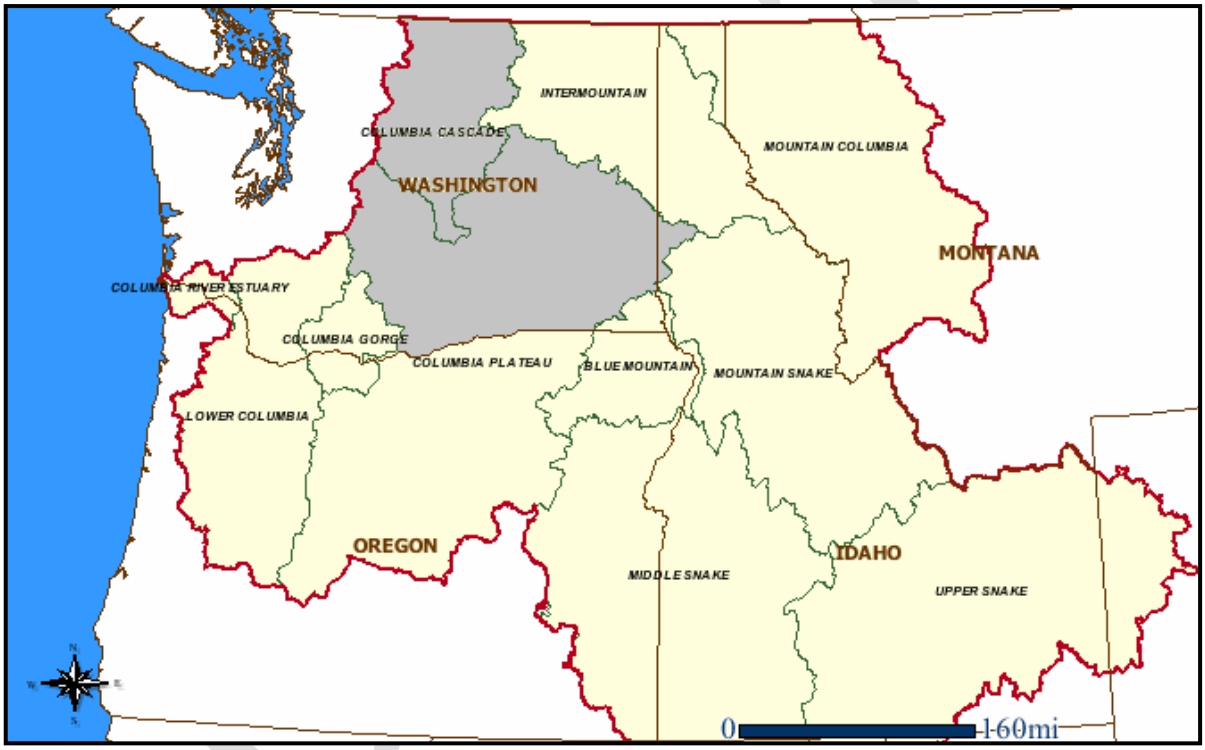
U.S. Fish and Wildlife Service - Pacific Region

Columbia River Basin Hatchery Review Team

Columbia River Basin, Columbia Cascade Province

Wenatchee, Entiat and Methow River Watersheds



Leavenworth, Entiat and Winthrop National Fish Hatcheries

Assessments and Recommendations

October 2006

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Summary

The US Fish and Wildlife Service (Service) initiated, in October 2005, a three-year review of 21 salmon and steelhead hatcheries that the Service owns or operates in the Columbia River Basin. The goal of the Service's review is to ensure that all federal 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 recent Puget Sound and Coastal Washington Hatchery Reform Project[1] and includes facilitation by Long Live the Kings (LLTK)[2], a non-profit organization devoted to restoring wild salmon to the waters of the Pacific Northwest. The Service plans to complete its reviews of 12 National Fish Hatcheries by the end of 2007.

The report presented here provides benefit-risk assessments and recommendations for propagation programs at three National Fish Hatcheries (NFHs) in the Mid-Columbia River region of Washington State: Leavenworth, Entiat and Winthrop NFHs. These three hatcheries are located on streams draining the east slope of the Cascades Mountains and are managed together as the "Leavenworth Complex." Their construction and operation was initially authorized under the Grand Coulee Dam Project , 49 Statue 1028, on August 30, 1935 as part of the Rivers and Harbors Act. The hatcheries were reauthorized under the Columbia Basin Project Act, 57 Statue 14, on March 10, 1943, and subsequently under the Fish and Wildlife Coordination Act, 60 Statue 1080, on August 14, 1946. The three hatcheries were constructed by the U.S. Bureau of Reclamation (BOR) in 1940 and 1941 and are currently operated by the Service with funding from BOR and the Bonneville Power Administration (U.S. Department of Energy) via interagency agreements. The primary purpose of the three hatcheries is to maintain runs of anadromous salmonid fishes as continued mitigation for fish losses associated with Grand Coulee Dam which blocks anadromous salmonids from 1,140 miles of the upper Columbia River.

The Leavenworth, Entiat, and Winthrop NFHs each propagate and release spring Chinook salmon *(Oncorhynchus tshawytscha*) as part of their mitigation responsibilities. The Winthrop NFH also releases steelhead (anadromous *O. mykiss*) in collaboration with the Washington Department of Fish and Wildlife (WDFW). Those four programs and the facilities at the three hatcheries are the focus of the review described here.

The Review Team considered four characteristics of each salmonid population/stock within the watersheds affected by the programs at each of the three NFHs: *biological significance, population viability, habitat* conditions, and *harvest* goals. The Review Team used both short- (10-15 years) and long-term (50–75 years) goals for each of those four characteristics, as identified by the co-managers, as a foundation for assessing the benefits and risks of the 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]

The Review Team also examined the Master Plan of the Yakama Nation for restoring coho salmon (*O. kisutch*) to the mid-Columbia region. The Team also received oral reports from Yakama Nation biologists and a summary of major results to date. Although the Yakama Nation's coho restoration

[1] *www.hatcheryreform.org*
[2] *www,LLTK.org*
[3] *www.fws.gov/Pacific/fisheries/HatcheryReview/*

program is using some of the facilities at the three Leavenworth Complex hatcheries, that program is not explicitly reviewed here but is included with some of the Team's recommendations.

Leavenworth National Fish Hatchery

Facility Overview: The Leavenworth NFH is located at river mile (RM) 2.8 of Icicle Creek, a tributary to the Wenatchee River 26 miles upstream from the Columbia River near Leavenworth Washington. The Wenatchee River enters the Columbia River at RM 468 at the town of Wenatchee, Washington. Adult fish returning to the Leavenworth NFH must migrate upstream a total of 497 miles and must pass over seven Columbia River hydropower dams. Water sources include seven wells, Icicle Creek, and supplemental summer releases from Snow and Nada Lakes located in the Alpine Lakes Wilderness. Major issues at the hatchery are a decaying intake water pipe that needs replacement and instream structures that impede fish migration. The hatchery hosts the annual Wenatchee River Salmon Festival, an internationally-recognized public outreach and education event each September. The Leavenworth NFH supports a spring Chinook program. It also provides facilities for the coho reintroduction program of the Yakama Nation.

Spring Chinook Program Overview: This program operates as a *segregated-harvest* program with returning hatchery-origin adults used for broodstock. The primary goal of the program is to provide harvest benefits from returning adults. The broodstock objective is to spawn approximately 1,000 adults annually with a release objective of 1.625 million yearling smolts. The propagated stock is largely an introduced stock from the Carson NFH (near Carson, Washington). The Carson NFH stock was developed in the late 1950's and early 1960's from a mixture of upper Columbia and Snake River populations intercepted at Bonneville Dam in the Columbia River Gorge.

Benefits: The program provides significant tribal and recreational harvest benefits in Icicle Creek. The tribal (Yakama Nation) harvest in Icicle Creek averaged 2,905 spring Chinook per year, 1999-2003. In addition, during that same time period, an average of over 3,000 hatchery-origin adults, trapped at the hatchery but surplus to broodstock needs, were provided directly to Columbia River tribes (Yakama Nation, Colville Confederated Tribes, Spokane Tribe, Kalispell Tribe) and food banks. Harvest benefits from recreational, non-tribal harvest in Icicle Creek averaged 1,252 fish per year, 1999-2003. In addition, commercial/tribal and recreational harvests averaged 835 and 732 fish per year, respectively, in the mainstem Columbia River. The harvest is restricted primarily to Icicle Creek because natural populations of spring Chinook in the Wenatchee River and mid-Columbia region are currently listed as endangered under the ESA.

Risks: The surface water intake pipe is at risk of catastrophic failure. Such a failure places all fish reared on hatchery surface water at immediate risk of 100% mortality. Such a failure would affect both the Service's spring Chinook program and the Yakama Nation's coho restoration program. In addition, spring Chinook from the introduced stock pose a genetic risk to ESA listed populations in the upper Wenatchee River, primarily because (a) ESA-listed hatchery-origin fish released by WDFW for recovery are given the same adipose fin mark as fish released from the Leavenworth NFH and (b) marked fish are deliberately passed upstream into the upper Wenatchee River to spawn naturally and assist with recovery. The Leavenworth NFH also poses a demographic risk to ESA-listed steelhead and bull trout (*Salvelinus confluentus*) because water intake screening does not comply with federal guidelines and passage facilities for upstream-migrating fish are inadequate. Instream flows in Icicle Creek do not meet minimum requirements between the hatchery's intake at RM 4.5 and the hatchery outflow at RM 2.4. In some years, this latter section of Icicle Creek has gone completely dry during the summer.

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Recommendations: The Review Team identified 10 specific recommendations to reduce risks and/or improve benefits of the current spring Chinook program. Several inter-related water issues exist at the Leavenworth NFH and Icicle Creek including a deteriorating water intake pipe, inadequate fish passage, and other water issues (water withdrawals, instream flows, and hatchery outflow) The Review Team was concerned that those issues are being addressed separately and not holistically. The Review Team concluded that a collaborative strategy with stakeholders, similar to the PATH process initiated recently, was highly desirable to address these water issues in a holistic and scientifically defensible manner. For example, these strategies should include options for providing hatchery outflow water directly for irrigation, rather than dewatering Icicle Creek to meet water rights of the hatchery and irrigation companies. The Review Team believed that the BOR could play a key intermediary role to facilitate those options. The Review Team also proposed three water intake and fish passage alternatives that combined elements of alternatives developed separately for intake and passage by an engineering firm. Regardless of which alternatives are selected, replacement of the existing water intake system to the hatchery needs to occur as soon as possible.

Program Alternatives: The Review Team considered the pros and cons of seven alternatives to the existing spring Chinook program, including the current program with full implementation of all program-specific recommendations (Alternative 1). The Review Team recommends continuation of the existing spring Chinook program (Alternative 1) until the water intake system for the hatchery is replaced. Once the existing intake system is replaced, the Review Team recommends transitioning the existing broodstock to a native spring Chinook broodstock that is integrated genetically with a Wenatchee River ESA recovery hatchery broodstock according to a proposed "stepping stone" model. Implementation of this latter recommendation would be contingent upon the issuance of special ESA permits to allow continued tribal and recreational harvests in Icicle Creek on Leavenworth NFH spring Chinook. The Review Team concluded that those latter fishery benefits should not be diminished.

Entiat National Fish Hatchery

Facility Overview: The Entiat NFH is located at RM 6.3 of the Entiat River, a tributary to the Columbia River at RM 485 between Wenatchee and Chelan, Washington. Adult fish returning to the Entiat NFH must migrate upstream a total of 491 miles and must pass over eight Columbia River hydropower dams. Water sources for the hatchery are the Entiat River, Packwood Spring, and six wells. However, surface river water is no longer used because of the presence of a *Myxosporidian* parasite. No barrier weir is present in the Entiat River to facilitate capture of broodstock or preclude hatchery-origin adults from migrating upstream of the hatchery into natural spawning areas. The Entiat NFH supports a spring Chinook program. It also provides facilities for the coho reintroduction program of the Yakama Nation.

Spring Chinook Program Overview: This program operates as a *segregated-harvest* program with returning hatchery-origin adults used for broodstock. The primary goal of the program is to provide harvest benefits from returning adults. The broodstock objective is to spawn approximately 300 adults annually with a release objective of 400,000 yearling smolts. An additional 100 adults are retained for experimental releases of progeny in the Okanogan River as part of a spring Chinook restoration study by the Colville Confederated Tribes. The propagated stock is largely an introduced stock from the Carson NFH with an ancestry similar to that of spring Chinook at the Leavenworth NFH.

Benefits: The program provides little or no terminal harvest benefit because natural populations of spring Chinook in the Entiat River and mid-Columbia region are currently listed as endangered under the ESA, thus precluding direct harvest opportunities. Less than 10% of returning adults from this

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program contribute to harvest, primarily in lower Columbia River commercial and recreational fisheries.

Risks: The use of well water for rearing juveniles and the absence of a barrier weir creates a significant straying genetic risk to ESA listed natural populations in the Entiat River. From 2000-2005, the Entiat NFH contributed an average of 31.4% of the estimated natural spawning escapement of spring Chinook salmon in the Entiat River. The lack of shade covers and screening over outside raceways poses demographic survival risks to the hatchery stock from behavioral crowding and bird predation.

Recommendations: The Review Team recommends termination of the current spring Chinook program and implementation of alternative programs. The Review Team concluded that the risks of the current program significantly outweigh benefits with little opportunity to alter this balance in the immediate future. In the interim, the Review Team recommends inclusion of the Entiat NFH as part of an emergency fish rearing plan for the Leavenworth NFH until the water intake system at Leavenworth is replaced. The Review Team also recommends that the Entiat NFH continue to provide facilities for the Yakama Nation's coho reintroduction program consistent with their Master Plan.

Program Alternatives: The Review Team considered the pros and cons of five alternatives to the existing spring Chinook program. The Team recommends replacement of the existing spring Chinook program with an *integrated* summer Chinook harvest program derived from natural-origin adults trapped in the Entiat River. (Alternative 3). Such a program is expected to provide significant harvest benefits in the Entiat River and downstream in the mainstem Columbia River. The Team also recommends construction of a barrier weir and fish sorting/bypass facility on the Entiat River to trap adult fish for broodstock and preclude hatchery-origin adults from natural spawning areas upstream of the hatchery. Such a weir and fish sorting facility are necessary also to monitor the population dynamics and recovery of ESA listed steelhead, spring Chinook, and bull trout in the Entiat River. This latter objective is a conservation and research need identified by comanagers and the Interior Columbia Technical Recovery Team (ICTRT). – In conjunction with a summer Chinook program, the Team also recommends using the Entiat NFH to assist with propagation of upper Columbia River species of high conservation or harvest value. This latter goal includes use of the spring Chinook stock at the Winthrop NFH to assist with development of terminal fisheries immediately downstream of Chief Joseph Dam and restoration of naturally spawning populations of spring Chinook in the Okanogan River, as proposed in the master plan of the Colville Confederated Tribes. However, these latter goals would be contingent upon the ability of the spring Chinook program at the Winthrop NFH to meet its intended goals (see below).

Winthrop National Fish Hatchery

Facility Overview: The Winthrop NFH is located near Winthrop, Washington at RM 44.8 of the Methow River, a tributary to the Columbia River at RM 524. Adult fish returning to the Winthrop NFH must migrate 569 miles upstream and pass over nine Columbia River hydropower dams. Water sources for the hatchery are the Methow River, two wells, and one natural spring. No barrier weir is present in the Winthrop River to collect broodstock or preclude hatchery-origin adults from migrating upstream into natural spawning areas, although a passable boulder dam (Foghorn Dam) impounds water for the hatchery intake and provides some adult trapping capability. The Winthrop NFH supports a spring Chinook program and a steelhead program. It also provides facilities for the coho reintroduction program of the Yakama Nation.

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Spring Chinook

Program Overview: The program is intended to operate as an *integrated conservation and harvest* program with natural-origin and hatchery-origin adults used for broodstock. The primary goal of the program is to assist with recovery of ESA listed spring Chinook in the Methow River and provide harvest benefits from returning adults. The program was recently transitioned from a *segregated-harvest* program that propagated an introduced Carson NFH stock (*Winthrop-Carson* stock) with an ancestry similar to stocks at the Leavenworth and Entiat NFHs. The Winthrop NFH now propagates the *Methow Composite* stock, derived primarily from natural-origin fish in the Methow River subbasin, but with approximately 25-30% of its current genetic ancestry derived historically from hatchery-origin Winthrop-Carson fish. The broodstock objective is to collect and spawn approximately 400 adults annually with a release objective of 600,000 yearling smolts. The hatchery coordinates broodstock collection and spawning with the Methow State Hatchery (SH) approximately 1 mile upstream of the Winthrop NFH. The Methow SH is the original source of the Methow Composite stock.

Benefits: The program provides little or no terminal harvest benefit because natural populations of spring Chinook in the Methow River and mid-Columbia region are currently listed as endangered under the ESA, thus precluding harvest opportunities. Less than 5% of returning adults from this program contribute to harvest, primarily in lower Columbia River commercial and recreational fisheries. Conservation benefits from this program to naturally spawning populations are unknown (undocumented) but are presumed to indirectly reduce extinction risks of ESA listed fish by increasing the total number of returning adults each year. Methow Composite fish are included in the ESA listings for spring Chinook.

Risks: The inability to trap sufficient numbers of natural-origin adults for broodstock poses a domestication risk to the hatchery stock and natural populations via the potential spawning of large numbers of hatchery-origin adults in the Methow River. At the present time, all hatchery-origin adults surplus to broodstock needs are precluded from entering the hatchery and allowed to spawn naturally. This forced natural spawning, concentrated in the immediate vicinity of the Winthrop NFH, also poses ecological risks to ESA listed species and other fish species via competition.

Recommendations: The Review Team identified 12 program-specific recommendations. The Review Team concluded that conservation and mitigation goals for spring Chinook at the Winthrop NFH, including the defined roles of the Winthrop NFH and Methow SH in recovery of natural populations, are inadequate. The lack of specific goals and long-range plans for artificial propagation of spring Chinook in the Methow River creates many biological risks and conflicts. Consequently, the Review Team recommends that the Service work with other salmonid comanagers to establish specific goals and objectives for the Winthrop NFH and – more generally – for spring Chinook in the Methow River. These goals and objectives should be coordinated with the Methow SH and should include the intended contribution of hatchery-origin fish to the conservation and recovery of spring Chinook in the Methow River and elsewhere (e.g. Okanogan River). Specific objectives should be quantified in terms of the number of natural and hatchery-origin adults needed for broodstock, proportion and number of hatchery-origin fish allowed to spawn naturally, the number of hatchery-origin fish to be released in defined locations, etc. In addition, the Service and other salmonid comanagers should review mitigation goals and objectives to ensure that mitigation activities of the Winthrop NFH are meeting federally-mandated obligations consistent with current conditions. Based on the proposed goals and objectives, the Service should develop a new *Hatchery and Genetic Management Plan* (HGMP) for spring Chinook at the Winthrop NFH. The Review Team also recommends improvement of adult collection facilities at Foghorn Dam, or the creation of a new facility, as a critical need for trapping

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natural-origin adults for broodstock and for monitoring and controlling the upstream passage of natural and hatchery-origin adults in the Methow River. This latter recommendation has been identified as a critical need also by WDFW. Moreover, hatchery-origin adults returning to the Winthrop NFH in excess of broodstock needs should not be precluded from entering the hatchery and forced to spawn naturally in unintended areas. Instead, all Methow Composite fish returning to the Winthrop NFH should be trapped and either outplanted directly, or spawned and their progeny outplanted, into specific areas designated for hatchery supplementation and restoration consistent with comanager plans and approved NOAA Fisheries recovery plans. These latter objectives may require development of acclimation release sites and ponds in the upper Methow River watershed. A monitoring and evaluation (M&E) program should also be developed for monitoring progress towards meeting the conservation and mitigation goals of the program. Rehabilitation of the adult holding and spawning facilities at the Winthrop NFH is also needed.

Program Alternatives: The Review Team considered the pros and cons of eight alternatives to the existing spring Chinook program, including the current program with full implementation of all recommendations (Alternative 1). The Team recommends modification of the present broodstock strategies for spring Chinook at the Winthrop NFH and Methow SH from their currently undefined roles to (a) establishment of a truly *integrated* Methow River conservation-recovery broodstock at the Methow SH, requiring systematic inclusion of natural-origin adults in the broodstock and the modification of the Foghorn Dam adult trapping site, and (b) establishment of a second broodstock at the Winthrop NFH that is genetically integrated with the Methow SH broodstock according to a proposed "stepping stone" model. As envisioned by the Review Team, the state's broodstock program would focus strictly on recovery objectives within the Methow River watershed while the Winthrop NFH program would focus on harvest objectives in the mid-Columbia region and restoration objectives outside the Methow watershed (e.g., Okanogan River). This recommendation includes reducing the number of spring Chinook released from the Winthrop NFH into the Methow River in order to make fish from this program available for a developing a new segregated harvest program in the mainstem Columbia River immediately downstream from Chief Joseph Dam and for restoration of spring Chinook in the Okanogan River, consistent with the Master Plan of the Colville Confederated Tribes. The Team also recommends reducing the size of the spring Chinook program at the Winthrop NFH to accommodate development of a self-sustaining steelhead broodstock program at the Winthrop NFH (see steelhead program below).

Steelhead

Program Overview: The program is intended to operate as an *integrated conservation and harvest* program with natural-origin and hatchery-origin adults used for broodstock. The primary goal of the program is to support recreational fisheries while contributing to recovery of ESA-listed (threatened) steelhead in the Methow River. At the present time, no adults are trapped for broodstock at the Winthrop NFH; rather, the program is a component of a state-run program where hatchery and natural-origin adults are trapped and spawned at Wells Dam on the mainstem Columbia River followed by the transfer of 125,000 eyed-egg embryos to the Winthrop NFH for hatching, rearing and release of yearling smolts one year later. Approximately 56 adults (28 females) are required to obtain 125,000 eyed-egg embryos for transfer. All fish currently transferred to the Winthrop NFH are the progeny of direct crosses between hatchery and natural-origin fish. An average of 118,400 yearlings per year were released from the Winthrop NFH into the Methow River, 1996-2005. WDFW has a release objective of an additional 320,000 smolts in the Methow River watershed, distributed equally among three release sites (upper Methow, Chewuch, and Twisp rivers).

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Benefits: Recreational fishery benefits are assumed in the Methow and mid-Columbia rivers, and downstream in tribal and non-tribal mixed stock fisheries in the lower Columbia River, but are undocumented because steelhead juveniles released from the Winthrop NFH are not coded wire tagged. Contribution to recovery of naturally spawning populations is also undocumented. However, total returns of natural-origin steelhead intercepted at Wells Dam has recently increased from an average of 901 adults per year (1998-2000) to 5,640 adults per year (2001-2005).

Risks: The trapping of adults at Wells Dam for broodstock poses a genetic diversity risk and a spatial structure demographic risk to naturally spawning populations in the Methow and Okanogan Rivers by preventing the establishment of locally-adapted populations. Adult steelhead returning to the Winthrop NFH are precluded from entering the hatchery and spawn in high concentration in the immediate vicinity of the hatchery, thus posing ecological risks to ESA listed species and other fish species via competition.

Recommendations: The Review Team identified 11 program-specific recommendations. These include development of a genetically-integrated broodstock at the Winthrop NFH derived from natural-origin adults in the Methow River and adults returning to the hatchery. The Review Team further recommends improvement of adult collection facilities at Foghorn Dam, or the creation of a new facility, as described for spring Chinook. As part of this new strategy to promote local adaptation, steelhead of Wells Dam origin should not be released upstream of Foghorn Dam. An improved fish sorting facility at Foghorn Dam should be used also to remove hatchery-origin steelhead surplus to supplementation goals in the upper Methow River. Also, heated water or rehabilitation of some rearing facilities at the Winthrop NFH may be necessary for producing smolt-size fish at one or two years of age, respectively.

Program Alternatives: The Review Team considered the pros and cons of three alternatives to the existing steelhead program, including the current program with full implementation of all recommendations (Alternative 1). The Team recommends adoption of all recommendations for the current program but increasing the size of the program to a minimum of 100 adults (50 natural and 50 hatchery-origin adults from a total of 56 adults) to meet minimum genetic guidelines (Alternative 2). If those recommendations are implemented, the total number of smolts released from the hatchery and/or outplanted in the upper Methow River basin would increase to approximately 200,000 smolts, thus reducing substantially the potential genetic influence of adults trapped at Wells Dam. To accommodate this expanded program, some reductions in the size of the spring Chinook program would be necessary.

Conclusions

The spring Chinook program at the Leavenworth NFH is the only program of the four programs reviewed here that is providing significant fishery benefits in the mid-Columbia region. Preservation of those fishery benefits to the Yakama Nation and recreational fishers in Icicle Creek should be a very high priority. The Review Team further recommends transitioning to a native Wenatchee River broodstock at the Leavenworth NFH after the failing water intake delivery system at the Leavenworth NFH is replaced.

In contrast to the Leavenworth NFH, the spring Chinook program at the Entiat NFH provides little or no measurable benefits, and the Review Team recommends its termination. The Review Team further concluded that an integrated summer Chinook hatchery program at the Entiat NFH offered the greatest opportunity to provide direct fishery benefits in the Entiat River and mid-Columbia region consistent

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with comanager goals. The Review Team concluded that the Entiat NFH could also play an important role assisting with restoration and recovery of spring Chinook and other species in the mid and upper Columbia River regions in collaboration with the Winthrop NFH.

