts are direct stream-released into Big Sheep Creek.

Benefits: The Little Sheep Creek steelhead program provides recreational and tribal harvest benefits in the Imnaha River basin. Estimates of harvest of Little Sheep Creek steelhead in the Imnaha River Basin for return years 1993/1994 through 2004/2005 averaged 183 fish per year (range = 24-397 fish/year). Estimates of harvest (1993/1994-2004/2005) of Little Sheep Creek steelhead, upstream of Ice Harbor Dam but outside the Imnaha River Basin, averaged 371 fish/year. Annual estimated harvest of Little Sheep Creek steelhead upstream of Ice Harbor Dam for return years 2003-2005 averaged 696 fish per year (range = 760 to 1,295 fish/year). Estimated harvest of Little Sheep Creek steelhead upstream of Ice Harbor Dam accounted for 66.4% of the total estimated harvest on the stock with 33.6% of the total harvest on hatchery-origin fish occurring downstream of Ice Harbor Dam in the Columbia and Snake rivers.

Risks: The proportion of naturally spawning steelhead composed of hatchery-origin fish (*pHOS*) exceeds the proportion of the broodstock composed of natural-origin fish (*pNOB*), thus posing genetic domestication risks to the naturally spawning population in Little Sheep Creek. High egg loading and juvenile rearing densities in nursery tanks at Irrigon FH increase fish health risks. Outplanting large numbers of hatchery-origin adults into Big Sheep Creek each year (mean ≈1000 fish/year since 1998), plus the annual outplanting of hatchery-origin smolts, most likely results in the number of hatchery origin adults substantially exceeding the number of natural origin adults spawning in Big Sheep Creek in most, if not all, years, thus posing a significant genetic

domestication risk to the naturally spawning steelhead population in Big Sheep Creek. The desired benefits or goal of those outplants have not been clearly defined.

Recommendations for current program: The Review Team identified 13 specific recommendations to reduce risks and/or improve benefits of the current Little Sheep Creek steelhead program. These recommendations include: (a) discontinue the release of smolts and adults into Big Sheep Creek unless the activity can be justified based upon specific goals for the program; (b) review and adjust the sliding scale for determining the number of hatchery-origin adults passed upstream of the weir in Little Sheep Creek, consistent with the research and conservation goals of the program; (c) reduce egg incubation and juvenile rearing densities from current levels to levels consistent with fish health guidelines; (d) institute more stringent fish health protocols at the Little Sheep Creek satellite facility, Irrigon FH, and Wallowa FH to better control bacterial coldwater disease (e.g., by adopting protocols similar to those used to control bacterial kidney disease); (e) test steelhead juveniles for *IHN* virus and the parasite *Myxobolus cerebralis* (causative agent of whirling disease) two to four weeks prior to release from the Little Sheep Creek acclimation pond, (f) repair the concrete apron immediately downstream of the weir in Little Sheep Creek to prevent scouring and undercutting of the underlying stream bed before the problem worsens; (g) evaluate the extent of post-release residualism of steelhead smolts downstream of the weir in Little Sheep Creek; and (h) develop a monitoring and evaluation program for Big Sheep Creek to determine whether the intended benefits of outplanting adults and releasing smolts – benefits which need to be defined and quantified – are indeed being achieved.

Alternatives to current program: The Review Team considered the pros and cons of six alternatives for the Little Sheep Creek hatchery steelhead program, ranging from (a) the current program with full implementation of all program specific recommendations (Alternative 1) to (b) termination of the program and decommissioning the Little Sheep Creek satellite facility (Alternative 6). The Review Team recommends Alternative 1: continuation of the current program with implementation of all program-specific recommendations. Implementation of Alternative 1 should maintain the genetic integrity of the broodstock, improve fish culture efficiency, decrease ecological and disease risks, and maintain the existing level of fishing opportunity for steelhead in the Imnaha River basin and in downstream fisheries. These recommendations emphasize the need to define goals for all management actions (e.g., outplanting 1,000 hatchery-origin adult steelhead in Big Sheep Creek annually) in terms of numeric outcomes that quantify intended benefits independent of, but consistent with, the mitigation goals of the overall program. The Review Team concluded also that the sliding scale for passing adult steelhead upstream of the weir on Little Sheep Creek needs to be adjusted so that the number of hatchery and natural-origin fish passed upstream are consistent with the research and conservation goals of the program. For example, the number of hatchery and natural-origin fish passed upstream of the weir should be as equal as possible to maximize the power and minimize bias of the experimental design to assess the relative reproductive success of hatchery and natural-origin fish.

Conclusions

The Review Team concluded that conflicts exist between actions intended to achieve LSRCP mitigation goals to support fisheries in the Snake River basin and conservation goals for individual populations within the Grande Ronde and Imnaha rivers of Oregon. For example, the spring Chinook program in the Imnaha River contributes significantly to the total number of hatchery-origin spring Chinook that return upstream of Lower Granite Dam in support of LSRCP mitigation goals; however, large numbers of hatchery-origin Chinook salmon are posing significant genetic and ecological risks

to the naturally-spawning population. The Review Team recommends the development of separate "Master Plans" for each population in each watershed (e.g., spring Chinook in Catherine Creek) to help resolve conflicts.

The Team concluded that the Lookingglass Creek Spring Chinook program, derived from the Catherine Creek stock for reintroduction, has increased adult recruits to the basin. However, the current productivity and capacity of Lookingglass Creek upstream of the hatchery may not be sufficient to provide the number of natural-origin adults sufficient to annually support an integrated broodstock of 170 adult spring Chinook. In addition, the existing management goal and sliding scale for passing hatchery-origin fish upstream of the hatchery weir will eventually pose a long- term risk to reestablishing a viable natural population at current levels of passage of hatchery-origin fish. The Team recommends increasing the number of smolts released from the hatchery and modification of the sliding scale to limit the number of hatchery-origin fish passed upstream of the weir when natural-origin adults achieve a threshold level viability abundance. The Team concluded that these changes to the program would reduce long-term risks to reestablishing a natural population in Lookingglass Creek while providing increased harvest opportunities on hatchery-origin spring Chinook. However, because of capacity limits of Lookingglass Hatchery, increasing the size of the Lookingglass Creek Spring Chinook program would require reducing the sizes of other programs, specifically, the Upper Grande Ronde River and Imnaha River spring Chinook programs.

The Team concluded that the Upper Grande Ronde River Spring Chinook program was providing a conservation benefit to the natural population by preventing extinction of a population at significant risk of extinction due to degraded habitat and low smolt-to-adult return rates. The Team also concluded that the near-term goal of the program should be to implement a safety net program sized to maximize the remaining genetic variability until the demographic risks to the population from poor habitat have been addressed and a natural population can be re-established in the upper Grande Ronde River.

The Team concluded that the Catherine Creek Spring Chinook program has provided a conservation benefit; however the current sliding scale should be modified to reduce the number of hatchery-origin fish passed upstream of the weir when escapement objectives for natural-origin fish have been met. Releasing surplus hatchery-origin fish to spawn naturally when escapement goals for natural-origin adults have been achieved poses unnecessary genetic and ecological risks to the natural population. In addition, the Team concluded that the outplanting of hatchery-origin adults into Indian Creek should be discontinued unless that outplanting can be justified and subsequently evaluated relative to an identified conservation goal.

The Team concluded that the Lostine-Wallowa River Spring Chinook program was providing a conservation benefit to the natural population; however, the inefficiency of the existing weir and the current sliding scale for determining the number of hatchery-origin fish passed upstream of the weir poses a long-term risk to the natural population. In addition, the Team concluded that the outplanting of hatchery-origin adults into the Wallowa River, Bear Creek, and Prairie creek should be discontinued unless that outplanting can be justified and subsequently evaluated relative to an identified conservation goal. The Team also supported development of the Northeast Oregon Hatchery (NEOH) in the Lostine River to relieve facility constraints at Lookingglass FH and to provide greater opportunities for achieving comanager goals in the Lookingglass Creek program and the Lostine-Wallowa rivers.

The Team concluded that the Imnaha River Spring Chinook program was providing a conservation, demographic benefit to the natural population; however, the large numbers of hatchery-origin fish

spawning in the Imnaha River upstream of the weir, coupled with the inefficiency of the existing weir and the deliberate outplanting of hatchery-origin adults into Big Sheep and Lick creeks, pose additional genetic risks to natural populations. The Team concluded that a slight reduction in the size of the program, an adjustment to the current sliding scale to reduce the number of hatchery-origin fish released above the weir, modification of the existing weir to improve trapping efficiency across the entire run, and discontinuation of adult outplants – unless justified and monitored - would reduce risks considerably while continuing harvest benefits and contributions to LSRCP mitigation goals.

The Team concluded that the segregated-harvest Wallowa stock steelhead program in the Grande Ronde River provides a significant harvest benefit; however, the continued straying of Wallowa stock steelhead into the Deschutes and John Day rivers did pose a significant risk to those natural populations. The Team concluded that continued monitoring of straying both within the Grande Ronde River and outside the Basin (Deschutes and John Day rivers) should be continued to ensure that the existing program does not significantly impact conservation goals in those areas. The Team also concluded that continued investigation of alternative broodstocks and broodstock strategies aimed at reducing straying should continue so that alternatives could be implemented if straying continues and risks to natural populations are deemed unacceptable. The Team concluded that straying of returning Wallowa stock steelhead into tributaries of the mid-Columbia River, including the Deschutes and John Day rivers, constitutes a substantial conservation issue.

The Team concluded that the Little Sheep Creek Summer Steelhead program in the Imnaha River also provides significant harvest benefits; however, the relatively large numbers of hatchery-origin fish spawning in Little Sheep Creek, and the outplanting of large numbers of hatchery-origin adults and juveniles into Big Sheep Creek, pose significant risks to the naturally spawning populations. The Team concluded that the sliding scale for releasing hatchery-origin fish upstream of the weir should be reviewed and adjusted to be consistent with the goals and objectives of the existing research and conservation program. The Team also concluded that the continued outplanting of adults and juveniles into Big Sheep Creek should be discontinued unless justified by clearly defined goals and objectives for continuing those outplants.

In general, the Team recognizes that the current LSRCP programs in the Grande Ronde and Imnaha River basins are making important contributions toward tribal and recreational fisheries in those terminal areas. However, those programs are not without risks to existing natural populations, and portions of those programs conflict with goals associated with conserving or reestablishing natural populations. The Team recommends that comanagers develop a series of Master Plans for each species and each watershed where hatchery propagation is intended to be a tool for achieving harvest and/or conservation goals. The Northeast Oregon spring Chinook master plan may serve as an appropriate starting point for generating specific plans for individual species in the Grande Ronde and Imnaha river systems. Hatchery and Genetic Management Plans for each hatchery program could be updated simultaneously as partial components of each species Master Plan. The Team recommends that those Master Plans identify specific short term conservation goals for natural populations in each watershed with objectives and benchmarks for achieving them via the use of hatchery propagation.

I. Introduction

In the past 150 years, habitat alterations, hydroelectric development and consumptive fisheries have affected the productivity, abundance, spatial distribution, and diversity of natural populations of Pacific salmon and steelhead (*Oncorhynchus mykiss*) in the Pacific Northwest. To mitigate for those impacts, hatcheries have been used to increase the number of fish available for harvest. However, long-term conservation needs of natural salmonid populations and their inherent genetic resources now require a reexamination of the role of hatcheries in basin-wide management and conservation strategies.

Hatcheries need to be part of a holistic and integrated strategy that combines habitat, hydropower and harvest needs for conserving and managing fishery resources. These strategies must establish short- and long-term goals for both hatchery-propagated and naturally-spawning populations. However, modifying hatchery programs and operations to achieve both conservation and harvest goals in a coordinated manner is difficult and complex. Scientific uncertainties exist regarding the ability of hatcheries and hatchery-origin fish to directly assist with recovery of naturally-spawning populations while, at the same time, sustaining major fisheries. Uncertainties also exist regarding genetic and ecological interactions between natural- and hatchery-origin fish. Only an objective, collaborative, science-based approach can address these problems in a manner that is both scientifically defensible and accepted by the public.

In an effort to improve its hatchery programs and to ensure that existing facilities are best meeting conservation and harvest goals, the U.S. Fish & Wildlife Service (Service) initiated, in October 2005, a review 21 salmon and steelhead hatcheries that the Service owns or operates in the Columbia River Basin. That review was expanded in 2008 to include three National Fish Hatcheries (NFHs) on the Olympic Peninsula of Washington State. The goal of these reviews is to ensure that Service hatcheries are operated in accordance with best scientific principles, and contribute to sustainable fisheries and the recovery of naturally-spawning populations of salmon, steelhead and other aquatic species.

This internal review is modeled after the recent Puget Sound and Coastal Washington Hatchery Reform Project conducted by the Hatchery Scientific Review Group (HSRG).[6] That project provided a solid template and operational tools (e.g. software spreadsheets, population dynamic models) for reviewing Service hatcheries in the Columbia River Basin. Much of the background information necessary for reviewing hatcheries in the Columbia River Basin has already been compiled in Hatchery and Genetic Management Plans (HGMPs),[7] Comprehensive Hatchery Management Plans (CHMPs),[8] and the Artificial Propagation Review and Evaluation (APRE)[9] database developed by the Northwest Power and Conservation Council (NWPCC).

Based on the recommendations of a Hatchery Review Working Group (Working Group),[10] the Service's Assistant Regional Director for Fisheries (ARD) assembled a Columbia Basin Hatchery

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[6] *For more information on this project and fall project publications see www.hatcheryreform.org and www.hatcheryreform.us.*

[7] *For more information on HGMPs, visit www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/Hatcheries/Hatchery-and-Genetic-Management-Plans.cfm.*

[8] *For more information on CHMPs, visit www.fws.gov/pacific/Fisheries/CHMP.htm.*

[9] *For more information on APRE, visit www.nwcouncil.org/fw/apre/.*

[10] *The Working Group was appointed in November 2004 by the Service's Assistant Regional Director for Fisheries, Pacific Region. The Working Group's report and all other Columbia Basin Hatchery Review documents are available from the project's website, www.fws.gov/pacific/fisheries/hatcheryreview/.*

Review Team (Review Team). This Review Team, comprised of Service and other federal agency scientists, has adapted the HSRG's scientific framework, principles and hatchery review tools for reviewing each federal hatchery program and facility. The Team provides continuity with the HSRG because the two co-chairs served on the HSRG and the Hatchery Reform Policy Coordinating Committee, respectively. The Service has contracted for project facilitation with Long Live the Kings (LLTK), a non-profit organization devoted to restoring wild salmon to the waters of the Pacific Northwest. LLTK has provided facilitation, communications and coordination for the Puget Sound and coastal Washington hatchery review process.

Review Team members include:

- **Don Campton** (Co-Chair), Science Advisor, USFWS, Pacific Regional Office, Portland, Oregon.
- **Douglas DeHart** (Co-Chair), Fish Biologist, Coffee Creek Bioscience, Oregon City, Oregon.
- **Tom Flagg**, Supervisory Fish Biologist, NOAA Fisheries, Manchester Research Station, Manchester, Washington.
- **Susan Gutenberger**, Supervisory Microbiologist, USFWS, Lower Columbia River Fish Health Center, Willard, Washington.
- **Joe Krakker**, Fishery Biologist, USFWS, Lower Snake River Compensation Plan Office, Boise, Idaho.
- **Bryan Kenworthy,** Project Leader and Manager , USFWS, Hagerman National Fish Hatchery, Hagerman Idaho
- **Larry Marchant**, Project Leader and Manager, USFWS, Spring Creek NFH, Underwood, Washington.
- **Doug Olson**, Hatchery Assessment Team Leader, USFWS, Columbia River Fisheries Program Office, Vancouver, Washington.
- **Chris Pasley**, Supervisory Fishery Biologist and Manager, USFWS, Winthrop NFH, Winthrop, Washington.
- **Herb Pollard,** Fish Biologist and Management Specialist, Independent Consultant.

Team support members include:

- **Michael Schmidt** (Facilitator), Director of Fish Programs, Long Live the Kings, Seattle, Washington.
- **Jed Moore,** Project Assistant, Long Live the Kings, Seattle, Washington.
- **Cheri Anderson** (Outreach), Information and Education Manager, USFWS, Spring Creek NFH, Underwood, Washington.

The Fisheries ARD has also appointed a Hatchery Oversight Team (Oversight Team), consisting of line supervisors with policy and managerial responsibilities, as the Service's primary internal mechanism to oversee the review process, monitor its progress, and transmit communications and reports from the Review Team to the ARD and project leaders within the Service's Pacific Region Fisheries Program. The Oversight Team, along with the ARD, will be the primary contact group between the Service and its partners for developing mechanisms and policies for implementing, or modifying, the Review Team's recommendations.

The review process began in October 2005 with the Warm Springs National Fish Hatchery (NFH). This hatchery is located on the Warm Springs River, in the Deschutes River watershed/Columbia Plateau province, in Oregon. This review was conducted as a pilot to help the Service test and refine the review process. Fishery comanagers and stakeholders were involved in the review process and asked to comment on draft reports and recommendations. The final report for Warm Springs NFH was released in May 2006 (available at www.fws.gov/Pacific/fisheries/hatcheryreview/reports.html).

Following this pilot review, the Service adjusted the process for reviewing federal hatcheries that support artificial propagation programs for four regions: Lower Columbia River, Mid-Columbia River, Snake River, and the Olympic Peninsula (Fig. 1). Facilities in those regions include five NFHs in the Lower Columbia River region (Eagle Creek, Carson, Little White Salmon, Willard and Spring Creek NFHs); three NFHs in the Mid-Columbia River region (Leavenworth, Entiat and Winthrop NFHs); three NFHs in the Snake River region: (Dworshak, Kooskia and Hagerman NFHs), three NFHs in the Olympic Peninsula region (Makah, Quilcene, and Quinault NFHs), and nine federally-owned hatcheries operated by the states of Idaho, Oregon, or Washington as part of the Lower Snake River Compensation Plan (LSRCP). The Service completed its review of all the National Fish Hatcheries in July 2009.

The report presented here reviews hatchery programs at three federally-owned LSRCP hatcheries in Oregon: Lookingglass Fish Hatchery (FH), Irrigon FH, Wallowa FH, and satellite facilities in Northeast Oregon (Fig. 2). These hatcheries rear fish that are released into the Grande Ronde and Imnaha river watersheds.

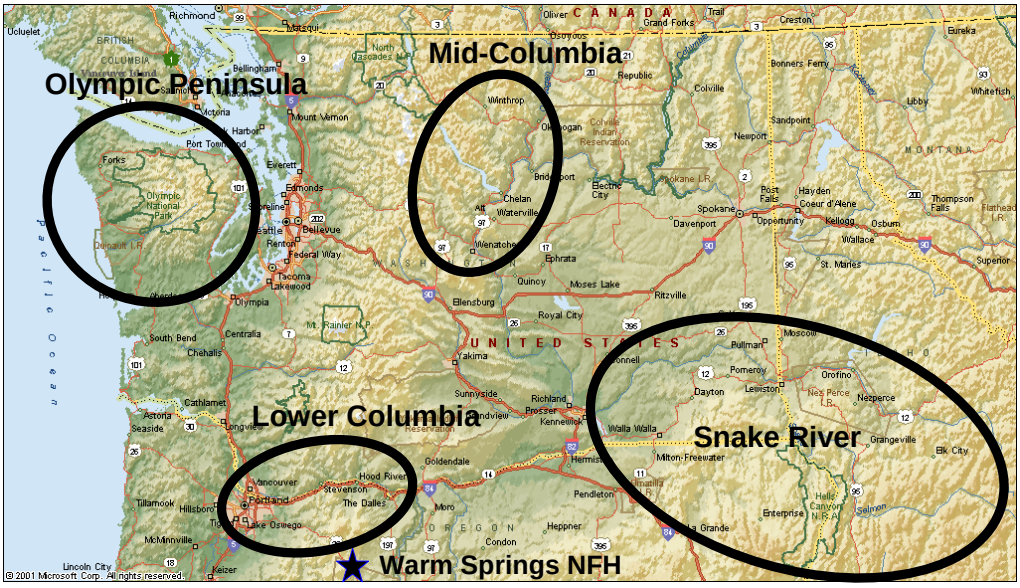

Figure 1. Regions of the Pacific Region Hatchery Review Project

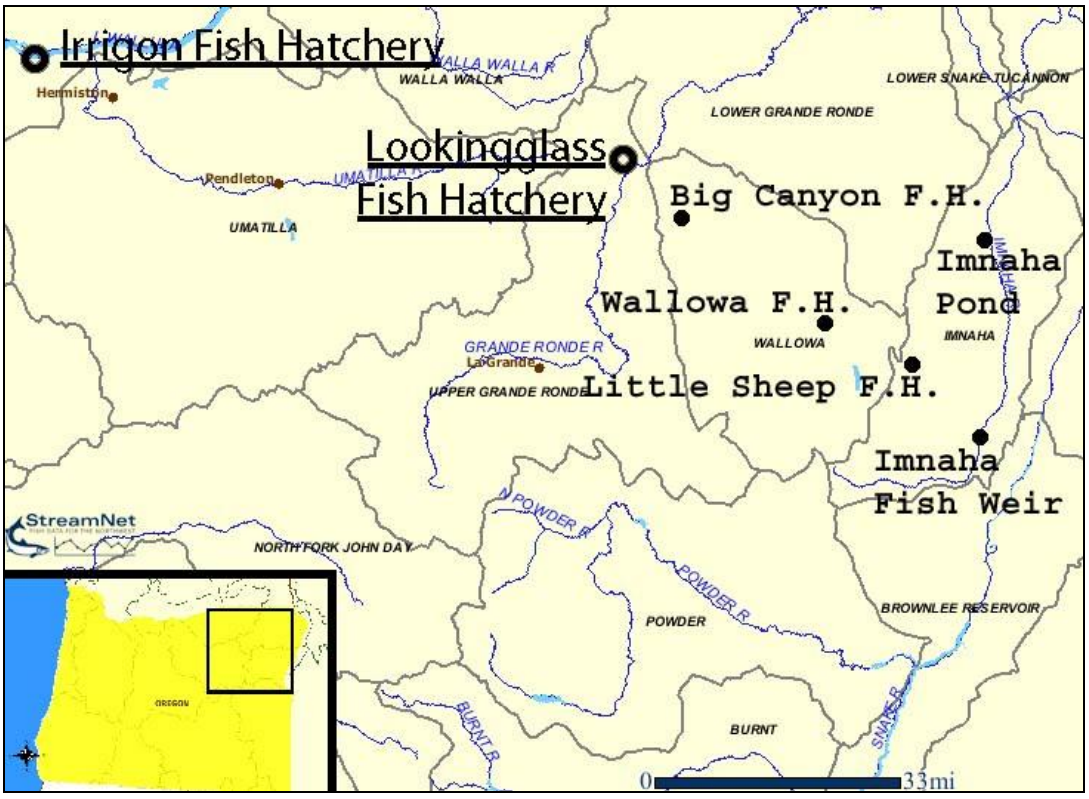

Figure 2. Oregon Lower Snake River Compensation Plan hatcheries reviewed in this report. [11]

[11] *Modified figure from: Streamnet. <http://map.streamnet.org/website/snetmapper/viewer.htm>*

II. Components of this Report

This report provides assessments and recommendations developed from a comprehensive review of current propagation programs at Lookingglass, Irrigon, and Wallowa fish hatcheries. Recommendations presented herein are based on the best scientific information available at the time of the review. This information includes peer-reviewed scientific information in published works (scientific journals, etc.), agency reports, and pertinent information directly accessible via electronic download. In its review, the Team followed three fundamental principles it adopted from the HSRG (Mobrand et al. 2005[12]): (1) hatchery programs need to have well-defined goals in terms of desired benefits; (2) hatchery programs and protocols must be scientifically defensible; and (3) hatchery programs need to monitor and evaluate their benefits and risks with programmatic flexibility to respond adaptively to new information.

The Review Team reviewed a large number of background documents, toured the three LSRCP state operated fish hatcheries and local habitat features, and received presentations on a variety of salmonid management issues within the Grande Ronde and Imnaha River watersheds. The Team met with biologists representing the LSRCP cooperators and regional stakeholders to discuss the purpose of the review, hatchery operations, stock goals, and specific issues the cooperators and stakeholders wanted the Review Team to consider. Workshops for gathering that information used the All-H Analyzer (AHA) decision support tool[13] to document goals, premises and explore alternatives (Appendix A). All source documents not readily available to the general public are accessible via the Service's hatchery review website[14]. Appendix B of this report summarizes the hatchery information on which the review and recommendations are based.

Based on the information gathered, the Review Team assessed benefits and risks of each hatchery program relative to current or short-term (10-15 years) goals and then drafted a set of preliminary recommendations designed to increase or maintain benefits while minimizing or reducing risks. The Team also examined possible program alternatives to address long-term (15-50 years or greater) conservation and/or harvest goals. The initial results of the review were presented orally to LSRCP cooperators. The Review Team then developed a draft report, circulated it to the cooperators for initial comment and revision, and then posted it on the Team's website for one month for public comment. The Team also conducted a public meeting with interested stakeholders (e.g., fishing guides, conservation groups, etc.) to introduce the review process and receive verbal input. The final report presented here was prepared after written comments on the draft report were received from cooperators, interested stakeholders, and the general public. Review Team responses to those written comments are presented in Appendix C. The complete texts of all written comments received are compiled in Appendix D. Finally, a summary of the annual operating costs associated with each hatchery is presented in Appendix E.

Watershed Overview

The following report contains a background overview of the Grande Ronde and Imnaha River watersheds. The overview includes information on geography, fisheries, conservation, habitat, and the

[12] *Mobrand, L., J. Barr, L. Blankenship, D.E. Campton, T.T.P. Evelyn, T.A. Flagg, C.V.W. Mahnken, L.W. Seeb, P.R. Seidel, and W.W. Smoker. 2005. Hatchery reform in Washington State: principles and emerging issues. Fisheries 30(6): 11-23.*

[13] *For more information on AHA, see the Analytical Tools page of www.hatcheryreform.us.*

[14] *www.fws.gov/Pacific/fisheries/hatcheryreview/*

current status of each salmonid stock within those watersheds. Information on the status and hatchery propagation of each stock is summarized in a table for quick reference.

Stock Status

An understanding of the current status of each salmonid stock in each watershed was necessary for assessing the benefits and risks associated with each hatchery program. The Review Team summarized the current status of each stock in terms of four population parameters: *biological significance*, *viability*, *habitat*, and *harvest*. Each of those parameters was given a generalized rating of "high", "medium", or "low" as a foundation for assessing the benefits and risks of each hatchery program. The Review Team also needed to understand the short-term (10–15 years) and long-term (50 years or greater) goals for each salmonid stock within each watershed relative to the four population parameters. However, it was neither the mandate nor the responsibility of the Review Team to perform detailed, scientific assessments of population status. Instead, the Review Team relied on the consensus assessments of the comanagers: Oregon Department of Fish and Wildlife (ODFW), National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NOAA Fisheries), Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and our own Service biologists. The Review Team also relied on the subbasin plans of the Northwest Power and Conservation Council (NWPCC)[15] and reports of the Interior Columbia Technical Recovery Team (ICTRT).[16] Working definitions for each of the four population parameters are provided below.

Biological significance is a measure of the biological uniqueness of a particular stock or population relative to other stocks of the same species. This measure considers the genetic origins of the stock (e.g. native or non-native), biological attributes that are unique or shared with other stocks (e.g. life history, physiological, or genetic attributes), and the extent to which the stock may be considered one component of a larger population structure, including population subdivisions within the stock. In general, a stock is defined as *low*, *medium* or *high* biological significance depending on its level of uniqueness and the ability of other stocks to potentially replace it in the occupying habitat if local extirpation were to occur. Stocks with *high* biological significance usually have one or more unique biological characteristics that may reflect local adaptations and would be difficult to replace by other stocks of the same species. Consequently, biological significance is not based on the degree to which the stock may be considered essential for harvest or recovery of a particular species, but rather on its own innate biological attributes within the watershed in which the stock occurs. For example, a particular stock or population may be abundant and productive and, therefore, considered to have high *management* significance for harvest or recovery. However, that stock would not necessarily be considered to have high *biological* significance unless (a) it possessed biological attributes not shared by other stocks of the same species or (b) all other stocks within the region or DPS/ESU[17] were substantially less viable. This approach thus distinguishes the *evolutionary legacy* of a stock within a particular watershed from co-manager decisions regarding the potential *management value* of that stock. In this context, *biological significance* ratings are based on the factors described by Mobrand et al. (2005)[18].

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[15] *http://www.nwcouncil.org/fw/subbasinplanning/Default.htm*

[16] *http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Index.cfm*

[17] *Distinct Population Segment (DPS) and Evolutionarily Significant Unit (ESU). ESU is NOAA Fisheries' definition for a Distinct Population Segment (DPS) of Pacific Salmon under the U.S. Endangered Species Act. NOAA Fisheries has retained DPS designations for steelhead.*

[18] *Mobrand, L., et al. 2005. Hatchery reform in Washington State: principles and emerging issues. Fisheries 30(6): 11-23.*

Population viability measures the ability of a stock to sustain itself under current environmental conditions. NOAA Fisheries has assembled *Technical Recovery Teams* (TRT) to assess viabilities and develop recovery criteria for ESA-listed salmon and steelhead populations throughout the Pacific Northwest. Those assessments involve significant mathematical modeling and attempt to predict extinction probabilities over the next 100 years based on four viability parameters: abundance, productivity, spatial structure, and diversity.[19] Preliminary viability estimates for listed salmonid stocks in the Snake River region have been compiled by the Interior Columbia TRT (ICTRT)[20]. Where available, the Review Team relied on those viability estimates, as developed by the ICTRT; otherwise, the Review Team relied on the viability criteria of Mobrand et al. (2005)[21]. The goal here was to establish a qualitative understanding of the current viability of each salmonid stock potentially affected by each Service hatchery program as a foundation for assessing potential benefits and risks of those programs. However, estimating the viability of a natural population, including *integrated* hatchery stocks, is difficult because those estimations require detailed evaluations of natural reproductive output and enumeration of natural-origin adult returns over multiple generations. In contrast, the viability of *segregated* hatchery stocks is relatively simple and is determined primarily by the number of hatchery-origin adult recruits (R) recaptured in fisheries, the hatchery, or other areas per adult spawner (S) in the hatchery one generation earlier (R/S).

Habitat conditions for a particular stock are assessed quantitatively through estimates of the *capacity* and *productivity* of the environment under current conditions to support returning adult spawners and juvenile fish (assessed via spawner-recruit models). In this context, premises regarding habitat refer primarily to natural populations and the specific watersheds in which hatcheries are located. These premises are important for assessing the ability of the local habitat and watershed to support self-sustaining natural populations and genetically *integrated* hatchery broodstocks, including assessment of risks posed by hatchery-origin fish spawning naturally. The productivity and capacity of a watershed are difficult to estimate directly, but the *Ecosystem Diagnosis and Treatment* (EDT) model attempts to predict those parameters for a "focal species" based on empirical estimates of a variety of habitat parameters (www.mobrand.com/MBI/edt.html). Where available, the Review Team relied on HSRG (2009) estimates of current and future habitat conditions (productivity and capacity) for each salmonid stock in the pertinent watersheds associated with a Service hatchery.[22] Habitat and capacity parameters can also be adjusted iteratively in spawner-recruit population dynamic models to yield results that best fit empirical estimates of total adult returns and/or smolt output under current conditions (Appendix A). This latter approach allows cooperators and others to evaluate potential alternative strategies for improving long-term population viabilities via habitat enhancements or other management actions.

Harvest on salmonid fishes occurs at different locations and times and can be assessed by the mean number of adult fish harvested annually in mixed stock ocean fisheries, mainstem Columbia River fisheries, and/or terminal fisheries within the particular sub-basin or watershed under consideration (Appendix A). Harvest parameters can be adjusted in a manner analogous to adjusting habitat

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[19] *McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmon populations and the recovery of evolutionary significant units. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-42, Seattle, WA 156pp. Also see www.nwfsc.noaa.gov/trt/trt_Columbia.htm*

[20] *http://www.nwfsc.noaa.gov/trt/columbia.cfm*

[21] *Mobrand, L., et al. 2005. Hatchery reform in Washington State: principles and emerging issues. Fisheries 30(6): 11-23.*

[22] *Hatchery Scientific Review Group (HSRG). 2009. Population Reports, Appendix E, Columbia River Systemwide Report. Available at: www.hatcheryreform.us/.*

parameters (as described above) to identify levels of harvest that are sustainable under a particular set of habitat conditions as measured by productivity and capacity.

Hatchery Programs

Hatchery programs are associated with many salmonid stocks. In general, all hatchery programs can be classified according to their type and purpose. Hatchery programs are classified (1) as either *integrated* or *segregated* according to the genetic management goals for the broodstock and (2) according to the purpose of the program with respect to intended benefits (e.g., harvest, conservation, research, etc.).

A hatchery program (or broodstock) is classified as *integrated* if natural-origin fish are purposefully included in the broodstock each year, or the intent of the program is to purposefully include natural-origin fish in the broodstock, with the goal that the natural environment will primarily determine the genetic constitution of hatchery-origin fish. The integrated strategy manages hatchery and wild fish as one population (or one gene pool) that spawns in two different environments but recognizes that the phenotypic performances of hatchery and wild fish can be quite different even when the two components are genetically the same. A properly integrated broodstock requires proportion of a broodstock composed of natural-origin fish (symbolized by "*pNOB*") exceed the proportion of natural spawners composed of hatchery-origin fish (*pHOS*).

A hatchery population is defined as *segregated* if it is propagated as a "closed" population where only hatchery-origin fish are used, or are intended to be used, for broodstock. *Segregated* programs or broodstocks are intended to maintain the hatchery population as a distinct, genetically-segregated population via the exclusive use of hatchery-origin adults for broodstock.

The segregated and integrated strategies yield very different broodstock goals and propagation protocols. The segregated strategy creates a hatchery-adapted population that can facilitate management goals (e.g. harvest) but which can also increase genetic and ecological risks to natural populations. In contrast, the integrated strategy attempts to increase the abundance of fish representing an existing natural population or gene pool.

Hatchery programs need to be defined also in terms of their intended benefits. The primary purpose of most hatchery programs is to achieve *harvest* or *conservation* benefits, or both. Secondary purposes can include conservation or harvest, but often include education, research, socioeconomic or cultural/ceremonial benefits. These purposes should be closely linked to the goals of hatchery programs. Although *mitigation* is often stated as a "purpose" of a hatchery program, mitigation typically refers to the replacement of wild fish with hatchery fish without defining specific goals in terms of desired benefits (e.g., *mitigate* for fish losses associated with hydropower dams).

Operational Considerations

The Review Team considered all components of each hatchery program. Major features and issues of each program were summarized into the following subcategories: (a) program goals and objectives; (b) broodstock choice and collection; (c) hatchery and natural spawning, including adult returns; (d) incubation and rearing; (e) release and outmigration; (f) facilities and operations; (g) research, monitoring, and accountability, and (h) education and outreach.

Benefit and Risk Assessment

In conducting this review, the Review Team considered a wide range of possible benefits and risks potentially conferred and imposed, respectively, by hatchery programs.

Benefits considered include:

- Contributions to tribal and non-tribal harvests (commercial and recreational).
- Short- and long-term conservation benefits (both demographic and genetic).
- Research opportunities afforded by the program.
- Educational, cultural, ceremonial and socioeconomic benefits conferred by the program and the hatchery facility itself.

Risks considered include:

Genetic Risks

- Risks from artificial propagation on the genetic constitution and fitness of hatchery-origin fish representing the cultured stock.
- Risks from natural spawning by hatchery-origin adults on the mean fitness of natural-origin fish of the same species in target and non-target watersheds.

Demographic Risks

- Pre-release risks from the hatchery facility and operations on the abundance of the propagated stock including the following: pre-spawning mortality associated with trapping, holding and/or bypassing adults; disease risks associated with overcrowding or high rearing densities of cultured fish; inadequate fish health protocols and water flow alarms to prevent catastrophic fish losses in the hatchery; poaching by humans; and predation by birds, mammals and fish at the point of release or on the hatchery grounds (e.g. by otters and birds).
- Post-release risks to the abundance of the propagated stock, including congregation of released fish at the release point and/or unnatural surface feeding (conditioned by hatchery rearing) that may increase vulnerability of released fish to predators, thus decreasing smolt-to-adult survival.
- Demographic risks from hatchery operations on the abundance of other stocks and species within the watershed in which the hatchery is located (e.g. effects of a barrier weir for trapping adults for hatchery broodstock).

Ecological Risks

- Competition, predation, and disease transfer from hatchery-origin adults and juveniles of the propagated stock to naturally spawning populations of the same species or stock in target and non-target watersheds.
- Competition, predation, and disease transfer from hatchery-origin adults and juveniles of the propagated stock to naturally spawning populations of different species in target and non-target watersheds, including non-salmonid fish species of particular concern (e.g. lamprey).

- Risks from the hatchery facility and operations on the aquatic biota and ecosystem within the target watershed, including the effects of hatchery effluent, water intake, use of chemicals, and upstream/downstream passage of fish and other aquatic species in the watershed.
- Risk of antibiotic use resulting in developing resistant strains of pathogenic organisms that infect salmonid fishes, other aquatic species, and humans.
- Producing fish that are not qualitatively similar to natural fish of the same species in size, growth rate, morphology, behavior, physiological status or health, which may adversely affect the performance of natural fish via competition or predation.
- The Team recognizes that hatchery-origin juveniles and adults may ecologically impact other fish species and populations in the estuary and ocean environment; however, little information on these *cumulative effects* is currently available.

Physical Risks

- Risks from the hatchery facility and operations to human health and safety, including potential contaminants.

The Team evaluated the benefits and risks of all operational and physical components of each hatchery program. These components are the same as those outlined above under *Operational Considerations.* Those evaluations then formed the bases of the Team's recommendations.

Recommendations

After careful assessment of the benefits and risks conferred by a hatchery program, the Review Team developed a series of recommendations to increase the likelihood of achieving the desired goals and benefits of the program and/or reducing biological and other risks. Recommendations for the current hatchery programs are grouped into the same categories as listed above under *Operational Considerations*. Recommendations for current programs are intended to address short-term goals and needs.

Alternatives

The review team then identified several alternatives to the current program, as suggested by comanagers or inferred from long term goals for salmonid stocks within the region, with an overall assessment of the value and merits (pros and cons) of those potential alternatives relative to the current program. By default, the following alternatives were included in each assessment: (a) the current program with full implementation of all recommendations and (b) termination of the current program and decommission of the hatchery in favor of alternative mitigation strategies (e.g., habitat restoration, construction of a new hatchery elsewhere, etc.). The Team then selected a recommended alternative, or combination of alternatives, that the Team concluded would provide the greatest benefit-risk ratio in support of long-term harvest and conservation goals.

III. Oregon Lower Snake River Basin - Grande Ronde and Imnaha River Watersheds

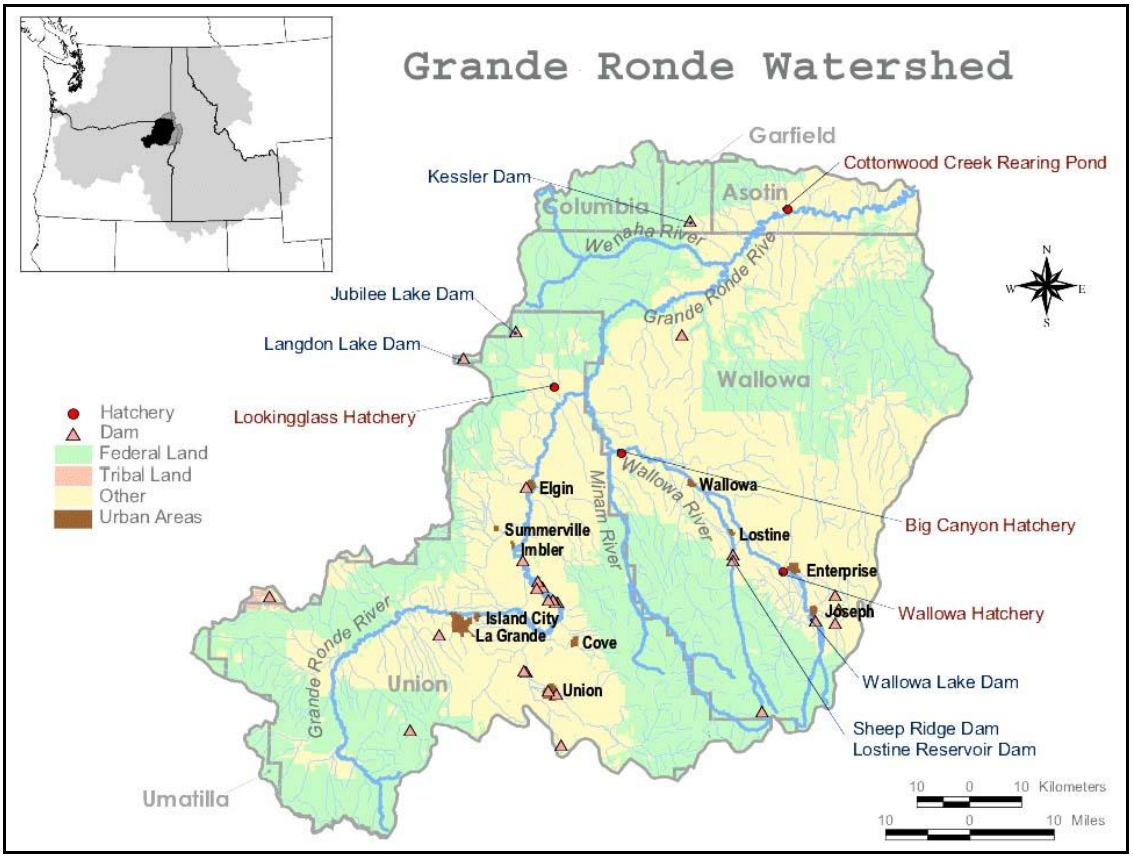

Figure 3. Grande Ronde River watershed[23]

[23] *Modified figure from: Artificial Production Review and Evaluation, Blue Mountain Province-level report < http://www.nwcouncil.org/fw/apre/provincereports/Blue%20Mountain%20Province%20Report.doc >*

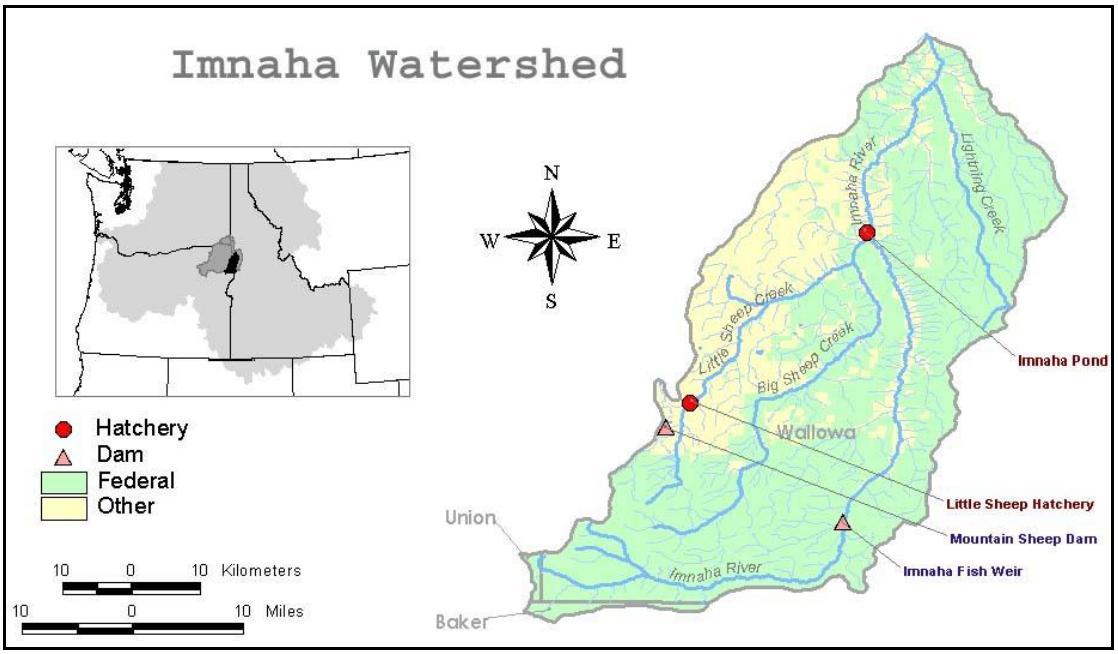

Figure 4. Imnaha River watershed[24]

[24] *Modified figure from: Artificial Production Review and Evaluation, Blue Mountain Province-level report < http://www.nwcouncil.org/fw/apre/provincereports/Blue%20Mountain%20Province%20Report.doc >*

Grande Ronde and Imnaha River Watersheds Overview

Watershed Description

The north eastern Oregon waters addressed in this report include the entire Grande Ronde and Imnaha river watersheds/subbasins that drain the northeast corner of Oregon before flowing into the Snake River.

The Grande Ronde River subbasin drains about 3,650 square miles of the extreme northeast corner of Oregon as well as 341 mi^2 of southeast Washington. The Grande Ronde River subbasin is characterized by rugged mountains and two major river valleys. It is defined by the Blue Mountains to the west and northwest, and the Wallowa Mountains to the southeast. The headwater streams of the Grande Ronde River begin in these mountain ranges, with peaks as high as 7,700 feet in the Blue Mountains and nearly 10,000 feet in the Wallowa Mountains.

The Grande Ronde River flows generally northeast 212 miles from its origin, crossing into Washington at river mile 38.7 before joining the Snake River (at RM169), about 20 miles upstream of Asotin, Washington and 493 miles from the mouth of the Columbia River. Major streams flowing into the Grande Ronde River are Catherine Creek, Joseph Creek, the Wallowa River, and the Wenaha River. The Wallowa River originates in the Lakes Basin area of the Eagle Cap Wilderness Area at elevations over 8,000 feet. The Wallowa River flows north into Wallowa Lake, the only large lake in the subbasin, then through the towns of Joseph, Enterprise and Wallowa, Oregon before joining the Grande Ronde River at river mile 82. The Minam River is the major tributary of the Wallowa River and lies almost entirely within the Eagle Caps Wilderness. The Wenaha River begins in the Wenaha-Tucannon Wilderness Area and flows east to its confluence with the Grande Ronde River at the town of Troy (RM 46).

Rugged mountains in the headwater areas have an important influence on the character of the Grande Ronde River subbasin. The relatively low elevation of the Blue Mountains usually results in early snow melt that, in turn, can result in low flows in the Grande Ronde River in late summer (July, August, & September).

The Grande Ronde Valley, between the Blue and Wallowa Mountains, lies at a relatively high elevation (2,600-2,800 ft.). The valley floor is virtually flat; over one stretch of 4.5 river miles, there is an elevation change of just 7 feet (USDA 1997).

The other major valley in the subbasin is the Wallowa Valley. The Wallowa Valley lies between the Wallowa Mountains to the south and west and high plateau country to the north and east and is oriented generally southeast to northwest. The valley is approximately 32 miles long. Elevations range from 4,680 feet at the south end of the valley (Wallowa Lake) to 2,760 feet at the north end.

The relief of the Blue and Wallowa Mountains creates several localized climatic effects. The diversity of landscapes between mountain ranges, rolling topography and deep, dissected canyons influences local climatic patterns. However, the major influence to the regional climate comes from the Cascade Mountains lying nearly 200 miles to the west. These mountains form a barrier against the modifying effects of moist winds from the Pacific Ocean resulting in a modified Continental climate in the Grande Ronde River subbasin. Winters are cold and moist. January is the coldest month, with an

average daily minimum temperature of 24°F. Summers in the subbasin are warm and dry. July is the warmest month with an average daily maximum of 84°F. Temperature and precipitation vary considerably with elevation. In winter, valleys tend to be colder than lower slopes of adjacent mountains due to cold air drainage. Average annual precipitation increases from 14 inches on the valley floor to more than 60 inches in some mountain areas. On average, precipitation increases approximately 5 inches with each 1,000-foot rise in elevation (USDA 1979). Precipitation occurs in the mountains throughout the year but falls primarily as winter snow.

The Imnaha River subbasin drains an area of 850 square miles, bordered to the west by the Grande Ronde River subbasin and to the east by Hells Canyon and the Snake River. Like the Grande Ronde River, the Imnaha River flows in a northerly direction and is a direct tributary to the Snake River, entering the Snake River at river mile 191.7, approximately 48 river miles upstream of Lewiston, Idaho, 23 miles upstream from the Grande Ronde, and 3.4 miles upstream of the Salmon River confluence. The headwaters of the Imnaha River drain the eastern escarpment of the Wallowa Mountains and originate within the Eagle Cap Wilderness. The extreme elevation differences – from nearly 10,000 feet at the headwaters to barely 1,000 feet at the Snake River -- create climate extremes ranging from cool, wet, alpine climate in the mountains to hot, arid, desert type climate in the lower canyons.

Fisheries

Tribal and recreational fisheries on salmon and steelhead in the Grande Ronde and Imnaha river subbasins are supported primarily by hatchery programs based at federally-owned Lookingglass, Wallowa, and Irrigon fish hatcheries. The current ESA status of natural populations of steelhead and Chinook salmon in northeastern Oregon preclude directed fisheries on natural populations (see Conservation section below). In addition, hatchery-origin rainbow trout are stocked in ponds to support recreational fisheries as partial mitigation for the lower Snake River dams.

Steelhead

Hatchery–origin steelhead returning to the Wallowa River and Little Sheep Creek on the Imnaha River support popular recreational fisheries in the northeastern Oregon. ODFW conducts creel census on recreational fisheries in three areas; the lower Grande Ronde River, the Wallowa River from the Grande Ronde confluence to Wallowa Fish Hatchery, and the Imnaha River. Between 1985 and 2005, annual steelhead harvest estimates ranged from 500 to 3,000 fish in the Wallowa spring fishing area, 500 to 2400 fish in the lower Grande Ronde River, and 100 to 500 fish in the Imnaha River. Angler effort ranged from 35,000 to 100,000 hours annually on the three sections. Tribal fishers harvest some steelhead in the same areas as recreational anglers, and the hatchery programs also contribute to harvest in recreational and tribal fisheries in downstream areas of the Snake and Columbia rivers.

Spring/summer Chinook

Historically, the Grande Ronde and Imnaha rivers provided important tribal fisheries for both resident and anadromous species. As European settlers arrived in the area, they also took part in fisheries for subsistence and recreation. However, since the 1970s, harvest of Chinook salmon has been restricted due to conservation concerns and low population numbers. The LSRCP hatcheries discussed in this report were established to mitigate for impacts of hydropower dams on natural populations, but conservation concerns for those populations constrain fisheries on hatchery-origin fish. All hatchery-origin Chinook salmon in the Grande Ronde and Imnaha River basins are included in the Snake River Spring/Summer Chinook ESU and are listed as *threatened* under the ESA. In the past decade, limited

tribal and recreational fishers have been allowed when the number of hatchery-origin adult Chinook returning to the Snake River exceeds conservation needs.

Resident Trout

Resident rainbow/redband and bull trout provide limited recreational fisheries in headwater streams of the Grande Ronde River drainage and throughout the Imnaha River drainage. Harvest of bull trout in recreational fisheries is prohibited and harvest of resident rainbow/redband trout is limited to two fish per day over eight inches minimum total length. Hatchery-reared trout released in ponds and lakes provide a popular fishing opportunity in valley areas.

Other species

Coho salmon were once common in the Wallowa River but have been considered extirpated since the 1980s. Anadromous sockeye salmon historically returned to Wallowa Lake and persist as a resident kokanee population, but the anadromous population was extirpated after the natural outlet of Wallowa Lake was blocked by a water control dam. Introduced populations of smallmouth bass occur in the lower main stems of the Grande Ronde and Imnaha rivers and attract a few local anglers. Most of these subbasins do not provide suitable habitat for species other than trout and salmon.

Conservation

Anadromous spring/summer Chinook, steelhead, and coho are native to northeastern Oregon, but habitat modifications have greatly reduced numbers and distribution of anadromous fish and extirpated some populations. Coho salmon were considered extinct in the Snake River in 1986. Spring/summer Chinook, fall Chinook, steelhead, and bull trout in the Snake River and tributaries are all listed as *threatened* species under the U.S. Endangered Species Act. Lamprey are greatly reduced from historical abundance and are a species of special concern.

Spring/summer Chinook

Native populations of spring /summer Chinook in the Grande Ronde and Imnaha rivers have been greatly reduced by habitat and environmental factors in the last century. However, several stocks of indigenous spring Chinook persist, and are the focus of conservation and mitigation hatchery programs at Lookingglass Fish Hatchery. Five separate artificial propagation programs are operated for spring/summer Chinook in the upper Grande Ronde River, Catherine Creek, Lostine River, Lookingglass Creek, and the Imnaha River. Natural populations of spring/summer Chinook salmon persist in the Wenaha and Minam rivers without hatchery propagation.

Fall Chinook

Fall Chinook spawn in the lower reaches of tributaries to the Snake River. Only a few fall Chinook redds are reported in the lower Imnaha River. An effort is underway to supplement the spawning population of the lower Grande Ronde River in Washington State with juvenile fall Chinook from Lyons Ferry Hatchery (see Washington LSRCP report).

Steelhead

Steelhead in the Snake River Basin are often classified as two life history forms, commonly referred to as "A-run" and "B-run" steelhead. B-run steelhead generally return later in the year and at a larger mean size and older age than A-run steelhead. The indigenous steelhead that spawn in Imnaha and Grande Ronde rivers and their tributaries are considered A-run steelhead. B-run steelhead spawn in the Clearwater and Salmon rivers and may occur as strays in the lower reaches of the Grande Ronde and

Imnaha rivers. Natural populations of steelhead in northeast Oregon and hatchery-origin steelhead of the Little Sheep Creek program are included with the Snake River Summer Steelhead Distinct Population Segment and are currently classified as *threatened* under the ESA. The Wallowa Hatchery steelhead stock was developed from a composite of fish collected at Snake River dams and is excluded from the Snake River steelhead DPS. The Wallowa Hatchery steelhead stock is managed as a distinct or *segregated* population.

Coho salmon

Coho salmon were declared extinct from the Snake River in 1986. Coho salmon were last observed spawning in the Snake River basin in spring-fed tributaries of the Wallowa River. The Snake River stock of coho salmon was unique relative to other populations of the species range-wide with respect to migration distance and altitude.

The Nez Perce Tribe is currently developing a reintroduction program for coho salmon in the Clearwater River, a tributary to the Snake River, utilizing hatchery-origin coho from the lower Columbia River. Tribal co-managers are interested in reintroducing coho salmon into other tributaries of the Snake River in northeast Oregon if the Clearwater River program is successful.

Sockeye Salmon

Sockeye salmon were historically abundant in Wallowa Lake and supported subsistence and commercial fisheries. However, the anadromous run was extirpated by construction of a water control dam at the outlet of Wallowa Lake in the early 1900s. The genetic material of the endemic stock may persist in the native kokanee (resident O. nerka) population.

Bull trout

Bull trout are present and locally abundant in the Imnaha and Grande Ronde rivers. Both fluvial and resident life history forms are reported. Spawning areas for resident populations are generally in higher elevation tributaries, while the fluvial life form moves downstream into the main stems and even into the Snake River before returning to spawn in headwater areas. No physical barriers separate bull trout populations in the Grande Ronde, Imnaha, and Salmon rivers or other tributaries. Flow or temperature barriers in the lower Grande Ronde River may isolate populations in some tributary streams. Bull trout are currently listed as a threatened species.

Pacific Lamprey

Pacific lamprey in Snake River drainages are considered an endangered species by the state of Idaho (IDFG 2001c), but are not listed under the Federal ESA. Throughout their range in the Columbia River Basin, Pacific lampreys have declined to only a remnant of their pre-1940s populations. Counts of upstream migrating Pacific lamprey at lower Snake River dams were over 30,000 fish in the late 1960s but have declined to less than 500 fish in recent years. Currently, an estimated 3% of the lamprey that pass Bonneville Dam are counted at Lower Granite Dam. Pacific lamprey in northeastern Oregon subbasins is thought to be extremely depressed based on adult counts at Lower Granite Dam.

Other species

Other species of conservation interest include inland redband/rainbow trout and mountain whitefish. Resident trout and mountain whitefish have been affected by many of the same habitat and anthropogenic factors that have affected the abundance of anadromous salmonids and are expected to benefit from recovery actions directed at salmon and steelhead in the Snake River basin.

Habitat

The abundance of salmon and steelhead in the northeastern Oregon subbasins is limited by two primary factors: (1) marine survival and anthropogenic factors outside the area (e.g. dams, harvest); and, (2) reduced habitat carrying capacity and fish survival within the subbasins due to land and water management activities which affect hydrology, levels of sedimentation, and water quality. The Grande Ronde and Imnaha rivers begin in the Wallowa and Blue Mountains. The headwaters are on National Forest multiple use lands and Wilderness areas. Generally, the headwater streams are in forested areas and habitat is in fair to good condition, including excellent condition within the designated Wilderness areas. The intermediate reaches of the Grande Ronde and Wallowa rivers flow through large, flat valleys that are heavily developed for agriculture, and the river is modified by flood control management, channel straightening, irrigation diversions and agricultural runoff. Water transfers from the Imnaha River Basin to the Wallowa River Basin and from the Wallowa River to the Lostine River via irrigation canals reduce instream flows and alter the hydrograph of major streams. The lower Grande Ronde River flows through a deeply incised canyon, and the physical structure of the river is largely intact, however the water quality impacts of upstream land use practices reduce the suitability of the river for anadromous fish. The Imnaha River also originates in the Wallowa Mountains, within the Eagle Caps Wilderness, before flowing through a narrow valley with cattle ranching operations. Riparian stability, instream flows, and water quality in the Imnaha River are affected by land use practices, but to a lesser extent than in the Grande Ronde River drainage.

Juvenile anadromous fish emigrating from the Grande Ronde and Imnaha river basins, and adult anadromous fish returning to spawn, must migrate through the Snake and Columbia Rivers to reach the ocean and return. The migration corridor has been modified by eight dams which, in addition to creating physical barriers, slow river flows and allow the water to warm, impeding migrations and creating enhanced conditions for native and introduced predatory fish.

Spring Chinook

Much of the suitable spawning habitat for spring Chinook in northeastern Oregon is located in the upper reaches of the drainages on National Forest and Wilderness areas where habitat is in good to excellent condition. However, land use and water flows limit rearing capacity and may affect migration through the lower main stems of the Grande Ronde and Imnaha rivers. Adult Chinook returning to the Lostine River, Catherine Creek and the upper Grande Ronde River may be blocked or delayed by low flows during the summer.

For subbasin planning purposes, Chinook habitats in the Grande Ronde River were assessed using the Ecosystem Diagnosis and Treatment (EDT) method. The capacity of Chinook salmon habitat in the Grande Ronde River is estimated to be reduced by 78% from historic conditions based on EDT modeling of the Northwest Planning and Conservation Commission. The EDT capacity estimate of about 5,000 adult Chinook salmon is less than half of the 12,000 adult Chinook capacity estimated for the Grande Ronde in the mid-20th century (see table below from the NWPCC Subbasin Plan for the Grande Ronde River).

Table 31. Summary of EDT estimated Grande Ronde spring Chinook current and historic returns by population.

	EDT Modeled Template Returns[1]		EDT Modeled Current		Miles of spawning habitat	EDT Adults/Mile Template	EDT Adults/ Mile Current	% Decrease Historic to Current
	count	% of total	count	% of total				
Wenaha Spring Chinook	555	11%	334	30%	45.60	12.17	7.33	40%
Minam Spring Chinook	950	19%	489	43%	42.54	22.33	11.50	49%
Wallowa-Lostine Spring Chinook	1,115	22%	112	10%	56.10	19.87	2.00	90%
Lookingglass Spring Chinook	368	7%	49	4%	29.82	12.34	1.64	87%
Catherine Creek Spring Chinook	701	14%	3	0%	29.82	23.50	0.10	100%
Upper Grande Ronde Spring Chinook	1,383	27%	141	13%	79.11	17.48	1.78	90%
Total	5,072		1,128		283.00	17.92	3.99	78%

Steelhead

Steelhead are able to utilize smaller headwater streams for spawning than spring Chinook, and the life cycle of the A-run steelhead indigenous to northeast Oregon allows them to use small and even intermittent streams. A-run steelhead of northeast Oregon migrate up the Columbia and Snake Rivers in late summer and early fall and overwinter in the main Snake and lower sections of the larger tributaries. When water temperatures begin to warm, coincident with spring rains and snow melt, steelhead ascend the tributary streams and spawn. The eggs hatch and fry emerge in early summer. Parr live one to three summers in the small headwater streams before beginning their smolt outmigration, also timed to utilize the spring freshets to carry them to the main Snake River and eventually through the Columbia River to the Pacific Ocean. As a result, steelhead are able to persist where salmon have been extirpated.

For subbasin planning purposes, steelhead habitats in the Grande Ronde River were assessed using the Ecosystem Diagnosis and Treatment (EDT) method (see table below).

Table 32. Summary of Estimated Grande Ronde summer steelhead current and historic returns by population (data provided by B. Jonnasson ODFW pers. comm. 2004).

	Estimated Historic Returns		Estimated Current Returns		Miles of spawning habitat	Adults /Mile Template	Adults /Mile Current	% Decrease Historic to Current
	count	% of total	count	% of total				
Lower Grande Ronde	2,400	16%	608	14%	253.84	9.45	2.39	75%
Joseph Creek	3,600	24%	945	21%	223.10	16.14	4.24	74%
Wallowa River	3,750	25%	1,193	27%	173.45	21.62	6.88	68%
Upper Grande Ronde	5,250	35%	1,755	39%	613.96	8.55	2.86	67%
Total	**15,000**		**4,500**		1,264.35			**70%**

According to the EDT model, current steelhead habitat capacity is reduced by 70 percent from its historical potential.

Fall Chinook

Fall Chinook occupy the main Snake River and lower reaches of the Grande Ronde and the Imnaha rivers. Over 80% of the potential spawning habitat for fall Chinook in the lower Snake River is

inundated by the pools behind four Snake River dams. Cold water and mid-winter floods reduce the suitability of the tributaries for fall-spawning stocks. Fall Chinook generally emigrate as subyearling smolts a few weeks after emerging from the gravel in the spring. However, a portion of the fall Chinook emerging from Snake River tributaries are now rearing in the reservoirs for one year before emigrating, and this altered life history may be successful in the altered habitats of the hydropower system. The sections of the Grande Ronde and Imnaha rivers covered by this report provide little habitat for fall Chinook.

Coho salmon

Coho salmon are native to the Snake River, but their historical occurrence in specific tributaries is not well documented. The same habitat factors that led to some local extirpations of spring Chinook may have led to the extirpation of coho salmon in most tributaries during the last century.

Current Status of Salmonid Stocks

The Interior Columbia Technical Recovery Team (ICTRT) has identified several demographically-independent populations of salmon and steelhead in the Grande Ronde and Imnaha river basins, including adjacent portions of the lower Snake River. The ICTRT initially classified "major population groups" (MPGs) within each ESU or DPS. The ICTRT then identified demographically independent populations within those major groups. The ICTRT relied heavily on genetic information and distances between spawning areas related to dispersal (straying distance) as evidence of reproductive isolation between putative populations. The ICTRT also considered drainage structure, particularly at the major grouping level. Life-history and morphological characteristics were also used as indirect measures of reproductive isolation and potential local adaptations. In cases where biological data on populations was lacking, the ICTRT relied upon environmental characteristics and historical population size for determining population boundaries.

Based on the population determinations of the ICTRT and input from state and tribal biologists, the Review Team identified 22 principal salmonid stocks in the Oregon portion of the Lower Snake River Basin, including one extirpated population of sockeye salmon that occurred historically in Lake Wallowa. These 22 populations are listed below.

Snake River Fall Chinook Salmon ESU (1 population)

- Lower Snake River mainstem fall Chinook (natural + integrated hatchery) [25]

Grande Ronde / Imnaha River Spring-Summer Chinook MPG (8 populations)

- Wenaha River (natural)
- Minam River (natural)
- Lostine River (natural + integrated hatchery)
- Lookingglass Creek (natural + integrated hatchery)[26]

[25] *Broodstock collection occurs at Lyons Ferry FH and Lower Granite Dam, and subyearling and yearling releases occur in the Snake River at Lyons Ferry FH, Captain John Rapids and Pittsburg Landing acclimation ponds, and into the Clearwater River near Big Canyon Creek. Eggs are also transferred to the Umatilla and Oxbow hatcheries for releases into the Snake River and to Irrigon FH for releases into the Grande Ronde River.*

- Catherine Creek (natural + integrated hatchery)
- Upper Grande Ronde River (natural + integrated hatchery)
- Imnaha River-mainstem (natural + integrated hatchery)
- Big Sheep Creek (natural)

Lake Wallowa sockeye-kokanee (2 populations)

- Lake Wallowa sockeye (extirpated)[27]
- Lake Wallowa kokanee (natural)

Grande Ronde River Summer Steelhead MPG (4 populations)

- Lower Grande Ronde River mainstem (natural)
- Upper Grande Ronde River mainstem (natural)
- Joseph Creek (natural)
- Wallowa River (natural)

Imnaha River Summer Steelhead MPG (1 population)

- Imnaha River (natural + integrated hatchery at Little Sheep Creek)

Segregated hatchery steelhead populations (2 populations)

- Wallowa Hatchery summer steelhead (Wallowa River, Wallowa FH)
- Oxbow Hatchery summer steelhead (Oxbow FH, lower Snake River at Hells Canyon)

Blue Mountain rainbow-redband trout (2 populations)

- Grande Ronde River rainbow-redband trout (natural)
- Imnaha River rainbow-redband trout (natural)

Blue Mountain bull trout (2 populations)

- Grande Ronde River (natural)
- Imnaha River (natural)

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[26] *A reintroduced population derived from hatchery-origin spring Chinook native to Catherine Creek. The native population of spring Chinook in Lookingglass Creek is considered extirpated. The comanager goal is to manage a reintroduced population of spring Chinook in Lookingglass Creek as a separate natural, integrated-hatchery population relative to other populations of spring Chinook in the Grande Ronde River.*

[27] *The Review Team has included Lake Wallowa sockeye as one of the stocks for background information because (a) preliminary assessments indicate that establishing a reintroduced population of sockeye salmon in Lake Wallowa is feasible if the outlet control dam from Lake Wallowa is modified with appropriate fish passage facilities and (b) reintroducing sockeye salmon to Lake Wallowa is a long-term goal of the Nez Perce Tribe.*

The following tables summarize the current status and management premises of the 22 salmonid stocks listed above. The principal sources of information for these tables were Grande Ronde River and Imnaha River Sub-Basin Plans of the Northwest Power and Conservation Council.[28] Additional information was obtained from Hatchery Science Review Group (HSRG)[29] reports, Hatchery and Genetic Management Plans (HGMPs), Supplemental Comprehensive Analysis (SCA) of the Federal Columbia River Power System[30], and various documents produced by the Interior Columbia Technical Recovery Team (ICTRT).[31]

Table 1. Lower Snake River mainstem fall Chinook (Lyons Ferry FH and satellite facilities)

Management Premises and Goals	
ESA Status	*Threatened* (1992). The Lower Snake River Fall Chinook population is part of the Snake River Fall Chinook ESU that is classified as threatened under the Endangered Species Act, April 22, 1992 (57 FR 14653) reaffirmed June 28, 2005.
Biological Significance	*High.* The *Snake River Fall Chinook Salmon ESU* consists of a single major population group and independent population: the Lower Snake River Mainstem population. This population occupies the Snake River from its confluence with the Columbia River to Hells Canyon Dam, and includes spawning habitat in the lower reaches of the Clearwater, Imnaha, Grande Ronde, Salmon, and Tucannon rivers. The HSRG (2009) classified the Snake River fall Chinook population as *primary* with respect to ESA recovery.
Population Viability	*Low (natural) to medium(hatchery).* Current numbers of natural-origin Snake River fall Chinook salmon have increased over the last few years, with estimates at Lower Granite dam of 2,652 fish in 2001, 2,095 fish in 2002, and 3,895 fish in 2003. The natural-origin returns were as low as 78 adults in 1990. The most recent 10-year geometric mean abundance was 1,273 for the years 1995-2004. The 1977-99 brood year recruit per spawner was 0.81 and the 1990-99 broodyear recruit per spawner was 1.24 (NOAA 2008 SCA). Interior TRT recommends minimum abundance threshold of 3,000 natural origin spawners, with no fewer than 2,500 natural origin spawners in the mainstem Snake River. HSRG (2009) estimated habitat productivity (R/S_{max}) and capacity as 2.95 and 7,125, respectively. Hatchery returns to the Snake basin have ranged from 1,800 to 18,000 for the years 1995 to 2005. Hatchery smolt to adult survival has been > 1% for release years after 1995, where prior to that it was often < 0.5% (Appendix B Tables 5 and 6 and Figure 8).
Habitat	*Low*. Only 10 to 15% of historical spawning and rearing habitat remains (NOAA 2008_SCA). Present habitat includes mainstem Snake River downstream of Hells Canyon Dam and the lower reaches of the Tucannon, Grande Ronde, Imnaha, Salmon, and Clearwater River subbasins.