The Review Team concluded that the Winthrop NFH offers significant potential to achieve both conservation and fishery objectives for ESA-listed spring Chinook and steelhead in the Methow River and upper Columbia region, but those roles need to be redefined with explicit goals and objectives. The Review Team further concluded that the current spring Chinook programs at the Methow SH and Winthrop NFH will not achieve their intended goals unless capabilities to trap natural-origin adults for broodstock and monitor the escapement of hatchery-origin adults in the Methow River are developed. The Service and the Winthrop NFH should also work with the Colville Confederated Tribes to implement the Tribes' Master Plan for spring Chinook in the Okanogan River and the upper Columbia River immediately downstream from Chief Joseph Dam.

The Review Team was impressed with the Coho Restoration Master Plan of the Yakama Nation and the early successes of that program. Because of those early successes, the Review Team recommends that the Service continue to assist the Yakama Nation with their efforts to restore coho salmon to the mid-Columbia region.

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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 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 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 those facilities are best meeting conservation and harvest goals, the US Fish and Wildlife Service (Service) is beginning a review of the 12 Columbia River Basin salmon and steelhead hatcheries that the Service owns or operates. The goal is to ensure that Service hatcheries are operated on the best scientific principles, and contribute to sustainable fisheries and the recovery of naturally-spawning populations of salmon, steelhead and other aquatic species of concern.

This internal review will, in many ways, resemble the recent Puget Sound and Coastal Washington Hatchery Reform Project.[4] That project provides 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),[5] Comprehensive Hatchery Management Plans (CHMPs),[6] and the Artificial Propagation Review and Evaluation (APRE)[7] database developed by the Northwest Power and Conservation Council (NWPCC).

Based on the recommendations of a Hatchery Review Working Group (Working Group),[8] the Assistant Regional Director for Fisheries (ARD) has assembled a Columbia Basin Hatchery Review Team (Review Team). This Review Team, comprised of Service and other federal agency scientists, has adapted the Puget Sound/Coastal Washington Hatchery Scientific Review Group's (HSRG) scientific framework, principles and hatchery review tools and is applying them to create

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[4] *For more information on this project, and for all project publications, see www.hatcheryreform.org.*
[5] *For more information on HGMPs, visit www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/Hatcheries/Hatchery-and-Genetic-Management-Plans.cfm.*
[6] *For more information on CHMPs, visit www.fws.gov/pacific/Fisheries/CHMP.htm.*
[7] *For more information on APRE, visit www.nwcouncil.org/fw/apre/.*
[8] *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/.*

recommendations for each hatchery program and facility. The team provides continuity with the HSRG because two members (including the chair) served on the HSRG, the vice chair served on the policy-makers' Hatchery Reform Coordinating Committee, and three other members represented the Service at HSRG regional review meetings. 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/Coastal Washington process.

Review Team members include:

- **Don Campton** (Chair), Senior Scientist, USFWS, Abernathy Fish Technology Center, Longview, Washington.
- **Douglas DeHart** (Vice Chair), Senior Fishery Biologist, USFWS, Pacific Regional Office, Portland, Oregon.
- **Ray Brunson**, Fish Health Biologist, USFWS, Olympia Fish Health Center, Olympia, Washington.
- **Tom Flagg**, Supervisory Fish Biologist, NOAA Fisheries, Manchester Research Station, Manchester, Washington.
- **Joe Krakker**, Fishery Biologist, USFWS, Lower Snake River Compensation Plan Office, Boise, 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.
- **Carl Schreck**, Senior Scientist/Professor, U.S. Geological Survey, Cooperative Fish and Wildlife Research Unit, Oregon State University, Corvallis, Oregon.
- **Larry Telles**, Fishery Biologist and Deputy Manager, USFWS, Quilcene NFH, Quilcene, Washington.
- **Dave Zajac**, Fish and Wildlife Biologist, USFWS, Western Washington Fish and Wildlife Office, Lacey, Washington.
- **David Carie** (alternate), Fisheries Management Biologist, USFWS, Mid-Columbia Fishery Resource Office, Leavenworth, Washington.
- **Susan Gutenberger** (alternate), Supervisory Microbiologist, USFWS, Lower Columbia River Fish Health Center, Willard, Washington.

Team support members include:

- **Michael Kern** (Facilitator), Project Director, Long-Live-the-Kings, Seattle, Washington.
- **Michael Schmidt** (Co-Facilitator), Fish Program Coordinator, Long-Live-the-Kings, Seattle, Washington.
- **Amy Gaskill** (Outreach), External Affairs Specialist, USFWS, Pacific Region Fisheries Program, Pacific Regional Office, Portland, Oregon.

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The Fisheries ARD has also appointed a Hatchery Oversight Team (Oversight Team) 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 is coordinated by the Pacific Region Hatchery/Science Team Leader and includes participation by line supervisors within the Fisheries Program. The Oversight Team, along with the ARD, will be the primary contact group between the Service and its partners, to develop 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 co-managers 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, and can be downloaded electronically at www.fws.gov/Pacific/fisheries/hatcheryreview/reports.html. Additional supporting documents can be downloaded also.

Following this pilot review, the Service adjusted the process and is reviewing federal hatcheries in three regions: Mid-Columbia, Lower Columbia, and Lower Snake River region. Facilities in these regions include five NFHs in the Lower Columbia region (Eagle Creek, Carson, Little White Salmon, Willard and Spring Creek NFHs); three NFHs in the Mid-Columbia region (Leavenworth, Entiat and Winthrop NFHs); and three NFHs in the Snake River region: (Dworshak, Kooskia and Hagerman NFHs). The Service plans to complete reviews of all National Fish Hatcheries by 2007.

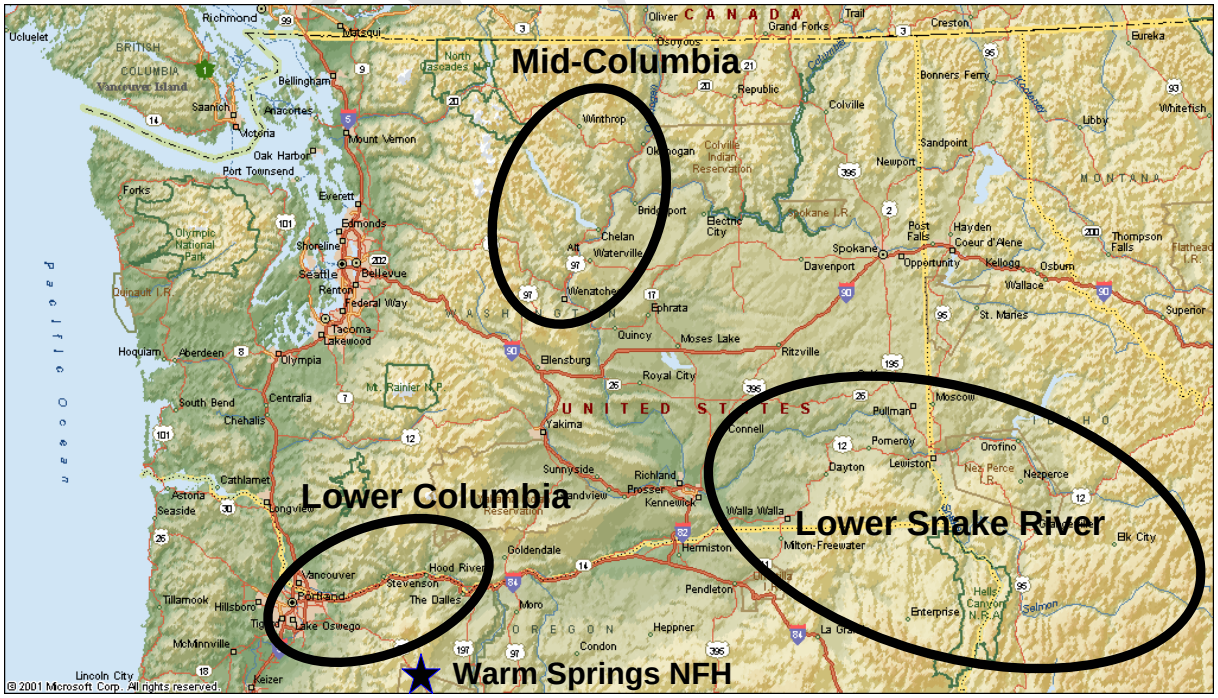

Figure 1. Regions of the Columbia River Basin Hatchery Review Project

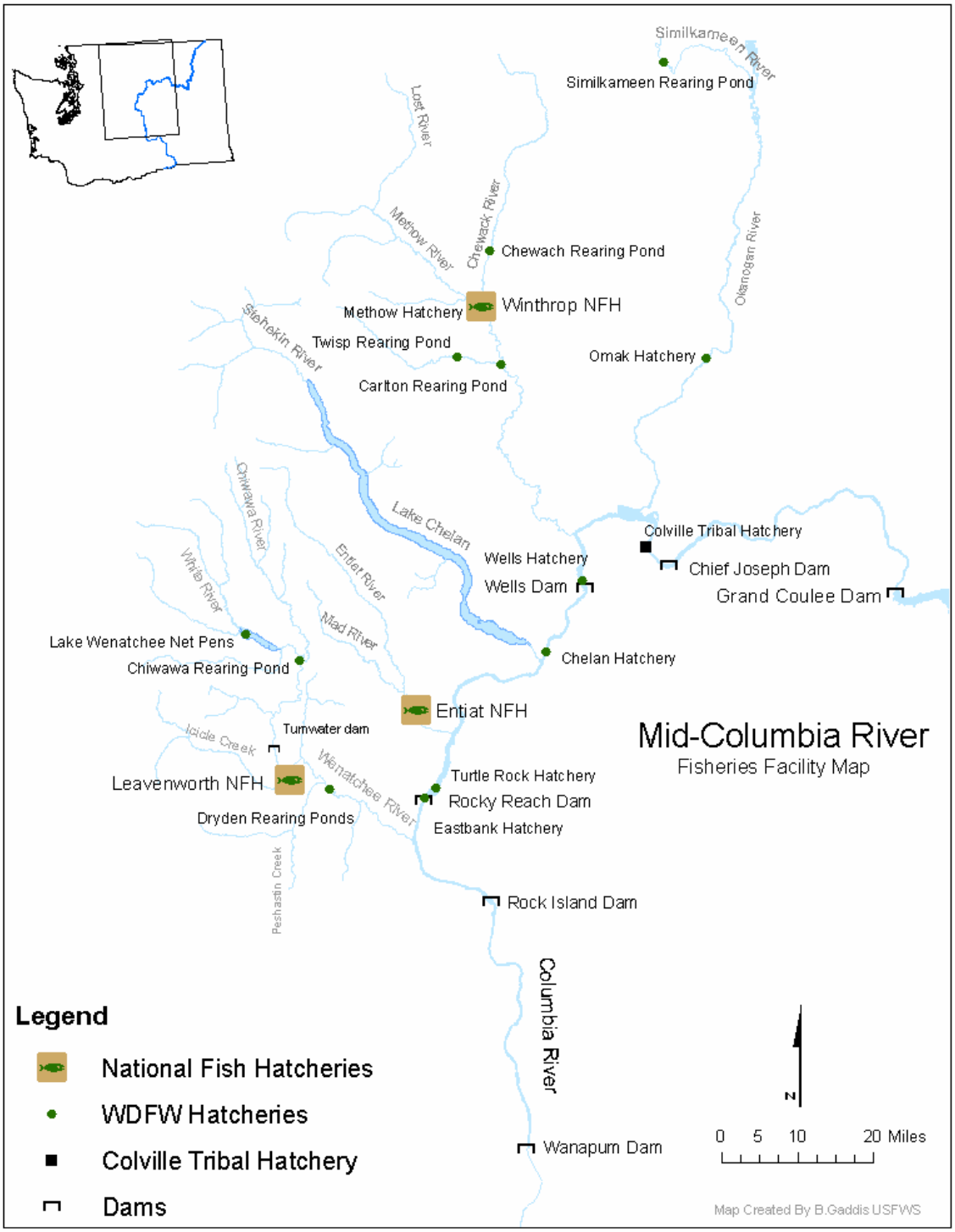

Figure 2. Mid-Columbia Fisheries Facilities

II. Components of this Report

This report provides assessments and recommendations developed by the Review Team upon reviewing the propagation programs conducted currently at the three NFHs in the Mid-Columbia/Leavenworth Complex (Leavenworth, Entiat and Winthrop NFHs). The recommendations contained in this report are based upon 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 and the Internet. In keeping with the tenets of adaptive management, it will be necessary to review and adapt these recommendations as new scientific information becomes available and/or goals change. All source documents not readily available to the general public are accessible via the Service's hatchery review website (www.fws.gov/pacific/fisheries/hatcheryreview). A briefing document, summarizing the hatchery information on which the review and recommendations are based, is also accessible via the website.

The review is focused explicitly on the goals, operations, benefits, and risks associated with the programs at the NFHs. An understanding of the current status of each salmonid stock in each watershed (see below), in terms of four population parameters (*biological significance*, *viability, habitat* conditions, and *harvest* goals), was necessary for assessing the benefits and risks associated with each hatchery program. The Review Team also needed to have an understanding of the short-term (10–15 years) and long-term (50 years or greater) goals, or expectations, of the co-managers for each of those four population/stock parameters (Appendix A). However, it was neither the mandate nor the responsibility of the Review Team to perform detailed, scientific assessments of those four parameters. Instead, the Review Team relied on the consensus assessments of the co-managers, the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation), Colville Confederated Tribes, Washington Department of Fish and Wildlife (WDFW), National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NOAA Fisheries), and our own Service biologists.

NOAA Fisheries has assembled a *Technical Recovery Team* (TRT) for the Interior Columbia Region (ICTRT), and one of their charges is to determine the long-term viability of salmonid stocks currently listed under the U.S. Endangered Species Act (ESA), particularly with respect to extinction risk over the next 100 years. Those assessments are based on four parameters (abundance, productivity, spatial structure, and diversity) and involve significant mathematical modeling. Viability estimates for listed salmonid stocks in the mid-Columbia region have recently become available as part of the Draft Upper Columbia Salmon and Steelhead Recovery Plan (Upper Columbia Salmon Recovery Board, December 2005, draft plan available at http://okanogancounty.org/water/Salmon%20Recovery.htm). Consequently, for stocks currently listed under the ESA, the Review Team relied on those viability estimates as part of its overall benefit-risk assessments. For non-listed stocks the Review Team followed the general approach of Mobrand et al. (2005) as developed for the Puget Sound and coastal Washington hatchery reviews.

The Review Team reviewed a large number of background documents, toured the NFHs and related habitat features, and received a presentation on a variety of Mid-Columbia salmonid management issues. The Team then met with co-manager and stakeholder biologists and managers to discuss the purpose of the review, hatchery operations, stock goals and interactions, and specific issues the co-managers wanted the Review Team to consider. The Review Team then assessed benefits and risks from the current hatchery programs to the stock propagated in the hatchery and other salmonid stocks in the respective basin, and drafted a set of preliminary recommendations for maintaining or increasing

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benefits while minimizing or reducing risks of the program. The Review Team also examined possible alternatives to the existing programs at each of the three hatcheries. The review concluded with an oral presentation of these findings to the co-managers. The final report presented here was prepared after written comments on the draft report were received from the co-managers and interested stakeholders.

Watershed Summary, Status of Stocks, and Hatchery Programs

The following report contains a general overview of each watershed, tables containing ratings for all salmonid stocks in the watersheds (as provided by the co-managers or extracted from comanager documents), and then an assessment and recommendations for each program at the three NFHs. These assessments include the effects of the programs on other stocks, and consistency of the program with management goals and priorities in the watershed.

The stock tables (Appendix A, summarized in Tables 1-29) provide stock goals/management premises for the historic and recent past (approximately 100 and 10 years ago, respectively), current condition, and short-term (10–15 year) and long-term (50–75 year) future goals or expectations. For stocks with hatchery programs, the stock tables also document program type, federal authorization and purpose(s), as expressed to the Review Team by the co-managers, purpose of the hatchery program, and Broodstock Origin(s). Workshops for gathering that information used the recently-developed All-H Analyzer (AHA) decision support tool[9] to document goals, premises and strategies (Appendix A).

As noted previously, the potential effects of a hatchery program on each salmonid stock were evaluated in the context of four characteristics of those stocks (biological significance, population viability, habitat conditions on which the stock depends, and the desired harvest level on that stock), as identified by the co-managers. These measures follow directly from the HSRG's process. The ratings for these four characteristics for each stock described here are intended to be qualitative for the purpose of evaluating benefits and risks of a hatchery program. These stock characteristics are described in more detail below and are the basis of the ratings included in the stock tables.[10]

Stock Status

Biological significance is a measure of the biological uniqueness of a particular stock 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 (e.g. life history, physiology, genetics) that are unique or shared with other stocks, 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 having either *low*, *medium* or *high* biological significance depending on its uniqueness and the ability of other stocks to potentially replace it in the occupying habitat if extirpation were to occur. This rating is not based on the degree to which the stock may be considered essential for recovery or harvest. 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 it possessed unique biological attributes not shared by other stocks of the same species. This approach thus distinguishes the *evolutionary legacy* of a stock from co-manager decisions regarding the potential management

[9] *For more information on AHA, see* AHA Technical Discussion Paper *on the Publications page of www.hatcheryreform.org.*
[10] *A more detailed discussion of these definitions is available in the HSRG's 2004* Principles and Recommendations *report and* Hatchery Reform in Washington State: Principles and Emerging Issues *essay for Fisheries Magazine (Mobrand et al. 2005), both of which are available on the Publications page of www.hatcheryreform.org.*

value of that stock. Based on those criteria, the *biological significance* rating for each stock described in this report are based on the criteria described by the HSRG[11].

Population viability measures the ability of a stock to sustain itself under current environmental conditions. Where available, the Review Team relied on the viability estimates provided by the Interior Columbia TRT. Those viability estimates consider four population parameters: abundance, productivity, spatial structure, and biological diversity (e.g. life history diversity, ecological diversity, genetic diversity, etc.). For unlisted salmonid stocks where those estimates of population viability were not available, the Review Team relied on the viability criteria of the HSRG (Mobrand et al. 2005). This latter qualitative measure considers three parameters: 1) the estimated genetic effective population size (N_e) derived from estimates of abundance and the age class structure of the species; 2) mean recruits per spawner or adult-to-adult replacement rates over the preceding five to ten generations; and 3) the proportion of naturally-spawning fish composed of hatchery-origin adults.[12] These three parameters are closely correlated with NOAA Fisheries criteria of *abundance, productivity,* and *diversity*, respectively.[13] For the purpose of our Service reviews of hatchery programs, diversity and spatial structure are encapsulated as part of the overall measure of effective population size (e.g. N_e is positively correlated with age class structure) and, to some extent, biological significance (e.g. biological significance is inversely correlated with spatial structure). The goal here was to establish a qualitative level of current viability for each salmonid stock potentially affected by each hatchery program as a foundation for assessing potential benefits and risks of those programs.

Habitat conditions for a particular stock are assessed quantitatively through estimates of the *capacity* and *productivity* of the habitat to support adult spawners and juveniles (e.g. via spawner-recruit models), and to subsequently produce smolts in sufficient numbers to yield returning adults. 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 genetically *integrated* hatchery broodstocks and for assessing the risks posed by hatchery-origin fish spawning naturally. The productivity and capacity of a watershed are difficult to estimate directly, but these parameters can be adjusted in mathematical models to yield results that best fit empirical estimates of total adult returns and/or smolt output under current conditions (Appendix A). Effects of future habitat improvements on overall population viability can then be evaluated iteratively. This approach allows co-managers and others to evaluate potential solutions for improving long-term population viabilities via habitat modifications.

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 watershed under consideration (Appendix A). Harvest parameters can be adjusted in a manner analogous to adjusting habitat parameters as described above—to identify levels of harvest that are sustainable under a particular set of habitat (i.e. productivity and capacity) conditions.

Hatchery Programs

Hatchery programs are classified as either *integrated* or *segregated.* Hatchery programs or, more specifically, the hatchery broodstocks are classified as *integrated* if the intent of the program is for the

[11] *Ibid.*
[12] *Ibid.*
[13] *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-NWFSX-42, Seattle, WA 156pp. Also see www.nwfsc.noaa.gov/trt/trt_Columbia.htm*

natural environment to drive the genetic constitution and adaptation of hatchery-origin fish via systematic inclusion of natural-origin fish into the broodstock each year. The integrated strategy manages hatchery and wild fish as one population in two environments where the natural environment is intended to be the principal determinant of mean fitness. *Segregated* programs or broodstocks are intended to maintain the hatchery population as a distinct, genetically segregated population via the use of hatchery-origin adults only for broodstock. 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.

Federal authorizations describe the legal authority or context under which the hatchery program operates.

The **primary and secondary purpose(s)** of the hatchery program are defined as either conservation, harvest, both and/or another purpose (such as education, research, socioeconomic or cultural/ceremonial).

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 the 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; 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 surface feeding under normal hatchery conditions that may

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increase vulnerability of released juveniles to predators, thus decreasing smolt-to-adult survival.

- Demographic risks from the hatchery facility and operations on the abundance of other stocks and species within the watershed in which the hatchery is located, including ESA listed stocks and species (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 in size, growth rate, morphology, behavior, physiological status or health, which may adversely affect the performance of natural fish and increase adverse ecological interactions.

Physical Risks

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

In the context of the benefits and risks outlined above, all operational and physical components of the hatchery program were reviewed. These components included trapping and holding of adult fish for broodstock, spawning and fertilization protocols, incubation of eggs, early rearing and ponding, feeding protocols (including the use of therapeutics and other measures to control disease), release protocols, and any other information available regarding the benefits and risks of the hatchery program between the time of release of juveniles to the return, capture and/or natural spawning of adults for broodstock.

As noted previously, the Review Team has also assembled a briefing document (excerpted from various background documents reviewed by the Team) containing detailed information about the facility and its program, goals and operations. This briefing document, which includes citations to the source documents, is available from the Service's hatchery review web site and serves as Appendix B of this report.

Recommendations, Co-Manager and Stakeholder Comments

After careful assessment of the benefits and risks conferred by the hatchery programs, 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

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current hatchery programs are grouped into the following categories: broodstock choice and collection, natural and hatchery spawning; incubation and rearing; release and outmigration; facilities and operations; monitoring and accountability; and research, education and outreach. The review team then considered potential alternatives to the existing programs with an overall assessment of the value and merits of the current program relative to those potential alternatives.

The co-managers were given the opportunity to review an earlier draft of this report, in order to provide corrections and comments prior to public distribution. These corrections and comments, along with Review Team responses appropriate for clarification, are included in this revised report.

Stakeholders in the Columbia River Basin were given the opportunity to provide direct comments on this report as part of a general public review process. Those stakeholder comments are included in this final version of this report, and the report was revised prior to publication to take into account stakeholder input. The Review Team has also prepared detailed responses to many of the stakeholder comments to further clarify issues, concepts, or potential misunderstandings.

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III. Wenatchee River Watershed[14]

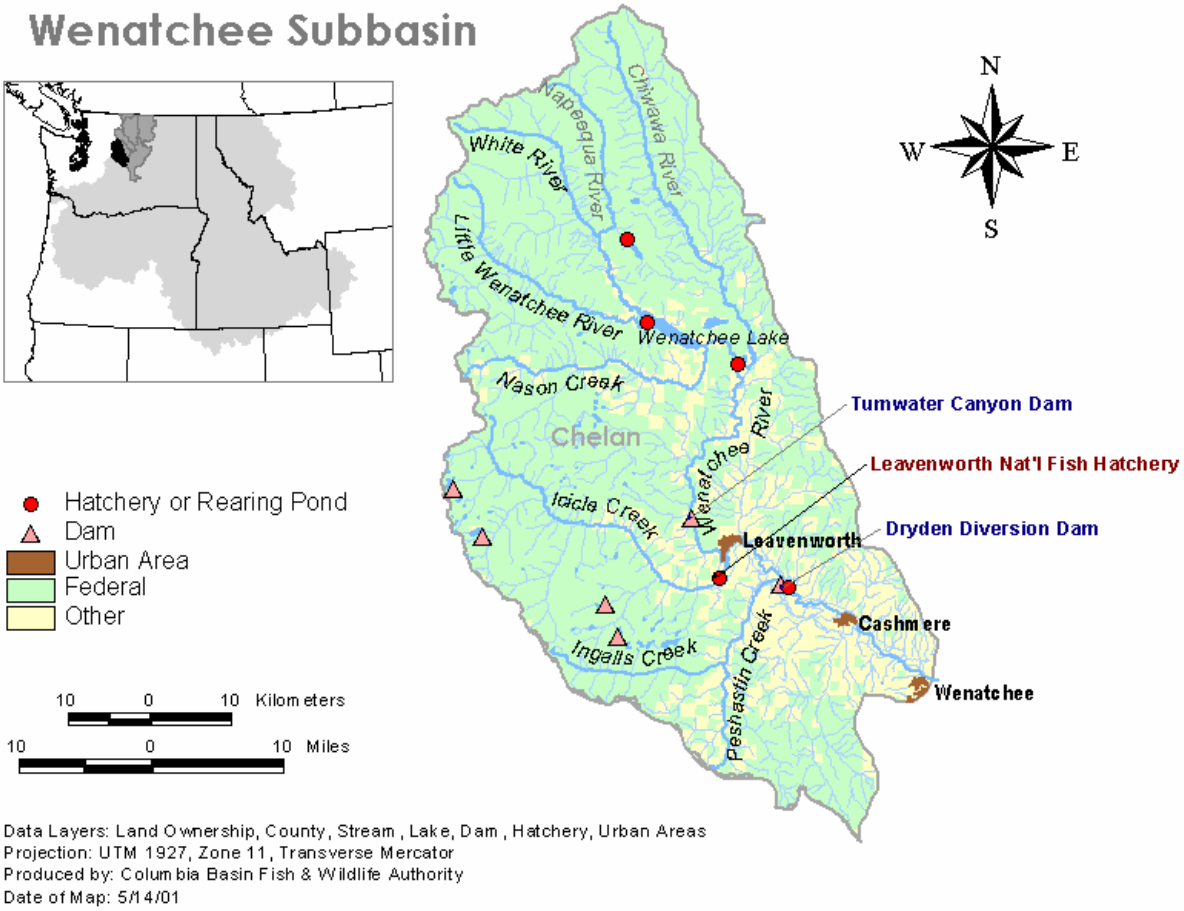

Figure 3. Wenatchee River Watershed Overview Map

[14] *Primary source documents for information in this section include:*
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Wenatchee River Overview

Watershed Description

The Wenatchee River flows in a southeasterly direction off the east slopes of the Cascade Mountains in north central Washington into the Columbia River. The watershed encompasses approximately 1,371 square miles in the Cascade Mountains, with numerous tributaries draining subalpine regions within the Alpine Lakes and Glacier Peak wilderness areas. The watershed is bounded on the west by the crest of the Cascade Mountains, on the north and east by the Entiat Mountains, and to the south by the Wenatchee Range. The Little Wenatchee and White Rivers flow into Lake Wenatchee, the source of the Wenatchee River. From the lake outlet at Wenatchee (RM 54.2) the river descends rapidly through Tumwater Canyon, dropping into a lower gradient section in the region of Leavenworth, where Icicle Creek joins the mainstem. Other major tributaries include Nason Creek, the Chiwawa River, Chumstick, Peshastin, and Mission creeks. The Cascade Mountain area is characterized by heavy precipitation, nearly 150 inches annually, with most precipitation occurring during the winter months as snow. Moisture progressively decreases eastward, resulting in arid conditions; less than 8.5 inches falls annually within the lowermost region of the watershed.

Fisheries

Terminal fisheries on anadromous salmonid fishes in the Wenatchee River basin are currently very limited. The only consistent fishery occurs in Icicle Creek on hatchery-origin spring chinook returning to the Leavenworth NFH. Spring Chinook salmon from the Leavenworth NFH supported successful sport and tribal fisheries in the Wenatchee River and Icicle Creek, and to a lesser extent, the Columbia River and ocean. Significant economic activity is generated through harvest of Leavenworth NFH spring Chinook salmon, for example in 2003, Washington Department of Fish and Wildlife estimated that 4,016 anglers fished a total of 29,133 hours during the Icicle Creek fishery. For the period 1999-2003, the mean number of hatchery-origin spring Chinook harvested annually in Icicle Creek exceeded 3,000 fish. An additional average of more than 3,000 spring Chinook adults in excess of broodstock needs were trapped at the Leavenworth NFH and provided directly to Columbia River tribes and food banks.[15]

Summer chinook from the region only harvested incidentally in lower Columbia River fisheries directed at other species, and no directed commercial fisheries on upper Columbia summer-run fish have occurred in the mainstem since 1964. Hatchery-origin summer Chinook from the Wenatchee River contributed an average of 1,386 adults to fishery harvests, the majority of which were harvested in Alaskan and Canadian fisheries (WDFW HGMP 2005).

Lake Wenatchee sockeye have been harvested incidentally in lower Columbia river fisheries directed at other species. Tribal and non-tribal commercial fisheries for sockeye can occur when the escapement goal of 75,000 adults at Bonneville Dam has been achieved and sufficient surplus is available to support harvest. Commercial harvest of sockeye has not occurred since 1988 except for small fisheries in 2000 and 2004. Terminal recreational fisheries on sockeye salmon in Lake Wenatchee have been allowed in years when the escapement goal of 27,000 adults to the lake was expected to be met. Recreational fisheries for sockeye occurred in Lake Wenatchee during the 1980s

[15] *Cooper (2006).*

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and early 1990s, and most recently during the 2001 and 2004 seasons, when 3,265 and 5,410 adults, respectively, were estimated to have been harvested (WDFW HGMP 2005).

Terminal fisheries on steelhead in the Wenatchee River are limited by their current ESA listing as *threatened* and the total predicted escapement upstream of Priest Rapids Dam on the Columbia River and the predicted escapement of natural-origin steelhead into the Wenatchee River. A potential fishery on steelhead occurs in the Wenatchee River when (a) the natural-origin steelhead run is predicted to exceed 1,300 fish at Priest Rapids Dam, the total hatchery + wild steelhead run is predicted to exceed 9,550 fish, and the predicted escapement of natural-origin steelhead to the Wenatchee River exceed 600 fish (WDFW HGMP)

Conservation

The rivers of the Upper Columbia basin historically were excellent salmonid producing streams. There were formerly good runs of steelhead trout, spring Chinook, and summer Chinook salmon in the Wenatchee River subbasin. Sockeye salmon inhabited Lake Wenatchee and coho salmon spawned throughout the Wenatchee River system. Bull trout were also distributed throughout the subbasin in their various life history forms. However, by the 1930's, anadromous populations were decimated because of over-fishing in the lower Columbia River fisheries, irrigation diversion practices in the watershed, and habitat degradation related to poor mining practices, grazing, and logging. Bull trout populations may have also been impacted by habitat fragmentation as a result of irrigation diversions dewatering lower reaches and diversion dams creating impassable barriers. With the construction of the Grand Coulee Dam in 1939, anadromous salmonids were barred from 1,140 miles of potential spawning and rearing habitat in the upper Columbia River drainage. Between 1939 and 1943 all adult salmon and steelhead were intercepted at Rock Island Dam downstream of the town of Wenatchee, for brood stock as part of the Grand Coulee Fish Maintenance Project. The various tributary stocks of each species were mixed in the hatchery program with the resultant juveniles being released throughout the Wenatchee, Entiat, Methow and Okanogan River drainages.

Restoration of viable and sustainable populations of salmon, steelhead, and other at-risk species is an important management goal in the Wenatchee watershed. In the short-term, projects designed to treat symptoms of habitat degradation should be implemented with caution until a long-term salmonid habitat protection and restoration strategy can be developed. A long-term strategy should maintain a subbasin-wide, ecosystem based approach and define a course of action to correct those factors that are causing the habitat degradation. Anadromous salmonid populations in the Wenatchee subbasin are influenced by degraded estuarine habitat, fish harvest, unfavorable ocean conditions, and the affects of seven Columbia River reservoirs and hydroelectric dams on smolt and adult migration. Within the subbasin, human alterations to the environment are exacerbating naturally limiting conditions by reducing habitat quality and quantity, thereby reducing a species' chances of successfully completing its life cycle. These alterations have primarily occurred in the lower gradient, lower reaches of watersheds in the lower subbasin and include road building and placement, conversion of riparian habitat to agriculture and residential development, water diversion, reduced large woody debris (LWD) recruitment, and flood control efforts that include LWD removal, berm construction, and stream channelization.

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Habitat

Maintaining the present level of habitat functionality and connectivity in watersheds of the upper Wenatchee subbasin is of primary importance for sustaining salmonid populations in the subbasin. This includes the Little Wenatchee and White rivers feeding into Lake Wenatchee, Nason Creek, and the Chiwawa River watersheds where overall, habitat function is rated as very high, with habitat concerns focused along transportation/utility corridors and on privately owned floodplains in lower reaches.

To provide for the year-round spawning, rearing and migratory habitat needs of all life history stages of spring and summer Chinook salmon, steelhead trout, sockeye salmon and bull trout, floodplain habitat along the Wenatchee River corridor must provide adequate quantities of naturally-forming, accessible, high quality, watered, off-channel habitat. Given that the level of functionality and connectivity of the upper watersheds is maintained, habitat conditions in the mainstem Wenatchee River (RM 0.0 – 54.2) have the greatest potential to affect salmonid fish production in the Wenatchee subbasin. The mainstem of the Wenatchee River serves as the corridor through which Chinook, steelhead, sockeye and fluvial bull trout must pass to access habitat within the subbasin. It also maintains connectivity among the watersheds in the Wenatchee subbasin as well as with the greater Columbia River system.

Icicle Creek is another major tributary to the Wenatchee River, but access by anadromous salmonids is restricted. Historical structures associated with the Leavenworth NFH between RM 2.4 and 4.5 impede upstream migration, although removal and/or modification of these structures is ongoing. In addition, a boulder field and cascades at RM 5.6 – exasperated by very low water flows during the summer – further impedes upstream migration and is believed to be an impassible barrier to Chinook salmon. Approximately 20 miles of habitat is available to anadromous salmonid fishes upstream of the boulder field, but the productivity (quality) and capacity (quantity) of this habitat for sustaining natural populations of spring Chinook and steelhead have not been quantified and are unknown. To fully realize the potential benefits of establishing full connectivity between the majority of the Icicle Creek watershed and the rest of the Wenatchee subbasin, low instream flows and high instream temperatures during the summer months between the mouth of Icicle Creek and RM 5.7would need to be addressed.

The drainage/watersheds located in the lower portion of the Wenatchee subbasin downstream from the confluence of Icicle Creek (e.g., Chumstick, Mission, and Peshastin creeks) have been severely altered from their naturally functioning condition and are highly fragmented. Salmon, steelhead and bull trout populations in these drainages/watersheds are significantly reduced from their historic potential and, due to the existing land use activities and management issues, have less potential for recovery than watersheds in the upper Wenatchee subbasin. Among the Chumstick, Mission, and Peshastin watersheds, Peshastin Creek is of primary importance given the watershed's potential to contribute to bull trout, spring Chinook, and steelhead production in the Wenatchee subbasin. The relative contribution to flows in the Wenatchee River from these drier watersheds of the subbasin is low, limiting the potential for these watersheds to contribute to improved flows in the mainstem Wenatchee River.

Current Status of Salmonid Stocks

Fishery co-managers have identified 11 principal salmonid stocks in the Wenatchee River watershed, four of which have been designated collectively as *Wenatchee River spring Chinook* by the Interior

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Columbia Technical Recovery Team (ICTRT). Stocks identified by the ICTRT are indicated by asterisks (*) in the list below.

- Leavenworth NFH spring Chinook (segregated hatchery)
- Wenatchee River spring Chinook (natural)*
    - White River spring Chinook (natural + integrated hatchery)
    - Little Wenatchee River spring Chinook (natural)
    - Chiwawa River spring Chinook (natural + integrated hatchery)
    - Nason Creek spring Chinook (natural)
- Wenatchee River summer Chinook (natural + integrated hatchery)
- Coho (segregated hatchery, Yakama Tribal program)
- Lake Wenatchee sockeye (natural + integrated hatchery)
- Wenatchee River steelhead (natural + integrated hatchery)*
- Wenatchee River bull trout*
- Wenatchee River westslope cutthroat trout

The following tables summarize the current and future status of those stocks, as identified by the co-managers and technical recovery teams. Summary data and parameter estimates for these assessments are presented in Appendix A (*AHA* analyses).

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Table 1. Wenatchee River spring Chinook

Stock Goals/Management Premises	
ESA Status	Endangered.
Biological Significance	*High*. Natural populations of spring Chinook in the mid-Columbia region occur only in the Entiat and Methow River outside the Wenatchee River watershed. Spring Chinook are extirpated in the Okanogan River.
Population Viability (Information here is derived from the Draft Recovery Plan and represents all populations (spawning aggregations) in the Wenatchee River watershed exclusive of Icicle Creek. The Draft Recovery Plan does not provide separate information for separate areas (e.g. Chiwawa River).	*Very Low*. The number of natural-origin adults in the Wenatchee River watershed ranged from 51 to 6,718 between 1960 and 2003 with a 12-year geometric mean ranging from 383 to 3,449 adults. The 12-year geometric mean (1987-1998) at the time of listing (1999) was 417 spawners. Adult recruits per spawner (R/S) between1960 and 1999 in the Wenatchee River watershed ranged from 0.06 to 4.59 with a12-year geometric mean of 0.31 to 1.19 adults. The 12-year geometric mean at the time of listing (1999) was 0.74 recruits per spawner. Based on expanded carcass recoveries from spawning ground surveys (2001-2004), spring Chinook from the Leavenworth National Fish Hatchery and other hatchery programs has accounted for 3-27% of the natural spawner composition in the Wenatchee River upstream from Tumwater Canyon. The Interior Columbia TRT has concluded that Wenatchee River spring Chinook have a high risk of extinction over the next 100 years. The 12-year geometric mean recovery-delisting goal is 2,000 natural-origin adults per year with a mean R/S > 1.2. [16]
Habitat	The Wenatchee River has an estimated EDT capacity and productivity of 2,092 adults/year and 4.26 recruits/spawner, respectively. However, the realized (adjusted) capacity and productivity due to hydropower effects are ≈750 adults/year and ≈1.5 recruits/spawner, respectfully. The long-term goal is for the realized capacity and productivity to increase to >1,800 adults/year and >2.0 recruits/spawner through habitat improvements and an ≈20% increase in downstream survival of juveniles through the hydropower system. Spring Chinook currently spawn and rear in the upper main Wenatchee River upstream from the mouth of the Chiwawa River, overlapping with summer Chinook in that area (Peven 1994). The primary spawning areas of spring Chinook in the Wenatchee watershed include Nason Creek and the Chiwawa, Little Wenatchee, and White rivers.
Harvest	Less than 200 adults are estimated to be incidentally harvested annually in mixed-stock fisheries.

[16] *Upper Columbia River DRAFT Recovery Plan, December 2005.*

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Table 2. Icicle Creek hatchery spring Chinook (Leavenworth NFH)

Stock Goals/Management Premises	
ESA Status	Not listed.
Biological Significance	*Low to medium*. This is an introduced hatchery stock, but the very low viabilities of natural populations of spring Chinook in the Wenatchee River increases the potential biological significance of this stock within the watershed (see viability of Chiwawa River stock).
Population Viability	*High*. Mean recruit per spawner >5.0.
Habitat	Icicle Creek has an estimated capacity to produce 500 adult recruits with a maximum productivity of 1.1 recruits per spawner. Total spawning habitat accessible to adult spring Chinook in Icicle Creek is restricted by a boulder field and cascades at RM 5.6. Until recently, spring Chinook were precluded from passing upstream of the hatchery at RM 2.8
Harvest	For the period 1999-2003, the mean number of fish harvested annually were the following. Tribal harvest in Icicle Creek: 2,905 fish/year; recreational non-tribal harvest in Icicle Creek: 1,252 fish/year; Columbia River gill net: 835 fish/year; Columbia River recreational: 732 fish/year. In addition, an average of over 3,000 surplus adults/year returning to the hatchery were provided directly to Columbia River tribes and food banks.[17] Expanded coded-wire tag recoveries for brood years 1986-98 indicate that harvest of this stock ranged from 14 to 6,132 fish/BY, averaging 1,464 fish/BY in the Columbia River and tributaries.[18]
Hatchery Program	
Facilities	Leavenworth NFH
Type	Segregated
Federal Authorization	Grand Coulee Dam Project , 49 Statue 1028, as part of the Rivers and Harbors Act in 1935; Columbia Basin Project Act, 57 Statue 14, in 1943; Fish and Wildlife Coordination Act, 60 Statue 1080, in 1946.
Primary Purpose	Harvest
Secondary Purposes	Cultural/Educational
Broodstock Origin(s)	Mixed. Carson NFH (1970-73, 75-81, 85), Little White Salmon NFH (1974, 77-79), Cowlitz River (1974, 76), Rock Island Dam (1940-1943). Adults are trapped from returnees back to the Leavenworth NFH.

[17] Cooper (2006).
[18] Pastor (2005)

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Table 3. Chiwawa River spring Chinook (Wenatchee River watershed)

Stock Goals/Management Premises	
ESA Status	Endangered.
Biological Significance	*High*. Only three other extant natural stocks in watershed: White River, Little Wenatchee River and Nason Creek. See APRE database and AHA worksheet.
Population Viability	*Low*. Adult returns from the hatchery program contributed an average of 44% of the natural spawning population from 1993–2003. Geometric mean recruits/spawner for natural-origin fish have averaged less than 1.0 since 1984. The Interior Columbia TRT has estimated that Wenatchee River spring Chinook have a high risk of extinction within the next 100 years.[19]
Habitat	Chiwawa River has an estimated EDT capacity and productivity of 2,092 adults/year and 4.26 recruits/spawner, respectively. However, the realized (adjusted) capacity and productivity due to hydropower effects are ≈750 adults/year and ≈1.5 recruits/spawner, respectfully. The long-term goal is for the realized capacity and productivity to increase to >1,800 adults/year and >2.0 recruits/spawner through habitat improvements and an ≈20% increase in downstream survival of juveniles through the hydropower system.
Harvest	Less than 200 adults are estimated to be incidentally harvested annually in mixed-stock fisheries.
Hatchery Program	
Facilities	Chiwawa River Acclimation Facility and trap, Eastbank Hatchery.
Type	Integrated.
Federal Authorization	Rock Island Dam mitigation. Program is the funded by Public Utility District Number 1 of Chelan County for the purpose of mitigation for lost fish production associated with hydroelectric power system development in the region. Operator: WDFW
Primary Purpose	Conservation. Assist with recovery of endangered upper Columbia spring Chinook.
Secondary Purposes	Minimal terminal harvest following upgrading to threatened status.
Broodstock Origin(s)	Native broodstock, Chiwawa River. Adults are trapped at Chiwawa River weir. Additional hatchery-origin adults are trapped at Tumwater Dam, if necessary.

[19] *Upper Columbia River DRAFT Recovery Plan, December 2005.*

Table 4. White River spring Chinook (Wenatchee River watershed)

Stock Goals/Management Premises	
ESA Status	*Endangered.*
Biological Significance	*High*. This is the most genetically distinct stock of spring Chinook salmon within the mid-Columbia region (upper Columbia River ESU).
Population Viability	*Very Low*. 80 redds in White River in 2005
Habitat	*Medium.*
Harvest	Incidental in lower Columbia River.
Hatchery Program	
Facilities	Aquaseed, Inc. (Rochester, WA) Little White Salmon and Willard NFHs
Type	Integrated.
Federal Authorization	Priest Rapids Dam mitigation. This recovery program has been incorporated into the mitigation responsibilities of Public Utility District No. 2 of Grant County through their Biological Opinion (dated May 3, 2004). Operated by WDFW.
Primary Purpose	Conservation. Captive broodstock program to prevent extinction and assist with recovery.
Secondary Purposes	None.
Broodstock Origin(s)	Pumped redds, White River.

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Table 5. Nason Creek spring Chinook (Wenatchee River watershed)

Stock Goals/Management Premises	
ESA Status	*Endangered*.
Biological Significance	*High*. .Strays from hatchery program for Chiwawa River spring Chinook may reduce biological significance of this stock within the Wenatchee River watershed. No unique attributes have been identified
Population Viability	*Very Low*. See Wenatchee River spring Chinook (Table 1).
Habitat	*Medium*
Harvest	Incidental.

Table 6. Little Wenatchee spring Chinook (Wenatchee River watershed)

Stock Goals/Management Premises	
ESA Status	*Endangered*.
Biological Significance	*High*. See White River spring Chinook.
Population Viability	*Very Low*. See White River spring Chinook.
Habitat	See White River spring Chinook
Harvest	See White River spring Chinook.

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Table 7. Wenatchee River summer Chinook

Stock Goals/Management Premises	
ESA Status	*Not listed*. Was reviewed in 1998 and determined to not warrant listing.
Biological Significance	*High* (APRE)
Population Viability	*Medium* (APRE)
Habitat	The Wenatchee River has an estimated habitat capacity to produce and average of ≈13,000 natural-origin adults with a maximum productivity ≈4.2 recruits/spawner)
Harvest	Hatchery-origin adults contribute an average of approximately 1,400 adults per year to harvest, with approximately 70-75% of the annual harvest occurring in Alaska and Canadian marine fisheries (commercial +recreational).
Hatchery Program	
Facilities	Dryden Dam trap and acclimation pond, Tumwater Dam trap, Eastbank SFH
Type	Integrated.
Federal Authorization	Mitigation for Columbia River dams, Chelan and Douglas PUDs.
Primary Purpose	Harvest.
Secondary Purposes	Conservation
Broodstock Origin(s)	Native Wenatchee River adults. Program began in 1989. Adults are trapped at Dryden Dam.

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Table 8. Lake Wenatchee sockeye

Stock Goals/Management Premises	
ESA Status	*Not listed*. Special concern.
Biological Significance	*High*. Major extirpations of sockeye salmon have occurred throughout the Columbia River Basin, thus increasing the biological significance of extant populations.
Population Viability	*Medium* (APRE)
Habitat	*Medium.*
Harvest	To be documented.
Hatchery Program	
Facilities	Tumwater adult trap, Eastbank SFH, Lake Wenatchee net pens.
Type	Integrated.
Federal Authorization	Mitigation for Columbia River dams, Chelan PUD.
Primary Purpose	Harvest.
Secondary Purposes	Conservation.
Broodstock Origin(s)	Lake Wenatchee, Little Wenatchee and White rivers. Adults are trapped at Tumwater Dam. Program began in 1989.

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Table 9. Wenatchee River steelhead

Stock Goals/Management Premises	
ESA Status	*Threatened*. Upgraded from endangered in 2006.
Biological Significance	*Medium to High*. The Interior Columbia TRT has not identified any unique or distinctive stocks within the upper Columbia River ESU. However, the very low viability of other steelhead populations in the Upper Columbia ESU increases the biological significance of the Wenatchee River population.
Population Viability	*Low*. Escapement of natural-origin steelhead in the Wenatchee watershed ranged from 70 to 2,864 adults between 1967 and 2003 with a 12-year geometric mean ranging from 185 to 919 adults. The geometric mean at the time of listing (1997) was 793 adults. Assuming hatchery fish do not contribute to returning natural-origin adults, then the number of recruits per spawner (R/S) ranged from 0.13 to 4.73 adults for spawn years 1978-1997 with a 12-year geometric mean ranging from 0.71 to 1.96 based on run reconstruction estimates derived from counts at Priest Rapids Dam. The geometric mean at the time of listing (1997) was 0.81. The "true" productivity of Wenatchee River steelhead is less depending on the extent that hatchery-origin steelhead reproduce successfully and thus inflate the number of natural-origin recruits. The Interior Columbia TRT has concluded that Wenatchee River steelhead have a moderate to high risk of extinction over the next 100 years. The 12-year geometric mean recovery-delisting goal is 1,000 natural-origin adults per year with a mean R/S > 1.1. (Upper Columbia Recovery Plan)
Habitat	The Wenatchee River currently has an estimated adult capacity of ≈900 spawners and a maximum productivity of ≈2.5 recruits per spawner. The short-term goal is to increase these parameters to ≈1,600 and ≈2.7, respectively, via habitat improvements.
Harvest	There is no directed harvest on natural-origin adults. An incidental mixed-stock harvest occurs in the mainstem Columbia River.
Hatchery Program	
Facilities	Dryden and Tumwater Dam traps, Eastbank SFH,
Type	Integrated.
Federal Authorization	Mitigation for Rock Island and Rocky Reach dams, Chelan PUD.
Primary Purpose	Conservation. Contribute to recovery of upper-Columbia steelhead ESU
Secondary Purposes	Harvest.
Broodstock Origin(s)	Adults are trapped at Dryden Dam and Tumwater Dam. Fish were first released from this program in 1998.

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Table 10. Wenatchee River hatchery coho

Stock Goals/Management Premises	
ESA Status	*Not listed*.
Biological Significance	*Low*. This is an introduced stock to restore coho salmon to the Wenatchee River. If restoration succeeds, the biological significance of this stock is expected to increase to medium in the short-term and high in the long-term as a self-sustaining, naturally reproducing population becomes established.
Population Viability	*Low*. If reintroduction succeeds, the viability of this stock is expected to increase. The long-term goal is for a self-sustaining, natural run of ≈2,000 adults per year.
Habitat	The Wenatchee River currently has an estimated capacity to support ≈1,800 adult spawners with a maximum productivity of ≈1.5 adult recruits per spawner. The long-range goal is to increase these parameters to >3,000 and ≈1.7 via habitat improvements.
Harvest	An incidental mixed-stock harvest of ≈2,800 adults is estimated to occur in the marine and main river fisheries.
Hatchery Program	
Facilities	Leavenworth NFH and Dryden Dam adult trap.
Type	Segregated, Will become integrated when a naturally-spawning population is established.
Federal Authorization	Northwest Electric Power Planning and Conservation Act of 1980; Bonneville Power Administration, U.S. Fish and Wildlife Service, NOAA Fisheries.
Primary Purpose	Conservation. The long-term goal is to re-establish self-sustaining, natural populations of coho. The short-term goal is to establish a hatchery-propagated run and then slowly transition from a segregated to an integrated program as natural populations become re-established.
Secondary Purposes	Cultural: subsistence and ceremonial. Long-term: Harvest.
Broodstock Origin(s)	Lower Columbia River hatchery stocks, primarily from Willard NFH, Eagle Creek NFH, Cascade SH (ODFW), and Bonneville SH (ODFW). The broodstocks are currently derived primarily from adult returnees back to the Wenatchee River. Fish were first released from this program in 1996. Coho salmon were extirpated from the upper/mid- Columbia River in the early 1900s.