[28] *http://www.nwcouncil.org/fw/subbasinplanning/Default.htm*

[29] *http://www.hatcheryreform.us*

[30] *http://www.nwr.noaa.gov/Salmon-Recovery-Planning/*

[31] *www.nwfsc.noaa.gov/trt/*

Harvest	*Medium.* For yearling on-station release 33% of all coded-wire tag recoveries were in the ocean fisheries and 17% in Columbia River fisheries for release years 1989-1998 combined (Table 7 of HGMP). The Pacific Salmon Commission uses the subyearling release and recovery data from Lyons Ferry Hatchery as surrogate for wild fish. For the 2003-2006 catch years, total fishing mortality (ocean and freshwater combined) was estimated as 27.8% (Table E.72 of Pacific Salmon Commission Technical Report, December 2008). Within the Columbia/Snake rivers, harvest rate is abundance based where harvest ranges from 21.5% to 45% depending on expected upriver bright and Snake River natural returns to the mouth of the Columbia River (Table A.3 of 2008-2017 *U.S. v Oregon* Management Agreement). The last fishery in the Snake River was 1988 followed by a more recent limited opening in 2008 (see "Benefits" section of this report on fall Chinook). The harvest contribution value used by HSRG (2009) for the current program was 18,767. Total exploitation rate averaged 75% from 1986-91, and 45% from 1992-2006 (NOAA 2008 SCA).
Hatchery Program	
Facilities	Lyons Ferry FH (WDFW) and satellite facilities managed by the Nez Perce Tribe (Captain John, Pittsburgh Landing, Big Canyon). Eggs are also transferred to Umatilla, Oxbow and Irrigon hatcheries.
Type	Integrated.
Authorization and Funding	LSRCP and BPA.
Primary Purpose	Harvest.
Secondary Purposes	Conservation.
Broodstock Origin(s)	Snake River at Ice Harbor and Lower Granite dams.

Table 2. Wenaha River spring-summer Chinook (natural)

Management Premises and Goals	
ESA Status	*Threatened*. Included with the Snake River Spring/Summer Chinook ESU.
Biological Significance	*High.* One of eight populations in the Grande Ronde Imnaha MPG. Only Wenaha and Minam are endemic populations with no history of direct hatchery influence. TRT reports

	that the Wenaha are geographically and genetically distinct from other Grande Ronde-Imnaha populations. For the HSRG review, the population has been classified as Primary.
Population Viability	*Low.* High risk, based on low numbers (10-year mean of 376 for an Intermediate (750) classified population) and concern for influence on out-of-basin hatchery-origin Chinook released in the Grande Ronde River in the 1970s-1990s (TRT). Recent 20-year average recruit per spawner estimated at 0.66 (NOAA 2008 SCA). The ICTRT reports that the abundance of spring Chinook for this subbasin has ranged from 47 to 2,545 adult fish (1964-2005). HSRG (2009) estimated habitat productivity and capacity as 5.2 and 488, respectively.
Habitat	*Excellent to poor.* The headwater areas used for spawning and rearing are located within a designated Wilderness and remain in nearly pristine condition. However, the lower Grande Ronde River has been modified by land and water use and the migration corridor through the Snake and Columbia Rivers has been highly modified by dams, inundation, and regulated water flows.
Harvest	*Low*. Naturally produced fish are not marked and are generally protected from harvest in fisheries. Also this is a relatively small population. However, some incidental harvest may occur in non-selective tribal fisheries in the Columbia River and some angling mortality may occur in ocean and river recreational fisheries. The ocean fishery mortality is very low (near zero) and the incidental take of natural-origin upriver spring/summer Chinook in the Columbia River harvest averaged 10.2% since 2001 (NOAA 2008 SCA). The harvest contribution value used by HSRG (2009) for the current program was 41.

Table 3. Minam River spring-summer Chinook (natural)

Management Premises and Goals	
ESA Status	*Threatened*. Included with the Snake River Spring/Summer Chinook ESU.
Biological Significance	*High.* One of eight populations in the Grande Ronde/ Imnaha MPG. Only Wenaha and Minam are endemic populations with no history of direct hatchery influence. TRT reports that the Wenaha are geographically and genetically distinct from other Grande Ronde-Imnaha populations. For the HSRG review, the population has been classified as Primary.
Population Viability	*Low.* . High risk, based on low numbers (10-year mean of 337 for an Intermediate (750) classified population) and concern for influence on out-of-basin hatchery-origin Chinook released in the Grande Ronde River in the 1970s-1990s (TRT). Recent 20-year average recruit per spawner estimated at 0.80 (NOAA 2008 SCA). Recently (1978-2005) the ICTRT reported that the abundance of spring Chinook for this subbasin ranged from 54 to 1,446 fish, HSRG (2009) estimated habitat productivity and capacity as 5.7 and 338, respectively.
Habitat	*Excellent to poor.* The headwater areas used for spawning and rearing are located within a designated Wilderness and remain in nearly pristine condition. However, the lower Grande Ronde River has been modified by land and water use and the migration corridor through the Snake and Columbia Rivers has been highly modified by dams, inundation, and regulated water flows.

Harvest	*Low.* Naturally produced fish are not marked and are generally protected from harvest in fisheries. Also this is a relatively small population. However, some incidental harvest may occur in non-selective tribal fisheries in the Columbia River and some angling mortality may occur in ocean and river recreational fisheries. The ocean fishery mortality is very low (near zero) and the incidental take of natural-origin upriver spring/summer Chinook in the Columbia River harvest averaged 10.2% since 2001 (NOAA 2008 SCA). The harvest contribution value used by HSRG (2009) for the current program was 25.

Table 4. Wallowa-Lostine River spring-summer Chinook (natural + integrated hatchery)

Management Premises and Goals	
ESA Status	*Threatened* with the Snake River Spring/Summer Chinook ESU.
Biological Significance	*High*. One of eight populations in the Grande Ronde-Imnaha MPG. The Wallowa-Lostine population includes Bear Creek and Hurricane Creek as well as the Wallowa and Lostine Rivers. The TRT determined that the Lostine portion of this population is distinct from other Grande-Ronde-Imnaha populations. Includes the integrated hatchery program founded from Endemic Lostine River Chinook using conventional and captive propagation techniques For the HSRG review, the population has been classified as Primary.
Population Viability	*Low (natural) to medium (hatchery).* . High risk, based on low numbers (10-year mean of 276 for a Large (1000) classified population and concern for low productivity, reduced life history variability and large number of hatchery-origin spawners (TRT). Recent 20-year average recruit per spawner estimated at 0.72 (NOAA 2008 SCA). According to the ICTRT, historic (1952-2005) abundance of spring Chinook for this subbasin has ranged from 37 to 1,463 fish. The hatchery program has achieved a R/S value of 11.00. HSRG (2009) estimated habitat productivity and capacity as 3.7 and 1300, respectively.
Habitat	*Excellent to poor.* The headwaters of the Lostine River are in a designated Wilderness and are in nearly pristine condition. However, the lower sections of the Lostine River and other tributaries are heavily impacted by agricultural practices, flood control, and water diversions. The migration corridor through the lower Grande Ronde River is highly modified and the corridor through the Snake and Columbia Rivers has been impounded and otherwise modified.
Harvest	*Low to moderate.* Chinook smolts produced by this program are marked with adipose-fin clips to allow harvest of returning adults. However, harvest in downriver (Mainstem Columbia and Snake Rivers) fisheries is limited by conservation concerns for the unmarked, naturally produced Chinook. The ocean fishery mortality is very low (near zero) and the incidental take of natural-origin upriver spring/summer Chinook in the Columbia River harvest averaged 10.2% since 2001 (NOAA 2008 SCA).Limited local recreational and tribal fisheries may be allowed in years when adult returns are predicted to exceed conservation needs. The harvest contribution value used by HSRG (2009) for the current program was 688.

Hatchery Program	
Facilities	Lookingglass Hatchery and Lostine River satellite facilities.
Type	Integrated. Lookingglass is a typical salmon hatchery with incubation and early rearing in a hatchery building and outside raceways for final rearing. The Lostine satellite facilities include temporary portable raceways used for a short final rearing, acclimation and release of smolts reared at Lookingglass Hatchery and an adult trap for broodstock collection.
Authorization and Funding	Authorized and funded through the Lower Snake River Compensation Plan and Bonneville Power Administration.
Primary Purpose	Harvest and Conservation. The primary purpose for the Lostine program is mitigation for losses to fisheries from construction of the four Federal Dams on the lower Snake River and to restore tribal and recreational fisheries. However, because of the depressed population status the current operation is conservation and restoration.
Secondary Purposes	Conservation.
Broodstock Origin(s)	The broodstock is a combination of natural and hatchery origin anadromous Chinook salmon adults collected at the adult trap on the lower Lostine River. This population was also supplemented with captive-reared adults resulting from parr collected in the Lostine River between 1997 and 2003.

Table 5. Lookingglass Creek spring-summer (natural + integrated hatchery)

Management Premises and Goals	
ESA Status	*Threatened*. Included with the Snake River Spring/Summer Chinook ESU. The Grande Ronde Lookingglass Creek population is considered extinct by the Interior Columbia Technical Recovery Team (ICTRT).
Biological Significance	*Low to moderate*. The endemic Chinook of Lookingglass Creek were extirpated by habitat issues and hatchery operations in the 1980s. The current population is founded on surplus smolts produced from the Catherine Creek captive broodstock. For the HSRG review, the population has been classified as Stabilizing.
Population Viability	*Low (natural) to medium (hatchery).* The endemic population of Lookingglass Creek is considered to be extirpated due to past habitat issues and hatchery practices. The current stock of Chinook released in Lookingglass Creek is based primarily on the Catherine Creek stock. The ICTRT analysis categorized the historical habitat potential of Lookingglass Creek as a "basic" rating, and a minimum abundance threshold criteria of 500 naturally produced spawners. HSRG (2009) estimated habitat productivity and capacity as 3.0 and 200, respectively.
Habitat	*Fair to poor*. The spawning and rearing habitat available in Lookingglass Creek has been impacted by land management activities but remains in fair condition. The migration corridor through the Lower Grande Ronde River has been modified by land and water

	management and the migration corridor through the Snake and Columbia Rivers has been modified by dams, inundation and water flow controls.
Harvest	*Low*. This program was founded with parr releases in 2001 and small smolt releases between 2002 and 2009. There are not yet enough returns to provide fishery benefits. The harvest contribution value used by HSRG (2009) for the current program was 339. The ocean fishery mortality is very low (near zero) and the incidental take of natural-origin upriver spring/summer Chinook in the Columbia River harvest averaged 10.2% since 2001 (NOAA 2008 SCA).
Hatchery Program	
Facilities	Lookingglass FH.
Type	Lookingglass is a typical salmon hatchery with an adult trap for broodstock collection, incubation and early rearing in a hatchery building and outside raceways for final rearing. Smolts are released directly from this hatchery.
Authorization and Funding	Authorized and funded through the Lower Snake River Compensation Plan.
Primary Purpose	Harvest and restoration. The primary purpose for the Lookingglass Creek program is mitigation for losses to fisheries from construction of the four Federal Dams on the lower Snake River and to restore tribal and recreational fisheries. However, because of the depressed population status the current operation is conservation and restoration.
Secondary Purposes	Conservation.
Broodstock Origin(s)	The broodstock is a combination of natural and hatchery origin anadromous Chinook salmon adults collected at the adult trap on Lookingglass Creek. This population was established by surplus eggs and smolts from the Catherine Creek captive broodstock starting in 2001.

Table 6. Catherine Creek spring-summer Chinook (natural + integrated hatchery)

Management Premises and Goals	
ESA Status	*Threatened.* Included with the Snake River Spring/Summer Chinook ESU.
Biological Significance	*High*. Catherine Creek is one of Eight populations in the Grande Ronde-Imnaha MPG. For the HSRG review, the population has been classified as Contributing.
Population Viability	*Low (natural) to medium (hatchery).* High risk, based on low numbers (10-year mean of 89) for a Large classified population (1000) and concern for low productivity, reduced life history variability and large number of hatchery-origin spawners (TRT). Recent 20-year average recruit per spawner estimated at 0.44 (NOAA 2008 SCA). The ICTRT reports that the abundance of spring Chinook for this subbasin has ranged from 27 to 2,947 fish. The hatchery program has an R/S value of 6.0 (HSRG 2009). HSRG (2009) estimated habitat

	productivity and capacity as 2.5 and 500, respectively.
Habitat	*Excellent to poor.* The headwaters of Catherine Creek are in a designated Wilderness and are in nearly pristine condition. However, the lower sections of Catherine Creek and other tributaries are heavily impacted by agricultural practices, flood control, and water diversions. The migration corridor through the lower Grande Ronde River is highly modified and the corridor through the Snake and Columbia Rivers has been impounded and otherwise modified
Harvest	*Low to moderate.* Chinook smolts produced by this program are marked with adipose-fin clips to allow harvest of returning adults. However, harvest in downriver (Mainstem Columbia and Snake Rivers) fisheries is limited by conservation concerns for the unmarked, naturally produced Chinook. The ocean fishery mortality is very low (near zero) and the incidental take of natural-origin upriver spring/summer Chinook in the Columbia River harvest averaged 10.2% since 2001 (NOAA 2008 SCA). Limited local recreational and tribal fisheries may be allowed in years when adult returns are predicted to exceed conservation needs. The harvest contribution value used by HSRG (2009) for the current program was 144.
Hatchery Program	
Facilities	Lookingglass Hatchery and Catherine Creek satellite facilities
Type	Integrated. Lookingglass is a typical salmon hatchery with incubation and early rearing in a hatchery building and outside raceways for final rearing. The Catherine Creek satellite facilities include temporary portable raceways used for a short final rearing, acclimation and release of smolts reared at Lookingglass Hatchery and an adult trap for broodstock collection.
Authorization and Funding	Authorized and funded through the Lower Snake River Compensation Plan and Bonneville Power Administration.
Primary Purpose	Harvest and conservation. The primary purpose for the Catherine Creek program is mitigation for losses to fisheries from construction of the four Federal Dams on the lower Snake River and to restore tribal and recreational fisheries. However, because of the depressed population status the current operation is conservation and restoration
Secondary Purposes	Conservation.
Broodstock Origin(s)	The broodstock is a combination of natural and hatchery origin anadromous Chinook salmon adults collected at the adult trap on Catherine Creek. This population is also supplemented with captive-reared adults resulting from parr collected from Catherine Creek between 1996 and 2003

Table 7. Upper Grande Ronde River spring-summer Chinook (natural + integrated hatchery

Management Premises and Goals	
ESA Status	*Threatened.* Included with the Snake River Spring/Summer Chinook ESU.
Biological Significance	*High.* Although this population may have been influenced by out-of-basin hatchery-origin smolt releases in the past, the current natural population and hatchery program contains the remnant of the endemic Chinook of the upper Grande Ronde River. For the HSRG review, the population has been classified as Stabilizing.
Population Viability	*Low (natural) to medium (hatchery).* Highest risk possible, based on very low numbers (10-year mean of 40) for a Large classified population (1000) and concern for low productivity, reduced life history variability and large number of hatchery-origin spawners (TRT). Recent 20-year average recruit per spawner estimated at 0.32 (NOAA 2008 SCA). The ICTRT reports that abundance of spring Chinook for this subbasin has ranged from 3 to 855 fish. HSRG (2009) estimated habitat productivity and capacity as 1.0 and 300, respectively. The hatchery program has achieved 5.0 recruits per spawner (HSRG 2009).
Habitat	*Fair to poor.* The spawning and rearing areas located in the headwaters of the upper Grande Ronde River lie on National Forest land and remain in fair condition. However, the lower sections of the river and other tributaries are heavily impacted by agricultural practices, flood control, and water diversions. The migration corridor through the lower Grande Ronde River is highly modified and the corridor through the Snake and Columbia Rivers has been impounded and otherwise modified.
Harvest	*Low to moderate.* Chinook smolts produced by this program are marked with adipose-fin clips to allow harvest of returning adults. However, harvest in downriver (Mainstem Columbia and Snake Rivers) fisheries is limited by conservation concerns for the unmarked, naturally produced Chinook. The ocean fishery mortality is very low (near zero) and the incidental take of natural-origin upriver spring/summer Chinook in the Columbia River harvest averaged 10.2% since 2001 (NOAA 2008 SCA).Limited local recreational and tribal fisheries may be allowed in years when adult returns are predicted to exceed conservation needs. The harvest contribution value used by HSRG (2009) for the current program was 198.
Hatchery Program	
Facilities	Lookingglass FH and upper Grande Ronde River satellite facilities.
Type	Lookingglass is a typical salmon hatchery with incubation and early rearing in a hatchery building and outside raceways for final rearing. The upper Grande Ronde satellite facilities include temporary portable raceways used for a short final rearing, acclimation and release of smolts reared at Lookingglass Hatchery and an adult trap for broodstock collection.
Authorization and Funding	Authorized and funded through the Lower Snake River Compensation Plan and Bonneville Power Administration.
Primary Purpose	Harvest and conservation. The primary purpose for the Upper Grande Ronde program is mitigation for losses to fisheries from construction of the four Federal Dams on the lower Snake River and to restore tribal and recreational fisheries. However, because of the

	depressed population status the current operation is conservation and restoration.
Secondary Purposes	Conservation.
Broodstock Origin(s)	The broodstock is a combination of natural and hatchery origin anadromous Chinook salmon adults collected at the adult trap on the Upper Grande Ronde River. This population is also supplemented with captive-reared adults resulting from parr collected in the upper Grande Ronde River from 1996 until present.

Table 8. Imnaha River mainstem spring Chinook (natural + integrated hatchery

Management Premises and Goals	
ESA Status	*Threatened.* Included with the Snake River Spring/Summer Chinook ESU.
Biological Significance	*High*. This is currently the largest (Numerically most abundant, including the hatchery component) of the 8 populations in the Grande Ronde-Imnaha MPG. For the HSRG review, the population has been classified as Primary. Prior to the construction of the four lower Snake River dams, maximum run size to the basin was 6,700 fish (NPPC 2004 as cited in HSRG 2009).
Population Viability	*Low (natural) to medium (hatchery).* High risk, based on low numbers (10-year mean of 395) for an intermediate classified population (750) and concern for low productivity, reduced life history variability and large number of hatchery-origin spawners (TRT) Recent 20-year average recruit per spawner estimated at 0.59 (NOAA 2008 SCA). The hatchery program has an R/S value of 11.0. HSRG (2009) estimated habitat productivity and capacity as 4.0 and 1,500, respectively
Habitat	*Excellent to poor.* The headwaters of Imnaha River are in a designated Wilderness and are in nearly pristine condition. However, the lower sections of Imnaha River and other tributaries are impacted by agricultural practices, flood control, and water diversions. The migration corridor through the Snake and Columbia Rivers has been impounded and otherwise modified
Harvest	*Low to moderate.* Chinook smolts produced by this hatchery program are marked with adipose-fin clips to allow harvest of returning adults. However, harvest in downriver (Mainstem Columbia and Snake Rivers) fisheries is limited by conservation concerns for the unmarked, naturally produced Chinook. The ocean fishery mortality is very low (near zero) and the incidental take of natural-origin upriver spring/summer Chinook in the Columbia River harvest averaged 10.2% since 2001 (NOAA 2008 SCA). NOAA allows 10% incidental take of the natural-origin Imnaha spring/summer Chinook population. The recreational fishers are allocated 1.5% and tribal fishers 8.5%. From 2001-2005, sport harvest in the Imnaha River has ranged from 22 to 302 hatchery fish (2008 AOP), Tribal fisheries also occur. The harvest contribution value used by HSRG (2009) for the current program was 1,176.

Hatchery Program	
Facilities	Lookingglass FH and Imnaha River satellite facilities.
Type	Integrated. Lookingglass is a typical salmon hatchery with incubation and early rearing in a hatchery building and outside raceways for final rearing. The Imnaha River satellite facilities include a large concrete pond used for a short final rearing, acclimation and release of smolts reared at Lookingglass Hatchery and an adult trap for broodstock collection.
Authorization and Funding	Authorized and funded through the Lower Snake River Compensation Plan.
Primary Purpose	Harvest and conservation. The primary purpose for the Imnaha River program is mitigation for losses to fisheries from construction of the four Federal Dams on the lower Snake River and to restore tribal and recreational fisheries. However, because of the depressed population status the current operation is conservation and restoration.
Secondary Purposes	Conservation.
Broodstock Origin(s)	The broodstock is a combination of natural and hatchery origin anadromous Chinook salmon adults collected at the adult trap on the Imnaha River.

Table 9. Big Sheep Creek spring Chinook (natural)

Management Premises and Goals	
ESA Status	*Threatened.* Included with the Snake River Spring/Summer Chinook ESU.
Biological Significance	*High.* However, this is the smallest and highest risk of the 7 extant populations in the Grande Ronde/Imnaha MPG. Big Sheep Creek, a tributary of the Imnaha River, includes both Little Sheep Creek and Lick Creek.
Population Viability	*Low*. Big Sheep Creek is considered by the ICTRT to be a "Basic" population, requiring a minimum abundance of 500 wild spawners. The TRT concluded that "Given the recent and proposed future outplanting of Imnaha Hatchery stock and the low natural abundance, this population may be functionally extinct.*"*
Habitat	*Fair to poor.* The spawning and rearing areas located in portions of Big Sheep Creek lie on National Forest land and remain in fair condition. However, interbasin water transfers reduce stream flows and other land management decisions have impacted habitat quality. The migration corridor through the Snake and Columbia Rivers has been impounded and otherwise modified.
Harvest	*Low.* Naturally produced fish are not marked and are generally protected from harvest in fisheries. Also this is a relatively small population. However, some incidental harvest may occur in non-selective tribal fisheries in the Columbia River and some angling mortality may occur in ocean and river recreational fisheries. The ocean fishery mortality is very low

	(near zero) and the incidental take of natural-origin upriver spring/summer Chinook in the Columbia River harvest averaged 10.2% since 2001 (NOAA 2008 SCA).

Table 10. Lake Wallowa sockeye (extirpated)

Management Premises and Goals	
ESA Status	Extirpated
Biological Significance	N/A.
Population Viability	N/A.
Habitat	*Poor to unknown*. Rearing Habitat in Wallowa Lake appears to be suitable for sockeye reintroduction. Nothing is known about the condition of spawning habitat or the effects of introduced species. Migration corridor is blocked by a dam on the lake outlet and the downstream migration corridor is degraded.
Harvest	N.A.

Table 11. Lake Wallowa kokanee[32]

Management Premises and Goals	
ESA Status	*Not listed*
Biological Significance	*Low to moderate*. A naturally reproducing population persists that may retain some genetic connection to the extirpated sockeye population. However, there have been periodic releases of hatchery-origin kokanee in Wallowa Lake since the 1920s. After a population collapse in the late 1950s, Large numbers of non-native kokanee were stocked and genetic surveys during sockeye status review indicated probable hatchery influence.
Population Viability	*High.* A kokanee population has persisted since the sockeye run was blocked by a dam in the early 1900s. However, the present kokanee population has been influenced by non-native kokanee releases. Introduced lake trout and mysis shrimp populations compete with and prey upon the kokanee.
Habitat	*Good to excellent.* Spawning habitat in inlet streams and shoreline areas and rearing habitat in the lake are in good to excellent condition.
Harvest	*Moderate to high.* Wallowa Lake is open to fishing for kokanee and trout under general

[32] *Information from Cramer, Steven, Kenneth Witty, ''Feasibility for Reintroducing Sockeye and Coho Salmon in the Grande Ronde Basin'', Project No. 1988-05301, 171 electronic pages, (BPA Report DOE/BP-30423-1), and telephone discussion with Bill Knox, ODFW fishery biologist 11/5/09.*

	recreational fishing regulations. Oregon State Record kokanee of 7 pounds, 1 ounce was caught in 2009.

Table 12. Lower Grande Ronde River mainstem summer steelhead (natural)

Management Premises and Goals	
ESA Status	*Threatened.* Included with the Snake River Steelhead DPS.
Biological Significance	*High.* This population includes natural origin steelhead in the Grande Ronde River and tributaries downstream from the Wallowa River, including the Wenaha River. For the HSRG review, the population has been classified as Primary.
Population Viability	*Low to medium.* Limited redd counts and fishery observations indicate that this population is persistent and well distributed but likely much less abundant than historical conditions. Recent 20-year average recruit per spawner estimated at 1.09 (NOAA 2008 SCA). The ICTRT classifies this population as Intermediate. HSRG (2009) estimated habitat productivity and capacity as 3.9 and 1,951, respectively. Adult escapement to the Lower Grande Ronde River and tributaries has been estimated at approximately 600 fish and recovery goal for abundance at 1,000 fish (HSRG 2009).
Habitat	*Excellent to poor.* The headwater areas of the Wenaha used for spawning and rearing are located within a designated Wilderness and remain in nearly pristine condition. Other tributaries have been impacted by land use including forestry and agriculture. The lower Grande Ronde River has been modified by land and water use and the migration corridor through the Snake and Columbia Rivers has been highly modified by dams, inundation, and regulated water flows.
Harvest	*Low.* Naturally produced steelhead are not marked for harvest (adipose fin clips) and are protected in recreational fisheries. Few steelhead (assumed zero) are caught in ocean fisheries. The recent Columbia River harvest rates on A-run steelhead in non-Indian and treaty Indian Fisheries range from 1.0% to 1.9% and 4.1% to 12.4%, respectively (NOAA 2008 SCA). The harvest contribution value used by HSRG (2009) for the current program was 135.

Table 13. Upper Grande Ronde River mainstem summer steelhead (natural)

Management Premises and Goals	
ESA Status	*Threatened*. Included with the Snake River Steelhead DPS.
Biological Significance	*High.* This population includes natural origin steelhead in the upper Grande Ronde River, including Catherine and Lookingglass Creeks. For the HSRG review, the population has been classified as Primary.
Population Viability	*Low to medium.* Limited red count, adult trapping, and fishery observations indicate that this population is persistent and well distributed but likely much less abundant than

	historical conditions. Recent 20-year average recruit per spawner estimated at 0.93 (NOAA 2008 SCA). The ICTRT classified the Upper Grande Ronde River population as a "Large" population based on historical habitat potential (ICTRT 2005). Recent estimates have put steelhead escapement at a little over 1,800 fish (Draft Snake River Recovery Plan as cited in HSRG 2009). Recovery goal is 1,500. HSRG (2009) estimated habitat productivity and capacity as 1.8 and 3,665, respectively.
Habitat	*Excellent to poor.* The headwater areas used for spawning and rearing in Catherine Creek are located within a designated Wilderness and remain in nearly pristine condition. Most other tributaries and the main stem of the Grande Ronde River have been modified by land and water use and the migration corridor through the Snake and Columbia Rivers has been highly modified by dams, inundation, and regulated water flows.
Harvest	*Low.* Naturally produced steelhead are not marked for harvest (adipose fin clips) and are protected in recreational fisheries. Few steelhead (assumed zero) are caught in ocean fisheries. The recent Columbia River harvest rates on A-run steelhead in non-Indian and treaty Indian Fisheries range from 1.0% to 1.9% and 4.1% to 12.4%, respectively (NOAA 2008 SCA).The harvest contribution value used by HSRG (2009) for the current program was 149.

Table 14. Joseph Creek summer steelhead (natural)

Management Premises and Goals	
ESA Status	*Threatened.* Included with the Snake River Steelhead DPS.
Biological Significance	*High*. The steelhead population of Joseph Creek is geographically isolated and genetically unique from other steelhead populations in this MPG and the Snake River Basin as a whole. The watershed is reserved for wild fish production only; therefore, no hatchery fish are released to the stream. For the HSRG review, the population has been classified as Primary.
Population Viability	*Low to medium*. Limited redd count and fishery observations indicate that this population is persistent and well distributed but likely much less abundant than historical conditions. ODFW biologists believe this population to be intact and resilient, but somewhat depressed in abundance. Recent 20-year average recruit per spawner estimated at 1.26 (NOAA 2008 SCA). The ICTRT classified the Joseph Creek population as a "Basic" population based on historical habitat potential (ICTRT 2005). Recovery goal for abundance is 500 adult fish. Recent estimates have put steelhead escapement at a little over 1,500 fish (Draft Snake River Recovery Plan as cited in HSRG 2009). HSRG (2009) estimated habitat productivity and capacity as 3 and 3,500, respectively.
Habitat	*Excellent to poor.* Joseph Creek is largely contained in a rugged canyon where habitat remains in excellent condition and the upper tributaries are on national forest land where habitat is in fair condition. The main stem of the Grande Ronde River has been modified by land and water use and the migration corridor through the Snake and Columbia Rivers has been highly modified by dams, inundation, and regulated water flows.
Harvest	*Low.* Naturally produced steelhead are not marked for harvest (adipose fin clips) and are protected in recreational fisheries. Few steelhead (assumed zero) are caught in ocean

	fisheries. The recent Columbia River harvest rates on A-run steelhead in non-Indian and treaty Indian Fisheries range from 1.0% to 1.9% and 4.1% to 12.4%, respectively (NOAA 2008 SCA). The harvest contribution value used by HSRG (2009) for the current program was 254.

Table 15. Wallowa River summer steelhead (natural)

Management Premises and Goals	
ESA Status	*Threatened.* Included with the Snake River Steelhead DPS.
Biological Significance	*High*. The Wallowa population includes the steelhead in the Minam and Lostine Rivers and Wallowa and tributaries. For the HSRG review, the population has been classified as Primary.
Population Viability	*Low to medium*. Limited red count, adult trapping, and fishery observations indicate that this population is persistent and well distributed but likely much less abundant than historical conditions. Wild adult escapement to the Wallowa River and tributaries has been estimated at approximately 1,200 fish (NPPC 2004 as cited in HSRG 2009). Recent 20-year average recruit per spawner estimated at 1.28 (NOAA 2008 SCA). The ICTRT classifies this population as Intermediate. Recovery goal for abundance is 1,000 adult fish. HSRG (2009) estimated habitat productivity and capacity as 2.9 and 2,000, respectively.
Habitat	*Excellent to poor.* The headwater areas used for spawning and rearing in Minam and Lostine River are located within designated Wilderness and remain in nearly pristine condition. Most other tributaries and the main stem of the Wallowa River have been modified by land and water use and the migration corridor through the Snake and Columbia Rivers has been highly modified by dams, inundation, and regulated water flows.
Harvest	*Low.* Naturally produced steelhead are not marked for harvest (adipose fin clips) and are protected in recreational fisheries. Few steelhead (assumed zero) are caught in ocean fisheries. The recent Columbia River harvest rates on A-run steelhead in non-Indian and treaty Indian Fisheries range from 1.0% to 1.9% and 4.1% to 12.4%, respectively (NOAA 2008 SCA).The harvest contribution value used by HSRG (2009) for the current program was 139.

Table 16. Imnaha River/Little Sheep Creek summer steelhead (natural + integrated hatchery)

Management Premises and Goals	
ESA Status	*Threatened* . Included with the Snake River Steelhead DPS.
Biological Significance	*High.* The TRT has determined that the Imnaha population is unique within the Snake River basin. For the HSRG review, the population has been classified as Primary.

Population Viability	*Low to medium*. Limited redd count, adult trapping, and fishery observations indicate that the natural population is persistent and well distributed but likely much less abundant than historical conditions. Recent 20-year average recruit per spawner estimated at 1.45 (NOAA 2008 SCA). The ICTRT classifies this population as Intermediate. Recovery goal for abundance is 1,500 adult fish. HSRG (2009) estimated Imnaha habitat productivity and capacity as 3 and 1,800, respectively and Little Sheep habitat productivity and capacity as 3 and 200, respectively. The hatchery propagated component of this population is abundant and productive.
Habitat	*Excellent to poor.* The headwaters of Imnaha River are in a designated Wilderness and are in nearly pristine condition. However, the lower sections of Imnaha River and other tributaries are impacted by agricultural practices, flood control, and water diversions. The migration corridor through the Snake and Columbia Rivers has been impounded and otherwise modified.
Harvest	*Low (natural) to moderate (hatchery).* Naturally produced steelhead are not marked for harvest (adipose fin clips) and are protected in recreational fisheries. Few steelhead (assumed zero) are caught in ocean fisheries. The recent Columbia River harvest rates on A-run steelhead in non-Indian and treaty Indian Fisheries range from 1.0% to 1.9% and 4.1% to 12.4%, respectively (NOAA 2008 SCA). The harvest contribution values used by HSRG (2009) for the current program were 122 for natura1 and 1,359 for hatchery production. Example of catch distribution and escapement of 3,752 hatchery fish from 2004-05 run year, 1% Columbia River Tribal Treaty Net, 3% Columbia River sport, 1% Deschutes River sport, 21% Snake River and tributary sport, 1% stray, and 73% in-basin escapement and hatchery weir (ODFW 2005 Progress Report).
Hatchery Program	
Facilities	Irrigon Hatchery and Little Sheep Creek satellite facility
Type	Integrated. Irrigon Hatchery is a typical northwest steelhead production facility designed to rear one-year smolts using well water of fairly constant temperature. Incubation and early rearing take place in a hatchery building with final rearing in outdoor concrete raceways. The Little Sheep Creek satellite facility consists of two large concrete acclimation ponds for final rearing and release of smolts produced at Irrigon Hatchery, and an adult trap.
Authorization and Funding	Authorized and funded through the Lower Snake River Compensation Plan
Primary Purpose	Harvest. The primary purpose for the Little Sheep Creek steelhead program is mitigation for losses to fisheries from construction of the four Federal Dams on the lower Snake River and to restore tribal and recreational fisheries.
Secondary Purposes	Conservation.
Broodstock Origin(s)	The broodstock is a combination of natural and hatchery origin anadromous steelhead adults collected at the adult trap on Little Sheep Creek.

Table 17. Wallowa hatchery summer steelhead (Irrigon FH, Wallowa FH)

Management Premises and Goals	
ESA Status	*Not listed*
Biological Significance	*Low.* This stock is not included in the listed Snake River Steelhead DPS.
Population Viability	*High.* This hatchery population is abundant and productive. The program has an R/S value of 15.0 (HSRG 2009).
Habitat	*Variable.* The hatchery population is negatively impacted by a modified migration corridor similar to natural populations.
Harvest	*Moderate to high.* All smolts produced from this program are marked for harvest. Few steelhead (assumed zero) are caught in ocean fisheries. The recent Columbia River harvest rates on A-run steelhead in non-Indian and treaty Indian Fisheries range from 1.0% to 1.9% and 4.1% to 12.4%, respectively (NOAA 2008 SCA).Recreational and tribal fisheries in the Snake River Basin take approximately 60% of the hatchery steelhead that pass Lower Granite Dam. The harvest contribution value used by HSRG (2009) for the current program was 6,030. Example of catch distribution and escapement of 12,862 hatchery fish from 2004-05 run year, 1% Columbia River Tribal Treaty Net, 2% Columbia River sport, <1% Deschutes River sport, 68% Snake River and tributary sport, 2% stray, and 27% in-basin escapement and hatchery weir (ODFW 2005 Progress Report).
Hatchery Program	
Facilities	Irrigon FH, Wallowa FH, and the Big Canyon satellite facility.
Type	*Segregated*. Irrigon Hatchery is a typical northwest steelhead production facility designed to rear one-year smolts using well water of fairly constant temperature. Incubation and early rearing take place in a hatchery building with final rearing in outdoor concrete raceways. The Big Canyon satellite facility consists of one large concrete acclimation ponds for final rearing and release of smolts produced at Irrigon Hatchery. Wallowa Hatchery includes two large concrete acclimation ponds for final rearing and release of smolts produced at Irrigon Hatchery and an adult trap.
Authorization and Funding	Authorized and funded through the Lower Snake River Compensation Plan
Primary Purpose	Harvest. The primary purpose for the Wallowa steelhead program is mitigation for losses to fisheries from construction of the four Federal Dams on the lower Snake River and to restore tribal and recreational fisheries.
Secondary Purposes	None.
Broodstock Origin(s)	The broodstock consists of hatchery origin anadromous steelhead adults collected at the adult trap at Wallowa Hatchery.

Table 18. Oxbow hatchery (Lower Snake River, Hells Canyon) summer steelhead (Oxbow FH, Niagara Springs FH, Idaho Department of Fish and Game)

Management Premises and Goals	
ESA Status	*Not listed*. Oxbow FH steelhead are not included with the *Snake River Steelhead DPS*. The ICTRT (2005) classified the Hells Canyon, Snake River population of A-run steelhead, which is the progenitor stock for the Pahsimeroi and Oxbow FH populations, as *extirpated*.
Biological Significance	*Medium*. This hatchery stock represents the genetic legacy of extirpated steelhead populations indigenous to the Snake River basin upstream of Hells Canyon. The HSRG (2009) classified the natural population below Hells Canyon Dam as *stabilizing* based on residual spawning and rearing habitat.
Population Viability	*High.* The HSRG (2009) estimated the habitat productivity and capacity for A-run steelhead in the Hells Canyon region of the Snake River as R/S = 2.0 and 500 natural-origin adults, respectively. The HSRG (2009) estimated R/S = 12.6 for hatchery-origin Oxbow A-run steelhead released in the Hells Canyon region of the Snake River.
Habitat	*Low*. Historic spawning and rearing habitat for steelhead are blocked by the Hells Canyon complex of dams. Fish passage, water flows and temperature in the downstream migration corridor have been greatly impacted by dams on the Snake and Columbia rivers.
Harvest	*Moderate to high.* Few steelhead (assumed zero) are caught in ocean fisheries. The recent Columbia River harvest rates on A-run steelhead in non-Indian and treaty Indian Fisheries range from 1.0% to 1.9% and 4.1% to 12.4%, respectively (NOAA 2008 SCA). Oxbow A steelhead contribute to sport and tribal fisheries in the Little Salmon River, the lower Snake River, and the lower Columbia River. For brood years 1992 to 1999, the sport fishery annually harvested an average of 220 (range 0-1,757) Oxbow A-run steelhead released into the Salmon River from Magic Valley FH and 1,580 (range 0-6,808) Oxbow A-run steelhead released into the Salmon River from Hagerman NFH.
Hatchery Program	
Facilities	Oxbow FH, Hells Canyon trap, and Niagara Springs FH. Oxbow FH A-run steelhead have been used in the past to "backfill" Sawtooth and Pahsimeroi FH A-run stocks reared at Hagerman NFH and Magic Valley FH.
Type	*Segregated.* Hatchery-origin fish are collected for broodstock at Hells Canyon Dam.
Authorization and Funding	Idaho Power Company Mitigation.
Primary Purpose	*Harvest.* Oxbow FH steelhead are reared at the Niagara Springs FH and released into the Little Salmon River (275,000 smolts) to support harvest and in the Snake River at Hells Canyon Dam (525,000 smolts) to support fisheries in the lower Snake River and provide adult returns for broodstock.
Secondary Purposes	*Conservation.* Although not explicitly stated as a purpose, the Oxbow FH stock represents the genetic legacy of natural populations of steelhead that are now extirpated upstream of the Hells Canyon Dam complex. Resident (non-anadromous) populations of *Oncorhynchus mykiss* (rainbow/redband trout) remain in those historic areas upstream of Hells Canyon.

Broodstock Origin(s)	The Oxbow FH stock of steelhead originated from the Pahsimeroi FH Stock, which was developed from natural-origin adult steelhead trapped at Oxbow and Hells Canyon dams from 1966 through 1970. The hatchery stock developed at Pahsimeroi FH may have included some steelhead and rainbow trout native to the Pahsimeroi River. Steelhead from the Pahsimeroi stock were first released into Hells Canyon in the early 1990's and returning fish founded the Oxbow FH stock.

Table 19. Grande Ronde River (non-anadromous) rainbow-redband trout (natural)

Management Premises and Goals	
ESA Status	*Not listed (non-anadromous). However, r*ainbow trout occurring in anadromous fish waters can receive the same protective measures as steelhead under the *similarity of appearance* clause of the ESA (Sec. 4(e)). Native populations of rainbow/redband trout upstream of natural anadromous fish barriers are currently excluded from ESA protections. Inland Columbia Basin redband trout are listed by the state as a sensitive species and protection of native trout is a high priority due to the ODFW Native Fish Conservation Policy
Biological Significance	*Medium to high*
Population Viability	*Low to medium*. Rainbow-redband trout persist throughout the Grande Ronde River Basin. Populations are locally abundant particularly in wilderness streams including the Wenaha and Minam rivers and the upper Lostine River Isolation of small populations due to passage barriers and streams dewatered by irrigation is a concern.
Habitat	*Excellent to poor*. Habitat in several headwater streams is in Wilderness and remains in nearly pristine condition. Other streams on public land provide fair habitat. Habitat is in excellent condition in the undeveloped headwaters, but low-elevation reaches have thermal and flow barriers and degraded habitat
Harvest	*Low to moderate*. Fisherman access is limited in many areas where Rainbow-redband trout are abundant. Recreational harvest is restricted by state regulations designed to protect wild, native trout and juvenile steelhead.

Table 20. Imnaha River (non-anadromous) rainbow-redband trout (natural)

Management Premises and Goals	
ESA Status	*Not listed (non-anadromous). However, r*ainbow trout occurring in anadromous fish waters can receive the same protective measures as steelhead under the *similarity of appearance* clause of the ESA (Sec. 4(e)). Native populations of rainbow/redband trout upstream of natural anadromous fish barriers are currently excluded from ESA protections. Inland Columbia Basin redband trout are listed by the state as a sensitive species and protection of native trout is a high priority due to the ODFW Native Fish Conservation Policy.

Biological Significance	*Medium to high.*
Population Viability	*Low to medium*. Rainbow-redband trout persist throughout the Grande Ronde River Basin. Populations are locally abundant particularly in wilderness streams including the Wenaha and Minam rivers and the upper Lostine River Isolation of small populations due to passage barriers and streams dewatered by irrigation is a concern.
Habitat	*Excellent to poor*. Habitat in several headwater streams is in Wilderness and remains in nearly pristine condition. Other streams on public land provide fair habitat. Habitat is in excellent condition in the undeveloped headwaters, but low-elevation reaches have thermal and flow barriers and degraded habitat.
Harvest	*Low to moderate*. Fisherman access is limited in many areas where Rainbow-redband trout are abundant. Recreational harvest is restricted by state regulations designed to protect wild, native trout and juvenile steelhead.

Table 21. Grande Ronde River bull trout (natural)

Management Premises and Goals	
ESA Status	*Threatened (1999).*
Biological Significance	*Medium to high.*
Population Viability	*Low to Medium*. Bull trout persist in isolated populations in headwater areas of the Grande Ronde River Basin and seasonally utilize portions of the main stem and lower tributaries. Populations are locally abundant particularly in wilderness streams including the Wenaha and Minam rivers and the upper Lostine River Isolation of small populations due to passage barriers and streams dewatered by irrigation is a concern.
Habitat	*Excellent to poor*. Habitat in several headwater streams is in Wilderness and remains in nearly pristine condition. Other streams on public land provide fair habitat. Habitat is in excellent condition in the undeveloped headwaters, but low-elevation reaches have thermal and flow barriers and degraded habitat.
Harvest	*Low*. Fisherman access is limited in areas where bull trout are abundant and harvest is prohibited by state regulations.

Table 22. Imnaha River bull trout (natural)

Management Premises and Goals	
ESA Status	*Threatened (1999).*
Biological	*Medium to high.*

Significance	
Population Viability	*Low to medium*. Bull trout persist throughout the Imnaha River Basin. Populations are locally abundant particularly in the upper Imnaha within the wilderness Isolation of small populations due to passage barriers and streams dewatered by irrigation is a concern.
Habitat	*Excellent to poor*. Habitat in Wilderness remains in nearly pristine condition. Other streams on public land provide fair habitat. Habitat is in excellent condition in the undeveloped headwaters, but low-elevation reaches may have thermal and flow barriers and degraded habitat
Harvest	*Low*. Fisherman access is limited in areas where bull trout are abundant and harvest is prohibited by state regulations.

Other Species of Concern

Table 23. Non-salmonid fish species native to the Grand Ronde and Imnaha watersheds[33, 34]

Common name	Scientific Name
Suckers	*Catostomus sp. (3 species)*
Chiselmouth	*Acrocheilus alutaceus*
Largescale sucker	*Catostomus macroheilus*
Dace	*Rhinichthys sp. (3 species)*
Sculpins	*Cottus sp.* (6 species)
Mountain whitefish	*Prosopium williamsoni*
Northern pikeminnow	*Ptychocheilus oregonensis*
Pacific lamprey[35]	*Lampetra tridentata*
Brook Lamprey	*Limper richardsoni*
Redside shiner	*Richardsonius balteatus*
Sandroller	*Percopsis transmontana*
Peamouth	*Mylocheilus caurinus*
White sturgeon	*Acipenser transmontanus*

[33] *Imnaha Subbasin Summary, Draft November 30, 2001, Table 13 Fish Species present in the Imnaha River subbasin (Mundy and Witty 1998) page 38.*

[34] *Grande Ronde Subbasin Plan may 2004. Appendix 2: Species Tables, Table 1. Fish Species known to occur in the Grande Ronde subbasin, pg 317.*

[35] *Pacific lamprey is a "species of special concern".*

Salmon and Steelhead Hatcheries in the Region[36]

Lookingglass Fish Hatchery (Oregon Department of Fish and Wildlife and LSRCP)

Lookingglass Hatchery was constructed in 1982 as part of the LSRCP program to mitigate for spring Chinook and summer steelhead losses caused by the four Federal dams constructed on the lower Snake River. The hatchery is operated by ODFW and is located 19 miles north of the town of Elgin, Oregon adjacent to Lookingglass Creek, 2.2 miles upstream of its confluence with the Grande Ronde River (RM 86) at an elevation of 2,520 feet above sea level. The area of the site is 22.5 acres, owned by the US Fish & Wildlife Service. Hatchery facilities include 288 vertical incubator trays with a capacity of 1.3 million eggs (4,500 eggs/tray) to hatching and 32 Canadian troughs for early rearing fish each with a capacity of 100 to 125 pounds of fish. Final rearing is in 18 concrete raceways (3,500 ft^3) each with a capacity of 4,000 lb.

Lookingglass is used to raise spring Chinook for the Grande Ronde and Imnaha rivers as part of LSRCP. The Grande Ronde sub-basin hatchery program provides adult Chinook for hatchery broodstock, adult Chinook to supplement natural spawning, and limited recreational and tribal harvest within the Lower Snake River Compensation Plan mitigation area (Snake River and tributaries above Ice Harbor Dam). The program utilizes three (Catherine Creek, Lostine River, and Upper Grande Ronde) endemic Chinook hatchery stocks that were founded on spring/summer Chinook indigenous to the Grande Ronde sub-basin. Lookingglass Hatchery has seven full time employees to operate Lookingglass Hatchery and the Imnaha Satellite Facility.

Irrigon Fish Hatchery (Oregon Department of Fish and Wildlife and LSRCP)

Irrigon Hatchery is located along the Columbia River upstream of John Day Dam, three miles west of Irrigon, Oregon. The facility is at an elevation of 277 feet above sea level, at latitude 45o 54’ 33” N (45.9090) and longitude 119o 32’ 39” W (119.5453). The area of the site is 33 acres, owned by the USFWS. The facility was completed in 1985 and is the primary LSRCP steelhead rearing facility in Oregon. The facility was designed to rear steelhead smolts for release into the Grande Ronde and Imnaha River systems. Irrigon FH receives eyed steelhead eggs from Wallowa Hatchery and rears them prior to transfer for release or acclimation.

Wallowa Fish Hatchery (Oregon Department of Fish and Wildlife and LSRCP)

Wallowa FH began operation in 1920 as a resident trout hatchery. In 1985, the hatchery was renovated by the U.S. Army Corps of Engineers under the LSRCP for production of summer steelhead. The main hatchery building includes an incubation area, office, bunkhouse, and storage area. A mechanical/storage building includes mechanical equipment and storage area for the facility. The facility also includes a concrete adult holding pond, weir and fish ladder, water diversion structure, two acclimation ponds, fish liberation pipeline, adult fish transportation system, spawning facility, domestic water system, and storage facility.

Big Canyon Satellite Facility (Oregon Department of Fish and Wildlife and LSRCP)

The Big Canyon acclimation facility is located at the junction of Deer Creek and the Wallowa River, just east of the town of Minam, Oregon. The site covers 48 acres and is at an elevation of 2,590 feet above sea level. This facility consists of three acclimation ponds and one adult holding pond. Water

[36] *See Figure 2.*

rights total 5,835 gpm from Deer Creek. The facility is staffed by Wallowa Hatchery personnel from February through May.

Big Canyon Satellite Facility was completed in 1987 by the U.S. Army Corps of Engineers under the LSRCP for acclimation and release of steelhead smolts and recapture of returning adult summer steelhead. The facility includes a diversion dam, intake structure, three acclimation ponds, an adult holding pond, spawning shelter, fish barrier and ladder, intake building, mechanical building, office and residence, shop, RV pad, domestic water well, above ground diesel fuel storage, and security fencing.

Upper Grand Ronde River Acclimation and Adult Collection Facilities (Confederated Tribes of the Umatilla Indian Reservation)

The Upper Grande Ronde Acclimation Facility (UGRAF) is located at river mile 170.5 of the Grande Ronde River and consists of four portable raceways lined with vinyl fabric. The Upper Grande Ronde River Adult Collection Facility (UGRACF) is located at river mile 153.5 of the Grande Ronde River. The facility consists of a floating weir that spans the entire stream effectively blocking upstream passage. The facility has a capacity to hold only 28 adult spring Chinook salmon.

Catherine Creek Acclimation and Adult Collection Facilities (Confederated Tribes of the Umatilla Indian Reservation)

The Catherine Creek Acclimation Facility (CCAF) is located at river mile 52.5 of Catherine Creek and is similar in design and operation to the UGRAF, consisting of four portable raceways lined with vinyl fabric. The Catherine Creek Adult Collection Facility (CCACF) is located at river mile 43.5 of Catherine Creek. The facility consists of a hydraulic weir which is attached at the bottom sill of a full channel width pool and chute type ladder. Trapping of both adult summer steelhead and spring Chinook salmon is accomplished at this facility.

Lostine River Acclimation Facility (Nez Perce Tribe)

The Lostine River acclimation facility for spring/summer Chinook is located on the Lostine River at river mile 10.2, near the town of Lostine, Oregon, and is similar in design and operation to the UGRAF and CCAF, consisting of four portable raceways lined with vinyl fabric. The Lostine River spring/summer Chinook adult trap consists of a temporary picket weir and trap box located in the Lostine River at river mile 1.0.

Imnaha River Acclimation Facility (Oregon Department of Fish and Wildlife and LSRCP)

The Imnaha River Acclimation Facility is a satellite of Lookingglass Hatchery. It is located along the middle section of the Imnaha River, 32 miles upriver from the town of Imnaha. The site is at an elevation of 3,760 feet above sea level. The facility was built in 1988. Facilities consist of two adult traps, two adult concrete raceways (4,560 ft^3), three adult circular holding tanks 942 $ft.^3$ (20'x3'), a spawning area, and one pond (13,000 ft^3). The pond can be used for holding adult fish in the summer and juvenile acclimation and release in the spring. Capacity for juveniles is about 19,500 pounds (390,000 fish at 20 fpp).

Little Sheep Creek Acclimation Facility (Oregon Department of Fish and Wildlife and LSRCP)

Little Sheep Satellite Facility was completed in 1987 by the U.S. Army Corps of Engineers, under the auspices of the LSRCP, for acclimation of steelhead smolts and recapture of adults. The facility includes a domestic water system, an acclimation pond, an in-stream weir with radial gates, fish ladder and finger weir, an adult trap and sorting area, an adult holding pond, intake structure, support and dormitory building, equipment storage area, spawning shed, and security fencing. The adult concrete holding pond is 3,200 cubic feet volume. The acclimation pond is 34,125 cubic feet volume. Water rights total 8,797 gpm from Little Sheep Creek.

Oxbow Fish Hatchery (Idaho Power Company, IPC/ Idaho Department of Fish and Game)

The Oxbow Fish Hatchery is owned by Idaho Power Company and is located immediately downstream of Oxbow Dam on the Snake River. IDFG operates the facility under contract. Idaho Power Company's current mitigation goal for steelhead production at Oxbow FH is to trap and spawn a sufficient number of adult steelhead to allow for the production of 200,000 lbs. of steelhead smolts at Niagara Springs FH. To produce the minimum 1.2 million eyed-eggs/ fry necessary to reach that goal, approximately 550 adult steelhead are trapped in the fall and held over winter. An additional 50 females or 10% of the broodstock are trapped the following spring. Steelhead spawn in the spring and the resulting eggs and swim-up fry are transferred to Niagara Springs FH beginning in June.[37]

Umatilla Fish Hatchery (Idaho Power Company, IPC/ Oregon Department of Fish and Game)

Umatilla Hatchery is located adjacent to the Columbia River, 3.5 miles west of Irrigon, Oregon. The site is at an elevation of 277 feet above sea level. The site area is 23 acres and is owned by the US Army Corps of Engineers. The Umatilla Hatchery was authorized under the Northwest Power Planning Council's (NPPC) Fish and Wildlife Program and began operation in 1991. Hatchery funding is provided by Bonneville Power Administration. The hatchery is used for egg incubation and rearing of spring Chinook, fall Chinook and summer steelhead.

Satellite facilities provide for broodstock collection, holding of adult fish, and pre-release acclimation of juveniles. Adult salmon and steelhead are trapped and held for broodstock at Three-Mile facility on the Umatilla River (RM 3.0). The Minthorn and South Fork Walla Walla River facilities are used for adult holding. Juvenile acclimation occurs at Pendleton, Minthorn, Thornhollow, and Imeques facilities. The satellite facilities are maintained and staffed by the Confederated Tribes of the Umatilla Indian Reservation. Fall Chinook, spring Chinook and summer steelhead are propagated at these facilities.

[37] *Salmon River AOP, p 24*

Lookingglass Creek Spring Chinook

Operator: Oregon Department of Fish and Wildlife

Summary of Current Program

Goals

- ***Harvest goal:*** No harvest goal exists at the present time. The program currently operates primarily as a reintroduction program. The program is intended to eventually contribute to recreational and tribal harvests and the overall LSRCP mitigation goal to return 5,860 hatchery-origin adult spring/summer Chinook—from the Grande Ronde River basin—upstream of Lower Granite Dam on the mainstem Snake River. A directed harvest in Lookingglass Creek is allowed at the present time if escapement predictions to Lookingglass Creek exceed 620 adults.

- ***Broodstock escapement goal:*** Collect up to 170 adult spring Chinook (85 pairs) to include up to 90% natural-origin fish (up to 10% of the males may be jacks).

- ***Conservation goal:*** Use Catherine Creek stock to reestablish a naturally spawning population of spring Chinook in Lookingglass Creek in a habitat where the indigenous stock was extirpated.

- ***Escapement goal for natural-origin adults*:** Currently, there is no escapement goal for natural origin adults. The long-term objective is to modify weir management guidelines to transition escapement upstream of Lookingglass FH from hatchery-origin to natural-origin adults. Annual escapement goals are based upon a sliding scale (See Table 24 below). The ICTRT minimum abundance threshold for Lookingglass Creek is 500 naturally produced spawners. The ICTRT classified the population size category as "basic".

- ***Research, education, and outreach goals:*** Provide accurate information and educational opportunities for the public, media, schools, Tribal, State, and Federal agencies, and elected officials to enhance participation in understanding and stewardship of Lookingglass FH and LSRCP programs. The La Grande Evaluation Office of ODFW monitors, evaluates, and coordinates fishery services and research activities for the Lookingglass FH programs.

Objectives

- Collect up to 85 male and 85 female adult spring Chinook in Lookingglass Creek for broodstock each year to produce approximately 286,350 green eggs and 250,000 smolts (includes pre-spawn mortality and potential culling of eggs from high BKD parents). The proportion of the broodstock composed of hatchery and natural-origin fish will follow a sliding scale that is a function of the predicted total number of adult Chinook expected to return to Lookingglass Creek (see scale below).

- Collect both unmarked natural-origin fish and marked hatchery-origin spring Chinook for broodstock.

- Surplus adult spring Chinook from the Catherine Creek program can be used for broodstock if needed.

- Use broodstock collection guidelines (sliding scale) based on estimated escapement to Lookingglass Creek (Table 24 below) to determine the number of adults and proportion of hatchery to natural-origin fish to retain for broodstock and the number and proportion of hatchery and natural-origin fish to pass upstream each year. Based upon the sliding scale, pass up to 450 hatchery-origin, adult spring Chinook upstream of the weir at Lookingglass FH, and retain a maximum of 25% of the adult, natural-origin spring Chinook for broodstock.

- Release 250,000 smolts from Lookingglass FH into Lookingglass Creek. Beginning on April 1, volitionally release the smolts for two weeks, and then perform a forced release into the river.

- Collect tissue samples of adult Chinook released upstream of the weir for future genetic analyses of reproductive success (pedigree analyses).

- Allow a directed harvest on marked, hatchery-origin spring Chinook when escapement predictions to Lookingglass Creek exceed 620 adults (hatchery and natural-origin combined).

Table 24. Proposed longer term broodstock management/upstream passage guidelines for the Lookingglass Creek Spring Chinook adult returns.

Estimated adult escapement to Lookingglass creek [a]	Ratio of hatchery to natural adults at the mouth	Maximum % of natural adults to retain for broodstock	% of hatchery adults to retain for broodstock	% of adults released above the weir can be of hatchery origin	Minimum % of broodstock of natural origin	% known Strays allowed above the weir
≤300 (below)	Any	50	na	na	na	≤5
301-449	Any	≤50	≤50	any	any	≤5
450-619	Any	≤25	≤35	any [b]	≥90	0
≥620[c]	Any					

[a] pre-season or adjusted season estimate for total escapement
[b] Not to exceed 450 total fish, no limit on naturalized adults
[c] Selective sport harvest threshold

- In the near term or until there is an established Lookingglass Creek stock, collections will be based on the following agreement:

Table 25. **Near term broodstock management/upstream passage guidelines for the Lookingglass Creek Spring Chinook adult returns**

Adults available (swim-ins and CC surplus)	Percent to	
	Pass	Keep
150	67	33
200	58	42
250	53	47
300	50	50
>300 adjustments based on brood needs.		

Program Description

Non-native spring Chinook from the Carson NFH (Columbia River Gorge) and Rapid River FH (Little Salmon River) were the original sources of broodstock used for the program with harvest as the principal goal. That stock was phased out in response to conservation and ESA concerns, and Lookingglass FH converted to the local Catherine Creek stock in 2001to reduce risks to local spring Chinook populations and to reestablish a naturally spawning population of spring Chinook in Lookingglass Creek. The program is intended to contribute to the recovery of the threatened Snake River Spring/Summer Chinook ESU.

Assessment of Current Program

Operational Considerations[38]

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- The native Lookingglass spring Chinook stock is considered extirpated.
- Carson NFH and Rapid River FH origin fish were used from the onset of the Lookingglass Hatchery program in 1982. Release of Rapid River and Carson origin fish was discontinued in 2000 after surplus fish were released as parr that summer.
- In 2001, Catherine Creek, a more localized stock, was selected as an appropriate stock to be used for Lookingglass Hatchery mitigation program.

[38] *See Appendix B of this document for supporting background information and references.*

- The first Catherine Creek parr were released from the hatchery into Lookingglass Creek in 2001, and adults were first released upstream of the hatchery in 2004.

- The Catherine Creek stock used for reintroduction is indigenous to the Grande Ronde River basin and occupies habitat similar to that available in Lookingglass Creek.

- Catherine Creek spring Chinook are listed as threatened under the ESA as part of the Snake River spring/summer Chinook ESU.

- Marked and unmarked returning adults returning to Lookingglass Creek in 2009 will be considered appropriate for broodstock or passage upstream to spawn naturally.

- Draft management guidelines[39,40]: ODFW proposes aggressive weir management guidelines to expedite adult escapement (Table 24). The intent is to use the hatchery resource to magnify adult numbers to provide: (1) sufficient number of broodstock (170 spawners) for the program to become self-sufficient; (2) escapement of 450 adults upstream of the hatchery, and (3) harvest when escapement predictions exceed 620 adults.

- The longer-term objective is to modify weir management guidelines to transition escapement upstream of Lookingglass Hatchery and broodstock to naturalized adults. [41]

- A sliding scale has been developed to determine the number of adults and proportion of hatchery to natural-origin fish to collect on an annual basis (Table 24). For the sliding scale, up to 25% of the returning natural-origin adults can be used for broodstock to provide up to 90% of the 170 fish required for broodstock.

- The adult trap at Lookingglass Hatchery will be operated from March (environmental conditions allow) through mid-September. Adult spring Chinook are typically first detected at the weir in early June; the earliest fish have returned is in mid-May. The weir is operated through mid-September.

- Known returns of Catherine Creek smolts released into Lookingglass, and unmarked jacks and four-year olds, will be passed upstream or used for broodstock.

- Success of this program will contribute to recovery of the threatened Snake River spring/summer Chinook ESU. However, according to the ICTRT, establishment of a self-sustaining population in Lookingglass Creek is not required for the recovery of the ESU.[42]

- The Lookingglass Creek spring Chinook population was classified by the HSRG as a "stabilizing" population.

- An approved recovery plan does not exist currently for listed Snake River spring/summer Chinook.

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[39] *Appendix M. Draft Lookingglass Creek Management Guidelines. 2009. ODFW.*

[40] *Provided by Scott Patterson, ODFW, June 2009.*

[41] *These management guidelines are draft. Comanagers have not reached agreement on these issues.*

[42] *Pers. comm. Rich Carmichael, ODFW, July 2009.*

- Broodstock collection guidelines (sliding scale) are based on estimated escapement to Lookingglass Creek. The sliding scale was developed cooperatively between ODFW, CTUIR, and the NPT.

- Up to 500 adults are held until August 1st. After August 1st, adult spring Chinook are sorted for broodstock or passage upstream.

Hatchery and Natural Spawning, Adult Returns

- Spring Chinook adults from Catherine Creek and Upper Grande Ronde River may be straying into Lookingglass Creek. In 2006, 12 of the 80 hatchery-origin adults collected at the Lookingglass FH weir were strays from Catherine Creek (1 tagged fish) and the Upper Grande Ronde River (11 tagged fish) programs. Tissue samples are being collected to determine whether natural-origin fish are also straying into Lookingglass Creek.

- In the 1990s, the Rapid River stock, released from Lookingglass FH, strayed at low levels into the Wenaha and Minam rivers, posing an unacceptable genetic risk to the then small spring Chinook natural populations in those streams.

- A thermal migration barrier may be present in the Grande Ronde River during the summer that inhibits upstream migration and potentially reduces survival and increases stray rates.

- Since 2002, all hatchery-origin adults not of Catherine Creek stock are removed at the Lookingglass FH weir. Only known Catherine Creek stock hatchery adults are passed upstream of the hatchery to spawn naturally.

- The first unmarked adults, presumed to be natural progeny of Catherine Creek spring Chinook that spawned successfully in Lookingglass Creek, returned in 2008 as four-year old fish.

- All adult spring Chinook trapped at the hatchery in 2009 (unmarked and marked) will be considered appropriate for natural spawning upstream of the hatchery or for broodstock at Lookingglass Hatchery.

- All adults retained for broodstock are injected with erythromycin (20 mg/kg) and oxytetracycline (unless spawned the next day) to control BKD and other bacterial diseases. A second injection of antibiotic occurs only if deemed necessary, as judged from pre-spawn mortalities, fish health examination, and ripeness of fish. Fish that are to be released are either not injected, or they are held for 21 days prior to release if they are injected.

- All spawning will be done at Lookingglass Hatchery. Sorting and spawning take place on the same day.

- Hatchery and co-manager staffs will determine fertilization matrices each day. All Tyvek tag numbers will be recorded on the spawning matrix sheets. Most spawning matrices will be 2 females x 2 males, but matrices of 1 x 1, 1 x 2, 2 x 1, or 3 x 2 can be used if necessary.

- Fertilized eggs are incubated at Lookingglass hatchery. Fecundity of each female is determined at eye-up.

- If a ripe female is available during sorting and no ripe male is available, the female will be returned to the holding pond until a ripe male is located. Ripe male gametes can be collected in an emergency.

- Current spawning protocols allow up to a maximum of 10% of the eggs to be fertilized by jacks (3-year old males), although a specific protocol or requirement for including jacks has not been established. The milt from up to six jacks may be pooled to fertilize one-half to one-third of the eggs from each females in a 1 x 2, 2x 2 or 2 x 3 (females x males) spawning matrix, where one of the males in the matrix actually represents the pooled milt from up to six jacks. However, the actual number of jacks spawned and/or the proportion of eggs fertilized by jacks is unknown or not reported (2009 HGMP, see Table below).

- Natural-origin males have often been used multiple times to fertilize eggs to increase the overall proportion of eggs fertilized by natural-origin males. In general, jacks are included in every tenth spawning matrix.

Table 26. Adult spawning data for spring/summer Chinook at Lookingglass Hatchery for producing the 2004 - 2008 brood years.[43]

Brood Year	Marked Males Spawned	Marked Females Spawned	Unmarked Males Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000's)	Fry Ponded (1,000's)	Smolts releases (1,000's)
2004	56	53	--	--	0.0%	0.95	2867	172	146	150
2005*	--	--	--	--	--	--	--	--	--	--
2006*	--	--	--	--	--	--	--	--	--	--
2007	41	23	--	--	0.0%	0.56	2997	68	51	N/A
2008	128	76	24	--	12%	0.50	3768	286	N/A	N/A

* Years 2005 and 2006, all fish released to spawn naturally.

- At least 120 adults are sampled for virus; all females are sampled for bacterial kidney disease, using the enzyme-linked immunosorbent assay (ELISA) to allow for culling of eggs from females with disease levels measuring >0.2 optical density (OD). In 2008, no females had an ELISA OD greater than 0.2.

- IHN virus (IHNV) occurs among spring Chinook spawned at Lookingglass Hatchery. In 2008, the percent of adult females with detectable levels of the virus were 63%, 40%, 30%, 8%, and 48% for the Lookingglass, Catherine Creek, Imnaha, Grande Ronde, and Lostine River stocks, respectively. Percentages for adult males ranged from 5 to 17% for the five stocks.

- Eggs are spawned into colanders to remove ovarian fluid, fertilized and water-hardened with 100 ppm iodophor for 45-60 minutes, and then placed into incubation. Each incubation tray contains eggs from only one female.

- In the Grande Ronde Basin, the annual LSRCP mitigation goal for all stocks combined was set at 5,860 hatchery adults. ODFW estimated in 2006 that 414 Lostine River, 225 Catherine Creek, 159 Grande Ronde River, and 120 Lookingglass Creek adults returned to the basin. The combined return to the compensation area was 924 hatchery-origin adults, 15.8% of the

[43] *Table 6.2.1.D from the DRAFT Hatchery and Genetic Management Plan (HGMP) for Grande Ronde Basin Spring/Summer Chinook Program, Oregon Department of Fish and Wildlife (May 1, 2009).*

mitigation goal. The primary factors causing low returns of hatchery-origin adults in the basin were insufficient numbers of conventional broodstock and smolts released in a sub-basin with characteristically low smolt-to-adult return rates, and the use of captive broodstock that has experienced (a) low survival to maturity due to bacterial kidney disease and (b) low fecundity due to slow growth rates.

Incubation and Rearing

- Eggs receive a formalin treatment (1,667 ppm) three times per week, beginning 48 hours post spawn until eggs are shocked and dead eggs removed. If formalin can't be used, hydrogen peroxide (100 ppm, three treatments per week) is used.

- Chilled well water is used on the early egg takes to reduce the water temperature to around 50 degrees F. UV treated surface water is used for egg incubation after August when surface water temperatures can reach 70 degrees F.

- Flows are regulated at 4 to 6 gpm per vertical stack of eggs.

- Eggs are reloaded into the incubation trays after eye-up at 1 female per tray or approximately 4,000 eggs per tray.

- After hatch, the fry are reared in 8 of 28 indoor tanks (Canadian troughs) at approximately 48,000 fish per trough. The troughs are 117 cubic feet, with a flow rate of up to 50 gpm.

- During January through March, water temperatures in Lookingglass Creek drop to 32 to 35 degrees F. At that time, well water is blended with treated surface water to increase the water temperature to approximately 40 degrees F.

- Every attempt is made not to exceed a density index of D.I. = 0.75 in the indoor tanks. However, at times, D.I. does exceed 0.85 due to the limited early rearing space.

- The flow index can reach approximately F.I. = 2.4 when the fish are 250 fpp. However, the water temperature at this time is between 35 and 40 degrees F.

- When the fish reach 250 fpp, they are transferred to the outdoor raceways to be reared on creek water (late April to early May). Juvenile fish are retained indoors until high spring flows and subsequent turbidity water decreases.

- Twelve of 18 raceways are used to rear juvenile spring Chinook for the upper Grande Ronde River, Wallowa-Lostine River, Catherine Creek, and Lookingglass Creek. The remaining six raceways at Lookingglass FH are used to rear spring Chinook for the Imnaha River. The number of raceways and loading capacities for each program are:
  - Lostine; 4 raceways; 3 raceways conventional and 1 raceway captive broodstock (60,000-65,000 fish per raceway)
  - Upper Grande Ronde; 4 raceways. (60,000-65,000 fish per raceway)
  - Catherine Creek; 2 raceways (60,000-65,000 fish per raceway)
  - Lookingglass Creek; 2 raceways (75,000 fish per raceway)
  - Imnaha; 6 raceways (60,000-65,000 fish per raceway)

- Fish are held indoors until 250 fpp because (a) the fish are too small in relation to the screen mesh size to put them out earlier, (b) water quality in the raceways is reduced during spring runoff, and (c) the previous brood year needs to be released and the raceways cleaned before subyearling fish can be transferred to the outdoor raceways.

- Pond screens are installed at the head of each raceway to preclude the movement of cultured fish into the supply intake and to prevent invasion of the raceways by fish from Lookingglass Creek (e.g., sculpins, bull trout, bullheads, steelhead, Chinook).

- Automated feeders are used to feed fish in the outdoor raceways. During cold weather (Jan-March), the fish are fed by hand because the automated feeders are inoperable.

- The raceways are cleaned by hand once per week. The cleaning effluent water is directed into a settling basin.

- The maximum flows in the raceways are approximately 800 gpm per raceway.

- The targeted density index for the Lookingglass Creek spring Chinook stock is D.I. = 0.2, and the flow index is F.I. = 1.5 in the outdoor raceways. However, this stock is sometimes loaded at 75,000 fish per raceway (two raceways) for final rearing. Under this scenario, the density index by release time reaches D.I. = 0.25.

- Water temperatures can reach 68 degrees F in the raceways during summer months.

- Fish are typically held in three to four raceways until they are marked and tagged (at 90 fpp-180 fpp), at which time they are reapportioned among six raceways. The fish are adipose-fin clipped and coded-wire tagged in June-July.

- A formalin treatment is applied (167 ppm for 1 hour) for two consecutive days after marking to control fungus. The fish are monitored to determine if additional treatment is needed.

- The fish receive one 28-day erythromycin treatment (2.25% aquamycin) to control BKD, typically in July shortly after marking.

- BKD has not been a problem among spring Chinook juveniles in the conventional rearing program, although it has caused some mortality among juveniles from the captive broodstock programs.

- Spring Chinook juveniles at Lookingglass FH are PIT tagged in October.

- Monthly health monitoring examinations are conducted on each spring/summer Chinook stock. The sample includes a minimum of 10 moribund/dead fish (if available) and 4-6 live fish per raceway. Results are reported on the ODFW Fish Health Examination report.

- Current survivals for Lookingglass Creek stock are: green-to-eyed egg = 92.6% and 76.9% for BY2007 and BY2008, respectively; eyed-egg-to-smolt survival = 95.6% for BY2007.

- Lookingglass Creek spring Chinook juveniles exceeding 150,000 fish, up to a maximum of 100,000 fish, are transferred to Irrigon FH for rearing between May and October if the total

number of all fish for all programs exceeds the capacity of Lookingglass FH. Pre-smolts are transferred back to Lookingglass FH in October and released from the adult holding pond in April.

- The causative agent of whirling disease, *Myxobolus cerebralis*, was recently detected among wild rainbow trout and steelhead juveniles upstream of the hatchery in Lookingglass Creek. Hatchery juveniles are sampled for this parasite every year prior to release. Through 2009, the parasite had not been detected among fish on station at the hatchery.

Release and Outmigration

- Lookingglass Creek spring Chinook have a target size of 25 fpp by October 31, and 20 fpp at release.

- Lookingglass Creek smolts are released directly from the outdoor rearing raceways at Lookingglass Creek Fish Hatchery. Screens are pulled on or about April 1; remaining fish are forced out after approximately two weeks. Release may be delayed or advanced depending on environmental conditions. Smolts leave the hatchery via the tail race and fish ladder into Lookingglass Creek (the normal route also for hatchery effluent water).

Facilities and Operations

- The Lookingglass Hatchery is operated under the "Quarantine Mode of Operation" initiating strict methodologies of sanitation and disinfection to prevent/reduce possible transfer of fish pathogens between ESA species.

- The current design of the spawning facility does not accommodate the complex spawning protocol associated with the Chinook programs at the facility. There is little space for multiple containers to hold different groups of fish (hatchery, natural, jack, etc.) and, during spawning, the facility is cramped. The spawn room is also occupied by research and fish health staff during spawning.

- Spawning wastes at the endemic building are hosed off the ground to the pollution abatement pond.

- The maximum flow for each endemic building tank is 170 gpm. The water supply line to the building limits the amount of water available.

- The endemic building floor is gravel, inhibiting effective cleaning and disinfecting, especially during spawning.

- There are three large tanks in the endemic building. Each tank can hold 150-175 adults. The tanks receive 150-175 gpm.

- Little natural light enters the endemic building.

- The raceways are not equipped with shade covers or bird wire/netting. Only minor predation occurs from minks and birds.

- Currently, only one mesh size is used for the raceway screens at Lookingglass FH. The mesh is too large to contain fish smaller than 220 fpp, preventing ponding of fish in the raceways

before early May. The screen mesh size is also too small to pass sediment and debris that enters the raceways during spring runoff, which disrupts pond cleaning.

- All surface water utilized in the incubation building is UV treated. The current system is able to process 1,400 gpm with 99% treatment efficiency, but drops to 18% efficiency during turbid conditions (spring runoff). The current system only uses 14 UV lights but can be increased to 28 lights to increase efficiency.

- During low summer flows (July through mid-August), water availability to the hatchery may be reduced to maintain a minimum instream flow of 10 cfs of water for fish passage in Lookingglass Creek between the water intake and outflow (approximately 660 feet).

- The capacity of the well is 2,000 gpm. Well water is a constant 60 degrees F. Well water is used for early rearing and to keep the intake from freezing. Well water is not used for the raceways.

- The facility has three chillers with a total capacity to chill 180 gpm of water. Chilled water is only used for incubation.

- The maximum drainage for the early rearing building was tested at 1,700 gpm; however, the maximum is unknown (could be as high as 2000 gpm) but could be a constraint to expanding early rearing capacity.

- Water rights for the hatchery total 38,782 (86.4 cfs); includes 22,442 (50) cfs) for fish propagation and 13,462 (30cfs) gpm for fishway operation.

- The owner of record for all the water rights at the facility is unknown.

- Although water flows in Lookingglass Creek can drop to as little as 35 cfs with elevated water temperatures during the summer and early fall, hatchery staff report that water flows in Lookingglass Creek are currently adequate.

- Water temperatures fluctuate daily and seasonally with mean daily temperatures ranging between 34^{o} and 61^{o}F. A secondary water source is supplied from a well that is capable of pumping 5 cfs of 57^{o}F water.

- The water intake for the hatchery may freeze during cold winter weather. Well water (up to 5 CFS) is used to keep the intake from freezing and to reduce incidence of slush ice forming at the intake and in raceways.

- The intake does not meet current NOAA screening criteria. Current mesh size and sweeping velocity are inadequate.

- Wild fish (e.g. juvenile bull trout, steelhead, and Chinook) enter the hatchery raceways through the surface water intake. Feral brook trout may be an issue as well.

- High spring water runoff creates problems with sediment deposition in incubation trays and early rearing troughs, raceways and associated plumbing.

- Hatchery staff must deal with gravel, rocks and woody debris after high water events at the water intake for the hatchery. A new intake screen is being installed.

- The hatchery standby power system can operate the facility for up to 7 days.

- Hatchery raceway effluent from cleaning operations is directed into a settling abatement pond.

- Flow through effluents from the raceways, adult holding pond, and non-cleaning operations are discharged directly into Lookingglass Creek.

- Spawning waste is hosed into a drain and directed to the settling pond.

- Hatchery effluent from the incubation and early rearing Canadian troughs, and from the tanks in the endemic building, is directed into the settling pond.

- The pollution abatement system was designed to provide for NPDES (0300-J) permit compliance.

- The settling basin has a 2-hour retention time based on a continuous inflow of 1,500 gpm, and has an active water volume above the sludge reservation of 27,000 ft^3. Effluent discharges meet Oregon Department of Environmental Quality (ODEQ) criteria.

- ODEQ administers, under delegated authority from EPA (primacy), the NPDES permits in Oregon. The General Permit for Fish Hatcheries expired in September 2007. ODFW has applied for a new NPDES permit.

- The hatchery has 504 Heath-style vertical incubator trays with a capacity of 2.52 million eggs at 5,000 eggs per tray.

- The hatchery is equipped with 28 deep Canadian troughs with a rearing capacity of 200-250 pounds of fish each. Twenty six of the 28 troughs are dedicated to specific spring Chinook programs, and two troughs are used variably among programs depending on need.

- The troughs are supplied with UV-treated water from Lookingglass Creek. Up to 1,400 gpm can be treated. The creek water entering the hatchery is supplemented with pathogen free well water at 57 ^oF to control rearing water temperatures.

- Final rearing of spring Chinook is in 18 concrete raceways (4,000 ft^3) with 3,000 cubic feet of rearing space. Water flows through the raceways range from 100 gpm to 800 gpm. Final rearing density indices range from D.I. = 0.17 to 0.24.

- Adult facilities at Lookingglass FH consist of one adult trap, two adult concrete holding ponds (4,560ft^3) each partitioned into two ponds , three 20-foot x 4-foot adult circular holding tanks(capacity =1,100ft^3).

- Two adult-holding ponds are present, each divided in half with a cyclone-type fence (total of 4 sections). Lookingglass FH spring Chinook and Catherine Creek spring Chinook are held on separate sides of the fence in one raceway. The Imnaha stock is held in its own raceway.

- Both the intake diversion structure and the lower weir site are barriers to fish passage during low-flow.

- Current housing restricts the number of people who live on-site to three employees, limiting the ability to provide adequate on-site monitoring and security.

- Tribal fishers access Lookingglass Creek through the hatchery property. The fishers frequently camp near the intake. Tribal fishing occurs immediately downstream of the ladder. Sport fishing is limited to downstream of the hatchery property.

- No RV pad is present to accommodate volunteers for interpretation and light maintenance.

Research, Education, and Outreach

- Lookingglass FH smolts are 100% marked with clipped adipose fins. All Lookingglass hatchery spring Chinook reared at Lookingglass FH are coded-wire tagged, and all Lookingglass spring Chinook reared at Irrigon FH are adipose-fin clipped only. In 2009, 1,000 fish were also PIT tagged for monitoring outmigration and smolt survival. Tags are apportioned equally across raceways.

- ODFW and collaborators are evaluating the Lookingglass Creek reintroduction program and the other captive broodstock and conventional supplementation programs in the Grande Ronde and Imnaha river basins.

- The following monitoring and evaluation activities are currently ongoing for smolts from all spring Chinook programs at Lookingglass FH:
  - Tisssue collection for genetic monitoring and pedigree analysis
  - Pre-liberation weight and length of smolts
  - Downstream migration survival
  - PIT tag survival studies through hydrosystem
  - Tag retention and fin clip quality
  - Captive vs. conventional broodstock
  - Hatchery vs. natural-origin smolts

- Coded wire tags are used to assess contribution to fisheries and to estimate smolt to adult survival.

- PIT tag data provide information regarding downstream migration timing and comparative performance of wild smolts, captive broodstock smolts, and smolts that are the offspring of hatchery-origin adults returning to the hatchery ("conventional" smolts).

- A significant amount of data collected for the spring Chinook programs on the Grande Ronde and Imnaha rivers has not been evaluated nor published in peer reviewed documents because of limited funding for professional staff and other priorities.

- Environmental monitoring is conducted at ODFW facilities to ensure these facilities meet the requirements of the National Pollution Discharge Elimination Permit (NPDES) authorized by the Oregon Department of Environmental Quality.

- Information for Lookingglass FH is maintained on the LSRCP web site. ODFW does not have a web page dedicated to Lookingglass FH. General information and an abridged version of the operation plans are posted on an ODFW hatcheries page; however, current program information is not readily available to the public.

- Less than 2,000 people visit the Lookingglass FH annually.

- Lookingglass FH staff provide tours as requested, primarily to student groups. Staff do not participate in any off-station educational or outreach activities.

- The LSRCP and visitor information signage provided by ODFW is outdated. ODFW is currently working to redo the state-managed educational signage at all of their facilities.

- ODFW utilizes hatchery volunteers, but not at the facilities associated with this program.

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,[44] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- None at this time. The Lookingglass Creek reintroduction is expected to contribute to future Tribal and recreational fisheries in the Grande Ronde basin.

Conservation Benefits

- Reintroduction of spring Chinook in Lookingglass Creek is expected to increase the total abundance of spring Chinook in the Grande Ronde basin.

Research, Education, Outreach and Cultural Benefits

- This program will determine whether a natural population can be reestablished in Lookingglass Creek via artificial propagation with an introduced stock form another tributary (Catherine Creek) to the Grande Ronde River.

- Monitoring and evaluation will allow assessments of potential increases in abundance, viability, and local adaptation of an introduced stock over multiple generations.

- Tribal harvest and surplus adult spring Chinook trapped at facilities provide ceremonial, cultural and subsistence benefits to Columbia River tribes.

- Hatchery and evaluation staff provide educational opportunities on-site at Lookingglass Hatchery.

[44] *See Section II, "Components of This Report", for a description of these potential benefits and risks.*

- The Catherine Creek, Lookingglass Creek, Lostine-Wallowa River, and Upper Grande Ronde River spring Chinook programs are part of a basin-wide assessment of natural spawning supplementation by hatchery-origin fish throughout the Snake River. These assessments have generated a long-term data set spanning over 10 years.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,[45] the Review Team identified the following benefits of this program:

Harvest Benefits

- None at this time. The Lookingglass Creek reintroduction project is expected to contribute to future tribal, commercial and recreational fisheries downstream of Lookingglass Creek and the project area, including the lower Columbia River.

Conservation Benefits

- This program can reduce the extinction risk of Catherine Creek spring Chinook by serving as a genetic reserve for that population.

- The program, if successful, will increase the demographic resiliency of spring Chinook throughout the Grande Ronde River.

Research, Education, Outreach and Cultural Benefits

- Contributes to the body of research regarding the use of hatchery propagation for the reintroduction of spring Chinook in watersheds where the native population is extirpated.

- Tribal harvest provides ceremonial, cultural and subsistence benefits to Columbia River tribes.

- The Catherine Creek, Lookingglass Creek, Lostine-Wallowa River, and Upper Grande Ronde River spring Chinook programs are part of a basin-wide assessment of natural spawning supplementation by hatchery-origin fish throughout the Snake River. These assessments have generated a long-term data set spanning over 10 years.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,[46] the Review Team identified the following risks of the hatchery program:

Genetic Risks

- No contingency plan has been established for reducing or eliminating the number of hatchery-origin fish passed upstream of the hatchery relative to the number of natural-origin adults trapped and available for passage upstream. Continuing to pass hatchery-origin fish upstream to spawn naturally after a reintroduced, naturally-spawning population has been established -

[45] *Ibid.*

[46] *Ibid.*

and has achieved a viable size - will impede local adaptation and productivity, thus posing a reproductive fitness risk to the natural population.

- At the present time, hatchery-origin fish dominate on the spawning grounds. Moreover, Utilizing the majority of natural-origin recruits for broodstock and allowing a larger proportion of hatchery-origin fish, compared to natural-origin fish, to pass upstream is likely to inhibit the development of a self-sustaining natural population.

- The estimated parametric productivity (k = 3.0 recruits/spawner) and capacity (C = 200 adult recruits) for spring Chinook in Lookingglass Creek, and the predicted mean number of natural-origin adult recruits per year (N=134) obtained by the HSRG under current conditions, may not be sufficient to maintain a properly-integrated hatchery program that requires 85 male and 85 female (hatchery + wild) spawners. In short, a naturalized population with *PNI* > 0.5 is – most likely – not obtainable under current conditions if the broodstock is maintained at 170 adults per year.

Demographic Risks

- Water supply constraints such as turbidity, sediment, and woody debris during spring runoff may disrupt flow, force holding fingerlings longer and at higher densities in hatchery nursery tanks, and decrease efficacy of UV disinfection system which may lead to higher incidences of disease during hatchery rearing.

- Late-summer and early-fall low stream flows and high water temperatures reduces water quality to the hatchery and may contribute to deteriorating health of spring Chinook adults held on station.

- Transportation of subyearlings and pre-smolts long distances to and from Irrigon FH increases stress and fish disease risks.

- The transfer of fish from the Hatchery raceways to extreme cold water conditions at the acclimation sites may pose a physiological (stress) risk for the fish.

Ecological Risks

- Spring Chinook and steelhead adults migrating upstream of the water intake structure for Lookingglass FH increase disease risks to spring Chinook on station.

- Potential amplification of disease within the hatchery poses a disease risk to the Lookingglass spring Chinook population.

- Wild juvenile fish that enter the raceways through the water intake structure pose a disease and ecological risk to spring Chinook reared on station.

- The transfer and short-term rearing of Lookingglass spring Chinook fingerlings at Irrigon FH, and subsequent transfer back to Lookingglass FH, poses a fish health risk to spring Chinook reared full-time at Lookingglass FH.

Physical Risks

- Lack of adequate safety railings at the intake poses a human health and safety risk. This risk is particularly high during high stream flow conditions in the spring.

- Restricted space and sorting containers in the spawning area at Lookingglass FH spawning increases human labor significantly and impedes biosampling, collection of data, and physical spawning of adult fish thereby increasing safety risks to personnel during those labor-intensive activities.

Research, Education, Outreach and Cultural Risks

- None.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,[47] the Review Team identified the following risks from the hatchery program:

Genetic Risks

- None identified, but concerns exist regarding potential straying of hatchery-origin spring Chinook into the Minam and Wenaha rivers.

Demographic Risks

- The current structures of the water intake weir and passage ladder at Lookingglass FH may prevent upstream and downstream passage of native fish, such as bull trout, during low stream flows.

Ecological Risks

- Spring Chinook at Lookingglass FH are reared on creek water with limited UV treatment, and a portion of those fish are transferred to Irrigon FH for subsequent rearing to the pre-smolt stage. This protocol poses a health risk to fish reared at Irrigon FH.

- Wild juvenile fish that enter the raceways through the water intake structure could pose a disease and ecological risk to fish at Irrigon FH.

- Potential amplification of disease within the hatchery poses a risk of pathogen transmission to fish populations downstream of Lookingglass FH and the risk of vectoring disease in the region.

Research, Education, Outreach and Cultural Risks

- None identified.

[47] *Ibid.*

Recommendations for Current Program[48]

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

Program goals and objectives

Issue LC-SC1a: Present program goals for Lookingglass Creek spring Chinook are not expressed in terms of specific numeric outcomes that quantify intended benefits, either for harvest or for reestablishing a naturally spawning population. *The short-term goal of the program is to (1) reestablish a naturally spawning population in Lookingglass Creek via hatchery fish supplementation and (2) provide a fishery when greater than 620 adult spring Chinook return to Lookingglass Creek. However, numeric goals regarding the future size of a "naturalized" population of spring Chinook in Lookingglass Creek have not been established. For example, is the natural spawning "supplementation" goal of the program to (a) reestablish a viable, self-sustaining natural population, or (b) maximize the total number of adult recruits (hatchery + wild) returning to Lookingglass Creek each year? The former goal would require the establishment of a sliding scale that ultimately results in no passage of hatchery-origin fish upstream of the weir on Lookingglass Creek. The latter goal would simply establish a specific number of adults to retain for broodstock (e.g., 85 females and 85 males) and an additional number of fish (hatchery + wild) to pass upstream each year where the proportion of natural and hatchery-origin recruits in the two groups would – most likely - be approximately equal. Preliminary analyses by the HSRG suggest that Lookingglass Creek, under current conditions, is not capable of maintaining a naturally spawning population of more than 200 adult recruits annually. A natural population of this size would most likely not be able to provide sufficient numbers of natural-origin fish for a properly integrated hatchery broodstock composed of 85 male and 85 female spring Chinook.*[49]

Issue LC-SC1b: Many LSRCP hatchery programs appear to be attempting to meet harvest, mitigation and conservation goals simultaneously without those goals being clearly stated or prioritized in terms of numeric outcomes that quantify intended benefits. *Short-term and long-term goals for many LSRCP programs have not been clearly stated or quantified – up front - independent of the methods for achieving them (e.g., "The goal of this program is to use supplementation to …"). The confounding of goals and methods impedes assessments of program benefits, particularly if desired benefits are not quantified as short-term and long-term goals. Prioritization of mitigation versus conservation goals appears to shift annually based upon the number of returning adults without a strong association to long-term goals for*

[48] *The Review Team believes that the ODFW and the USFWS LSRCP office will be the logical parties to coordinate and implement most of the following recommendations.*

[49] *A "properly integrated broodstock", or hatchery program, is one in which the proportion of the broodstock composed of natural-origin fish (pNOB) exceeds the proportion of natural spawners composed of hatchery-origin fish (pHOS). Under these conditions, the natural environment is expected to have a greater influence than the hatchery environment on the mean phenotypic values of heritable traits related to reproductive success (e.g., egg size) and early life history viability (e.g., feeding behavior).*

the programs (e.g., as described in Annual Operating Plans). Prioritization of short and long-term goals often differs among comanaging parties.

Recommendation LC-SC1: Comanagers should restate and prioritize program goals for all LSRCP programs in terms of both short-term and long-term numeric outcomes for the following parameters: (a) natural population abundance and viability (conservation goals); (b) the number of hatchery-origin fish returning to specified target areas (mitigation goal), and (c) the proportions and desired numbers of fish from the two preceding groups allocated for broodstock, natural-spawning escapement, and harvest. Both short-term and long-term goals need to be clearly articulated up front (e.g., natural spawning escapement numbers) independent of the chosen methods for achieving them (e.g., supplementation spawning by hatchery-origin fish). Short-term goals need to be realistic and attainable biologically under current conditions. Long-terms goals should also be realistic biologically but can consider the removal of factors that prevent their achievement in the short-term (e.g., repair of riparian habitats, engineering improvements to fish passage structures, etc.). Quantitative benchmarks should also be established for measuring success or failure of the program towards meeting identified goals, thus allowing for mid-course corrections in programs or adjustments in the goals themselves. Prioritization of program goals, both short-term and long-term, must be made consistent among comanagers.

Issue LC-SC2: The presumed longer-term objective for the Lookingglass spring Chinook program is to modify weir management guidelines to emphasize natural-origin adults for broodstock and escapement upstream of Lookingglass Hatchery. *The sliding scale for the Lookingglass spring Chinook program addresses the near term objective for increasing the abundance of spring Chinook in Lookingglass Creek. However, no contingency exists in the sliding scale at higher levels of abundance when only natural-origin adults would be passed upstream. Continuing to pass hatchery-origin fish upstream after a naturalized population attains a viable size will impede attainment of long-term conservations goals (e.g., contributing to recovery) associated with establishing a self-sustaining natural population.*

Recommendation LC-SC2: Establish a sliding scale for broodstock and natural-spawning escapement that includes contingencies for not passing any hatchery-origin fish upstream when the predicted number of natural-origin recruits exceeds the viability threshold identified by comanagers.

Issue LC-SC3: Separate funding sources for different components of the Grande Ronde spring Chinook programs are well coordinated for program management, evaluation, and accountability. *Portions of the programs are administered under the LSRCP program and portions are administered under the BPA/Northwest Power and Conservation Council's Fish and Wildlife Program. (e.g. more difficult to address facility constraints)*

Recommendation LC-SC3: Continue program coordination (i.e. AOP, basin wide monitoring and evaluation plans, HGMP's, etc.) and assessment of funding through LSRCP and BPA to assure adequate funding levels to meet program goals and objectives.

Broodstock Choice and Collection

No issues identified.

Hatchery and Natural Spawning, Adult Returns

Issue LC-SC4: The relative genetic contribution of jacks (3-year old males) to each brood year is difficult to ascertain under current spawning protocols. *Spawning protocols at Lookingglass Hatchery are designed to maximize the genetic contributions of parents and the genotypic diversity among offspring. These goals are accomplished via the matrix spawning of males and females in 2x2, 1x2, and 2x3 (females x males) combinations. Jacks (3-year old males) are specifically included in the spawning matrices with the requirement that they fertilize no more than 10% of the eggs for each brood year. When jacks significantly outnumber 4-year old males, the milt from up to six jacks may be pooled to fertilize one-third to one-half of the eggs of each female in the matrix (the milt from 2-6 jacks is treated like the milt from one 4-year old male in these situations). In general, these spawning protocols are commendable because they maximize the total number of males used in the broodstock; however, the actual proportion and/or total number of eggs fertilized by jacks are not reported, although the Grande Ronde River Spring Chinook Management Plan specifies the inclusion of jacks in the broodstock at a rate of 1 jack for every 5 "adult"(age > 3 years) males.*

Recommendation LC-SC4: Report the proportion (and/or number) of eggs fertilized by jacks for each brood year in annual reports.

Issue LC-SC5: A significant number of spring Chinook returning to Lookingglass Creek weir are strays from other programs in the Grande Ronde basin. *Upper Grande Ronde and Catherine Creek spring Chinook have entered Lookingglass Creek. In 2006, 12 of the 80 hatchery-origin adults collected at the Lookingglass FH weir were strays from Catherine Creek (n=1) and the Upper Grande Ronde River (n=11) programs. ODFW managers have hypothesized that Spring Chinook may enter into Lookingglass Creek in summer months to avoid warm water temperatures in the Grande Ronde River. Catherine Creek and Upper Grande Ronde fish are reared at Lookingglass FH which may also contribute to these stray rates. The continuous inclusion of stray hatchery fish in the hatchery broodstock and naturally spawning population inhibits the development of a naturalized, locally adapted population.*

Recommendation LC-SC5: Continue to identify stray hatchery-origin spring Chinook trapped at the weir on Lookingglass Creek. In order to establish and maintain a localized Lookingglass Creek population that is demographically distinct from other hatchery-supplemented populations, exclude – to the extent possible - stray hatchery-origin fish from the Lookingglass broodstock and passage upstream once enough Lookingglass Creek hatchery- and natural- origin adults are returning to satisfy the reintroduction goal and sustain the program.

Issue LC-SC6: Juvenile spring Chinook reared on Lookingglass Creek water are exposed to several fish pathogens from salmonids residing or spawning upstream of the hatchery. *These pathogens include IHN virus (IHNV), Renibacterium salmoninarum (causative agent of bacterial kidney disease), and Myxobolus cerebralis (causative agent of whirling disease). These pathogens can decrease the pre- and post-release survival of juvenile spring Chinook reared at Lookingglass Hatchery. After adult salmon were allowed to pass upstream of the hatchery beginning in 1992, outbreaks of IHNV began occurring among juvenile fish at the hatchery, beginning in 1995. In addition, steelhead have always been allowed to migrate and spawn upstream of the hatchery intake. Infected hatchery-origin juveniles are potential vectors of disease and can return to their natal watersheds as infected adults.*

Recommendation LC-SC6: Improve treatment of the water supply used for incubation and early rearing at Lookingglass FH to reduce disease risks to juvenile spring Chinook reared on station (see *Issue LC-SC13-turbidity and UV treatment* under Facilities/Operations and Issue *LC-SC10 erythromycin* under Incubation/Rearing). Closely monitor the incidence and prevalence of pathogens among all spring Chinook stocks reared on station. If disease and pathogen loads at Lookingglass Hatchery become an increasing problem, then the benefits of passing anadromous salmonids upstream of the weir will need to be reassessed relative to the disease risks to four stocks of spring Chinook (Lostine River, Catherine Creek, upper Grande Ronde River, and Imnaha River) that are currently included with the "threatened" ESA-listing of the Snake River Spring-Summer Chinook ESU. If the demographic and natural population benefits of passing anadromous fish upstream of the hatchery do not outweigh disease risks to those four spring Chinook stocks (five stocks if the developing Lookingglass stock is included), then increased disinfection of the hatchery water supply will be necessary (e.g., ozonation) or the passage of anadromous salmonids upstream of the hatchery should be discontinued.

Incubation and Rearing

Issue LC-SC7: Spring Chinook early rearing densities exceed fish health guidelines to maximize use of UV-treated water from February to April when fry are most susceptible to IHN and whirling disease pathogens. However, the high early rearing densities increase the potential for stress and subsequent fish health issues (e.g. BKD).*The current goal is not to exceed D.I. = 0.75, but, early rearing densities at times can reach D.I. = 0.85. The Review Team recommends a maximum density index of D.I. = 0.2. The maximum flow index during early rearing is also high (F.I. = 2.4). The Review Team recommends that, ideally, the flow index should be less than 1.0.*

Recommendation LC-SC7: Reduce early rearing densities for the spring Chinook programs so that they are within a maximum of D.I. = 0.2 and, as a best management practice, reduce the flow indexes so that they are less than 1.0, or at least a level that allows effluent oxygen levels to be at least 6 ppm or greater than 80% of oxygen saturation[50], until further evaluation identifies more specific and optimum density and flow indices for the conditions at Lookingglass FH. Alternatives for achieving reduced density and flow indices may include one or more of the following facility modifications: installing moist-air incubators to reduce the incubation and chilling footprint and water demand so that additional troughs can be installed; increasing the amount of treated water available (see Recommendation LC-SC13); and/or increasing the capacity of the effluent drain for the early rearing building. Alternatively, program sizes or the number of programs maintained at Lookingglass FH could be reduced.

Issue LC-SC8: Final rearing densities of Lookingglass spring Chinook sometimes exceed the D.I. ≤ 0.20 guideline, thereby increasing fish health risks (e.g. BKD). *This group of fish occupies two raceways at Lookingglass FH with as many as 75,000 fish per raceway. The current goal is not to exceed D.I. = 0.20 DI, and depending on inter-annual variations in program size and rearing strategies, final rearing density can reach D.I. = 0.25.*

[50] *Wedemeyer, Gary A. 1996. Water Quality Requirements, pgs 72-74, Physiology of Fish in Intensive Culture Systems". Chapman Hall, New York, New York.*

Recommendation LC-SC8: Reduce final rearing densities for the spring Chinook programs so that they are all within the maximum recommended level of D.I. = 0.20 as a best management practice. Alternatives for achieving reduced density indices may include facility modifications such as (a) constructing additional rearing ponds or (b) modifying adult holding ponds to accommodate the number of programs at the recommended densities. Alternatively, program sizes or the number of programs maintained at Lookingglass FH could be reduced.

Issue LC-SC9: The flow index of F.I. = 1.5 in the outdoor raceways exceeds the best management practice guideline of F.I. ≤ 1.0 recommended by the Hatchery Review Team. *The Review Team recommends that, ideally, the flow index should be less than 1.0 to reduce fish health risks to spring Chinook; however, the Lookingglass FH staff have found that they can safely rear spring Chinook with a flow index up to F.I. = 1.5.*

Recommendation LC-SC9: As a best management practice, consider managing fish culture in the outdoor raceways to achieve a flow index less than 1.0, or at least a level that allows effluent oxygen levels to be at least 6 ppm or greater than 80% of oxygen saturation. Recommended flow indexes can be achieved by increasing the rearing space or reducing the number of spring Chinook reared.

Issue LC-SC10: High water temperatures and low flows during summer months increases the risk of disease to spring Chinook reared at Lookingglass FH.

Recommendation LC-SC10: Evaluate opportunities for chilling and/or disinfecting incoming water for use during summer months.

Issue LC-SC11: Spring Chinook reared at Lookingglass FH receive treatments of erythromycin-medicated feed. *To help control bacterial kidney disease (BKD) outbreaks, juvenile spring Chinook are given one 28-day treatment of erythromycin-medicated feed, whereas captive brood progeny with moderate to high ELISA titers receive two 28-day treatments. These treatments are given therapeutically (i.e. when R. salmoninarum is detected) and are necessary, in part, because infected spring Chinook adults are present in the water supply (see Issue LC-SC6). The U.S. Department of Agriculture and other federal agencies have published warnings and advisories regarding the biological risks and potential overuse of antibiotics. Although improved fish culture practices (lowered rearing densities, erythromycin injections of adults, and culling of infected broodstock females) have significantly reduced BKD among hatchery salmon, further reductions of medicated feed (with erythromycin) may be possible. Some spring Chinook salmon hatcheries that depend on a river water supply with anadromous adults have been able to reduce erythromycin feedings by decreasing rearing densities in the raceways below the published recommendation of D.I. = 0.2 DI, in addition to continuing the fish culture practices mentioned above.*

Recommendation LC-SC11: Re-assess the need for annual use of erythromycin feed with the goal of reducing its use. Evaluate raceway rearing densities by enumerating juvenile mortality, ELISA values for *Renibacterium* at release, and adult returns (via coded wire tags) to further reduce BKD in hatchery salmon populations. Additionally, a study that evaluates adult returns from erythromycin-treated and untreated (control) juvenile groups, potentially in combination with the sensitive polymerase chain reaction (PCR) techniques, might be done to determine the most efficacious use of erythromycin. ODFW may also wish to consider erythromycin

injections of adult Chinook salmon that are passed upstream of the hatchery to reduce vertical and horizontal transmission of *R. salmoninarum*.

Issue LC-SC12a: Due to space limitations at Lookingglass FH, Lookingglass stock spring Chinook production above 150,000 smolts has been transferred to Irrigon FH for rearing. *In 2009, approximately 100,000 spring Chinook were transferred to Irrigon FH during the period from May to October. Those fish are returned to Lookingglass FH in April of the following year.*

Issue LC-SC12b: Although Lookingglass spring Chinook are reared on UV treated river water, the UV treatment can be inefficient at precluding pathogens such as IHNV and M. cerebralis. *This is of special concern during spring flows prior to transfer to Irrigon FH, posing a disease risk to the fish reared at Irrigon FH. Similarly, diseases could be transferred back to Lookingglass FH from fish reared at Irrigon FH.*

Recommendation LC-SC12: Reprogram the Lookingglass FH so that the combined programs do not exceed the overall rearing capacity of the facility, precluding the need to temporarily transfer juvenile to other facilities such as Irrigon FH. This will require slight reductions in one or more programs (see the Team's recommended alternatives for the spring Chinook programs as an example). Program reductions may also help reduce early rearing densities (see *Issue LC-SC7*).

Release and Outmigration

No issues identified.

Facilities/Operations

Issue LC-SC13: The current availability of raceway screens of only one mesh size significantly affects raceway use. *The current mesh size is too large to contain fish smaller than 250 fpp, which delays transfers of fish from the nursery building until early May, resulting in high rearing densities prior to transfer. In addition, the mesh size of the screens is too small to pass sediment or debris that enter the raceways during high stream flows in the spring. The small mesh size also impedes cleaning of the raceways after fish are transferred and feeding rates have increased in response to larger fish size.*

Recommendation LC-SC13: Acquire additional screens with smaller and larger mesh sizes than the current screens for each raceway to increase raceway management flexibility.[51]

Issue LC-SC14: Surface water is turbid during spring runoff, compromising the efficiency of the UV treatment for early rearing. *The current system uses a drum filter to screen out waterborne particles >40 microns and is able to process 1,400 gpm with 99% treatment efficiency (reduction of total bacterial counts), but decreases to 50%-60% efficiency - and has been recorded to drop as low as 18% efficient - during turbid conditions (spring runoff). UV treatment is necessary to reduce the potential for pathogen transmission (esp. for causative agents of BKD, IHN, and whirling disease) from anadromous and resident fish that are passed upstream above the weir in Lookingglass Creek, the facility's water supply.*

[51] *ODFW reported that they are constructing larger-sized mesh screens in late 2009/early 2010.*

Recommendation LC-SC14: Consult with engineers to improve water treatment for early rearing. The Review Team recommends that water treatment consistently be 95-98% efficient to prevent the transmission of IHNV and *R. salmoninarum, M. cerebralis, and other pathogens of concern***.** Options may include upgrading the filtration and/or UV system (for example, the current system only uses 14 UV lights but can be increased to 28 lights), developing a settling basin for the intake water, and/or investigating alternative forms of water treatment (e.g., ozone). An UV transmissibility meter should be acquired to assess actual UV doses under variable conditions.

Issue LC-SC15: Several stocks of spring Chinook salmon are reared at Lookingglass FH. Some of these stocks are in adjacent indoor rearing troughs prior to transfer to outdoor raceways. At the present time, there are no barriers to prevent fish from jumping between adjacent troughs.

Recommendation LC-SC15: Install a physical barrier to preclude fish of different stocks from jumping between adjacent troughs.

Issue LC-SC16: The current design of the spawning facility does not accommodate the complex spawning protocol associated with the Chinook programs at the facility. *Little space is available for multiple containers to hold different groups of fish (hatchery, natural, jack, male, female, etc.) during spawning, and the facility is cramped. The spawn room is also occupied by research and fish health staff during spawning***.**

Recommendation LC-SC16: Consult with engineers to redesign the spawning facility (layout or entire facility) so that the design can efficiently accommodate the number of personnel required on spawn days consistent with the spawning protocol for the current programs.

Issue LC-SC17: The endemic building floor is gravel, inhibiting effective cleaning and disinfecting. *Chinook salmon are spawned in the endemic building. Spawning waste can remain in the gravel and be transferred to other rearing areas, posing a risk of pathogen transmission between stocks.*

Recommendation LC-SC17: Install a concrete floor and drainage in the endemic building.

Issue LC-SC18: Shade covers are not present over raceways. *Lack of shade, particularly during summer months, increases crowding of fish, potentially increasing stress and disease risks to the fish reared on station**. For example, in 2009, dorsal lesions occurred among juvenile fish in most raceways. Fish health specialists speculated that the lesions were steatitis, a syndrome that can be aggravated by intense UV-exposure, nutritional imbalances in the feed, and water-borne bacteria (such as F. pyschrophilum). This condition can be controlled by reducing intense UV exposure and/or increasing pigmentation through specialty feeds.*

Recommendation LC-SC18: As a best management practice, consider constructing shade covers over the raceways. Investigate the different shade covers being used at other facilities and undertake a feasibility study to determine if shade covers benefit the fish. This could be as simple as good quality floating Styrofoam sheets on the water and examining fish behavior.

Issue LC-SC19: Surface water intake screens do not meet NOAA Fisheries screening criteria. *The current mesh size and sweeping velocity are inadequate. The mesh size for the traveling water screens is a 0.146" square wire braid type mesh; however, NOAA Fisheries requires 3/32 (0.094)" mesh. Wild fish currently enter the hatchery raceways through the water intake, posing a health risk to the fish reared on station and a pathogen transmission risk to natural populations located in areas where the hatchery fish are outplanted for other programs (e.g., Catherine Creek). Raceway head screens have been installed as a secondary measure to prevent introduction of other species or natural-origin spring Chinook. Nevertheless, the intake screen should meet NOAA Fisheries screening criteria as the primary preclusion device. In addition, if juvenile brook trout are pulled into the raceways, there may be risk posed to bull trout if fish are released off-station into areas occupied by bull trout.*

Recommendation LC-SC19: Replace the water intake screen for Lookingglass FH so that it complies with the criteria of NOAA Fisheries (mesh size, water approach velocity, sweeping velocity, screen angle, etc.).

Issue LC-SC20: The fish ladder adjacent to the water intake is open, posing a human safety risk.

Recommendation LC-SC20: Cover or enclose the fish ladder.

Issue LC-SC21: The Oregon Department of Environmental Quality (ODEQ) General NPDES Permit for Fish Hatcheries expired in September 2007. *The ODEQ has not set a time line for issuance of a new permit and is allowing the hatchery to operate under the requirements of the old permit.*

Recommendation LC-SC21: ODFW should initiate a review of the NPDES permit with ODEQ.

Issue LC-SC22: Methods for manually removing debris (e.g., tree branches, rocks, etc.) from the adult ladder and intake diversion dam may pose a human safety risk.

Recommendation LC-SC22: Conduct a job hazard analysis. The analysis will assist in identifying alternate or improved methods for this activity.

Issue LC-SC23: Lookingglass FH spring Chinook and Catherine Creek spring Chinook are held in the same adult holding pond, posing a risk of pathogen transmission between stocks. *The two stocks are separated by a cyclone-type fence that splits the pond. Holding two stocks of spring Chinook in the same pond increases the potential for pathogen transmission between stocks. This situation is of increasing concern as the Lookingglass FH spring Chinook program transitions toward developing a locally-adapted broodstock from returning adults instead of using Catherine Creek fish for broodstock.*

Recommendation LC-SC23: Consult with engineers to divide and plumb the adult holding ponds so that the two stocks of fish can be held separately with separate water supplies. Dividing the holding pond could be used also for additional rearing space and to reduce rearing densities.

Issue LC-SC24: The Lower Snake River Compensation Plan office is reviewing the ownership status of water rights associated with all the facilities which divert water for fish culture*. Water use needs to be recorded to ensure documentation of beneficial use in support of the facilities water right(s) as required by state law. Adequate documentation and reporting of beneficial use are required to maintain the right to divert water.*

Recommendation LC-SC24: LSRCP cooperators should work with the Service's Division of Water Resources to ensure water use is properly measured, documented, and reported.

Issue LC-SC25: The water intake diversion and lower weir on Lookingglass Creek are both low-flow fish passage barriers and do not meet NOAA Fisheries criteria for fish passage*.*

Recommendation LC-SC25: Consult with engineers to modify the intake diversion and lower weir site so that they meet fish passage criteria.

Issue LC-SC26: Current housing is inadequate to accommodate enough staff to provide after-hours support (on-site monitoring and security). *The Lookingglass FH is in a remote location. Offsite staff cannot access the facility quickly and at times access is obstructed during inclement weather. LSRCP has acquired a site suitable for an additional house.*

Recommendation LC-SC26: Construct the additional house on-site as planned.

Issue LC-SC27: No facilities are present at Lookingglass FH to accommodate volunteer staff. *Volunteer staff at other facilities provide important public interpretation and light maintenance support.*

Recommendation LC-SC27: Construct facilities such as an RV pad to accommodate volunteer staff.

Issue LC-SC28: The access road to the Lookingglass FH may not be consistent with safety standards. The road is narrow, the pavement is deteriorating, and the road lacks guard rails.

Recommendation LC-SC28: Consult with engineers to perform a Road Safety Audit through the Western Lands Federal Highway Administration. The audit will provide guidance for improving the condition of the access road.

Research, Monitoring, and Accountability

Issue LC-SC29: The evaluation and dissemination of monitoring data for Oregon LSRCP hatchery programs is adequate for management decisions based on current information. However, a backlog of important research data is available but has not been fully analyzed or published because of funding limitations. *For example, the large-scale evaluation of supplementation natural spawning by hatchery-origin fish in the Grande Ronde and Snake/Columbia rivers is not coordinated at a greater funding level. This precludes the proper assessment of supplementation to meet co-manager goals and objectives and provide timely results that could be used to modify programs to meet co-manager goals.*

Recommendation LC-SC29: The Service should continue to work with LSRCP comanagers to develop a comprehensive data management and evaluation plan that incorporates goals and objectives, data management, and reporting requirements at both the program and regional levels with funding for publication of research data a high priority.

Issue LC-SC30: ODFW has a historical baseline data set for the Grande Ronde River basin (including Lookingglass Creek), including (a) data on early life history of spring Chinook prior to initiation of the hatchery programs, (b) pre- and post-hatchery data for spring Chinook in Lookingglass Creek(including data for introduced Carson and Rapid River hatchery fish at Lookingglass FH), (c) data on natural populations in control streams with no direct hatchery influence (e.g., Minam and Wenaha rivers), (d) data for a Snake River basin wide assessment of supplementation programs, and (e) preliminary data on the reintroduction program for fish from Catherine Creek released into Lookingglass Creek.

Recommendation LC-SC30a: Continue current monitoring and evaluation programs to continue long term data sets and assess reintroduction of Catherine Creek stock in Lookingglass Creek.

Recommendation LC-SC30b: Initiate a reproductive success study (pedigree analysis) in Lookingglass Creek using Catherine Creek stock.

Education and Outreach

Issue LC-SC31: The LSRCP and state visitor information and signage are outdated. ODFW is currently working to redo the state-managed educational signage at all of their facilities.

Recommendation LC-SC31: Update the displays and handouts so that they accurately reflect the present state of salmon and steelhead and the associated programs at Lookingglass FH.

Issue LC-SC32: Information available currently to the public regarding Lookingglass Fish Hatchery and its associated programs are inadequate. *Technical information, such as Annual Operations Plans are available from comanager web sites. However, both the LSRCP web site and the ODFW web site lack information directed towards the public. Additionally, ODFW does not currently manage a web page for Lookingglass Fish Hatchery.*

Recommendation LC-SC32: Information regarding harvest and conservation benefits of the LSRCP hatchery programs in Oregon should be readily available to the public in the appropriate formats (e.g., brochures, interactive web pages, etc.). For example, fishery benefits provided by the program for each hatchery could be updated annually on the LSRCP web site and provided in a brochure at the hatchery. If the LSRCP web site is the primary source of information for the program, then an ODFW page for Lookingglass Hatchery and the facility's programs should be linked to the LSRCP site.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing Lookingglass Creek Spring Chinook Program and developed six alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the "no hatchery" option. Following these descriptions of alternatives, the Review Team has identified recommended alternatives.

Alternative 1: Current program with recommendations

Continue to develop a "Lookingglass Stock" of spring Chinook, founded from eggs or fish in excess of the conservation needs of the Catherine Creek stock. The purpose of the program is to reestablish a naturally spawning population of spring Chinook in Lookingglass Creek while contributing to LSRCP mitigation goals and ultimately providing fish for harvest. The Team's recommendations include establishing clearly articulated goals for escapement, broodstock, and harvest, and integrating natural spawning escapement with the hatchery program consistent with those goals. Alternative 1 would maintain the current release of 250,000 smolts. The Team's recommendation to discontinue the transfer and rearing of spring Chinook at Irrigon FH will require reductions to other spring Chinook programs at Lookingglass FH.

Pros

- Provides harvestable fish for tribal and recreational fisheries in Lookingglass Creek and the Grande Ronde River.
- Develops a locally adapted broodstock for reintroducing spring Chinook to Lookingglass Creek.
- Potentially provides a genetic repository for the ESA-listed Catherine Creek population.
- Enhances ecological processes in Lookingglass Creek.
- Contributes to the LSRCP mitigation goal for Grande Ronde basin spring Chinook upstream of lower Granite Dam in the long term.
- Reestablishing a naturally spawning population of spring Chinook to Lookingglass Creek is consistent with interim recovery objectives for the Grande Ronde Spring/Summer Chinook MPG.
- Over the long-term, reduces the number of hatchery-origin adults spawning naturally in Lookingglass Creek as the number of natural-origin adults available for upstream passage increases.
- Reduces fish health risks by terminating the transfer of fish from Lookingglass FH to Irrigon FH.

Cons

- The current estimated productivity (k = 3.0 recruits/spawner) and capacity (C = 200 adult recruits) for a natural population of spring Chinook in Lookingglass Creek (HSRG 2009)

appear to be insufficient for developing a properly integrated hatchery population of the size desired by comanagers (broodstock size = 85 females + 85 males).

- The continued passage of spring Chinook upstream of the Lookingglass FH intake poses a disease risk to other spring Chinook stocks reared on surface water at Lookingglass FH (i.e., Lostine-Wallowa River, Upper Grande Ronde River Catherine Creek, and Imnaha River).

Alternative 2. Convert the current integrated program to a two-broodstock, stepping-stone program

Convert the current integrated program to a stepping-stone program designed to provide 450 hatchery-origin adult fish from an integrated broodstock program for natural spawning escapement and fish for harvest from a second broodstock derived from returning adult progeny of the integrated broodstock. This program would maintain a total release of 250,000 smolts, but could be increased if the number of smolts reared for other stocks at Lookingglass FH was reduced (see alternative 4).

The intent of this alternative is to develop a program that contributes to the LSRCP mitigation goal of returning 5,860 adult spring Chinook, originating from the Grande Ronde River, upstream of Lower Granite Dam while, at the same time, meeting the conservation goals for a natural population of spring Chinook in Lookingglass Creek. This two-broodstock, stepping-stone program could be implemented by differentially marking and tagging the progeny of each broodstock where the integrated component from the first broodstock would be coded-wire tag-only and the harvest component from the second broodstock would be 100% adipose-fin clipped with a portion given coded-wire tags for monitoring. The broodstock program sizes would be a maximum of 60 adult fish for the integrated *conservation* component (30 females + 30 males to yield ≈88,000 smolts) and approximately 160 adults for the second-stage broodstock or *harvest* component (80 males + 80 females to yield ≈235,000 smolts).[52] Progeny of the harvest broodstock would continue to be released from the hatchery but comanagers may wish to acclimate and release progeny of the integrated broodstock upstream of the weir in Lookingglass Creek.

Pros

- Increases emphasis on the reintroduction of a naturally spawning population of spring Chinook in Lookingglass Creek.

- Increases the likelihood that a properly integrated broodstock (i.e. of a smaller size) can be developed to meet conservation objectives in Lookingglass Creek.

- If successful, provides more fish for harvest from the harvest component of the program (Depending on allocation of rearing space and capacity at Lookingglass FH).

- Increases the potential for meeting LSRCP mitigation goals in most years for spring/summer Chinook originating in the Grande Ronde River basin.

[52] *These numbers assume that a mean annual spawning escapement of 100 natural-origin adults into Lookingglass Creek would yield a mean of 130 natural-origin adult recruits per year, 30 of which would be available for the integrated broodstock. These numbers further assume a mean recruit per spawner of R/S = 9.0 for spring Chinook spawned at Lookingglass Hatchery (HSRG 2009).*

- Over the long-term, reduces the number of hatchery-origin adults spawning naturally in Lookingglass Creek.

- Reduces fish health risks by terminating the transfer of fish from Lookingglass FH to Irrigon FH and associated fish health concerns.

Cons

- May not meet LSRCP mitigation goals if smolt-to-adult return rates are lower than anticipated.

- Further complicates the operation of Lookingglass FH which is already complicated because of the number of spring Chinook stocks currently reared.

- The continued passage of spring Chinook upstream of the Lookingglass FH intake poses a disease risk to other spring Chinook stocks reared on surface water at Lookingglass FH (e.g. Lostine-Wallowa River, Upper Grande Ronde River, Catherine Creek, and Imnaha River).

Alternative 3. Convert the current integrated program to a segregated program

Convert the current integrated program to a segregated program. Discontinue passing hatchery-origin spring Chinook upstream after five years and allow only natural-origin fish to pass. This program maintains a 250,000 smolt release, but could be increased if production of other stocks at Lookingglass FH were reduced (see Alternative 4).

Pros

- Simplifies the Lookingglass spring Chinook program.

- Reduces hatchery influence on the reintroduced, naturally spawning population once it is established. Minimizes use of natural-origin spring Chinook for broodstock after a natural population becomes established.

- Maintains the number of released smolts at current or higher levels than established to meet the LSRCP mitigation goal for spring Chinook originating from the Grande Ronde River Basin.

- Increases the number of hatchery-origin spring Chinook available for harvest after hatchery-origin fish are no longer passed upstream to spawn naturally.

- Reduces fish health risks by terminating the transfer of fish from Lookingglass FH to Irrigon FH.

Cons

- Lookingglass Creek may not be able to support a self-sustaining population of spring Chinook without hatchery intervention.

- The risk of domestication influence to populations where Lookingglass spring Chinook may stray (e.g. Wenaha and Minam rivers) is increased with a segregated versus an integrated broodstock program.

- The continued passage of spring Chinook upstream of the Lookingglass FH water intake poses a disease risk to other Chinook stocks reared on surface water at Lookingglass FH (e.g., Lostine-Wallowa River, Upper Grande Ronde River, Catherine Creek, and Imnaha River). This risk may be reduced because fewer spring Chinook would be passed upstream.

Alternative 4. Increase the size of the Lookingglass Creek spring Chinook program for harvest mitigation and reduce the size of the Upper Grande Ronde River and Imnaha River programs at Lookingglass FH

Expand the size of the Lookingglass spring Chinook program to 325,000 smolts (requires six raceways at Lookingglass Hatchery) and concurrently reduce the number of smolts reared and released for the Imnaha River and Upper Grande Ronde River programs. This Alternative is intended to increase harvest mitigation benefits in Lookingglass Creek and the Grande Ronde River while, at the same time, reducing genetic and ecological risks in the Imnaha River resulting from surplus adult returns (see Alternatives 2 and 5 for the Imnaha River spring Chinook program). Alternative 4 can be combined with one of the three previous alternatives. Alternative 4 does not preclude transfer of the Imnaha River spring Chinook program to the proposed Northeast Oregon Hatchery facility.

Pros

- Potentially increases the number of harvestable spring Chinook available to support tribal and recreational fisheries in Lookingglass Creek and the Grande Ronde River.

- Transfers a portion of the smolt releases from the Imnaha River and upper Grande Ronde River to Lookingglass Creek which has fewer biological risks and potentially higher harvest opportunities.

- Continues to release fish to meet LSRCP mitigation goals for the Grande Ronde River.

- Reduces fish health risks by terminating the transfer of fish from Lookingglass FH to Irrigon FH.

Cons

- May not meet the in-place, in-kind intent of the LSRCP mitigation program, and may reduce the number of hatchery-origin spring Chinook available for harvest if smolt-to-adult return rates for Lookingglass Creek spring Chinook are significantly less than those for Imnaha River spring Chinook.

- May reduce the demographic buffer afforded to the Imnaha River population by hatchery fish during periods of low ocean productivity if the number of spring Chinook released into the Imnaha River is reduced.

- May increase straying risks of hatchery-origin spring Chinook from Lookingglass Creek to natural populations in the Wenaha and Minam rivers.

Alternative 5: Rear only Lookingglass Creek spring Chinook and Imnaha River spring Chinook at Lookingglass FH to support mitigation goals for the Oregon portion of the LSRCP

Transfer the rearing of Catherine Creek, Lostine River, and Upper Grande Ronde River spring Chinook to new and/or other existing hatchery facilities (e.g., NEOH). Continue to develop a locally adapted stock of Lookingglass hatchery spring Chinook. Discontinue passing hatchery-origin spring Chinook upstream of the hatchery after five years and allow only natural-origin fish to pass. Maintain the smolt releases required to meet LSRCP adult return goals for the Grande Ronde (5,860 fish) and Imnaha (3,210 fish) rivers. Total replacement of the current rearing of 1.24 million smolts at Lookingglass FH with Lookingglass Creek and Imnaha River stocks would result in a Lookingglass spring Chinook program of approximately 650,000 smolts (or other size based upon future SAR data) and an Imnaha River program of approximately 520,000 smolts. Those potential programs would require a 0.90% SAR in the Grande Ronde River and a 0.62% SAR in the Imnaha River to meet LSRCP mitigation goals. Each of those two programs would be managed as *segregated*.

Pros

- Simplifies fish culture at Lookingglass FH.

- Reduces genetic and ecological risks to the reintroduced, naturally spawning population after it is established and self-sustaining if all upstream migration can be controlled via the hatchery weir. Minimizes use of natural-origin spring Chinook for broodstock after a natural population becomes established.

- Increases the number of hatchery-origin spring Chinook available for harvest after hatchery-origin fish are no longer passed upstream to spawn naturally in Lookingglass Creek or the Imnaha River.

- Maintains smolt releases at current or higher levels than established to meet LSRCP mitigation goals for spring Chinook in the Imnaha and Grande Ronde River basins.

- Reduces fish health risks by terminating the transfer of fish from Lookingglass FH to Irrigon FH.

Cons

- Would not meet current LSRCP mitigation goals if current smolt-to-adult survivals (≈ 0.5%) upstream of Lower Granite Dam continue.

- Lookingglass FH would not be contributing directly to recovery or short-term conservation goals for spring Chinook in the Grande Ronde and Imnaha rivers basin stocks other than providing demographic buffers and genetic repositories for natural populations in each of the two subbasins.

- May increase the number of unharvested, surplus spring Chinook returning to the Grande Ronde River, Lookingglass Creek, and the Imnaha River, unless harvest demand increases, and incidental take of natural-origin Imnaha River spring/summer Chinook is reduced.

- Requires a significant investment to modify existing facilities or build new hatchery facilities to maintain and support conservation hatchery programs for the Upper Grande Ronde River, Catherine Creek, and the Lostine-Wallowa River programs, and/or the integrated broodstock portions of the possible stepping-stone programs for Lookingglass Creek or the Imnaha River.

Alternative 6: Terminate the Lookingglass spring Chinook program and all other programs at Lookingglass FH and decommission the facility

Decommission hatchery in favor of alternative mitigation strategies such as habitat restoration, passage improvements, or alternative hatchery programs at another facility.

Pros

- Reduces hatchery influence on native spring Chinook populations in the Grande Ronde and Imnaha River basins.

- Eliminates fish disease risks imposed by the Lookingglass FH programs in the Grande Ronde River, the Imnaha River, and Irrigon FH.

- Eliminates the need for investing new dollars into the hatchery and acclimation facilities in the Grande Ronde and Imnaha rivers.

Cons

- Significantly reduces the number of spring Chinook available for harvest in the Imnaha and Grande Ronde River basins.

- Does not meet LSRCP mitigation goals for the spring Chinook in the Grande Ronde and Imnaha rivers.

- Eliminates hatchery conservations efforts for spring/summer Chinook native to the Imnaha and Grande Ronde river basin.

- Is inconsistent with interim recovery objectives for the Grande Ronde Spring/Summer Chinook MPG.

Recommended Alternatives

The Team recommends Alternative 4: expand the Lookingglass Creek spring Chinook program from 250,000 to 325,000 smolts. This expanded program would require a minimum of five raceways at Lookingglass FH. This production change concurrently reduces the number of smolts released into the Upper Grande Ronde River from 250,000 to 130,000 smolts, and from 360,000 to 325,000 smolts in the Imnaha River. The intent of this alternative is to increase harvest benefits in Lookingglass Creek and the Grande Ronde River while reducing genetic and ecological risks in the Imnaha River.

Alternative 4 is intended to be implemented consistent with all recommendations in Alternative 1 (recommendations to the current program). For example, Alternatives 1 and 4 continue to develop a "Lookingglass Creek Stock" of spring Chinook, founded from eggs or fish in excess of the conservation needs of the Catherine Creek program. The purpose of the expanded Lookingglass Creek program is to reestablish a naturally spawning population in Lookingglass Creek while contributing fish towards meeting LSRCP mitigation goals. The hatchery program would be integrated with natural spawning escapement with clearly articulated goals for escapement, broodstock, and harvest. Alternative 4 could also be implemented with development of a stepping stone (Alternative 2) or segregated broodstock management strategy (Alternative 3).

Implementing Alternative 4 with the Team's recommended alternatives for the other spring Chinook programs at Lookingglass FH will need to address the rearing capacity issues at Lookingglass FH for both early rearing in the hatchery building and outside rearing in the raceways (see issues LC-SC 7, 8, and 11). Lookingglass FH has 18 outside raceways, each with a capacity to rear up to 65,000 spring Chinook smolts for a total capacity of 1.17 million smolts. Under current conditions, rearing constraints at Lookingglass FH could be addressed by modifying the facility, reducing the total number of smolts produced, or through construction of NEOH which would move all fish for the Lostine-Wallowa River program and one-half of the fish for the Imnaha River program to that new facility. Implementation of any one of these latter three options would also eliminate the need to transfer 100,000 fish from Lookingglass FH to Irrigon FH, and back again, thereby reducing fish health risks at both hatcheries and to the transferred fish themselves.

The Team concluded that, out of all the areas where spring Chinook smolts are currently released in the Grande Ronde River, Lookingglass Creek and the area of the Grand Ronde River immediately downstream appeared to provide the best opportunity to increase harvest opportunities, contribute to LSRCP mitigation goals, and at the same time minimize conservation risks. Conservation efforts could then be concentrated where needed most: endemic populations in the upper Grande Ronde River, Catherine Creek, and the Lostine River. The Team also concluded that conservation efforts were least needed at the present time in the Imnaha River, but that some logistical constraints and other factors were posing biological risks that could be reduced (see later section on Imnaha spring Chinook program).

The Team's recommendation is intended to meet the near-term conservation goals of the Grande Ronde River spring Chinook populations while developing a harvest component to meet fishery objectives in the area. The Team's recommended alternative is also meant to be consistent with the intent of the current *US v. Oregon* agreement.

While the Team also considered the other alternatives, we did not recommend these alternatives as a preferred alternative for a wide variety of facility, biological, and logistic reasons. The Team also felt that our recommended alternative would be consistent with any potential actions that may be taken in the future to address ICTRT recovery recommendations.

The Team did not recommend Alternative 7 (terminate all spring Chinook programs and decommission Lookingglass FH), because of the long-term need to conserve and recover spring Chinook salmon in the Grande Ronde River while also meeting the management intent of the states and tribes under the current *US v Oregon* agreement.

Upper Grande Ronde River Spring Chinook

Operator: Oregon Department of Fish and Wildlife

Summary of Current Program

Goals

- ***Harvest goal:*** No numeric harvest goal exists at the present time. The program currently operates primarily as a conservation program. The program is intended to eventually contribute to recreational and tribal harvests and the overall LSRCP mitigation goal to return 5,860 hatchery-origin adult spring/summer Chinook—from the Grande Ronde River basin—upstream of Lower Granite Dam on the mainstem Snake River.

- ***Broodstock escapement goal:*** The current goal is to annually capture 85 male and 85 female adult spring Chinook in the upper Grande Ronde River for broodstock to yield 250,000 smolts for release, with jacks composing up to 10% of the male spawning contribution.

- ***Conservation goal:*** Short-term goal: Prevent extinction of endemic spring Chinook in the upper Grande Ronde River, maintain a naturally spawning population in the Upper Grande Ronde River, provide a foundation to reverse the decline in abundance of spring Chinook in the Grande Ronde River, and ensure a high probability of population persistence into the future. The hatchery program is currently operated as a safety net because the naturally spawning population would most likely become functionally extinct without hatchery intervention. An intermediate goal of this program, in concert with other programs for indigenous populations (Catherine Creek and Lostine-Wallowa River), is restoration of spring Chinook salmon in the Grande Ronde Basin. This intermediate goal includes the reestablishment of a naturally spawning population of spring/summer Chinook in Lookingglass Creek. The long-term conservation goal of this program is to contribute to recovery and de-listing of the Snake River Spring/Summer Chinook ESU, including continued mitigation for fish losses occurring as a result of the construction and operation of the four Lower Snake River Dams. The ICTRT classified the Upper Grande Ronde River population as "large" based on historical habitat potential. A Chinook population classified as "large" for ESA recovery has a mean minimum abundance threshold criteria of 1,000 natural-origin spawners/year with a sufficient intrinsic productivity to achieve a 5% or less risk of extinction (greater than 1.45 recruits per spawner at the threshold abundance level) over a 100-year timeframe. The Columbia River Treaty Tribe's long-term recovery goal for spring/summer Chinook in the Grande Ronde River is an annual return of 16,000 adults.

- ***Escapement goal for natural-origin adults:*** Comanagers have not yet quantified a natural spawning escapement goal for spring Chinook upstream of the weir in the upper Grande Ronde River under current conditions. The current strategy is to release all adult spring Chinook, both hatchery and natural-origin, which are not retained for broodstock. The current habitat capacity is estimated to be 300 natural-origin adult recruits back to the upper Grande Ronde basin (HSRG 2009).

- ***Research, education, and outreach goals:*** Evaluate the benefits and risks of the program toward meeting its harvest and conservation goals.

Objectives

Conventional broodstock program:

- Collect 85 male and 85 female adult spring Chinook at the Upper Grande Ronde River trap to yield approximately 250,000 smolts (This program size accounts for pre-spawn mortality of adults and potential culling of eggs from female parents testing positive for moderate to high levels of *Renibacterium*). Collect both unmarked natural-origin and marked hatchery-origin fish for broodstock. Up to 50% of the trapped natural-origin adults and up to 100% of the hatchery-origin adults from the conventional program can be retained for broodstock at this location. The collection of broodstock needs to be closely monitored based on projected adult returns.

- Pass 100% of hatchery-origin adults from the captive broodstock program (see below) upstream of the weir for natural spawning.

- Transfer adults retained for broodstock to Lookingglass FH.

- Spawn adult spring Chinook at Lookingglass FH. Incubate and hatch the fertilized eggs, and rear the resulting fish to the yearling smolt stage at Lookingglass FH.

- Transfer 250,000 yearling smolts to the Upper Grand Ronde River acclimation facility in two phases: mid-March and around April 1.

- Acclimate the smolts for one week, then allow at least two weeks for the fish to volitionally emigrate, and then force release the remaining smolts into the Grande Ronde River.

Captive broodstock program:

- Remove three to four eyed eggs annually from each spawned female from the conventional program.

- Incubate and hatch the retained eggs, and rear 300 fish to the smolt stage at Wallowa Fish Hatchery.

- Transfer the captive smolts to Bonneville FH adjacent to Bonneville Dam on the south shore of the Columbia River.

- Rear the transferred smolts captively to adult size at Bonneville FH.

- Spawn the captive broodstock as needed to provide additional fish for release, as needed, to meet the smolt release objective (250,000 smolts) of the conventional program.[53]

Program Description

The Upper Grande Ronde River Spring Chinook Program is one of three conservation hatchery programs in the Grande Ronde River Basin. Similar programs exist also for Catherine Creek and the

[53] *This type of captive broodstock program is known as a Safety Net Artificial Propagation Program (SNAPP).*

Lostine-Wallowa River. All three programs are intended to help maintain naturally-spawning populations in their respective tributaries via supplemental natural spawning by hatchery-origin fish. These programs are intended to also provide limited recreational and tribal harvest within the Lower Snake River Compensation Plan mitigation area (Snake River and tributaries upstream of Ice Harbor Dam). Each program propagates a separate "endemic" stock of spring Chinook founded from fish indigenous to the respective sub-basins of the Grande Ronde River.

Upper Grande Ronde River Spring Chinook are reared at Lookingglass Hatchery under the Lower Snake River Compensation Plan mitigation program for northeast Oregon. LSRCP currently coordinates funding for facilities, equipment, and personnel for fish culture, monitoring and evaluations, and fish health monitoring of fish prior to release in the Upper Grande Ronde River. Bonneville Power Administration funds an adult collection weir/trap and juvenile acclimation facilities located on the Upper Grande Ronde River and operated by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) as co-managers with ODFW.