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Table 11. Wenatchee River bull trout

Stock Goals/Management Premises	
ESA Status	*Threatened*.
Biological Significance	*Medium*
Population Viability	*Medium*. Adult spawning surveys were conducted consistently across all populations from 2000–04. Redds counts during this period ranged from 309–607 in the core area, which translates into 618–1,700 adults based on 2.0–2.8 fish per redd. Number of redds for Little Wenatchee, Nason Creek, Ingalls Creek, and Chiwaukum Creek are very low, and there are no known spawning areas in Icicle Creek. However, multiple size classes of bull trout have been observed in Icicle Creek (USFWS). The 12-year geometric mean recovery-delisting goal is 1,612-2,257 natural-origin adults based on redd count expansions.
Habitat	*Medium to High.*
Harvest	No directed harvest occurs on bull trout.

Table 12. Wenatchee River westslope cutthroat trout

Stock Goals/Management Premises	
ESA Status	*Not listed*. Special concern.
Biological Significance	*High*. Populations on the east slope of the Cascade Range are geographically isolated from "core" populations in the upper Columbia and Snake River watersheds.
Population Viability	*Medium*
Habitat	*Medium to High.*
Harvest	*Minor.*

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Other Species of Concern

Table 13. Expected fish species present in Icicle Creek[20]

Salmonid Species	Scientific Name	Non-salmonid Species	Scientific Name
Spring Chinook salmon	*Oncorhynchus tshawytscha*	Longnose dace	*Rhinichthys cataractae*
Summer Chinook salmon	*O. tshawytscha*	Mottled sculpin	*Cottus bairdi*
Sockeye salmon	*O. nerka*	Largescale sucker	*Catostomus macrocheilus*
Coho salmon	*O. kisutch*	Bridgelip sucker	*C. columbianus*
Summer steelhead	*O. mykiss*	Pacific lamprey	*Lampetra tridentata*
Westslope cutthroat trout	*O. clarki lewisi*	Northern pikeminnow	*Ptychocheilus oregonensis*
Redband trout	*O. mykiss gairdneri*		
Bull trout	*Salvelinus confluentus*		
Brook trout	*S. fontinalis*		
Mountain whitefish	*Prosopium williamsoni*		

Other Species of concern in Icicle Creek include resident rainbow (redband) trout (*O. mykiss*), mountain whitefish (*Prosopium williamsoni),* Pacific lamprey (*Lampetra tridentata*) and various sucker species (*Catostomus* sp.). Ecological effects of the Leavenworth NFH on those resident species are unknown. Predation and possible disease transmittance within the facility is caused by Great Blue Heron (*Ardea herodias),* Mallard ducks (Anas *platyrhynchos)* and mink (*Mustela vison).*

Salmon and Steelhead Hatcheries in the Watershed and Vicinity[21]

Leavenworth National Fish Hatchery (U.S. Fish and Wildlife Service)

The Leavenworth NFH is located at river mile (RM) 2.8 of Icicle Creek, a tributary to the Wenatchee River 26 miles upstream from the Columbia River near Leavenworth Washington. The hatchery was originally authorized by the Grand Coulee Dam Project , 49 Statue 1028, as part of the Rivers and Harbors Act in 1935. It began operations in 1942. The Leavenworth NFH includes two adult holding ponds, 45-8x80' concrete raceways, 14-10x100' covered raceways, 40 small and 22 large Foster-Lucas rearing ponds, 108 indoor nursery tanks, and egg incubation facilities. Water sources include seven wells, Icicle Creek, and Snow and Nada Lakes located in the Alpine Lakes Wilderness.

The hatchery propagates an introduced hatchery stock of spring Chinook, derived primarily from spring Chinook propagated at the Carson NFH, but may include some native fish genetic ancestry. Leavenworth NFH has reared and released Chinook salmon annually since 1942, except for brood years 1967 and 1968. The facility is also used currently for the acclimation , release, and restoration of coho salmon in the Wenatchee River in cooperation with the Yakama Nation. Adult fish returning to

[20] *From LNFH –HGMP page 16*
[21] *See Figure 3.*

the Leavenworth NFH must migrate upstream a total of 497 miles and must pass over seven Columbia River hydropower dams.

Chiwawa Acclimation Facility and adult weir/trap (Wash. Dept. of Fish and Wildlife)

The Chiwawa River weir is located adjacent to the Chiwawa Acclimation Facility on the Chiwawa River RM 1.3 (RKm 2.0), a tributary to the Wenatchee River near Lake Wenatchee. The weir is the picket-type and spans the entire width of the river, but can be raised or lowered in about 30 seconds via hydraulically-operated pistons. An adult holding facility is located adjacent to the weir. The Chiwawa River weir is the primary adult broodstock collection site for the Chiwawa River spring Chinook hatchery program. Adults are trapped and transported to the Eastbank State Hatchery on the mainstem Columbia River (immediately downstream from Rocky Reach Dam. Adults are spawned at Eastbank Hatchery and their progeny transferred to the Chiwawa River Acclimation Facility prior to release into the Chiwawa River.

The Chiwawa Acclimation Facility consists of two ponds. These ponds are used to overwinter and acclimate subyearling hatchery-produced Chiwawa River spring Chinook. Subyearlings are transferred from the Eastbank State Fish Hatchery in September and allowed to volitionally release into the Chiwawa River the following April and May.

Dryden Dam and Rearing Ponds (WDFW and Yakama Nation)

The Dryden Dam fish collection facility is located at RM 17.6 (RKm 28.2) on the Wenatchee River. This facility is owned and maintained by Chelan County Public Utility District. Two trapping facilities exist within the Dryden Dam structure adjacent to the northern (left bank) and southern (right bank) shores, respectively, of the Wenatchee River. The left bank trap leads directly into an adult holding area. The right bank trap consists of (a) a small concrete apron that spans approximately half the width of the Wenatchee River and (b) expandable/retractable water-filled bladder atop the apron to block upstream-migrating fish which are diverted into a holding area via a V-trap weir. Adult broodstock for the summer Chinook (WDFW), summer steelhead (WDFW), and coho restoration (Yakama Nation) hatchery programs are trapped at Dryden Dam

Eastbank State Fish Hatchery (WDFW)

Eastbank Hatchery is located on the east side of the Columbia River near Rocky Reach Dam, seven miles north of Wenatchee, Washington. The hatchery was built to mitigate for smolt losses at Rock Island Dam and began operation in 1989. The Eastbank Hatchery includes three ponds for adult holding, 12 concrete raceways, 32 rearing ponds, and incubation facilities.

Eastbank Hatchery is part of the Rock Island Complex, one of two hatchery complexes within the mid Columbia River region. These complexes are funded by the Public Utility Districts (PUDs) in the mid-Columbia region to mitigate for the impacts of hydropower dams on the mainstem Columbia River. The Eastbank Hatchery rears Chiwawa River spring Chinook , Wenatchee River summer Chinook (from adults trapped at Dryden Dam), Wenatchee River summer steelhead (adults trapped at Dryden Dam), and Lake Wenatchee sockeye salmon (adults trapped at Tumwater Dam).

Rocky Reach Hatchery Annex (WDFW)

Rocky Reach FH is located on the east bank of the Rocky Reach tailrace. This facility is funded by Chelan PUD, and has an incubation building (which contains 44 vertical incubator stacks where fall/winter temperatures often reach 17.7^{0}C which precluded the use of this system for egg/fry rearing)

and eight 1,600 ft vinyl raceways. Water supply for the Annex is 6.2 cfs of water seeping around the grout wall at Rocky Reach Dam. This facility works in conjunction with the Eastbank Hatchery and Turtle Rock Satellite, where the summer Chinook undergo final rearing and release.

Tumwater Dam and adult trap (WDFW and Yakama Nation).

Tumwater Dam is located at RM 30.8 (RKm 49.4) on the Wenatchee River. This facility is owned and maintained by the Cowlitz County Public Utility District. WDFW and the Yakama Nation are co-operators of this facility. Tumwater Dam consists of a trap, two adult holding facilities, and a denil fish ladder and chute that connects the two adult ponds. The trap is situated at the top of the ladder providing fish passage around the dam on the left bank of the river. Fish are trapped through closure of a gate at the top of the trap, which prevents upstream passage, maintaining the fish in a 10' x 50' x 8' deep holding pond. The trap can be operated passively or be actively depending on the number of fish migrating upstream and available personnel. Adult broodstock for the Chiwawa River spring Chinook and Lake Wenatchee sockeye hatchery programs are trapped at Tumwater Dam. All spring Chinook migrating upstream are intercepted at Tumwater Dam, enumerated, and biosampled for population dynamic and genetic studies before they are passed upstream

Lake Wenatchee net pens (WDFW)

Lake Wenatchee is located at RM 56.7 of the Wenatchee River. The Lake Wenatchee net pens help support the Lake Wenatchee sockeye hatchery program (WDFW). The pens are located at the west end of the lake near the mouths of the Little Wenatchee and White rivers. The pens are used to hold adult sockeye broodstock prior to spawning and acclimate juveniles prior to release into Lake Wenatchee. The pens consist of six floating net pens for juvenile rearing (approximately 20 x 20 x 20 ft. each) and two adult holding pens (approximately 16 x 16 x 20 ft. each). Adult sockeye are trapped at Tumwater Dam and transported to the net pens for final maturation prior to spawning. The adults are spawned at the net pens and their gametes transported to the Eastbank Hatchery for fertilization and early rearing of progeny. Subyearling sockeye are transported to the net pens for acclimation and final rearing prior to release into Lake Wenatchee (up to 200,000 subyearlings). The sockeye hatchery program was initiated in 1989.

Peshastin Coho Incubation Facility (Yakama Nation)

The Peshastin Incubation Facility is a fruit warehouse in Peshastin which has been modified for incubation of coho salmon eggs in support of the Yakama Nations coho restoration program. The facility consists of three deep trough incubators; each trough contains four incubation cells. The total incubation capacity is approximately 972,000 fertilized eggs. Chilled water is supplied to each incubator via two water sources; Peshastin city water (unchlorinated) and a well located within the warehouse. The dual water sources provide primary and back-up sources.

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Leavenworth NFH Spring Chinook

Operator: U.S. Fish and Wildlife Service
Cooperator: None

Summary of Current Program

Goals

- ***Harvest goal:*** Support tribal and recreational fisheries in Icicle Creek and the mid-Columbia region. No specific numerical harvest goal has been established, although over 2,000 adult fish have been harvest annually in Icicle Creek in recent years. The program is intended to function as a segregated harvest program in partial mitigation for Grand Coulee Dam

- ***Broodstock escapement goal:*** Collect and spawn 1,000 adult fish to produce 1.625 million yearling spring Chinook juveniles for direct release into Icicle Creek annually.

- ***Conservation goal:*** The program has no direct conservation goals. The hatchery stock propagated by the Leavenworth NFH is not included in the ESA-listed Upper Columbia River Spring Chinook ESU.

- ***Escapement goal for natural origin adults:*** All unmarked, natural-origin fish trapped during broodstock collection are transported upstream of the hatchery and released into Icicle Creek. A boulder field/cascade blocks Chinook salmon from migrating upstream approximately three miles upstream of the facility. This cascade is believed to be passable to bull trout and steelhead during certain times of the year depending on water flows.

- ***Education/outreach/cultural goal:*** Provide the public with quality aquatic interpretation and education, customer service and comprehensive outreach to enhance public understanding, participation, and support of Service and Leavenworth NFH programs.

Objectives

- Trap and spawn 1,000 adult hatchery-origin spring Chinook.

- Release 1.6 million yearling spring Chinook into Icicle Creek annually.

Program Description

The Leavenworth NFH spring Chinook salmon program is intended to function as a segregated harvest augmentation program and the Icicle Creek stock utilized by Leavenworth NFH is not included in the ESA-listed UCR spring Chinook salmon ESU. Leavenworth NFH spring Chinook salmon were first collected from commingled upriver stocks intercepted at Rock Island Dam (1940-1943). Occasionally, Leavenworth NFH has imported eggs from other Columbia River hatcheries, primarily Carson NFH, and also Cowlitz and Little White Salmon NFH's. Genetic analysis indicates current brood is more closely related to the lower Columbia River stocks than the natural population in the Wenatchee River.

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However, Leavenworth NFH has not imported the Carson eggs or fry for over twenty years. Brood stock collection at the hatchery is managed to maintain the genetic integrity of the stock. All broodstock used for production are volunteers to the facility. Adult fish swim up the collection ladder and into one of two holding ponds. The Service management goals are to ensure that adult brood stock is randomly collected for spawning across the run in proportion to the rate at which they return. Inclusion of stock other than Leavenworth NFH is believed minimal as few natural or other hatchery origin adult fish have been observed in the adult holding ponds at this facility.

Most years, more fish enter the hatchery than are needed for brood stock. Between 1980-2005, Leavenworth NFH averaged 5,649 (SD = 4,034, +/- 71% of average; 1980-2005) returning adult fish to the Wenatchee River Basin and was unable to achieve a minimum broodstock goal of 1,000 adult fish in only one of twenty-six years (1995 or 1/26 years = 4%). For the brood year period of 1990-1999, the total smolt-to-adult return of spring Chinook has averaged 0.404% for Leavenworth NFH and total recruits per spawned adult (RPS) has averaged 7.2. Brood stock excess to hatchery needs are transferred to the Bureau of Indian Affairs for distribution to the Yakama Nation, Colville Confederated Tribes, Spokane Indian Tribe, and others for ceremonial and subsistence use. Periodically, the local Trout Unlimited group will receive excess fish via an agreement with the Service.

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Assessment of Current Program

Operational Considerations

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

- Broodstock were first collected from co-mingled upriver stocks intercepted at Rock Island Dam (1940–43). Some early imports of spring Chinook salmon from the lower Columbia River (1942) and McKenzie River, Oregon (1941) were part of homing studies, and probably few, if any, contributed to future production. Since 1974, Leavenworth NFH has imported eggs from other Columbia River hatcheries, primarily Carson NFH, and also Cowlitz and Little White Salmon NFHs. Fish and/or eggs have not been imported to Leavenworth NFH since 1985 and brood has consisted of adult fish that volunteer into the hatchery ladder. Consequently, the ancestry of the current hatchery stock is derived primarily from the Carson NFH.

- The broodstock collection goal is 1,000 adult fish. The 10-year average return (harvest + escapement) is 2,969 adults.

- Spawning protocols and the number of adults spawned exceed minimal genetic standards.

- ESA-listed bull trout and steelhead are occasionally inadvertently intercepted during broodstock collection. These fish are handled according to a NOAA ESA section 7 permit.

Hatchery and Natural Spawning, Adult Returns

- Fish are randomly selected and mated as close to a 1:1 male/female ratio as possible. Typically, the sex ratio for the returning adults is skewed 60:40 in favor of the females. Jacks (age-3 males) are randomly included in the spawning population, but limited to 5% of the total number of males used (per Regional genetics guidelines for spring Chinook).

- For the period of 1984-2003, the Leavenworth NFH is estimated (based on the difference in dam counts between Rock Island and Rocky Reach) to have contributed an average of 72.5% (SD = 16.9%) of all adult spring Chinook returning to the Wenatchee River.

- All hatchery-produced spring Chinook from the state's Chiwawa River program are 100% adipose fin clipped. Chiwawa River hatchery-origin adults and Leavenworth NFH adults cannot be distinguished, thus precluding separation of the two groups of fish at Tumwater Dam where all upstream-migrating adults are individually counted. As a result, Leavenworth NFH adults are allowed to pass upstream into the upper Wenatchee River basin.

- For the period of 2001-2003,,the estimated percentage of Leavenworth NFH adults straying to the upper Wenatchee River averaged 2.6% (SD = 0.6%) of all returning adults to the Wenatchee River based on carcass surveys and recoveries of coded wire tags. However, because of the very low numbers of natural-origin spring Chinook in the upper Wenatchee River, adults from the Leavenworth NFH composed an average of 34.6% (SD = 10.5%) of all carcasses recovered.

- ESA listing of upper Columbia spring Chinook as an endangered species restricts harvest of hatchery-origin fish to a terminal harvest in Icicle Creek only (approximately 2.5 miles) resulting in substantial surpluses of returning adults back to the hatchery.

- Upstream fish passage is a significant issue in Icicle Creek. At the present time, hatchery structures impede upstream fish passage at three locations: (1) "Structure 5" immediately upstream of the hatchery fish ladder and bypass canal spillway at RM 2.8; (2) "Structure 2" and associated headgate for diverting Icicle Creek water into the bypass canal; and (3) a low-head dam at RM 4.5 for diverting Icicle Creek water into the intake pipe for the hatchery.

- A boulder field at RM 5.6 is a major impediment to upstream fish passage and is believed to be a complete barrier to passage of spring Chinook salmon, thus limiting the amount of habitat available to spring Chinook in Icicle Creek. Larger bull trout, thought to be fluvial, have been seen above the boulder field. However, the boulder field appears to also limit passage of bull trout and possibly steelhead, and is completely impassible during the low-flow summer months when water is withdrawn for irrigation.

- The Service relies on the Yakama Nation's estimates of tribal harvest for Icicle Creek for calculating total harvest.

- Erythromycin injections for spring Chinook salmon female brood stock are used to control bacterial kidney disease, help control mortality and reduce horizontal transmission of *R. salmoninarum* among adults in the brood pond.

- Carcasses were outplanted in 2000-2003 for nutrient enhancement of streams but are no longer outplanted at the request of WDFW.

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- Brood stock excess to hatchery needs are transferred to the Bureau of Indian Affairs for distribution to the Yakama Nation, Colville Confederated Tribes, Spokane Indian Tribe, and others for ceremonial and subsistence use. The local chapter of Trout Unlimited receives excess fish as well by agreement with the Service.

- Natural spawning by returning hatchery-origin adults outside of Icicle Creek is not intended but is considered a biological risk to naturally spawning populations currently listed as endangered under the ESA.

Incubation and Rearing

- Icicle Creek water experiences extreme temperatures in winter and summer, with summer temperatures being particularly limiting.

- The amount of available Icicle Creek water is limited during the irrigation withdrawal season, and the viability of the well field is in question because of uncertainties related to use of the bypass channel to recharge the shallow well aquifer. Summer quantities are supplemented by water from Snow Lakes, which also provides some temperature relief. Supplemental flows from Snow Creek ranging from 45–60 cfs enter Icicle Creek one-mile above the hatchery's intake system.

- Expanding the water right has been considered, but is unlikely since water is already over-appropriated in the watershed and the wells are considered to be in continuity with Icicle Creek

- Beginning with brood year 1991, rearing space has been managed so that density indices (the ratio of weight of fish to rearing unit volume and fish length) at no time exceed 0.2. In order to achieve these low indices, total production was reduced from 2.2 million to 1.625 million smolts. Reduced production numbers appears to have led to a decline of incidence of BKD.

- Only the upper bank of raceways receives single pass fresh groundwater. There is a need to plumb groundwater to middle and lower decks of 8'x80' raceways to improve water quality. This project is identified by the Bureau of Reclamation in their RAX (Replacements, Additions, and Extraordinary Maintenance) survey.

- Fish from this program are 100% adipose fin clipped. However, distinguishing unlisted Leavenworth NFH fish from listed Chiwawa River hatchery spring Chinook is compromised because these latter fish are also given an adipose fin clip.

- Leavenworth NFH receives coho yearlings (primarily reared at the lower Columbia River hatcheries of Willard NFH and Cascade SFH) on station in winter for one to four months acclimation and subsequent release into Icicle Creek. These coho yearling are the progeny of returning adults trapped at Dryden Dam. Yearlings had initially been acclimated behind dam 5 in Icicle Creek; however, more recently they are acclimated in renovated Foster-Lucas ponds prior to release into Icicle Creek.

- The Service has been approached in the past about spawning adults or rearing juvenile fish from broodstock surpluses to the WDFW Chiwawa River spring Chinook program; these fish have not been accepted, due to space limitations.

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Release and Outmigration

- The release date has remained consistent around the third week in April and although some attempt is made to coincide with a discharge event, this facility is constrained within a spill window negotiated with Chelan PUD for Rock Island Dam.

- Smolt releases are made directly into Icicle Creek.

- Smolts are mass released directly into Icicle Creek at a size of 18 fish per pound. There are no native spring Chinook stocks in Icicle Creek.

- Detection of PIT tagged fish at McNary and Bonneville Dams' bypass facilities provides evidence of rapid movement of smolts released from Leavenworth NFH. The average travel time from release to McNary Dam, 1998-2003, ranged from 20 days (1998) to 35 days (2001) and averaged 27.2 days.

- Competition between hatchery- and ESA-listed, natural-origin spring Chinook appears to be minimal. There is evidence that fully-smolted hatchery fish outmigrate rapidly, and available information does not indicate that a significant number of hatchery juveniles residualize.

Facilities and Operations

- The current Icicle Creek water intake and some of the delivery system is part of the original construction of the Hatchery (1939 and 1940). The system is deteriorating rapidly and causing operational and maintenance problems, including a high risk of catastrophic failure of the intake pipe for the Hatchery. Icicle Creek transports large amounts of silt and sediment during heavy spring runoff resulting in accumulation of significant amounts of sediment at the intake and intake works. The failure to remove these materials results in restricted flows into the intake over time, especially during the summer months.

- Water quantity and high summer temperatures in Icicle Creek during the summer are significant factors affecting instream flows, hatchery operations and capabilities. Major water right holders for Icicle Creek are the Icicle/Peshastin Irrigation District (117 cfs at RM 5.7), Leavenworth NFH (42 cfs at RM 4.5), and the Cascade Orchard Irrigation Company (12 cfs at RM 4.5). Water is extremely limited when irrigators are removing water.

- Irrigation diversions in Icicle Creek remove 48%, 79% and 54% of the mean August, September and October flows, respectively (Mullan et al. 1992).

- USFWS is responsible for providing water to the Cascade Orchard Irrigation Company (currently via the hatchery intake) as a result of contractual obligations established in 1939.[22] The Company has a water right to withdraw up to 12 cfs from the hatchery intake for its irrigation.

- Diversion of water from two alpine lakes, Nada and Snow lakes, is necessary during the summer months to provide water of sufficient quantity and temperature for the hatchery. During the low-flow summer months, water from Nada and Snow lakes can be 4-5° C cooler than Icicle Creek.

[22] *As stated in Article 14 of the contract between the United States and the Cascade Orchard Irrigation Company dated November15, 1939, and recorded in Auditor's File No. 304562 of the County of the State of Washington.*

- Freezing at the water intake grates is a recurring problem and can limit water quantity to the hatchery. Manually removing this ice presents a significant physical risk to hatchery staff. A component of the proposed intake structure rehabilitation project includes piping warmer well water to the intake structure to reduce icing problems.

- Screens at the water intake do not comply with NOAA-Fisheries fish exclusion guidelines[23] and are of poor design and orientation. Current fish screening and bypass measures are located at the downstream end of the supply pipe, near the hatchery, rather than at the point of diversion, which is preferred and less stressful on fish. This issue is to be addressed in rehabilitation of Icicle Creek water delivery system.

- Hatchery water supply dams and intake structures at Nada and Snow lakes (required for regulating summer water temperature at the hatchery) have been determined to be in an unsafe condition by the National Dam Safety Survey, because of deterioration and the risk of failure. In addition, hiking or helicoptering is required to reach these structures.

- The estimated April 2000 cost to replace the hatchery intake pipe and structure (preferred alternative) was $3.72 million. The estimated April 2000 cost to rehabilitate or remove fish passage structures in Icicle Creek (preferred alternative) was $9.35 million.

- Discussions are ongoing with neighboring property owners concerning existing easements for the hatchery intake water pipeline. The outcome of these discussions could affect the placement of the intake pipeline; operation and modification of fish bypass ditch, and replacement of the intake.

- NOAA Fisheries, the USFWS-ES office in Wenatchee, and Washington Trout are very concerned about passage issues for ESA listed bull trout and summer steelhead at the lowermost structure in Icicle Creek and at the intake structure.

- Raceway and nursery tank cleaning effluent is sent to a pollution abatement pond where solids are removed prior to discharge to Icicle Creek. Cleaning effluent and total discharge (normal operation) effluent are monitored weekly for suspended and settled solids. Environmental Protection Agency standards have only been exceeded once (1998) for either cleaning effluent or total discharge since monitoring began in 1974.

- There is a need to rehabilitate the effluent/pollution abatement pond to meet expected new guidelines.

- The hatchery has voluntarily included a pump-back system component to the Water Supply System Rehabilitation Project. The pump-back system will allow the hatchery to return up to 20 cfs of water to Icicle Creek at river mile 4.5.

Research, Education, and Outreach

- This stock serves as an indicator stock under the Pacific Salmon Treaty, providing data to help estimate exploitation rates on upper Columbia River spring Chinook.

[23] *Anadromous Salmonid Passage Facility Guidelines and Criteria, National Marine Fisheries Service, Northwest Region, Portland, Oregon (Draft, 31 January 2004).*

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- Research studies to assess the reproductive success of surplus hatchery-origin adults outplanted into Peshastin and Ingalls Creek have recently been completed. Those outplants resulted in a mean of 1 redd per 4.6 adults outplanted (SD=1.8 fish/redd) in 2001-2004.

- The Service's Mid-Columbia Fishery Resource Office, which is responsible for monitoring and evaluation of adult returns and related activities, is located immediately adjacent to the hatchery grounds, thus providing opportunities for onsite research and monitoring activities (e.g. adult outplanting studies).

- Leavenworth NFH serves 150,000 visitors annually. Permitted Special Uses on hatchery lands include a cross-country ski trail system, summer horseback rides, winter sleigh rides, outdoor theater and weekly meetings and activities for the Friends of Northwest Hatcheries and the Boy Scouts. Other public uses include hatchery tours, sport fishing for spring Chinook salmon, walking on the Icicle Creek Nature Trail, and bicycling and picnicking at Hatchery Park. Requests are received throughout the year for special events produced by community organizations. The largest special event is the Wenatchee River Salmon Festival held annually in September for the public.

- The Leavenworth NFH Complex houses one of the most comprehensive Information and Education Outreach Departments (I&E) in the National Fish Hatchery System, serving Leavenworth, Entiat and Winthrop National Fish Hatcheries and many partners in the private sector, schools, tribes and local, city, state and federal government agencies.

- The Discovery School, an alternative high school for students with disadvantaged backgrounds or other problems, is located on the hatchery grounds and is strongly supported by the Administrative staff of the hatchery. The Discovery School makes significant contributions to the local community, particularly for students who have difficulties in traditional high school learning environments.

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,[24] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- Harvest benefit conferred to the Yakama Nation from a terminal fishery in Icicle Creek. The tribal harvest in Icicle Creek averaged 2,905 spring Chinook per year, 1999-2003. In addition, an average of over 3,000 hatchery-origin adults surplus to hatchery broodstock needs were provided directly to Columbia River tribes (Yakama Nation, Colville Confederated Tribes, Spokane Tribe, Kalispell Tribe) and food banks.

- Harvest benefit from recreational, non-tribal harvest in Icicle Creek. The recreational harvest averaged 1,252 spring Chinook per year, 1999-2003. In 2002, Leavenworth NFH spring Chinook supported 3,811 angler-days and 17,150 angler-hours on Icicle Creek . This is one of only two

[24] *See Components of This Report for a description of these potential benefits and risks.*

recreational harvest opportunities for salmon or steelhead in the Wenatchee, Entiat, and Methow rivers (summer steelhead in the Methow River is the other).

- Harvest benefit from treaty and non-treaty mixed-stock fisheries in the Columbia River. This includes a contribution to gill net fisheries averaging 835 fish per year and to Columbia River recreational fisheries averaging 732 fish per year.

Conservation Benefits

- The hatchery program provides no direct conservation benefit. However, spring Chinook from the Leavenworth NFH constitute the vast majority of spring Chinook returning to the Wenatchee River annually. An average of 5,649 adult spring Chinook salmon returned to Icicle Creek and the Leavenworth NFH, 1980-2005.

- Because naturally spawning populations of spring Chinook are currently listed as *endangered* under the ESA, the Leavenworth NFH stock represents a potential "back-up" stock for the Wenatchee River and mid-Columbia region if naturally spawning populations go extinct.

Research, Education, Outreach and Cultural Benefits

- Public education, cultural, and economic benefit to the community from the Wenatchee River Salmon Festival.

- Educational benefit from visiting school groups, and the *Kids-in-the-Creek* and *Salmon in the Classroom* programs.

- Education benefit from the Discovery School, an alternative high school located on the hatchery grounds. The curriculum includes science class projects at the hatchery.

- Cultural benefit to Columbia River tribes (Yakama Nation, Colville Confederated Tribes, Spokane Tribe, Kalispell Tribe, and Snoqualmie Tribe), local chapter of Trout Unlimited, and food banks from distribution of hatchery-origin adults surplus of broodstock needs. Trout Unlimited uses the monetary proceeds for habitat improvement projects.

- Economic benefit to Cascade Orchard Irrigation Company from withdrawing righted water via the hatchery's intake and pipeline.

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, stocks, and communities,[25] the Review Team identified the following benefits of this program:

Harvest Benefits

- The Colville Confederated Tribes will be submitting an HGMP for comprehensive management of spring Chinook in the Okanogan River and the Columbia River below Chief Joseph Dam. This HGMP outlines an Isolated Harvest Program based on Carson NFH-derived stock of spring

[25] *Ibid.*

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Chinook, potentially from the Leavenworth NFH. This proposed harvest program would partially mitigate for the effects to the fishery resources of the Tribes resulting from federal hydropower developments on the Columbia River.

Conservation Benefits

- Location of the Leavenworth NFH on Icicle Creek in a terminal fishery area allows for an intensive tribal and recreational fishery on adults returning to the hatchery with little or no harvest impact on ESA-listed spring Chinook in the mainstem Wenatchee River.

Research, Education, Outreach and Cultural Benefits

- Research benefit from serving as an indicator stock under the Pacific Salmon Treaty.
- Education, outreach, and cultural benefits from the Wenatchee River Salmon Festival to the state and region. This event attracts participants and visitors from throughout Washington State and the Northwest.
- Research benefit to other stocks from providing surplus fish from this non-listed stock for passage studies at mainstem Columbia hydropower facilities and to universities for research studies.

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,[26] the Review Team identified the following risks of the hatchery program:

Demographic Risks

- Demographic risk from failure of the surface water intake pipe. Failure is likely within the next few years because the pipe is past its designed life expectancy and in a deteriorated condition.
- Demographic risk from ice on the water intake screens interrupting the water supply to the hatchery and thereby compromising the survival of the fish on station.
- Demographic risk from pathogen amplification in the hatchery environment, particularly during periods of high water temperature and low stream flow which characterize Icicle Creek during he summer.

Ecological Risks

- Ecological risk from upstream passage of adult spring Chinook, and possibly other migratory fish (e.g. steelhead), that can transmit pathogens into the hatchery water supply and thus result in disease outbreaks among juvenile fish.
- Ecological risk from non-treatment of wastewater, although cleaning effluent water from ponds and raceways is discharged into a settling pond and meets the latest NPDES standards.

[26] *Ibid.*

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- Ecological risk from antibiotic resistance in bacterial flora from erythromycin injections of adults held for broodstock and therapeutic use of medicated feeds for hatchery-reared fish prior to release, including antibiotics in effluent water from ponds and raceways.

Physical Risks

- Physical risk to adult fish held for broodstock due to lack of a protection alarm systems.

- Physical risk from ice on the water intake structures to the safety of hatchery personnel during manual removal of ice from screens to maintain water flow to hatchery.

Research, Education, Outreach and Cultural Risks

- Economic risk to Cascade Orchard Irrigation Company if the intake water pipeline to the hatchery fails.

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,[27] the Review Team identified the following risks from the hatchery program:

Genetic Risks

- Genetic risk from hatchery-origin fish straying to the upper Wenatchee watershed and spawning with ESA-listed, natural-origin spring Chinook. Based on estimates derived from expanded coded-wire tag recoveries 2001-2003, adult strays from the Leavenworth NFH have composed a combined average of 9% (SD=13%) of the natural spawners (i.e. carcass recoveries) in the Chiwawa River, Chickamin Creek and Rock Creek, 53% (SD = 41%) of the natural spawners in the Little Wenatchee River, 18% (SD = 10%) of the natural spawners in Nason Creek , and 3% (SD = 6%) of the natural spawners in the White River, Napeequa Creek and Panther Creek. Returning adults from the Leavenworth NFH have composed an average of 89% (SD = 18%) of the natural spawners to the upper Wenatchee River mainstem. Although only 2.6% of adult spring Chinook from the Leavenworth NFH actually stray outside of Icicle Creek, they constitute a relatively high proportion of the natural spawners in some tributaries because of the very low abundance of natural-origin adults. Additional Wenatchee River basin spawning ground data are available from WDFW and Chelan County PUD (Tonseth 2003, Grassell 2003-2004, Mosey & Murphy 2000 & 2002).

Demographic Risks

- Demographic risk to natural-origin juveniles in Icicle Creek from inadequate water intake screening. These screens do not meet anadromous fish screening criteria as described in section 12.7 (page 66) of the Anadromous Salmonid Passage Facility Guidelines And Criteria, developed by National Marine Fisheries Service, Northwest Region, Portland, Oregon (1-31-04 external review draft).

[27] *Ibid.*

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- Demographic risk to ESA-listed bull trout and steelhead from interception during broodstock collection. However, only minor incidental take occurs at this time. If listed summer steelhead or bull trout enter the collection ladder at Leavenworth NFH, staff transport them upstream of Structure 2 at the head of the bypass Canal. Effects of the barrier dam at Structure 2 on listed fish are being addressed under a separate consultation process (USFWS 2002).

- Demographic risk to ESA-listed bull trout and steelhead from incidental take as by-catch during tribal and recreational fisheries in Icicle Creek.

- Demographic risk to ESA-listed Chiwawa River hatchery-origin spring Chinook from incidental take as by-catch during tribal and recreational fisheries in Icicle Creek. (Chiwawa River hatchery fish are given an adipose fin clip and cannot be visually distinguished from Leavenworth NFH fish).

- Demographic risk to upstream migration of several species (including ESA-listed bull trout and steelhead) from inadequate fish passage at hatchery.

Ecological Risks

- Ecological risk from dewatering of Icicle Creek in low stream flow conditions in the stream reach between the hatchery water intake and discharge to meet hatchery program needs. These hatchery water withdrawals occur downstream from other withdrawals of Icicle Creek water for irrigation.

- Ecological risk from non-treatment of waste water, although pond cleaning effluent water is discharged into a settling pond, and tested water meets standards of most recent NPDES permit. USFWS anticipates changes to effluent standards in forthcoming permit.

- Ecological risk from potential contaminants in the effluent pond.

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Recommendations for Current Program[28]

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.

Broodstock Choice and Collection

Issue LE1: Leavenworth NFH and WDFW Chiwawa spring Chinook are currently given the same distinguishing mark. *Both hatchery programs apply an adipose fin clip to their released fish*

[28] *The Review Team believes that the Leavenworth Hatchery Evaluation Team—as a whole, in task teams and/or with outside assistance and expertise—will be the logical body to implement most of the following recommendations.*

for identification purposes. This results in an inability to non-invasively distinguish ESA-listed Chiwawa River hatchery spring Chinook from unlisted Leavenworth NFH spring Chinook at Tumwater Dam or elsewhere in the Wenatchee River basin (e.g. the Chiwawa River weir). As a result, significant numbers of Leavenworth NFH spring Chinook can be passed upstream as part of the state's hatchery supplementation program for the Chiwawa River. The lack of distinguishing marks potentially inhibits harvest or surplus opportunities for Leavenworth NFH spring Chinook intercepted outside of Icicle Creek in the Wenatchee River basin. An incidental but undocumented harvest on Chiwawa River spring Chinook could also be occurring in Icicle Creek.

Recommendation LE1a: Work with WDFW to establish a system for differentially marking or tagging Leavenworth NFH spring Chinook and Chiwawa River hatchery spring Chinook to allow increased selective fisheries or removal of Leavenworth NFH fish, to reduce straying risks from Leavenworth NFH in the upper basin, and to reduce harvest risks on listed Chiwawa River hatchery spring Chinook. For example, Chiwawa River hatchery spring Chinook could be given a coded-wire tag only (that could be detected with an electronic wand), and not adipose fin clipped. Alternatively, coded-wire tags could simply be applied to Chiwawa River hatchery spring Chinook at a location other than the snout if WDFW wished to retain the adipose fin clip for other monitoring and evaluation activities.

Recommendation LE1b: If a system for differentially marking Leavenworth NFH spring Chinook and Chiwawa spring Chinook is not established by the brood year 2006 marking cycle, implement a temporary, secondary identifying mark on Leavenworth fish until such a system is established.

Hatchery and Natural Spawning, Adult Returns

Issue LE2: Limited locations for terminal harvest limits harvest on returning Leavenworth NFH spring Chinook*. Tribal harvest presently occurs in a limited area immediately adjacent to Leavenworth NFH. Sport fishing occurs at a few sites along Icicle Creek that provide minimal access for fishing. In recent years, more adult spring Chinook have been collected at the hatchery ladder than are required for broodstock.*

Recommendation LE2: Explore opportunities for additional fishing sites in Icicle Creek, if potential by-catch of ESA-listed fish can be minimized via differential marks/tags

Issue LE3: Latter portion of the spring Chinook run may be thermally precluded from entering Icicle Creek. *This makes these fish unavailable for harvest and may lead them to stray to other streams.*

Recommendation LE3: After Recommendation LE1 is implemented, assess temporal distribution of straying adults at Tumwater Dam. If the strays are concentrated in the latter portion of the run when water temperatures in Icicle Creek may exceed those in the mainstem Wenatchee River, develop a risk/benefit assessment investigating the possibility of selective breeding for early return timing to further segregate the hatchery stock from upriver natural stocks.

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Issue LE4: In high return years, large numbers of adults returning to Icicle Creek are surplus to hatchery broodstock needs and the ability of tribal and recreational fisheries to capture them. *These fish can then either stray, or lead to additional pre-spawning mortality in Icicle Creek.*

Recommendation LE4: Manage the hatchery ladder and ponds to provide additional surplus adult fish to tribes for Grand Coulee mitigation in years where the estimated return is ~5,000 fish or greater.

Incubation and Rearing

Issue LE5: Effluent water and/or contaminants in effluent pond. *The existing settling pond provides limited treatment of effluent water only during pond cleaning cycles. PCB contaminated paint chips and other environmental contaminants may be present in the sediment in the effluent settling pond.*

Recommendation LE5a: Continue to work with EPA to complete the NPDES permitting process.

Recommendation LE5b: Expedite removal of sediments in effluent pond.

Issue LE6: Pathogen amplification during periods of high water temperature and low flow. *During the late summer period, temperature of the hatchery water supply increases and reduced flow results in increased reuse of water in rearing ponds. These conditions increase the risk of disease outbreaks for fish reared in the hatchery. (Margin of safety too low).*

Recommendation LE6a: Modify the water distribution system to allow the possibility of providing single pass ground water to the lower decks.

Recommendation LE6b: Reduce rearing densities to a density index of 0.15 or less in order to better match fish densities to water availability, particularly during the summer months. This may require reducing the total number of smolts reared and released by approximately 25% (to 1.2M smolts) to maintain the current size at release. Lower rearing densities are expected to also increase in-hatchery and post-release survival. Lowered densities are also expected to provide an increased margin of safety against a water supply system that depends on summer releases from Snow Lake and an intake pipe that needs replacement.

Release and Outmigration

Issue - The Review Team did not identify any issues of concern regarding release and outmigration of juveniles from the hatchery.

Facilities/Operations

Issue LE7: Several interrelated problems associated with fish passage, instream flows in Icicle Creek, and the existing water conveyance system exist at the Leavenworth NFH. These issues are complex and are described in the following narrative.

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The U.S. Fish and Wildlife Service and staff at the Leavenworth NFH are well aware of several water problems at the hatchery and in Icicle Creek. These include: 1) Failing water intake delivery pipe that requires replacement or a new water delivery system as soon as possible; 2) Inadequate upstream passage for fish at three separate locations in Icicle Creek, including the water intake diversion dam at RM 4.5; 3) Water intake screening that is not NOAA Fisheries compliant (See appendix X for NOAA Fisheries Fish Screening Criteria) ; 4) Icing on water intake screens; 5) Insufficient instream flows during summer months resulting in high water temperatures and low dissolved oxygen, and sometimes a dewatered reach of Icicle Creek, between the hatchery intake diversion at RM 4.5 and the hatchery outflow at RM 2.6; 6) Human safety issues at several locations during operations and maintenance, particularly at the water intake when staff must physically remove ice from the screens; 7) Shared water withdrawal with Cascade Orchards Irrigation Company; and 8) Water right withdrawals (up to 117 cfs) upstream of the hatchery intake by the Icicle-Peshastin Irrigation District at RM 5.7 on Icicle Creek.

The above-listed issues have been raised in several other forums/reports including: an Environmental Assessment (USFWS 2003); Washington Trout (letters in 2005, meeting in 2006); Wenatchee River Basin Dissolved Oxygen, pH, and Phosphorous Total Maximum Daily Load Study (DOE 2006); and Wenatchee Watershed Management Plan (Planning Unit 2006). Furthermore, fish passage is generally addressed in the "National Fish Passage Program" (USFWS 2000) and in the "Region One Fisheries Work Activity Guidance" (USFWS 2000).

After examining the available documents, the Review Team was concerned that water issues in Icicle Creek were being addressed separately and not collectively or holistically. For example, the engineering report of Sverdrup Civil, Inc. (Sverdrup 2000; referred hereafter as the "Sverdrup Report") identified seven alternatives for improving fish passage and six alternative for replacing the existing water intake pipe and structures, but those two sets of alternatives were not examined in concert (Tables X1 and X2). The Review Team concluded that the relative merits of those two sets of alternatives could not be fully determined if evaluated independently. The Review Team was also hindered by a general lack of engineering expertise to fully understand the physical limitations and opportunities of those alternatives.

The Review Team was also concerned that the need to maintain instream flows in Icicle Creek was not addressing the potentially large water withdrawals by the Icicle-Peshastin Irrigation District (up to 117 cfs). A collaborative approach for maintaining instream flows for ESA listed species (steelhead, bull trout, spring Chinook) and other fishes (e.g. Pacific lamprey, mountain whitefish) would seem highly desirable. For example, collaborative approaches with irrigators have successfully restored instream flows in the Umatilla and Walla Walla rivers. In this context, outflow water from the Leavenworth NFH could theoretically be provided directly to the two irrigation companies, but the Review Team is unaware of any document where this option was proposed. Related concerns include the shared water withdrawal system with the Cascade Orchards Irrigation Company and the potential need to relocate the water intake infrastructure of the hatchery. The Review Team believes that a collaborative approach with the irrigators and local landowners could yield a potentially high benefit-to-cost ratio depending on the actions taken relative to the entire watershed and alternative water withdrawal sites.

Consequently, the water share arrangement with the Cascade Orchards Irrigation Company and the mutual needs of the Icicle-Peshastin Irrigation District generated much interest among Team members regarding the desirability to discuss instream flow needs and alternative fish passage and water intake options directly with those stakeholders. However, the Review Team understands that a watershed planning process is currently in progress and may be discussing water appropriations and instream

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flows in Icicle Creek.[29] The Review Team contacted the lead agency for the Wenatchee River watershed planning process (Chelan County) to determine whether the Service is currently involved and whether that process could be a forum for communications with the Cascade Orchards Irrigation Co., the Icicle-Peshastin Irrigation District, and other stakeholders. Alternatively, the implementation phase (after approval of the plan by the Chelan County Commissioners) may be the time when the Service could engage in discussions with various irrigation companies via the watershed planning forum.

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[29] *The Wenatchee River watershed has been listed by the Washington State Department of Ecology as one of 16 basins in the state with critical and inadequate stream flows for fish. These basins are also referred to as "over-appropriated," meaning that more water has been allocated to out-of-stream uses than is naturally available in some years (Wenatchee Watershed Management Plan 2006).*

Table 14. Water intake alternatives at the Leavenworth NFH, as described in Sverdrup (2000)

Alternative	Major Action	Major Features	Estimated FY2001 cost
A	No Action	• Remedial actions only to maintain existing intake structure • High risk would remain for water intake failure	Maintenance only
B	Rehabilitate intake system and screen at existing water intake (RM 4.5)	• Gravity-feed intake pipe would be replaced with a similar gravity-feed line on existing private property easement. • Intake screen and sediment sluice replaced.	Construct: $3.72 M Operat: $53.1K/yr
C	Rehabilitate intake system and construct new screen at settling basin at hatchery	• Similar to Alternative B except new, more reliable screening (drum screen) would be constructed at settling basin on hatchery grounds instead of intake structure.	Construct: $4.94 M Operat: $73.1 K/yr
D	Abandon intake system and use only ground water for rearing fish	• Intake pipeline and surface water for rearing fish would be abandoned and replaced with a new water infiltration system to recharge wells.	Construct: $5.86 M Operat: $111.2 K/yr
E	Abandon existing intake and construct new intake at headgate and Structure 2	• Existing intake structure would be modified to supply surface water for Cascade Orchard Irrigation Co. only. • Intake water would gravity feed to a new settling basin on hatchery grounds and then pumped to hatchery. • Allows potential removal of all existing intake structures if pumped water can be provided to Irrigation Co.	Construct: $6.41 M Operat: $168.9 K/yr
F	Abandon existing intake and construct new intake immediately upstream of Structure 5	• Similar to Alternative E except new intake would be located near present site of Structure 5, which would be demolished. • Intake water would gravity feed to a new settling basin immediately east of canal and then pumped to hatchery.	Construct: $10.5 M Operat: $252.6 K/yr

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Table 15. Fish passage alternatives at the Leavenworth NFH, as described in Sverdrup (2000)

Alternative	Major Action	Major Features	Estimated FY2001 cost
1	No Action	• All existing hatchery-related structures in Icicle Creek would be retained. • Fish passage by current methods or trucking.	Maintenance only
2	Remove all Instream structures with natural flushing of stream channel	• Structure 5 replaced with a seasonal fish barrier and fish sorting facility. • Bypass canal would be abandoned and headgate (Structure 2) removed. • Adult holding and spawning facilities would be relocated to east side of canal (no attractor water from canal). • Sediments in stream channel would be flushed naturally.	Construct: $10. 1M Operat: $124K/yr
3	Remove most instream structures with mechanical dredging of stream channel	• Structure 2 and headgate retained to manage flows in bypass canal and natural stream channel. Permanent fishway constructed around Structure 2. • Structures 3 and 4 removed (already completed). • Structure 5 replaced with a seasonal fish barrier and fish sorting facility. • Heaviest sediment deposits in stream channel dredged mechanically.	Construct: $9.4 M Operat: $123 K/yr
4	Retain and modify all Instream structures (no longer applicable)	• Similar to Alternative 3 except Structures 3 and 4 retained but modified (notched) for fish passage. • Structures 3 and 4 already removed.	Construct: $9.9 M Operat: $132 K/yr
5	Fish ladder bypassing canal spillway	• Similar to Alternative 1 except a new fish passage and sorting facility would connect existing fish ladder (that leads to adult holding facility) to canal.	Construct: $2.1 M Operat: $68 K/yr
6	Modify Structure 2 and Structure 5 only (no longer applicable.	• Similar to Alternative 3 except Structures 3 and 4 retained. • Structures 3 and 4 already removed.	Construct: $8.6 M Operat: $132 K/yr
7	Alternative 3 with historical preservation of Structure 4 (no longer applicable)	• Similar to Alternative 3 but Structure 4 retained and rehabilitated for pedestrian passage and historical significance • Structure 3 already removed.	Construct: $9.3 M Operat: $126 K/yr

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The Review Team reviewed several documents including the Sverdrup Report, a draft environmental assessment (USFWS 2003), and an environmental impact statement (USFWS 2002) concerning fish passage and water conveyance alternatives for the hatchery. Some of these alternatives include replacing the existing gravity-feed water intake structures with a pumping station further downstream in the immediate vicinity of the hatchery. Although a gravity feed system may be preferred based on its simplicity, the Review Team did not reject the potential desirability of a pumping station as a preferred water intake method because of the advantages it may confer for fish passage and water easement right-a-ways. A pumping station could also reduce substantially the length of Icicle Creek that would potentially be dewatered by hatchery withdrawals. It could also eliminate the need for a water diversion dam and intake structure at the present site (RM 4.5) if pumped water could be supplied directly to the Cascade Orchards Irrigation Company. Consequently, the Review Team concluded that the potential advantages of eliminating the water intake structures at RM 4.5 should be given serious consideration. However, if the biological, environmental, ecological, cultural, and legal concerns can be addressed via a gravity flow water intake system, then the Review Team endorses that method due to increased reliability and decreased operational costs. **Regardless of which alternative is selected, replacement of the existing water delivery system needs to occur as soon as possible to avoid a catastrophic failure.**

Immediate Recommendations

Recommendation LE7a: Develop an emergency fish rearing plan in case the current water intake system fails before replacement is complete. This plan should include permitting, purchase of equipment, and provisions for developing a temporary water supply. It should also include emergency fish distribution/release/transfer options, depending on fish life stage. For example, the Review Team concluded that the Entiat NFH should be considered an emergency fish rearing station for the Leavenworth NFH until the pipeline is replaced and during construction. Developing the emergency fish rearing plan should be assigned to a Task Force that includes the Hatchery Evaluation Team.

Recommendation LE7b: Identify and possibly restructure Service representation in the Wenatchee Watershed Planning Process to expedite discussions with other Icicle Creek righted water users regarding potential modification to water withdrawal locations, sharing of water withdrawal and delivery systems, and overall infrastructure modifications and potential relocations. Assemble a task team that includes the Mid-Columbia Fisheries Resource Office, Leavenworth NFH, FWS Regional Office Engineering staff, and Regional Office Line Supervisors.

Recommendation LE7c: Develop a long-term plan to address the potential future need to disinfect Icicle Creek intake water because of increased fish passage and abundance upstream of the new water intake. This need is independent of the future location or type of intake structure constructed. Disinfection of effluent water may also be a future need to meet evolving NPDES standards.

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Guidelines for Fish Passage and a New Water Intake at the Leavenworth NFH

For the purpose of developing specific infrastructure recommendations, the Review Team agreed to use the "form follows function" paradigm to propose three generalized alternatives that combine a fish passage alternative and a water intake alternative as identified in the Sverdrup Report. During these discussions, the Review Team focused on the biological, environmental, ecological, socioeconomic and cultural concerns that need to be corrected or maintained, but with the intent of relying on design and engineering experts to "fine tune" the relative merits of those alternatives.

The Review Team first identified the following 10 guidelines as criteria for improving fish passage, maintaining instream flows in Icicle Creek, and providing surface water intake to the hatchery.