The Upper Grande Ronde River program is one of three components of the Grande Ronde Endemic Spring Chinook Salmon Supplementation Program (GRESCSP) that is assisting with maintaining naturally spawning populations via hatchery supplementation. Specific objectives of the GRESCSP are: (a) prevent extinction of native wild Chinook populations in the Lostine River, upper Grande Ronde River and Catherine Creek; (b) maintain genetic diversity for indigenous populations of spring Chinook in the Grande Ronde River; (c) maintain genetic diversity for natural populations where hatchery-origin fish are not released, specifically in the Minam and Wenaha rivers; and (d) use Catherine Creek stock to reintroduce spring Chinook salmon into Lookingglass Creek.

The Upper Grande Ronde River program at Lookingglass FH focuses on conserving the indigenous spring Chinook population of the Upper Grande Ronde River. Natural-origin adult fish from this population are included within the broodstock annually, and hatchery origin adults are allowed to spawn naturally in the upper Grand Ronde River each year. The overall justification for the hatchery program is that smolt-to-adult return rates, and the overall number of adult recruits per spawner, are greater for hatchery-spawned fish than naturally-spawning fish in the river. Hatchery propagation and supplementation thus increases the overall productivity of the population in a population dynamics sense, thus reducing the overall likelihood of extinction. In addition, all returning adult progeny from the captive broodstock program are allowed to spawn naturally, thus providing an additional "safety net". Options also exist to outplant hatchery-origin adults as prescribed by the Grande Ronde Spring Chinook Hatchery Management Plan.

In 1995, comanagers initiated captive broodstock programs for each of the three previously-mentioned populations of spring Chinook in the Grande Ronde River Basin: Lostine-Wallowa River, Catherine Creek, and upper Grande Ronde River. Those programs are sponsored by the LSRCP and funded by BPA. Fish for those programs were raised to the smolt stage at hatcheries in the Grande Ronde River Basin, and then reared from smolts to adults at the ODFW's Bonneville Fish Hatchery and at NOAA Fisheries' Manchester Research Station near Port Orchard, Washington. Because of positive population responses in the Lostine River and Catherine Creek, the captive broodstock programs for those populations are being phased out. In 2009, comanagers initiated actions to continue captive broodstock efforts for spring Chinook in the Upper Grande Ronde River through a Safety Net Artificial Propagation Program (SNAPP) because adult returns are still too low in that part of the watershed to sustain the conventional hatchery supplementation program. This latter SNAPP is expected to run for 10 years, and size of the program is not expected to change.

Assessment of Current Program

Operational Considerations[54]

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- Upper Grande Ronde spring Chinook (including hatchery fish) are listed as threatened under the endangered species act as part of the Snake River Spring/Summer Chinook ESU.

- The program is currently using captive broodstock technology and conventional supplementation to prevent the extinction (preservation/conservation) of the upper Grande Ronde River population of spring Chinook.

- The current broodstock size of 85 males and 85 females to yield 250,000 smolts is based on a pre-spawn survival of 92% for adult females (spawn 78 females), a mean fecundity of 3,846 eggs to yield a total of 300,000 green eggs, and an 83.4% survival from green egg to smolt to yield a release of 250,000 smolts.

- The program includes a captive broodstock component with the intent to convert to a 100% conventional program after target populations have consistent returns of 150 adults spawning in nature. The program is also intended to contribute to LSRCP mitigation goals and eventually harvest when adult returns allow.

- The program utilizes an endemic Chinook stock that was founded on spring Chinook indigenous to the Upper Grande Ronde River.

- Conventional broodstock for the Spring Chinook Salmon Program is collected from adults trapped at the Upper Grande Ronde River weir. Adults retained for broodstock are transferred to Lookingglass Hatchery for spawning. The broodstock is composed of both hatchery-origin and natural-origin adults. The ratio of hatchery to wild fish collected for broodstock is based on the Grande Ronde Basin Hatchery Management Plan (Zimmerman et al. 2002).

- Wild adults trapped in the Upper Grande Ronde River are included with the broodstock annually, and hatchery-origin adults are allowed to spawn naturally in Upper Grande Ronde River each year.

- Based on population productivity and capacity information provided by the HSRG, substantial habitat improvements will be required to support a self-sustaining, natural population in the upper Grande Ronde River.

- The comanagers have designed, and are implementing, a sliding scale broodstock protocol that is designed to achieve the long-term goal of a "primary population" as defined by the HSRG (pHOS < 5%; PNI > 0.67).

[54] *See Appendix B of this document for supporting background information and references.*

- The HSRG designated the current Upper Grande Ronde River population as stabilizing based on the proportion of natural spawners composed of hatchery fish (pHOS = 77%), the mean proportion of the broodstock composed of natural-origin fish (currently, pNOB ≈ 10%), and proportional influence of the natural environment on the population as a whole (PNI = < 0.10).

- Spring Chinook are collected from broodstock at the Upper Grande Ronde River trap and weir at river mile 153. The origin of this brood stock is natural-origin fish collected at this site starting in 1995.

- Both unmarked natural-origin fish and marked hatchery-origin fish are collected for broodstock or passed upstream to spawn naturally.

- The Upper Grande Ronde River spring Chinook program uses the endemic population for hatchery broodstock. Broodstock collection guidelines, at the present time, do not follow any adult sliding scale. No Captive Broodstock progeny adults (F1) are used for brood. Broodstock collection guidelines are: (a) up to 50% of the wild fish returning to the weir can be collected for broodstock; (b) conventional progeny hatchery fish can be collected at a rate necessary to meet the remainder of the broodstock goal (could be up to 100% of the hatchery-origin adult from the conventional program).

- The number of hatchery-origin adults passed upstream depends upon the run size and broodstock needs.

- From 1997-2008, between 1 and 119 natural-origin spring Chinook have been captured at the Upper Grande Ronde River trap; from 2002-2006, between 3 and 376 adult progeny of captively-reared adults returned; from 2005-2008, between 9 and 140 hatchery-origin fish from the conventional program returned (Appendix Table 7 of 2009 CTUIR report to BPA). Estimated number of spring Chinook allowed to pass upstream of the weir to spawn naturally has ranged from 16 to 453 fish over this same time period.

- All first generation progeny of the captive broodstock program are passed upstream to spawn naturally or may be outplanted into tributaries in the upper Grande Ronde River. Surplus "jacks" from the captive broodstock program may be sacrificed for coded-wire tag recovery.

- The broodstock collection number (85 pair) could go up or down slightly depending upon fecundity.

- The weir is installed on the Upper Grande Ronde River on March 1st, depending upon environmental conditions and before high flows prevent installation. The trap is used to monitor adult steelhead from March through mid-May. Adult spring Chinook are typically first detected at the weir in mid-May. Fish are processed at the trap three to seven days per week. Approximately 28 adults can be held in the trap. The weir is operated through July 31st.

- Approximately 80-90% of the adult spring Chinook returning to the Upper Grande Ronde River are trapped. The adult trap was moved ten miles downstream from its original location after the 2006 trapping season. The trap was moved downstream below existing spawning habitat so that a more representative sample of the entire population could be trapped. The weir was temporarily washed out in 2008, limiting trap efficiency for that year.

- A target of 85 pairs should be collected to produce 250,000 smolts. This is based on a female pre-spawning survival of 92%, mean fecundity of 4,062 eggs/female, and 81% survival from green egg to smolt.

- To yield 250,000 smolts, approximately 300,000 green eggs are needed, assuming 83.4% green egg-to-smolt and an estimated five-year average fecundity of 3,846 eggs per female.

- Overnight staffing at the weir occurs after April 15 and trapping continues, if river conditions allow, through July 31.

- From 2001-2004, only natural-origin spring Chinook were used for broodstock for the upper Grande Ronde River (8 females and 8 males, 25 females and 17 males, 23 females and 20 males, and 7 females and 7 males respectively, 2001-2004). For 2005 and 2006, hatchery-origin fish were also used in the broodstock. In 2005, 38 hatchery and 2 wild females plus 22 hatchery and 3 wild males were spawned. In 2006, 71 hatchery and 13 wild females plus 45 hatchery and 12 wild males were spawned. These numbers result in a weighted mean proportion of the broodstock composed of natural-origin adults (*pNOB*) in 2005 and 2006 of *pNOB* = 0.13, or an overall mean *pNOB*= 0.57 for the four-year period 2003-2006 (1 salmon generation).

- Staff check the trap daily for adult fish. When water temperature exceeds 65°F (18.3°C), fish are not handled. Pickets within the weir are pulled, and fish are allowed to pass upstream freely.

- Trapped adults are scanned for coded-wire tags at the trap. Unmarked hatchery-origin adults (which are coded-wire tagged) receive a yellow Tyvek tag, and natural-origin adults receive a green Tyvek tag. The colored tags greatly facilitate sorting and spawning at Lookingglass FH.

- Dead fish in the trap are recorded as "kept fish" and are transported to a Fish Health lab, fresh if possible, for examination. Pre-spawned dead fish discovered during stream bank surveys are also sent to a Fish Health lab for examination. Following examination, the carcasses may be disposed of in a landfill.

- Epizootic ameloblastomas (skin tumors of the mouth) have been noted in both the conventional and captive spring Chinook adult broodstock (Grande Ronde, Lostine, Imnaha and Catherine Creek). The specific cause of those tumors is unknown.

Hatchery and Natural Spawning, Adult Returns

- The ICTRT classified the Upper Grande Ronde population as a "large" population based on historical habitat potential. A Chinook population classified as large has a mean minimum abundance threshold criteria of 1,000 natural-origin spawners with a sufficient intrinsic productivity to achieve a 5% (greater than 1.45 recruits per spawner at the threshold abundance level) or less risk of extinction over a 100-year timeframe.

- Stray rates of out-of-basin spring Chinook into the Upper Grande Ronde River appear to be low (less than 1-2%). Strays are generally fish that are part of the Grande Ronde spring/summer Chinook MPG; however, one PIT tagged John Day Chinook was trapped at the weir.

- Since the conventional program began in 2001, *pHOS* and *pNOB* have averaged ≈77% and ≈60%, respectively, although mean *pNOB* for 2005-2008 only averaged ≈20%.

- Since the captive (1995) and conventional (2001) hatchery programs began, *pHOS* has ranged from 0% to >50%, and *pNOB* has ranged from 100% to 11%.[55] The HSRG noted that the most current values were *pHOS* = 77% and *pNOB* = 5%.

- Smolt-to-adult survival for hatchery-origin spring Chinook released in the upper Grande Ronde River averaged 0.18% (range = 0.03% to 0.35%) for both the captive and conventional smolt components for brood years 1998-2003. Smolt-to-adult survival estimated for the natural-origin spring Chinook in the upper Grande Ronde River (for broodyears 1992, 1993, 1996, 1997, 1998, and 2000) averaged 0.58% (range = 0.32% to 1.35%).

- Preliminary results to date suggest that conventional broodstock progeny have higher SARs than captive broodstock progeny.

- Water temperatures in the Grande Ronde River can get quite warm during the summer, and a thermal barrier may inhibit upstream migration that could result in reduced escapement (e.g. lower survival, increased stray rates).

- Progeny of females with moderate levels of *Renibacterium* antigen (based on ELISA assays) in one year resulted in only one adult return from 75,000 smolts compared to 162 adults from the release of 70,000 smolts that were the progeny of females with low levels of Renibacterium antigen.

- Jacks (3-year old males) typically comprise 15 -20% of the returning hatchery-origin fish and 5-10% of the returning natural-origin fish of a particular broodyear.

- The proportion of jacks among returning adults has increased significantly in the last couple of years. This trend is not unique to the Upper Grande Ronde River population.

- Three complete surveys of the spawning grounds occur above and below the weir from the third week of August through September (15.9 miles in 5 survey sections upstream of the weir, and 0.3 miles in 1 section immediately downstream of the weir). Intensive counts occur in index areas for long-term comparisons. Survey frequency ranges from daily to weekly depending on water temperatures and fish activity. Information is used to determine if salmon are accumulating below the weirs.

- Spring Chinook passed upstream of the weir are opercle punched so that they can be recovered on the spawning grounds and used to determine trap efficiency, population abundance, and wild/hatchery fish ratios above the weir. Population abundance and wild/hatchery data are expanded for the entire river.

- Redd counts have been highly variable. The Upper Grande Ronde River population dropped to a very low level in 1989 with no redds counted in the spawning area. Redd counts again dropped to very low levels in the mid-to-late 1990's with only four redds counted in 1994, seven in 1995, no redds in 1999, and one red in 2007. The two highest red counts were in

[55] *Derived from Appendix Table 7 CTUIR BPA 2009 report.*

2004 (186) and 2005 (91). Aside from one year, these levels are well below the highest historically recorded redd counts (304 in 1968, 185 in 1987, 116 in 1988, and 116 in 1992).

- The adult return in 2001 was estimated at 34 fish of which 100% were natural-origin.
- The first adult returns from the captive brood hatchery program occurred in 2002.
- Composition of the return was 94.4% natural origin in 2002 and 93.7% in 2003.
- Long-term expectation is for about 170 adults to be collected at random for broodstock from the return with no restriction or priority for the percent of hatchery-origin fish (conventional and captive) escaping to spawn naturally in habitat upstream of the weir in the upper Grande Ronde River.
- The ICTRT classified the Upper Grande Ronde population as a "large" population based on historical habitat potential. A Chinook population classified as large has a mean minimum abundance threshold criteria of 1,000 naturally-produced spawners with a sufficient intrinsic productivity to achieve a 5% (greater than 1.45 recruits per spawner at the threshold abundance level) or less risk of extinction over a 100-year timeframe. The HSRG classified the upper Grande Ronde population as "stabilizing" because of low habitat productivity with no short-term solution to improve habitat or population viability.
- The ICTRT has identified three major spawning areas and two minor spawning areas for spring Chinook within the upper Grande Ronde River. Current spawning distribution is reduced substantially from historic distributions. Currently, spawning only occurs consistently in the upper Grande Ronde River mainstem beginning at the confluence of Meadow Creek (the weir is currently located immediately upstream of Meadow Creek) upstream to the East Fork Grande Ronde River. Spawning distribution is reduced from historic times because of poor habitat conditions. Spawning is absent in the Grande Ronde River downstream of Meadow Creek and in numerous tributaries, such as Meadow Creek, that historically supported spring Chinook. Hatchery-origin fish have comprised a significant proportion of natural spawners in most years since the mid-1980s.
- The weir and trap on the upper Grande Ronde River is located at rivermile 153.5.
- Between 2001 and 2006, an average of 148 hatchery (range = 0-433) and 63 natural-origin (range = 14-121) spring Chinook were trapped at the weir in the upper Grande Ronde River.
- In 2006, 26 hatchery and 28 natural–origin spring Chinook were trapped and released upstream of the weir to spawn naturally.
- Collected adults are transported at least once every three days (daily during peak season) in a 300-gallon transport tank from the adult trap on the Grand Ronde River to Lookingglass Hatchery.
- The adults are held in one or two circular tanks in the endemic building at Lookingglass FH.
- The desired protocol is to spawn the fish in a 2x2 matrix (2 females x 2 males in all pairwise combinations, and the repeated with another group of 2 females and 2 males). Occasionally

the fish are spawned 1 female x 2 males depending on the number of mature fish available. The objective is to include at least one natural-origin adult in the spawning matrix to achieve a minimum value of *pNOB* > 0.25.

- Current spawning protocols allow up to a maximum of 10% of the eggs to be fertilized by jacks (3-year old males), although a specific protocol or requirement for including jacks has not been established. The milt from up to six jacks may be pooled to fertilize one-half to one-third of the eggs from each female in a 1 x 2, 2x 2 or 2 x 3 spawning matrix, where one of the males in the matrix actually represents the pooled milt from up to six jacks. However, the actual number of jacks spawned and/or the proportion of eggs fertilized by jacks is unknown or not reported (2009 AOP[56], see Table below). Natural-origin males have often been used multiple times to fertilize eggs to increase the overall proportion of eggs fertilized by natural-origin males, although actual records may not be available. In general, jacks are included at every tenth spawning matrix.

Upper Grande Ronde River spring/summer Chinook salmon spawning data 2001-07

Brood Year	Marked Females Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take	Fry Ponded	Smolt releases
2001	0	8	100%	1.00:1	4,420	35,360	*25,339	26,923
2002	0	25	100%	1.09:1	3,454	86,355	70,250	70,088
2003	0	23	100%	1.10:1	5,249	120,733	105,374	104,347
2004	0	7	100%	1.00:1	2,979	20,850	19,057	18,901
2005	37	3	7.5%	1.54:1	3,877	155,080	119,963	118,803
2006	71	13	15.5%	1.45:1	3,539	297,244	269,439	259,932
2007	25	6	19.4%	1.14:1	3,960	122,750	99,136	94,500
2008	8	4	33.3%	1:1	3,950	47,402	42,458	40,00
Total	**141**	**89**	**37.2%**		**3,846**	**885,774**	**725,677**	**693,494**

*Inventory correction; In 2004, eggs have been electronically counted
Numbers in blue current inventory
2001-06 brood, estimate survival from green egg to smolt at 83.4%.

- Every female is screened for risk of BKD. If the ELISA titer is above 0.8 optical density (OD), then eggs from those females are destroyed. Eggs are held separately by female until the disease profiles and screening are complete. If needed, eggs are consolidated among female parents (families) after eye-up to economize incubator space at Lookingglass FH. From 2004 through 2008, 100% of the females spawned at Lookingglass Hatchery had BKD levels below O.D. = 0.213.

- Adults collected for broodstock receive an erythromycin injection (20mg/kg) and an oxytetracycline injection (10 mg/kg) at capture to control BKD and furunculosis, respectively. A second treatment of erythromycin is applied the first week of August, if necessary. The second treatment only occurs if BKD is detected among the pre-spawning mortalities.

[56] *ODFW, CTUIR, Nez Perce Tribe. February 3, 2009. LSRCP Grande Ronde and Imnaha Basins Annual Operation Plan for 2009. Final Version.*

- Adult spring Chinook receive a formalin treatment three times per week to control fungus while they are held at Lookingglass FH prior to spawning. Depending upon the number and health of the adults, treatment can run into September.

- Eggs are spawned into colanders to remove ovarian fluid, fertilized, and then water-hardened in 100ppm iodophor for a minimum of 15 minutes.

- Effluent from the circular tanks in the endemic building (where the upper Grande Ronde River spring Chinook adults are held prior to spawning) is directed to the pollution abatement pond.

- In the Grande Ronde Basin, the annual LSRCP mitigation goal for all stocks combined was set at 5,860 hatchery adults. ODFW estimated in 2006 that 414 Lostine River, 225 Catherine Creek, 159 Grande Ronde River, and 120 Lookingglass Creek adults returned to the basin. The combined return to the compensation area was 924 hatchery-origin adults, 15.8% of the mitigation goal.

- Estimates of harvest outside the project area of upper Grande Ronde River spring Chinook were 19 fish in 2006 (8 – Ocean, 3-Columbia River non-treaty net, and 8- Columbia River sport), 89 fish in 2005 (20-Columbia River non-treaty net, and 69 Columbia River sport), 154 fish in 2004 (5- Ocean, 1- Columbia River ceremonial/subsistence, 18-Columbia River treaty net, 22- Columbia River non-treaty net, and 108-Columbia River sport), 8 fish in 2003 (Columbia River sport), and 0 fish in 2002.

Incubation and Rearing

Conventional component

- Eggs receive a formalin treatment (1667 ppm) 3x per week, beginning 48 hours post spawn until the eggs are shocked and dead eggs removed.

- Chilled well water is used on the early egg takes to reduce the water temperature to around 50 degrees F. UV treated surface water is used for egg incubation after August when surface water temperatures can reach 70 degrees F.

- Flows are regulated at 4 to 6 gpm per vertical stack of incubators.

- Eggs are reloaded into the incubation trays after eye-up at 1 female per tray or approximately 3,500 eggs per tray.

- After hatch, the fry are reared in 5 of the 28 indoor tanks (Canadian troughs) at approximately 60,000 fish per trough. The troughs are 117 cubic feet, with a flow rate of up to 50 gpm.

- During January through March, water temperature in Lookingglass Creek drop to 32 to 35 degrees F. At that time, well water is blended with treated surface water to increase the water temperature to approximately 40 degrees F.

- Every attempt is made not to exceed a density index of D.I. = 0.75 in the indoor tanks. However, at times, D.I. does exceed 0.85 due to the limited early rearing space.

- The flow index can reach approximately F.I. = 2.4 when the fish are 250 fpp. However, the water temperature at this time is between 35 and 40 degrees F.

- When the fish reach 250 fpp, they are transferred to the outdoor raceways to be reared on raw creek water (late April to early May). Juvenile fish are retained indoors until high spring flows and subsequent sediment/turbid water decreases.

- The causative agent of whirling disease, *Myxobolus cerebralis*, was recently confirmed as present among wild rainbow trout and steelhead juveniles upstream of the hatchery in Lookingglass Creek (S. Onjukka, ODFW, 2009, pers. comm.). Hatchery juveniles are sampled for this parasite every year, prior to release, and through 2009, the parasite had not been detected among the fish prior to release.

- Fish are held indoors until 250 fpp because (a) the fish are too small in relation to the screen mesh size to put them out much earlier, (b) water quality in the raceways is reduced during spring runoff, and (c) the previous brood year needs to be released and the raceways cleaned before subyearling fish can be transferred to the outdoor raceways.

- Automated feeders are used to feed fish in the outdoor raceways. During cold weather (January-March), the fish are fed by hand because the automated feeders are inoperable.

- The raceways are cleaned by hand once per week. The cleaning effluent water is directed into a settling basin.

- The maximum flows in the raceways are approximately 800 gpm per raceway.

- The targeted density index is not to exceed D.I. = 0.17 in the outdoor raceways. The flow index is F.I. = 1.5 in the outdoor raceways.

- Fish are typically held in two or three raceways (if "safety-net" fish are produced, then one of the three raceways is used for those fish) until they are marked and tagged (at 90-180 fpp), at which time they are apportioned among four raceways. The fish are adipose-fin clipped and coded-wire tagged in June and July.

- A formalin treatment is applied (167 ppm for 1 hour) for two consecutive days after marking to control fungus. The fish are monitored to determine if additional treatment is needed.

- The fish receive one 28-day erythromycin treatment (2.25% aquamycin) to control BKD, typically in July shortly after marking.

- BKD has not been a problem among spring Chinook juveniles in the conventional rearing program although it has caused some mortality among juveniles from the captive broodstock programs.

- In June 2009, white open wounds anterior to the dorsal fin were observed among juvenile spring Chinook in most raceways. Occasionally, the coldwater disease bacterium is also detected among juvenile spring Chinook at Lookingglass FH.

- Spring Chinook for the Upper Grande Ronde River program are PIT tagged in October.

- Monthly health monitoring examinations are conducted on each spring/summer Chinook stock. The sample includes a minimum of 10 moribund/dead fish (if available) and 4-6 live fish per raceway. Results are reported on the ODFW Fish Health Examination report.

- Current green egg-to-smolt survival for the upper Grand Ronde River stock is 83.4% (based on a five year average). The categorized assumptions for survival are: 90% for green-to-eyed-egg; 95% for eyed-egg-to swim-up fry; 93% for swim-up fry to fingerling (at marking); 99% for fingerling (at marking) to smolt release.

Captive Broodstock/SNAP component

- For the captive broodstock, four or five eyed eggs are collected from each family of the conventional broodstock pairing and transferred to Wallowa FH for final incubation, hatching, and rearing to the smolt stage. Smolts are then transferred to the Bonneville FH.

- Wild parr collected for the captive broodstock program are also reared at Wallowa FH. Since these fish are generally smaller than the fish from the conventional broodstock (because of collection timing), their culture is accelerated so they can achieve the same mean size as the fish transferred from Lookingglass FH.

- Green egg to smolt survival rates for the offspring of the captive broodstock are consistently lower than those for offspring of the conventional broodstock because large numbers of eyed eggs from the captive broodstock are from female parents with high ELISA for the Renibacterium antigen, thus requiring culling to reduce the risk of BKD among the retained offspring. Eyed eggs are culled from females with ELISA levels > 0.8 for Catherine Creek and Grande Ronde River stocks and > 0.2 for the Lostine-Wallowa River stock. If culled eggs were not included in the survival calculations, green egg-to-smolt survival rates were 61.1% for the Lostine-Wallowa River stock, 69.9% for the Upper Grande Ronde River stock, and 62.0% for the Catherine Creek stock, all of which are lower than the mean survival rates for offspring from the counterpart, conventional broodstocks (range ≈ 82-84%).

Release and Outmigration

- For release years 2003-2007, the number of smolts released from the captive and conventional programs were 210,113 and 26,923 (2003), 75,063 and 69,856 (2004), 1,019 and 104,350 (2005) 76 and 18,901 (2006), and 20,620 and 118,803 (2007), respectively.

- Due to limited capacity of the Upper Grande Ronde acclimation facility, spring Chinook smolts are acclimated and released in two phases: the first phase occurs in mid-March, and the second phase around April 1. The fish are acclimated for one week and then allowed at least two weeks to volitionally emigrate, after which they are forced into the river. The target size at transfer from Lookingglass FH to the acclimation facility is 25 fpp for both captive and conventional progeny groups.

- Surplus eyed eggs are released in the upper Grande Ronde River as opposed to destroying them. These surpluses have occurred twice since the program began in 2001. Surpluses occurred when more eggs were taken or survive to eye-up than were needed to meet program release objectives.

- Lookingglass FH adheres to the ODFW Fish Health Management Policy for fish releases and transfers. Fish with health problems are not commingled with the other fish at the acclimation

site. If a pathogen of concern, such as IHNV, is detected among the smolts at the hatchery, fish in the affected raceway(s) will be transferred and released separately from those in the non-affected raceways, with the option of later release from the acclimation site and/or direct stream release downriver from the acclimation site.

- If epizootic instances of disease occur (greater than 0.1% mortality per day for three days), then the fish are held at Lookingglass FH and not transferred to the acclimation facility for release until the disease is below epizootic levels. If treatment is not effective or if the fish are held too far beyond their release date, they may be destroyed. These protocols are more restrictive than IHOT. An epizootic outbreak of IHN virus has not occurred at Lookingglass FH for 15 years.

- The spring Chinook of the Upper Grande Ronde River stock have a target size of 25 fpp by October 31 and 20 fpp at the time of release. The expected target size for transfer to the acclimation site is 22 fpp.

- The maximum density index at the acclimation facility is D.I. = 0.15 at 20 fpp. The flow index is F.I. = 0.95.

- The main water sources for Upper Grande Ronde River acclimation facility is gravity fed from the Upper Grande Water River. The acclimation facility uses approximately 5 cfs from February to April.

- The fish are fed a maintenance diet during acclimation and at a decreasing level throughout the volitional release period.

- The current strategy is to acclimate smolts for one week, followed by a two-week volitional release. At the end of the volitional release period, fish remaining in the pond are forced out. The time frame for smolt acclimation and release is from mid-March to mid-April.

Facilities and Operations

- *See Lookingglass FH spring Chinook, Facilities and Operations section for Lookingglass FH operational considerations.*

- The CTUIR operates an acclimation facility on the Upper Grande Ronde River at rivermile 170.5. Acclimation occurs in four raceways approximately 8'x85'x3.25' (2,210 ft3) in size. The site's capacity is approximately 150,000 fish at 20 fpp.

- The Upper Grande Ronde River trap and acclimation facilities are temporary. The facilities have some safety and structural deficiencies (e.g., no safety rails on catwalks, incidence of icing at the water intake). Predator deterrence is limited to a security fence around the facility that excludes terrestrial predators; however, the fish are on-site for a short-period of time and predation is minor. These facilities are funded by the Bonneville Power Administration and managed by the CTUIR.

- In 2002, 50,100 smolts were lost at the acclimation ponds due to intake icing during a cold period in early March.

Research, Education, and Outreach

- If captive brood progeny are used to backfill the deficiencies of fish from the conventional program, then the captive brood progeny are 100% adipose-fin clipped and coded-wire tagged, and conventional fish are 100% coded-wire tagged with no adipose-fin clip. If all fish come from the conventional program, then (a) 50% will be coded-wire tagged with no adipose fin clip, (b) 25% will be adipose-fin clipped and coded-wire tagged, and (c) 25% will be adipose-fin clipped only. Approximately 2,000 juveniles are PIT tagged. Tags are apportioned equally across raceways.

- Age and broodyear of trapped adult fish is estimated from the size distributions of the returning adults.

- Coded wire tags recovered from adult fish are used to estimate contribution to fisheries and smolt-to-adult survivals.

- PIT tag data provide information regarding downstream migration timing and comparative performance of wild, captive brood, and conventional juveniles.

- ODFW operates a smolt trap below the spawning and upper rearing areas on the Upper Grande Ronde River near the town of Starky. The trap is used to collect wild fish so that they can be PIT tagged and used to determine smolt outmigrant timing to Lower Granite Dam. The trap provides abundance information and provides a basis for SARs for wild adults.

- During migration years 1994 through 2007, ODFW estimated that an average of 12,734 (range 51-38,725) juvenile natural-origin spring Chinook smolts migrated from the upper rearing areas in the upper Grande Ronde River with an average of 23% (range = 1%-83%) leaving as early migrants and 77% (range = 17%-99%) leaving as late migrants.

- Survival of natural-origin spring Chinook juveniles from the upper Grande Ronde River to Lower Granite Dam was estimated as 24.2% for fish tagged in the fall of 2006 at the trap, 13.8% for fish tagged that winter above the trap, and 37.3% for fish tagged in the spring 2007 at the trap.

- ODFW developed release-recapture information of PIT-tagged smolts from each raceway to calculate Cormack-Jolly-Seber (CJS) survival probabilities to Lower Granite Dam using the SURPH 2.2 program with a single release recapture model. Mean stock survival was calculated as the weighted average of the raceways for each stock with the number of smolts in each raceway as the weight. Mean survival rate for hatchery-origin smolts released from the Upper Grande Ronde River in 2006 was 55%.

- The Confederated Tribes of the Umatilla Indian Reservation initiated a multi-year project in 2000, designed to monitor and evaluate supplementation of endemic spring Chinook salmon in Catherine Creek and the upper Grande Ronde River with the following objectives: (1) evaluate and contrast performance of supplemented endemic juvenile spring Chinook salmon of conventional and captive broodstock hatchery origin acclimated and released at facilities on Catherine Creek and the upper Grande Ronde River, and compare to natural-origin juveniles; (2) Evaluate life history differences between natural and supplemented (hatchery-origin F1) adult spring Chinook salmon from Catherine Creek and the upper Grande Ronde River; and

(3) Describe life history characteristics and genetic stock structure of adult summer steelhead from Catherine Creek and the upper Grande Ronde River.

- Research results are reported in annual reports and project review meetings.
- *See the Lookingglass Creek Spring Chinook program for more information.*

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,[57] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- Limited, on incidentally-caught fish. With the exception of recent fisheries targeting a few hundred surplus Rapid River stock hatchery fish in Lookingglass Creek, spring Chinook sport harvest has not occurred in the Grande Ronde basin since 1978.
- Estimates of sport harvest (2002-2006) of upper Grande Ronde spring Chinook on the mainstem Snake River upstream of Lower Granite Dam were 2 fish in 2003 and 12 fish in 2004.

Conservation Benefits

- Reduces the risk of extinction of spring Chinook in the upper Grande Ronde River by providing a demographic buffer and contributing directly to maintaining a naturally spawning population.

Research, Education, Outreach and Cultural Benefits

- The program provides research opportunities for evaluation of captive broodstock vs. conventional programs.
- Tribal harvest provides ceremonial, cultural, and subsistence benefits to Columbia River tribes.
- Hatchery and evaluation staffs provide educational opportunities on site at Lookingglass Fish Hatchery.
- The Catherine Creek, Lookingglass, Lostine, and Upper Grande Ronde River spring Chinook are part of a Snake River basin-wide assessment of supplementation that has generated a long-term data set.

[57] *See Section II, "Components of This Report", for a description of these potential benefits and risks.*

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,[58] the Review Team identified the following benefits of this program:

Harvest Benefits

- The Upper Grande Ronde spring Chinook program provides limited contribution to total tribal, commercial, and recreational fisheries downstream of the project area, including the lower Columbia River.

Conservation Benefits

- Naturally spawning spring Chinook in the Upper Grande Ronde River are expected to support ecological processes in the watershed (e.g., nutrients from carcasses).

Research, Education, Outreach and Cultural Benefits

- Tribal harvest provides ceremonial, cultural, and subsistence benefits to Columbia River tribes.

- The program provides opportunities for evaluation of captive broodstock vs. conventional programs.

- The program provides research and information on supplementation issues.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,[59] the Review Team identified the following risks of the hatchery program:

Genetic Risks

- The comparatively low recruit-to-spawner ratio for naturally spawning fish, coupled with the high proportion of hatchery-origin spring Chinook spawning in the Upper Grande Ronde River, inhibits development of a properly integrated program which poses a genetic domestication risk to the remnant Upper Grande Ronde spring Chinook population. However, under current conditions, the naturally spawning population is not able to sustain itself, and the demographic risks of extinction far outweigh these genetic risks.

- Continued reliance on a captive broodstock program to supplement the Upper Grande Ronde River spring Chinook population reduces the effective population size, particularly because of the relatively large number of eggs that need to be culled from captive females with high risk of BKD.

[58] *Ibid.*

[59] *Ibid.*

Demographic Risks

- *See the Lookingglass Creek Spring Chinook program for demographic risks associated with rearing at Lookingglass FH.*

- Continued trapping of the majority of returning adults for broodstock limits the number and diversity of natural spawners.

- Transportation of adult and juvenile fish long between distantly-located facilities increases stress and disease risks.

- Extreme cold water conditions at the acclimation site may result in diminished flows or complete loss of water, resulting in catastrophic fish loss.

- The transfer of fish from hatchery raceways to extreme cold water conditions at the acclimation site may pose a physiological (stress) risk for the fish.

- The weir structure on the upper Grande Ronde River may inhibit natural upstream migration of adults back to the major spring Chinook spawning areas, thus resulting in increased pre-spawning mortality and reduced reproductive success.

Ecological Risks

- Potential amplification of disease within the hatchery program poses a disease risk to the Upper Grande Ronde River spring Chinook population.

- Anadromous fish in the Upper Grande Ronde River upstream of the water intake for the acclimation facility pose a minor fish health risk to hatchery-origin juvenile Chinook prior to release and outmigration.

Physical Risks

- *See the Lookingglass Creek Spring Chinook program for physical risks associated with rearing at Lookingglass FH.*

- Placement and resetting of the temporary weir can pose a safety risk to operating personnel.

Research, Education, Outreach and Cultural Risks

- None identified.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,[60] the Review Team identified the following risks from the hatchery program:

Genetic Risks

- None identified.

[60] *Ibid.*

Demographic Risks

- *See the Lookingglass Creek Spring Chinook program for demographic risks associated with rearing at Lookingglass FH.*

Ecological Risks

- Potential amplification of disease within the hatchery program poses a disease risk to other native fish populations in the Upper Grande Ronde River when smolts are transferred and released from the upper Grande Ronde River.

Research, Education, Outreach and Cultural Risks

- None identified.

Recommendations for Current Program[61]

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

Program goals and objectives

Issue UGR-SC1: Many LSRCP hatchery programs appear to be attempting to meet harvest, mitigation and conservation goals simultaneously without those goals being clearly stated or prioritized in terms of numeric outcomes that quantify intended benefits. *Short-term and long-term goals for many LSRCP programs have not been clearly stated or quantified – up front - independent of the methods for achieving them (e.g., "The goal of this program is to use supplementation to …"). The confounding of goals and methods impedes assessments of program benefits, particularly if desired benefits are not quantified as short-term and long-term goals. Prioritization of mitigation versus conservation goals appears to shift annually based upon the number of returning adults without a strong association to long-term goals for the programs (e.g., as described in Annual Operating Plans). Prioritization of short and long-term goals often differs among comanaging parties. Although the Spring Chinook program for the upper Grande Ronde River is clearly focusing on conservation as a first priority at the present time, short-term and long-term goals have not been clearly articulated. For example, comanagers have not yet specified a near-term natural spawning escapement goal for spring Chinook in the upper Grande Ronde River upstream of the weir, although the stated first "goal" of the program is to prevent extinction of the population.*

Recommendation UGR-SC1: Comanagers should restate and prioritize program goals for all LSRCP programs in terms of both short-term and long-term numeric outcomes for the

[61] *The Review Team believes that the ODFW and the USFWS LSRCP office will be the logical parties to coordinate and implement most of the following recommendations.*

following parameters: (a) natural population abundance and viability (conservation goals); (b) the number of hatchery-origin fish returning to specified target areas (mitigation goal), and (c) the proportions and desired numbers of fish from the two preceding groups allocated for broodstock, natural-spawning escapement, and harvest. Both short-term and long-term goals need to be clearly articulated up front (e.g., natural spawning escapement numbers) independent of the chosen methods for achieving them (e.g., supplementation spawning by hatchery-origin fish). Short-term goals need to be realistic and attainable biologically under current conditions. Long-terms goals should also be realistic biologically but can consider the removal of factors that prevent their achievement in the short-term (e.g., repair of riparian habitats, engineering improvements to fish passage structures, etc.). Quantitative benchmarks should also be established for measuring success or failure of the program towards meeting identified goals, thus allowing for mid-course corrections in programs or adjustments in the goals themselves. Prioritization of program goals, both short-term and long-term, must be made consistent among comanagers.

Also see LC-SC3 under Program Goals and Objectives recommendations for Lookingglass Creek spring Chinook.

Broodstock Choice and Collection

Issue UGR-SC2: The Upper Grande Ronde weir and trap are not consistently efficient. *The estimated annual trap efficiency ranges from 80 to 90%. However, high flows have compromised the trap in some years. The trap was relocated in 2006 to increase efficiency. The trap has washed out once since it was moved. Inconsistent control of upstream passage will impede achievement of conservation goals for the program.*

Recommendation UGR-SC2: Continue to assess efficiency of the current weir to trap across the entire adult return, and assess the need for modification or construction of a new adult trapping facility that will meet program goals and objectives.

Hatchery and Natural Spawning, Adult Returns

Issue UGR-SC3: The relative genetic contribution of jacks (3-year old males) to each brood year is difficult to ascertain under current spawning protocols. *Spawning protocols at Lookingglass Hatchery are designed to maximize the genetic contributions of parents and the genotypic diversity among offspring. These goals are accomplished via the matrix spawning of males and females in 2x2, 1x2, and 2x3 (females x males) combinations. Jacks (3-year old males) are specifically included in the spawning matrices but with the requirement that they fertilize no more than 10% of the eggs for each brood year. When jacks significantly outnumber 4-year old males, the milt from up to six jacks may be pooled to fertilize one-third to one-half of the eggs of each female in the matrix (the milt from 2-6 jacks is treated like the milt from one 4-year old male in these situations). In general, these spawning protocols are commendable because they maximize the total number of males used in the broodstock; however, the actual proportion and total number of eggs fertilized by jacks are not reported, although the Grande Ronde River Spring Chinook Management Plan specifies the inclusion of jacks in the broodstock at a rate of 1 jack for every 5 "adult"(age > 3 years) males.*

Recommendation UGR-SC3: Report the proportion (and/or number) of eggs fertilized by jacks for each brood year in annual reports.

Also see LC-SC6 under Hatchery and Natural Spawning, Adult Returns recommendations for Lookingglass Creek spring Chinook.

Incubation and Rearing

See the Lookingglass Creek Spring Chinook section for recommendations regarding incubation and rearing.

Release and Outmigration

Issue UGR-SC4: Spring Chinook destined for the early release are transferred and held at the Upper Grande Ronde acclimation site during inclement weather. Icing of the water intake requires constant maintenance during periods of extreme cold conditions and can lead to catastrophic loss at the acclimation facility. Additionally, the release of fish in two phases may be inconsistent with optimum outmigration times relative to water flows and/or water release strategies from mainstem dams on the Snake and Columbia rivers. .

Recommendation UGR-SC4: Weigh the benefits of the current acclimation and release strategy versus the risk of catastrophic loss, or the risk of releasing fish too early or too late. Evaluate acclimation and release alternatives such as: (a) reducing the acclimation and/or release period, (b) allow the fish to volitionally outmigrate at any point during acclimation, (c) direct stream release of all or a portion of the fish, (d) increasing acclimation capacity, or (e) reducing the program size. Consider acclimating only one group during optimum weather and stream conditions and direct stream releasing the other group during the same period. The two groups should be differentially marked with coded wire tags and should include representative PIT tags for evaluation of survival, homing, and straying**.** Alternative release strategies should be evaluated comparatively (differential tagging) to determine which strategy results in the best survival/contribution to broodstock and adult escapement.

Issue UGR-SC5: It is policy that surplus eggs are outplanted into the Grande Ronde River; however this action has occurred only twice since 2001*. The Team understands that the Upper Grande Ronde River spring Chinook program is a conservation program; however, the benefits derived from this action are unknown. The risks are assumed to be lo**w.***

Recommendation UGR-SC5: Conduct monitoring and evaluation to determine the benefits from egg outplanting. Alternatively, if benefits cannot be quantified, consider developing streamside incubators for surplus eggs or terminate egg outplanting.

Facilities/Operations

Refer to Recommendations for Current Program>Facilities/Operations under Lookingglass Creek spring Chinook for recommendations regarding the Lookingglass FH.

Issue UGR-SC6: The existing facilities may not accommodate long-term needs of the program. *The weir may not be efficient at controlling upstream passage, and the acclimation facility is not large enough to acclimate 250,000 smolts, thus requiring two acclimation/release phases in the spring. Furthermore, the Upper Grande Ronde trap and acclimation facilities have some safety and structural deficiencies. For example, the water intake and outfalls ice up during extreme cold conditions, and the catwalks at the adult trap do not have handrails.*

Recommendation UGR-SC6: Comanagers should investigate improvement options for the current facility for meeting the long-term needs of the program.

Issue UGR-SC7: The existing weir was moved to the current location after 2007 in an attempt to trap a better representation of the adult run back to the major spawning areas in the upper Grande Ronde River. *In 2008, the weir was opened for an extended period due to high flows.*

Recommendation UGR-SC7: Continue to monitor the existing weir site to determine if the location and structure will adequately meet all program goals and objectives while minimizing risks to the naturally spawning population.

Research, Monitoring, and Accountability

Also see LC-SC29 in the Lookingglass Creek spring Chinook section.

Issue UGR-SC8: ODFW has a historical baseline data set for the Grande Ronde River basin (including the upper Grande Ronde River), including (a) data on early life history of spring Chinook prior to initiation of the hatchery programs, (b) pre- and post-hatchery data for spring Chinook in the upper Grande Ronde River for both the conventional and captive programs, (c) data on natural populations in control streams with no direct hatchery influence (e.g., Minam and Wenaha rivers), (d) data for a Snake River basin wide assessment of supplementation programs, and (e) preliminary data on the use of an endemic broodstock for supplementation in the upper Grande Ronde River.

Recommendation UGR-SC8a: Continue current monitoring and evaluation programs to continue long term data sets and assess hatchery supplementation of upper Grande Ronde stock in the upper Grande Ronde River.

Recommendation UGR-SC8b: Initiate a reproductive success study (pedigree analysis) in the upper Grande Ronde River using upper Grande Ronde River stock.

Issue UGR-SC9: A significantly higher proportion of hatchery-origin spring Chinook program return as adult jacks in the upper Grande Ronde River compared to natural-origin fish.

Recommendation UGR-SC9: Continue monitoring and evaluation studies such as measuring growth rates, size and time at release to evaluate affects upon survival and age composition of hatchery-origin fish. Use this information to adjust the program according to program objectives.

Education and Outreach

See the Lookingglass Creek Spring Chinook section for recommendations regarding Lookingglass FH.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing Upper Grande Ronde River Spring Chinook Program and developed four alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the "no hatchery" option. Following these descriptions of alternatives, the Review Team has identified recommended alternatives.

Alternative 1: Current program with recommendations

Continue to maintain the Upper Grande Ronde River stock of spring Chinook, using captive and conventional artificial propagation techniques as necessary until habitat is improved and out-of-sub-basin survival increases sufficiently to allow other management options.

Pros

- Maintains the abundance and distribution of an endemic stock of spring Chinook that might not persist without artificial propagation and supplementation.
- Provides a genetic repository for the listed Upper Grande Ronde River spring Chinook population.

Cons

- Current program provides little contribution towards meeting the LSRCP mitigation goal of returning 5,860 hatchery-origin adult Chinook to the Grande Ronde River basin.
- High likelihood of domestication effects to the integrated hatchery population because of the relatively low numbers of hatchery and natural-origin fish returning to the Grande Ronde River and the likely long-term need to maintain a naturally-spawning population via hatchery intervention.
- Degraded habitat conditions and low smolt-to-adult return rates limit natural productivity and inhibit maintenance of a properly integrated hatchery program.
- Requires careful broodstock and upstream passage management to limit the domestication influence of hatchery-origin fish on the natural population of spring Chinook.

Alternative 2: Reduce the size of the Upper Grande Ronde program with an exclusive focus on maintaining the population, and increase the Lookingglass or Lostine programs to better meet harvest mitigation benefits for the Grande Ronde basin

Reduce the size of the program in the near term to a level that focuses exclusively on the goal of maintaining the Upper Grande Ronde spring Chinook population. Continue to implement an aggressive habitat restoration effort in the upper Grande Ronde River basin. Reduce the Upper Grande Ronde River Stock program to annual releases of 130,000 with the intent of maintaining an annual broodstock size that is a minimum of 60 females and 60 males. Based upon the history of the program, for approximately 6 out of 7 years, the broodstock goals can be met when only 130,000 fish are

released. Use the rearing space at Lookingglass FH to increase the Lookingglass or Lostine spring Chinook programs to better meet harvest and mitigation objectives for the Grande Ronde basin. The SNAP component of the program for the upper Grande Ronde River would be maintained under this alternative.

Pros

- Simplifies the Upper Grande Ronde spring Chinook program.
- Frees up two raceways at Lookingglass FH for the Lostine or Lookingglass spring Chinook programs.
- Increases the number of returning adult spring Chinook available to support recreational and tribal fisheries provided by other programs in the Grande Ronde River basin.
- Increases the potential for meeting LSRCP mitigation goals for Grande Ronde River basin spring Chinook.
- Focuses effort on habitat restoration, the primary problem limiting the viability of spring Chinook in the Upper Grande Ronde River.

Cons

- Reduces the potential for tribal and sport harvest on spring Chinook in the Upper Grande Ronde River.
- Requires extensive habitat restoration in the Upper Grande Ronde River basin.
- May result in surplus numbers of adult spring Chinook returning to Lookingglass Creek or the Lostine River.

Alternative 3: Transfer production for the Upper Grande Ronde spring Chinook program to a new and/or other existing hatchery facilities AND rear only Lookingglass Creek and Imnaha River spring Chinook at Lookingglass FH to meet mitigation goals for the Oregon portion of the LSRCP

See Alternative 5 for the Lookingglass Creek Spring Chinook program.

Alternative 4: Terminate the program and decommission the Upper Grande Ronde satellite facility

Decommission the satellite facility and terminate the Upper Grande Ronde spring Chinook program in favor of alternative mitigation strategies such as habitat restoration, passage improvements, or alternative hatchery production at another site.

Pros

- Continuation of the current program has low potential for success due to degraded habitat that limits natural productivity and inhibits maintenance of a properly integrated hatchery program.
- Continuation of the current program poses a domestication risk to the integrated hatchery-wild population because of the likely need for long-term hatchery intervention.
- The existing facilities may not accommodate the long-term needs of the program. The weir may not be efficient at controlling upstream passage, and the acclimation facility cannot accommodate the current program size and is subjected to icing.
- The weir structure may inhibit natural upstream migration of adult spring Chinook back to the major spawning areas.
- Installation and operation of the temporary weir each year poses a safety risk to operating personnel.
- Current program provides little contribution towards meeting the LSRCP mitigation goal of 5,860 adult spring Chinook back to the Grande Ronde River basin.

Cons

- Would reduce the future potential for tribal and sport harvest of spring Chinook in the Upper Grande Ronde River.
- Terminates the continued development of an extensive data set comparing conventional to captive propagation.
- Current program maintains the abundance and distribution of an endemic stock of spring Chinook that might not persist without artificial propagation and supplementation.
- Current program provides a genetic repository for the listed Upper Grande Ronde River spring Chinook population.

Recommended Alternatives

The Review Team considered the pros and cons of four alternatives to the existing spring Chinook program, ranging from the current program with full implementation of all program specific recommendations (Alternative 1) to terminating the program and decommissioning the Upper Grande Ronde trap and acclimation site (Alternative 4).

The Review Team recommends Alternative 2 in the near term: reduce the size of the Upper Grande Ronde program with an exclusive focus on conservation and maintaining the endemic population. This alternative would focus on the comanager goal of preventing extinction of endemic spring Chinook in the upper Grande Ronde River while, at the same time, increasing harvest opportunities elsewhere in the Grande Ronde River in support of LSRCP mitigation goals. The recommended alternative would reduce the Upper Grande Ronde River stock program to annual releases of 130,000 smolts with the intent of maintaining a minimum broodstock size of 60 females and 60 males each year. The Team recommends continuation of the SNAP program as a back-up safety measure for maintaining the population. The recommended alternative would free up two raceways at Lookingglass FH for the

Lookingglass Creek spring Chinook program to increase the number of spring Chinook available for recreational and tribal fisheries (see Alternative 4 for the Lookingglass Creek program). The recommended alternative assumes implementation of aggressive habitat restoration efforts in the upper Grande Ronde River basin to increase the viability and productivity of the naturally spawning population. Over the long term, habitat improvements are expected to increase smolt-to-adult survivals and the overall productivity of the natural population while facility constraints are addressed.

Catherine Creek Spring Chinook

Operator: Oregon Department of Fish and Wildlife

Summary of Current Program

Goals

- ***Harvest goal:*** No numeric harvest goal exists at the present time. The program currently operates primarily as a conservation program. The program is intended to eventually contribute to recreational and tribal harvests and the overall LSRCP mitigation goal to return 5,860 hatchery-origin adult spring/summer Chinook—from the Grande Ronde River basin—upstream of Lower Granite Dam on the mainstem Snake River.

- ***Broodstock escapement goal:*** The desired goal is to annually capture 48 male and 48 female adult spring Chinook in Catherine Creek for broodstock to yield 150,000 smolts for release, with jacks composing up to 10% of the male spawning contribution. However, because of space constraints at Lookingglass FH, the current goal is to annually capture 41 males and 41 females for broodstock to yield 130,000 smolts for release with jacks composing up to 10% of the males. Natural-origin adults from Catherine Creek are incorporated within the broodstock annually, and hatchery-origin adults are allowed to spawn naturally in Catherine Creek each year. A sliding scale has been developed to help determine the proportion of the broodstock and natural spawners composed of hatchery and natural-origin fish annually (see Operational Considerations).

- ***Conservation goal:*** Short-term goal: Prevent extinction of endemic spring Chinook in Catherine Creek, maintain a naturally spawning population in Catherine Creek, provide a future basis to reverse the decline in abundance of Grande Ronde River spring/summer Chinook salmon, and ensure a high probability of population persistence into the future. An intermediate goal of this program, in concert with other programs for indigenous populations (upper Grande Ronde River and Lostine-Wallowa River), is restoration of spring Chinook salmon in the Grande Ronde Basin. This intermediate goal includes the reestablishment of a naturally spawning population of spring/summer Chinook in Lookingglass Creek. The long-term conservation goal of this program is to contribute to recovery and de-listing of the Snake River Spring/Summer Chinook ESU, including continued mitigation for fish losses occurring as a result of the construction and operation of the four Lower Snake River Dams. The ICTRT classified the Catherine Creek population, which includes Indian Creek and a portion of the mainstem Grande Ronde River, as "large" based on historical habitat potential. However, this population is treated as "intermediate" for abundance and productivity measures because analyses of those latter two parameters for recovery are based on spawners in Catherine Creek only. A Chinook population classified as intermediate for ESA recovery has a mean minimum abundance threshold criteria of 750 natural-origin spawners with a sufficient intrinsic productivity to achieve a 5% or less risk of extinction (greater than 1.6 recruits per spawner at the threshold abundance level) over a 100-year timeframe. The Columbia River Treaty Tribe's long-term recovery goal for spring/summer Chinook in the Grande Ronde River is an annual return of 16,000 adults.

- ***Escapement goal for natural-origin adults:*** Comanagers have not yet quantified a natural spawning escapement goal for spring Chinook upstream of the weir in Catherine Creek under current conditions. The current strategy is to follow a sliding scale that increasingly restricts the proportion of hatchery-origin fish passed upstream of the weir as the predicted number of spring Chinook returning to Catherine Creek increases (see Operational Considerations). The current habitat capacity is estimated to be 500 natural-origin adult recruits back to Catherine Creek (HSRG 2009).

- ***Research, education, and outreach goals:*** Evaluate the benefits and risks of the program toward meeting its harvest and conservation goals.

Objectives

- Collect 41 males and 41 females (assuming an average fecundity of 3,818 eggs/female) at the Catherine Creek trap to yield approximately 130,000 smolts (This program size accounts for pre-spawn mortality of adults and potential culling of eggs from female parents testing positive for moderate to high levels of *Renibacterium*). Collect both unmarked natural-origin fish and marked hatchery-origin Catherine Creek spring Chinook for broodstock.

- Use broodstock collection guidelines (sliding scale) based on estimated escapement to Catherine Creek to determine the number and proportion of hatchery-origin and natural-origin fish to retain for broodstock and pass upstream (Table 27).

- Outplant up to 100 hatchery-origin adults in Indian Creek and all surplus fish to Lookingglass Creek.

- Transfer adults retained for broodstock to Lookingglass FH.

- Spawn adult spring Chinook at Lookingglass FH. Incubate and hatch the fertilized eggs and rear the resulting fish to the yearling smolt stage at Lookingglass FH.

- Transfer 130,000 yearling smolts to the Catherine Creek acclimation facility in one to two phases (The four raceways at the acclimation facility are not large enough to accommodate 130,000 smolts). If fish are transferred in two phases, the first phase occurs in early March, and the second phase around April 1. Acclimate for one week and allow two weeks for fish to volitionally emigrate, and then perform a forced release into the river.

Table 27. Catherine Creek Spring Chinook broodstock/upstream passage management guidelines.[62]

Estimated total adult escapement to the Lostine River mouth (hatchery plus natural) [a]	Ratio of hatchery to natural adults at the mouth	Maximum % of natural adults to retain for broodstock	% of hatchery adults to retain for broodstock [b]	% of adults released above the weir can be of hatchery origin	Minimum % of broodstock of natural origin	% Strays allowed above the weir [c]
<250	Any	40	40	d	d	≤5
251-500	Any	20 [d]	20	≤70	≥20	≤5
>500	Any	≤20	[e]	≤50	≥30	≤5

[a] Pre-season estimate of total escapement
[b] Conventional hatchery adults only, all captive brood adults released to spawn naturally or outplanted
[c] For hatchery adults originating from different gene conservation groups (Rapid River stock or strays from outside the Grande Ronde basin)
[d] Not to exceed 130,000 smolt production initially
[e] Not decision factor at this level of escapement, percentage determined by other criteria

Program Description

Catherine Creek spring Chinook are reared at Lookingglass Hatchery under the Lower Snake Compensation Plan mitigation program for northeast Oregon. LSRCP currently provides the facilities, equipment, and personnel for fish culture, evaluations, and fish health monitoring of juvenile fish. Bonneville Power Administration funds an adult collection weir and trap and juvenile acclimation facilities located on the Catherine Creek and operated by the Confederated Tribe of the Umatilla Indian Reservation (CTUIR) as co-managers with ODFW.

From broodyears 1994-2006, a captive broodstock program was operated in tandem with the conventional program. The captive broodstock program used several facilities including Bonneville, Oxbow, Irrigon, Wallowa, and Lookingglass fish hatcheries, and the Manchester Experiment Station (NOAA Fisheries) for rearing adults. All returning adults from the captive broodstock program are allowed to spawn naturally.

[62] *Provided by Scott Patterson, ODFW, June 2009.*

Assessment of Current Program

Operational Considerations[63]

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- Natural and hatchery-origin spring Chinook returning to Catherine Creek are used for broodstock. Hatchery-origin fish are included the Snake River Spring/Summer Chinook ESU which is listed as threatened under the ESA.

- The captive brood program began in 1995, and the conventional program began in 2001. The captive brood program was discontinued in 2006.

- The program uses an endemic spring Chinook stock founded from natural-origin fish trapped in Catherine Creek in 1995.

- Adult fish are trapped for broodstock at the Catherine Creek trap and weir at river mile 43.5.

- Both unmarked natural-origin fish and marked hatchery-origin fish are collected for broodstock or passed upstream to spawn naturally.

- All first generation progeny of the discontinued captive broodstock program trapped at the Catherine Creek weir are passed upstream to spawn naturally.

- The program objective is to collect 41 males and 41 females (assuming an average fecundity of 3,818 eggs/female) at the Catherine Creek trap to yield approximately 130,000 smolts. The program size is based on a female survival of 95% (spawn 40 females), fecundity of 3,818 eggs per female to yield 153,000 green eggs, and a green egg-to-smolt survival of 87.1% to yield 130,000 smolts.

- The broodstock collection number (41 pair) could go up or down slightly depending upon fecundity.

- At the predicted run size in 2009 of between 250 and 912, the adult sliding scale for broodstock collection is <20% of wild and hatchery-origin fish. Hatchery-origin adults released above the weir should be ≤70% of the total. Ten percent of the males above the weir may be hatchery-origin "jacks" (age 3 males). In season PIT-tag detections of returning adults at mainstem Columbia and Snake river dams are used to adjust the projected run size with potential surplus hatchery fish transferred to Lookingglass Hatchery.

- Based upon the sliding scale, predicted returns for 2009, and an adult pre-spawning mortality of 5%, adult collection numbers were as follows: males – 41 (spawn 39), natural (spawn >= 8), hatchery (spawn <= 31-one jack equals one male); females – 41 (spawn 39), natural (spawn >= 8), hatchery (spawn <= 31). Adjustments can be made in season based upon

[63] *See Appendix B of this document for supporting background information and references.*

corrections in predicted returns. At an average fecundity of 3,818 eggs/female, the above numbers of fish retained for broodstock would yield 148,902 green eggs and 130,000 smolts based on a mean 87.1% green egg-to-smolt survival.

- Comanagers outplant all surplus hatchery-origin, adult spring Chinook trapped in Catherine Creek. The surplus adults are used to reintroduce spring Chinook into Lookingglass Creek and to supplement the Indian Creek population. The objective is to outplant 100 surplus fish into Indian Creek annually (21 adults from the captive brood program were outplanted in 2005). In 2004, 2005, and 2009, 226, 21, and 1 spring Chinook trapped in Catherine Creek were outplanted into Lookingglass Creek.

- The weir is installed in Catherine Creek around March 1 each year depending upon environmental conditions and before high water flows in spring prevent installation. The trap is used to monitor upstream migration of steelhead from March through mid-May. Adult spring Chinook are typically first detected at the weir in mid-May. Fish are processed at the trap three to seven days per week. Approximately 90 adults can be held in the trap. The weir is operated through July 31.

- The weir is able to trap approximately 95% of all adult spring Chinook migrating upstream in Catherine Creek.

- Broodstock collection guidelines (sliding scale) are based on estimated escapement to Catherine Creek. The sliding scale was developed cooperatively between ODFW, CTUIR, and the NPT.

- To achieve a release of 130,000, 153,000 green eggs are needed assuming 87.1% survival from green egg-to-smolt and an estimated five-year average fecundity of 3,818 eggs per female.

- The long-term expectation for the program is to collect approximately 170 adults for broodstock annually with the following caveats: <70% of the fish passed upstream of the weir in Catherine Creek are hatchery origin if the total run size is between 251 and 500 fish, and <50% of fish passed upstream are hatchery-origin if the run size is greater than 500 fish (surplus hatchery-origin fish may be taken to Lookingglass FH for Lookingglass Creek broodstock).

- From 2001-2004, only natural origin fish trapped in Catherine Creek were used for broodstock: 13 females and 7 males in 2001, 20 females and 15 males in 2002, 28 females and 19 males in 2003, and 9 females and 7 males in 2004. In 2005 and 2006, hatchery-origin fish were also used for broodstock. In 2005, 9 hatchery-origin females and 16 hatchery-origin males plus 8 natural-origin females and 2 natural-males were spawned as broodstock. In 2006, 29 hatchery-origin females, 16 hatchery-origin males, eight natural-origin females, and 12 natural-origin males were spawned. The mean proportion of the broodstock composed of natural-origin fish (*pNOB*), with the genetic contributions of males and females weighted equally (accounts for unequal sex ratio), was *pNOB* = 31%.

- From broodyears 2001-2008, 55% of the spawned females were natural-origin.

- Trapping facilities are checked daily. When water temperature exceeds 65°F (18.3°C), fish are not handled, the pickets in the weir are pulled, and fish are allowed to pass freely upstream.

- Returning adults from the captive broodstock program (F1) are passed upstream of the weir or outplanted.

- Epizootic ameloblastomas (skin tumors of the mouth) have been noted in both the conventional and captive spring Chinook adult broodstock (Grande Ronde, Lostine, Imnaha and Catherine Creek). The cause of those tumors is unknown.

Hatchery and Natural Spawning, Adult Returns

- The Catherine Creek portion of the Lookingglass Creek Fish Hatchery program focuses on the indigenous spring Chinook salmon stock of Catherine Creek. Wild anadromous adults from this stock are incorporated within the broodstock annually and portions of hatchery origin adults are allowed to spawn naturally in the target tributary each year.

- The HSRG designated the current Catherine Creek population as "contributing" (currently *pHOS* = 51% and PNI = 0.37). The HSRG recommended reducing the number of smolts released into Catherine Creek as a solution to meeting a primary designation.

- Stray rates of out-of-basin spring Chinook into Catherine Creek appear to be low (less than 1-2%). Strays are generally fish that are part of the Grande Ronde spring/summer Chinook MPG.

- Since the conventional program began in 2001, *pHOS* and *pNOB* have averaged 59.9% (range = 51.8%-66.4%) and 29.7% (range = 28.6%-30.8%), respectively (return years 2002-2006 and return years 2005-2006, respectively).

- Smolt-to-adult survival for hatchery-origin spring Chinook in Catherine Creek averaged 0.24% (range = 0.07 - 0.57%) for broodyears 1998 through 2003 for both the captive and conventional programs. Smolt-to-adult survival estimated for natural-origin spring Chinook in Catherine Creek averaged 1.4% (range = 0.51% to 2.86%) for broodyears 1993-2000.

- Jacks typically comprise 15 to 20% of the returning hatchery-origin fish and 5-10% of the returning natural-origin fish.

- The proportion of returning fish composed of jacks has increased significantly in the last couple of years. This trend is not unique to the Catherine Creek population.

- Collected adults are transported at least once every three days (daily during peak season) from the adult trap on Catherine Creek to Lookingglass Hatchery in a 240-gallon transport tank.

- The intent is to spawn Catherine Creek spring Chinook in a 2:2 matrix (2 females x 2 males in all pairwise combinations). Occasionally the fish are spawned 1 female to 2 males depending on the number of mature fish available. At least one natural-origin adult is included in each of the spawning matrices

- Current spawning protocols allow up to a maximum of 10% of the eggs to be fertilized by jacks (3-year old males), although a specific protocol or requirement for including jacks has

not been established. The milt from up to six jacks may be pooled to fertilize one-half to one-third of the eggs from each female in a 1x2, 2x2 or 2x3 (females x males) spawning matrix, where one of the males in the matrix actually represents the pooled milt from up to six jacks. However, the actual number of jacks spawned and/or the proportion of eggs fertilized by jacks is unknown or not reported. Natural-origin males have often been used multiple times to fertilize eggs to increase the overall proportion of eggs fertilized by natural-origin males. In general, jacks are included at every tenth spawning matrix.

Catherine Creek spring/summer Chinook salmon spawning data for the 2001-07

Brood Year	Marked Females Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take	Fry Ponded	Smolt releases
2001	0	12	100%	1.71:1	3,651	43,813	26,426	24,392
2002	0	20	100%	1.18:1	4,096	81,926	71,750	70,959
2003*	0	28	100%	1.47:1	**4,639**	**129,888**	**123,394**	**120,753**
2004	0	9	100%	1.50:1	2,912	26,204	24,465	23,216
2005	9	8	47.1%	1.42:1	3,149	53,533	49,222	49,696
2006	28	8	22.2%	1.24:1	3,642	131,139	121,868	116,882
2007	30	15	33.3%	1.45:1	3,801	171,065	146,207	139,000
2008	21	11	31.3%	1.6:1	3,885	124,317	117,605	**111,800**
	88	**111**	55.8		**3,818**	**761,885**	**680,937**	**656,698**

*Inventory correction; Since 2004, eggs have been electronically counted
Numbers in blue current inventory
2001-06 brood, estimate survival from green egg to smolt at 87.1%

- Every female is screened for *Renibacterium*. If the ELISA titer for a female parent is greater than O.D. (optical density) = 0.8, then the eggs from that female are destroyed. Eggs are incubated separately by female until the bacterial profiles and screening are complete. If needed, eggs are consolidated or pooled among females parents after eye-up. From 2004 through 2008, 100% of the females spawned at Lookingglass Hatchery had ELISA levels of O.D. < 0.165.

- Adults collected for broodstock receive an erythromycin injection (20mg/kg) and an oxytetracycline injection (10 mg/kg) at capture to control BKD and Furunculosis, respectively. A second treatment of erythromycin is applied the first week of August if necessary. The second treatment only occurs if BKD is detected among the pre-spawning mortalities.

- Adult spring Chinook held for broodstock receive a formalin treatment 3 times per week. Depending upon the number and health of the adults, treatments can run into September.

- Eggs are spawned into colanders to remove ovarian fluid, fertilized, and then water-hardened in 100ppm iodophor for a minimum of 15 minutes.

- Natural spawning of spring Chinook occurs in mainstem Catherine Creek upstream of the town of Union and in the North and South Forks of Catherine Creek. Spawning distribution is now constrained to the area upstream of Union because of water withdrawals and high water temperatures in Catherine Creek downstream of Union.

- Three complete surveys of the spawning grounds occur upstream and downstream of the weir (17.3 miles in 9 survey sections upstream of the weir and 2.4 miles in one section immediately

below the weir) from the third week of August through mid-September. Index areas are used for long-term monitoring. Survey frequency ranges from daily to weekly depending on water temperatures and fish activity. Information is used to determine if salmon are accumulating below the weirs.

- Spring Chinook passed upstream of the weir are opercle punched so that they can be recovered on the spawning grounds and used to determine trap efficiency, population abundance, and the ratio of natural-origin and hatchery-origin fish upstream of the weir. Population abundance and wild/hatchery data are expanded for the entire river.

- Between 2001 and 2006, an average of 245 hatchery-origin (range = 31-635) and 129 natural-origin (range = 60-254) spring Chinook were trapped at the Catherine Creek weir.

- In the Grande Ronde Basin, the annual LSRCP mitigation goal for all stocks combined was set at 5,860 hatchery adults. ODFW estimated in 2006 that 414 Lostine River, 225 Catherine Creek, 159 Grande Ronde River, and 120 Lookingglass Creek adults returned to the basin. The combined return to the compensation area was 924 hatchery–origin adults, 15.8% of the LSRCP mitigation goal.

- Estimates of harvest outside the project area of Catherine Creek spring Chinook include; 4 fish in 2006 (ocean), 32 fish in 2005 (2-Columbia River non-treaty net, and 30 Columbia River sport), 164 fish in 2004 (31-Columbia River treaty net, 33- Columbia River non-treaty net, 90-Columbia River sport, and 1- Deschutes River sport), 45 fish in 2003 (7-Columbia River ceremonial/subsistence, and 38-Columbia River sport), and 77 fish in 2002 (37- Columbia River ceremonial/subsistence, 3-Columbia River non-treaty net, 36-Columbia River sport, and 1-Columbia River test fishery).

Incubation and Rearing

- Eggs receive a formalin treatment (1667 ppm) 3 times per week, beginning 48 hours post spawn until the eggs are picked.

- Chilled well water is used on the early egg takes to reduce the water temperature to around 50 degrees. UV treated surface water is used for incubation after August, when surface temperatures can reach 70 degrees.