1. Address the failing water intake for the hatchery as soon as possible.
2. Reduce the number of fish passage impediments in Icicle Creek, if possible. Three structures associated with the Leavenworth NFH currently exist within Icicle Creek (water intake diversion dam, Structure 2 and headgate, Structure 5). Reducing the number of in-stream structures should be a high priority criterion for selecting a specific alternative.
3. Provide a physical mechanism to preclude hatchery-origin fish upstream of the future site of the hatchery water intake, but allow natural-origin fish to move upstream with minimal impediments. This is necessary for both natural population management and fish health management at the hatchery.
4. Increase instream flows between the water intake and outflow sites of the hatchery.
5. Reduce instream water temperatures and increase dissolved oxygen levels in Icicle Creek.
6. Minimize the potential for pathogen spread or amplification as a result of modified or new water conveyance infrastructure.
7. Preserve tribal and recreational harvest benefits in Icicle Creek.
8. Improve water conveyance for fish culture and hatchery operations.
9. Explore possibilities with BOR and the two irrigation companies to relocate irrigation water diversions to downstream of the hatchery outflow, including the potential opportunity to directly provide hatchery outflow water to the irrigation companies.
10. Retain and rehabilitate Structure 2 and headgate, including construction of a permanent fishway bypass, to maintain optimal rearing and passage conditions downstream in the natural stream channel, control downstream flooding, recharge the hatchery well field, and potentially provide surface water for a new hatchery intake (see Facility Alternative #2 below). The Review Team concluded that the benefits of maintaining this water control structure outweighed the costs, both in terms of hatchery operations and fish passage. The Review Team further concluded that construction of a permanent fishway around Structure 2 and the headgate was the simplest solution for providing fish passage.

The Review Team then examined seven fish passage and six intake alternatives evaluated in the Sverdrup Report. Some of those alternatives include construction of a new fish sorting and bypass facility at the current site of Structure 5. However, that report did not examine the merits of locating such a facility at Structure 2. The Review Team believes that locating a fish sorting facility at Structure 2, associated with a new permanent bypass fishway, has potential merit that the Service

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should consider (see below). Consequently, as part of its discussions dealing with passage and intake, the Review Team identified the following pros and cons regarding the merits of locating a new fish sorting facility at Structure 2 versus the current site of Structure 5. These perspectives are presented here without providing a specific recommendation, the decision for which would need to be made in combination with the specific fish passage and water intake alternatives that are selected.

Option 1: Locate a new fish sorting facility at the current site of Structure 2. This option removes the need for a seasonal fish barrier weir at the present site of Structure 5.

Pros

- Allows complete removal of Structure 5, thus reducing the number of fish passage impediments in Icicle Creek and potentially reducing maintenance costs.
- Increases the fishable portion of Icicle Creek on hatchery-origin fish by 1.5 miles of stream.

Cons

- May reduce the ability to meet broodstock collection goals with current adult collection facilities. As a result, this option may require relocation of the adult trapping and holding facility to the Structure 2 site, which could be a contingency plan if insufficient numbers of broodstock are collected with existing facilities. Alternatively, adults retained for broodstock at Structure 2 could be trucked to the existing adult holding ponds.
- Potentially increases security and poaching problems with a fish sorting facility at a more remote site than the current site of Structure 5.
- Changes access and locations of tribal fishery in Icicle Creek.

Option 2: Locate a new fish sorting facility at the current site of Structure 5. This option requires a new, seasonal fish barrier weir to replace Structure 5.

Pros

- Is not expected to decrease the ability to collect broodstock with existing adult collection facilities.
- Preserves tribal fishery at present location.
- Does not increase potential security or poaching problems.
- Allows management and control of fish composition in the natural stream channel (1.5 miles) between the current sites of Structures 2 and 5.

Cons

- Retains two instream structures that need to provide fish passage as opposed to a single structure at the current site of Structure 2.
- Requires maintenance of two structures instead of a single structure, thus increasing maintenance costs relative to Option 1.

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Three Recommended Alternatives for Fish Passage and a New Water Intake

The Review Team did not select a specific alternative. Rather, based on the Sverdrup Report, other documents (e.g. the EIS for the Icicle Creek Restoration Project), and personal communications with staff at the Leavenworth NFH, the Review Team identified **three combinations of water intake and fish passage modifications** that appeared to best satisfy the infrastructure needs of the Leavenworth NFH consistent with the 10 generalized recommendations presented above and the two possible locations for a new fish sorting facility. The three alternatives have the following common features:

- Fish passage is improved by modifying existing instream structures and/or reducing the number of instream structures from the current number of three structures.
- Structure 2 and headgate are retained to manage water flows in the bypass canal and in the natural stream channel downstream.
    - Reduces the risks of flooding downstream, including protection of a new seasonal fish barrier weir at the site of Structure 5, if constructed.
    - Provides surface water for recharging the hatchery wells.
    - Controls instream flows through the natural stream channel for optimizing rearing conditions for fish.
    - Upgrades Structure 2 to include a permanent fishway bypass.
- A new fish sorting facility would be constructed at either Structure 2 or the current site of Structure 5, as described above, thus providing options for excluding hatchery-origin fish and allowing passage of natural-origin fish upstream of the hatchery water intake.
- The ability to supplement instream flows and water temperatures in Icicle Creek with Snow Lake releases would continue, although this need could potentially be reduced if hatchery outflow water could be provided directly for irrigation. All three alternatives encourage the delivery of hatchery outflow water for irrigation and/or the relocation of irrigation withdrawals downstream from the hatchery.

1. Facility Alternative #1: Combines Passage Alternative 3 and Intake Alternative B of the Sverdrup Report (with modification).

Features

- Replaces the existing gravity feed water intake pipeline with a new gravity feed pipeline along existing or alternative route.
- Rehabilitates existing water intake diversion dam at RM 4.5 with a new fish ladder or roughened channel for fish passage.
- Rehabilitates existing water intake structure and replaces intake screens with screens that comply with NOAA Fisheries specifications.
- May include pump-back hatchery outflow water to a point immediately downstream from hatchery intake to maintain minimum instream flows in Icicle Creek if alternative agreements with irrigation companies cannot be reached (e.g. direct pumping of hatchery outflow water for irrigation).

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Pros

- Does not require pumping of intake water for the hatchery.
- Provides the best water quality for intake into the hatchery (e.g. does not require disinfection at this time).
- Increases flows in the dewatered section of Icicle Creek via outflow pump-back.
- Continues to provide irrigation water to Cascade Orchards Irrigation Co. without any functional changes in the current arrangement.
- Provides an option for Cascade Orchards Irrigation Co. to use the outflow water from the pump back line and for the Peshastin-Icicle Irrigation District to partially meet its water right needs, thus potentially reducing substantially direct withdrawals of irrigation water from Icicle Creek which would improve water quality.
- Potentially reduces the number of instream passage impediments from three to two if Structure 5 is removed and the fish sorting facility is constructed at the site of Structure 2.

Cons

- Does not reduce the number of instream structures from the current three structures if a fish sorting facility and a seasonal barrier weir are constructed at the site of Structure 5.
- Requires continued easement of intake pipeline across private property, including disruption of private property during construction to replace the gravity feed pipeline.
- The water intake and screening facility would continue at a remote site.
- May require an outflow pump back system and associated maintenance and operation costs.
- May reduce attractor water from existing ladder and adult holding pond if hatchery outflow water is pumped back immediately below intake or is provided directly to irrigators.
- May reduce instream water quality and fish rearing conditions in Icicle Creek immediately downstream from the current site of the hatchery intake (RM 4.5) relative to Facility Alternatives #2 and #3.

2. Facility Alternative #2: Combines Passage Alternative 3 and Intake Alternative E of the Sverdrup Report (with modification).

Features

- Replaces the existing gravity feed pipeline and hatchery intake with a new gravity feed pipeline immediately upstream of Structure 2, coupled to a new water intake settling pond and pumping station on the hatchery grounds (as described in the Sverdrup Report).
- May include pump-back hatchery outflow water to a point immediately downstream from new hatchery intake at Structure 2 to maintain minimum instream flows in Icicle Creek if alternative agreements with irrigation companies for maintaining instream flows cannot be reached (e.g. direct pumping of hatchery outflow water for irrigation).
- Transfers responsibility of current water intake diversion dam and intake screens to the Cascades Orchards Irrigation Company. Alternatively, the existing diversion dam and

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water intake structures at RM 4.5 can be removed completely if hatchery outflow water can be provided directly to the irrigation company.

Pros

- Potentially the only alternative that results in a single, instream structure (located at Structure 2) requiring fish passage if hatchery outflow water can be provided directly for irrigation and the new fish sorting facility is located at Structure 2 (e.g. as part of a new, permanent bypass fishway).
- Does not require water line easements and new construction of intake structures on private property.
- Creates the opportunity to completely restore natural instream flows in Icicle Creek upstream of Structure 2 if hatchery outflow water can be provided directly to irrigators and/or water withdrawals for irrigation are relocated downstream of hatchery outflow.
- Increases flows in the natural stream channel between Structures 2 and 5 via the outflow water pump-back system.
- Reduces the outflow pumping head relative to Alternative 1 and reduces the intake pumping head relative to Alternative 3.

Cons

- Requires modification of the existing agreement with Cascade Orchards Irrigation Co.
- Hatchery intake water quality may be reduced relative to Alternative 1.
- Requires pumping intake water.
- The intake and screening facility would continue at a remote site, although substantially less remote than the current location.
- May require an outflow pump back system and associated maintenance and operation costs.
- May reduce attractor water from existing ladder and adult holding pond if hatchery outflow water is pumped back immediately below intake or is provided directly to irrigators.
- May reduce instream fish rearing conditions in the natural stream channel between Structures 2 and 5.

3. Facility Alternative #3: Combines Passage Alternative 3 and Intake Alternative F of the Sverdrup Report (with modification).

Features

- Replaces the existing gravity feed pipeline and hatchery intake with a new water intake and pumping station immediately upstream of a new, seasonal fish weir at the current site of Structure 5 (as described in the Sverdrup Report).
- Transfers responsibility of existing water intake diversion dam and intake screens to the Cascades Orchards Irrigation Company. Alternatively, the existing diversion dam and

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water intake structures at RM 4.5 can be removed completely if hatchery outflow water can be provided directly to the irrigation company.

- New fish sorting facility would be constructed at the current site of Structure 5.

Pros

- Eliminates the need for instream structures at current site of the hatchery water intake (RM 4.5) if hatchery outflow water can be provided directly for irrigation.
- Does not require water line easements and new construction of intake structures on private property.
- Creates the opportunity to completely restore natural instream flows in Icicle Creek upstream of Structure 2 if hatchery outflow water can be provided directly to irrigators and/or water withdrawals for irrigation are relocated downstream of hatchery outflow.
- Pump back of hatchery outflow water is not necessary to maintain instream flows that would otherwise be reduced due to hatchery withdrawals.

Cons

- Requires modification of existing agreement with the Cascade Orchards Irrigation Co.
- Hatchery intake water quality may be reduced relative to Alternatives 1 and 2.
- Requires pumping intake water.
- Requires the presence of a seasonal fish barrier weir at the present site of Structure 5 and removes the option of potentially locating the fish sorting facility at Structure 2.

Overall, the Review Team saw considerable merit in relocating the water intake structure downstream from the current site to either Structure 2 or Structure 5, although such a change would require pumping of hatchery intake water. However, the degree to which intake water quality would be reduced by relocating the intake structure downstream was not clear. We also anticipate that implementation of a specific alternative would be influenced by engineering feasibility and construction costs, areas that the Review Team lacks specific expertise.

Research, Monitoring, and Accountability

Issue LE8: Incidental take of ESA-listed fish in terminal fisheries is not adequately quantified.

Fisheries on Leavenworth NFH spring Chinook must be managed so that incidental take of listed fish species remains below levels identified in ESA permits and biological opinions. Accurate information on incidental take is required, so that harvest regimes can be modified for compliance, if necessary.

Recommendation LE8: Establish a program for monitoring all elements of the Icicle Creek terminal fishery, both to determine the amount of incidental take of ESA-listed fish and to better quantify the harvest benefits derived from those fisheries.

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Education and Outreach

Issue LE9: Leavenworth NFH has a well-developed education/outreach component. *The education and outreach program at Leavenworth NFH has been innovative and aggressive in providing benefits to the local community and the region. This program serves as a model within the National Fish Hatchery System.*

Recommendation LE9: Continue support for existing outreach and education efforts, and find ways to evaluate the effectiveness of these efforts.

Issue 10: Recreational anglers have some difficulty identifying ESA-listed bull trout. *Selective fisheries rely on the ability of the angler to identify protected species, such as bull trout, and to release them in such a way as to ensure they are unlikely to be harmed.*

Recommendation LE10: Expand efforts to educate the public on identifying and protecting bull trout.

Alternatives to Current Program[30]

The Review Team considered the benefits and risks of the existing spring Chinook program at the Leavenworth NFH 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 a recommended alternative (or alternatives).

**Alternative 1: Current program with recommendations*

Maintain existing spring Chinook segregated–harvest program with full implementation of all recommended changes, including reducing rearing densities not to exceed a 0.15 density index (approximately 1.2M smolts or 20% reduction).

Pros

- Maintains tribal and recreational fishery benefits in Icicle Creek.
- More efficient use of water and facilities; more cost efficient.
- Improved fish health.
- Creates increased margin of safety with respect to low summer flows and potential failure of water intake pipe.
- Reduces number of hatchery-origin strays upstream of Tumwater Canyon.

[30] *Alternatives with asterisks (*) were favored by the Review Team over alternatives without asterisks.*

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- Reduces suspended solids, etc. in effluents.

Cons

- May reduce number of harvested fish in low return years.
- May reduce number of surplus fish available in years of high return that are provided to tribes, food banks, etc. However, this reduction is expected to be less than 25% because of compensatory increases in survival of individual fish.

Alternative 2: Integrated spring Chinook harvest-conservation program

Phase out existing spring Chinook segregated–harvest program (over five years) and replace with an integrated harvest-conservation program (1.2M smolts) derived from ESA-listed Chiwawa River hatchery-origin spring Chinook and natural-origin spring Chinook trapped at Tumwater Dam. This alternative program would be modeled after the spring Chinook program at the Warm Springs NFH where a sliding scale would be developed for annually including a variable number of natural-origin adults in the broodstock depending on the size of the run and the number of natural-origin adults available for broodstock.

Pros

- Would increase the total number of ESA-listed spring Chinook adults returning to the Wenatchee River, potentially by a factor of three (3x), thus reducing demographic risks of extinction. (In recent years, more than 70% of all adult spring Chinook returning to the Wenatchee River are from the Leavenworth NFH.)
- Reduces stray risks to ESA-listed natural populations in the upper Wenatchee River watershed.
- Would comply with NOAA Fisheries and WDFW recommendations regarding phase-out of the current unlisted stock at the Leavenworth NFH.
- ESU fish would be readily available for additional supplementation in the upper basin if necessary to meet conservation objectives.

Cons

- The number of natural-origin spring Chinook returning to the upper Wenatchee River watershed may be insufficient to support two genetically integrated hatchery broodstocks: one designed to support conservation objectives (Chiwawa River) and the other to support harvest objectives (Icicle Creek).
- Requires annual trapping of natural-origin spring Chinook at Tumwater Dam to maintain genetic integration of the Leavenworth NFH broodstock with ESA listed spring Chinook salmon in the upper Wenatchee River.
- Inclusion of wild fish in the broodstock and harvest of their hatchery-produced offspring would represent a direct take of endangered fish under the ESA.

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- Special permits from NOAA Fisheries may be needed to allow a direct harvest (take) on hatchery-origin fish that are listed as endangered, particularly when natural-origin fish are included in the broodstock and the harvest is directed at their offspring (e.g. in Icicle Creek).

- May reduce harvest of spring Chinook in Icicle Creek.

**Alternative 3: Integrated "stepping stone" spring Chinook harvest program*

Phase out existing spring Chinook segregated–harvest program (over five years) and replace with a new "stepping stone" broodstock, harvest program that is genetically integrated with the Chiwawa River hatchery stock or other upper Wenatchee River spring Chinook hatchery broodstocks that meet genetic integration guidelines (see following Figure).

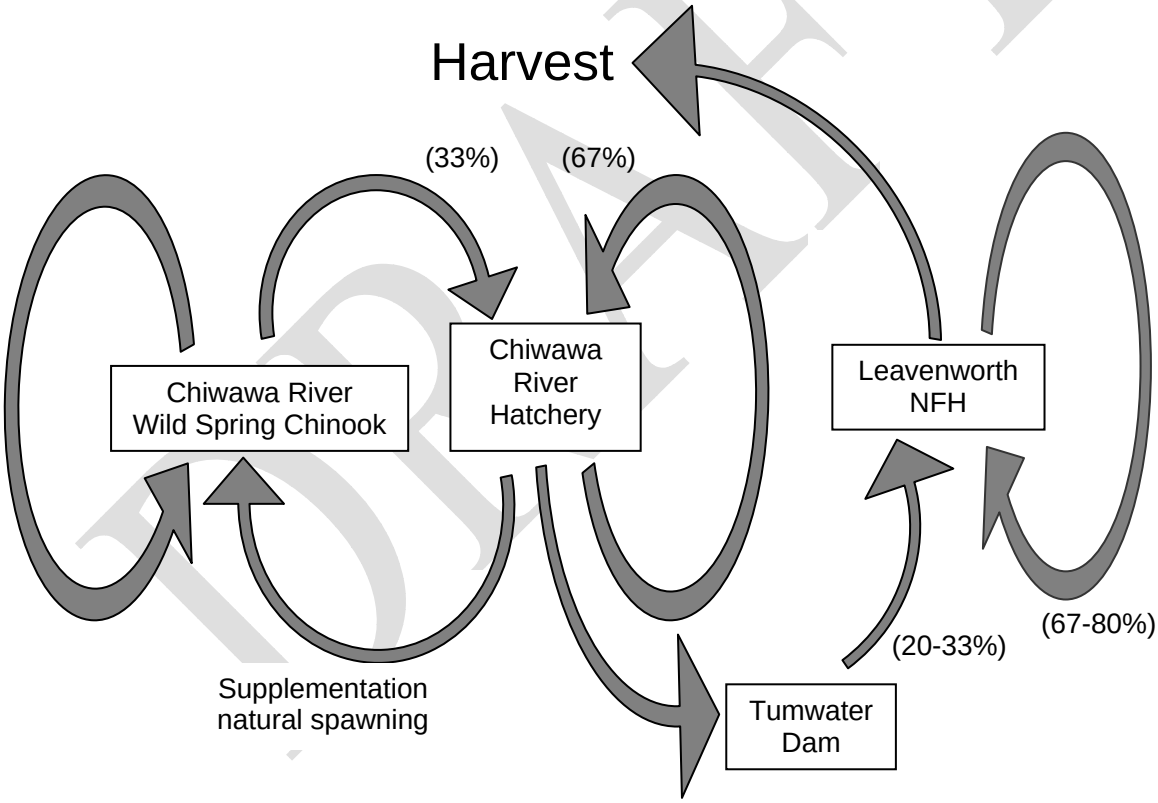

Figure 4. Stepping stone" gene flow diagram for a new Leavenworth NFH broodstock that is integrated genetically with the Chiwawa River hatchery broodstock. The Chiwawa River Hatchery broodstock serves as a genetic "stepping stone" for maintaining gene flow between a naturally spawning population and the Leavenworth NFH broodstock.

Pros

- Achieves all the pros described under Alternative 2 but does not require a direct take on listed, natural-origin adults for broodstock.

- Provides an annual, ongoing outlet for surplus Chiwawa River or other integrated hatchery-origin adults (e.g. Nason Creek) that exceed broodstock and supplementation needs upstream of Tumwater Dam.

- Provides a biological mechanism for reducing genetic straying risks to ESA listed natural populations while maintaining tribal and recreational fisheries in Icicle Creek.

- Provides a scientifically defensible, legal mechanism for NOAA-Fisheries to permit a direct harvest (take) on listed, hatchery-origin spring Chinook in Icicle Creek with little harvest risk to ESA-listed Wenatchee River spring Chinook.

Cons

- Special permits from NOAA Fisheries may be needed to allow a direct harvest (take) on hatchery-origin fish that are listed as endangered under the ESA.

- Requires annual trapping of Chiwawa River hatchery-origin spring Chinook at Tumwater Dam to maintain genetic integration of the Leavenworth NFH broodstock with an integrated, ESA-listed upper Wenatchee River hatchery broodstock.

Alternative 4: Segregated summer Chinook harvest program

Phase out the existing spring Chinook segregated-harvest program (over five years) and replace with a summer Chinook segregated-harvest program developed from the existing Wenatchee River summer Chinook broodstock program.

Pros

- Broodstock is readily available at Dryden Dam.

- Increases overall harvest opportunities outside of Icicle Creek because summer Chinook are not listed, thus potentially increasing harvest-mitigation benefits.

- Eliminates or significantly reduces straying risks to endangered spring Chinook in the upper Wenatchee River basin as currently imposed by the current segregated hatchery program.

Cons

- Eliminates the highly-valued spring Chinook fishery in Icicle Creek.

- May eliminate harvest opportunities for Chinook salmon in Icicle Creek because of a thermal barrier that may preclude upstream ascent by summer Chinook adults during low summer flows.

- May require annual trapping of broodstock at Dryden Dam if hatchery-origin adults are thermally precluded from entering Icicle Creek.

- Moves harvest downstream of Icicle Creek and outside the Columbia River basin because the majority of hatchery-origin summer Chinook from the Wenatchee River are currently harvested in Alaska and Canadian commercial fisheries.

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- May substantially reduce Tribal terminal fisheries on Chinook salmon in the Wenatchee River watershed.

- Provides no conservation or demographic benefit to endangered spring Chinook, or other listed species, other than reducing straying risks.

**Alternative 5: Combination of Alternatives 3 and 4*

Phase out existing spring Chinook segregated-harvest program (over five years) and replace with a variable-production spring Chinook harvest program (Alternative 3, stepping stone model) and a variable-production segregated summer Chinook harvest program. Alternative 5 combines some of the pros and cons of Alternatives 3 and 4 but varies the size of each program annually depending on the number of Chiwawa River hatchery-origin spring Chinook that would be available for the Leavenworth NFH broodstock.

Pros

- Would increase the total number of ESA-listed spring Chinook adults returning to the Wenatchee River.

- Reduces stray risks to ESA-listed natural populations in the upper Wenatchee River watershed.

- Complies with NOAA Fisheries and WDFW recommendations regarding phase-out of the current unlisted stock at the Leavenworth NFH

- ESU hatchery-origin fish might be available for additional supplementation in the upper basin if necessary to meet conservation objectives.

- Summer Chinook broodstock are readily available at Dryden Dam.

- Increases harvest opportunities outside of Icicle Creek because summer Chinook are not listed, thus potentially increasing harvest-mitigation benefits.

Cons

- Harvest on spring Chinook in Icicle Creek would be a direct take under ESA and may require special permits from NMFS to allow a terminal harvest.

- May substantially reduce harvest opportunities for Chinook salmon in Icicle Creek because of a thermal barrier that may preclude upstream ascent by adults during low summer flows.

- May require continue trapping of summer Chinook broodstock at Dryden Dam if hatchery-origin adults are thermally precluded from entering Icicle Creek and volunteering into the hatchery.

- Substantially reduces the highly-valued spring Chinook fishery in Icicle Creek.

- Would substantially reduce terminal fisheries in the Wenatchee River basin because the majority of hatchery-origin summer Chinook from the Wenatchee River are currently harvested in Alaska and Canadian commercial fisheries.

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- The variable number of adult fish spawned for broodstock each year and the variable numbers of reared fish of each stock would complicate hatchery management and may create facility conflicts for space between the two programs.

- Maintaining genetic separation of spring and summer Chinook, both in the hatchery and in Icicle Creek, may be problematic, thus increasing potential genetic risks to ESA-listed spring Chinook relative to other alternatives.

Alternative 6: Integrated coho restoration and harvest program

Phase out or reduce the existing segregated-harvest spring Chinook program and replace with an integrated coho restoration program consistent with the Yakama Nation's Master Plan.

Pros

- Reduces stray risks to endangered spring Chinook in the upper Wenatchee River.

- Would comply, at least partially, with NOAA Fisheries and WDFW recommendations to phase-out the current unlisted stock at the Leavenworth NFH.

- May accelerate restoration of naturally-spawning coho populations in the Wenatchee River.

- Provides late-summer, early-fall fisheries on coho in Icicle Creek and potentially downstream in the mainstem Wenatchee River.

- Would eliminate need for coho rearing space at lower Columbia River hatcheries.

Cons

- Coho salmon was not identified as a "mitigation" species under the federal acts that authorized mitigation for fish losses imposed by Grand Coulee Dam.

- Substantially reduces or eliminates highly-valued spring Chinook fishery in Icicle Creek.

- Substitutes a highly-valued fishery with a lower-valued one.

- Rearing capacity for coho reintroduction program is currently available at other sites.

Alternative 7: Decommission hatchery

Terminate existing spring Chinook segregated-harvest program and decommission hatchery in favor of alternative mitigation strategies such as habitat restoration, removal or bypass of barriers that impede upstream migration of anadromous fishes in Icicle Creek, and construction of a new hatchery elsewhere (e.g., Okanogan River, base of Chief Joseph Dam, etc.). This alternative could include partial removal or bypass of the boulder field at RM 5.6 to provide endangered spring Chinook, threatened steelhead, and fluvial threatened bull trout with ready access to upper Icicle Creek.

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Pros

- Would provide conservation benefits to three ESA-listed species in Icicle Creek.
- If access to upper Icicle Creek is provided, then an additional naturally spawning population of spring Chinook salmon could become established in the Wenatchee River watershed, thus providing additional abundance and spatial diversity towards achieving VSP[31] recovery goals.