- Flows are regulated at 4 to 6 gpm per vertical stack.

- Eggs are reloaded after eye-up at 1 female per tray at approximately 3,500 eggs per tray.

- After hatch, the fry are reared in 3 of the 28 indoor tanks (Canadian troughs), at approximately 50,000 fish per trough. The troughs are 117 cubic feet, with a flow rate of up to 50 gpm.

- In January-March, Lookingglass Creek temperatures drop to 32-35 degrees F. At this time well water is blended with treated surface water to increase the water temperature to approximately 40 degrees.

- Every attempt is made not to exceed 0.75 DI in the indoor tanks. However, at times, DI's exceed 0.85 due to the limited early rearing space.

- The flow index can reach approximately 2.4 when the fish are 250 fpp. However, the water temperature at this time is between 35 and 40 degrees.

- Once the fish reach 250 fpp, they are transferred to the outdoor raceways to be reared on raw creek water (late April to early May). Juvenile fish are retained indoors until high spring flows and subsequent turbidity decreases.

- Fish are held indoors until 250 fpp because: the fish are too small in relation to the screen mesh size to put them out much earlier; in attempt to avoid putting the fish out in the raceways during spring runoff; and to provide time to move the prior year's fish out and clean the raceways.

- The causative agent of whirling disease, *Myxobolus cerebralis*, was recently confirmed as present in wild rainbow trout and steelhead juveniles that reside above the hatchery in Lookingglass Creek. Hatchery juveniles are sampled for this parasite every year, prior to release, and through 2009, it had not been detected in the production fish.

- Fish in the outdoor raceways are fed using automated feeders. During cold weather (Jan-March), the fish are fed by hand because the automated feeders are inoperable.

- The raceways are cleaned by hand once per week. The cleaning effluent water is directed into a settling basin.

- The maximum flows in the raceways are approximately 800 gpm per raceway.

- The targeted density index is not to exceed 0.17 D.I in the outdoor raceways. The flow index is 1.5 in the outdoor raceways.

- Fish are typically held in one raceway until they are marked and tagged (90 fpp-180 fpp), at which time they are split across two raceways. The fish are adipose-fin clipped and coded-wire tagged in June-July.

- A formalin treatment is applied (167 ppm for 1 hour) for 2 consecutive days after marking. The fish are monitored to determine if additional treatment is needed. Formalin treatment is applied to control fungus.

- The fish receive one 28 day erythromycin treatment (2.25% aquamycin) to control BKD, typically in July shortly after marking.

- Bacterial kidney disease is not a problem in the conventional spring Chinook juveniles; although it has caused some mortality in the juveniles from the captive broodstock programs.

- In June 2009, white open wounds anterior to the dorsal fin were observed in the juvenile spring Chinook in most of the raceways. Occasionally, the coldwater disease bacterium is also detected in the juvenile Chinook at Lookingglass.

- In October, Catherine Creek spring Chinook are PIT tagged.

- Monthly health monitoring examinations are conducted on each spring/summer Chinook stock. The sample includes a minimum of 10 moribund/dead fish (if available) and 4-6 live fish per raceway. Results are reported on the ODFW Fish Health Examination report.

- Survival data is categorized in the following sentence and production projections are modeled using 85% survival of green eggs to smolt. Green egg to eyed-egg: 90%; eyed-egg to swim-up fry: 98%; swim-up fry to fingerling (marking): 97%; and fingerling to smolt (marking to release): 99%.

- Compared to the Conventional spring Chinook Broodstock Programs, survival rates for the Captive spring Chinook Broodstock Programs were consistently lower, mostly due to large numbers of eyed eggs being culled because of high enzyme-linked immunosorbent assay (ELISA) levels in female broodstock, in an effort to reduce the incidence of bacterial kidney disease (BKD) in their offspring. Co-managers decided to cull eyed eggs produced from females with ELISA levels > 0.8 for Catherine Creek and Grande Ronde River stocks and > 0.2 for Lostine River females. If culled eggs were not included in the survival calculations, green egg-to-smolt survival rates were 61.1% for Lostine River stock, 69.9% for the Upper Grande Ronde stock, and 62.0% for Catherine Creek stock, still lower than their Conventional Broodstock counterparts (82-84%).

Release and Outmigration

- Lookingglass FH adheres to the ODFW Fish Health Management Policy for fish releases and transfers. Fish having health issues are not commingled with the other fish at the acclimation site. If a pathogen of concern, such as IHNV, is detected in the smolts at the hatchery, the affected raceway(s) will be transferred and released separately from non-affected raceways, with the option of later release from the acclimation site and/or direct stream release downriver from the acclimation site.

- If epizootic instances of disease occur (greater than 0.1% mortality per day for three days), the fish are held at Lookingglass FH, and they are not transferred to the acclimation facility and released until the disease is below epizootic levels. If treatment is not effective or if the fish are held too far beyond their release date, they may be destroyed. These protocols are more restrictive than IHOT. An epizootic outbreak of IHN has not occurred at Lookingglass FH for 15 years.

- The Catherine Creek stock has a target size of 25 fpp by October 31 and 20 fpp at release (Grande Ronde Basin Chinook AOP). The target size at transfer is 25 fpp for both groups.

- The CTUIR operates an acclimation facility on Catherine Creek at river mile 52.5. Acclimation occurs in four raceways approximately 8'x85'x3.25' (2,210 ft3) in size. The site's capacity is approximately 150,000 fish at 20 fpp. The maximum density index is 0.15 at 20 fpp. The flow index is 0.95.

- Due to limited capacity of the Catherine Creek acclimation facility, the spring Chinook are often acclimated and released in two phases: the first in mid-March, and the second, April 1. The fish are acclimated for one week and allowed at least two weeks for fish to volitionally emigrate, and then remaining fish are force released into the river. The CTUIR have pushed the first acclimation phase back and shortened the time frame to reduce the risks of icing at the facility.

- The current strategy is to acclimate smolts for 1 week, followed by a two week volitional release. At the end of the volitional release period, fish remaining in the pond are forced out. The time frame for smolt acclimation and release is from mid-March to mid-April.

- The water source for Catherine Creek acclimation facility is a submersible pump in Catherine Creek powered by a diesel generator. The acclimation facility uses approximately 5 CFS from February to April. The adult collection facility is located in the stream.

- The fish are fed a maintenance diet during acclimation and at a decreasing level throughout the course of the volitional release.

Facilities and Operations

- *See Lookingglass Creek Spring Chinook, Facilities and Operations section for Lookingglass FH operational considerations.*

- The Catherine Creek acclimation site is a temporary facility. The facility has some structural discrepancies. Predator deterrence is limited to a security fence around the facility that precludes terrestrial predators; however, the fish are on-site for a short-period of time and predation is minor. The facilities are funded by the Bonneville Power Administration and managed by the CTUIR.

- Gravel and sand accumulates behind the Catherine Creek weir and requires constant maintenance.

Research, Education, and Outreach

- Evaluation of the captive broodstock program has increased knowledge regarding this artificial propagation tool. The smolt-to-adult returns for the captive broodstock program was comparable to the conventional program. Instances of BKD were more common for the captive broodstock program (those fish reared to adults on station) compared to the conventional program.

- For broodyear 2010, Catherine Creek spring Chinook will be 100% adipose-fin clipped and a representative group will be coded-wire tagged (likely 50%). Twenty one thousand will be PIT tagged. Tags are apportioned equally across raceways.

- Coded wire tags are used to assess contribution to fisheries and to estimate smolt to adult survival.

- PIT tag data provides information regarding downstream migration timing and comparative performance of wild, captive brood, and conventional juveniles.

- Catherine Creek spring Chinook are monitored as part of the Comparative Survival Study.

- ODFW operates a smolt trap on Catherine Creek located below spawning and upper rearing areas near the town of Union at river mile 19.8. The trap is used to collect wild fish so that they can be PIT tagged and used to determine smolt outmigrant timing to Lower Granite Dam. The trap provides abundance information and provides a basis for SARs for wild adults.

- During migration years 1995 through 2007, ODFW estimated that an average of 24,938 (range 4,442-64,012) juvenile spring Chinook salmon migrated out of upper rearing areas in Catherine Creek with an average of 21% (range 9%-49%) leaving as early migrants and 79% (range 51%-91%) leaving as late migrants.

- Catherine Creek juvenile spring Chinook salmon survival probability by location and tag group from time of tagging to Lower Granite Dam for Chinook salmon tagged from fall 2006 to spring 2007 and detected at the dams during 2007 was 0.203 for Chinook tagged in the fall at the trap, 0.088 for Chinook tagged in the winter above the trap, and 0.310 for Chinook tagged in the spring at the trap.

- Smolt migration success was monitored for all stocks based on survival to Lower Granite Dam. ODFW developed release-recapture information of PIT-tagged smolts from each raceway to calculate Cormack-Jolly-Seber (CJS) survival probabilities to Lower Granite Dam using the SURPH 2.2 program with a single release recapture model. Mean stock survival was calculated as the weighted average of the raceways for each stock with the number of smolts in each raceway as the weight. Mean survival rate for smolts released from Catherine Creek in 2006 was 31%.

- The Confederated Tribes of the Umatilla Indian Reservation initiated a multi-year project in 2000, designed to monitor and evaluate supplementation of endemic spring Chinook salmon in Catherine Creek and the upper Grande Ronde River to; 1) evaluate and contrast performance of supplemented endemic juvenile spring Chinook salmon of conventional and captive broodstock hatchery origin acclimated and released at facilities on Catherine Creek and the upper Grande Ronde River and naturally produced juveniles, 2) Evaluate life history differences between natural and supplemented (hatchery-origin F1) adult spring Chinook salmon from Catherine Creek and the upper Grande Ronde River and 3) Describe life history characteristics and genetic stock structure of adult summer steelhead from Catherine Creek and the upper Grande Ronde River.

- *See Lookingglass Creek Spring Chinook program for more information.*

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,[64] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- The Catherine Creek spring Chinook program provides limited recreational and tribal harvest in the Grande Ronde basin. With the exception of recent fisheries targeting a few hundred surplus Rapid River stock hatchery fish in Lookingglass Creek, spring Chinook sport harvest has not occurred in the Grande Ronde basin since 1978.

[64] *See Section II, "Components of This Report", for a description of these potential benefits and risks.*

- Estimates of harvest (2002-2006) of Catherine Creek spring Chinook within the project area (outside the Grande Ronde River Basin on the mainstem Snake River above Lower Granite Dam) included; 2 fish in 2006 (Snake River sport), and 4 fish in 2004 (Snake River sport).

Conservation Benefits

- Reduces demographic and genetic risks of small population size to the spring Chinook population and maintains a naturally spawning population in Catherine Creek.

- The Catherine Creek spring Chinook program is expected to preserve/conserve the Catherine Creek population in the short term, and to assist in restoration of the population to historic levels.

Research, Education, Outreach and Cultural Benefits

- The Catherine Creek, Lookingglass, Lostine, and Upper Grande Ronde River spring Chinook are part of a Snake River basin-wide assessment of supplementation that has generated a long-term data set.

- Tribal harvest and surplus adults trapped at facilities provide ceremonial, cultural and subsistence benefits to Columbia River tribes.

- The program provides opportunities for evaluation of captive broodstock vs. conventional broodstock programs.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,[65] the Review Team identified the following benefits of this program:

Harvest Benefits

- The Catherine Creek spring Chinook program provides limited contribution to total tribal, commercial and recreational fisheries downstream of the project area, including the lower Columbia River.

Conservation Benefits

- There is a potential, but undocumented, demographic benefit to the naturally spawning populations in Indian Creek where adults are outplanted.

- Adult outplants into Lookingglass Creek are expected to contribute to the reintroduction of a naturally spawning population of spring Chinook.

Research, Education, Outreach and Cultural Benefits

- Tribal harvest provides ceremonial, cultural and subsistence benefits to Columbia River tribes.

- The program provides opportunities for evaluation of captive broodstock vs. conventional program.

[65] *Ibid.*

- The program provides research and information on supplementation issues.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,[66] the Review Team identified the following risks of the hatchery program:

Genetic Risks

- The comparatively low recruit-to-spawner ratio for naturally spawning fish, coupled with the high proportion of hatchery-origin spring Chinook spawning in Catherine Creek, inhibits development of a properly integrated population and hatchery program, thus posing a genetic domestication risk to the spring Chinook population in Catherine Creek.

- The present sliding scale for determining the proportion of adult fish composed of natural-origin and hatchery-origin adults passed upstream of the weir on Catherine Creek results in the passage of hatchery-origin adults when the escapement objective for natural-origin adults is achieved, resulting in excessive genetic influence of hatchery-origin fish and the environment on the naturally spawning population.

Demographic Risks

- *See the Lookingglass Creek Spring Chinook program for demographic risks associated with rearing at Lookingglass FH.*

- Extreme cold water conditions at the acclimation site may result in diminished water flows or complete loss of water prior to release of smolts.

- The transfer of fish from Lookingglass FH to extreme cold water conditions at the acclimation site may pose a physiological (stress) risk for the fish.

- Transportation of adult and juvenile spring Chinook between Lookingglass FH and Catherine Creek increases disease risks and potential egg loss from females.

Ecological Risks

- *See the Lookingglass Creek Spring Chinook program for ecological risks associated with rearing at Lookingglass FH.*

- Potential amplification of disease within the hatchery program poses a disease risk to the Catherine Creek spring Chinook population.

- Anadromous fish in Catherine Creek upstream of the water intake for the acclimation facility increases disease risks to the juvenile Chinook held at the Catherine Creek trap and acclimation facility.

[66] *Ibid.*

Physical Risks

See the Lookingglass Creek Spring Chinook program for physical risks associated with rearing at Lookingglass FH.

Research, Education, Outreach and Cultural Risks

- None identified.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,[67] the Review Team identified the following risks from the hatchery program:

Genetic Risks

- Outplanting adult spring Chinook from Catherine Creek into Indian Creek poses a genetic risk to any naturally-produced spring Chinook in this area.

Demographic Risks

See the Lookingglass Creek Spring Chinook section for demographic risks associated with rearing Chinook at Lookingglass FH.

Ecological Risks

- Outplanting adult spring Chinook from Catherine Creek into Lookingglass Creek and Indian Creek poses fish health risks to naturally spawning spring Chinook.

- Outplanting adult spring Chinook from Catherine Creek into Indian Creek poses an ecological risk to the survival and growth of any naturally-produced spring Chinook in this area.

- Potential amplification of disease at Lookingglass FH poses a disease risk to natural populations of fish in Catherine Creek when smolts are transferred and released from the acclimation facility.

Research, Education, Outreach and Cultural Risks

- None identified.

[67] *Ibid.*

Recommendations for Current Program[68]

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

Program goals and objectives

Issue CC-SC1: Many LSRCP hatchery programs appear to be attempting to meet harvest, mitigation and conservation goals simultaneously without those goals being clearly stated or prioritized in terms of numeric outcomes that quantify intended benefits. *Short-term and long-term goals for many LSRCP programs have not been clearly stated or quantified – up front - independent of the methods for achieving them (e.g., "The goal of this program is to use supplementation to …"). The confounding of goals and methods impedes assessments of program benefits, particularly if desired benefits are not quantified as short-term and long-term goals. Prioritization of mitigation versus conservation goals appears to shift annually based upon the number of returning adults without a strong association to long-term goals for the programs (e.g., as described in Annual Operating Plans). Prioritization of short and long-term goals often differs among comanaging parties. Although the Spring Chinook program for Catherine Creek is clearly focusing on conservation as a first priority at the present time, short-term and long-term goals have not been clearly articulated. For example, comanagers have not yet specified a near-term natural spawning escapement goal for spring Chinook in Catherine Creek upstream of the weir, although the stated first "goal" of the program is to prevent extinction of the population.*

Recommendation CC-SC1: Comanagers should restate and prioritize program goals for all LSRCP programs in terms of both short-term and long-term numeric outcomes for the following parameters: (a) natural population abundance and viability (conservation goals); (b) the number of hatchery-origin fish returning to specified target areas (mitigation goal), and (c) the proportions and desired numbers of fish from the two preceding groups allocated for broodstock, natural-spawning escapement, and harvest. Both short-term and long-term goals need to be clearly articulated up front (e.g., natural spawning escapement numbers) independent of the chosen methods for achieving them (e.g., supplementation spawning by hatchery-origin fish). Short-term goals need to be realistic and attainable biologically under current conditions. Long-terms goals should also be realistic biologically but can consider the removal of factors that prevent their achievement in the short-term (e.g., repair of riparian habitats, engineering improvements to fish passage structures, etc.). Quantitative benchmarks should also be established for measuring success or failure of the program towards meeting identified goals, thus allowing for mid-course corrections in programs or adjustments in the goals themselves. Prioritization of program goals, both short-term and long-term, must be made consistent among comanagers.

[68] *The Review Team believes that the ODFW and the USFWS LSRCP office will be the logical parties to coordinate and implement most of the following recommendations.*

Issue CC-SC2: The sliding scale for the Catherine Creek spring Chinook program does not indicate when hatchery-origin spring Chinook should no longer be passed upstream. *Continuing to pass hatchery-origin fish upstream onto the natural spawning grounds after a natural population is considered viable poses a greater reproductive fitness risk than abundance benefit to the naturally spawning population. The ICTRT has identified 750 natural-origin spawners per year as the threshold level for sustainable viability for the Catherine Creek population. However, comanagers have not yet quantified a natural spawning escapement goal for spring Chinook upstream of the weir in Catherine Creek under current conditions.*

Recommendation CC-SC2: Sliding scales should include contingencies for not deliberately passing any hatchery-origin fish upstream when the predicted number of natural-origin recruits exceeds the viability threshold identified by comanagers. This approach minimizes hatchery influence (*pHOS*) and maximizes natural influence (*PNI*).

Issue CC-SC3: The goals for outplanting hatchery-origin spring Chinook from Catherine Creek into Indian Creek are not stated in terms of numeric outcomes that quantify intended benefits or goals. *Up to 100 hatchery-origin spring Chinook from Catherine Creek spring Chinook are outplanted annually into Indian Creek. The measurable benefits desired from those actions have not been identified.*

Recommendation CC-SC3: Discontinue the outplanting of adults into Indian Creek unless the activity can be justified based upon specific goals for the program. Goals should be developed in terms of measurable benefits (e.g., production of natural-origin smolts assessed via DNA markers) and weighed against biological and other risks to justify the action.

Also see LC-SC3 under Program Goals and Objectives recommendations for Lookingglass Creek spring Chinook.

Broodstock Choice and Collection

No issues identified.

Hatchery and Natural Spawning, Adult Returns

Issue CC-SC4: The relative genetic contribution of jacks (3-year old males) to each brood year is difficult to ascertain under current spawning protocols. *Spawning protocols at Lookingglass Hatchery are designed to maximize the genetic contributions of parents and the genotypic diversity among offspring. These goals are accomplished via the matrix spawning of males and females in 2x2, 1x2, and 2x3 (females x males) combinations. Jacks (3-year old males) are specifically included in the spawning matrices but with the requirement that they fertilize no more than 10% of the eggs for each brood year.[69] When jacks significantly outnumber 4-year old males, the milt from up to six jacks may be pooled to fertilize one-third to one-half of the eggs of each female in the matrix (the milt from 2-6 jacks is treated like the milt from one 4-year old male in these situations). In general, these spawning protocols are commendable because they maximize the total number of males used in the broodstock; however, the actual proportion and total number of eggs fertilized by jacks are not reported although the Grande*

[69] *ODFW. Draft Catherine Creek spring Chinook HGMP. February 2010.*

Ronde River Spring Chinook Management Plan specifies the inclusion of jacks in the broodstock at a rate of 1 jack for every 5 "adult"(age > 3 years) males.

Recommendation CC-SC4: Report the proportion (and/or number) of eggs fertilized by jacks for each brood year in annual reports.

Also see LC-SC6 under Hatchery and Natural Spawning, Adult Returns recommendations for Lookingglass Creek spring Chinook.

Incubation and Rearing

See the Lookingglass Creek Spring Chinook section for recommendations regarding incubation and rearing.

Release and Outmigration

Issue CC-SC5: Spring Chinook destined for the release are transferred and held at the Catherine Creek acclimation facility in two phases when the total number of smolts to be released exceeds the capacity of the facility. If needed, the early acclimation may occur during times of inclement weather which increases demographic risks to the fish prior to release. Additionally, releasing fish in two phases may be inconsistent with optimum outmigration times relative to water flows and/or water release strategies from mainstem dams on the Snake and Columbia rivers.

Recommendation CC-SC5: Weigh the benefits of the current acclimation and release strategy versus the risk of catastrophic loss, or the risk of releasing fish too early or too late. Evaluate acclimation and release alternatives such as: (a) reducing the acclimation and/or release period, (b) allow the fish to volitionally outmigrate at any point during acclimation, (c) direct stream release of all or a portion of the fish, (d) increasing acclimation capacity, or (e) reducing the program size. Consider acclimating and releasing only one group during optimum weather and stream conditions and direct stream releasing the other group during the same period. The two groups should be differentially marked with coded wire tags and should include representative PIT tags for evaluation of survival, homing, and straying. Alternative release strategies should be evaluated comparatively (differential tagging) to determine which strategy results in the best survival/contribution to broodstock and escapement.

Facilities/Operations

Refer to Recommendations for Current Program>Facilities/Operations under Lookingglass Creek spring Chinook for recommendations regarding the Lookingglass FH.

Issue CC-SC6: The existing facilities may not accommodate long-term needs of the program. *The weir may not be efficient at controlling upstream passage, and the acclimation facility is not large enough to acclimate 130,000 smolts, thus requiring two acclimation/release phases in the spring.*

Recommendation CC-SC6: Comanagers should investigate improvement options for the current facility for meeting the long-term needs of the program**.**

Research, Monitoring, and Accountability

Also see LC-SC29 in the Lookingglass Creek spring Chinook section.

Issue CC-SC7: In association with the need to identify the desired benefits of outplanting adult spring Chinook in Indian Creek (Issue CC-SC3), there is limited monitoring or evaluation of those releases.

Recommendation CC-SC7: If outplanting adult spring Chinook in Indian Creek continues after goals are defined in terms of desired benefits, develop a monitoring and evaluation program to assess whether the desired benefits are indeed achieved.

Issue CC-SC8: ODFW has a historical baseline data set for the Grande Ronde River basin (including Catherine Creek), including (a) data on early life history of spring Chinook prior to initiation of the hatchery programs, (b) pre- and post-hatchery data for spring Chinook in Catherine Creek for both the conventional and captive programs, (c) data on natural populations in control streams with no direct hatchery influence (e.g., Minam and Wenaha rivers), (d) data for a Snake River basin wide assessment of supplementation programs, and (e) preliminary data on the use of an endemic broodstock for supplementation in the upper Catherine Creek.

Recommendation CC-SC8a: Continue current monitoring and evaluation programs to continue long term data sets and assess hatchery supplementation of Catherine Creek stock in Catherine Creek.

Recommendation CC-SC8b: Continue to fund the reproductive success study (pedigree analysis) of hatchery and natural-origin spring Chinook in Catherine Creek.

Issue CC-SC9: A significantly higher proportion of hatchery-origin spring Chinook program fish return as adult jacks in the upper Grande Ronde River compared to natural-origin fish.

Recommendation CC-SC9: Continue monitoring and evaluation studies such as measuring growth rates, size and time at release to evaluate affects upon survival and age composition of hatchery-origin fish. Use this information to adjust the program according to program objectives.

Education and Outreach

See the Lookingglass Creek Spring Chinook section for recommendations regarding Lookingglass FH.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing Catherine Creek Spring Chinook Program and developed four alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the "no hatchery" option. Following these descriptions of alternatives, the Review Team has identified recommended alternatives.

Alternative 1: Current program with recommendations

Continue to supplement the Catherine Creek stock of spring Chinook, using conventional artificial propagation techniques and employing sliding scales for adult escapement, broodstock collection, and juvenile production levels to minimize hatchery influence on the population as natural production increases.

Pros

- Increases the abundance and distribution of spring Chinook in Catherine Creek.
- Provides a genetic repository for the listed Catherine Creek spring Chinook population.

Cons

- Current program provides little support for the LSRCP mitigation goal of 5,860 adult Chinook returned to the Grande Ronde River basin.
- Hatchery-origin adults outplanted into Indian Creek pose genetic, fish health and ecological risks to any naturally-produced spring Chinook in this area.
- Requires careful broodstock and upstream passage management to limit the domestication influence of hatchery-origin Chinook on the natural population.

Alternative 2. Convert the current integrated program to a stepping-stone program

Convert the current integrated program to a stepping-stone program designed to provide fish from an integrated program for natural spawning escapement and fish for harvest from a segregated program.

Pros

- Maintains the current integrated artificial propagation program and its associated conservation benefits.
- Can provide fish for harvest from the secondary component of the program (Depending on allocation of rearing space and capacity at Lookingglass FH).
- Can continue to serve as a broodstock source for initiating other Grande Ronde basin reintroduction programs as was done with Lookingglass Creek.

- Increases the capability for meeting LSRCP mitigation goals for Grande Ronde River basin spring Chinook.

Cons

- Further complicates the operation of Lookingglass hatchery which is currently being called upon to raise several separate stocks and programs.
- Requires more rearing space at Lookingglass FH and an investment in improving the sorting and holding facilities there.
- Limited harvest opportunities in Catherine Creek may not justify increased production.
- There are no additional identified management needs (other than Indian Creek) for outplants and no additional identified management needs for supplementation outside of Catherine Creek and Lookingglass Creek.

Alternative 3: Transfer production for the Catherine Creek spring Chinook program to new and/or other existing hatchery facilities AND rear only Lookingglass program spring Chinook and Imnaha spring Chinook at Lookingglass FH to meet mitigation goals for the Oregon portion of the LSRCP

See Alternative 5 for the Lookingglass spring Chinook program.

Alternative 4: Terminate the program and decommission the Catherine Creek satellite facility

Decommission the satellite facility and terminate the Catherine Creek spring Chinook program in favor of alternative mitigation strategies such as habitat restoration, passage improvements, or alternative hatchery production at another site.

Pros

- Frees up rearing space that can be used to increase production for the other spring Chinook programs located at Lookingglass FH.
- Reduces complexity of multiple rearing programs at Lookingglass FH.

Cons

- Significantly reduces conservation and possible harvest benefits for Catherine Creek.
- Eliminates the capability to supplement natural production of spring Chinook in Catherine Creek during multi-year periods of low natural returns.
- Terminates an extensive annual data collection describing the results of the supplementation and reintroduction program.

Recommended Alternatives

The Review Team recommends Alternative 1, continuation of the current program. There appears to be little value in increased production for harvest at this site given the limited opportunity for a local fishery. The Team sees some merit in consideration of rearing of local spring Chinook broodstocks including Catherine Creek at another site, per Alternative 3, to allow the Lookingglass hatchery facility to concentrate primarily on production rearing for the Lower Snake River Compensation Program.

Lostine-Wallowa River Spring/Summer Chinook

Operator: Oregon Department of Fish and Wildlife

Summary of Current Program

Goals

- ***Harvest goal:*** No numeric harvest goal exists at the present time. The program currently operates primarily as a conservation program. The program is intended to eventually contribute to recreational and tribal harvests and the overall LSRCP mitigation goal to return 5,860 hatchery-origin adult spring/summer Chinook—from the Grande Ronde River basin—upstream of Lower Granite Dam on the mainstem Snake River.

- ***Broodstock escapement goal:*** The desired goal is to annually capture 70 male and 70 female adult spring/summer Chinook in the Lostine River for broodstock to yield 250,000 smolts for release, with jacks composing up to 10% of the male spawning contribution. Natural-origin adults from the Lostine River are incorporated within the broodstock annually, and hatchery-origin adults are allowed to spawn naturally in the Lostine River each year. A sliding scale has been developed to help determine the proportion of the broodstock and natural spawners composed of hatchery and natural-origin fish annually (see Operational Considerations).

- ***Conservation goal:*** Short-term goal: Prevent extinction of endemic spring/summer Chinook in the Lostine River, maintain a naturally spawning population in the Lostine River, provide a future basis to reverse the decline in abundance of Grande Ronde River spring/summer Chinook salmon, and ensure a high probability of population persistence into the future. An intermediate goal of this program, in concert with other programs for indigenous populations (upper Grande Ronde River and Catherine Creek), is restoration of spring/summer Chinook salmon in the Grande Ronde Basin. The long-term conservation goal of this program is to contribute to recovery and de-listing of the Snake River Spring/Summer Chinook ESU, including continued mitigation for fish losses occurring as a result of the construction and operation of the four Lower Snake River Dams. The ICTRT classified the Lostine River population as "large" based on historical habitat potential. A Chinook population classified as "large" for ESA recovery has a mean minimum abundance threshold criteria of 1,000 natural-origin spawners with a sufficient intrinsic productivity to achieve a 5% or less risk of extinction (greater than 1.6 recruits per spawner at the threshold abundance level) over a 100-year timeframe. The long- term goal is to maintain a natural self-sustaining population of 1,716 spring/summer Chinook in the Lostine River. The Columbia River Treaty Tribe's long-term recovery goal for spring/summer Chinook in the Grande Ronde River is an annual return of 16,000 adults.

- ***Escapement goal for natural-origin adults:*** Comanagers have not yet quantified a natural spawning escapement goal for spring/summer Chinook upstream of the weir in the Lostine River under current conditions. The current strategy is to follow a sliding scale that increasingly restricts the proportion of hatchery-origin fish passed upstream of the weir as the predicted number of spring/summer Chinook returning to the Lostine River increases (see Operational Considerations). The mid-term goal identified by the NPT in the Northeast Oregon Hatchery (NEOH) Project, Spring Chinook Management Plan is to achieve an annual

escapement of 500 natural-origin adult recruits annually in the Lostine River. The current habitat capacity is estimated to be 1,300 natural-origin adult recruits back to the Lostine River (HSRG 2009).

- ***Research, education, and outreach goals:*** Evaluate the benefits and risks of the program toward meeting its harvest and conservation goals.

Objectives

- Collect 70 males and 70 females (assuming an average fecundity of 4,426 egg/female) at the Lostine River trap site to produce approximately 250,000 smolts (This program size accounts for pre-spawn mortality of adults and potential culling of eggs from female parents testing positive for moderate to high level of *Renibacterium*). Collect both unmarked natural-origin fish and marked hatchery-origin Lostine River spring Chinook for broodstock.

- Use broodstock collection guidelines (sliding scale) based on estimated escapement to the mouth of Lostine River to determine the number and proportion of hatchery-origin to natural-origin fish to collect, and the number and proportion of hatchery and natural-origin fish to retain for broodstock and pass upstream (Table 28).

- Outplant up to 250 hatchery-origin adults to Wallowa River, 100 hatchery-origin adults to Bear Creek, and 100 hatchery-origin adults to Prairie Creek.

- Transfer adults retained for broodstock to Lookingglass FH.

- Spawn adult spring Chinook at Lookingglass Hatchery. Incubate and rear the juveniles at Lookingglass FH.

- Transfer 250,000 yearling smolts to the Lostine River acclimation facility in two phases, the first phase in early March, and the second phase around April 1. Acclimate for two weeks and allow at least one week for fish to volitionally emigrate, and then perform a forced release into the river.

Table 28. Lostine River Spring/Summer Chinook broodstock/upstream passage management guidelines [70]

Lostine River Adult Management Table - 250 K Program - 140 Adults for Broodstock NOAA Fisheries 4/4/07 Draft

Estimated Natural Run to River Mouth as a Proportion of minimum TRT abundance threshold	Number of Natural Fish to River Mouth	Max % Natural for Broodstock	Number of Natural Fish Retained for Broodstock (Proportion of Natural Brood)	Max Proportion of Hatchery Fish Released Above Weir	Minimum % Natural in Broodstock	Proportion of Natural Influence Based on the Minimum % Natural Fish in Broodstock	Proportion of Natural Influence Based on Number of Natural Fish Retained for Broodstock
> .05 of Critical	> 8	0	0	NA	NA		
.05 - .5 of Critical	8 - 74	50%	04 - 37 (.02 - .22)	NA	NA		
.5 - Critical	75 -149	40%	30 - 60 (.18 - .36)	70%	20%	0.22	.2 - .33
Critical - .5 of Viable	150 -249	40%	60 - 100 (.36 - .6)	60%	25%	0.29	.36 - .5
.5 Viable - Viable	250 - 499	30%	75 - 150 (.44 - .89)	50%	30%	0.38	.47 - .6
Viable - 1.5 Viable	500 - 749	30%	150 - 225 (.89 - 1.0)	40%	40%	0.5	.69 - .71
1.5 - 2 Viable	750 - 999	25%	188 - 250 (1)	25%	50%	0.67	0.8
> 2 Times Viable	> 1000	25%	> 250 (1)	0%	100%	1	1

Calculated by
NOB / (NOB + HOS)

Lostine River Contributes about 50% of production for Wallowa/Lostine Population
Viable level is 50% of TRT minimum abundance threshold for Wallowa/Lostine population (1000)after broodstock collection and fishery

Program Description

Lostine River spring/summer Chinook is one of four Chinook stocks reared at Lookingglass Hatchery under the Lower Snake Compensation Plan mitigation program for northeast Oregon. LSRCP currently provides the facilities, equipment, and personnel for fish culture evaluations, and fish health monitoring of juveniles produced for release in the Lostine River. Bonneville Power Administration funds an adult collection weir and trap and juvenile acclimation facilities located on the Lostine River and operated by the Nez Perce Tribe as co-managers with ODFW.

From broodyears 1994-2006, a captive broodstock program was operated in tandem with the conventional program. The captive broodstock program utilized multiple facilities, including Bonneville, Oxbow (ODFW), Irrigon, Wallowa, Lookingglass, and Manchester for rearing of adults, spawning and production of smolts that are progeny of the captive-reared adults. All adults returning from the captive brood origin smolts are allowed to spawn naturally. A portion of returning hatchery

[70] *Provided by Scott Patterson, ODFW, June 2009.*

adults can be out-planted in areas determined by the Grande Ronde Spring Chinook Hatchery Management Plan.

The captive broodstock program was phased out after the 2006 brood year. The current operation is an integrated conventional broodstock program. Long-term expectation is for about 170 adults to be collected at random from the return with 500 adults allowed to spawn naturally in habitat upstream from the Lostine adult trap weir. A total of 1,585 Chinook salmon were removed from the Lostine River from 1997 to 2007 for broodstock, adult out-plants, harvest, and mortality. Production of Lostine River spring/summer Chinook salmon smolts currently occurs at Lookingglass FH.

The Lostine River supplementation program utilizes two strategies to obtain egg sources for production of smolts for supplementation: captive broodstock and conventional broodstock. The captive broodstock strategy involves 1) capture of natural juvenile spring/summer Chinook salmon smolts from the Lostine River, 2) rearing those to adult and spawning them, and 3) rearing the resultant progeny for eventual acclimation and release back into the Lostine River. The conventional broodstock strategy involves 1) capture of natural and hatchery origin adults returning to the Lostine River, 2) holding those adults and spawning them, and 3) rearing the resultant progeny for acclimation and release back into the Lostine River.

The Lostine River Chinook Hatchery program may release up to 250,000 juveniles annually, of which 150,000 may be from captive broodstock and the remainder from endemic returns. The captive brood program is phasing out, with a target production of 62,500 through broodyear 2009. Fish are generally released at approximately 20 fpp. Smolts are acclimated at ponds located in the Lostine River beginning in early March. The juveniles are allowed to volitionally emigrate from the ponds starting in late March, but are then forced out in mid-April.

Assessment of Current Program

Operational Considerations[71]

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- Lostine spring/summer Chinook (including hatchery fish) are listed as threatened under the endangered species act as part of the Snake River spring/summer Chinook ESU.

- The program utilizes an endemic Chinook stock that was founded from spring/summer Chinook indigenous to the Lostine River.

- The Lostine River supplementation program is considered integrated with the indigenous Lostine River stock. Managers have identified both conservation and harvest objectives for

[71] *See Appendix B of this document for supporting background information and references.*

this population. Their strategy for Lostine River spring/summer Chinook salmon is meant to maintain existing natural spawning populations as well as use hatchery-origin Chinook salmon to supplement natural reproduction.

- Broodstock for the program are collected at Lostine River trap and weir at river mile 1. This stock originated from natural fish collected at this site starting in 1997.

- Both unmarked natural-origin fish and marked hatchery-origin fish are collected for broodstock.

- All first generation, adult progeny from the discontinued captive broodstock program returning to the Lostine River are passed upstream to spawn naturally (see brief description of program in the research, education, and outreach section below).

- The number of adult fish retained for broodstock (approximately 70 pairs) varies among years depending on average fecundity of females.

- Up to 450 surplus hatchery-origin spring/summer Chinook collected at the Lostine River trap are outplanted in the Wallowa River (n = 250 fish), Bear Creek (n = 100), and Prairie Creek (n = 100 fish) to supplement natural spawning of spring/summer Chinook in those areas

- The weir is installed on the Lostine River on May 1st before high water flows prevent installation. Adult spring/summer Chinook are typically first detected at the weir June 1st. Fish are processed at the trap three to seven days per week. Approximately 75 adults can be held in the trap. The weir is operated through October 31st.

- There are 14 irrigation diversions on the Lostine River. In August, river flow can be reduced to 6 cfs. Normal water flows in the Lostine River are restored in September when the demand for irrigation water is reduced. Low flows inhibit access upstream to the trap and to spawning areas. Low water flows result in a temporal gap during the summer when fish are not available for broodstock collection. .

- Broodstock collection guidelines (sliding scale) are based on estimated escapement to the mouth of Lostine River. The sliding scale was developed cooperatively between ODFW, the NPT, and CTUIR.

- Some spring/summer Chinook spawn as late as October in the lower Lostine/Wallowa River downstream of the weir.

- To meet smolt release objectives, 292,000 green eggs are required based on a mean 83.8% survival from green egg to smolt and an estimated five-year average fecundity of 4,426 eggs per female.

- Epizootic ameloblastomas (skin tumors of the mouth) have been noted among adult spring Chinook collected for both the conventional and captive broodstocks from the Grande Ronde River, Lostine River, Imnaha River, and Catherine Creek.

Hatchery and Natural Spawning, Adult Returns

- The ESA recovery goal for the Grande Ronde River is 2,500 natural-origin spring/summer Chinook adults, of which the Lostine River spawning aggregate is one component. The Lostine River comprises approximately 20 percent of the adult spawner capacity in the Grande Ronde River, therefore 500 natural-origin adults (20%) was used as the adult return goal for the Lostine River.

- Based upon habitat capacity, the ICTRT indicated that the intermediate recovery goal for the Lostine/Wallowa Rivers is 1,000 adults; the Nez Perce Tribe indicated 500 adults in the NEOH plan; and the HSRG estimated a sustainable population with a mean return of 890 adults.

- Straying of out-of-basin spring/summer Chinook into the Lostine River is considered low. From 2001 through 2006, only 5 of 388 adult fish with CWT's recovered in the Lostine River originated from outside the Lostine River (4 fish from Lookingglass Creek, and 1 fish from Catherine Creek).

- From 2001 through 2006, a total of 57 adult fish with Lostine River CWT's were recovered outside the Lostine River within in the Grande Ronde River basin during spawning ground surveys (2 fish in Lookingglass Creek, 2 fish in the Wenaha River, 1 fish in Catherine Creek, 4 fish in the Imnaha River, 30 fish in the Wallowa River, 17 fish in Bear Creek, and 1 fish in Hurricane Creek). CWT recoveries from Chinook carcasses in the Wallowa River, Bear Creek, and Hurricane Creek are most likely the result of adult outplanting.

- Estimates of *pHOS* and *pNOB* for return years 2001 through 2007 averaged 0.53 (range = 0.30-0.75) and 0.51 (range = 0.27 - 0.71), respectively. The HSRG used a *pHOS* = 47% and *pNOB* = 51% during their assessment of the program.

- Smolt-to-adult survival for hatchery-origin spring/summer Chinook returning to the Lostine River has averaged 0.87% (range = 0.21%-1.94%) for the conventional program (BY's 1997, 2000-2002) and 0.67% (range = 0.19%-1.65%) for the captive program (BY's 1998-2002). Smolt-to-adult survival has averaged 3.27% (range 1.01%-6.05%) for natural-origin fish (BY's 1997-2001).

- Three complete surveys of the spawning grounds occur upstream and downstream of the adult weir from the third week of August through October. One index unit (3 miles) and 7 extensive units (21 miles) are surveyed annually. The lower extensive survey unit begins at the mouth of the Lostine River and extends 2.7 miles upstream (the adult weir is located at about river mile 1 and all other survey units are located upstream of the adult weir). Intensive counts occur in index areas for long-term comparisons. Survey frequency ranges from daily to weekly depending on water temperatures and fish activity.

- Spring/summer Chinook passed upstream of the weir are opercle punched so that they can be recovered on the spawning grounds and used to determine trap efficiency, population abundance, and wild/hatchery fish ratios above the weir. Population abundance and wild/hatchery data are expanded for the entire river.

- The estimated total spring/summer Chinook escapement to the Lostine River has averaged 837 fish (range = 593-1,339) from 2001-2007 (average of 509 hatchery-origin and 328 natural-

origin fish, respectively). The estimated spring/summer Chinook escapement upstream of the weir has averaged 485 fish (range = 335-664) from 2001-2007 (average of 256 hatchery-origin and 229 natural-origin fish, respectively). The estimated spring/summer Chinook escapement downstream of the weir averaged 106 fish (range = 5-345) from 1997-2007. The estimated trap efficiency rate) has averaged 53.53% (range 10.0%-100%) from 1997-2007 based on ratio of opercle-punched to non-punched carcasses. Trap efficiencies improved during 2001-2007 and averaged 76.5% (range = 56.3%-100%). The weir and adult trap is less efficient during high flows.

- "Jacks" (3-year old males) typically comprise 15-20% of all returning hatchery-origin fish and 5-10% of all returning natural-origin fish for a particular broodyear.

- The proportion of returning adults composed of jacks has increased significantly in the last couple of years. This trend is not unique to the Lostine River population.

- ICTRT identified three major spawning areas and one minor spawning area for spring/summer Chinook in the Wallowa and Lostine rivers. Currently, spawning occurs in the Lostine River from the mouth to the headwaters, in the Wallowa River upstream of the confluence with Lostine River, in Hurricane Creek, Bear Creek, and in some years, Parsnip Creek.

- Adult Chinook collected for broodstock are transported at least once every three days (daily during peak season) from the adult trap to Lookingglass Hatchery in a 250-gallon transport tank.

- Lostine River spring/summer Chinook are held in circular tanks in the "endemic building" at Lookingglass FH prior to spawning.

- The intent is to spawn the Lostine spring/summer Chinook according to a replicated, 2x2 factorial design (2 females x 2 males in all four pairwise combinations). Occasionally the fish are spawned 1:2 for 2:1, depending upon the number of ripe fish available. At least one natural-origin adult is included in the spawning matrix.

- Current spawning protocols allow up to a maximum of 10% of the eggs to be fertilized by jacks (3-year old males), although a specific protocol or requirement for including jacks has not been established. The milt from up to six jacks may be pooled to fertilize one-half to one-third of the eggs from each female in a 1 x 2, 2 x 2 or 2 x 3 (females x males) spawning matrix, where one of the males in the matrix actually represents the pooled milt from up to six jacks. However, the actual number of jacks spawned and/or the proportion of eggs fertilized by jacks is unknown or not reported (2009 AOP[72], see Table below). Natural-origin males have often been used multiple times to fertilize eggs to increase the overall proportion of eggs fertilized by natural-origin males. In general, jacks are included at every tenth spawning matrix.

[72] *ODFW, CTUIR, Nez Perce Tribe. February 3, 2009. LSRCP Grande Ronde and Imnaha Basins Annual Operation Plan for 2009. Final Version.*

Lostine River spring/summer Chinook salmon spawning data, 1997-2008

Brood Year	Marked Females Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take	Fry Ponded	Smolt releases
1997	0	4	100%	0.92:1	4,496	17,000	12,000	11,871
1998	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0
2000	0	8	100%	0.66:1	4,329	34,630	32,000	31,490
2001	11	25	69%	1.06:1	4,463	*160,680	105,000	101,012
2002	1	27	96%	1.03:1	4,766	133,444	130,000	116,370
2003	0	21	100%	1.31:1	5,078	106,646	103,000	102,557
2004	29	22	43%	1.30:1	4,351	221,888	206,421	199,716
2005	39	17	30%	1.37:1	4,182	234,192	207,291	205,000
2006	45	12	21%	1.26:1	4,393	241,715	206,313	194,861
2007	41	20	32.8%	1.13:1	4,290	261,719	227,838	**187,000
2008	37	19	33.9%	0.95:1	4,783	267,834	247,274	
	203	**175**	**46.3%**		**4,426**	**1,679,748**	**1,477,137**	**962,877**

*Inventory correction due to large losses with egg shipment;
**Does not include 41,997 parr released in the Lostine River Km 21 June 25, 2008
In 2004, eggs have been electronically counted
Numbers in blue current inventory
2001-06 brood, estimate survival from green egg to smolt at 83.8%

- Every adult female Chinook is screened for BKD risk. If the ELISA titer is above 0.2 optical density (OD), then the eggs from those females are destroyed. Fertilized eggs from each are incubated separately until the disease risk profiles and screening are complete. If needed, retained eggs are pooled after eye-up to consolidate incubator space. From 2004 through 2008, 98-100% of the females spawned at Lookingglass Hatchery had BKD levels below 0.231 OD.

- Adults collected for broodstock receive an erythromycin injection (20mg/kg) and an oxytetracycline injection (10 mg/kg) at the time of capture to control BKD and Furunculosis, respectively. A second treatment of erythromycin is applied during the first week of August, if necessary. The second treatment only occurs if BKD is found among fish that die in captivity prior to spawning.

- Outplanted adults do not receive erythromycin or oxytetracycline injections.

- Adult Chinook retained for broodstock receive a formalin treatment three times per week. Depending upon the number and health of the adults, treatments can run into September.

- Eggs are spawned into colanders to remove ovarian fluid, fertilized, and then water-hardened in 100ppm iodophor for a minimum of 15 minutes.

- In the Grande Ronde Basin, the annual LSRCP mitigation goal for all stocks combined was set at 5,860 hatchery adults. ODFW estimated in 2006 that 414 Lostine River, 225 Catherine Creek, 159 Grande Ronde River, and 120 Lookingglass Creek adults returned to the basin. The combined return to the compensation area was 924 hatchery-origin adults, 15.8% of the mitigation goal. The primary factors causing low returns of hatchery-origin adults in the basin were insufficient numbers of conventional broodstock and smolts released in a sub-basin with

characteristically low smolt-to-adult return rates, and the use of captive broodstock that has experienced (a) low survival to maturity due to bacterial kidney disease and (b) low fecundity due to slow growth rates

- A spring/summer Chinook sport fishery opened on the Wallowa River for ten days (July 4 – July 13) in 2008. The area open to anglers extended from the Minam State Park (RM 8) up to the mouth of the Lostine River (RM 25) on the Wallowa River. Bag limit included one adipose fin-clipped Chinook adult per day and five fin clipped jacks. Wallowa River anglers contended with marginal angling conditions throughout the season.

- The Lostine spring/summer Chinook program provides limited contribution to total tribal, commercial and recreational spring Chinook fisheries downstream of the project area, including the lower Columbia River. Estimates of harvest outside the project area of Lostine River spring/summer Chinook include; 110 fish in 2006 (4-Ocean, , 32- Columbia River treaty net, 19- Columbia River non-treaty net, and 55- Columbia River sport), 32 fish in 2005 (18-Ocean, 2-Columbia River treaty net, 2-Columbia River non-treaty net, and 10-Columbia River sport), 97 fish in 2004 (7-Ocean, 43-Columbia River treaty net, and 47-Columbia River sport), 64 fish in 2003 (13-Columbia River ceremonial/subsistence, 12-Columbia River treaty net, 4-Columbia River non-treaty net, 34-Columbia River sport and 1- Deschutes River sport), and 18 fish in 2002 (18-Columbia River sport).

Incubation and Rearing

- Eggs receive a formalin treatment (1,667 ppm) three times per week, beginning 48 hours post spawn until eggs are shocked and dead eggs removed. If formalin can't be used, hydrogen peroxide (100 ppm, three treatments per week) is used.

- Chilled well water is used on the early egg takes to reduce the water temperature to around 50 degrees. UV treated surface water is used for incubation after August, when surface temperatures can reach 70 degrees F.

- Flows are regulated at 4 to 6 gpm per vertical stack.

- Eggs are reloaded into the incubation trays after eye-up at 1 female per tray or approximately 4,000 eggs per tray.

- After hatch, the fry are reared in 5 of 28 indoor tanks (Canadian troughs), at approximately 60,000 fish per trough. The captive stock is reared in 2 additional troughs. The troughs are 117 cubic feet, with a flow rate of up to 50 gpm.

- During January through March, water temperatures in Lookingglass Creek drop to 32 to 35 degrees F. At that time, well water is blended with treated surface water to increase the water temperature to approximately 40 degrees F.

- Every attempt is made not to exceed a density index of D.I. = 0.75 in the indoor tanks. However, at times, D.I. does exceed 0.85 due to the limited early rearing space.

- The flow index can reach approximately F.I. = 2.4 when the fish are 250 fpp. However, the water temperature at this time is between 35 and 40 degrees F.

- Once the fish reach 250 fpp, they are transferred to the outdoor raceways to be reared on creek water (late April to early May). Juvenile fish are retained indoors until high spring flows and subsequent turbidity decreases.

- Typically, Lostine River fish for the conventional program are reared in three outside raceways, and fish for the captive program are reared in one raceway.

- The causative agent of whirling disease, *Myxobolus cerebralis*, was recently confirmed as present in wild rainbow trout and steelhead juveniles that reside upstream of the hatchery in Lookingglass Creek. Hatchery-origin juveniles are sampled for this parasite every year, prior to release, and through 2009, the parasite not been detected among those fish prior to release.

- Fish are held indoors until 250 fpp because (a) the fish are too small in relation to the screen mesh size to put them out earlier, (b) water quality in the raceways is reduced during spring runoff, and (c) the previous brood year needs to be released and the raceways cleaned before subyearling fish can be transferred to the outdoor raceways.

- Fish in the outdoor raceways are fed using automated feeders. During cold weather (Jan-March), the fish are fed by hand because the automated feeders are inoperable.

- The raceways are cleaned by hand once per week. The effluent water during cleaning is directed into a settling basin.

- The maximum flows in the raceways are approximately 800 gpm per raceway.

- The targeted density index is not to exceed D.I. = 0.17 in the outdoor raceways. The flow index is F.I. = 1.5 in the outdoor raceways.

- Fish are typically held in two raceways until they are marked and tagged (90 fpp-180 fpp), at which time they are apportioned among four raceways. The fish are adipose fin clipped and coded-wire tagged in June-July.

- A formalin treatment is applied (167 ppm for 1 hour) for two consecutive days after marking. The fish are monitored to determine if additional treatment is needed. Formalin treatment is applied to control fungus.

- The fish receive one 28-day erythromycin treatment (2.25% aquamycin) to control BKD, typically in July shortly after marking.

- Bacterial kidney disease is not a problem among the conventional spring/summer Chinook juveniles; although it has caused some mortality in the juveniles from the captive broodstock programs.

- Lostine River spring/summer Chinook are PIT tagged in October.

- Monthly health monitoring examinations are conducted on each spring/summer Chinook stock. The sample includes a minimum of 10 moribund/dead fish (if available) and 4-6 live fish per raceway. Results are reported on the ODFW Fish Health Examination report.

- In June 2009, white open wounds anterior to the dorsal fin were observed among juvenile spring/summer Chinook in most of the raceways. Occasionally, the coldwater disease bacterium is also detected in the juvenile Chinook at Lookingglass Hatchery.

- Green egg to smolt survival averaged (BY2001-2006) 83.8% with the following component survivals: green to eyed-egg = 90%; eyed-egg to swim-up fry = 95%; swim-up fry to fingerling (at marking) = 93%; fingerling to smolt (marking to release) = 99%.

- Compared to the Conventional spring/summer Chinook Broodstock Programs, survival rates for the Captive spring/summer Chinook Broodstock Programs were consistently lower, mostly due to large numbers of eyed eggs being culled because of high enzyme-linked immunosorbent assay (ELISA) levels in female broodstock, in an effort to reduce the incidence of bacterial kidney disease (BKD) in their offspring. Co-managers decided to cull eyed eggs produced from females with ELISA levels > 0.8 for Catherine Creek and Grande Ronde River stocks and > 0.2 for Lostine River females. If culled eggs were not included in the survival calculations, green egg-to-smolt survival rates were 61.1% for Lostine River stock, 69.9% for the Upper Grande Ronde stock, and 62.0% for Catherine Creek stock, still lower than their Conventional Broodstock counterparts (82-84%).

Release and Outmigration

- Management protocol is to release surplus juvenile fish as parr. Surplus parr have been released in June when more fish were on station than needed to meet program release goals. These surpluses have resulted from the production of more fish than needed to backfill a fluctuating captive broodstock program. The captive broodstock program has been discontinued, so the practice of releasing surplus parr should happen infrequently in the future.

- Lookingglass FH adheres to the ODFW Fish Health Management Policy for fish releases and transfers. Fish having health issues are not commingled with the other fish at the acclimation site. If a pathogen of concern, such as IHNV, is detected in the smolts at the hatchery, fish in the affected raceway(s) will be transferred and released separately from raceways with non-infected fish, with the option of later release from the acclimation site and/or direct stream release downriver from the acclimation site.

- If epizootic instances of disease occur (greater than 0.1% mortality per day for three days), the fish are held at Lookingglass FH, and they are not transferred to the acclimation facility for release until the disease is below epizootic levels. If treatment is not effective or if the fish are held too far beyond their release date, they may be destroyed. These protocols are more restrictive than IHOT. An epizootic outbreak of IHN virus has not occurred at Lookingglass FH for 15 years.

- The Lostine stock has a target size of 25 fpp by October 31 and 20 fpp at release (Grande Ronde Basin Chinook AOP). The expected size at transfer is 22 fpp.

- The NPT operates an acclimation facility on the Lostine River at river mile 12.0. Acclimation occurs in four raceways approximately 8'x 85'x 3.25' (2,210 ft^3) in size. The capacity of the acclimation facility is approximately 150,000 fish at 20 fpp. The maximum density index is D.I. ≈ 0.14 at 20 fpp. The flow index is F.I. = 0.95.

- Due to the limited fish-holding capacity of the Lostine River acclimation facility, Chinook smolts are acclimated and released in two groups or phases. The first group is transferred to the Lostine River acclimation facility in early March and the second group in late March.

- The Lostine River is the main water sources for the acclimation facility. Water use is ≈5 cfs from February to April. Water temperatures fluctuate daily and seasonally with mean daily temperatures ranging between 33^{o} and 61^{o}F.

- The current strategy is to acclimate smolts for 2 weeks, followed by a one to two week volitional release. At the end of the volitional release period, fish remaining in the pond are forced out. Smolt acclimation and release occurs from early March to mid-April. In 2009, 124,500 fish were released for the early group, and 123,900 fish were released for the late group.

- The fish are fed a maintenance diet during acclimation and at a decreasing level throughout the course of the volitional release.

Facilities and Operations

- *See Lookingglass Creek Spring Chinook, Facilities and Operations section for Lookingglass FH operational considerations.*

- The Lostine River trap and acclimation ponds are temporary facilities. The facilities have structural and safety deficiencies (e.g. leaking ponds, intake and outfall icing, bank instability adjacent to the acclimation site, trap catwalks without appropriate safety rail protection). The trap is not efficient under all flow conditions. There is no predator deterrence at the acclimation facility. Bird, mink and otter predation is an issue, especially during cold weather. The facilities are funded by the Bonneville Power Administration and managed by the Nez Perce Tribe.

- Effluent from the circular tanks in the endemic building (where the Lostine River spring/summer Chinook adults are held prior to spawning) is directed to the pollution abatement pond.

Research, Education, and Outreach

- Evaluation of the captive broodstock program has increased knowledge regarding this artificial propagation tool. The smolt-to-adult return rates for the captive broodstock program were comparable to the conventional program. Instances of BKD were more common for the captive broodstock program (those fish reared to adults on station) compared to the conventional program.

- For broodyear 2010, Lostine River spring/summer Chinook will be 100% adipose-fin clipped and a representative group will be coded-wire tagged (likely 50%). Approximately 4,800 will be PIT tagged, dependent upon available funding. Tags are apportioned equally across raceways.

- Coded wire tags are used to assess contribution to fisheries and estimate smolt-to-adult survival.

- PIT tag data provides information regarding downstream migration timing and comparative performance of wild, captive brood, and conventional juveniles.

- ODFW operates a smolt trap in the Lostine River near the town of Lostine at river mile 1.9. The majority of natural spawning occurs upstream of this site. The trap is used to collect natural-origin smolts so that they can be PIT tagged and used to determine smolt outmigrant timing to Lower Granite Dam. The trap provides abundance information and provides a basis for SARs for wild adults.

- During migration years 1997 through 2007 (did not include migration year 2004 due to limited trapping operations which prevented complete population estimates and migration timing), ODFW estimated that an average of 28,429 (range = 4,496-54,602) juvenile spring/summer Chinook salmon migrated out of upper rearing areas in the Lostine River with an average of 31% (range 15%-52%) leaving as early migrants and 69% (range 48%-95%) leaving as late migrants.

- Lostine River juvenile spring/summer Chinook salmon survival probability by location and tag group from time of tagging to Lower Granite Dam for Chinook salmon tagged from fall 2006 to spring 2007 and detected at the dams during 2007 was 0.223 for Chinook tagged in the fall at the trap, 0.135 for Chinook tagged in the winter above the trap, and 0.589 for Chinook tagged in the spring at the trap.

- The Nez Perce Tribe's, Lostine River Monitoring and Evaluation program was initiated in 1997 to assess supplementation of Lostine River spring/summer Chinook salmon. The program's scope of work included monitoring and evaluation of Chinook salmon produced by the conventional hatchery program for the Lostine River (BPA Project 199800702) and conducting the monitoring and evaluation of juvenile acclimation and adult returns for the Grande Ronde Basin Spring Chinook Captive Broodstock Program (BPA Project 199801001 and 199801006).

- Nez Perce Tribe staff involved in the Lostine River spring/summer Chinook program participate in an annual BPA sponsored meeting to discuss and share data about BPA funded Nez Perce Tribal hatchery programs.

- *See the Lookingglass Creek Spring Chinook program for more information.*

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,[73] the Review Team identified the following benefits of this hatchery program:

[73] *See Section II, "Components of This Report", for a description of these potential benefits and risks.*

Harvest Benefits

- The Lostine spring/summer Chinook program provides limited recreational and tribal harvest in the Grande Ronde basin. Between 1978 and 2008, fisheries in the Grande Ronde River Basin targeted only surplus Rapid River stock hatchery fish in Lookingglass Creek.

- A spring/summer Chinook sport fishery opened on the Wallowa River for ten days (July 4 – July 13) in 2008. ODFW surveyed 60 anglers who fished 120 hours on the Wallowa River. No anglers reported catching any marked or unmarked Chinook. However, incidental reports suggest several adult Chinook were caught and retained by anglers fishing the large pool at Minam State Park.

- Estimates of harvest (2002-2006) of Lostine River spring/summer Chinook within the project area (outside the Grande Ronde River Basin in the mainstem Snake River above Lower Granite Dam) include; 6 fish in 2006 (Snake River sport), 2 fish in 2003 (Snake River sport, and 4 fish in 2002 (Snake River sport).

Conservation Benefits

- The Lostine River spring/summer Chinook program is expected to preserve/conserve the Lostine River population in the short term, and to assist in restoration of the population to historic levels.

- Reduces demographic risks to the Lostine River spring/summer Chinook population and maintains a naturally spawning population in the Lostine River.

- The long-term goal of this program is recovery, de-listing, and to provide fish for harvest to mitigate for effects of the four lower Snake River dams on natural populations.

Research, Education, Outreach and Cultural Benefits

- Tribal harvest and surplus adults trapped at facilities provide ceremonial, cultural and subsistence benefits to Columbia River tribes.

- The program provides opportunities for evaluation of captive broodstock vs. conventional program.

- The Catherine Creek, Lookingglass, Lostine, and Upper Grande Ronde River spring/summer Chinook are part of a Snake River basin-wide assessment of supplementation that has generated a long-term data set.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,[74] the Review Team identified the following benefits of this program:

[74] *Ibid.*

Harvest Benefits

- The Lostine spring/summer Chinook program provides limited contribution to total tribal, commercial and recreational spring Chinook fisheries downstream of the project area, including the lower Columbia River.

Conservation Benefits

- Spring Chinook adults outplanted in the Wallowa River, Bear Creek, and Prairie Creek and naturally spawning Chinook in the Lostine River are intended to increase the abundance of natural-origin smolts and enhance ecological processes (e.g., via carcass decomposition).

- There is a potential, but undocumented, demographic and/or ecological benefit to the naturally spawning populations in the Wallowa River, Bear Creek, and Prairie Creek where adults are outplanted.

Research, Education, Outreach and Cultural Benefits

- Tribal harvest provides ceremonial, cultural and subsistence benefits to Columbia River tribes.

- The program provides opportunities for evaluation of captive broodstock vs. conventional program.

- The program provides research and information on supplementation issues.

- The Catherine Creek, Lookingglass, Lostine, and Upper Grande Ronde River spring/summer Chinook are part of a Snake River basin-wide assessment of supplementation that has generated a long-term data set.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,[75] the Review Team identified the following risks of the hatchery program:

Genetic Risks

- The comparatively low recruit to spawner ratio for naturally spawning fish coupled with the high proportion of hatchery-origin spring/summer Chinook spawning in the Lostine River inhibits development of a properly integrated hatchery program, thus posing a genetic domestication risk to the Lostine River spring/summer Chinook population.

- The present sliding scale for the number of natural origin and hatchery origin adults passed upstream of the weir in the Lostine River results in the upstream passage of hatchery-origin adults under conditions when the number of natural-origin adults alone meets the escapement objective, further increasing genetic domestication risks and the genetic influence of the hatchery environment on the naturally spawning population.

[75] *Ibid.*

- Inefficiency of the temporary adult weir and trap during higher water flows can result in uncontrolled numbers of spring/summer Chinook passing upstream, thereby increasing the genetic domestication risk of the hatchery environment on the naturally spawning population.

Demographic Risks

- *See the Lookingglass Spring Chinook program for demographic risks associated with rearing at Lookingglass FH.*

- Structural deficiencies in the temporary raceways and acclimation facilities could result in catastrophic loss of juvenile fish during acclimation.

- Transportation of juveniles and adults long distances for long periods may pose a stress condition on the fish leading to higher incidence of disease, or egg loss in the case of adult females.

- Extreme cold water conditions at the acclimation site may result in diminished or complete water flow loss resulting in catastrophic fish loss.

- The transfer of fish from hatchery raceways to extreme cold water conditions at the acclimation site may pose a physiological (stress) risk to the fish.

Ecological Risks

- *See the Lookingglass Creek Spring Chinook program for ecological risks associated with rearing at Lookingglass FH.*

- Hatchery propagation increases disease risks to the Lostine River spring/summer Chinook population.

- Lack of predator deterrence at the acclimation ponds may result in significant fish loss.

- Anadromous fish in the Lostine River above the acclimation facility intake pose a minor fish health risk to the Chinook held at the Lostine River acclimation facility.

- Large numbers of hatchery fish spawning naturally are expected to reduce the productivity or mean recruit per spawner of natural-origin adults.

Physical Risks

- *See the Lookingglass Creek Spring Chinook program for physical risks associated with rearing at Lookingglass FH.*

- The temporary adult trap poses some safety risks to personnel.

Research, Education, Outreach and Cultural Risks

- Since the weir is inefficient during high flows, the inability to sample adults during the full distribution of the run in some years prevents accurate estimation of abundance, return timing and composition (hatchery versus natural) of adult spring/summer Chinook.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,[76] the Review Team identified the following risks from the hatchery program:

Genetic Risks

- Outplanting surplus Lostine River spring/summer Chinook into the Wallowa River, Bear Creek, and Prairie Creek poses a genetic risk to any naturally-produced spring/summer Chinook in these areas.

Demographic Risks

See the Lookingglass Creek Spring Chinook program for demographic risks associated with rearing at Lookingglass FH.

Ecological Risks

- Outplanting surplus Lostine River spring/summer Chinook into the Wallowa River, Bear Creek, and Prairie Creek poses fish health risks and an ecological risk to the survival and growth of any naturally-produced spring/summer Chinook in these areas.

- Potential amplification of disease within the hatchery poses a disease risk to other native fish populations in the Lostine River when smolts are transferred and released from the Lostine River acclimation facility.

Research, Education, Outreach and Cultural Risks

- None identified.

[76] *Ibid.*

Recommendations for Current Program[77]

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

Program goals and objectives

Issue LR-SC1: Many LSRCP hatchery programs appear to be attempting to meet harvest, mitigation and conservation goals simultaneously without those goals being clearly stated or prioritized in terms of numeric outcomes that quantify intended benefits. *Short-term and long-term goals for many LSRCP programs have not been clearly stated or quantified – up front - independent of the methods for achieving them (e.g., "The goal of this program is to use supplementation to …"). The confounding of goals and methods impedes assessments of program benefits, particularly if desired benefits are not quantified as short-term and long-term goals. Prioritization of mitigation versus conservation goals appears to shift annually based upon the number of returning adults without a strong association to long-term goals for the programs (e.g., as described in Annual Operating Plans). Prioritization of short and long-term goals often differs among comanaging parties.*

Recommendation LR-SC1: Comanagers should restate and prioritize program goals for all LSRCP programs in terms of both short-term and long-term numeric outcomes for the following parameters: (a) natural population abundance and viability (conservation goals); (b) the number of hatchery-origin fish returning to specified target areas (mitigation goal), and (c) the proportions and desired numbers of fish from the two preceding groups allocated for broodstock, natural-spawning escapement, and harvest. Both short-term and long-term goals need to be clearly articulated up front (e.g., natural spawning escapement numbers) independent of the chosen methods for achieving them (e.g., supplementation spawning by hatchery-origin fish). Short-term goals need to be realistic and attainable biologically under current conditions. Long-terms goals should also be realistic biologically but can consider the removal of factors that prevent their achievement in the short-term (e.g., repair of riparian habitats, engineering improvements to fish passage structures, etc.). Quantitative benchmarks should also be established for measuring success or failure of the program towards meeting identified goals, thus allowing for mid-course corrections in programs or adjustments in the goals themselves. Prioritization of program goals, both short-term and long-term, must be made consistent among comanagers.

Issue LR-SC2: The sliding scales for spring/summer Chinook programs still allow hatchery-origin spring/summer Chinook to be passed upstream once a natural population is at a return size that is considered (or at least stated in the sliding scale as) viable. *Continuing to pass hatchery-origin fish upstream onto the natural spawning grounds when the number of natural-*

[77] *The Review Team believes that the ODFW and the USFWS LSRCP office will be the logical parties to coordinate and implement most of the following recommendations.*

origin adult recruits exceeds escapement goals for a viable natural population most likely poses a greater reproductive fitness risk to the natural population than the demographic abundance benefit resulting from natural spawning by hatchery fish. Comanagers have not yet quantified a natural spawning escapement goal for spring/summer Chinook upstream of the weir on the Lostine River under current conditions. However, the current sliding scale indicates a "viable" population as 500 natural-origin spawners per year. At this point on the sliding scale (n = 500-749 natural-origin adult recruits), up to 40% of the spring/summer Chinook passed upstream of the weir can be hatchery origin. Only when the predicted number of natural-origin adult recruits is twice (2x) the estimated viability level for the population are no hatchery-origin adults passed upstream.

Recommendation LR-SC2: Re-evaluate the current sliding scale so that hatchery-origin fish are passed upstream of the weir only when the predicted or expected number of natural-origin fish spawning upstream of the weir is less than the population viability threshold for the population. In general, sliding scales should include contingencies for not deliberately passing any hatchery-origin fish upstream when the predicted number of natural-origin recruits exceeds natural escapement goals. This approach reduces the hatchery influence (from *pHOS*) and increases the influence of the natural environment (*PNI*) on the mean phenotypic values of traits related to natural spawning success and early life history viability.

Issue LR-SC3: The goals for outplanting hatchery-origin Lostine Spring/summer Chinook into the Wallowa River watershed are not stated in terms of numeric outcomes that quantify intended benefits or goals. *Up to 450 hatchery-origin Lostine spring/summer Chinook adults are outplanted into the Wallowa River, Bear Creek and Prairie Creek. The measurable benefits desired from these actions have not been clearly identified.*

Recommendation LR-SC3: Discontinue the outplanting of adults into Wallowa River, Bear Creek, and Prairie Creek unless the activity can be justified based upon specific goals for the program. Goals should be developed in terms of measurable benefits (e.g. harvest, restoration, ecological enhancement) and the likelihood of achieving those goals weighed against the risks of outplanting.

Also see LC-SC3 under Program Goals and Objectives recommendations for Lookingglass Creek spring Chinook.

Broodstock Choice and Collection

Issue LR-SC4: The Lostine River weir and trap are not consistently efficient. The estimated trap rate ranges from 50%-80%. High flows periodically compromise the trap. Inconsistent control of upstream passage will prevent consistent achievement of conservation goals for the program.

Recommendation LR-SC4: Construct a new weir and adult trap that can be operated efficiently throughout the entire spring/summer Chinook run to meet the goals and objectives of the program. A weir design has been proposed as part of the proposed Northeast Oregon Hatchery (NEOH) process.

Hatchery and Natural Spawning, Adult Returns

Issue LR-SC5: The relative genetic contribution of jacks (3-year old males) to each brood year is difficult to ascertain under current spawning protocols. *Spawning protocols at Lookingglass Hatchery are designed to maximize the genetic contributions of parents and the genotypic diversity among offspring. These goals are accomplished via the matrix spawning of males and females in 2x2, 1x2, and 2x3 (females x males) combinations. Jacks (3-year old males) are specifically included in the spawning matrices but with the requirement that they fertilize no more than 10% of the eggs for each brood year. When jacks significantly outnumber 4-year old males, the milt from up to six jacks may be pooled to fertilize one-third to one-half of the eggs of each female in the matrix (the milt from 2-6 jacks is treated like the milt from one 4-year old male in these situations). In general, these spawning protocols are commendable because they maximize the total number of males used in the broodstock; however, the actual proportion and total number of eggs fertilized by jacks are not reported, although the Grande Ronde River Spring Chinook Management Plan specifies the inclusion of jacks in the broodstock at a rate of 1 jack for every 5 "adult"(age > 3 years) males*.

Recommendation LR-SC5: Report the proportion (and/or number) of eggs fertilized by jacks for each brood year in annual reports.

Also see LC-SC6 under Hatchery and Natural Spawning, Adult Returns recommendations for Lookingglass Creek spring Chinook.

Incubation and Rearing

See the Lookingglass Creek Spring Chinook section for recommendations regarding incubation and rearing.

Release and Outmigration

Issue LR-SC6: Spring/summer Chinook destined for the early release are transferred and held at the Lostine River acclimation site during cold weather. Icing of the water intake requires constant maintenance during periods of extreme cold conditions and can lead to catastrophic loss at the acclimation facility. Additionally, releasing fish in two phases may be inconsistent with optimum outmigration times relative to water flows and/or water release strategies from mainstem dams on the Snake and Columbia rivers.

Recommendation LR-SC6: Weigh the benefits of the current acclimation and release strategy versus the risk of catastrophic loss, or the risk of releasing fish too early or too late. Evaluate acclimation and release alternatives such as: reducing the acclimation and/or release period, allow the fish to volitionally outmigrate at any point during acclimation, direct stream releasing all or a portion of the fish, increasing acclimation capacity, or reducing the program size. Consider acclimating and releasing only one group during optimum weather and stream conditions and direct stream releasing the other group during the same time the acclimated group is being released. The two groups should be differentially marked with coded wire tags and should include representative PIT tags for evaluation of survival, homing, and straying. Alternative release strategies should be evaluated comparatively (differential tagging) to determine which results in the best survival/contribution to broodstock and escapement.

Issue LR-SC7. The current management protocol is to release surplus juvenile fish as parr. *Surplus parr have been released in June when more fish were reared than needed to meet program release goals. In general, parr have very low survival rates and may provide no benefits while, at the same time, posing ecological risks to natural-origin parr***.**

Recommendation LR-SC7: Terminate parr outplanting unless the activity can be justified based upon specific goals for the program.

Facilities/Operations

Refer to Recommendations for Current Program>Facilities/Operations under Lookingglass Creek spring Chinook for recommendations regarding the Lookingglass FH.

Issue LR-SC8: The existing facilities cannot accommodate program needs. *The weir is not efficient at controlling upstream passage of adult spring/summer Chinook and collecting broodstock throughout the run. In addition, the acclimation facility is not large enough to acclimate 250,000 smolts, thus resulting in two acclimation/release phases/periods in the spring. The Lostine River trap and acclimation facilities also have several deficiencies, posing safety risks to personnel and demographic risks of catastrophic fish losses. The NEOH proposal describes new hatchery facilities on the Lostine River and would also modify facilities at Lookingglass FH.*

Recommendation LR-SC8: Approve, fund, and implement the NEOH proposal.

Research, Monitoring, and Accountability

Also see LC-SC29 in the Lookingglass Creek spring Chinook section.

Issue LR-SC9: The results or benefits of outplanting adult spring/summer Chinook in Wallowa River, Bear Creek and Prairie Creek (LR-SC4) are largely unknown because of inadequate monitoring or evaluation.

Recommendation LR-SC9: Develop a monitoring and evaluation program to determine whether the benefits of outplanting adult fish into the Wallowa River, Bear Creek and Prairie Creek are being obtained.

Issue LR-SC10: The Grande Ronde River basin (including Lostine River) has a long baseline data set including; early life history data initiated prior to the hatchery programs, pre and post-hatchery data (including Lostine River captive and conventional production), data on control streams with no direct hatchery influence (Minam and Wenaha), a Snake River basin wide assessment of supplementation programs, and initial data on the supplementation program using Lostine River stock in the Lostine River.

Recommendation LR-SC10a: Continue current monitoring and evaluation programs to continue long term data sets and assess supplementation of Lostine River stock in the Lostine River.

Recommendation LR-SC10b: If not completed, perform a reproductive success study (pedigree analysis) in the Lostine River using Lostine River stock.

Issue LR-SC11: The proportion of hatchery-origin adults composed of jacks exceeds significantly the proportion of natural-origin adults composed of jacks.

Recommendation LR-SC11: Continue monitoring and evaluation studies such as hatchery growth rates, size and time at release to evaluate affects upon survival and age composition. Use this information to adjust the program according to program objectives.

Education and Outreach

See the Lookingglass Creek Spring Chinook section for recommendations regarding Lookingglass FH.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing Lostine River Spring/summer Chinook Program and developed seven alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the "no hatchery" option. Following these descriptions of alternatives, the Review Team has identified recommended alternatives.

Alternative 1: Current program with recommendations

Continue the current program using conventional artificial propagation techniques but adjust the sliding scales for adult escapement and broodstock collection to reduce the number of hatchery-origin adults spawning naturally as abundance of natural-origin adults increases.

Pros

- Increases the abundance and distribution of spring/summer Chinook in the Lostine River.
- Provides a genetic repository for the listed Lostine River spring/summer Chinook population.

Cons

- Current program provides little support towards achieving the LSRCP mitigation goal of 5,860 hatchery-origin adult Chinook returned to the Grande Ronde River basin.
- Hatchery-origin adults outplanted into the Wallowa River, Bear Creek and Prairie Creek pose genetic, fish health and ecological risks to natural-origin fish in these areas.
- Requires careful broodstock and upstream passage management of hatchery and natural-origin spring/summer Chinook in the Lostine River.

Alternative 2: Implement components of the Northeast Oregon Hatchery (NEOH) proposal to provide a permanent facility for maintaining the Lostine River spring/summer Chinook program and subsequently reduce fish culture constraints at Lookingglass FH

The following actions were proposed (April 2004) as components of the NEOH Step II Revised Preliminary Design Report: (a) construct a new adult spring/summer Chinook trapping and holding facility on the Lostine River; and (b) construct a new incubation and rearing facility in the Lostine River to accommodate the egg incubation and rearing of 250,000 smolts for the Lostine River, the incubation of all eggs for producing 490,000 smolts for the Imnaha River, and the rearing of 245,000 smolts (1/2 of the total number of fish) for release in the Imnaha River (see also Alternative 2 for Imnaha spring/summer Chinook). Alternative 2 could be implemented in conjunction with Alternatives 3, 4, or 5 for the Lostine/Wallowa spring/summer Chinook program.

Pros

- Increases the abundance and distribution of spring/summer Chinook in the Lostine River.
- Maintains a genetic repository for the listed Lostine River spring/summer Chinook population.
- An existing proposal that would achieve this alternative (NEOH) is in place. The proposal has been agreed to by the comanagers and received programmatic approval by the Northwest Power and Conservation Council.
- Reduces fish culture constraints at Lookingglass FH such as high densities during early rearing.
- Increases the number of spring/summer Chinook available for harvest in the Imnaha River.
- Eliminates the need for transfers to/from the Lostine River and the associated stress/fish health risks to the transferred fish.
- Provides full-term rearing for Lostine spring/summer Chinook on Lostine River water.
- Eliminates fish health risks from the Lostine spring/summer Chinook population to other spring/summer Chinook programs at Lookingglass FH.
- Improves the adult collection facility so that the weir is more efficient, adult holding is expanded, and safety risks are reduced.
- Would likely reduces predation, icing, and pond leakage at the existing (temporary) Lostine River acclimation facility.

Cons

- Requires significant capital investment to construct new facilities and requires significant funds for annual operations and maintenance.
- Current program provides little contribution towards achieving the LSRCP mitigation goal of 5,860 hatchery-origin adult Chinook salmon returned to the Grande Ronde River basin.

- Hatchery-origin adults outplanted into the Wallowa River, Bear Creek and Prairie Creek pose genetic, fish health and ecological risks to natural populations.

- Requires careful broodstock and upstream passage management of hatchery and natural-origin spring/summer Chinook in the Lostine.

Alternative 3: Convert the current integrated program to a stepping-stone program

Convert the current integrated program to a two-broodstock, stepping-stone program designed to provide fish from an integrated broodstock for natural spawning escapement and fish for harvest from a segregated broodstock. This program maintains a total of 250,000 smolt release, but could be increased if the number of fish from other stocks reared at Lookingglass FH were reduced (see alternative 4).

Pros

- Maintains the current integrated artificial propagation program and its potential conservation benefits.

- Potential to provide more fish for harvest from the harvest component of the program (Depending on allocation of rearing space and capacity at Lookingglass FH).

- Increases the likelihood of maintaining a properly integrated program that is sized according to the current capacity and productivity of the naturally spawning population in the Lostine River

- Increases the likelihood of contributing to LSRCP mitigation goals for Grande Ronde River basin spring/summer Chinook.

Cons

- Further complicate the operation of the adult weir and trap on the Lostine River and Lookingglass FH.

- Requires more rearing space at Lookingglass FH and an investment in improving the sorting and holding facilities there.

- There are no additional identified management needs (other than Wallowa River, Bear Creek and Prairie Creek) for outplants and no additional identified management needs for supplementation outside of the Lostine River.

Alternative 4: Convert the current integrated program to a segregated program

Under this alternative, natural-origin spring/summer Chinook would not be retained for broodstock, and hatchery-origin fish would not be passed upstream of the weir. Instead, the naturally spawning population upstream of the weir and the hatchery stock would be managed as two separate populations. This program maintains a 250,000 smolt release, but could be increased if the number of fish from other stocks reared at Lookingglass FH were reduced (see alternative 4).

Pros

- Simplifies the Lostine River spring/summer Chinook program.
- Reduces hatchery influence on the naturally spawning population upstream of the Lostine River weir.
- Maintains the number of released smolts at current or higher levels than established to meet LSRCP mitigation goals for the Grande Ronde.
- Increases the number of hatchery-origin spring/summer Chinook available for harvest since hatchery-origin fish would no longer be passed upstream to spawn naturally.

Cons

- The naturally spawning Lostine River spring/summer Chinook population may not be able to sustain itself without hatchery intervention.
- The risk of domestication influence to populations where Lostine spring/summer Chinook may stray (e.g. Imnaha, Wenaha, Catherine Creek, Lostine River below the weir) is increased with a segregated versus an integrated program.
- Terminates an extensive annual data collection describing the results of the supplementation program.

Alternative 5: Increase the Lostine River spring/summer Chinook program for harvest mitigation and reduce the Upper Grande Ronde and/or Imnaha programs at Lookingglass FH

This alternative could be combined with one of the two previous alternatives. Alternative 5 would increase the Lostine River spring/summer Chinook program from 250,000 to 370,000 smolts, and would reduce the number of smolts reared and released for the Upper Grande Ronde and/or Imnaha rivers to increase harvest mitigation benefits in the Lostine, Wallowa, and Grande Ronde rivers. This alternative could include smolt releases and adult recaptures at Wallowa Hatchery, the Big Canyon acclimation facility, or other suitable acclimation and adult recapture sites.

Pros

- Potentially increases the number of harvestable spring/summer Chinook available to support tribal and recreational fisheries in the Lostine, Wallowa and Grande Ronde rivers.
- Returns more fish to more accessible locations in the Grande Ronde basin, versus the more remote location of the Imnaha River, with the intent of increasing the number of harvested fish and reducing surplus escapement of hatchery-origin fish (see spring/summer Chinook program for the Imnaha River).
- Maintains the number of released smolts at current or higher levels than established to meet LSRCP mitigation goals for the Grande Ronde River.

Cons

- May not meet the "in-place, in-kind intent of the LSRCP mitigation program if the number of number of spring/summer Chinook returning to the Imnaha River is reduced.
- May reduce the number of adult spring/summer Chinook available for harvest in the Imnaha River if the size of the Imnaha River program is reduced.
- May reduce the demographic buffer afforded to the Imnaha and/or Upper Grande Ronde river populations by hatchery fish during periods of low ocean productivity if the number of fish released into the Imnaha and/or Upper Grande Ronde River is reduced.
- Increases straying risks to naturally spawning populations in other tributaries of the Grande Ronde River (e.g., Wenaha River and Catherine Creek).

Alternative 6: Transfer the Lostine River spring/summer Chinook program to new and/or other existing hatchery facilities AND rear only spring/summer Chinook for the Lookingglass Creek and Imnaha River programs at Lookingglass FH to meet mitigation goals for the Oregon portion of the LSRCP

See pros and cons for Alternative 5 for the Lookingglass Creek spring Chinook program.

Alternative 7: Terminate the program and decommission the Lostine River satellite facility

Decommission the satellite facility and terminate the Lostine-Wallowa River spring/summer Chinook program in favor of alternative mitigation strategies such as habitat restoration, passage improvements, or alternative hatchery production at another site.

Pros

- Frees up rearing space that can be used to increase the number of smolts reared and released for the other spring Chinook programs located at Lookingglass FH.
- Reduces the number of programs at Lookingglass FH.
- Eliminates the need to invest in new adult collection and acclimation facilities for the Lostine River.

Cons

- Significantly reduces conservation and harvest benefits for the Wallowa-Lostine river watershed.
- Decreases the abundance and distribution of spring/summer Chinook in the Lostine River.
- Eliminates a genetic repository for the Lostine-Wallowa River spring/summer Chinook population.

- Terminates an extensive annual data collection describing the results of the supplementation and reintroduction program.

Recommended Alternatives

Short- term recommendation: The Team recommends the implementation of Alternative 1: continue the current program with implementation of the Team's recommendations listed in the preceding section. Alternative 1 includes the construction of a new, permanent weir in the Lostine River to meet both broodstock and natural escapement goals.

Long-term recommendation: To provide greater flexibility for comanagers to adjust programs to meet harvest goals for the Grande Ronde and Imnaha River basins, the Team endorses the NEOH facility concept (Alternative 2). The NEOH facility and weir provides comanagers the opportunity to increase the size of the Lostine River spring/summer Chinook program for harvest., The Team also recommends conversion of the program to a two-broodstock, stepping-stone program (Alternative 3) so that the program can continue to provide conservation benefits to the Lostine River spring/summer Chinook population upstream of the weir while providing increased harvest benefits.

Absent a new NEOH facility for the Lostine program, the comanagers may wish to reassess other programs at Lookingglass FH to determine whether they should be reduced in size while increasing the size of the Lostine River spring/summer Chinook program (Alternative 5).

Imnaha River Spring/Summer Chinook

Operator: Oregon Department of Fish and Wildlife

Summary of Current Program

Goals

- ***Harvest goal:*** No numeric harvest goal exists at the present time. The program is intended to contribute to recreational and tribal harvests and the overall LSRCP mitigation goal to return 3,210 hatchery-origin adult spring/summer Chinook—from the Imnaha River—upstream of Lower Granite Dam on the mainstem Snake River.

- ***Broodstock escapement goal:*** The desired goal is to annually capture 166 male and 166 female adult spring/summer Chinook in the Imnaha River for broodstock to produce 490,000 smolts for release (420,000 into the Imnaha River and 70,000 into Big Sheep Creek). with jacks composing up to 10% of the male spawning contribution (U.S. vs. Oregon agreement). However, because of space constraints at Lookingglass FH, the current goal is to annually capture 108 males and 108 females for broodstock to yield 360,000 smolts for release in the Imnaha River with jacks composing up to 10% of the males. Natural-origin adults from the Imnaha River are included within the broodstock annually, and hatchery-origin adults are allowed to spawn naturally in the Imnaha River each year. A sliding scale has been developed to help determine the proportion of the broodstock and natural spawners composed of hatchery and natural-origin fish annually (see Operational Considerations).

- ***Conservation goal:*** Short-term goal: Restore spring/summer Chinook salmon in the Imnaha River using the indigenous stock The short-term goal identified by the Nez Perce Tribe in the Northeast Oregon Hatchery Project, Spring Chinook Management Plan is to maintain a minimum annual escapement of 700 natural and hatchery-origin spring/summer Chinook in the Imnaha River. The mid-term goal is to achieve an annual escapement of 2,000 adult Chinook salmon in the Imnaha River. The long-term goal is to maintain a natural, self-sustaining population of 3,820 adults in the Imnaha River and meet the LSRCP mitigation goal for hatchery-origin fish of 3,210 adults. The Columbia River Treaty Tribe's long-term recovery goal for spring/summer Chinook in the Imnaha River is an annual return of 6,700 adults.

- ***Escapement goal for natural-origin adults:*** Comanagers have not yet quantified a natural spawning escapement goal for spring/summer Chinook upstream of the weir in the Imnaha River under current conditions. A mean of 40% of the adult run reaching the weir passes the weir without being captured (before the weir can be installed). The current passage strategy is to follow a sliding scale that increasingly restricts the proportion of hatchery-origin fish passed upstream of the weir as the predicted number of spring/summer Chinook returning to the Imnaha River increases (see Operational Considerations). The current habitat capacity is estimated to be 1,500 natural-origin adult recruits back to the Imnaha River (HSRG 2009).

- ***Research, education, and outreach goals:*** Evaluate the benefits and risks of the program toward meeting its harvest and conservation goals.

Objectives

- Collect a maximum of 108 adult males and 108 adult females at the Imnaha Satellite Facility to provide sufficient numbers of fertilized eggs to yield approximately 360,000 smolts (includes pre-spawn mortality and potential culling of eggs from high BKD parents). Collect both unmarked natural-origin fish and marked hatchery-origin fish for broodstock.

- Use broodstock collection guidelines (sliding scale) and estimated escapement to the mouth of Imnaha River (tables 29 and 30 below) to determine the number and proportions of hatchery and natural-origin fish to collect for broodstock and to pass upstream on an annual basis.

- Transfer adults retained for broodstock to Lookingglass FH for holding prior to being spawned.

- Outplant up to 500 hatchery-origin adults from the Imnaha Satellite Facility to Big Sheep Creek and Lick Creek in the Big Sheep Creek watershed.

- Spawn adult spring Chinook at Lookingglass FH. Fertilize, incubate, and hatch the eggs, and rear the resulting fish to the yearling smolt stage at Lookingglass FH.

- Transfer 360,000 yearling smolts to the Imnaha Satellite facility acclimation pond in mid-March, approximately 3 weeks prior to release. Allow 2 to 4 weeks for fish to volitionally emigrate, and then perform a forced release into the river in mid-April.

Table 29. Imnaha River Spring/summer Chinook broodstock/upstream passage management guidelines (LSCRP objective: n = 490,000 smolt release)[78]

Imnaha River Adult Management Table - Future 490K Program - 322 Adults for Broodstock NOAA Fisheries 4/4/07 Draft

Estimated Natural Run to River Mouth as a Proportion of minimum TRT abundance threshold	Number of Natural Fish to River Mouth	Expected Handle Rate at Weir of Natural Fish (50%)	Max % Natural for Broodstock	Number of Natural Fish Retained for Broodstock (Proportion of Natural Brood)	Max Proportion of Hatchery Fish Released Above Weir	Minimum % Natural in Broodstock	Proportion of Natural Influence Based on the Minimum % Natural Fish in Broodstock	Proportion of Natural Influence Based on Number of Natural Fish Retained for Broodstock
> .05 of Critical	> 15	> 8	0	0	NA	NA		
.05 - .5 of Critical	15 - 149	8 - 74	50%	04 - 37 (.01 - .11)	NA	NA		
.5 - Critical	150 -299	75 -149	40%	30 - 60 (.09 - .19)	70%	20%	0.22	.11 - .21
Critical - .5 of Viable	300 - 499	150 -249	40%	60 - 100 (.19 - .31)	60%	25%	0.29	.24 - .34
.5 Viable - Viable	500 - 999	250 - 499	30% **40%**	75 - 150 (.23 - .47) **(.31 - .62)**	50%	30%	0.38	.31 - .48 **.38 - .55**
Viable - 1.5 Viable	1000 - 1499	500 - 749	30% **40%** **40%**	150 - 225 (.47 - .7) **(.62 - .93)** **(.62 - .93)**	40% **30%**	40%	0.5	.54 - .64 **.61 - .7** **.67 - .76**
1.5 - 2 Viable	1500 - 1999	750 - 999	25%	188 - 250 (.58 - .78)	25%	50%	0.67	.7 - .76
> 2 Times Viable	> 2000	> 1000	25%	> 250 (> .78)	0%	100%	1	1

Proportion of Natural Influence values for adults above weir Calculated by
Viable level is TRT minimum abundance threshold for main stem (750) with half encountered at weir NOB / (NOB + HOS)
River mouth #s are those needed to achieve TRT minimum abundance threshold after fishery and broodstock collection

[78] *Provided by Scott Patterson, ODFW, June 2009.*

Table 30. Imnaha River Spring/summer Chinook broadstock/upstream passage management guidelines (current comanager objective: n = 360,000 smolt release)[79]

Imnaha River Adult Management Table - Current 360K Program - ~~242~~ 216 Adults for Broodstock NOAA Fisheries 4/4/07 Draft

Estimated Natural Run to River Mouth as a Proportion of minimum TRT abundance threshold	Number of Natural Fish to River Mouth	Expected Handle Rate at Weir of Natural Fish (50%)	Max % Natural for Broodstock	Number of Natural Fish Retained for Broodstock (Proportion of Natural Brood)	Max Proportion of Hatchery Fish Released Above Weir	Minimum % Natural in Broodstock	Proportion of Natural Influence Based on the Minimum % Natural Fish in Broodstock	Proportion of Natural Influence Based on Number of Natural Fish Retained for Broodstock
> .05 of Critical	> 15	> 8	0	0	NA	NA		
.05 - .5 of Critical	15 - 149	8 - 74	50%	04 - 37 (.02 - .15)	NA	NA		
.5 - Critical	150 -299	75 -149	40%	30 - 60 (.12 - .25)	70%	20%	0.22	.15 - .26
Critical - .5 of Viable	300 - 499	150 -249	40%	60 - 100 (.25 - .41)	60%	25%	0.29	.29 - .41
.5 Viable - Viable	500 - 999	250 - 499	30% **35%**	75 - 150 (.31 - .62) **(.36 - .72)**	50%	30%	0.38	.38 - .55 **.42 - .59**
Viable - 1.5 Viable	1000 - 1499	500 - 749	30% **35%**	150 - 225 (.62 - .93) **(.72 - 1.0)**	40% **35%**	40%	0.5	.61 - .7 **.67 - .73**
1.5 - 2 Viable	1500 - 1999	750 - 999	25%	188 - 250 (.78 - 1)	25%	50%	0.67	.76 - .8
> 2 Times Viable	> 2000	> 1000	25%	> 250 (1)	0%	100%	1	1

Proportion of Natural Influence values for adults above weir Calculated by
Viable level is TRT minimum abundance threshold for main stem (750) with half encountered at weir NOB / (NOB + HOS)
River mouth #s are those needed to achieve TRT minimum abundance threshold after fishery and broodstock collection

Program Description

The Imnaha River spring/summer Chinook program is an Integrated Recovery action that is managed for natural spawning "supplementation" and in some years, integrated harvest. The purpose of this program is to mitigate for fish losses occurring as a result of the construction and operation of the four Lower Snake River Dams. A secondary purpose is restoration of spring/summer Chinook salmon in the Imnaha River. Natural spawning supplementation by hatchery-origin fish has been ongoing in the Imnaha River with Imnaha River stock since the mid 1980's. Hatchery fish have comprised a significant fraction of natural spawners since 1985. Stray fish from other Snake River hatchery programs or from outside Snake Basin programs have rarely been observed in the Imnaha River. Managers have identified this population as a "primary population"; however, this population is not currently meeting the biological risk standards for a Contributing or Primary population designation because of the relatively large numbers of hatchery-origin fish potentially spawning in the Imnaha River (currently *pHOS* is 57% and *PNI* is 0.38) because of inefficiencies of the existing adult weir.

The program mitigation goal is to return 3,210 hatchery-origin adults upstream of Ice Harbor Dam. Based upon this adult return goal and an estimated 0.65% smolt-to-adult survival rate, the smolt objective was initially set at 490,000 fish. Lookingglass Hatchery is used for spawning, incubation

[79] *Provided by Scott Patterson, ODFW, June 2009.*

and rearing of listed Snake River spring/summer progeny from the endemic adult supplementation programs and endemic captive broodstock programs in the Grande Ronde River Basin, and the endemic spring/summer Chinook program in the Imnaha River. The adult collection and smolt acclimation satellite facility is located adjacent to the Imnaha River,, approximately 30 miles south of Imnaha, Oregon at river mile 45.5.

The U.S. Fish and Wildlife Service, through the Lower Snake River Compensation Plan (LSRCP), funds operation and maintenance expenditures at Lookingglass hatchery and Imnaha satellite facility. The Nez Perce Tribe, Oregon Department of Fish and Wildlife, and the Confederated Tribes of the Umatilla Indian Reservation are co-managers of the Imnaha River spring/summer Chinook salmon program.

Assessment of Current Program

Operational Considerations[80]

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- Imnaha spring/summer Chinook (including hatchery fish) are listed as threatened under the endangered species act as part of the Snake River spring/summer Chinook ESU.
- The program propagates an endemic Chinook stock that was founded from spring/summer Chinook indigenous to the Imnaha River.
- The broodstock for the Imnaha River spring/summer Chinook program consists of anadromous adult returns to the trap and weir at river mile 49 on the Imnaha River. The origin of this brood stock is natural fish collected at this site starting in 1982.
- Both unmarked natural-origin fish and marked hatchery-origin fish are collected for broodstock or passed upstream to spawn naturally.
- Annual adult broodstock collection is not expected to exceed 166 males and 166 females. However, under the current program, the target is only 108 males and 108 females (based upon the rearing space available at Lookingglass FH).
- Up to 500 surplus hatchery-origin spring/summer Chinook collected at the Imnaha Satellite Facility are outplanted into Big Sheep Creek and Lick Creek to supplement natural spawning of spring/summer Chinook population in those streams. Prior to July 15th, the spring/summer Chinook are held at Lookingglass FH prior to transfer to the Big Sheep Creek Watershed. After July 15, the surplus hatchery-origin adults are transferred directly from the Imnaha Satellite facility to the Big Sheep Creek watershed.

[80] *See Appendix B of this document for supporting background information and references.*

- The weir is installed as soon as river conditions allow (≈July 4th) and operated until September 11 or until the last scheduled spawning ground survey above the weir. Fish are processed at the trap and transferred to Lookingglass FH at least once a week, but usually more often due to the large numbers of fish returning or depending on the general "ripeness" of level of sexual maturity of the fish. Approximately 240 adults can be held in the trap.

- Adult spring/summer Chinook are first detected at the weir location in early June, typically before the weir can be installed.

- Fish spawn below the weir location and some fish pass above the weir prior to installation, therefore, an average of only 59% of the adults returning to the Imnaha River are trapped. Broodstock collection guidelines (sliding scale) are based on estimated escapement to the mouth of Imnaha River. The sliding scale was developed cooperatively between ODFW and the NPT.

- To meet smolt release objectives, approximately 439,000 green eggs are required assuming 82% survival from green egg to smolt and an estimated five-year fecundity average of 4,503 eggs per female.

- Epizootic ameloblastomas (skin tumors of the mouth) have been noted in both the conventional and captive spring Chinook adult broodstocks for the Grande Ronde River, Lostine River, Imnaha River, and Catherine Creek programs.

Hatchery and Natural Spawning, Adult Returns

- The Imnaha River population of spring/summer Chinook is intended to serve as a "primary population" for recovery of the Snake River spring-summer Chinook salmon ESU. However, the HSRG designated the Imnaha River population as a stabilizing due to the high numbers of hatchery-origin fish spawning naturally. The HSRG recommended improved broodstock and escapement management at the Imnaha weir and eliminating adult outplants to Big Sheep Creek and Lick Creek to meet the primary population designation (currently *pHOS* = 57% and *PNI* = 0.38) because of the inefficiencies of the existing adult weir.

- Program specific goals include: (a) establish an annual supply of brood fish that can provide an egg source capable of meeting mitigation goals; (b) restore and maintain the natural spawning population; (c) reestablish sport and tribal fisheries; (d) establish a total return of adult fish resulting from LSRCP activities in Oregon that meets the LSRCP mitigation goal; and (e) minimize the impacts of the program on resident stocks of game fish.

- The ICTRT classified the Imnaha River population as "intermediate" based on historical habitat potential. A Chinook population classified as "intermediate" for ESA recovery has a mean minimum abundance threshold criteria of 750 natural-origin spawners with a sufficient intrinsic productivity to achieve a 5% or less risk of extinction (greater than 1.8 recruits per spawner at the threshold abundance level) over a 100-year timeframe. ODFW's recovery goal is the same as the TRT's intermediate recovery goal.

- Stray rates of out-of-basin spring/summer Chinook into the Imnaha River appear to be low. From 2001 through 2006, only 5 CWT's (0.56%) out 896 total CWT's recovered in the Imnaha River during spawning ground surveys originated from programs outside the Imnaha River (2-Lostine River, 2-Catherine creek, and 1-Rapid River).

- From 2001 through 2006, five fish with Imnaha River CWT's were recovered outside the Imnaha River within in the Grande Ronde River basin during spawning ground surveys (1-Lookingglass Creek, 2-Wenaha River, 1-Catherine Creek, 1-Lostine River).

- The HSRG estimated mean *pHOS* for the naturally spawning populations to be 57% and mean *pNOB* for the hatchery broodstock to be 35%.

- The 10-year average (broodyears 1994-2003) smolt-to-adult survival for hatchery-origin spring/summer Chinook to the mouth of the Imnaha River is 1.21% (range 0.082% - 2.80%). This includes the jack returns.

- Estimated smolt-to-adult survival for naturally produced spring/summer Chinook PIT-tagged at the Imnaha River juvenile migration trap (located on the Imnaha River 7 rkm upstream from the Snake River) back to Lower Granite Dam averaged 1.02% (range = 0.25%-1.86%) for fall outmigrant tagged fish and 1.19% (range = 0.24%-2.49%) for spring outmigrant tagged fish for broodyears 1996 through 2001.

- Estimated smolt-to-adult survival for naturally produced spring/summer Chinook (PIT-tagged at the Imnaha River juvenile migration trap located on the Imnaha River 7 rkm upstream from the Snake River) from Lower Granite Dam back to Lower Granite Dam averaged 2.52% (range = 0.61%-3.11%) for fall outmigrant tagged fish and 1.39% (range = 0.29%-2.94%) for spring outmigrant tagged fish for broodyears 1996 through 2001.

- Jacks typically comprise greater than 20% of the returning hatchery-origin fish and ≈10% of the returning natural-origin fish for a particular broodyear.

- The proportion of returning adult fish composed of jacks has increased significantly in the last couple of years. This trend is not unique to the Imnaha population.

- Fisheries managers have estimated that, prior to construction of the four lower Snake River dams, 6,700 spring/summer Chinook escaped to the Imnaha basin annually (COE 1975).

- Spring/summer Chinook spawn in the mainstem (a 30-mile section from Freezeout Creek to the Blue Hole), Big Sheep Creek (an 11.5-mile section from Coyote Creek to 0.25 miles above Lick Creek) and Lick Creek (a 2.8-mile section from the confluence to the crossing of Forest Service Road 39). Spawning historically occurred in Little Sheep Creek and was documented for the first time in the South Fork Imnaha River in 1988.

- Historically, approximately 70% of the Imnaha River spring/summer Chinook population spawned upstream of the weir (located at river mile 45.5). Coincident with increased hatchery-origin adult returns since 2000, the proportion of spawners downstream from the weir has increased to approximately 40 percent of the total.

- Three complete surveys of the spawning grounds occur above and below the weir from the third week August to approximately mid-September. Two index units (9.7 miles) and six extensive units (39.4 miles) are surveyed annually. The two index and three extensive units (21.4 miles) are above the Imnaha weir and three extensive units (18 miles) are located below the weir. Intensive counts occur in index areas for long-term comparisons of abundance, etc. Surveys will be conducted by walking the stream bank below each weir. Survey frequency

ranges from daily to weekly depending on water temperatures and fish activity. Information is used to determine if salmon are accumulating below the weirs.

- Spring/summer Chinook passed above the weir are opercle punched so that they can be recovered on the spawning grounds and used to determine trap efficiency, population abundance, and wild/hatchery fish ratios above the weir. The population abundance and wild/hatchery data collected are expanded for the entire river.

- Collected adults are transported weekly or as needed from the adult trap to Lookingglass Hatchery in an 800-gallon transport tank.

- Although the Imnaha Satellite Facility was established with the intent to hold and spawn, adults are not currently held and spawned at Imnaha Satellite facility due to space and operation constraints, and risk of siltation from the Imnaha River. ODFW is investigating improving the holding capabilities so that the adults can be transferred to Lookingglass FH in fewer, larger lots.

- The intent is to spawn the Imnaha spring/summer Chinook in a 2:2 matrix. Occasionally the fish are spawned 1:2, depending upon the number of ripe fish available. At least one natural-origin adult is included in the spawning matrix.

- Current spawning protocols allow up to a maximum of 10% of the eggs to be fertilized by jacks (3-year old males), although a specific protocol or requirement for including jacks has not been established. The milt from up to six jacks may be pooled to fertilize one-half to one-third of the eggs from each females in a 1 x 2, 2x 2 or 2 x 3 (females x males) spawning matrix, where one of the males in the matrix actually represents the pooled milt from up to six jacks. However, the actual number of jacks spawned and/or the proportion of eggs fertilized by jacks is unknown or not reported (2009 AOP[81], see Table below). Natural-origin males have often been used multiple times to fertilize eggs to increase the overall proportion of eggs fertilized by natural-origin males. In general, jacks are included at every tenth spawning matrix.

[81] *ODFW, CTUIR, Nez Perce Tribe. February 3, 2009. LSRCP Grande Ronde and Imnaha Basins Annual Operation Plan for 2009. Final Version.*

Table 31. Number of adult spring/summer Chinook spawned at the Imnaha River facility.

Imnaha River spring/summer Chinook salmon spawning data, 1990-2008.

Brood Year	Marked Males Spawned	Marked Females Spawned	Unmarked Males Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000's)	Fry Ponded (1,000's)	Smolts releases (1,000's)
1990	35	49	39	25	43.2%	1.00	4,414	327	270	263
1991	11	24	27	15	54.5%	1.03	4,954	193	163	158
1992	46	86	69	28	42.4%	0.99	4,754	542	465	439
1993	134	139	58	54	29.1%	1.01	5,425	1,047	1,010	873
1994	15	13	6	9	34.9%	1.05	5,082	112	96	91
1995	16	9	30	6	59.0%	0.33	4,541	68	51	51
1996	15	7	37	17	71.1%	0.46	4,276	103	102	93
1997	54	50	8	7	12.6%	0.92	4,962	283	206	195
1998	53	33	31	28	40.7%	0.59	5,059	309	183	180
1999	183	31	14	6	8.5%	*0.16	4,566	169	126	123
2000	240	58	46	10	15.8%	*0.19	5,048	334	311	304
2001	114	56	54	49	37.8%	*0.38	4,371	459	275	268
2002	117	83	14	14	12.3%	0.62	4,695	455	397	398
2003	125	72	24	26	20.2%	0.65	5,081	498	434	435
2004	74	79	32	25	27.1%	0.98	4,652	488	447	442
2005	108	88	21	29	20.3%	0.90	4,545	532	437	433
2006	85	74	28	24	24.6%	0.86	4,138	406	363	349
2007	82	72	23	21	15.7%	0.88	4,391	408	300	
2008	123	82	82	22	33.6%	0.50	4,627	472		

- Every female is screened for BKD. If the titer is above 0.2 optical density (OD) as measured by ELISA, then the eggs from those females are destroyed. Eggs are held separately by female until the disease profiles and screening are complete. If needed, eggs are consolidated after eye-up. From 2004 through 2008, 97 - 100% of the females spawned at Lookingglass Hatchery had BKD levels below 0.213 OD.

- Adults collected for broodstock receive an erythromycin injection (20mg/kg) and an oxytetracycline injection (10 mg/kg) at capture to control BKD and Furunculosis, respectively. The second treatment only occurs if BKD is found in the earlier taken pre-spawning mortalities.

- Adults that are outplanted do not receive erythromycin or oxytetracycline injections.

- The adults receive a formalin treatment 3 times per week. Treatment is typically concluded in mid-August.

- Effluent from the adult holding pond cannot be directed to the pollution abatement pond, but is discharged directly into Lookingglass Creek.

- Eggs are spawned into colanders to remove ovarian fluid, fertilized, and then water-hardened with 100ppm iodophor for a minimum of 15 minutes.

- NOAA allows 10% incidental take of the natural-origin Imnaha spring/summer Chinook population. The recreational fishers are allocated 1.5% and tribal fishers 8.5%. This has resulted in an estimated average of 159 fish harvested (range 22-302) in the recreational fishery (2001-2005). As a result of incidental take restrictions, using current fishing methods

an average of 5.68% of the hatchery-origin (range 2.1% - 10.4%) and 0.7% of the natural-origin (range 0.2% - 1.6%) spring/summer Chinook returning to the Imnaha River are impacted (sport fishery impact estimate include both harvest and a 10% fishery mortality for both hatchery and wild fish caught and released).

Incubation and Rearing

- Eggs receive a formalin treatment (1667 ppm) 3x per week, beginning 48 hours post spawn until the eggs are picked.
- Chilled well water is used on the early egg takes to reduce the water temperature to around 50 degrees F. UV treated surface water is used for incubation after August, when surface temperatures can reach 70 degrees F.
- Flows are regulated at 4 to 6 gpm per vertical stack.
- Eggs are reloaded after eye-up at 1 female per tray at approximately 4,000 eggs per tray.
- After hatch, the fry are reared in 8 of the 28 indoor tanks (Canadian troughs), at approximately 48,000 fish per trough. The troughs are 117 cubic feet, with a flow rate of up to 50 gpm.
- In January-March, Lookingglass Creek temperatures drop to 32-35 degrees F. At this time well water is blended with treated surface water to increase the water temperature to approximately 40 degrees F.
- Every attempt is made not to exceed D.I. = 0.75 in the indoor tanks. However, at times, DI's exceed 0.85 due to the limited early rearing space.
- The flow index can reach approximately 2.4 when the fish are 250 fpp. However, the water temperature at this time is between 35 and 40 degrees F.
- Once the fish reach 250 fpp, they are transferred to the outdoor raceways to be reared on raw creek water (late April to early May). Juvenile fish are retained indoors until high spring flows and subsequent turbidity decreases.
- The causative agent of whirling disease, *Myxobolus cerebralis*, was recently confirmed as present in wild rainbow trout and steelhead juveniles that reside upstream of the hatchery in Lookingglass Creek. Hatchery juveniles are sampled for this parasite every year, prior to release, and through 2009, it had not been detected in the production fish.
- Fish are held indoors until 250 fpp because: the fish are too small in relation to the screen mesh size to put them out much earlier; in attempt to avoid putting the fish out in the raceways during spring runoff; and to provide time to move the prior year's fish out and clean the raceways.
- Fish in the outdoor raceways are fed using automated feeders. During cold weather (Jan-March), the fish are fed by hand because the automated feeders are inoperable.
- The raceways are cleaned by hand once per week. The cleaning effluent water is directed into a settling basin.

- The maximum flows in the raceways are approximately 800 gpm per raceway.
- The targeted density index for Imnaha spring/summer Chinook is not to exceed D.I. = 0.17 in the outdoor raceways. The flow index is F.I. = 1.5 in the outdoor raceways.
- Water temperatures can reach 68 degrees F in the raceways during summer months.
- Fish are typically held in three to four raceways until they are marked and tagged (90 fpp-180 fpp), at which time they are split across six raceways. The fish are adipose-fin clipped and coded-wire tagged in June-July.
- A formalin treatment is applied (167 ppm for 1 hour) for two consecutive days after marking. The fish are monitored to determine if additional treatment is needed. Formalin treatment is applied to control fungus.
- The fish receive one 28 day erythromycin treatment (2.25% aquamycin) to control BKD, typically in July shortly after marking.
- Bacterial kidney disease is not a problem in the conventional spring/summer Chinook juveniles; although it has caused some mortality in the juveniles from the captive broodstock programs.
- In June 2009, white open wounds anterior to the dorsal fin were observed in the juvenile spring/summer Chinook in most of the raceways. Occasionally, the coldwater disease bacterium is also detected in the juvenile Chinook at Lookingglass FH.
- In October, Imnaha spring/summer Chinook are PIT tagged.
- Monthly health monitoring examinations are conducted on each spring/summer Chinook stock. The sample includes a minimum of 10 moribund/dead fish (if available) and 4-6 live fish per raceway. Results are reported on the ODFW Fish Health Examination report.
- Based on a five year average for survival: 82% survival of green eggs to smolt. The categorized survival assumptions include: Green to eye-egg: 90%; Eye-egg to swim-up fry: 95%; Swim-up fry to fingerling (marking): 93%; Fingerling to smolt (marking to release): 99%.

Release and Outmigration

- Lookingglass FH adheres to the ODFW Fish Health Management Policy for fish releases and transfers. Fish having health issues are not commingled with the other fish at the acclimation site. If a pathogen of concern, such as IHNV, is detected in the smolts at the hatchery, the affected raceway(s) will be transferred and released separately from non-affected raceways, with the option of later release from the acclimation site and/or direct stream release downriver from the acclimation site.
- Low levels of IHNV and mortality (typically less than 0.02% per day) have been detected in Imnaha smolts in 2005, 2006 and 2009. In 2009, to prevent the possibility of on-station pathogen transmission, the affected raceway of fish was direct-stream released two to three weeks earlier than the standard release, in the Imnaha River about 9 miles downriver from the

Imnaha facility. The non-affected raceways were transferred at the normal time to the Imnaha Satellite Facility acclimation pond. No virus was detected at Lookingglass Hatchery in any other raceways of spring/summer Chinook throughout April—June, 2009.

- If epizootic instances of disease occur (greater than 0.1% mortality per day for three days), the fish are held and treated. If treatment is not effective or if the fish are held too far beyond their release date, they may be destroyed. These protocols are more restrictive than IHOT. An epizootic outbreak of IHN has not occurred at Lookingglass FH for 15 years.

- The Imnaha spring/summer Chinook are transferred to the Imnaha Satellite Facility's acclimation pond in mid-March. The expected size at transfer is 22 fpp. The release size is 20 fpp.

- The Imnaha Satellite Facility's acclimation pond capacity is 390,000 fish at 20 fpp.

- The maximum density index is 0.26 at 20 fpp. The flow index is 0.85.

- The current strategy is to acclimate smolts for 2 to 3 weeks. After 2 to 3 weeks, the pond screens are removed and smolts are allowed to volitionally migrate for a two week period. At the end of the two weeks, fish remaining in the pond are forced out. The time frame for smolt acclimation and release is from the second week in March to mid-April.

- The fish are fed a maintenance diet during acclimation and at a decreasing level throughout the course of the volitional release.

Facilities and Operations

Imnaha Satellite Facility

- The current weir is a picket and tripod weir on a concrete sill that was originally designed for an electric weir. The weir cannot be installed until high flows subside and most often after a significant portion of the spring/summer Chinook run has passed. Once installed and the river flows subside, the weir is highly effective.

- The acclimation pond has a 9.9 cfs water right (March-May1) and 15 cfs (May 1-October). Water use is recorded and reported to the USFWS Region 1 office. However, water flows are measured over a stop log structure and may not meet USFWS standards for accuracy.

- The flow through the acclimation pond, adult trap and ladder is 4,000-6,000 gpm.

- Imnaha adult collection and smolt acclimation facility is located two to three hours from Lookingglass hatchery, approximately 30 miles south from the town of Imnaha, Oregon adjacent to the Imnaha River at river mile 45.5.

- There were a number of deficiencies identified (NEOH Step II submittal from Montgomery Watson Harza) with the existing fish ladder at the adult collection facility at the Imnaha River facility. The toe of the picket barrier is located upstream from the fish ladder entrance causing migrating fish to have to drop back from the barrier to find the fish ladder entrance creating potential fish delay problems. The water flow and velocities exiting the fish ladder are

insufficient to provide attraction to the fish ladder which becomes more pronounced at higher flow stages. The ladder is too small and the pools do not meet NMFS design criteria.

- The intake screen does not meet NOAA screening criteria.
- The intake screen ices-up often. Staff must maintain the intake constantly on especially cold days. The head and tail screens of the acclimation pond also ice over, requiring maintenance.
- An RV pad is not present to accommodate volunteer staff for interpretation and light maintenance.
- The size of the adult trap is not sufficient to accommodate the number of spring/summer Chinook that must be handled. Sorting capabilities are also limited. To address these issues, ODFW is working to expand the adult trap/holding area into the acclimation pond (the trap is currently located at the tail end of the acclimation pond).
- The facility is not equipped with bird netting or predation fencing. However, predation is not considered a problem, in part because fish are on-site for a limited period of time. A security fence is present on the perimeter of the property.

Research, Education, and Outreach

- Imnaha spring/summer Chinook are 100% adipose-fin clipped. Approximately 180,000 are adipose fin-clipped and coded-wire tagged. 21,000 are PIT tagged. Tags are apportioned equally across raceways.
- Coded wire tags are used to assess contribution to fisheries and estimate smolt-to-adult survival.
- PIT tag data provide information regarding downstream migration timing and comparative performance of wild, captive brood, and conventional juveniles.
- The *pHOS* and *pNOB* are monitored constantly and used to guide the program.
- Observations indicate that there may be a divergence in run timing forming between the hatchery and wild fish. The mean of the hatchery return is shifting later than the natural return. The spawn timing may also be shifting; however, this is harder to determine.
- Imnaha spring/summer Chinook are monitored as part of the Comparative Survival Study.
- The Nez Perce Tribe conducts Lower Snake River Compensation Plan Hatchery evaluation studies and the Imnaha River Smolt Monitoring in the Imnaha River, Oregon. These studies are closely coordinated and provide information about juvenile natural and hatchery spring/summer Chinook salmon and steelhead biological characteristics, emigrant timing, survival, arrival timing and travel time to the Snake River dams and McNary Dam on the Columbia River. These studies also provide information on listed Chinook salmon and steelhead for the Federal Columbia River Power System Biological Opinion.
- LSRCP hatchery evaluation studies in the Imnaha River determine natural and hatchery Chinook salmon and steelhead smolt performance, emigration characteristics and survival. A

long term monitoring effort was established to document smolt emigrant timing and post release survival within the Imnaha River, estimate smolt survival downstream to McNary Dam, compare natural and hatchery smolt performance, and collect smolt-to-adult return information.

- This project collects information for, and is part of, a larger effort entitled Smolt Monitoring by Federal and Non-Federal Agencies (BPA Project No. 198712700). This larger project provides data on movement of smolts out of major drainages and past dams on the Snake River and Columbia River. In season indices of migration strength and migration timing are provided for the run-at large at key monitoring sites. Marked smolts are utilized to measure travel time and estimate survival through key index reaches. Fish quality and descaling measures are recorded at each monitoring site and provide indicators of the health of the run.

- Co-managers in the Imnaha River subbasin have identified the need to collect information on life history, migration patterns, juvenile emigrant abundance, reach specific smolt survivals, and Smolt-to-Adult Return rates (SAR.s) for both steelhead and Chinook salmon smolts. The current study provides information related to the majority of the high priority data needs. Current funding does not allow for determination of a total (annual) juvenile emigrant abundance and installation of adult passive integrated transponder (PIT) tag detectors at the mouth of the Imnaha River to calculate tributary specific SARs.

- Nez Perce Tribal staff involved in the Imnaha spring/summer Chinook program participate in an annual BPA sponsored meeting to discuss and share data about BPA funded Nez Perce Tribal hatchery programs.

- Over 5,000 people visit the Imnaha Satellite Facility annually. The Imnaha facility is on a road that provides recreational access for camping, hiking, fishing, etc.

- There is little visitor information signage and what exists is dated.

- ODFW utilizes hatchery volunteers, but not at the facilities associated with this program.

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,[82] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- The Imnaha spring/summer Chinook program provides recreational and tribal harvest in the Imnaha River basin. ODFW opened spring/summer Chinook sport fishing in the Imnaha River from 2001-2005 and in 2008. Estimated sport harvest of spring/summer Chinook in the Imnaha River during those years averaged 164 fish (range = 22-302 fish). Estimated tribal harvest in the Imnaha River from 2001 through 2007 averaged 160 fish (range = 33-316 fish).

[82] *See Section II, "Components of This Report", for a description of these potential benefits and risks.*

- Estimates of harvest (2002-2006) of Imnaha spring/summer Chinook within the project area (on the mainstem Snake River upstream of Lower Granite Dam) were 23 fish in 2006 (Snake River sport), 2 fish in 2005 (Snake River sport), and 13 fish in 2002 (Snake River sport).

Conservation Benefits

- Reduces demographic risks to the Imnaha River spring/summer Chinook population and maintains a naturally spawning population in the Imnaha River.

Research, Education, Outreach and Cultural Benefits

- The program is closely monitored and has provided important information on the benefits and risks of hatchery-origin fish spawning naturally.

- Tribal harvest and surplus adults trapped at facilities provide ceremonial, cultural, and subsistence benefits to Columbia River tribes.

- Hatchery and evaluation staff provide educational opportunities on site at Lookingglass Fish Hatchery.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,[83] the Review Team identified the following benefits of this program:

Harvest Benefits

- The Imnaha spring/summer Chinook program contributes to tribal, commercial, and recreational fisheries in downstream fisheries, including the lower Columbia River. Harvest is limited.

- Estimates of Imnaha River spring/summer Chinook harvest outside the project area include; 257 fish in 2006 (3-ocean, 74 fish in the Columbia River treaty net fishery, 32 fish in the Columbia River non-treaty net fishery, and 148 fish in the Columbia River sport fishery), 122 fish in 2005 (11-ocean, 17- Columbia River treaty net, 12-Columbia River non-treaty net, and 82-Columbia River sport), 180 fish in 2004 (10-ocean, 101-Columbia River treaty net, 5-Columbia River non-treaty net, 63-Columbia River sport, and 1- Deschutes River sport), 155 fish in 2003 (3-ocean, 25-Columbia River ceremonial/subsistence, 36-Columbia River treaty net, 9-Columbia River non-treaty net, and 82-Columbia River sport), 139 fish in 2002 (12-ocean, 10-Columbia River ceremonial/subsistence, 3- Columbia River treaty net, 11-Columbia River non-treaty net, 97-Columbia River sport, and 6-Deschutes River sport), 228 fish in 2001 (9-ocean, 82-Columbia River ceremonial/subsistence, 47-Columbia River treaty net, 6-Columbia River non-treaty net, 70-Columbia River sport, 1-Columbia River test fishery, and 13-Deschutes River sport).

Conservation Benefits

- There is a potential, but undocumented demographic and/or ecological benefit to the naturally spawning populations in the Big Sheep Creek and Lick Creek where adults are outplanted.

[83] *Ibid.*

- Carcasses resulting from hatchery-origin spring/summer Chinook in the Imnaha River, Big Sheep Creek, and Lick Creek are expected to enhance ecological processes in the watershed.

Research, Education, Outreach and Cultural Benefits

- Tribal harvest provides ceremonial, cultural and subsistence benefits to Columbia River tribes.

- The program provides research and information on supplementation issues.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,[84] the Review Team identified the following risks of the hatchery program:

Genetic Risks

- The comparatively low recruit to spawner ratio for naturally spawning fish in some years coupled with the high proportion of hatchery-origin spring/summer Chinook spawning in the Imnaha River inhibits development of a properly integrated program, thus posing a genetic domestication risk to the Imnaha River spring/summer Chinook population.

- Proper management of the hatchery and natural population is not possible because the current weir structure cannot be installed until high spring flows subside, after a large portion of the spring/summer Chinook return to the Imnaha River.

    - The return timing of the natural population appears to be shifting to a later date since hatchery broodstock can currently only be collected from the later portion of the run and a large proportion of naturally spawning fish is composed of hatchery-origin adults.

    - Although the intent is to manage the Imnaha population as integrated, the mean return date of fish retained for broodstock is significantly later than the mean return date of all fish returning to the Imnaha River

    - Hatchery-origin adults are able to pass upstream of the Imnaha weir site in uncontrolled numbers during periods of high flow in some years, thereby resulting in an uncontrolled genetic influence of the hatchery environment on the naturally spawning population.

- The present sliding scale and the proportion of natural-origin and hatchery origin adults passed upstream of the Imnaha weir results in upstream passage of hatchery-origin adults under conditions when no supplementation is required to meet the escapement objective, resulting in excessive genetic influence of the hatchery environment on the naturally spawning population.

Demographic Risks

- Transportation of juveniles and adults in trucks over long distances for long periods may pose a stress condition on the fish leading to higher incidence of disease, or egg loss in the case of adult females.

[84] *Ibid.*

- Extreme cold water conditions at the acclimation site increases survival risks because of icing and diminished or complete loss of water flow.

- The transfer of fish from hatchery raceways to extreme cold water conditions at the acclimation site may pose a physiological (stress) risk to the fish.

Ecological Risks

- Potential amplification of disease within the hatchery increases disease risks to the Imnaha River spring/summer Chinook population.

- Large numbers of hatchery-origin fish spawning naturally are expected to reduce the productivity or mean recruit per spawner of the natural-origin fish because of competition and density-dependent processes. Based upon habitat capacity, the ICTRT indicated that the intermediate recovery goal for the Imnaha River is 700 adults.

- Anadromous fish in the Imnaha River upstream of the water intake for the satellite facility pose a minor fish health risk to the Chinook held at the Imnaha Satellite facility.

- *See the Lookingglass Creek Spring Chinook program for ecological risks associated with rearing at Lookingglass FH.*

Physical Risks

- Installation of the existing weir during high flows poses a human safety risk.

- Removing ice from the intake screen or cleaning it during high flows poses a human safety risk.

- The fish ladder is not covered, posing a safety risk to the public.

- *See the Lookingglass Creek Spring Chinook program for physical risks associated with rearing at Lookingglass FH.*

Research, Education, Outreach and Cultural Risks

- Since the weir cannot be installed until high spring flows subside, the inability to sample adults during the full distribution of the run in most years prevents accurate estimation of abundance, return timing and composition (hatchery versus natural) of adult spring/summer Chinook.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,[85] the Review Team identified the following risks from the hatchery program:

[85] *Ibid.*

Genetic Risks

- Outplanting surplus Imnaha River spring/summer Chinook into Big Sheep and Lick creeks poses a genetic risk to any naturally-produced spring/summer Chinook in this area.

Demographic Risks

See the Lookingglass Creek Spring Chinook section for demographic risks associated with rearing Chinook at Lookingglass FH.

Ecological Risks

- Outplanting surplus Imnaha River spring/summer Chinook into Big Sheep and Lick creeks poses fish health risks and an ecological risk to the survival and growth of any naturally-produced spring/summer Chinook in these areas.

- Potential amplification of disease within the hatchery poses a disease risk to other native fish populations in the Imnaha River when smolts are transferred and released from the Imnaha Satellite facility.

Research, Education, Outreach and Cultural Risks

- None identified.

Recommendations for Current Program[86]

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

Program goals and objectives

Issue IR-SC1: Many LSRCP hatchery programs appear to be attempting to meet harvest, mitigation and conservation goals simultaneously without those goals being clearly stated or prioritized in terms of numeric outcomes that quantify intended benefits. *Short-term and long-term goals for many LSRCP programs have not been clearly stated or quantified – up front - independent of the methods for achieving them (e.g., "The goal of this program is to use supplementation to …"). The confounding of goals and methods impedes assessments of program benefits, particularly if desired benefits are not quantified as short-term and long-term goals. Prioritization of mitigation versus conservation goals appears to shift annually based upon the number of returning adults without a strong association to long-term goals for the programs (e.g., as described in Annual Operating Plans). Prioritization of short and long-*

[86] *The Review Team believes that the ODFW and the USFWS LSRCP office will be the logical parties to coordinate and implement most of the following recommendations.*

term goals often differs among comanaging parties. [NOTE: The Imnaha River Spring/Summer Chinook Program appears to have stated goals more clearly than other LSRCP programs].

Recommendation IR-SC1: Comanagers should restate and prioritize program goals for all LSRCP programs in terms of both short-term and long-term numeric outcomes for the following parameters: (a) natural population abundance and viability (conservation goals); (b) the number of hatchery-origin fish returning to specified target areas (mitigation goal), and (c) the proportions and desired numbers of fish from the two preceding groups allocated for broodstock, natural-spawning escapement, and harvest. Both short-term and long-term goals need to be clearly articulated up front (e.g., natural spawning escapement numbers) independent of the chosen methods for achieving them (e.g., supplementation spawning by hatchery-origin fish). Short-term goals need to be realistic and attainable biologically under current conditions. Long-terms goals should also be realistic biologically but can consider the removal of factors that prevent their achievement in the short-term (e.g., repair of riparian habitats, engineering improvements to fish passage structures, etc.). Quantitative benchmarks should also be established for measuring success or failure of the program towards meeting identified goals, thus allowing for mid-course corrections in programs or adjustments in the goals themselves. Prioritization of program goals, both short-term and long-term, must be made consistent among comanagers.

Issue IR-SC2: Hatchery-origin Imnaha Spring/summer Chinook are outplanted into the Big Sheep Creek watershed; however, the purpose or goal of this activity has not been established or described clearly*. Up to 500 hatchery-origin spring/summer Chinook adults are outplanted each year into Big Sheep Creek and Lick Creek (in the Big Sheep Creek watershed), respectively. The intended benefits of those activities have not been adequately defined or quantified.*

Recommendation IR-SC2: Discontinue the outplanting of adults into the Big Sheep Creek watershed unless the activity can be justified based upon specific goals for the program. Goals should be developed in terms of measurable benefits (e.g. harvest, restoration, ecological enhancement) and weighed against the risks that the outplanted adults pose to the natural populations of Chinook in those areas.

Broodstock Choice and Collection

See IR-SC7 below. Also see LC-SC6 under Hatchery and Natural Spawning, Adult Returns recommendations for Lookingglass Creek spring Chinook.

Hatchery and Natural Spawning, Adult Returns

Issue IR-SC3a: Hatchery-origin spring/summer Chinook can compose up to 70% of the naturally spawning fish intentionally passed upstream of the weir based on the current comanager-developed sliding scale. However, approximately 40% of the adult fish returning to the Imnaha River are able to avoid capture or migrate upstream past the weir site before the weir can be installed and any fish are trapped. *As a result, large numbers of hatchery-origin fish are able to escape capture and spawn in the Imnaha River, and the deliberate passage of additional hatchery-origin fish exacerbates that problem. For example, for run year 2009, the predicted return of spring/summer Chinook to the Imnaha River was estimated to be 6,210*

hatchery-origin fish and 1,316 natural-origin fish. Only 59% of those natural and hatchery-origin fish are expected to be intercepted by the weir. Consequently, approximately 2,546 hatchery and 540 natural-origin fish (41%) are predicted to escape capture and spawn naturally in the Imnaha River. On top of those numbers, the current sliding scale dictates for 2009 that hatchery-origin fish compose 40% of all the fish intentionally passed upstream of the weir although nearly 2,500 hatchery-origin adults are already predicted to be spawning naturally. The deliberate passage of hatchery-origin adults under these latter circumstances is expected to reduce the natural productivity of natural-origin adults that are deliberately passed upstream (see Issue IR-SC3d below).

Issue IR-SC3b: The ICTRT has identified a short-term recovery goal for spring/summer Chinook in the Imnaha River of 750 natural-origin spawners per year as the threshold level for sustainable viability. *Approximately 1,300 natural-origin spring/summer Chinook are predicted to return to the Imnaha River in 2009, of which approximately 700 fish will be passed upstream of the weir to spawn naturally. Based on those predicted numbers, the current sliding scale requires the deliberate upstream passage of an additional an 466 hatchery-origin spring/summer Chinook (i.e., 40% of the fish intentionally passed upstream of the weir) although (a) nearly 2,500 hatchery-origin adults are already predicted to escape capture and potentially spawn in the Imnaha River and (b) the predicted escapement numbers of natural-origin recruits exceed the viability threshold of the ICTRT.*

Issue IR-SC3c: The relative compositions of hatchery and natural-origin fish in the hatchery broodstock and among naturally-spawning fish have not been consistent with genetic guidelines and conservation goals for spring/summer Chinook in the Imnaha River. *Recently developed genetic guidelines dictate that the proportion of a hatchery broodstock composed of natural-origin fish (pNOB) should exceed the proportion of natural spawners composed of hatchery origin fish (pHOS) when conservation is a goal of an integrated hatchery program. In recent years, pHOS has exceeded pNOB by a factor of nearly two-to-one (mean pHOS = 57%, mean pNOB = 35%; HSRG 2009). The net result is that the hatchery environment is predicted to have a significantly greater long-term genetic influence on early life history and reproductive traits than will the natural environment.*

Issue IR-SC3d: Time-series analyses conducted by ODFW indicate that supplementation spawning by hatchery-origin spring/summer Chinook in the Imnaha River has not increased the mean number of natural-origin adult recruits returning to the Imnaha River relative to control streams. *Although hatchery-origin fish spawning naturally are expected to produce natural-origin recruits, spawner-recruit models (e.g., Beverton-Holt spawner-recruit relations) predict that large numbers of hatchery-origin fish spawning naturally will significantly reduce the recruit-per-spawner for natural-origin fish spawning simultaneously with hatchery-origin fish, thus reducing the overall productivity of the "natural-origin" portion of the population.*

Recommendation IR-SC3: Re-evaluate the current sliding scale for passing hatchery-origin fish upstream of the current weir in the Imnaha River. Hatchery-origin spring/summer Chinook should be deliberately passed upstream of the weir *only* in low return years because approximately 40% of the returning adults, both hatchery and wild, are able to migrate upstream before the weir can be installed. Deliberately passing surplus hatchery-origin adults upstream to spawn naturally in medium and high return years is expected to significantly reduce the mean recruit per spawner of natural-origin adults that are spawning naturally in the Imnaha River (e.g., according to a Beverton-Holt spawner-recruit relationship). For example,

one possible adjustment to the sliding scale would preclude the deliberate passage of hatchery-origin adults whenever the predicted or expected number of natural-origin fish spawning upstream of the weir exceeds the population viability threshold established by the ICTRT. The escapement goal here should be focused more on maximizing the overall productivity and population viability of natural-origin adult spawners, and focused less on maximizing the total number of fish (hatchery + wild) spawning naturally. In general, sliding scales should include contingencies for not passing any hatchery-origin fish upstream when the predicted number of natural-origin recruits exceeds escapement goals. Construction of a new, permanent weir in the Imnaha River would be expected to greatly increase the efficacy of natural population management upstream of the weir (see Recommendation IR-SC7).

Issue IR-SC4: In 2009, the predicted number of hatchery-origin fish returning to the Imnaha River (n = 6,210 adults) is expected to exceed the LSRCP mitigation goal of the program (n = 3,210 spring/summer Chinook upstream of Ice Harbor Dam) by 3,000 fish. In 2008, the estimated number of hatchery-origin fish approximately equaled the mitigation goal. Incidental take restrictions combined with the current size of the program and recent smolt-to-adult returns (SARs) result in a surplus of hatchery-origin spring/summer Chinook returning to the Imnaha facility. *NOAA Fisheries allows 10% incidental take of the natural-origin Imnaha spring/summer Chinook population. As a result of incidental take restrictions, only 15% of the hatchery-origin spring/summer Chinook returning to the Imnaha River are harvested based on current fishing methods and effort.*

Recommendation IR-SC4: Establish numeric harvest goals consistent with incidental take restrictions and the resulting harvest effort in the Imnaha River. Establish other options for surplus Chinook (e.g. increased number to food banks, direct distribution of adults trapped at the satellite facility to tribes), increase harvest opportunities, or reduce the size of the program.

Issue IR-SC5: The relative genetic contribution of jacks (3-year old males) to each brood year is difficult to ascertain under current spawning protocols. *Spawning protocols at Lookingglass Hatchery are designed to maximize the genetic contributions of parents and the genotypic diversity among offspring. These goals are accomplished via the matrix spawning of males and females in 2x2, 1x2, and 2x3 (females x males) combinations. Jacks (3-year old males) are specifically included in the spawning matrices but with the requirement that they fertilize no more than 10% of the eggs for each brood year. When jacks significantly outnumber 4-year old males, the milt from up to six jacks may be pooled to fertilize one-third to one-half of the eggs of each female in the matrix (the milt from 2-6 jacks is treated like the milt from one 4-year old male in these situations). In general, these spawning protocols are commendable because they maximize the total number of males used in the broodstock; however, the actual proportion and total number of eggs fertilized by jacks are not reported, although the Grande Ronde River Spring Chinook Management Plan specifies the inclusion of jacks in the broodstock at a rate of 1 jack for every 5 "adult"(age > 3 years) males.*

Recommendation IR-SC5: Report the proportion (and/or number) of eggs fertilized by jacks for each brood year in annual reports.

Incubation and Rearing

See the Lookingglass Creek Spring Chinook section for recommendations regarding incubation and rearing.

Release and Outmigration

Issue IR-SC6: Spring/summer Chinook rearing density indexes (D.I.) during acclimation exceed fish culture guidelines (D.I. = 0.20), increasing the potential for stress and subsequent fish health issues. The maximum density index for the Imnaha Satellite Facility is D.I. = 0.26 when the spring/summer Chinook reach 20 fpp prior to release.

Recommendation IR-SC6: Reduce the acclimation rearing density so that it is within a maximum of D.I. = 0.2 until further evaluation identifies a more specific and optimum density index. Alternatives for reducing the rearing densities may include reducing the acclimation and release period or allowing the fish to volitionally outmigrate at any point during acclimation, direct stream release of all or a portion of the fish, increasing acclimation capacity, reducing fish size at release, or reducing the program size. Alternative release strategies should be evaluated comparatively (differential tagging) to determine which results in the best survival/contribution to broodstock and escapement.