Cons

- Eliminates the highly-valued spring Chinook fishery in Icicle Creek.
- Icicle Creek has limited natural production capacity for spring Chinook because of the boulder field at RM 5.6, and the overall capacity and potential productivity of upper Icicle Creek upstream of the boulder field for spring Chinook is unknown.
- Substantially reduces or eliminates social and economic benefits of the Leavenworth NFH to the Leavenworth community at large.
- Potentially increases ecological risks to resident fish species in upper Icicle Creek.
- Alternate hatchery sites are very limited and expensive to develop.

Recommended Alternatives

Immediate recommendation: Implement Alternative 1.

Maintain existing spring Chinook segregated–harvest program with full implementation of recommended changes, including reduced rearing densities and a reduced level of production (approximately 1.2M smolts). Implementation of Alternative 1 includes the following requirements and caveats:

- Completion of infrastructure improvements regarding water conveyances (hatchery water intake, instream passage and flows in Icicle Creek, effluent treatment) should be the first priority before major programmatic changes at the Leavenworth NFH are implemented.
- Differential mark/tagging of Leavenworth NFH fish and other hatchery stocks of spring Chinook in the Wenatchee River is required so that stray Leavenworth NFH fish can be intercepted and removed at Tumwater Dam, thus eliminating or reducing straying risks to ESA listed spring Chinook in the upper Wenatchee River. This differential mark/tagging would be necessary regardless of what stock of spring Chinook is propagated at the Leavenworth NFH.
- Reduce raceway density indices to approximately 0.15 and overall production to approximately 1.2M smolts to reduce risks to fish health and facilitate infrastructure improvements and new construction. Reduced smolt releases also reduces ecological risks to listed spring Chinook via reduced competition.

[31] *Viable Salmonid Population* (McElhaney et al. 2000)

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- Predicted return rates and adult returns based on lowered rearing densities need to be estimated for the Leavenworth NFH based on the results of previously-conducted density studies of spring Chinook in the mid-Columbia region. In general, reduced rearing densities and smolt releases are not expected to significantly reduce adult returns or the number of harvested fish in Icicle Creek because reduced risks to fish health and improved water quality/management are expected to increase smolt-to-adult return rates. Based on previous studies, density indices of 0.15-0.17 maximized adult return yields per raceway.

- Continue to provide facilities for coho reintroduction program consistent with the Yakama Nation's Master Plan.

Goal: Implement Alternative 3.

After the water intake system has been replaced as outlined in the immediate recommendation above, initiate phase out of the existing spring Chinook segregated–harvest program and replace with a new "stepping stone" broodstock that is genetically integrated with the Chiwawa River hatchery stock, or other within-ESU upper Wenatchee River spring Chinook broodstock. Once initiated, the transition to a new broodstock would require 5-10 years depending on the number of upper Wenatchee brood fish available each year and the desire to maintain total smolt releases as current recommended levels. Implementation of Alternative 3 should be given the highest priority but is contingent on the following requirements:

- Demonstrated ability of the Chiwawa River or other upper Wenatchee River hatchery programs to provide a minimum of 250 hatchery-origin adults each year from adults trapped at Tumwater Dam.

- Written guarantees or *Memoranda of Understanding* from NMFS that a terminal harvest in Icicle Creek on ESA-listed spring Chinook from the new Leavenworth NFH broodstock would be permitted under the ESA, with the understanding that those fish were produced explicitly for harvest and not for recovery. This may require designating listed spring Chinook propagated at the Leavenworth NFH as an "experimental population".

- Completion of water infrastructure improvements, particularly water intake, before an ESA-listed broodstock is developed at the Leavenworth NFH.

- A long-term goal would be to assist with recovery of spring Chinook in the mid-Columbia region and implement Alternative 2 at some time in the future when sufficient numbers of natural-origin adults were available to fully integrate the Leavenworth broodstock with one or more naturally-spawning populations in the Wenatchee River watershed.

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IV. Entiat River Watershed[32]

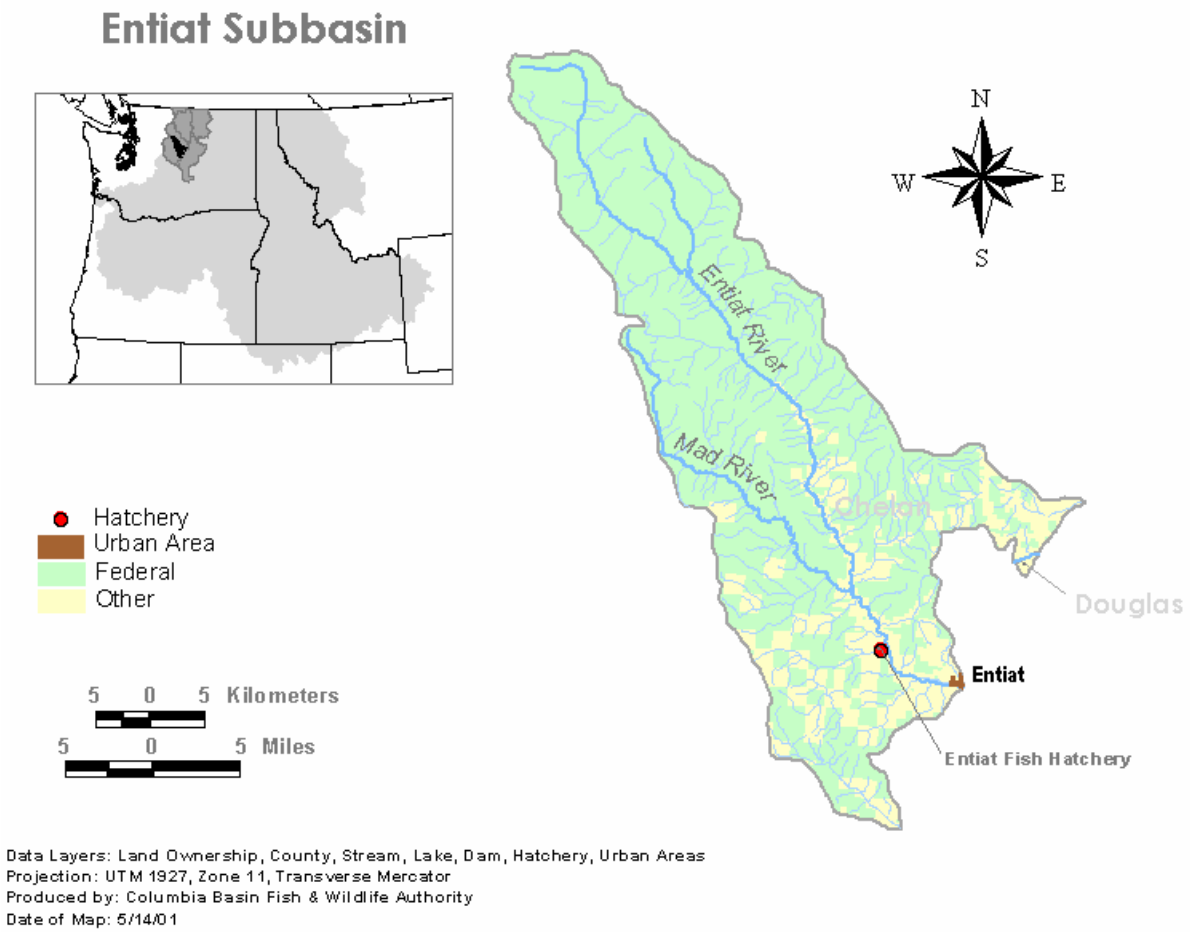

Figure 5. Entiat River Watershed Overview Map

[32] *Primary source documents for information in this section include:*
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Entiat River Overview

Watershed Description

The Entiat River watershed, RM 0.0-53.4, is located in north-central Washington State in Chelan County. It originates in a glaciated basin near the crest of the Cascade Mountains and flows southeasterly, meeting the Columbia River near the town of Entiat, about 20 miles upstream from Wenatchee. The topography is extremely steep and dissected with the highest elevation in the watershed at 9,249 feet (Mt. Furnow) and the lowest elevation at approximately 700 feet at the confluence with the Columbia River (RM 484). Soils are generally highly susceptible to erosion and are unstable. Vegetation ranges from semi-arid shrub steppe in the lower end of the watershed, through temperate forest, to alpine meadows in the upper reaches. The drainage area is about 268,000 acres of which approximately 224,000 acres (84%) are in public ownership, primarily National Forest. There are 1,300 acres of orchard land in the lower valley, much of it classified as prime agricultural land.

Mean annual precipitation in the Entiat watershed, ranges from 90 inches in the moist alpine type higher elevations to less than 10 inches in the arid shrub steppe of the lowest elevations. Most winter precipitation falls as snow; however rain is not unusual. During the summer months, thunderstorms frequently develop over the mountains, resulting in heavy downpours for brief periods which occasionally result in flash floods at the mouths of narrow canyons. During the summer, mean temperatures in the lower watershed usually range between 60 and 70 degrees, decreasing to the 50's at higher elevations.

Fisheries

Many species of anadromous and non-anadromous fish utilize the aquatic habitat of the Entiat and Mad River watersheds. Some fish found in the subbasin are currently listed under the ESA; spring Chinook *(Oncorhynchus tshawytscha)* are listed as endangered, summer steelhead *(O. mykiss),* and bull trout *(Salvelinus confluentus)* as threatened. Other species present include: summer Chinook *(O. tshawytscha)*, sockeye *(O. nerka)*, coho *(O. kisutch)*, Westslope cutthroat trout *(O. clarki lewisi)*, Redband trout *(O. mykiss)*, brook trout *(S. fontinalis)*, and mountain whitefish *(Prosopium williamsoni)*.

Terminal fisheries in the Entiat River watershed are currently limited to recreational fishing for mountain whitefish (December 1-March 31) and resident trout upstream of Entiat Falls (RM 29.2, limit of anadromy).

Conservation

Sustainable natural reproduction of trout, salmon, and steelhead is an important fisheries management goal in this watershed. The current spring Chinook program at Entiat NFH is the only species stocked in the basin and is not listed under the ESA. Steelhead and bull trout are listed as threatened, and the natural spawning stock of spring Chinook as endangered. Some fishery managers consider the Entiat as a "reference" stream, where supplementation programs in other basins can be compared to a non-stocked stream. Currently, bull trout found in the mainstem Entiat and Mad River are considered to be

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two distinct local populations. The Entiat River bull trout stock is listed as native with wild reproduction; however, stock status is listed as unknown.

Habitat

Native Americans used the Entiat valley for hunting and gathering prior to its use by trappers and settlers of European origin. Trapping in the 1880's was the first non-native American activity to occur in the Entiat watershed. Sheep grazing also began about 1880, and was one of the most extensive earlier uses of the valley.

Between 1885 and 1910, gold and other minerals were prospected for and mined in the valley, and commercial pumice was mined up until 1956. Logging within the valley has had a rich and varied history. In 1892, the first log mill was established near the mouth of the Entiat River. Logging began to increase early in the twentieth century in response to home construction and the apple box industry. Several log-holding dams, associated with sawmills, were constructed in the lower watershed, until 1948 when floods washed-out the last remaining dam. The last operating mill in the valley closed in 1979. Fruit production has always been very important to the local economy, and continues in that capacity to present day.

The Entiat valley has been shaped in large part by a long history of natural disturbance events such as wildfire, flooding, earthquakes, landslides, glaciation, and volcanic eruptions. Wildfire and flooding are very common events in the subbasin, as evidenced by the past 50 years; wildfires in 1970, 1976, 1988, and in 1994 affected over 60% of the subbasin. The most significant flood recorded occurred in 1948. Other significant floods occurred in 1972, twice in 1977, and in 1989 following wildfire events.

The Entiat River can be divided into three analysis zones; Transport, Transitional, and Depositional. These analysis zones serve to characterize sub-watersheds and evaluate ecosystem conditions within the Entiat watershed. They can also be used to define salmonid distribution as it relates to geology and hydrology.

Transport Zone (Entiat Falls and above): No anadromous fish utilize this zone as Entiat Falls is a complete migration barrier. Rainbow and cutthroat trout dominate this zone. Stream channels are mostly within wilderness or roadless areas and have not been greatly impacted by past management. The current condition is believed to describe the past condition.

Transitional Zone (McCrea Creek to Entiat Falls): Historic and current management influences have been significant. The current condition of aquatic habitat has been modified from historic, with a 30 to 60% loss of pools in the mainstem. The trend in habitat conditions is variable and uncertain. The fair to excellent quality habitat in this zone is utilized primarily by bull trout and other resident fishes, with spring Chinook and steelhead limited to the lower reaches by natural barrier falls.

Depositional Zone (Mouth to McCrea Creek): This zone contains the principle spawning/rearing habitat for anadromous fishes in the Entiat watershed. Most (90%) of anadromous spawning/rearing habitat lies outside the Forest boundary, on private land. The zone is utilized by spring Chinook, late-run Chinook, sockeye salmon, summer steelhead, bull trout and other resident fishes. The trend in habitat conditions is variable and uncertain, partially due to the frequency and extent of recent wildfires which burned over 60% of the watershed. The lower 10 to 15 miles of the Entiat River was channelized to aid in flood control, leaving few resting areas for both adult and juvenile salmon.

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Current Status of Salmonid Stocks

Fishery co-managers have identified six principal salmonid stocks in the Entiat River watershed. ESA listed stocks identified by the Interior Columbia Technical Recovery Team (ICTRT) are indicated by asterisks (*) in the list below.

- Entiat NFH spring Chinook (segregated hatchery)
- Entiat River spring Chinook (natural)*
- Entiat River summer Chinook (natural)
- Entiat River summer steelhead (natural)*
- Entiat River bull trout (natural)
- Entiat River westslope cutthroat trout (natural)

The following tables summarize the current and future status of those stocks, as identified by the co-managers. More detailed assessments associated with these tables are presented in Appendix A (*AHA* analyses). Qualitative ratings of *biological significance* and *population viability* in the tables are based on the criteria described by the HSRG (Mobrand et al. 2005) and elaborated more fully in Appendix A. More detailed analyses of population viability for ESA listed stocks are currently under development by NOAA Fisheries.

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Table 16. Entiat River hatchery spring Chinook (Entiat NFH)

Stock Goals/Management Premises	
ESA Status	*Not listed*.
Biological Significance	*Low*. An introduced hatchery stock, primarily of Carson NFH ancestry.
Population Viability	*Medium*. The hatchery averaged ≈5.5 recruits per spawner, BY1990–99
Habitat	Because of its small size (relative to other watersheds in the Upper Columbia) and natural barriers, the Entiat watershed offers limited numbers of suitable habitat areas for spring Chinook. The Entiat River has an estimated capacity to support ≈350 adult spawners with a maximum productivity of ≈2.0 recruits per spawner. The long-range goal is to increase these parameters to >550 and >2.3, respectively, via habitat improvements.
Harvest	The program provides very little direct harvest Private land downstream from hatchery limits or precludes harvest opportunities.. Incidental harvests occur in the Columbia River gill net fishery (≈100 fish/year) and the Columbia River sport fishery (≈80 fish/year) (1999-2003). An average of 1,235 surplus adults/year returning to the hatchery were provided to the Columbia River tribes from 1999-2003.
Hatchery Program	
Facilities	Entiat NFH
Type	Segregated.
Federal Authorization	Grand Coulee Dam Project , 49 Statue 1028, as part of the Rivers and Harbors Act in 1935; Columbia Basin Project Act, 57 Statue 14, in 1943; Fish and Wildlife Coordination Act, 60 Statue 1080, in 1946.
Primary Purpose	Harvest.
Secondary Purposes	None.
Broodstock Origin(s)	Mixed. Carson NFH (1975-81), Little White Salmon NFH (1976, 78, 79, 81), Cowlitz River (1974), Leavenworth NFH (1979-81, 94), Rock Island Dam (1942,44). Adults are obtained from returnees back to the Entiat NFH.

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Table 17. Entiat River spring Chinook

Stock Goals/Management Premises	
ESA Status	*Endangered*.
Biological Significance	*Medium*. This stock does not have any unique characteristics or attributes that distinguish it from stocks in the Wenatchee and Methow Rivers. Recent studies suggest significant genetic influence from Entiat NFH spring Chinook. Approximately one-third of natural spawners have been composed of hatchery-origin spring Chinook in recent years.
Population Viability	*Low*. The number of natural-origin adults in the Entiat River ranged from 18 to 1,197 between 1960 and 2003 with a 12-year geometric mean ranging from 90 to 490 adults. The 12-year geometric mean at the time of listing (1999) was 92 spawners. During the period 1960–99, recruits per spawner (R/S) for spring Chinook in the Entiat watershed ranged from 0.16–4.72 with a 12-year geometric mean ranging from 0.41–1.12. The 12-year geometric mean at the time of listing (1999) was 0.76. The Interior Columbia TRT concluded that spring Chinook in the Entiat River have a high risk of extinction over the next 100 years. Two factors contributed to this high-risk rating and both were related to the Entiat National Fish Hatchery propagating an introduced stock of spring Chinook. The 12-year geometric mean recovery-delisting goal is 500 natural-origin adults per year with a mean R/S > 1.4. (data from Draft Upper Columbia Recovery Plan, Interior Columbia TRT)
Habitat	Same as description for Entiat River hatchery spring Chinook.
Harvest	A few fish are estimated to be harvested incidentally in downstream, mixed stock fisheries.

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Table 18. Entiat River summer Chinook

Stock Goals/Management Premises	
ESA Status	*Not listed*.
Biological Significance	*Low*. Uncertainties exist regarding the historical presence of summer Chinook in the Entiat River. Approximately 30% of the natural spawners in the watershed are hatchery-origin strays from the Turtle Rock and Wells Dam hatchery programs on the mainstem Columbia River. Whether natural-origin fish represent the remnants of a historical population or are the descendants of hatchery-origin adults is unknown.
Population Viability	*Low to medium*? The large presence of hatchery-origin strays from mainstem Columbia River hatchery programs confounds the viability of this population.
Habitat	*Low to medium.*
Harvest	*Medium* in mixed stock fisheries in Columbia River. No terminal harvest.

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Table 19. Entiat River summer steelhead

Stock Goals/Management Premises	
ESA Status	*Threatened*. Upgraded from endangered in 2006.
Biological Significance	*Medium*. This stock has been proposed by the co-managers as a reference, population for comparison to supplemented streams.
Population Viability	*Low*. Between 1967 and 2003, escapement of naturally produced steelhead in the Entiat watershed ranged from 9–366 adults with a 12-year geometric mean ranging from 24–118 adults. Estimated recruits per spawner are the same as those described for Wenatchee River steelhead because run reconstructions are based on adult counts at Priest Rapids Dam. The Interior Columbia TRT has concluded that Entiat River steelhead have a moderate to high risk of extinction over the next 100 years. The 12-year geometric mean recovery-delisting goal is 500 natural-origin adults per year with a mean R/S > 1.2. (Upper Columbia Recovery Plan)
Habitat	The Entiat River watershed offers limited numbers of suitable habitat patches for steelhead because of its comparatively small size, relative to other watersheds in the mid-Columbia region, and natural barriers. (TBD)
Harvest	Incidental mixed stock fisheries in Columbia River. No terminal harvest.

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Table 20. Entiat River bull trout

Stock Goals/Management Premises	
ESA Status	*Threatened*.
Biological Significance	*High*. (APRE)
Population Viability	*Medium* (APRE). The U.S. Forest Service (USFS) has conducted spawning surveys for bull trout redd in the Entiat River watershed since 1989, primarily in the Mad River. Redd counts have ranged from 10 to 52 redds in the Mad River and 0 to 46 redds in the Entiat River, which translate into 20 to 274 adults based on 2.0 to 2.8 fish per redd. A large increase in numbers of redds counted in the Entiat River in 2004 resulted from increasing the survey area and changes in survey effort. Nevertheless, numbers of bull trout redds in the Entiat watershed have increased since they were first counted in 1989, suggesting an increasing trend in viability. The 12-year geometric mean recovery-delisting goal is 298-417 natural-origin adults based on redd count expansions.
Habitat	Bull trout occur in both the Mad and Entiat rivers. Natural falls currently restrict the distribution of migratory bull trout in the Entiat watershed. It is assumed that most of the bull trout in the Entiat watershed are fluvial fish, with perhaps a resident form in the upper reaches of the Mad River drainage. Recent studies suggest that bull trout from this core area use the mainstem Columbia River for overwintering habitat and foraging. An AHA dataset with estimated EDT productivity and capacity parameters has not been developed.
Harvest	Incidental catch and release in recreational fisheries.

Table 21. Entiat River westslope cutthroat trout

Stock Goals/Management Premises	
ESA Status	*Not listed*. Special concern.
Biological Significance	*High.* (APRE)
Population Viability	*Medium* (APRE)
Habitat	*.Low to Medium*
Harvest	Minor..

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Other Species of Concern

Table 22. Expected fish species present in Entiat River[33]

Salmonid Species	Scientific Name	Non-salmonid Species	Scientific Name
Spring Chinook salmon	*Oncorhynchus tshawytscha*	Longnose dace	*Rhinichthys cataractae*
Summer Chinook salmon	*O. tshawytscha*	Mottled sculpin	*Cottus bairdi*
Sockeye salmon*	*O. nerka*	Largescale sucker	*Catostomus macrocheilus*
Coho salmon*	*O. kisutch*	Bridgelip sucker	*C. columbianus*
Summer steelhead	*O. mykiss*	Pacific lamprey	*Lampetra tridentata*
Westslope cutthroat trout	*O. clarki lewisi*	Northern pikeminnow	*Ptychocheilus oregonensis*
Redband trout	*O. mykiss gairdneri*	Redside shiner	*Richardsonius balteatus*
Bull trout	*Salvelinus confluentus*		
Brook trout	*S. fontinalis*		
Mountain whitefish	*Prosopium williamsoni*		

*Sockeye and coho salmon represent occasional strays that enter the Entiat River during their upstream migration to the Okanogan and Methow rivers, respectively.

Other species of concern found in the Entiat River include sockeye salmon (*O. nerka*), resident rainbow (redband) trout (*O. mykiss*), mountain whitefish (*Prosopium williamsoni*), Pacific lamprey (*Lampetra tridentata*) and various sucker species (*Catostomus* sp.). Effects on these other species of the Entiat NFH program are unknown, but thought to be minimal. Predation and possible disease transmittance within the facility is a problem caused by Great Blue Herons (*Ardea herodias),* kingfishers (*Ceryle alcyon)* and mink (*Mustela vison).*

Salmon and Steelhead Hatcheries in the Watershed and Vicinity[34]

Entiat National Fish Hatchery (U.S. Fish and Wildlife Service)

The Entiat NFH is located at RM 6.3 of the Entiat River, a tributary to the Columbia River at RM 485 between Wenatchee and Chelan, Washington. Rearing facilities include 43 starter tanks, 30 raceways and two adult holding ponds. Water sources for the hatchery are the Entiat River, Packwood Spring, and six wells. However, surface river water is no longer used because of the presence of a *Myxosporidian* parasite. No barrier weir is present on the Entiat River to facilitate capture of broodstock or preclude hatchery-origin adults from migrating upstream of the hatchery into natural spawning areas. Adult fish returning to the Entiat NFH must migrate upstream a total of 491 miles and must pass over eight Columbia River hydropower dams. The Entiat NFH supports a spring Chinook program. It also provides facilities for the coho reintroduction program of the Yakama Nation.

[33] *From ENFH-HGMP page 17*
[34] *See Figure 3.*

Chelan State Fish Hatchery

Chelan Hatchery is located on the Columbia River above Rocky Reach Dam near Chelan Falls, Washington. The hatchery is used for incubation and early rearing of summer steelhead, rainbow trout, and kokanee (nonanadromous *O. nerka*). The Chelan facility includes one adult holding pond, 16 concrete raceways, two portable vinyl lined raceways, eight intermediate raceways, four spawning channels, and incubation facilities. Chelan Hatchery began operation in 1965 as a mitigation for Rocky Reach Dam.

Turtle Rock State Fish Hatchery (Washington Department of Fish and Wildlife)

The Turtle Rock State Hatchery is located along the Columbia River, two miles upstream from Rocky Reach Dam. The hatchery includes the old Rocky Reach Hatchery, located just downstream from Rocky Reach Dam. The Turtle Rock Hatchery includes one rearing pond, 8 vinyl-lined raceways, and incubation facilities. The Turtle Rock Hatchery is operated as mitigation facilities for the fishery impacts caused by the construction and operation of Rocky Reach Dam. The hatchery is used for incubation, rearing, and release of summer Chinook and the rearing of steelhead.

Adult broodstock for the summer Chinook program are trapped at Wells Dam. The progeny are reared initially at Eastbank Hatchery and Rocky Reach Hatchery prior to final rearing and release from the Turtle Rock Hatchery. The Turtle Rock Hatchery also provides rearing space for the Wenatchee River steelhead program

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Entiat NFH Spring Chinook

Operator: U.S. Fish and Wildlife Service
Cooperator: None

Summary of Current Program

Goals

- ***Harvest goal:*** No numeric harvest goal has been established. Adult returns to the Entiat NFH for the past 25 years have averaged slightly greater than 600 adults, which prohibits any significant harvest. The long term goal of the program is to provide fish for tribal, commercial, and recreational fisheries in the Columbia and Entiat Rivers, and to meet tribal trust responsibilities, as mitigation for Grand Coulee Dam.

- ***Broodstock goal:*** Trap and spawn 300 hatchery-origin adults to yield 400,000 yearling smolts for on-station release into the Entiat River. In the past, up to 100 additional adults were secured for transfer and experimental studies in Omak Creek, Okanogan County.