Facilities/Operations

Imnaha Satellite Facility

Issue IR-SC7a: Due to high flows, the current picket and tripod weir cannot be installed at the beginning of the Imnaha spring/summer Chinook run, inhibiting broodstock and upstream passage management. *In some years, 40-50% of the run can pass the weir before it is installed. Broodstock cannot be collected before the weir is installed; therefore the broodstock does not represent the entire spectrum of the run. The number of hatchery-origin spring/summer Chinook that reach the spawning grounds before the weir is installed cannot be controlled.*

Issue IR-SC7b: The toe of the picket barrier is located upstream from the fish ladder entrance causing migrating fish to have to drop back from the barrier to find the fish ladder entrance creating potential fish delay problems. *The water flow and velocities exiting the fish ladder are insufficient to provide attraction to the fish ladder which becomes more pronounced at higher flow stages. The ladder is too small and the pools do not meet NOAA design criteria.*

Recommendation IR-SC7: Design and install a new weir and ladder that can be operated throughout the spring/summer Chinook run and meets NOAA design criteria. A new weir and ladder design has been proposed in the Northeast Oregon Hatchery (NEOH) process and should be evaluated.

Issue IR-SC8: The fish ladder is not covered, posing a liability risk to the Service and a safety risk to the public*. Although the facility is enclosed with a fence, the public regularly visits and tours the facility unguided, and tribal fishers use the facility grounds to access fishing areas.*

Recommendation IR-SC8: Install a cover over the ladder, such as a grated walkway.

Issue IR-SC9: The water intake screen for the acclimation and adult trapping facility does not meet NOAA Fisheries screening criteria. NOAA criteria require a screen mesh size of 3/32" and include parameters for water approach velocity, sweeping velocity, and screen angle. *Screens with a mesh size that may have been compliant were removed from the intake because*

they clogged with debris and were subject to icing posing a risk of catastrophic loss to the fish held at the facility.

Recommendation IR-SC9: Replace the water intake screen for the Imnaha Satellite Facility so that it complies with NOAA Fisheries criteria (mesh size, water approach velocity, sweeping velocity, screen angle, etc.). This may require modifications such as revolving drum screens within a heated enclosure to prevent debris accumulation and icing that could obstruct the water supply.

Issue IR-SC10: The size of the adult trap is not sufficient to accommodate the number of spring/summer Chinook that must be handled. Sorting and holding capabilities are limited*. For example, during broodstock collection, due in part to the limited holding capability of the trap, broodstock must be transferred to Lookingglass FH for holding and spawning more than once per week. To address these issues, ODFW is working to expand the adult trap/holding area into the acclimation pond (the trap is currently located at the tail end of the acclimation pond).*

Recommendation IR-SC10: Modify the adult trap as planned to increase the capacity of the facility for holding and sorting adult spring/summer Chinook.

Issue IR-SC11: The water intake screen and the head and tail screens of the acclimation pond ice over on especially cold days, thus requiring continuous monitoring and maintenance. *Although this situation only occurs periodically and for very short time periods (i.e. over a period of one week), icing poses a human safety issue and a risk of catastrophic loss to the fish reared in the pond. Currently, one staff person is on site 24/7 during acclimation.*

Recommendation IR-SC 11: Investigate options for de-icing the intake screen and head and tail screens. Consider having additional staff on-site during severe weather. Alternatively, consider alternative acclimation and release strategies to avoid the short period of time where icing is a problem. For example, transfer the spring/summer Chinook to the acclimation pond in late March/early April and reduce the acclimation and release period.

Issue IR-SC12: Facilities to accommodate volunteer staff are not present at the Imnaha Satellite Facility. *Volunteer staff are used at other facilities to provide interpretation and light maintenance support****.***

Recommendation IR-SC 12: Construct facilities such as an RV pad to accommodate volunteer staff.

Refer to Recommendations for Current Program>Facilities/Operations under Lookingglass Creek spring Chinook for recommendations regarding the Lookingglass FH.

Research, Monitoring, and Accountability

Also see LC-SC29 in the Lookingglass Creek spring Chinook section.

Issue IR-SC13: Adult, hatchery-origin spring/summer Chinook are transferred and outplanted annually from the Imnaha River to Big Sheep Creek and Lick Creek (up to 500 fish each).

At the present time, no monitoring and evaluation is conducted to determine whether the desired benefits of those transfers are realized.

Recommendation IR-SC13: If outplanting adult spring/summer Chinook in Big Sheep and Lick creeks continues after the goal and intended benefits dare defined (recommendation IR-SC2), develop a monitoring and evaluation program for Big Sheep Creek to assess whether those desired benefits are realized. The benefits versus risks of outplanting adult spring/summer Chinook into Big Sheep Creek should be assessed based on the status of spring/summer Chinook in that watershed. Discontinue outplanting adults into the Big Sheep Creek watershed if intended benefits are not realized or if they do not outweigh the risks of the transfers. In this latter situation, alternative benefits for surplus hatchery-origin adults trapped in the Imnaha River should be identified (e.g., direct transfer to the tribes for subsistence and ceremonial purposes).

Issue IR-SC14: A long timeline of data exists for spring/summer Chinook in the Imnaha River basin including early life history data initiated prior to the hatchery programs, pre and post-hatchery data (including Imnaha River conventional production), data on control streams with no direct hatchery influence, a Snake River basin wide assessment of supplementation programs, and initial data on the supplementation program using Imnaha River stock in the Imnaha River.

Recommendation IR-SC14a: Continue current monitoring and evaluation programs to continue developing long term data sets to assess the effects of hatchery supplementation of Imnaha River stock in the Imnaha River.

Recommendation IR-SC14b: Initiate a reproductive success study (pedigree analysis) in the Imnaha River using Imnaha River stock after a new weir capable of trapping most of the upstream migrants is constructed (recommendation IR-SC7).

Issue IR-SC15: A high proportion of hatchery-origin spring/summer Chinook adults return as jacks compared to the proportion of natural-origin adults that return as jacks.

Recommendation IR-SC15: Continue monitoring and evaluation studies such as hatchery growth rates, size and time at release to evaluate affects upon survival and age composition. Use this information to adjust the program according to program objectives.

Education and Outreach

Also see the Lookingglass Creek Spring Chinook section for recommendations regarding Lookingglass FH.

Issue IR-SC16: The Imnaha Satellite Facility lacks appropriate displays to provide information to tourists visiting the facility. Due to its location on a popular recreational access road, approximately 5,000 people visit the facility annually, significantly more than other Oregon LSRCP facilities.

Recommendation IR-SC16: Install displays that accurately describe the present state of salmon and steelhead and the Imnaha spring/summer Chinook program.

Issue IR-SC17: Current staffing levels cannot meet interpretation needs when tourist traffic is high. Only one staff person is on station.

Recommendation IR-SC17: Establish a volunteer program at the facility to provide interpretive tours for visitors as well as on station operational support (See also recommendation IR-SC12 to create an RV pad).

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing Imnaha River Spring/summer Chinook Program and developed eight alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the "no hatchery" option. Following these descriptions of alternatives, the Review Team has identified recommended alternatives.

Alternative 1: Current program with recommendations

Continue to propagate the Imnaha River stock of spring/summer Chinook, using conventional artificial propagation techniques and employing sliding scales for adult escapement and broodstock collection to reduce hatchery influence on the population as natural production increases. Maintain a release objective of 360,000 smolts annually of the Imnaha River stock. This alternative includes constructing a new, more efficient weir that can be installed at the beginning of the Imnaha spring/summer Chinook run so that the program can be managed as intended.

Pros

- Increases the abundance and distribution of spring/summer Chinook in the Imnaha River.
- Provide a genetic repository for the listed Imnaha River spring/summer Chinook population.
- Provides tribal and sport harvest opportunities on the Imnaha River.
- Provides surplus spring/summer Chinook to food banks.
- The newly constructed weir will increase management control of the program by allowing the collection of broodstock from the entire spectrum of the run and reducing the number of hatchery-origin adults spawning naturally.

Cons

- Current program size produces more adult fish than are currently harvested or can be used for conservation purposes.
- Current harvest rates and conservation concerns for fishery impacts to natural-origin fish in impedes harvest of hatchery-origin spring/summer Chinook that are in excess of broodstock or escapement needs.

- Requires a significant investment to construct a new weir on the Imnaha River.
- Adults outplanted into Big Sheep Creek and Lick Creek pose genetic, fish health and ecological risks to natural-origin spring/summer Chinook in those areas.
- Requires careful broodstock and upstream passage management to limit the domestication influence of hatchery-origin Chinook on the natural population.

Alternative 2: Reduce the program size to address Lookingglass FH facility constraints and increase production of Lookingglass FH spring Chinook

Reduce the program goal from 360,000 to 325,000 smolts annually to address facility constraints at Lookingglass FH and to meet the Team's recommended alternative to increase the number of smolts released into Lookingglass Creek (see issues LC-SC7, 8, and 11 and the recommended alternative in the Lookingglass Creek spring Chinook section). This includes implementing the Teams current program recommendations and constructing a new, more efficient weir that can be installed at the beginning of the Imnaha spring/summer Chinook run so that the program can be managed as intended.

Pros

- Maintains the abundance and distribution of spring/summer Chinook in the Imnaha River.
- Continues to provide a genetic repository for the listed Imnaha River spring/summer Chinook population.
- Continues to provide tribal and sport harvest opportunities on the Imnaha River.
- Continues to provide surplus spring/summer Chinook to food banks.
- The newly constructed weir will increase management control of the program by allowing the collection of broodstock from the entire spectrum of the run and reducing the number of hatchery-origin adults spawning naturally.
- Potentially increases the number of harvestable spring/summer Chinook available to support tribal and recreational fisheries in Lookingglass Creek and the Grande Ronde River.
- Lookingglass Creek has fewer biological risks and harvest opportunities and accessibility are potentially higher in the Grande Ronde River.
- Eliminates the transfer of fish from Lookingglass FH to Irrigon FH and associated fish health concerns.

Cons

- The reduced program size may continue to produce more adult fish than are currently harvested or can be used for conservation purposes.

- Current harvest rates and conservation concerns for fishery impacts to natural-origin fish in impedes harvest of hatchery-origin spring/summer Chinook that are in excess of broodstock or escapement needs.

- May not meet the "in-place, in-kind" intent of the LSRCP mitigation program and may reduce the number of adults available for harvest if it reduces the total number of spring/summer Chinook returning upstream of Lower Granite Dam.

- Requires a significant investment to construct a new weir on the Imnaha River.

- Adults outplanted into Big Sheep Creek and Lick Creek pose genetic, fish health and ecological risks to any natural-origin spring/summer Chinook in those areas.

- Requires careful broodstock and upstream passage management to limit the domestication influence of hatchery-origin Chinook on the natural population.

Alternative 3: Implement the NEOH component that provides a permanent facility on the Lostine River to rear a portion of the original 490,000 smolts for the Imnaha spring/summer Chinook program, thereby reducing fish culture constraints at Lookingglass FH

Develop a permanent hatchery facility on the Lostine River, as proposed as one component of the Northeast Oregon Hatchery proposal, and improve the Imnaha satellite facility. The following actions were proposed as components of the April 2004 NEOH Step II Revised Preliminary Design Report: (a) construct a new incubation and rearing facility on the Lostine River to accommodate a 250,000 smolt program for the Lostine/Wallowa River spring/summer Chinook program, incubation to eye-up of all eggs for the Imnaha River spring/summer Chinook program, and hatch/rearing to the yearling smolt stage of 245,000 fish for release into the Imnaha River; and (b) improve the existing Imnaha River satellite facility (new controlled weir type fish barrier, new fish ladder auxiliary water supply system, extend the adult trap and holding area, second acclimation pond, and other improvements). This action would resolve facility constraints at Lookingglass FH that currently prevents the spring/summer Chinook program for the Imnaha River from meeting its LSRCP smolt release objective as stated in the original LSRCP design criteria and US vs. Oregon. Under this proposal, half of fish to be released into the Imnaha River would remain at Lookingglass FH and the other half would be reared at the new hatchery on the Lostine River. This alternative also requires the construction of a new weir on the Imnaha River.

Pros

- Increases the abundance and distribution of spring/summer Chinook in the Imnaha River.

- Maintains a genetic repository for the listed Imnaha River spring/summer Chinook population.

- Meets the original production criteria identified to achieve the Imnaha portion of the LSRCP mitigation goal for spring/summer Chinook adult returns above Lower Granite Dam.

- An existing proposal that would achieve this alternative (NEOH) is in place. The proposal has been agreed to by the comanagers and received programmatic approval by the Northwest Power and Conservation Council.

- Reduces fish culture constraints at Lookingglass FH such as high densities during early rearing.

- Increases the number of spring/summer Chinook available for harvest in the Imnaha River.

- Reduces the number of hatchery-origin adults spawning naturally in the Imnaha River via a new weir.

Cons

- Current program size produces more adult fish than are currently harvested or can be used for conservation purposes.

- Increases the number of unharvested, surplus hatchery-origin spring/summer Chinook in the Imnaha River unless harvest demand increases and incidental take of natural-origin Imnaha spring/summer Chinook is reduced.

- Limited harvest opportunities in the Imnaha River may not justify increasing the number of smolts released.

- Requires a significant investment to construct new facilities, including a new weir on the Imnaha River, and requires significant funds for annual operations and maintenance.

- Increasing the number of fish released to 490,000 smolts would still not meet the LSRCP mitigation goal unless smolt-to-adult survivals are at least 0.66% in most years.

Alternative 4: Convert the current integrated program to a two-broodstock, stepping-stone program

Convert the current Imnaha River spring/summer Chinook program from an integrated to a stepping stone program. This could be accomplished at Lookingglass FH or the proposed NEOH facility by differentially marking the offspring of each broodstock where the offspring of the first broodstock (integrated component) would be coded-wire tag-only and the offspring of the second broodstock (harvest component) would be 100% adipose-fin clipped and a portion coded-wire tagged for monitoring. The program size would be approximately 120,000 smolts for the integrated component and 240,000 smolts[87] for the harvest component (see HSRG 2009 report for Imnaha River spring/summer Chinook; Appendix A). The integrated component would continue to provide fish for natural spawning escapement. This alternative requires the construction of a new weir on the Imnaha River and an improved holding and sorting facilities as proposed in the current program recommendations. Depending upon the level of harvest desired, Alternative 4 may require the expansion of existing or construction of new facilities (e.g. NEOH).

Pros

- Continues emphasis on the conservation benefits of the current integrated artificial propagation program.

[87] *The two components are divided to maximize the rearing space at Lookingglass FH currently dedicated to the Imnaha program (six raceways) and are sized to stay within the Team's recommended rearing densities (65k max per raceway).*

- Increases the likelihood that a properly integrated broodstock (i.e. of a smaller size) can be developed to meet conservation objectives in the Imnaha River.
- With a newly constructed weir, reduces the number of hatchery-origin adults spawning naturally.
- Potential to provide more fish for harvest from the harvest component of the program (Depending on allocation of rearing space and capacity at Lookingglass FH).
- This alternative provides one mechanism for achieving the mitigation goal of the NEOH program with a reduced conservation risk.

Cons

- Further complicates the operation of Lookingglass FH which currently raises several separate stocks for different programs.
- Requires a significant investment to construct a new weir on the Imnaha River and improve the holding and sorting facilities at the Imnaha satellite facility and likely at Lookingglass FH.
- Limited harvest opportunities in the Imnaha River may not justify an increase in the number of smolts released.
- The remote location and conservation concerns for natural-origin spring/summer Chinook in the Imnaha River limits harvest of hatchery-origin Chinook that are in excess of program needs.

Alternative 5: Rear spring/summer Chinook at Lookingglass FH only for release in Lookingglass Creek and the Imnaha River to meet mitigation goals for the Oregon portion of the LSRCP

See alternative 5 for the Lookingglass Creek Spring Chinook program.

Alternative 6: Reduce the size of the Imnaha River program with a greater focus on conservation benefits

Reduce the size of the Imnaha River program to 120,000[88] smolts with the intent of maintaining an annual broodstock size that is a minimum of 60 females and 60 males. The 120,000 smolt release is based on the capacity of the natural environment to return 1,000 adults back to the Imnaha River in the absence of a hatchery (i.e., a natural SAR of 0.83%). Alternative 6 may not require construction of a new weir. Use of the existing weir plus alternative adult collection methods (e.g. hook-and-line, net, traps), coupled with reduced numbers of returning hatchery-origin adults, may satisfy broodstock needs while reducing the number of hatchery-origin spring/summer Chinook accessing potentially spawning in the Imnaha River for a properly integrated program.

[88] *120,000 smolt release is consistent with the HSRG's recommendation of 115,000 smolts and takes into account the production capacity of individual raceways at Lookingglass FH at the Team's recommended rearing densities (65,000 max per raceway).*

Pros

- Improves conservation benefits in the Imnaha River.
- Allows for operation of a more efficient integrated program.
- Reduces the influence of hatchery-origin fish on the naturally spawning population.
- Reduces surpluses of fish returning to the Imnaha River and the Imnaha River weir.
- Reduces adult sorting and holding demands at the Imnaha River satellite facility.

Cons

- This alternative would not satisfy the LSRCP mitigation goal.
- Reduces the number of returning adult spring/summer Chinook available for harvest in the Imnaha River.
- May increase risks to other naturally spawning spring/summer Chinook populations where the number of released smolts is increased (e.g., Lostine River).
- Reduces the size of the demographic buffer afforded by hatchery fish during periods of low ocean productivity.

Alternative 7: Same as alternative 6, except transfer the rest of the production to the Grande Ronde River programs to increase harvest mitigation benefits there

Reduce the Imnaha River production program to 120,000[89] smolts - with the intent of maintaining an annual broodstock size of a minimum of 60 females and 60 males - and use the available space at Lookingglass FH for rearing additional spring/summer Chinook (e.g., Lookingglass Creek or Lostine River stock) for release into the Grande Ronde River to meet harvest and mitigation goals (see alternatives listed for Lostine River and Lookingglass Creek spring/summer Chinook programs). Alternative 7 is identical to the previous alternative; however, the Grande Ronde programs would be expanded to compensate for the reduced number of smolts released into the Imnaha River. Alternative 7 may not require construction of a new weir on the Imnaha River (see Alternative 6).

Pros

- Improves conservation benefits in the Imnaha River.
- Allows for operation of a more efficient integrated program.
- Potentially increases the number of returning adult spring/summer Chinook available to support fisheries in Northeast Oregon.

[89] *120,000 smolt release is consistent with the HSRG's recommendation of 115,000 smolts and takes into account the production capacity of individual raceways at Lookingglass FH at the Team's recommended rearing densities (65,000 max per raceway).*

- Returns more fish to the more accessible Grande Ronde basin versus the more remote Imnaha River to increase harvest opportunities.
- Reduces surpluses of fish returning to the less accessible Imnaha River.
- Reduces the influence of hatchery-origin fish on the naturally spawning Imnaha spring/summer Chinook population.
- Reduces adult sorting and holding demands at the Imnaha River satellite facility.
- Maintains the total number of spring/summer Chinook smolts released in NE Oregon streams at current levels established to meet LSRCP mitigation for spring/summer Chinook returns upstream of Lower Granite Dam.

Cons

- Does not meet the in-place in kind intent of the LSRCP mitigation program because this alternative reduces the number of spring/summer Chinook returning to the Imnaha River.
- May increase risks to naturally spawning spring/summer Chinook populations where the number of released smolts is increased (e.g., Lostine River).
- Reduces the number of adult spring/summer Chinook available for harvest in the Imnaha River.
- Reduces the demographic buffer afforded by hatchery fish to the Imnaha River population of spring/summer Chinook during periods of low ocean productivity.

Alternative 8: Terminate the program and decommission the Imnaha satellite facility

Decommission the satellite facility and terminate the Imnaha River spring/summer Chinook program in favor of alternative mitigation strategies such as habitat restoration, passage improvements, or alternative/expanded hatchery programs at other sites.

Pros

- Eliminates the influence of hatchery-origin fish on the naturally spawning population of spring/summer Chinook in the Imnaha River.
- Focuses effort on the real problems limiting spring/summer Chinook production in the Imnaha River (e.g. mainstem Snake and Columbia River mortalities, habitat constraints, etc.).
- Reduces fish culture constraints at Lookingglass FH.
- Eliminates the need for investing in new hatchery and related infrastructure (e.g. new weir and improved holding facility) to support the Imnaha River program.

Cons

- Decreases the abundance and distribution of spring/summer Chinook in the Imnaha River.
- Eliminates a genetic repository for the listed Imnaha River spring/summer Chinook population.
- Greatly reduces tribal and sport harvest opportunities on the Imnaha River.

Recommended Alternatives

The Team recommends Alternative 2: continue to propagate the Imnaha River stock of spring/summer Chinook via conventional artificial propagation techniques but modify the existing sliding scale for adult escapement and broodstock collection to reduce hatchery influence on the naturally spawning population upstream of the weir as the number of natural-origin adults returning to the Imnaha River increases. The intent of this alternative is to develop specific adult escapement goals and objectives for conservation of the spring/summer Chinook population in the Imnaha River upstream of the weir while also (a) maintaining a harvest component to provide for Tribal and recreational fisheries and (b) attempting to meet the LSRCP mitigation goal of 3,210 adults back to the Imnaha River. While the Team's recommended alternative proposes a slight reduction in the number of smolts released into the Imnaha River as prescribed under the current *US v. Oregon* agreement, this alternative is consistent with the intent of the mitigation and conservation goals of the LSRCP for the spring/summer Chinook in the Imnaha River.

Alternative 2 reduces slightly the size of the program to a release of 325,000 smolts annually to address facility constraints at Lookingglass FH and to meet the Team's recommended alternatives for the spring/summer Chinook programs in the Grande Ronde River basin. This small reduction in program size should not significantly affect achievement of harvest and conservation goals in conjunction with the Team's recommendations to adjust the escapement sliding scale to reduce the number of hatchery-origin fish passed upstream of the weir and to consider discontinuing the outplanting of surplus hatchery-origin adults if the activity cannot be justified (IR-SC2 and 3). Effective implementation of Alternative 2 also requires the installation of a new, more efficient weir that can be used to effectively manage adult passage upstream of the weir and to collect broodstock across the entire run.

The Team recognizes that the number of hatchery-origin spring/summer Chinook allowed to pass upstream of the weir - at the current program size, harvest rates, and recent smolt-to-adult survivals - are surplus to the natural escapement goals for the Imnaha population above the weir. Additional surpluses could result from implementation of other recommendations by the Team (e.g., IR-SC2 and IR-SC3) even with the recommended slight reduction in program size. These issues reinforce the need for a new weir as top priority, and for the comanagers to consider alternatives for managing the surplus fish (IR-SC4), especially if the program continues at its current size or is increased in the future.

Wallowa Hatchery Summer Steelhead

Operator: Oregon Department of Fish and Wildlife

Summary of Current Program

Goals

- ***Harvest goal:*** Provide sport and tribal fishing opportunities for summer steelhead in the Grande Ronde River, Snake River, its tributaries and downstream in the Columbia River. There is currently no quantified "harvest" goal for this program separate from the mitigation goals. The LSRCP mitigation goal for the program is to "return" 9,184 adults to the Snake River Basin upstream of Ice Harbor Dam

- ***Broodstock escapement goal:*** Collect and spawn 450 adult steelhead (180 winter/spring-trapped females and 45 fall-trapped females) at the Wallowa FH.

- ***Conservation goal:*** The program has no conservation goal. This is a segregated-harvest program.

- ***Escapement goal for natural-origin adults:*** Interim minimum abundance thresholds developed by the ICTRT for natural-origin steelhead in the project areas are as follows.

Lower Grande Ronde	B	Intermediate	1,000
Joseph Cr.	B	Basic	500
Wallowa R.	B	Intermediate	1,000
Upper Grande Ronde	B	Large	1,500

- ***Research, education, and outreach goals:*** Provide accurate information and educational (I/E) opportunities for the public, media, schools, Tribal, State, and Federal agencies, and elected officials to enhance participation in understanding and stewardship of Irrigon FH, Wallowa FH, and LSRCP programs. New research: Evaluate the ability to develop an early returning or "fall-returning" steelhead broodstock back to the Wallowa FH.

Objectives

- Collect and spawn 450 adults (180 males and 180 females collected in the winter/spring at Wallowa FH and 45 males and 45 females caught in the fall in the Grande Ronde River) to yield produce approximately 1,13 million green eggs or 1.02 million eyed eggs at Wallowa FH.

- Incubate the fertilized eggs to the eyed stage at Wallowa FH.

- Transfer approximately 1.02 million eyed eggs from Wallowa FH to Irrigon FH. Hatch the eggs at Irrigon FH and raise the fish to the yearling smolt stage to yield 800,000 smolts

(640,000 smolts from winter/spring-trapped adults and 160,000 smolts from fall-trapped adults).

- Transfer 480,000 smolts from Irrigon FH to the Wallowa FH acclimation site for release (320,000 winter- spring smolts and 160,000 fall smolts[90]) in two phases: the first in late February and the second in late April. Force-release the first group in early April and volitionally release the second group for 10-14 days from the end of April to mid-May, after which time the smolts are force released.

- Transfer 320,000 winter-spring smolts from Irrigon FH to the Big Canyon Satellite Facility for release in two phases: the first in late February and the second in late April. Force-release the first group in mid-April and volitionally release the second group for 10-14 days from the end of April to mid-May, after which time they are force released or removed if greater than 70% of the remaining fish are precocious males.

- If greater than 70% of the remaining fish are precocious males, all the fish are retained and transferred to a closed water body for recreational fishing (e.g., Wallowa Wildlife Pond or Victor Pond) to reduce the number of steelhead that would have a high likelihood of residualizing if released into the watershed.

Program Description

The Wallowa Hatchery stock of steelhead originated from collections of adults during the spring at Ice Harbor (1976) and Little Goose (1977, 1978) dams and included transfers of eyed eggs from Pahsimeroi Fish Hatchery (ID) in 1979. Since 1979, steelhead adults returning to Wallowa FH, Big Canyon facility, and the Cottonwood Creek trap have been used for broodstock. ODFW has attempted to maintain a stable return timing through inclusion of adults from across the run. The current broodstock consists of approximately 80% winter/spring fish and 20% fall returning fish collected from the Lower Grande Ronde River during the early fall and at existing trapping facilities.

Adult steelhead are collected for broodstock from among fish returning to Wallowa FH. Adults are spawned and the fertilized eggs incubated to the eyed stage at Wallowa FH. Eyed eggs are transferred to Irrigon FH for hatch and grow-out to the yearling stage. Approximately 480,000 and 320,000 yearling smolts are transferred from Irrigon FH to Wallowa FH and the Big Canyon facility, respectively, for acclimation and release.

Irrigon FH currently raises 800,000 summer steelhead smolts for release at the Wallowa FH (480,000) and Big Canyon Satellite Facility (320,000) in the Grande Ronde River Basin. All juvenile steelhead are marked with adipose fin clips, and a portion of each release group receives left or right ventral fin clips and coded wire tags. Steelhead harvest in the Grande Ronde River Basin is managed as a mark-selective fishery.

[90] *Smolt offspring of adults trapped in the fall are hereafter referred to as "fall smolts", and offspring of adults trapped in the winter and spring are referred to as "winter-spring smolts. Similarly, adult offspring of adults trapped in the fall are hereafter referred to as "fall adults", and offspring of adults trapped in the winter and spring are referred to as "winter-spring adults.*

Assessment of Current Program

Operational Considerations[91]

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- The Wallowa FH steelhead represent a segregated hatchery stock that is not included with the ESA-listed Snake River steelhead DPS.

- The Wallowa stock originated from collections of adults during the spring at Ice Harbor (1976) and Little Goose (1977, 1978) dams and included eyed eggs from Pahsimeroi Fish Hatchery (ID) in 1979.

- Currently, 80% of the smolts released are the progeny of winter-spring broodstock, and 20% of the smolts are the progeny fall returning adults.

- Fall-returning females are the progeny of fish originally caught by hook-and-line from the Lower Grande Ronde River during the early fall (caught in years 2002-2006).

- The fall-returning component was originally developed to determine whether or not they can develop an early-returning stock with lower stray rates. Managers are also investigating whether or not the fall-returning component can improve the fall steelhead fishery in the Grande Ronde basin.

- Age and size composition among returning adults do not differ significantly between winter-spring steelhead and fall steelhead. Stray rates between the two groups of fish do not differ significantly based on current data.

- Approximately 110 adult steelhead are collected in October for the fall broodstock. Those fish are held on well water for four to five months in the hatchery brood ponds prior to spawning. Formalin treatments for treating fungus are not necessary or applied. Fall-trapped adults are spawned at the same time as the winter-spring adult, March through early May.

- The Wallowa FH trap is installed when winter conditions allow, typically in February. Adult fish collections continue until no fish are caught for 10 consecutive days, typically by the end of May.

- The majority of surplus adult fish are distributed to food banks or stocked into local fishing ponds in Union and Wallowa Counties in northeast Oregon. Approximately 260 fish are stocked annually from adult returns to the Big Canyon facility and Wallowa FH . Fish not outplanted or given to food banks are buried at the Wallowa Hatchery.

- Unmarked adults – presumed to be natural-origin fish - trapped at Wallowa FH are transported to the Fish Hatchery Lane Bridge, about one mile downstream of Wallowa FH, and released

[91] *See Appendix B of this document for supporting background information and references.*

after bio-sampling and collection of data. The purpose of these transfers is to give natural-origin fish an additional opportunity to spawn naturally in the Wallowa River. About 10-30 unmarked fish are trapped annually at Wallowa FH. Bio-samples include small amounts of tissue (from opercle punch) and recording of sex, and length. The genetic work performed on the unmarked fish returning to Wallowa FH indicates that roughly 70% of the unmarked adult fish appeared to be Wallowa stock hatchery fish and 30% are natural-origin fish representing unidentified populations within the Snake River steelhead DPS.

- Adult steelhead return with non-debilitating infections of *M. cerebralis* (agent of whirling disease), likely obtained as smolts when exposed to the parasite-endemic waters of the Wallowa River and Spring Creek.

- The adult bypass ladder is managed during steelhead runs so that no steelhead are intentionally passed upstream of the weir at Wallowa FH. The hatchery is located on Spring Creek, a tributary to the Wallowa River. The water intake for the facility draws water from upstream of the weir. Fish are not intentionally passed upstream of the weir in part to prevent pathogen transmission to the fish reared on station. However, the ladder is open the remainder of the year and can allow an occasional adult Chinook to pass, while juvenile anadromous fish can pass upstream (or downstream) of the weir at any time of the year.

- The Big Canyon trap is installed when winter conditions allow, which is typically in early-February. Collections of adult fish continue until no fish are caught for 10 consecutive days.

- At the Big Canyon facility, all unmarked fish are passed upstream of the weir in Deer Creek. No hatchery-origin fish are intentionally passed above the weir on Deer Creek at the present time. Tissue samples were taken for genetic analyses for several years. Early results indicate that the Deer Creek population has been influenced by the Wallowa hatchery stock. Wallowa FH steelhead were passed upstream above the weir in the early years of the program.

- Otoliths from carcasses that fall back over the weir are taken for potential strontium/calcium analyses (only a couple fish per year). Samples are taken to compare resident/anadromous life-history traits for the Deer Creek population.

- Hatchery-origin adult fish collected at the Big Canyon trap are stocked in local fishing ponds, "recycled" alive to downstream locations to support recreational fisheries in the Wallowa River (100 fish total over several weeks, see below), or transferred to Wallowa Hatchery to supplement the program's broodstock. Adult fish from the Big Canyon facility are normally not required for broodstock unless there is a shortfall of returning adults at Wallowa FH. Broodstock "backfills" from the Big Canyon facility have not occurred in 15 years. Occasionally, returns to Big Canyon or Wallowa FH have been used to backfill the WDFW Cottonwood Creek program (twice in the last ten years).

- Starting in late February and continuing through April 11, approximately 100 fish are "recycled" to a downstream location in the Wallowa River to in the fishery. Recycled fish are uniquely marked with an opercle punch and outplanted at the Minam boat ramp, downstream of the Big Canyon facility. Re-captures will be processed to food banks or landfill. The habitat between the Minam boat ramp and the Big Canyon weir is not considered to be steelhead spawning habitat.

- For the 2005-2006 run year, 130 steelhead were recycled. Sixty-six of those fish were recaptured at the weir and seven were harvested. Fifty-seven steelhead were not accounted for. For the 2004-2005 run year, 36 steelhead were recycled. Eighteen of those were recaptured at the weir and 13 were harvested.

Hatchery and Natural Spawning, Adult Returns

- Based on recent analyses, the Wallowa stock strays into the Deschutes and John Day rivers at a higher rate than other stocks of steelhead from the Snake River basin. For run years 1993/1994 through 2004/2005, an average of 586 (range = 143-1,365) Wallowa stock steelhead released by ODFW in the Grande Ronde River were recovered as strays outside the Snake River Basin (based on PSMFC and ODFW mark recovery databases). Wallowa stock steelhead recovered as strays outside the Snake River Basin averaged 6.0% (range = 1.4%-11.5%) of the total estimated harvest and escapement by run year for the ODFW program. In contrast, an average of only 14 Little Sheep Creek hatchery-origin steelhead were recovered as strays (range = 0-56 fish), or 0.88% of the total estimated harvest and escapement by run year for this latter program. A recent study indicates that the downstream barging of juvenile steelhead may result in stray rates that are two to three times greater than those for juveniles that were not barged.[92] Increased stray rates may also be influenced by higher water temperatures in the Columbia River.[93]

- Currently, there is no evidence that stray rates are lower for the fall-returning group compared to the production group. However, these initial results are based on only two years of data.

- Stray rates for fish released from the Big Canyon facility are similar to those of fish released from the Wallowa FH.

- Trapping on Lookingglass Creek, the Upper Grande Ronde River, and Catherine Creek indicate very little straying of Wallowa hatchery steelhead into the Grand Ronde River upstream of the confluence of the Wallowa River. In 2002-2005, of the 1,800 steelhead trapped at those spring Chinook facilities, only 14 steelhead were hatchery-origin. Of the 4,348 steelhead trapped at the Big Canyon and Wallowa FH traps, only 13 steelhead were strays from the other facility.

- Although only two years of data exist at the present time, data collected at Bonneville Dam indicate that the adult progeny of fall-returning fish enter the Columbia River earlier than the progeny of winter/spring-returning fish. ODFW managers also indicate that the adult progeny of fall-returning fish are contributing to fisheries in the Grande Ronde River for a longer period of time than the adult progeny of winter/spring returning fish.[94]

- Adult steelhead retained for broodstock are taken directly from the Wallowa FH trap and spawned once per week for six or seven weeks, beginning in mid-March.

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[92] *Keefer, ML, C. Caudill, C. Peery, S. Lee. 2008. Transporting Juvenile Salmonids Around Dams Impairs Adult Migration. Ecological Applications. Vol 18(8). p. 1888-1900.*

[93] *Keefer, ML. C. Peery, B. High. 2009. Behavioral thermoregulation and associated mortality trade-offs in migrating adult steelhead (Oncorhynchus mykiss): variability among sympatric populations. Canadian Journal of Fisheries and Aquatic Sciences. Vol. 66. p. 1734-1747.*

[94] *Rich Carmichael, ODFW, pers. comm.*

- "Fall adults" and "spring adults"[95] return to the Wallowa FH trap at approximately the same time. Adults are distinguished during spawning by left versus right ventral clips.

- A total of 450 adults should be spawned to meet smolt release objectives. The current protocol is to spawn 225 males (180 winter/spring adults and 45 fall adults) and 225 females (180 winter/spring adults and 45 fall adults).

- Adult spawning, fertilization, and egg incubation to the eyed stage all occur at Wallowa FH. All eyed eggs are transferred to Irrigon FH for hatch and grow-out to the yearling stage.

- One day per week, during spawning season, adults are automatically crowded and lifted to a CO_2 bath, sorted and ripe fish are sent through a pneumatic fish stunner.

- A 1:1 male to female ratio is used during spawning. Fertilized eggs are loaded into Heath trays at 1 female per tray (at approximately 5,100 eggs per tray). Eggs collected from fall-returning broodstock are segregated from winter/spring eggs. Males from fall-returning broodstock may be used twice during the spawning protocols.

- During spawning at Wallowa FH ovarian fluid is drained, eggs are fertilized and then water hardened in 100ppm iodophor for a minimum of 15 minutes.

- The ovarian fluid is drained off the eggs during spawning to help reduce potential transmission of *Flavobacterium psychrophilum* (agent of coldwater disease)

- The eggs are water-hardened in iodophor (100 ppm) to reduce/prevent vertical transmission of virus and other pathogens (e.g., such as *Flavobacterium psychrophilum*).

- Water flow from the Wallowa River is diverted through the trap and ladder at Wallowa FH. The trap can hold up to 500 adults.

- Pre-spawning mortality of adults is estimated at 1 % for females and 2% for males.

- Spawners are selected randomly from among ripe fish sorted on spawning day. Adults are typically not held in the trap for more than one week.

- Spawning effluent is typically routed to a holding tank which is periodically pumped out and trucked off station. If the holding tank is not used, the effluent is sent to the facility's abatement pond.

- For fish health sampling, ovarian and tissue samples are taken from up to 20 females of every spawn take of the winter/spring fish. All spawned fall-returning females are sampled. The adults (females only) are sampled for viruses (e.g. IHN) and reportable bacterial pathogens. Adults are not screened for BKD because this clinical disease does not occur in the Wallowa hatchery steelhead stock and it is not required by ODFW fish health policy. Culling for IHNV because prevalence of the virus is very low (from 2000 to 2009, prevalence averaged 1.5%, with a range of 0 to 7.8%); therefore, eyed eggs of all spawned adults are retained.

[95] *Adult of offspring of fall-returning and winter/spring returning adults, respectively.*

Incubation and Rearing

- Wallowa FH incubation facilities consist of 216 vertical incubation trays. Wallowa steelhead eggs are incubated on a mixture of well (56^{o} F and D.O. = 8.4) and spring water (42-53^{o} F and D.O. = 9.8) at 5,100 eggs per tray and 4.0 GPM. At times, steelhead eggs are loaded at 2 females per tray if incubation space is needed to support other programs. The percentage of well water can be increased to accelerate eye up when necessary.

- Green eggs are treated with formalin at the target dose of 1667 ppm (1:600) for 15 minutes. Treatments occur two times per week and have shown to prevent excessive fungus problems.

- Average survival to the eyed-egg stage is 89.5% (2003 – 2008). Average survival from eyed egg to smolt is 77.9% (2003 – 2008).

- Eyed Wallowa steelhead eggs are transferred to Irrigon FH in April and May to avoid exposure to *Myxobolus cerebralis*, the causative agent of whirling disease. Upon arrival at Irrigon FH, eyed eggs are disinfected in 75 ppm iodophor for 10 minutes. Irrigon FH receives approximately 1,027,000 Wallowa stock eyed eggs from Wallowa FH.

- *Myxobolus cerebralis* is prevalent in the Wallowa River and Spring Creek water sources for Wallowa FH.

- Steelhead are transferred to Irrigon FH in part due to space constraints at Wallowa FH and in part to the presence of whirling disease in the Wallowa River watershed, including Spring Creek. Whirling disease is endemic to the Wallowa River. Irrigon FH utilizes well water for rearing, avoiding the potential for the presence of whirling disease.

- Winter/spring steelhead are reared separately from the fall steelhead until the fish are differentially marked.

- At Irrigon FH, Wallowa steelhead eyed-eggs are loaded into 20, 12-tray incubator units at 10,000 eggs per tray (120,000 eggs per unit total). The flow rate for each unit is 5 gpm. Both chilled (42 degree) and un-chilled (~54 degree) well water is used. Variable water temperatures are used to synchronize hatching and ponding.

- Wallowa steelhead eggs are incubated in April and May.

- Newly-hatched fry are transferred from the incubator trays to the indoor nursery tanks at about 950 TU and 2,800 fish per pound at Irrigon Hatchery. Forced ponding occurs in mid to late June.

- Fry are initially reared in indoor nursery tanks (6’ diameter x 3’ deep circular fiberglass) with a water capacity of 57 cu.ft. (at 2 feet depth).

- Approximately 900,000 Wallowa steelhead fry are loaded into approximately 28 (of 56 total) indoor tanks at 40,000 fish per tank. Maximum density index (DI) in the tanks is D.I. = 0.83 at 400 fpp. Maximum flow index (FI) in the tanks is F.I. = 1.9.

- The water exchange rate in the nursery tanks is 2.27 exchanges per hour. Total flow required is 910 gpm.

- Maximum pounds of fish per tank is 85.5 lbs. (at 400 fish per pound).

- In mid-July, when the fish reach 400 fpp, they are transferred into 20 (of 32 total) outdoor concrete raceways (100' x 20' x 3.5') with a capacity of 140,000 cubic feet.

- Maximum density in the raceways is D.I. = 0.15. Maximum flow index in the raceways is F.I. = 0.71. The raceway water exchange rate per hour is 1.77 exchanges/hour at 1,543 gpm. Pounds of fish per gpm is 5.67, and pounds of fish per cubic foot is 1.2l. Total water flow is 24,688 gpm (40cfs) for the Wallowa steelhead program at Irrigon FH.

- Juvenile steelhead are reared on well water (seasonal temperature variations 50°F to 62°F).

- Dissolved oxygen levels are monitored during peak production and maintained greater than 6 ppm at the outfall of the lower raceways, by increasing flows or adding liquid oxygen. Liquid oxygen is used from mid-December through February. The liquid oxygen increases the incoming water's dissolved oxygen level by 2 ppm (from ~10 to 12 ppm).

- Raceways are broom cleaned weekly and dead fish are removed daily.

- Cleaning effluent water is routed to the abatement pond. Raceway water outflows directly into the Columbia River.

- Fish are started on Bio Diet Starter then switched to Silver Cup Salmon (extruded feed) from 800 fpp to smolt. Feed rate starts at 5.0% body weight per day (BWD) and by the end of the rearing cycle is down to 0.9% BWD. Feed conversion is normally 1:1.

- In September, both Wallowa and Little Sheep Creek stock steelhead are adipose-fin clipped. In October, steelhead are ventral clipped and coded-wire tagged. PIT tagging occurs as early as December and as late as January.

- Losses from coldwater disease usually occur after ponding into the indoor circular tanks in late June/early July. The prevalence is the same for the Wallowa and Little Sheep Creek stocks.

- Coldwater disease has required antibiotic treatment in six of the last eight years. When needed, juvenile fish are treated with florfenicol (Aquaflor) to control coldwater disease while in the circular tanks. Prior to 2008, florfenicol used at 15 mg/kg for ten days (on fish pills) had been effective in controlling disease before the fish were moved into the outdoor raceways. In June 2008, an outbreak of coldwater disease occurred in both the Wallowa and Little Sheep Creek stock steelhead, and - in accordance with new regulatory mandates - fish were treated with a lower dosage of florfenicol (10 mg/kg) beginning July 1st & 8th for 10 days. A repeat antibiotic treatment was required to control the disease in August after fish were moved into the raceways.

- Examinations for *Myxobolus cerebralis*, agent of whirling disease, are conducted annually on 60 fish held for a minimum of 180 days at the facility.

- Monthly fish health examinations are conducted on each lot of juvenile steelhead. A minimum of five healthy-appearing fish and a combination of ten moribund, fresh-dead or frozen fish (if available) are sampled per fish lot.

Release and Outmigration

- Yearling steelhead are transferred to Big Canyon and Wallowa FH at 5 fpp.

- A pre-release fish health exam is done at Irrigon FH to check for viruses and other pathogens. This is done according to ODFW fish health policy, no more than six weeks prior to transfer. At the acclimation sites, fish health is monitored through to release.

- The steelhead are transferred in 5,000 gallon tanker trucks at 1 pound of fish per gallon of water.

- All Wallowa stock steelhead are released as yearling smolts, about 12-14 months after the parents were initially spawned.

- All steelhead smolts for the program are planned for a release size of 4.5 fpp.

- Steelhead are sampled for length and weight at each acclimation site prior to release. Samples are taken to ensure that 90% of the population is over 170mm in length. The mean (2005-2009) coefficient of variation (CV) is 9.7 for the Wallowa steelhead stock. The Wallowa stock is size-graded during the rearing cycle at Irrigon FH to reduce size variation.

- **Wallowa FH Acclimation**: Approximately 480,000 smolts are released from the Wallowa acclimation site, 360,000 smolts in the "early" group and 120,000 smolts in the "late" group. The early group is transferred in to the acclimation site around the third week of February and fish are forced-released at the end of the first week of April. The late group is transferred into the acclimation site in mid-April and fish are volitionally released through the first week of May.

- **Big Canyon Acclimation:** Approximately 320,000 smolts are released from the Big Canyon acclimation site, 160,000 smolts in the early group and 160,000 smolts in the late group. The early group is transferred in to the acclimation site in late February or early March depending on temperatures and ice conditions. Fish are typically force-released the second week of April. The late group is transferred into the acclimation site in mid-April and fish are volitionally released through the second week of May.

- Near the end of the release period for the second group, before the remaining fish are force released, as a best management practice, the remaining steelhead are sampled and removed if greater than 70% of the fish are males. When greater than 70% of the fish are males, this results in about 1,000 fish being removed instead of released. This is one approach applied in steelhead programs in attempt to reduce the number of steelhead released that have a high likelihood of residualism. Other management practices include weekly visual checks during volitional release to quantify the number of steelhead that are in the process of smolting based on morphological factors. If a large proportion of the fish are not at the appropriate smoltification stage, the fish are removed.

- Steelhead are sometimes transferred to the Big Canyon acclimation site during extreme cold periods. Significant stress-related mortality (12,000 fish loss in 2009) has occurred following the transfer even though tempering of the transport truck water does occur during the transfer.

- Attempts are made to reduce the number of Wallowa FH steelhead that residualize in the Grande Ronde basin. 1) see release measures in objectives section and 2) there is a selective fishery for adipose-fin clipped residual steelhead (called rainbow trout in fishing regulations) in the Wallowa River in attempt to reduce the number of residualized hatchery steelhead in the watershed.

- The four Columbia River and four Snake River dams significantly reduce the survival of outmigrating juveniles and returning adults, posing a demographic risk to the return of sufficient numbers of adults for harvest on a consistent basis.

Facilities and Operations

Irrigon Hatchery

- The hatchery water supply is provided from five wells that can deliver a total of approximately 21,000 gpm. Water rights and design capacity is about 25,000 gpm. The 21,000 gpm is available year round. Well water is pumped by 13 pumps to an aeration facility which aerates incoming rearing water prior to distribution to the hatchery building and outside raceways. The pumps are used variably to control the water flow. Two of the pumps have variable speed.

- Dam operators are considering lowering the pool behind the John Day Dam, adjacent Irrigon FH. Lowering the pool will likely result in the facility being able to draw less than 21,000 gpm; however, the pool will only be lowered in the spring and summer, when water demands for the facility are low.

- The lowest water use occurs in June when only 2,400 gpm is needed. Water use increases as production demands require.

- Liquid oxygen is used in the aeration facility from December through March to increase dissolved oxygen in the well water. Tank levels in the liquid oxygen system are monitored daily and dissolved oxygen is measured in the facility's effluent water on a weekly basis.

- The hatchery conducts NPDES monitoring and is compliant.

- The Oregon Department of Environmental Quality (ODEQ) administers, under authority delegated from EPA (primacy), the NPDES permits in Oregon. The General Permit for Fish Hatcheries expired in September 2007. The ODFW has applied for a new NPDES permit.

- Approximately twenty, 12-tray incubation stacks are used for the Wallowa steelhead program at Irrigon FH.

- The main hatchery building includes sixty eight -6'diameter x 2.42' depth circular fiberglass tanks of which 56 are in the room used to rear Wallowa steelhead and 12 in the room used to rear Little Sheep Creek stock steelhead.

- The outside concrete raceways used for steelhead rearing include thirty two raceways which are 100' x 20' x 5' with a capacity (at 3.5' water depth) of 7,000 cubic feet per pond. Two banks or raceways exist, 16 upper and 16 lower raceways in series. Water flows from the upper series of raceways and is re-used in the lower series prior to discharge.

- There is no temperature monitoring system that alarms hatchery staff if the chiller unit fails to cool the water. There is a power failure alarm; however the chillers have no backup power supply. However, power outages are infrequent during incubation.

- Filling fish transport trucks diverts water from the incubation chilling system. When this occurs, the supply of chilled water to the eggs in the incubation room decreases resulting in a periodic (a few hours), 10 degree increase of temperature in the incubation stacks.

- Incubation stacks are old and due for replacement. Tray screens must be repaired annually.

- The raceways are enclosed in bird netting. However, the design of the mechanisms for raising and lowering the side nets allow birds access to the ponds. Herons are of primary concern.

- There are no shade covers over the raceways.

- Unique pneumatic automated feeders are used at Irrigon FH.

- Raceway cleaning requires increased water use to ensure that sufficient fresh water is available to the downstream raceway during cleaning. During peak production, when cleaning, total water use does not exceed 21,000 gpm.

- The pollution abatement pond likely has not been cleaned since the facility was built in 1984. There may be sediment accumulating in the pond. The pond cannot easily be drained since the water level in the river is higher than the bottom of the pond.

- The facility alarm system is antiquated. ODFW is in the process of updating the system.

Wallowa Hatchery

- Wallowa FH has a weir and fish ladder located on Spring Creek, an adult holding pond, and spawning facility. The adult holding pond is 80' x 20' x 4.0' (7,200 cubic feet volume).

- Water rights for the entire hatchery total 23,813 gpm from several sources (Spring Creek, Wallowa River water, two springs and two wells). The facility also has a water right for Hurricane Creek, which is currently not used. Water diversions are reported to ODFW headquarters, but water diversion for LSRCP programs is not reported to the US Fish and Wildlife Service's Water Resources Division

- The incubation room receives water from the springs and wells.

- The adult concrete trap is 25' x 8.6' x 5.0' (931 cubic feet volume).

- The adult holding pond is 80' x 20' x 4.0' (7,200 cubic feet volume).

- The main hatchery building includes 288 vertical Heath tray incubators.

- The hatchery is staffed with 3 FTE's. A Hatchery Host is on site from April through September as part of the State's volunteer program.

- An RV pad with full hook up is on site for volunteers to use.

- The facility meets NPDES requirements. The ODEQ administers, under delegated authority from EPA (primacy), the NPDES permits in Oregon. The General Permit for Fish Hatcheries expired in September 2007. The ODFW has applied for a new NPDES permit.

- The screens on the Wallowa River and on lower Spring Creek were replaced within the last 5 years and are compliant with NOAA's screening criteria.

- Two large raceways/ponds are not used since they have no adequate water supply. Maintenance of these raceways is not funded by LSRCP.

- The flow alarm system for the incubation and adult holding areas are adequate.

- Although there is a perimeter fence for security, there is no bird wire or predation fencing. Bird and mammal predation is not significant at this facility.

Wallowa FH – Acclimation Pond

- There are two concrete acclimation ponds 300' x 42' x 3.50' (44,100 cubic feet volume).

- The acclimation ponds receive water from Spring Creek.

- The upper Spring Creek intake screen which supplies the acclimation pond is 1/8" mesh and does not meet the NOAA screening criteria. It is believed there are bull trout upstream of the intake and there are fish ladders to allow anadromous fish upstream as well.

- The water flow alarm system is adequate. The water intake itself doesn't have an alarm; however, the ponds contain alarm probes. The pond outflow is designed so that the water will drop and set off the alarm if the flow is cut off.

Big Canyon Acclimation Facility

- Big Canyon Satellite Facility has a fish barrier and fish ladder located on Deer Creek, an adult holding pond, spawning shelter, and staff housing.

- Big Canyon Satellite Facility has two 150' x 30' x 3.50' concrete acclimation ponds for a total of 31,500 cubic feet.

- The adult holding pond is 30' x 10' x 4.50' (1,350 cubic feet volume). Water rights total 5,835 gpm from Deer Creek. Water diversions are reported to ODFW headquarters, but not to the Fish and Wildlife Service's, Water Resources Division

- Staff remain on-station 24/7 during acclimation and release, and throughout the adult return period (February-June). Flow alarm systems are adequate.

- Extreme cold and ice-up of the water intake and inflow and outflow of the acclimation ponds creates problems early in the acclimation season. Intake screens are pulled when they ice up. Pond screens tend to have enough flow even when icing is an issue.

- ODFW is considering investigating the potential for installing a well to de-ice the intake and temper the water to reduce stress-related mortalities that the steelhead periodically experience during extreme cold conditions.

- The water intake screen is NOAA compliant.

- No NPDES permit is required for this facility.

Research, Education, and Outreach

- Both Wallowa and Big Canyon releases are used for Comparative Survival Studies (CSS).

- Current tagging regimes are as follows:

  Wallowa FH
  - 100,000 Ad, RV, CWT (fall-returning/experimental)
  - 60,000 Ad, RV (fall-returning/experimental)
  - 100,000 Ad, LV, CWT (production)
  - 220,000 Ad only
  - Of the above, 12,700 fish are PIT tagged in representative groups from each raceway that has coded-wire tagged fish (of these 3,800 are CSS).

  Big Canyon:
  - 50,000 Ad, LV, CWT
  - 270,000 Ad only
  - Of the above, 10,000 fish are PIT tagged in representative groups from each raceway that has coded-wire tagged fish (of these 3,200 are CSS).

- Mark/recapture data provides valuable information on harvest rates (tribal and sport), stray rates, and smolt-to-adult survival rates.

- Extensive evaluation of straying to within-basin natural production areas occurs. Lookingglass Creek, Catherine Creek, upper Grande Ronde River, and Lostine River weirs are used to evaluate stray rates within the Grande Ronde River. For run years 1993/1994 through 2004/2005 an average of 21 (range = 0-87) Wallowa stock steelhead (ODFW) recoveries were identified as within Snake River Basin strays accounting for an average of 0.28% of the total estimated harvest and escapement recoveries by run year.

- All facilities have visitor information centers or displays which provide accurate information and educational opportunities for the public. Irrigon Hatchery receives approximately 4,000 visitors annually.

- Irrigon FH staff provide tours, primarily to student groups. Staff do not participate in any off-station educational or outreach activities.

- The LSRCP and state visitor information signage is dated. ODFW is currently working to redo the state-managed educational signage at all of their facilities.

- Irrigon FH information is maintained on the LSRCP web site. ODFW does not have a web page dedicated to Irrigon FH. General information and an abridged version of the operation plans are posted on an ODFW hatcheries page; however, current program information is not available.

- There is a public fishing dock on the hatchery grounds at Irrigon FH.

- Data on fish production are recorded in Oregon's Hatchery Management Information System (HMIS) which is a computerized system to collect, report, summarize and analyze hatchery production data. This system is a tool to be used in production control at all hatchery management levels.

- There is a significant creel survey effort associated with both the Wallowa and Little Sheep Creek programs.

- Since 2007, ODFW fish health personnel have conducted pathogen surveys of wild fish in Baker County watersheds, sampling fish from screw traps in NE Oregon and Wallowa Lake. Parasite (including *M. cerebralis*) and virus testing of the collected fish provide baseline assessments of pathogen loads in wild/naturalized fish populations.

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,[96] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- The Wallowa stock steelhead program provides recreational and tribal harvest within the Grande Ronde Basin. Estimates of harvest of Wallowa steelhead in the Grande Ronde River Basin from run years 1993/1994 through 2004/2005 averaged 2,381 fish (range = 760-4,820) per year.

- Estimates of harvest (1993/1994-2004/2005) of Wallowa steelhead outside the Grande Ronde River Basin but within the Snake River project area averaged 2,352 fish (range = 759-3,874) per year.

- Estimated harvest (expanded from CWT recoveries) within the project area of Wallowa stock steelhead (for both release locations for return years 2003-2005) accounted for 90.7% of the total estimated harvest on the stock (9.3% below the project area).

- Provides significant recreational fishing opportunities (including catch and release) in the Grande Ronde River basin and Snake River. Conservation Benefits

[96] *See Section II, "Components of This Report", for a description of these potential benefits and risks.*

Conservation Benefits

- None identified.

Research, Education, Outreach and Cultural Benefits

- Hatchery and evaluation staff provide educational opportunities on site at Irrigon Fish Hatchery.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,[97] the Review Team identified the following benefits of this program:

Harvest Benefits

- The program confers both sport and tribal harvest benefits in the Columbia River, downstream of the project area. Tribal harvest primarily occurs in zone 6 fisheries (between the Snake River confluence and Bonneville Dam) in the late summer and fall when summer Chinook, fall Chinook, and coho are also harvested.

- The Wallowa steelhead program contributes to tribal, commercial and recreational fisheries in downstream fisheries, including the lower Columbia River. Estimates of harvest of Wallowa steelhead from run years 1993/1994 through 2004/2005 averaged 4 fish (range 0-19) in the ocean, 1,514 fish (range 489-3,927) in the Columbia River (Treaty net, C&S, sport, Test, tributary sport fisheries), and 224 fish (range 25-469) in the Deschutes River (sport and C&S).

- Estimated harvest (expanded from CWT recoveries) downstream of the project area in the Columbia and Deschutes rivers including sport and tribal fisheries for return years 2003-2005 averaged 693 (range 534 to 799).

- Estimated harvest (expanded from CWT recoveries) below the project area of Wallowa stock steelhead (for both release locations for return years 2003-2005) accounted for 9.3% of the total estimated harvest on the Wallowa stock (90.7% within the project area).

- Estimated harvest (expanded from CWT recoveries) of Wallowa stock steelhead, (for both release locations for return years 2003-2005) below the project area occurred in the ocean (0.1%), net (3.3%) and sport (6.0%) fisheries.

Conservation Benefits

- None identified.

Research, Education, Outreach and Cultural Benefits

- Tribal harvest provides subsistence and cultural benefits to the Columbia River tribes.

- Hatchery staff provide educational opportunities offsite to other communities.

[97] *Ibid.*

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,[98] the Review Team identified the following risks of the hatchery program:

Genetic Risks

- None identified.

Demographic Risks

- High densities during early rearing (when the steelhead are in the indoor circular tanks) may contribute to cold water disease.

- The late winter transportation to acclimation sites and resulting introduction to extremely cold water temperatures can result in significant mortality

Ecological Risks

- Amplification of disease within the Irrigon Hatchery poses a disease risk to the propagated stock.

Physical Risks

- There is no temperature monitoring system that alarms hatchery staff if the chiller unit fails to cool the water posing a mortality risk to the propagated stock.

- Irrigon FH's alarm system is antiquated, posing a risk of catastrophic fish loss.

Research, Education, Outreach and Cultural Risks

- None identified.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,[99] the Review Team identified the following risks from the hatchery program:

Genetic Risks

- The release of unmarked adults (that return to Wallowa FH) downstream of Wallowa FH may pose genetic and ecological risks to the natural population in the watershed if those fish are hatchery origin.

- Wallowa steelhead released in the Grande Ronde River stray into areas of the lower Columbia River basin, including the upper reaches of the Deschutes and John Day rivers posing a genetic risk to other Columbia Basin stocks.

[98] *Ibid.*

[99] *Ibid.*

Demographic Risks

- None identified.

Ecological Risks

- The continued release of an out-of-basin stock into the Lower Grande Ronde River may pose genetic and ecological risks to the natural-origin steelhead populations in the Grande Ronde River basin downstream of the Wallowa/Grande Ronde River confluence.

- Residualized Wallowa steelhead that do not emigrate and remain in freshwater pose competition risks to natural populations of steelhead in the Grande Ronde River basin.

Research, Education, Outreach and Cultural Risks

- None identified.

Recommendations for Current Program[100]

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

Program goals and objectives

Issue WW-SS1: Present program goals for Wallowa stock steelhead are not fully expressed in terms of numeric outcomes that quantify intended benefits or goals. *For example, there is currently no quantified harvest goal separate from the mitigation goal. The mitigation goal may not be the best reflection of the harvest and recreational benefit the program is attempting to produce. Potentially quantifiable benefits include number of fish harvested, number of angler hours provided by the program, and contribution to catch per unit effort of recreational fishers.*

Recommendation WW-SS1: Restate and quantify program goals in terms of the specific benefits the program is intended to provide, consistent with the mitigation goal.

Broodstock Choice and Collection

Issue WW-SS2: The transfer and release of unmarked adults (that return to Wallowa FH) downstream of Wallowa FH may pose genetic and ecological risks to the natural population in the watershed if those fish are hatchery origin fish with regenerated fins. *Unmarked*

[100] *The Review Team believes that the ODFW and the USFWS LSRCP office will be the logical parties to coordinate and implement most of the following recommendations.*

adults are transported and released at the Fish Hatchery Lane Bridge, about one mile downstream of Wallowa FH. The intent of this management action is to provide trapped ESA-listed natural-origin steelhead an opportunity to spawn naturally. However, genetic work performed on the unmarked fish returning to Wallowa FH indicates that roughly 70% of the unmarked fish are Wallowa stock hatchery fish and 30% are natural origin. The relative risks to the ESA listed steelhead population in the Grande Ronde River of releasing all unmarked fish versus retaining and sacrificing those fish are unknown.

Recommendation WW-SS2: In view of the scientific uncertainties regarding the benefits versus risks associated with this issue, the Team recommends that unmarked steelhead - indistinguishable from natural origin steelhead - continue to be released downstream from the hatchery in the Wallowa River. The Team also recommends the evaluation of marking techniques to determine if they can be improved.

Hatchery and Natural Spawning, Adult Returns

Issue WW-SS3: Wallowa steelhead released in the Grande Ronde River stray at comparatively high rates into mid-Columbia River tributaries, particularly the upper reaches of the Deschutes and John Day rivers. *These strays pose genetic and ecological risks to other steelhead stocks in the Columbia River basin. For broodyears 1980 and 1982-1997, Wallowa hatchery steelhead had a mean stray rate of 11.2% (range 0% - 32.7%) into the Deschutes River. There is also evidence that Wallowa steelhead stray higher upriver in the Deschutes River onto the steelhead spawning areas than other steelhead stocks, increasing the genetic risk. Stray Wallowa steelhead were recovered throughout the Deschutes River basin: 37.2% from the mouth, 26.7% from the middle reach, and 36.1% from the upper reaches at the two hatchery traps (Pelton Dam and Warms Springs NFH). Stray rates for fall and winter/spring Wallowa steelhead are not significantly different based on initial data. However, these latter results are based on only two years of data, and ODFW managers indicate that the fall-returning fish are contributing to fisheries in the Grande Ronde for a longer time period than the winter-spring fish. Of the four hatchery steelhead stocks used in the data analysis (Wallowa, Dworshak B, Little Sheep Creek, and Pahsimeroi A), , Wallowa steelhead comprised 81.9% of the Snake River steelhead recoveries at the Pelton Dam and Warm Springs NFH traps.*

Recommendation WW-SS3: Continue to research different broodstock management strategies (e.g. utilizing fall-returning adults versus winter/spring-returning adults), other broodstock sources, and research different rearing and release strategies. Other broodstock sources may include in-basin endemic steelhead and Little Sheep Creek steelhead (see Alternatives 2 and 3). Finally, it may be worthwhile for comanagers to investigate facility modifications that would allow steelhead to be reared their full hatchery life cycle at Wallowa FH. A pathogen free water source would be required to avoid problems with whirling disease during early rearing (e.g. disinfection of surface water or a new well water source). Raceway modifications or additional raceways would also be required. Alternately, an earlier transfer of the steelhead juveniles from Irrigon Hatchery to the two acclimation sites would allow for a longer rearing and acclimation time at the release sites which might reduce straying. Control/treatment evaluations should be performed to determine whether changes in the program affect survival and stray rates before large-scale changes to the program occur.

Issue WW-SS4: The continued release of an out-of-basin stock into the Lower Grande Ronde River may pose genetic and ecological risks to the natural steelhead populations in the Grande

Ronde River basin downstream of the confluence of the Wallowa and Grande Ronde rivers. *Of special concern are Joseph Creek and Wenaha River populations which are managed for natural reproduction only. Existing data indicate that Wallowa hatchery steelhead stray within the Grande Ronde River basin at a very low rate and return with a high degree of fidelity to their release sites. For example, of the 4,348 steelhead trapped at both the Big Canyon and Wallowa traps, only 13 fish were steelhead that strayed between the two facilities.*

Recommendation WW-SS4: Continue monitoring natural escapement to ensure that less than 5% of the naturally spawning population is composed of hatchery-origin Wallowa hatchery steelhead, particularly in Joseph Creek and the Wenaha River. This recommendation includes monitoring the selective fishery in the lower Wenaha to estimate the proportion of natural versus hatchery-origin steelhead intercepted by anglers.

Issue WW-SS5: Recycled Wallowa stock steelhead provide very little harvest benefit but pose genetic and ecological risks to natural populations in the Grande Ronde River basin. *Approximately 100 adult hatchery-origin fish are recycled about to about one mile downstream of the Big Canyon acclimation facility on the Wallowa River. Few recycled fish are recovered in the fishery, and the percent of recycled fish that go unaccounted can be high. For example, for the 2005-2006 run year, 130 steelhead were recycled, of which 66 fish were recaptured at the weir and only seven were harvested. The fate of the remaining 57 steelhead was unknown, but those fish could have potentially spawned in the Wallowa River.*

Recommendation WW-SS5: As a best management practice, discontinue the practice of recycling Wallowa steelhead. The Team concluded that the risks of this practice outweigh the benefits.

Incubation and Rearing

Issue WW-SS6: Rearing densities in the nursery tanks at Irrigon FH exceed the Hatchery Review Team's recommended rearing density index (DI) and flow index (FI) guidelines for steelhead (DI < 0.5 and FI <1.0). *At maximum loading, the nursery tanks reach rearing densities of DI=0.83 and flows of FI=1.9. High early rearing densities can exacerbate infections (e.g. cold water disease), resulting in acute mortality that generally begins several months after hatching. At some northwest hatcheries, outbreaks of coldwater disease have been significantly reduced when early rearing densities are lowered.*

Recommendation WW-SS6: To achieve a rearing density of D.I. $\leq$ 0.5, either (a) increase the nursery rearing space, or (b) reduce the number of eggs incubated on station and/or the number of fry transferred to the nursery tanks. ODFW may also wish to evaluate rearing constraints and fish health concerns under current protocols; for example, the hatchery could conduct an early rearing density study.

Issue WW-SS7: In most years, coldwater disease causes mortality in the Wallowa and Little Sheep stocks of steelhead. *Elevated losses from disease usually occur through June/early July when the fish are in the indoor nursery tanks. Coldwater disease is a major problem in many northwest hatcheries. Flavobacterium psychrophilum, the bacterium causing coldwater disease, is transmitted vertically from female parents to their progeny and horizontally through the water via infected animals. This epizootiology complicates disease control. At*

Irrigon FH, the fish are treated with florfenicol (Aquaflor) if coldwater disease mortalities are elevated. Formerly, fish were fed pills coated with 15 mg florfenicol/kg of fish weight as prescribed by a veterinarian. New FDA regulations now designate the use of florfenicol-medicated feed at 10 mg drug/kg fish weight with a Veterinary Feed Directive. At this lower dosage, the medicated feed is less effective in controlling disease, and additional treatments may be needed, increasing fish losses and the possibility of developing drug-resistant forms of F. psychrophilum. Further, delays in deliveries of the medicated feed after diagnosis of elevated coldwater disease can exacerbate mortalities.

Recommendation WW-SS7: Continue working with the Bacterial Coldwater Disease Research Group, as supported by the Pacific Northwest Fish Health Protection Committee, to develop fish culture practices and treatment options to control or eliminate coldwater disease. Consider investigating different densities (D.I. = 0.83, 0.5, and 0.2) of fry in the tanks to determine whether early rearing densities influence the development of coldwater disease (see Issue LF-SS7). In addition, some hatcheries have found that saline rinses of eggs prior to fertilization improves eye-up and may reduce external loads of *F. psychrophilum.* Communication with the USFWS Aquatic Animal Drug Approval Partnership Program (AADAP) and the newly-formed Working Group on Aquaculture Drugs, Chemicals and Biologics (AFS-Fish Culture Section) may help recapture efficacious antibiotic treatment of coldwater disease.[101]

Release and Outmigration

Issue WW-SS8: Steelhead transferred to the Big Canyon acclimation site during extreme cold periods at times experience significant stress-related mortality. *Steelhead are transferred to the acclimation site in late February or early March. Attempts are made to delay transfer until conditions are appropriate and to acclimate the fish to colder water temperatures during transfer. However, space constraints at Irrigon FH require transfer of the fish by early March. However, the need to get two groups acclimated and released from the same pond limits the ability to delay transfer until after freezing conditions have passed.*

Recommendation WW-SS8a: Consider acclimating only one group during optimum weather and stream conditions and direct stream releasing the other group during the same time the acclimated group is being released. The two groups should be differentially marked with coded wire tags and should include representative PIT tags for evaluation of survival, homing, and straying.

Recommendation WW-SS8b: Continue to investigate the development of well water to be used during the early portion of the acclimation period (see recommendation WW-SS19).

[101] *A strategy similar to the region-wide efforts used to control* Renibacterium salmoninarum *(causative agent of BKD) may be needed to control coldwater disease in northwest hatcheries. This could include broodstock testing, antibiotic injections of adults, culling/segregation of progeny from highly infected fish and/or reduced rearing densities of juvenile fish.*

Facilities/Operations

Irrigon FH

Issue WW-SS9: Currently, only two of the thirteen pumps in the Irrigon FH pump station have variable speed. This inhibits water use efficiency and increases power demands.

Recommendation WW-SS9: Install a third variable speed pump to increase water use efficiency and decrease power demands.

Issue WW-SS10a: There is no temperature monitoring system that alarms hatchery staff if the chiller unit fails to cool the water. *There is a power failure alarm; however the chillers have no backup power supply. Although, power outages are infrequent during incubation, the outages result in significant increases in temperature which could result in thermal shock and subsequent mortality.*

Issue WW-SS10b: Fish transport truck filling operations divert water from the incubation chilling system, resulting in a periodic 10 degree increase in temperature in the incubation stacks. *A rapid increase in water temperature can result in thermal shock and subsequent mortality.*

Recommendation WW-SS10: Install an alarm system and backup power supply for the chiller unit. Install an additional in-line chiller as backup and to use during transport truck filling operations.

Issue WW-SS11: The incubation stacks and trays are deteriorating. Tray screens must be repaired annually.

Recommendation WW-SS11: Replace vertical incubation stacks and trays.

Issue WW-SS12: The mechanisms for raising and lowering bird netting for access to the ponds are inadequate. Birds access the ponds through the openings created by the mechanisms, resulting in fish loss due to predation.

Recommendation WW-SS12: Modify the bird netting to prevent predator access.

Issue WW-SS13: Lack of shade covers over the raceways increases crowding of fish, particularly during the summer months, potentially increasing stress and disease risks to the steelhead.

Recommendation WW-SS13: Construct covers over raceways as a best management practice.

Issue WW-SS14: The ODEQ General NPDES Permit for Fish Hatcheries expired in September 2007. *The ODEQ has not set a time line for issuance of a new permit and is allowing the hatchery to operate under the requirements of the old permit.*

Recommendation WW-SS14: The ODFW should complete the ongoing review of the NPDES permit with ODEQ.

Issue WW-SS15: Irrigon FH's alarm system is antiquated, posing a risk of catastrophic fish loss. ODFW is in the process of updating the system.

Recommendation WW-SS15: ODFW should continue to work to modify the alarm system.

Wallowa FH and acclimation pond

Issue WW-SS16: The Wallowa FH has been in operation since 1920. The water rights for this facility have been established under Oregon Code. However, it is uncertain what the status of the water rights are for the Wallowa, Big Canyon, and Little Sheep Creek acclimation facilities*. The Lower Snake River Compensation Plan office is reviewing the ownership status of water rights associated with all the facilities which divert water for fish production that are operated by the Cooperators. Although ownership of several of the facilities has been transferred to the Service, the appropriate documentation to transfer the water rights may not have been filed in the respective state agency which administers water rights. Moreover, facility staff may not consistently or adequately record water use to ensure documentation of beneficial use in support of its water right(s) and as required by state law. Adequate documentation and reporting are required to maintain the right to divert water.*

Recommendation WW-SS16: Transfer the water rights to the US Fish and Wildlife Service. ODFW should work with the Lower Snake River Compensation Plan office to establish owner of record for the water rights and ensure water diverted for fish production is measured and reported to conform with Service and State standards, and the information is maintained by the Service's, Region 1 Engineering, Division of Water Resources.

Issue WW-SS17: The ODEQ General NPDES Permit for Fish Hatcheries expired in September 2007. *The ODEQ has not set a time line for issuance of a new permit and is allowing the hatchery to operate under the requirements of the old permit.*

Recommendation WW-SS17: The ODFW should complete the ongoing review of the NPDES permit with ODEQ.

Issue WW-SS18: The upper Spring Creek water intake screen does not comply with current NOAA Fisheries ESA screening criteria. The screen mesh is 1/8"; however, NOAA requires 3/32" mesh. NOAA criteria also include parameters for water approach velocity, sweeping velocity, and screen angle.

Recommendation WW-SS18: Replace the Spring Creek water intake screen so that it complies with NOAA Fisheries criteria. This may require modifications such as revolving drum screens to prevent debris accumulation that could obstruct the water supply.

Big Canyon Acclimation Facility

Issue WW-SS19: The water intake screen and the head and tail screens at the Big Canyon Acclimation facility ice over on very cold days, requiring constant maintenance. *Icing poses a catastrophic fish-loss risk and is a safety issue for personnel. Currently, one staff person is on site 24/7 during acclimation.*

Recommendation WW-SS19: Consult with professional engineers to investigate options for de-icing the intake screen and head and tail screens. Continue to investigate the potential for installing a well to de-ice the intake (and to temper the water to reduce stress-related mortalities [see WW-SS8b]). Additional staff may be desired on-site during severe weather. Alternatively, consider other acclimation and release strategies to avoid the period of time where icing is a problem (see WW-SS8a).

Research, Monitoring, and Accountability

Also see LC-SC29 in the Lookingglass Creek spring Chinook section and WW-SS3 above.

Issue WW-SS20: Residualized Wallowa hatchery steelhead pose ecological risks to natural populations in the Grande Ronde River basin. *ODFW attempts to reduce these risks by controlling fish size, place, and time of release, and by attempting to select fish which exhibit migrating behavior.*

Recommendation WW-SS20: Continue to monitor the degree of residualism in the release areas and downstream in the Grande Ronde River and continue to implement actions to minimize residualism including outplanting non-migrant yearlings to closed bodies of water (lakes or ponds) at the end of volitional release periods. Depending upon monitoring and evaluation results, determine whether current management actions are effective or alternative management actions are desired to reduce the risk of residualism.

Issue WW-SS21: Coded-wire tagged fish (including other tagging strategies such as PIT tagging) may not accurately represent the steelhead population released at Big Canyon. According to the 2009 AOP, fish in only one of four raceways at Irrigon FH receive coded-wire tags for the release at the Big Canyon facility. *Because the fish in different raceways often represent the progeny of different spawn takes and the pond environments can differ (e.g., flow index and flow pattern, pathogen loads, etc.), fish in just one of several raceways may not accurately represent the entire release group for that brood year.*

Recommendation WW-SS21: Ensure that the tagging strategy accurately represents the entire population of progeny from all spawn groups for a particular brood year. For example, all spawn groups should be proportionately represented among tag groups and raceways. Coded-wire tags can be applied to fish across all four raceways. This recommendation applies to any tagging strategy, including PIT tags.

Education and Outreach

Issue WW-SS22: The LSRCP and state visitor information and signage is dated. ODFW is currently working to redo the state-managed educational signage at all of their facilities.

Recommendation WW-SS22: Update the displays and handouts so that they accurately represent the present state of salmon and steelhead and the associated programs at Irrigon FH.

Issue WW-SS23: The information available to the public for Irrigon Fish Hatchery and its programs is inadequate. *Technical information, such as Annual Operations Plans are available from the web sites. However, both the LSRCP web site and the ODFW web site lack*

information directed towards the public. Additionally, ODFW does not currently manage a web page for Irrigon Fish Hatchery.

Recommendation WW-SS23: Information describing harvest and conservation benefits of the hatchery programs should be provided by the Service and ODFW in a format for the public (e.g. simple brochures, interactive web pages, etc.). For example, fishery benefits provided by the program for each hatchery could be updated annually on the LSRCP web site and provided in a brochure at the hatchery. If the LSRCP web site is the primary source of information for the program, any ODFW page for Irrigon Fish Hatchery (and/or the facility's programs) should be linked to the LSRCP site.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing Wallowa steelhead program at the Wallowa FH, Irrigon FH, and the Big Canyon acclimation site and developed five alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the "no hatchery" option. Following these descriptions of alternatives, the Review Team has identified recommended alternatives.

Alternative 1: Current program with recommendations

This alternative includes recommendations for addressing the high stray rate of the Wallowa stock and genetic risk imposed on other steelhead populations within the Columbia River Basin (e.g., Deschutes and John Day river populations).

Pros

- Maintains mitigation harvest opportunities on Wallowa stock steelhead in the Grande Ronde River basin and Snake River.

- Maintains significant recreational fishing opportunities (including catch and release) in the Grande Ronde, Snake and Columbia rivers.

Cons

- Wallowa stock steelhead released in the Grande Ronde River basin stray into the Deschutes and John Day rivers and relatively high numbers and may be spawning with natural populations.

- Additional monitoring in the Grande Ronde River and associated tributaries may be necessary to ensure that hatchery-origin steelhead compose less than 5% of the naturally-spawning fish.

- The continued release of an out-of-basin stock into the Grande Ronde River may ultimately reduce the viability of natural populations.

Alternative 2. Replace the Wallowa stock with the Little Sheep Creek stock

Terminate the use of Wallowa stock and replace the existing program with steelhead from the Little Sheep Creek (LSC) stock. Continue to use Wallowa FH and the Big Canyon facility as acclimation and release sites and use these two sites to collect returning LSC fish for broodstock after the Wallowa stock has been phased out.

Pros

- Utilizes a stock indigenous to a stream that is much closer geographically to the Grand Ronde River.
- Is expected to reduce stray rates to the upper Deschutes and John Day rivers based on existing data for the Little Sheep Creek stock.
- Maintains mitigation harvest opportunities on steelhead in the Grande Ronde River basin and Snake River.
- Maintains significant recreational fishing opportunities (including catch and release) in the Grande Ronde, Snake and Columbia rivers.

Cons

- Additional monitoring in the Grande Ronde River and associated tributaries may be necessary to ensure that hatchery-origin steelhead compose less than 5% of the naturally-spawning fish.
- The continued release of an out-of-basin stock into the Grande Ronde River may ultimately reduce the viability of natural populations.

Alternative 3: Terminate the Wallowa steelhead program at Wallowa FH and Big Canyon and develop a program derived from an endemic population in the Grande Ronde River

The goal of the program would be to return enough adults to continue to satisfy harvest/mitigation goals utilizing an endemic stock of summer steelhead.

Pros

- Reduces genetic risks associated with use of Wallowa stocks on natural populations in the Grande Ronde, Deschutes, and John Day rivers.
- Is expected to reduce out of basin straying.

Cons

- The cause of out-of-basin straying of the Wallowa stock is unknown; therefore, the use of an endemic stock from the Grand Ronde River may not reduce straying to natural populations in the Deschutes and John Day basins.

- Would likely require major infrastructure in one or two tributaries of the Grande Ronde River basin (e.g., Joseph Creek) to collect adult fish for broodstock.

- Would temporarily reduce harvest and recreational opportunities in a large portion of the project area.

Alternative 4: Expand the fall-returning component of the steelhead program and phase out the winter/spring-returning component of the program

The goal of the program would be to return enough adults to continue to satisfy harvest/mitigation goals utilizing fall-returning Wallowa stock summer steelhead.

Pros

- Increases the number of steelhead available for harvest and recreation in the Grande Ronde basin during the fall season when the quality of the fish is more desirable.

- May reduce straying.

- Maintains mitigation harvest opportunities on Wallowa stock steelhead in the Grande Ronde River basin and Snake River.

Cons

- The continued release of an out-of-basin stock into the Grande Ronde River may ultimately reduce the viability of natural populations.

- May not reduce straying.

- Additional monitoring in the Grande Ronde River and associated tributaries may be necessary to ensure that hatchery-origin fish compose less than 5% of the naturally-spawning fish.

Alternative 5: Terminate the program and decommission the facility

Decommission hatchery in favor of alternative mitigation strategies such as habitat restoration, passage improvements, or alternative hatchery production at another site.

Pros

- Reduces hatchery influence on natural populations of steelhead in the Grande Ronde River basin.

- Reduces the number of stocks reared at Irrigon FH and increases the rearing space available for other programs.

- Eliminates the risk of transporting pathogens, including IHNV, from Irrigon FH to the Grande Ronde River basin.

- Allows the Wallowa River and Deer Creek to serve as control/indicator streams for natural populations of summer steelhead.

Cons

- The weirs would still have to be operated to prevent hatchery fish from migrating upstream.
- Reduces tribal and sport harvest opportunities within and downstream of the project area.

Recommended Alternatives

After reviewing alternatives, the Team recommended Alternative 1, maintaining the current program with recommendations. When compared to alternatives 2, 3, and 4, this alternative continues to meet mitigation obligations and maintains greater harvest opportunities in the Grande Ronde River basin and the Snake and Columbia rivers.

The Wallowa stock is a composite, hatchery-maintained stock derived from a mixture of steelhead trapped at the lower Snake River Dams and initially included eggs from the Pahsimeroi Fish Hatchery. This stock is not included with the Snake River Steelhead DPS (listed as threatened under the ESA). Straying and spawning by Wallowa stock fish is considered to be a risk to other listed populations. In reviewing the Wallowa steelhead program, Team members had concern related to the affects this program may have where these fish stray into natural spawning areas in the Deschutes and John Day rivers. Information provided by ODFW staff indicates that straying within the Grande Ronde River basin is relatively minor; however, the team recommends ODFW continue monitoring escapement of hatchery-origin steelhead to tributaries in the lower Grande Ronde River, particularly in Joseph Creek and the Wenaha River, to ensure that less than 5% of the naturally spawning populations are hatchery-origin fish.

Other current program recommendations include:

- Continue to investigate the use of fall-returning adults versus winter/spring-returning adults. Although limited data suggests there is no difference in stray rate for the fall-returning program, they do contribute to fisheries in the Grande Ronde River for a longer time period than the winter/spring fish.
- Investigate other broodstock sources as alternatives to the current Wallowa stock.
- Improve marking techniques of hatchery fish to ensure no hatchery-origin adults are included among unmarked fish released to spawn naturally in the Wallowa River downstream from Wallowa FH. In addition, discontinue the recycling of Wallowa stock adult steelhead trapped at the Big Canyon facility is support of the recreational fishery. The Team concluded that the benefits of this practice are minor and that the risks outweigh the benefits.
- Investigate facility modifications at the Wallowa FH, Irrigon FH, and at the Big Canyon acclimation site to improve rearing conditions and other operational constraints.
- In the implementation of Alternative 1, particularly regarding broodstock sources, the team believes control/treatment evaluations of alternative stocks released from Wallowa FH (e.g., comparable to ongoing evaluations of fall-returning vs. winter/spring-returning broodstocks)

should be performed before large-scale changes to the hatchery steelhead program for the Grande Ronde River occur.

Little Sheep Creek Summer Steelhead

Operator: Oregon Department of Fish and Wildlife

Summary of Current Program

Goals

- ***Harvest goal:*** There is currently no quantified "harvest" goal for this program separate from the mitigation goals. The goal of the LSRCP program is to "return" 2,000 adults to the Snake River Basin upstream of Ice Harbor Dam. In addition, the program is intended to provide sport and tribal fishing opportunities for summer steelhead in the Snake River, its tributaries and downstream in the Columbia River.

- ***Broodstock escapement goal:*** Approximately 67 pairs of adult steelhead are required for broodstock at the Little Sheep Creek facility to meet the 2,000 adult return goal depending on SARS.

- ***Conservation goal:*** None stated.

- ***Escapement goal for natural-origin adults:*** ODFW has established separate natural escapement goals for Big Sheep Creek (500 adults) and Little Sheep Creek (250 adults), both of which are tributaries to the Imnaha River (2009 AOP). The ICTRT categorized the Imnaha River as "Intermediate" in terms of the interim minimum abundance thresholds with a recovery goal of 1,000 natural-origin spawners.

- ***Research, education, and outreach goals:*** Provide accurate information and educational (I/E) opportunities for the public, media, schools, Tribal, State, and Federal agencies, and elected officials to enhance participation in understanding and stewardship of Irrigon FH, Wallowa FH and LSRCP programs.

Objectives

- Collect and spawn 134 adult steelhead (67 males and 67 females) at the Little Sheep Creek facility to yield approximately 315,000 green eggs and 67 milt samples for transfer to Wallowa FH. A sliding scale has been developed to determine the number of adults and proportion of hatchery to natural-origin fish to collect for broodstock on an annual basis (ref. table below).

- Transport the gametes to Wallowa FH for fertilization. Incubate the fertilized eggs to the eyed egg stage.

- Transfer 282,000 eyed eggs to Irrigon FH for incubation, hatch, and grow-out to yield 215,000 yearling smolts for transfer to the Imnaha River watershed.

- Transfer 165,000 yearling steelhead from Irrigon FH to the Little Sheep Creek Acclimation Facility at 5 fpp in early March. Acclimate for four weeks and volitionally release for four weeks beginning on April 1st. Sample 100 of these fish at the end of April to quantify sex

ratio. If greater than 70% of the remaining fish are males, all the remaining fish are transferred to a closed water body to provide fishing opportunity. This procedure is intended to reduce the number of released steelhead that would have a high likelihood of residualizing in the watershed. If less than 70% of 100 sampled fish are males, then all the remaining fish are force released in early May

- Transfer 50,000 yearling steelhead from Irrigon FH and direct stream-release into Big Sheep Creek at 5 fpp in mid-April.

Program Description

The Little Sheep Creek steelhead program uses an endemic steelhead hatchery stock that was founded from natural-origin summer steelhead trapped in Little Sheep Creek. The purpose of this program is to mitigate for fish losses occurring as a result of the construction and operation of the four Lower Snake River Dams. The program was developed to provide harvest mitigation within the Imnaha River watershed. The targeted basins for released hatchery-origin fish are Little Sheep Creek and Big Sheep Creek. Initial adult collection for the program occurred in 1982. Resulting smolt releases began in 1983.The original size of the program was based on a 0.61% smolt-to-adult survival rate, thus requiring the release of 330,000 smolts to yield a return 2,000 adult steelhead back to the Snake River basin upstream of Ice Harbor Dam. The direct releases of smolts into Big Sheep Creek began in 2000.

Currently, the Little Sheep Creek steelhead program targets a total release of 215,000 smolts into with 165,000 smolts released into Little Sheep Creek and 50,000 smolts released into Big Sheep Creek. The program uses three facilities to accomplish these objective: the Little Sheep adult collection and acclimation facility is used for adult collection, spawning, and acclimation of smolts prior to release; the Wallowa FH is used for early incubation to the eyed stage, and Irrigon FH provides incubation and rearing from the eyed-egg stage to the smolt stage.

The Little Sheep Creek program is comanaged with the Nez Perce Tribe.

Assessment of Current Program

Operational Considerations[102]

Listed below are the principal operational components of the hatchery program that the Review Team considered as part of its review.

Broodstock Choice and Collection

- Steelhead in the Imnaha River are listed as *threatened* under the Endangered Species Act as part of the Snake River summer steelhead DPS. The Little Sheep Creek steelhead stock is a component of the Imnaha River population.

- The hatchery broodstock was founded from endemic steelhead in 1982. A minimum of 5% natural-origin fish have been included in the broodstock annually since the program began.

[102] *See Appendix B of this document for supporting background information and references.*

- The current broodstock collection goal is 67 females and 67 males. Annual broodstock collection includes hatchery-origin and natural-origin steelhead returning to the Little Sheep Creek weir.

- Trapping of adult steelhead at the Little Sheep Creek facility begins at the end of February and continues until 10 days have elapsed without capturing fish, usually around early June. Surplus hatchery-origin adults are outplanted to Big Sheep Creek. The maximum number of fish that can be outplanted into Big Sheep Creek is unclear. The natural-origin escapement objective for Big Sheep Creek is 500 adults; however it is unclear how the escapement is determined annually. The 2009 AOP indicates that surplus hatchery-origin adult steelhead trapped in Little Sheep Creek are used to meet the escapement objective for Big Sheep Creek. From 1999 through 2008, an average of 1,186 (range = 42-2,030) adult steelhead have been outplanted into Big Sheep Creek for natural spawning.

- Less than 25% of the natural-origin adult steelhead trapped at the weir are retained for broodstock; all others are passed upstream to spawn naturally. Program operations have attempted to incorporate at least 5% natural-origin fish in the broodstock annually ($pNOB$>0.05) and has averaged 7.4% with a range of 3.7% to 12.1% of the broodstock composed of natural-origin fish (2001-2005).

- The guideline for the proportion of the broodstock composed of natural-origin fish is as follows: At less than or equal to 100 natural-origin adult fish returning to Little Sheep Creek, use 10% of natural run for broodstock. At greater than 100 natural-origin adult returns, use 10 natural-origin fish plus 40% of the natural-origin fish in excess of 100 for broodstock. A total of 134 adults (hatchery and natural origin combined) are required for broodstock.

- From 1999 through 2008, an average of 71.85% of the fish passed upstream have been hatchery origin ($pHOS \approx 72\%$).

- The weir on Little Sheep Creek is 100% effective, allowing complete control of the number and composition of fish passed upstream to spawn naturally.

- All known out-of-basin, hatchery-origin strays are removed and destroyed.

Hatchery and Natural Spawning, Adult Returns

- Stray rates to Little Sheep Creek are low, less than 2%.

- Spawning begins in March (in lower elevation and spring-fed tributaries) and continues through early June at the Little Sheep Creek facility. Timing is the same for natural spawning in the Imnaha Basin.

- Most adult fish are killed during the spawning process, however natural-origin males are live spawned and passed upstream of the weir when their condition suggests they will survive and potentially spawn again. No anesthesia is used in the spawning of the fish.

- Adult steelhead return with non-debilitating infections of *M. cerebralis* (agent of whirling disease), likely obtained as smolts when exposed to the parasite-endemic waters of Little Sheep Creek and the Grande Ronde system. In 2008 testing, 38 of 65 adults were positive for the parasite.

- Adult steelhead are spawned at the Little Sheep Creek facility and unfertilized gametes are transported in coolers to Wallowa FH for fertilization and early incubation.

- Target sex ratio for this program has been a 1:1 male-to-female spawning ratio. Hatchery and natural-origin fish are matrix spawned usually in 3 X 3 combinations with the intent of not using less than 1 natural fish in any group to maximize the contribution of natural-origin fish. A maximum of 18 fish are spawned per spawn day.

- The natural-origin adult escapement objective for Little Sheep Creek is 250 adults upstream of the weir. If this escapement objective is not met, then hatchery-origin fish are passed upstream. A sliding scale has been developed to incorporate hatchery-origin fish in the escapement.[103]

- Pre-spawning mortality of spring-collected adults is estimated at 1% for females and 2% for males.

- Spawners are selected systematically throughout the run. Adults are sorted and randomly selected from ripe fish on spawning day. Extra males are not used to increase fertilization rates of green eggs; however, occasional reuse of males occurs when male broodstock numbers are low. This applies to both hatchery and natural-origin males.

- Spawning effluent at the Little Sheep Creek adult collection facility drains to the river.

- Attempts are made to reduce the number of Little Sheep Creek steelhead that residualize in the Imnaha basin (see release measures in objectives section).

- For fish health sampling, ovarian and tissue samples are taken from all of the females spawned. The adults (females only) are sampled for viruses (e.g. IHN) and reportable bacterial pathogens. Adults are not screened for BKD because clinical disease does not occur in this stock and it is not required by ODFW fish health policy. No males are sampled. There is no culling for IHNV because prevalence of the virus is very low (similar to that of the Wallowa steelhead stock with a range of 0 to 7.8%); therefore, the progeny of all adults are retained.

- Spawning is done once per week. In some years, the females can be overripe, which may lead to variable eye-up of eggs which results in approximately 10 to 15% egg mortality.

- During fertilization at Wallowa FH, ovarian fluid is drained, eggs are fertilized and then water hardened in 100ppm iodophor for 15 minutes.

- Steelhead spawn below the weir on Little Sheep Creek.

- Redd surveys occur on Little Sheep Creek and throughout the Grande Ronde River basin.

Incubation and Rearing

- Wallowa FH incubation facilities consist of 216 vertical incubation trays. 48 incubation trays are used for the Little Sheep Creek program. Little Sheep Creek stock eggs are incubated on a mixture of well (56^{o} F and D.O. = 8.4) and spring water (42-53^{o} F and D.O. = 9.8) at 11,500-

[103] *2009 Annual Operations Plan.*

16,200 eggs per tray and 4.0 GPM. The well water percentage can be increased to accelerate eye up when necessary.

- Green eggs are treated with formalin at the target dose of 1667 ppm (1:600) for 15 minutes. Treatments occur three times per week and have shown to prevent excessive fungus problems.

- Average survival to the eyed-egg stage for the Little Sheep Creek stock is 88.5% (2009 AOP).

- All eyed eggs (n ≈ 282,000) are transferred to Irrigon FH in May/June for hatching and grow-out, in part to avoid exposure to *Myxobolus cerebralis*, the causative agent of whirling disease, at Wallowa FH.

- Eyed eggs transferred to Irrigon FH are disinfected in 75 ppm iodophor for 10 minutes.

- Twelve, 6 ft. diameter circular tanks are used as nursery tanks for the Little Sheep Creek steelhead after they hatch. Maximum density index (DI) in the tanks is D.I. = 0.83 at 400 fpp. Maximum flow index (FI) in the tanks is F.I. = 1.9. The water exchange rate in the tanks is 2.27 water exchanges per hour. Total flow required is 300 gpm.

- Maximum pounds of fish per tank is 85.5 lbs. (at 400 fish per pound).

- In mid-July, when the fish reach 400 fpp, they are transferred into five outdoor concrete raceways (100' x 20' x 3.5'), each with a capacity of 35,000 cubic feet. Pond loading is approximately 35,000 fish per pond.

- Maximum density in the raceways is D.I. = 0.15. Maximum flow index in the raceways is F.I. = 0.71. The raceway water exchange rate per hour is 1.77 raceway volumes at 1,543 gpm. Pounds of fish per gpm is 5.67 and pounds of fish per cubic foot is 1.2l. Total flow is 7,715 gpm for the Little Sheep steelhead program at Irrigon FH.

- Average eyed-egg to smolt survival for the Little Sheep Creek stock is 76.2% (2009 AOP).

- *See Wallowa Steelhead section for additional details on steelhead rearing at Irrigon FH.*

Release and Outmigration

- Little Sheep Creek steelhead are released as yearling smolts, about 12-14 months after the parents were initially spawned.

- Steelhead smolts for the program are planned for a release size of 5.0 fpp.

- In early March, 165,000 steelhead (at 5 fpp) are transferred from Irrigon FH to the Little Sheep Creek facility for a four-week acclimation and a four-week volitional release into Little Sheep Creek beginning April 1st. At the end of April, 100 fish are "grab-sampled" to quantify sex ratio. If 70% or more of the fish are males, all of the remaining fish in the acclimation pond are removed and transported to local lakes. It has been determined that the male fish that have not volitionally migrated by this time will residualize. If less that 70% of the fish are males, then all the remaining fish in the acclimation pond are forced out. Approximately 5,000-7,000 fish generally remain by the end of April.

- A pre-release fish health exam is done at Irrigon FH to check for viruses and other pathogens. These examinations comply with ODFW fish health policy and are performed no more than six weeks prior to transfer. At the acclimation site, fish health is monitored through release.

- Fifty thousand smolts at 5 fish/pound are transported from Irrigon Hatchery for direct stream release into Big Sheep Creek in early April.

- Smolts are transported from Irrigon FH to the acclimation facility via tanker trucks ranging in size from 2,000 to 5,000 gallon capacity. Loading density criteria are described in the Oregon State Liberation Manual.

- Steelhead are sampled for length and weight at the Little Sheep acclimation site prior to release. Samples are taken to ensure that 90% of the population is over 170mm in length. The mean (2005-2009) coefficient of variation (CV) is 13.1. The Little Sheep Creek stock is not size graded.

- Smolts are forced from the Little Sheep acclimation pond on the target release date if less than 70% are males.

- During the acclimation period at Little Sheep, an attendant is on station 24/7 from March through May.

- Feed rations are decreased and then terminated during the volitional release period from Little Sheep Creek.

- The four Columbia River and four Snake River dams significantly reduce the survival of outmigrating juveniles and returning adults, posing a demographic risk to the return of sufficient numbers of adults for harvest on a consistent basis

Facilities and Operations

Little Sheep Creek adult holding and acclimation facility

- The Little Sheep Creek adult trap consists of a fish ladder leading from the base of a concrete and steel grate weir to a finger weir at the upper end. Flow from Little Sheep Creek is diverted through the trap and ladder. The weir excludes all migration upstream past the facility except through the ladder and trap.

- The acclimation pond is 195’ x 50’ x 3.50’ (34,125 cubic feet volume).

- The adult concrete holding pond on Little Sheep Creek is 40’ x 20’ x 4.00’ (3,200 cubic feet volume). Water from Little Sheep Creek is diverted to the holding pond at 2300 gpm. Target maximum densities are 2.5 ft^3/fish and 2 gpm/fish.

- Water rights total 8,797 gpm from Little Sheep Creek. Water diversion is reported by ODFW to Oregon water resource department, but not to the Fish and Wildlife Service’s Water Resources Division.

- Screening on the water intake at the Little Sheep Creek facility meets NOAA screening criteria.

- A fully furnished 2 bedroom apartment exists at the acclimation facility.
- The operational area of the facility is not paved and is plagued by weeds during the summer months.
- The facility has a flow alarm system that notifies on-station staff.
- The weir design has resulted in scouring and some undercutting below the concrete sill of the weir. The sill is now a low flow passage barrier during summer months when the weir is opened.
- Downstream migrants fall over the weir and onto the concrete sill, which can result in injury and mortality. A 4 x 8 sheet of plywood is set against the weir to slow the fall of fish passing over the weir.
- There is significant silt load from Little Sheep Creek. Significant accumulation of silt occurs in the acclimation pond. The silt is removed annually.
- *See Wallowa Steelhead section for more information on facilities utilized in this program (Irrigon and Wallowa Hatcheries).*

Research, Education, and Outreach

- For the Little Sheep Creek release, all fish are adipose fin-clipped, and 25,000 fish are LV fin-clipped and coded-wire tagged, and 16,900 are PIT–tagged.
- Mark/recapture data provides valuable information on harvest rates (tribal and sport), stray rates, and smolt-to-adult survival rates.
- Hatchery data are recorded in a Hatchery Management Information System (HMIS) which is a computerized system to collect, report, summarize and analyze hatchery production data. This system is a tool to be used in production control at all hatchery management levels.
- Electrofishing is used to determine relative abundance of natural origin *O. mykiss* and hatchery steelhead residuals and fingerling in Little Sheep Creek at rkm 8.0. From 1996 through 2004, an average of 122 (range = 50-184) hatchery-origin and 22 (range = 3-82) natural-origin steelhead were sampled during July. Average densities/100m^2 were 26.19/100m^2 (range = 10.5/100m^2- 46.8/100m2) for hatchery fish and 4.67/100m^2 (range = 0.3/100m^2 – 16.8/100$m^{2)}$.
- Natural origin juvenile *O. mykiss* will be sampled from various natural production areas in the course of genetic monitoring. Samples will be collected using electrofishing gear.
- In addition to adult trapping, density and hatchery/natural ratio of spawners in selected natural spawning areas is monitored via observation.
- NOAA Fisheries is currently conducting a genetic analysis of reproductive success of hatchery and natural-origin steelhead passed upstream of the weir in Little Sheep Creek.

- There is a significant creel survey effort associated with both the Wallowa and Little Sheep Creek programs.

Benefit and Risk Assessment

BENEFITS CONFERRED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to the propagated stock and local community,[104] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- The Little Sheep Creek steelhead program provides recreational and tribal harvest in the Imnaha River Basin. Estimates of harvest of Little Sheep Creek steelhead in the Imnaha River Basin averaged 183 fish (range = 24-397) per season for run-years 1993/1994 through 2004/2005.

- Estimates of harvest (1993/1994-2004/2005) of Little Sheep Creek steelhead within the project area (in the Snake River upstream of Ice Harbor Dam but outside the Imnaha River Basin) averaged 371 (range = 3-1,301) fish per year (Snake River sport).

Conservation Benefits

- The program can *potentially* serve as a genetic repository for the listed Little Sheep Creek steelhead program if managed differently (see recommendations).

Research, Education, Outreach and Cultural Benefits

- Tribal harvest and surplus adults trapped at facilities provide ceremonial, cultural and subsistence benefits to Columbia River tribes.

- Hatchery and evaluation staff provide educational opportunities on site at Irrigon Fish Hatchery.

- Genetic analyses of reproductive success of hatchery- and natural-origin steelhead in Little Sheep Creek are providing information regarding the benefits and risks of hatchery fish spawning naturally.

BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible harvest, conservation, and other benefits that a hatchery program can confer to other species and stocks,[105] the Review Team identified the following benefits of this program:

Harvest Benefits

- The Little Sheep Creek steelhead program contributes to tribal, commercial and recreational fisheries in downstream fisheries, including the lower Columbia River. Estimates of harvest of

[104] *See Section II, "Components of This Report", for a description of these potential benefits and risks.*

[105] *Ibid.*

Little Sheep Creek steelhead from run years 1993/1994 through 2004/2005 averaged 1 (range = 0-4) fish in the ocean, 289 (range = 123-647) fish in the Columbia River (Treaty net, C&S, sport, Test, tributary sport fisheries), and 45 (range = 6-227) fish in the Deschutes River (sport and C&S).

- The program confers both sport and tribal harvest benefits in the Columbia River, downstream of the project area. Tribal harvest primarily occurs in zone 6 fisheries (between the Snake River confluence and Bonneville Dam) in the late summer and fall when summer Chinook, fall Chinook, and coho are also harvested.

- Estimated harvest (expanded from CWT recoveries) of Little Sheep stock steelhead, (for both release locations for return years 2003-2005) below the project area occurred in the tribal net (6.8%) and sport (26.8%) fisheries.

Conservation Benefits

- None identified.

Research, Education, Outreach and Cultural Benefits

- Tribal harvest provides ceremonial, cultural and subsistence benefits to Columbia River tribes.

RISKS POSED TO THE PROPAGATED STOCK AND LOCAL COMMUNITY

In the context of all possible genetic, demographic, ecological and other risks that a hatchery program can pose to the propagated stock,[106] the Review Team identified the following risks of the hatchery program:

Genetic Risks

- The mean proportion of adult steelhead composed of hatchery-origin fish on the spawning grounds (*pHOS*) exceeds the mean proportion of the broodstock composed of natural-origin fish (*pNOB*), posing a domestication risk to the propagated stock and to the natural spawning population in Little Sheep Creek (i.e., $PNI < 0.5$).

Demographic Risks

- High loading densities in incubation trays may contribute to disease problems during incubation and subsequent rearing.

- High densities during early rearing (when the steelhead are in the indoor nursery tanks) may contribute to cold water disease during the rearing cycle.

Ecological Risks

- Released hatchery-origin steelhead that residualize in Little Sheep Creek or Big Sheep Creek pose competition risks to natural origin steelhead.

- Anadromous fish passed upstream of the trap in Little Sheep Creek can be infected with the IHN virus, serving as a potential source of infection to adult steelhead held in the trap and juvenile steelhead present in the acclimation pond.

[106] *Ibid.*

- Amplification of disease within the Irrigon Hatchery poses a disease risk to the propagated stock.

Physical Risks

- See Wallowa hatchery stock steelhead section.

Research, Education, Outreach and Cultural Risks

- None identified.

RISKS POSED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

In the context of all possible genetic, demographic, ecological, and other risks that a hatchery program can pose to other stocks and species in a watershed,[107] the Review Team identified the following risks from the hatchery program:

Genetic Risks

- Outplanting of large numbers of hatchery-origin adults into Big Sheep Creek (average of about 1000 annually during the past 10 years) plus the annual outplanting of hatchery-origin smolts poses genetic risks to naturally spawning steelhead population in Big Sheep Creek.

Demographic Risks

- The release of untreated effluent from the spawning area poses water quality and fish health risk to fish and other species downstream of the Little Sheep Creek acclimation facility.

- The weir design poses mortality risks to downstream juvenile outmigrants which must pass over the weir and fall directly onto the concrete sill several feet below.

Ecological Risks

- Residualized hatchery-origin steelhead pose competition risks to natural-origin salmonids in Little and Big Sheep creeks and the Imnaha River.

- Outplanting large numbers of hatchery-origin adult steelhead into Big Sheep Creek (average of about 1000 adult steelhead annually during the past 10 years) poses additional ecological to natural populations of salmonids in Big Sheep Creek. The intended benefit or measurable goal of these actions has not been clearly defined, thus impeding assessments of the benefits versus risks of those actions. .

Research, Education, Outreach and Cultural Risks

- None identified.

[107] *Ibid.*

Recommendations for Current Program[108]

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that some of the risks outlined in the preceding section were either minor or their probability of occurrence was small and, thus, did not warrant a proposed change or recommendation for the current program. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address the identified risks or potential problems considered by the Review Team to warrant a potential modification to the current program. Preceding each numbered recommendation is a brief summary of the issue.

Program goals and objectives

Issue LSC-SS1: Present program goals for Little Sheep Creek stock steelhead released into Little Sheep Creek are not fully expressed in terms of numeric outcomes that quantify intended benefits or goals. *For example, there is currently no quantified harvest goal separate from the mitigation goals. The mitigation goal may not accurately reflect the harvest and recreational benefits the program is attempting to produce. Potentially quantifiable benefits include number of fish harvested, number of angler hours, and catch per unit effort.*

Recommendation LSC-SS1: Restate and quantify program goals in terms of the specific benefits the program is intended to provide, consistent with the mitigation goal.

Issue LSC-SS2: The current release of up to 1,500 adult hatchery-origin steelhead and 50,000 smolts annually into Big Sheep Creek appears inconsistent with conservation goals for the Imnaha River steelhead population. *Approximately 50,000 hatchery-origin steelhead smolts and up to 1,500 surplus hatchery-origin adult steelhead are released annually into Big Sheep Creek. The ultimate goal and measurable benefits of those outplantings have not been clearly described. The ultimate goal of those outplantings are not stated in terms of numeric outcomes that quantify intended benefits; therefore, the desired benefits of those actions cannot be assessed relative to known risks. Those actions may conflict with the ICTRT conservation objectives for the Imnaha River basin, and they pose genetic and ecological risks to natural populations of salmonid fishes in Big Sheep Creek. The ultimate goal of those outplantings are not stated in terms of numeric outcomes that quantify intended benefit; therefore, the desired or realized benefits of those actions cannot be assessed relative to the identified risks.*

Recommendation LSC-SS2: Discontinue the release of smolts and adults from Little Sheep Creek into Big Sheep Creek unless the activity can be justified based upon specific goals for the program. Goals need to be developed in terms of measurable benefits (e.g., contribution to harvest, number of natural-origin recruits, viabilities of natural populations) and weighed against the risks imposed by the outplanting actions.

Broodstock Choice and Collection

None identified.

[108] *The Review Team believes that the ODFW and the USFWS LSRCP office will be the logical parties to coordinate and implement most of the following recommendations.*

Hatchery and Natural Spawning, Adult Returns

Issue LSC-SS3: The number of hatchery-origin steelhead passed upstream of the weir in Little Sheep Creek has generally been substantially greater than the number of natural-origin fish passed upstream. However, an experimental study is currently underway to assess the relative reproductive success of hatchery and natural-origin steelhead passed upstream of the weir. *In this context, the intent of the existing sliding scale for passing hatchery and natural-origin fish upstream is unclear. The current protocol leads to an unbalanced experimental design which reduces the power of the study (i.e., to detect a statistically significant difference in relative reproductive success of hatchery and natural origin fish) and can lead to experimental bias. In addition, the current sliding scale may be inconsistent with the conservation goal of the program to maintain a natural population upstream of the weir (pHOS is greater than pNOB).*[109]

Recommendation LSC-SS3: Revisit and adjust the sliding scale so that it is consistent with the research and conservation goals of the program. If needed, develop a more accurate escapement goal based upon habitat capacity and productivity. The number of hatchery and natural-origin fish passed upstream of the weir should be as equal as possible to maximize the power and minimize bias of the experimental design to assess the relative reproductive success of the two groups of fish, particularly in a relatively small stream that may have limited spawning habitat.

Incubation and Rearing

Issue LSC-SS4: Egg loading densities in incubation trays (~3 females per tray or up to approximately 16,000 eggs/tray) exceed recommended loading density guidelines as implemented for steelhead at National Fish Hatcheries and other LSRCP facilities. *Additionally, density guidelines developed by the Integrated Hatchery Operation Team (IHOT) for steelhead in the Columbia River basin recommend a maximum of 9,000 eggs per tray post-fertilization to the eyed-egg stage and 8,000 eggs per tray from the eyed-egg stage to hatch. The overloading of incubation trays may be contributing to the relatively poor eyed-egg-to-smolt survival rate at Irrigon FH.*

Recommendation LSC-SS4: Reduce initial loading densities of the incubation trays to eggs from a maximum of two females per tray.

Issue LSC-SS5: Rearing densities in the nursery tanks exceed the Hatchery Review Team's recommended density index (D.I.) and flow index (F.I.) guidelines for steelhead (D.I. < 0.5 and F.I. <1.0). *At maximum loading, the nursery tanks reach rearing densities of D.I.=0.83 and flows of F.I.=1.9. High early rearing densities can exacerbate infections (e.g. bacterial coldwater disease), resulting in acute mortality that generally begins several months after hatching. At some northwest hatcheries, outbreaks of bacterial coldwater disease have been significantly reduced when early rearing densities are lowered.*

Recommendation LSC-SS5: To achieve a rearing density no greater than D.I. = 0.5, either (a) increase the amount of nursery rearing space, or (b) reduce the number of hatched fry

[109] *Changes were made by the Oregon comanagers to the Little Sheep Creek summer steelhead program in response to this issue after the initial draft report of the Review Team was provided.*

produced on station. The Service may also wish to evaluate rearing constraints and fish health concerns under current protocols; for example, the hatchery could conduct an early rearing density study.

Issue LSC-SS6: In most years, coldwater disease causes mortality in the Wallowa and Little Sheep stocks of steelhead. *Elevated losses from disease usually occur through June and early July when the fish are in the indoor nursery tanks. Coldwater disease is a major problem in many northwest hatcheries. Flavobacterium psychrophilum, the bacterium causing coldwater disease, is transmitted vertically from the female parents to their progeny and horizontally through the water via infected animals. This epizootiology complicates disease control. At Irrigon FH, the fish are treated with florfenicol (Aquaflor) if coldwater disease mortalities are elevated. Formerly, fish were fed pills coated with 15 mg florfenicol/kg of fish weight as prescribed by a veterinarian. New FDA regulations now designate the use of florfenicol medicated feed at 10 mg drug/kg fish weight with a Veterinary Feed Directive. At this lower dosage, the medicated feed is less effective in controlling disease and additional treatments may be needed, increasing fish losses and the possibility of developing drug-resistant forms of F. psychrophilum. Further, delays in deliveries of the medicated feed after diagnosis of elevated coldwater disease can exacerbate mortalities.*

Recommendation LSC-SS6: Continue working with the Bacterial Coldwater Disease Research Group, as supported by the Pacific Northwest Fish Health Protection Committee, to develop fish culture practices and treatment options to control or eliminate coldwater disease. Consider investigating different densities (e.g., D.I. = 0.83, 0.5, and 0.2) of fry in the troughs to determine whether early rearing densities influence the development of coldwater disease (see Issue LF-SS7). In addition, some hatcheries have found that saline rinses of eggs prior to fertilization improves eye-up and may reduce external loads of *F. psychrophilum.* Communication with the USFWS Aquatic Animal Drug Approval Partnership Program (AADAP) and the newly-formed Working Group on Aquaculture Drugs, Chemicals and Biologics (AFS-Fish Culture Section) may help recapture efficacious antibiotic treatment of coldwater disease.[110]

Release and Outmigration

Issue LSC-SS7*:* ***Anadromous fish passed upstream of the trap in Little Sheep Creek can be infected with the IHN virus and M. cerebralis. Both pathogens could potentially infect the juveniles reared in the acclimation pond prior to release into Little Sheep Creek (the water intake for the acclimation pond is located at the adult trap****). Pre-release exams are performed at Irrigon Hatchery prior to transport to Little Sheep Creek acclimation ponds, and all juvenile steelhead have been negative for virus and M. cerebralis prior to transfer. Fish health is monitored monthly at Little Sheep Creek because the fish are acclimated for 30 days followed by a 30 day volitional release. However, the current health testing of fish in the acclimation pond does not include assays for virus and M. cerebralis. In some years, the smolts that do not voluntarily leave the acclimation pond are outplanted to area lakes. This may exponentiate the spread of pathogens to other areas.*

[110] *A strategy similar to the region-wide efforts used to control* Renibacterium salmoninarum *(causative agent of BKD) may be needed to control coldwater disease in northwest hatcheries. This could include broodstock testing, antibiotic injections of adults, culling/segregation of progeny from highly infected fish and/or reduced rearing densities of juvenile fish.*

Recommendation LSC-SS7: As per Oregon's Fish Health Management Policy, ensure that fish released or transferred from the Little Sheep Creek acclimation facility do not expand the geographic distribution of pathogens such as IHNV and *M. cerebralis.* It may be desirable to sample the steelhead juveniles for IHNV and *M. cerebralis* prior to release from the acclimation pond. If IHNV is found, DNA genotyping could be performed to determine the specific strain in order to monitor and track new strains of IHNV. Assays for *M. cerebralis* among Little Sheep Creek smolts might clarify when/where steelhead pick up the parasite during their life cycle. Those assays may also provide infectivity information on endemic strains of the parasite.

Facilities/Operations

See the Wallowa FH summer steelhead Facilities and Operations recommendations section for issues and recommendations regarding Irrigon FH.

Little Sheep Creek acclimation facility

Issue LSC-SS8: The release of untreated organic waste and effluent from the spawning area poses a potential water quality and health risk to fish and other species downstream of the Little Sheep Creek acclimation facility. *The health risk is believed to be small because Little Sheep Creek steelhead spawned for broodstock largely represent adult returns back to Little Sheep Creek and, thus, maintain the same disease profiles as natural-origin adult fish. However, the discharge of organic waste material (e.g. ovarian fluid, milt, blood) in concentrated form may increase the risk of pathogen transmission to fish residing in Little Sheep Creek immediately downstream from the acclimation facility.*

Recommendation LSC-SS8: As a best management practice, investigate retaining spawning effluent for proper disposal, either offsite or via effluent disinfection.

Issue LSC-SS9: The Little Sheep Creek facility has limited storage capacity for equipment and supplies. The facility had a temporary unit; however, high winds in the Little Sheep Creek canyon destroyed the unit.

Recommendation LSC-SS9: Consult with professional engineers to construct a permanent storage facility that can withstand the weather conditions of the area.

Issue LSC-SS10a: The weir design has resulted in scouring below the concrete sill of the weir. *The sill is now a low flow passage barrier to fish (including bull trout) during summer months when the weir is opened.*

Issue LSC-SS10b: Downstream juvenile outmigrants must pass over the weir and – in so doing - fall directly onto the concrete sill several feet below, which can result in injury or mortality*. ODFW staff have installed a 4'x8' sheet of plywood as a temporary measure to slow the fall of fish passing over the weir.*

Recommendation LSC-SS10: Consult with professional engineers to modify the weir design to eliminate scouring and facilitate upstream passage of fish during low flows when the weir is opened and safe downstream passage juvenile fish when the weir is closed.

Research, Monitoring, and Accountability

Also see LC-SC29 in the Lookingglass Creek spring Chinook section and WW-SS3 above.

Issue LSC-SS11: *Very limited monitoring and evaluation occurs* ***to identify the benefits of releasing juvenile and adult steelhead in Big Sheep Creek (see issue and recommendation LSC- SS2). Consequently, the benefits versus risks of those actions cannot be evaluated.***

Recommendation LSC-SS11: Develop a monitoring and evaluation program to determine whether the desired benefits of outplanting juvenile and adult steelhead from Little Sheep Creek into Big Sheep Creek are realized after the goal of those outplants are identified in terms of measurable benefits, assuming that those outplants continue.

Issue LSC-SS12: Residualized hatchery-origin steelhead from Little Sheep Creek pose ecological risks to natural populations in the Imnaha River basin. *ODFW attempts to reduce these risks by controlling fish size, place, and time of release, and by attempting to select fish which exhibit migrating behavior.*

Recommendation LSC-SS12: Continue to monitor the degree of residualism in the release areas and downstream in the Imnaha River and continue to implement actions to minimize residualism including outplanting non-migrant yearlings to closed bodies of water (lakes or ponds) at the end of volitional release periods. Depending upon monitoring and evaluation results, determine whether current management actions are effective or alternative management actions are desired to reduce the risk of residualism.

Issue LSC-SS13: Coded-wire tagged fish (including other tagging strategies such as PIT tagging) may not accurately represent the steelhead population released at Little Sheep/Big Sheep creeks. According to the 2009 AOP, fish in only one of five raceways at Irrigon FH receive coded-wire tags for the Little Sheep/Big Sheep releases. *Because the fish in different raceways often represent the progeny of different spawn takes and the pond environments can differ (e.g., flow index and flow pattern, pathogen loads, etc.), fish in just one of several raceways may not accurately represent the entire release group for that brood year.*

Recommendation LSC-SS13: Ensure that the tagging strategy accurately represents the entire population of progeny from all spawn groups for a particular brood year. For example, all spawn groups should be proportionately represented among tag groups and raceways. Coded-wire tags can be applied to fish across all five raceways for the Little Sheep/Big Sheep release. This recommendation applies to any tagging strategy, including PIT tags. In this latter case, unique PIT tag groups will differentiate between Little Sheep and Big Sheep creeks.

Education and Outreach

None identified.

Alternatives to Current Program

The Review Team considered the benefits and risks of the existing Little Sheep Creek steelhead program at Irrigon FH and developed six alternatives designed to reduce risks and/or increase benefits. The first alternative is the current program with all previously-described recommendations adopted. The last alternative is the "no hatchery" option. Following these descriptions of alternatives, the Review Team has identified recommended alternatives.

Alternative 1: Current program with recommendations

This alternative as identified here includes addressing issues related to the proportion of hatchery origin steelhead adults above the Little Sheep Creek weir and the large number of steelhead outplants into Big Sheep Creek.

Pros

- Maintains mitigation harvest opportunities on Little Sheep stock steelhead in the Imnaha and Snake rivers.
- Maintains significant recreational fishing opportunities (including catch and release) in the Imnaha, Snake and Columbia rivers.
- Maintains a genetic repository for the listed Little Sheep Creek steelhead program if managed according to recommendations.
- Provides a research benefit for testing the use of artificial propagation for the recovery of listed steelhead populations.
- Reduces the demographic risk of extinction and potentially contributes to the recovery of the Snake River steelhead DPS.

Cons

- Continued fish health risks associated with transfers from Irrigon FH and passage of adult fish upstream on Little Sheep Creek.
- May reduce the number of natural-origin steelhead smolts in Big Sheep Creek.

Alternative 2: Manage Little Sheep Creek as an integrated conservation program

Manage the Little Sheep Creek steelhead program so that it serves as a genetic repository for the natural Little Sheep Creek steelhead population. The program size would be reduced to an annual release of approximately 85,000 smolts, consistent with HSRG (2009) recommendations for the integrated component of a stepping-stone program.

Pros

- Maintains a genetic repository for the listed Little Sheep Creek steelhead program if managed according to recommendations.

- Research benefit in testing the use of artificial propagation for the recovery of listed steelhead populations.

- Reduces the demographic risk of extinction and potentially contributes to the recovery of the Snake River steelhead DPS.

- Reduces genetic and ecological risks to natural-origin steelhead in Little Sheep Creek.

Cons

- Potentially reduces the number of adult steelhead available for harvest and recreational fishing.

- The risk of transporting pathogens, including IHNV, from Irrigon FH to offsite locations would still exist.

Alternative 3: Manage the Little Sheep Creek as a segregated, harvest program where only natural-origin fish are passed upstream of the weir and only hatchery-origin fish are used for broodstock

This alternative would manage hatchery and wild steelhead in Little Sheep Creek as two distinct populations and would treat the area of Little Sheep Creek upstream of the weir as a natural population refuge.

Pros

- Maintains current harvest and recreational benefits.

- Minimizes hatchery influence on the Little Sheep Creek natural-origin steelhead population upstream of the weir.

- Reduces logistic and broodstock constraints for managing the hatchery population for Little Sheep Creek

Cons

- The weir would still have to be operated to preclude hatchery fish from migrating upstream.

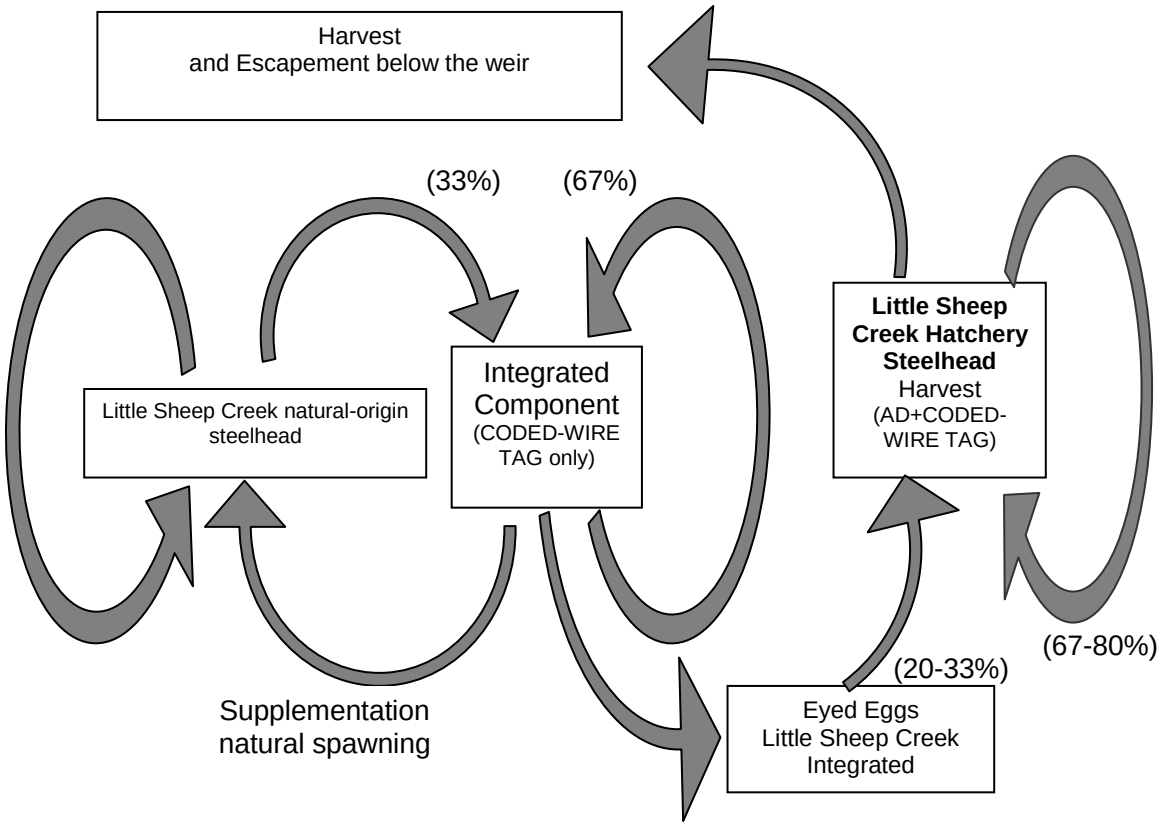
- The risk of transporting pathogens, including IHNV, from Irrigon FH to offsite locations would still exist.

- Does not preclude the natural spawning of hatchery-origin steelhead downstream of the weir

Alternative 4: Convert the current integrated program to a two-broodstock, stepping-stone program consistent with HSRG (2009) recommendations

To work toward meeting the LSRCP mitigation goal of 2,000 adult steelhead back to the project area and to jointly work toward meeting conservation goals for natural-origin steelhead in Little Sheep Creek steelhead, convert the current integrated program to a two-broodstock, stepping-stone program.

This alternative could be implemented at the Little Sheep Creek facility/Irrigon FH by differentially marking offspring of each broodstock where the integrated conservation component would be 100% coded-wire tagged with no adipose fin clips, and the harvest component would be 100% adipose-fin clipped and a portion given coded-wire tags for monitoring and evaluation purposes. The HSRG proposed a program, based on AHA modeling, of 85,000 smolts for the offspring of the integrated broodstock and 126,300 smolts for the offspring of the harvest broodstock.



Pros

- Provides fish explicitly for sport and tribal fisheries.
- Separates harvest and conservation benefits according to two distinct broodstocks.
- Potentially reduces genetic and ecological risks to the listed steelhead stock.
- Serves as a genetic reserve for the listed Little Sheep Creek population and a conservation program for the population upstream of the weir.
- Reduces the demographic risk of extinction and potentially contributes to the recovery of the Snake River steelhead DPS.

Cons

- Would reduce the number of natural-origin fish passed upstream to spawn naturally.

- Further complicates rearing space limitations at the Irrigon FH.
- Only serves as a conservation program for the naturally spawning component of the population upstream of the weir.
- The risk of transporting pathogens, including IHNV, from Irrigon FH to offsite locations would still exist.

Alternative 5: Develop a program on Big Sheep Creek to provide harvest opportunity in Big Sheep Creek

Develop a local broodstock from Big Sheep Creek natural-origin steelhead and establish a program of at least 100,000 smolts to replace the current release of 50,000 Little Sheep Creek smolts and up to 1,500 hatchery-origin adults (from Little Sheep Creek) into the Big Sheep Creek watershed. This alternative would require that the Little Sheep Creek program be reduced by at least 50,000 smolts.

Pros

- Maintains harvest opportunity in the Imnaha River watershed while reducing risks associated with current outplants of Little Sheep Creek steelhead into Big Sheep Creek.
- Reduces the number of surplus adults returning to Little Sheep Creek.
- Eliminates the need to truck adults from Little Sheep Creek to Big Sheep Creek.

Cons

- Would likely require juvenile acclimation or adult recapture facilities on Big Sheep Creek.
- Requires detailed habitat assessments to properly size the Big Sheep Creek component of the program.
- Would require additional incubation and rearing space for eggs and juvenile steelhead, respectively, at Irrigon FH or elsewhere.
- May increase genetic, ecological, and fish health risks to the natural steelhead population in Big Sheep Creek.
- May be inconsistent with long-term conservation goals for Big Sheep Creek.

Alternative 6: Terminate the program and decommission the facility

Decommission hatchery in favor of alternative mitigation strategies such as habitat restoration, passage improvements, or alternative hatchery production at another site.

Pros

- Eliminates hatchery influence on natural populations of steelhead in Little Sheep Creek and Big Sheep Creek.

- Reduces the number of stocks reared at Irrigon FH and increases the rearing space available for other LSRCP programs.

- Eliminates the risk of transporting pathogens, including IHNV, to the Imnaha River watershed.

- Allows for the Imnaha River basin to act as a control/indicator stream for natural summer steelhead populations.

Cons

- The weir would still have to be operated to preclude hatchery fish from migrating upstream until hatchery fish were no longer present (approximately four years post-termination of the program_.

- Reduces tribal and sport harvest opportunities within and downstream of the project area.

Recommended Alternatives

The Review Team recommends Alternative 1: retention of the current Little Sheep steelhead program with implementation of all program-specific recommendations. If implemented, this alternative should maintain the genetic integrity of the broodstock, improve fish culture efficiency, decrease ecological and disease risks, and maintain the existing level of fishing opportunity for steelhead in the Imnaha River and in downriver fisheries. This includes defining goals in terms of numeric outcomes that quantify intended benefits or goals which are consistent with mitigation goals.

The Review Team is concerned about the continued releases of smolts and large numbers of surplus hatchery-origin adults into Big Sheep Creek. These releases should be discontinued unless a management goal is clearly defined in terms of measurable benefits, and those benefits outweigh the identified risks. The significant habitat in the Big Sheep Creek watershed appears to make this area a likely candidate for a natural-population management strategy, or for a strategy of only minor supplementation in low return years.

The sliding scale for passing adult steelhead upstream of the weir on Little Sheep Creek needs to be adjusted so that it is consistent with the research and conservation goals of the program. The number of hatchery and natural-origin fish passed upstream of the weir should be as equal as possible to maximize the power and minimize bias of the experimental design to assess the relative reproductive success of the two groups of fish, particularly in a relatively small stream that may have limited spawning habitat; for example, large numbers of hatchery-origin fish could simply outcompete or displace comparatively small numbers of natural-origin fish.

Although not selected as the preferred alternative, the Team strongly considered Alternative 4 that would convert the current program to a stepping-stone program consistent with HSRG (2009) recommendations. The Review Team sees this latter alternative as a viable option that may support long-term goals for the program because it would develop an integrated broodstock better adapted at assisting with the conservation and rebuilding of the natural population upstream of the Little Sheep Creek weir. The Team favored Alternative 1 because of the comparatively small size of Little Sheep Creek and uncertainties regarding the actual number of fish that could be harvested.

VI. Conclusions

The Review Team concluded that conflicts exist between actions intended to achieve LSRCP mitigation goals to support fisheries in the Snake River basin and conservation goals for individual populations within the Grande Ronde and Imnaha rivers of Oregon. For example, the spring Chinook program in the Imnaha River contributes significantly to the total number of hatchery-origin spring Chinook that return upstream of Lower Granite Dam in support of LSRCP mitigation goals; however, large numbers of hatchery-origin Chinook salmon are posing significant genetic and ecological risks to the naturally-spawning population. The Review Team recommends the development of separate "Master Plans" for each population in each watershed (e.g., spring Chinook in Catherine Creek) to help resolve conflicts.

The Team concluded that the Lookingglass Creek Spring Chinook program, derived from the Catherine Creek stock for reintroduction, has increased adult recruits to the basin. However, the current productivity and capacity of Lookingglass Creek upstream of the hatchery may not be sufficient to provide the number of natural-origin adults sufficient to annually support an integrated broodstock of 170 adult spring Chinook. In addition, the existing management goal and sliding scale for passing hatchery-origin fish upstream of the hatchery weir will eventually pose a long- term risk to reestablishing a viable natural population at current levels of passage of hatchery-origin fish. The Team recommends increasing the number of smolts released from the hatchery and modification of the sliding scale to limit the number of hatchery-origin fish passed upstream of the weir when natural-origin adults achieve a threshold level viability abundance. The Team concluded that these changes to the program would reduce long-term risks to reestablishing a natural population in Lookingglass Creek while providing increased harvest opportunities on hatchery-origin spring Chinook. However, because of capacity limits of Lookingglass Hatchery, increasing the size of the Lookingglass Creek Spring Chinook program would require reducing the sizes of other programs, specifically, the Upper Grande Ronde River and Imnaha River spring Chinook programs.

The Team concluded that the Upper Grande Ronde River Spring Chinook program was providing a conservation benefit to the natural population by preventing extinction of a population at significant risk of extinction due to degraded habitat and low smolt-to-adult return rates. The Team also concluded that the near-term goal of the program should be to implement a safety net program sized to maximize the remaining genetic variability until the demographic risks to the population from poor habitat have been addressed and a natural population can be re-established in the upper Grande Ronde River.

The Team concluded that the Catherine Creek Spring Chinook program has provided a conservation benefit; however the current sliding scale should be modified to reduce the number of hatchery-origin fish passed upstream of the weir when escapement objectives for natural-origin fish have been met. Releasing surplus hatchery-origin fish to spawn naturally when escapement goals for natural-origin adults have been achieved poses unnecessary genetic and ecological risks to the natural population. In addition, the Team concluded that the outplanting of hatchery-origin adults into Indian Creek should be discontinued unless that outplanting can be justified and subsequently evaluated relative to an identified conservation goal.

The Team concluded that the Lostine-Wallowa River Spring Chinook program was providing a conservation benefit to the natural population; however, the inefficiency of the existing weir and the current sliding scale for determining the number of hatchery-origin fish passed upstream of the weir poses a long-term risk to the natural population. In addition, the Team concluded that the outplanting

of hatchery-origin adults into the Wallowa River, Bear Creek, and Prairie Creek should be discontinued unless that outplanting can be justified and subsequently evaluated relative to an identified conservation goal. The Team also supported development of the Northeast Oregon Hatchery (NEOH) in the Lostine River to relieve facility constraints at Lookingglass FH and to provide greater opportunities for achieving comanager goals in the Lookingglass Creek program and the Lostine-Wallowa rivers.

The Team concluded that the Imnaha River Spring Chinook program was providing a conservation, demographic benefit to the natural population; however, the large numbers of hatchery-origin fish spawning in the Imnaha River upstream of the weir, coupled with the inefficiency of the existing weir and the deliberate outplanting of hatchery-origin adults into Big Sheep and Lick creeks, pose additional genetic risks to natural populations. The Team concluded that a slight reduction in the size of the program, an adjustment to the current sliding scale to reduce the number of hatchery-origin fish released above the weir, modification of the existing weir to improve trapping efficiency across the entire run, and discontinuation of adult outplants – unless justified and monitored - would reduce risks considerably while continuing harvest benefits and contributions to LSRCP mitigation goals.

The Team concluded that the segregated-harvest Wallowa stock steelhead program in the Grande Ronde River provides a significant harvest benefit; however, the continued straying of Wallowa stock steelhead into the Deschutes and John Day rivers did pose a significant risk to those natural populations. The Team concluded that continued monitoring of straying both within the Grande Ronde River and outside the Basin (Deschutes and John Day rivers) should be continued to ensure that the existing program does not significantly impact conservation goals in those areas. The Team also concluded that continued investigation of alternative broodstocks and broodstock strategies aimed at reducing straying should continue so that alternatives could be implemented if straying continues and risks to natural populations are deemed unacceptable. The Team concluded that straying of returning Wallowa stock steelhead into tributaries of the mid-Columbia River, including the Deschutes and John Day rivers, constitutes a substantial conservation issue.

The Team concluded that the Little Sheep Creek Summer Steelhead program in the Imnaha River also provides significant harvest benefits; however, the relatively large numbers of hatchery-origin fish spawning in Little Sheep Creek, and the outplanting of large numbers of hatchery-origin adults and juveniles into Big Sheep Creek, pose significant risks to the naturally spawning populations. The Team concluded that the sliding scale for releasing hatchery-origin fish upstream of the weir should be reviewed and adjusted to be consistent with the goals and objectives of the existing research and conservation program. The Team also concluded that the continued outplanting of adults and juveniles into Big Sheep Creek should be discontinued unless justified by clearly defined goals and objectives for continuing those outplants.

In general, the Team recognizes that the current LSRCP programs in the Grande Ronde and Imnaha River basins are making important contributions toward tribal and recreational fisheries in those terminal areas. However, those programs are not without risks to existing natural populations, and portions of those programs conflict with goals associated with conserving or reestablishing natural populations. The Team recommends that comanagers develop a series of Master Plans for each species and each watershed where hatchery propagation is intended to be a tool for achieving harvest and/or conservation goals. The Northeast Oregon spring Chinook master plan may serve as an appropriate starting point for generating specific plans for individual species in the Grande Ronde and Imnaha river systems. Hatchery and Genetic Management Plans for each hatchery program could be updated simultaneously as partial components of each species Master Plan. The Team recommends that those

Master Plans identify specific short term conservation goals for natural populations in each watershed with objectives and benchmarks for achieving them via the use of hatchery propagation.

Appendices

Appendix A: All-H Analyzer (AHA) output for salmon and steelhead stocks in the Grande Ronde and Imnaha River Watersheds

Available from the Pacific Region Federal Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

Appendix B: Oregon LSRCP Facilities Briefing Document

Available from the Pacific Region Federal Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

Appendix C: Comments on Draft Report and Review Team Responses

Available from the Pacific Region Federal Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

Appendix D. Complete Text of Comment Letters Received from Stakeholders

Available from the Pacific Region Federal Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

Appendix E: Washington LSRCP Facilities Operations and Maintenance Costs Summary

Available from the Pacific Region Federal Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

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For Columbia River Basin Hatchery Review Information
www.fws.gov/pacific/Fisheries/Hatcheryreview/

The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

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