- ***Conservation goal:*** The program has no direct conservation goals. The hatchery stock propagated by the Entiat NFH is not included in the ESA-listed Upper Columbia River Spring Chinook ESU. The program goal is to minimize impacts to ESA listed and other native species, their habitat, and the environment.

- ***Escapement goal, natural-origin adults:*** No numeric escapement goal of natural-origin adults upstream of the hatchery has been established. No barrier weir exists on the Entiat River to trap broodstock, and all upstream migrating fish can freely migrate upstream, including hatchery-origin spring Chinook that do not volitionally swim up the hatchery ladder.

- ***Education/outreach/cultural goal:*** Provide information and education about the Service programs and Entiat NFH to internal and external audiences. Develop forums for public participation (or input) into Entiat NFH issues.

Objectives

- Trap and spawn 300 hatchery-origin adults for broodstock.

- Rear and release 400,000 yearling spring Chinook smolts at 18-20 fish/pound directly from the hatchery into the Entiat River annually.

- Achieve a minimum 0.1% smolt to adult return back to the hatchery.

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Program Description

The Entiat NFH spring Chinook salmon program is intended to function as a mitigation program and the Entiat River stock utilized by Entiat NFH is not included in the ESA-listed UCR spring Chinook salmon ESU. The Entiat NFH began operations in 1942. The original brood stock used to start the program were adults trapped at Rock Island Dam (commingled and destined for the upper Columbia Basin). No spring Chinook releases were made from the facility from 1945 to 1975. Spring Chinook production resumed in 1974, with releases in 1976. Since 1974, eggs sources and subsequent yearling releases have been from several lower river sources as well as from Leavenworth and Winthrop NFHs. Brood stock is obtained entirely from adults volunteering to the hatchery's collection ladder. The ladder operates from mid-May to mid-July, which covers the full spectrum of the run. For the brood year period of 1990-1999 the total smolt-adult return has averaged 0.302% for Entiat NFH and total recruits per spawned adult (RPS) has averaged 5.5. The average adult return to Entiat NFH for the past 25 years has been just over 600 adults, which prohibits any significant harvest.

Assessment of Current Program

Operational Considerations

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 original brood stock used to start the program was trapped at Rock Island Dam and brought to Entiat NFH in 1942 and 1944. No spring Chinook releases were made from the facility from 1945–1975.
- Since 1974, eggs sources and subsequent yearling releases have been from several lower river sources: Cowlitz River (1974), Carson NFH (1975–82), Little White NFH (1976, 78, 79 and 81) as well as from Leavenworth and Winthrop NFHs.
- Brood stock is obtained entirely from adults volunteering to the hatchery's collection ladder. The ladder operates from mid-May to mid-July, which covers the full spectrum of the run.
- Adults may be held up to three months before spawning.
- A flow-through formalin treatment is administered every other day to help control parasites and fungus. Adults are injected with erythromycin 60 days, and again 30 days, prior to spawning, to control bacterial kidney disease.
- The spawning protocol is 1:1 mating, but the sex ratio of returning adults is typically skewed 60:40 in favor of the females.
- In recent years, jacks have been used in broodstocks in the same proportion as they occur in the run, which has been as high as 20%. The Service protocol is to cap the use of jacks at five percent.

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Hatchery and Natural Spawning, Adult Returns

- There is no barrier weir in the Entiat River that prohibits hatchery-origin adults from passing upstream of the Entiat NFH.

- From 2000-2005, the Entiat NFH stray rate to the Entiat Basin spawning grounds, relative to adults trapped at the hatchery, has averaged 7.9% (SD = 5.9%) with notable increases in 2004 and 2005 . The contribution of these fish to the estimated total spawning escapement in the Entiat River has averaged 31.4% (SD = 12.8%).

- The total escapement of hatchery-origin fish in 2000-2005 has averaged 45% of all natural spawners in the Entiat River, with the remaining 13.6% from the Chiwawa River Rearing Ponds (5.7%), Winthrop NFH (3.6%), Methow State Fish Hatchery (2.1%), Leavenworth NFH (1.1%), and Oregon Department of Fish & Wildlife Hatcheries (1.1%).

- According to Ford et. al. (2003), "The [genetic] similarity between Entiat River wild and Entiat NFH spring Chinook samples, suggests that Entiat NFH salmon have successfully spawned and introgressed into or replaced the natural Entiat River population."

- In a 2003 Biological Opinion, NOAA Fisheries requested that the Service leave the Entiat NFH ladder and trapping facility open throughout the entire duration of the Carson-lineage spring Chinook adult return period, to maximize removal of fish from critical habitat for listed spring Chinook salmon.

- There is an agreement with Bureau of Indian Affairs for adults collected in excess of brood stock needs to be donated to various tribes for ceremonial and subsistence purposes.

- Up to 100 adults may be transferred to Omak Creek in Okanogan County.

Incubation and Rearing

- Eggs are incubated in low pathogen ground water. River water is not used because of the presence of *Myxosporidian*.

- Fry are reared on first pass ground water.

- Density and flow criteria include efforts to remain below a density index of 0.17 and below a flow index of 0.75, while maintaining production goals.

- Rearing units are designed for serial re-use of water. Water for fish production is re-used up to three times.

- All fish are fed moist feed. The use of dry feeds seemed to amplify losses due to BKD.

- Current production is marked at 50% coded wire tag and adipose fin clip combination, with the remaining 50% having an ad-clip only.

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Release and Outmigration

- Yearlings (smolts) are force released directly from the raceways and adult holding ponds into the Entiat River

- River conditions and by-pass operations at Rocky Reach and Rock Island Dams are also considered prior to release.

Facilities and Operations

- In 1990, the production program was reduced when ground water was substituted for surface water as the primary production water source. Though ground, spring and well water is limited, especially in July and August, it provides a higher quality water source and is free from the presence of a detrimental parasite that occurs temporally in the Entiat River (*Myxosporidian sp*.)

- The lack of cover and predator exclusion over outdoor raceways is a concern. BOR has identified this project in their RAX (Replacements, Additions, and Extraordinary Maintenance) survey.

- Pump motors at the wells are single speed, without remote monitoring capability. This limits the facility's ability to adjust pumping rates at each well and to turn pumps on and off from the facility. Wells need significant annual repairs.

- Entiat NFH has used chilled water to delay ponding, in order to accommodate holding and spawning of coho broodstock for the tribal Coho program. Problems could occur if the chiller malfunctioned, with no backup equipment or storage capacity.

- Use of pesticides in orchards in close proximity to the facility is a concern, as water quality could be compromised.

- Environmental Protection Agency standards have never been exceeded for either cleaning effluent discharge or total discharge since monitoring began in the early 1980s. This is primarily due to the use of ground water. The National Pollution Discharge Elimination System (NPDES) permit was issued in the early 1980s and needs to be updated.

- The Entiat River intake structure is located approximately one-half mile upstream of the hatchery. There are plans to permanently replace the intake structure and bring it into compliance with the ESA screening criteria.

Research, Education, and Outreach

- Juvenile fish are fin clipped, coded-wire tagged and/or PIT tagged at Entiat NFH by CRFPO to monitor and evaluate fish cultural techniques, survival and fishery contribution. Presently all spring Chinook are fin clipped at Entiat NFH to identify hatchery fish in selective fisheries and to measure the impact on wild anadromous and resident stocks of fish in Entiat River.

- Use of passive integrated transponder (PIT) tags began with brood year 2000 fish at Entiat NFH. PIT tagging at Entiat NFH is part of a larger comparative survival study conducted by the Fish Passage Center, Portland, Oregon.

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- The Leavenworth National Fish Hatchery Complex houses one of the most comprehensive Information and Education Outreach Departments (I&E) in the National Fish Hatchery System, serving Leavenworth, Entiat and Winthrop National Fish Hatcheries and many partners in the private sector, schools, tribes and local, city, state and federal government agencies.

- The hatchery hosts an annual open house and Kid's Fishing Day event to increase visitation.

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,[35] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- No terminal harvest benefit is being derived from this program. These fish do make a small contribution to lower Columbia River gillnet and sport fisheries. Less than 10% of the adult returns from this program are harvested.

Conservation Benefits

- The program provides no direct conservation benefits.

Research, Education, Outreach and Cultural Benefits

- Educational benefit from school groups visitations.

- Cultural and economic benefit from hatchery-origin adults surplus to broodstock needs provided to Colville Confederated Tribes, Spokane Tribe, Kalispell Tribe and Snoqualmie Tribe.

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 in a watershed,[36] the Review Team identified the following benefits of this program:

Harvest Benefits

- A minor harvest benefit occurs in mixed-stock Columbia River fisheries.

Conservation Benefits

- Program provides no direct conservation benefit.

[35] *See Components of This Report for a description of these potential benefits and risks.*
[36] *Ibid.*

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Research, Education, Outreach, and Cultural Benefits

- Research benefit form the used of Entiat NFH spring Chinook for an experimental reintroduction program conducted by the Colville Confederated Tribes in the Okanogan River Basin (Omak Creek).

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,[37] the Review Team identified the following risks of the hatchery program:

Demographic

- Demographic risk from the lack of available river water for rearing necessitating reuse and chilling of available ground water. This lowers water quality and may reduce survival.
- Demographic risk from potential failure of aging water supply and delivery system.
- Demographic risk from lack of shade covers and protection from birds.
- Demographic risk from lack of broodstock protection alarm systems.
- Demographic risk from pathogen amplification.

Ecological

- Ecological risk from use of ground water throughout rearing cycle, which may promote straying.
- Ecological risk from use of pesticides in adjacent orchard potentially compromising quality of rearing water.
- Ecological risk from antibiotic resistance in bacterial flora within naturally-spawning component from erythromycin injections and therapeutic use of medicated feeds for hatchery-reared fish, and antibiotics in effluent.
- Ecological risk from non-treatment of wastewater, although cleaning effluent water is discharged into a settling pond and meets most recent NPDES standards.

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,[38] the Review Team identified the following risks from the hatchery program:

[37] *Ibid.*
[38] *Ibid.*

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Genetic

- Genetic risk from hatchery-origin fish spawning in the upper Entiat watershed with ESA-listed, natural-origin spring Chinook.

Demographic

- Demographic risk to ESA-listed bull trout and steelhead from possible incidental take of ESA-listed fish during broodstock collection.

Ecological

- Ecological competition risk from relatively large numbers of hatchery-origin spawners out-competing natural-origin fish for spawning locations but reproducing less successfully.

- Ecological risk from using the effluent pond for kids' trout fishing derby (makes cleaning the pond more difficult, may reduce water quality, may amplify pathogen transmission).

Recommendations for Current Program[39]

After considering all the benefits and risks outlined in the preceding section, the Review Team determined that the risks from the current program outweigh the benefits, and that the current program cannot be modified to alter this balance. Our recommendation is to discontinue the current program and replace it with the preferred alternative described in the following section.

In the interim, the Review Team proposes the inclusion of the Entiat NFH as part of an emergency fish rearing plan for the Leavenworth NFH until the water intake pipeline at this latter facility is replaced. The Review Team also recommends that the Entiat NFH continue to provide facilities for the coho reintroduction program consistent with the Yakama Nation's Master Plan (see recommended alternatives below)

Alternatives to Current Program[40]

The Review Team developed five alternatives designed to increase benefits and/or reduce risks relative to the existing spring Chinook program at the Entiat NFH. 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 a recommended alternative (or alternatives).

[39] *The Review Team believes that the Warm Springs Hatchery Evaluation Team—as a whole, in task teams and/or with outside assistance and expertise—will be the logical body to implement most of the following recommendations.*
[40] *Alternatives with asterisks (*) were favored by the Review Team relative to alternatives without asterisks.*

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*Alternative 1: Integrated-spring Chinook conservation program

Discontinue existing spring Chinook segregated–harvest program and replace with an integrated, conservation-recovery program derived from natural-origin spring Chinook in the Entiat River.

Pros

- Reduces risk of extinction of spring Chinook in the Entiat River and potentially contributes to recovery of an endangered species.
- Would be smaller than the existing program.
- Could be conducted in conjunction with one or more of the other proposed alternatives.
- Fish from the discontinued program could be made available as founding broodstock for a segregated harvest hatchery program below Chief Joseph Dam.

Cons

- Would require a weir for broodstock collection and for managing the escapement of hatchery and natural-origin adults allowed to pass upstream of the hatchery.
- Protocols would need to be developed for managing the proportions of natural-origin fish in the broodstock and hatchery-origin fish on spawning grounds.
- Would not contribute to harvest mitigation goals.
- Would not allow the Entiat River to serve as a non-hatchery "reference stream" for assessing recovery of spring Chinook in the mid-Columbia region.

*Alternative 2: Coho restoration central facility

Discontinue existing segregated spring Chinook program and convert Entiat NFH to a central rearing facility for coho salmon in support of the mid-Columbia coho restoration program of the Yakama Nation.

Pros

- Would substantially increase the hatchery rearing capacity for coho salmon within the mid-Columbia region, thus reducing by at least 25% reliance on out-of-region hatcheries in the lower Columbia River for rearing coho salmon juveniles prior to acclimation and release in mid-Columbia rivers and streams.
- Would provide the Yakama Tribe with a hatchery base of operation. This may require a cooperative agreement with the Yakama Nation similar to the one with the Confederated Tribes of the Warm Springs Reservation in Oregon and the Warm Springs NFH.
- Would provide an opportunity to release coho into the Entiat River at some future date, although this latter action is not part of the Master Plan for restoring coho salmon.

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Cons

- Coho salmon was not identified as a "mitigation" species under the federal acts that authorized mitigation for fish losses imposed by Grand Coulee Dam.
- Would still require extensive rearing of coho salmon in lower Columbia River hatcheries to meet smolt release objectives of the Yakama Nation's Master Plan.
- May require a new weir on the mainstem Entiat River if one goal is to manage the upper Entiat River exclusively for natural reproduction with little or no hatchery fish.
- Would not provide any direct fishery benefits in the immediate future.

**Alternative 3: Integrated summer Chinook harvest program*

Discontinue existing segregated spring Chinook program and replace with an integrated summer Chinook harvest program derived from natural-origin adults trapped in the Entiat River

Pros

- Would support a local fishery in the lower Entiat River, particularly at the mouth and immediately upstream, and a downstream selective fishery in the mainstem Columbia River.

Cons

- May require a weir on the Entiat River at the hatchery for broodstock collection and to preclude hatchery-origin fish from migrating upstream of the hatchery.
- Protocols would need to be developed and implemented for proportions of natural-origin fish in broodstock and hatchery-origin on spawning grounds.
- Majority of harvest would occur outside the Columbia River basin because nearly two-thirds of hatchery-origin summer Chinook from the mid-Columbia region are currently harvested in Alaska and Canada commercial fisheries.

**Alternative 4: Conservation facility for upriver stocks*

Discontinue existing segregated spring Chinook program and use the Entiat NFH for propagation of upper Columbia River basin species of high conservation or harvest concern, including - but not limited to – reintroduction of spring Chinook to the upper Columbia and Okanogan rivers consistent with the Colville Tribe's Restoration plan .

Pros

- Hatchery would propagate species of greatest conservation and or harvest need.
- The Entiat NFH could rear Methow Comp fish exceeding the capacity of the Winthrop NFH for release below Chief Joseph Dam, rather than forcing surplus hatchery-origin adults to spawn naturally in the Methow River (see following section dealing with Winthrop NFH).

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- Would assist with restoration and recovery of extirpated stocks.
- Gives the hatchery flexibility to respond to changing priorities and mandates (e.g. potential restoration of coho salmon in the Entiat River).
- A research component could be part of the hatchery's new mission.
- Could provide temporary rearing space for juvenile spring Chinook from the Leavenworth NFH when a new water intake and other modifications were under construction at that latter facility.

Cons

- This new role for the Entiat NFH would need to be further defined, developed, and coordinated with comanagers.
- Would probably require annual or semi-annual planning documents to define the immediate use of the facility over each two to five year period.
- Would not necessarily meet a defined mitigation responsibility but may do so indirectly (e.g. helping to restore a fishery on spring Chinook below Chief Joseph Dam).

Alternative 5: Decommission hatchery

Terminate existing spring Chinook program and decommission hatchery in favor of alternative mitigation strategies such as habitat restoration, removal or bypass of barriers that impede upstream migration, and construction of a new hatchery elsewhere (e.g. Okanogan River). Use the Entiat NFH as a monitoring and evaluation site and the Entiat River as a non-hatchery "reference stream" for assessing the status and natural recovery of steelhead, spring Chinook, and bull trout. This latter role could also occur for steelhead under the other alternatives but would require construction of a weir and bypass channel for monitoring upstream migration and recruitment of natural-origin adults.

Pros

- Would provide potential conservation benefits to three ESA-listed species in the Entiat River (spring Chinook, steelhead, bull trout).
- Would be consistent with some comanager goals to use the Entiat River as a "non-hatchery" reference stream for monitoring the effects of hatchery supplementation elsewhere in the mid-Columbia region.

Cons

- Provides no direct harvest benefit.
- The Entiat River has limited natural production capacity relative to the Wenatchee and Methow River subbasins.
- Inconsistent with Congressionally authorized mitigation responsibilities, and alternate hatchery sites are very limited and expensive to develop.

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- Need to operate a weir on the Entiat River even if there is no hatchery program at this facility, for monitoring purposes, to control straying, and to maintain the river's ability to function as a reference stream.

Recommended Alternatives

Primary Recommendation: Implement Alternative 3.

Discontinue existing segregated spring Chinook program as soon as feasible and replace with an integrated summer Chinook harvest program derived from natural-origin summer Chinook trapped in the Entiat River to support harvest in the Entiat River, at Chelan Falls, and mainstem Columbia River.

- Develop an adult weir and bypass facility at the Entiat NFH to trap upstream migrating adults for broodstock, monitor escapement of natural-origin salmon, steelhead and bull trout, and exclude hatchery-origin adults of all species from the Entiat River upstream of the hatchery.

- Continue to provide facilities for coho reintroduction program consistent with the Yakama Nation's Master Plan.

- Construct covers for the fish rearing ponds.

- Replace single speed well-pump motors with variable speed motors

Secondary recommendation: Implement Alternative 4

Implementation of Alternative 3 would, most likely, not require complete use of all rearing facilities at the Entiat NFH, particularly if summer Chinook were released as subyearlings consistent with their natural life history. Consequently, the Review Team recommends that the facilities not used for rearing summer Chinook be used to help propagate other upper basin species of high conservation or harvest value.

- Collaborate with the Winthrop NFH, as necessary, and use the Methow Composite stock to help reintroduce spring Chinook to the Okanogan River, and develop a new hatchery broodstock at Chief Joseph Dam consistent with the Colville Tribes' Restoration plan (see recommendations for the spring Chinook program at the Winthrop NFH).

- Continue to provide facilities for coho reintroduction program consistent with the Yakama Nation's Master Plan.

- Provide back-up rearing support for other species and stocks as needed or desired.

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V. Methow River Watershed[41]

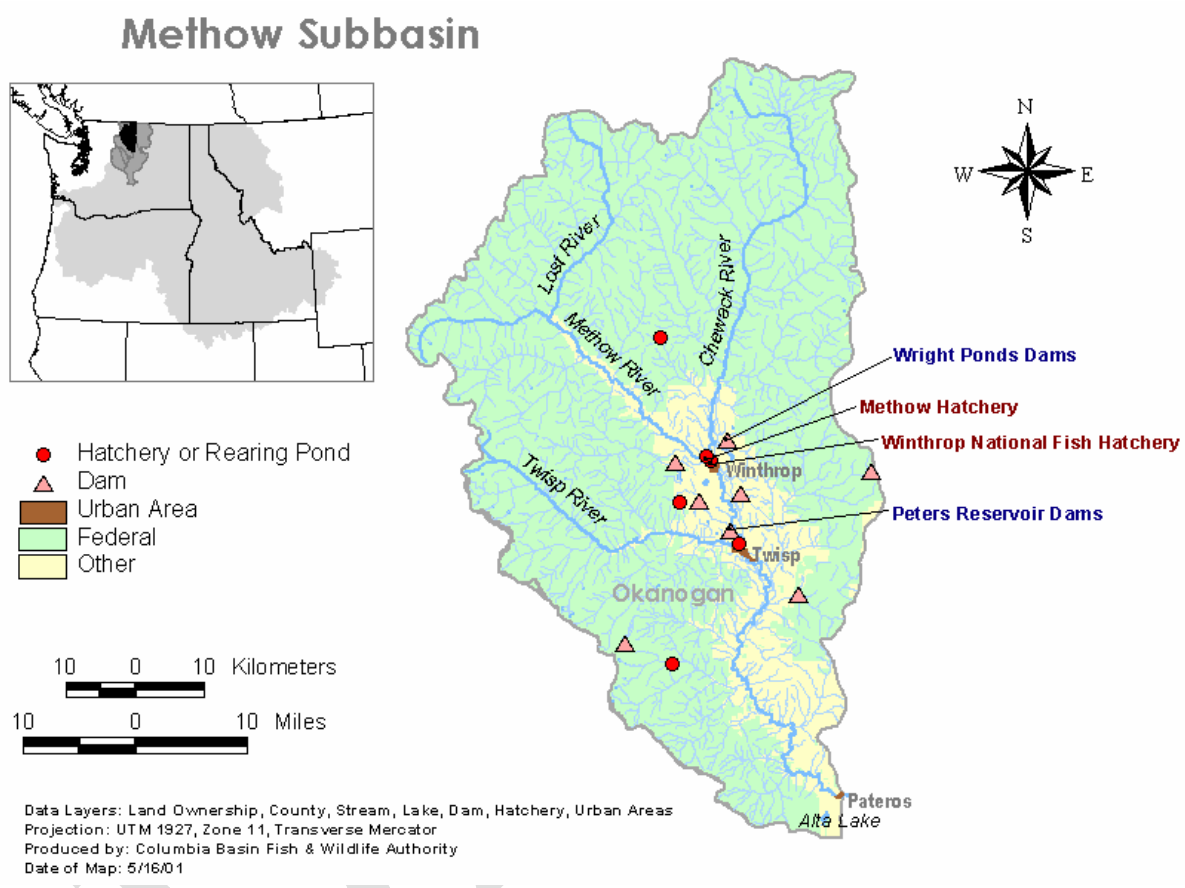

Figure 6. Methow River Watershed Overview Map

[41] *Primary source documents for information in this section include:*
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Overview of Methow River

Watershed Description

The mouth of the Methow River is located at River Mile (RM) 524 on the Columbia River in north central Washington State. The Methow watershed extends northward from the confluence with the Columbia River, to its headwaters located along the Cascade Crest and the Canadian border. It is bordered to the east by the Okanogan watershed. The Methow River drains roughly a 1,800 square mile watershed, extending approximately 86 river miles from its headwaters to its mouth. Topography within the basin is varied, and ranges from mountainous sub-alpine and alpine terrain along the Cascade Crest to the gently sloping, wide valley found along the middle reaches of the Methow River. Elevation ranges from over 8,500 feet in the headwaters of the basin to approximately 800 feet at the confluence of the Methow and Columbia Rivers.

Elevation, topography and geographic location on the east side of the Cascade Mountains influence the climate of the Methow River Basin. Annual precipitation ranges from over 80 inches along the Cascade Crest to approximately 10 inches near the town of Pateros. The temporal distribution of precipitation has a high degree of seasonality, with approximately two-thirds of the precipitation occurring between October and March, mostly in the form of snow. Summers are generally hot and dry with precipitation coming from brief and intense thunderstorms. In fall, precipitation increases and generally peaks in the winter as snowfall occurring between December and February.

Natural characteristics of the Methow watershed, including spatial and temporal variation in precipitation, as well as variation in elevation, aspect, geology, soils and vegetation, affects runoff patterns and water storage in the basin. The seasonal distribution of runoff is influenced by snow storage and melt. The runoff regime in the basin is primarily snowmelt dominated. The maximum volume of streamflow and the highest peak flows occur during spring and early summer. Some peak flows occur in November and December. These are generally rain-on-snow events. Approximately 60 percent on the annual runoff volume, as measured at Pateros, occurs during May and June.

Fisheries

The Methow River supports several populations of economically and culturally important fish species. The watershed currently supports anadromous runs of Chinook salmon and steelhead. Sockeye salmon are occasionally observed. Coho salmon were once abundant in the Methow watershed, but are now considered extinct (the Yakama Nation is currently attempting to re-introduce this species in the upper Columbia Basin). Important inland species include mountain whitefish, bull trout, rainbow trout, and westslope cutthroat trout. Spring Chinook are listed as endangered, and steelhead and bull trout are listed as threatened, both under the ESA.

A recreational fishery exists for steelhead (adipose fin-clipped, hatchery only), resident rainbow, and brook trout. Currently, no sport fishing for salmon is allowed on the Methow River.

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Conservation

Sustainable natural reproduction of trout, salmon, and steelhead is an important fisheries management goal in this watershed. Although summer steelhead are ESA listed, those released form Winthrop NFH are allowed for harvest in the Methow and Columbia Rivers. These steelhead have an adipose fin-clip, which denotes them as hatchery fish. ESA listed spring Chinook salmon are propagated at both Winthrop NFH and Methow State Fish Hatchery. Current management of these stocks is directed at bolstering the natural population, therefore no harvest is allowed. In 1998, seventeen bull trout/Dolly Varden stocks were identified in the Methow watershed. The status of all bull trout stocks in the Methow River watershed has been classified as unknown, except for the Lost River stock which has been classified as healthy.

Habitat

Native American tribes lived in the region and harvested fish and wildlife for thousands of years. More intensive land development occurred with the first influx of settlers over 100 years ago. Since that time, grazing by livestock, farming practices, timber harvest, road construction/maintenance, mining, and construction of dams have all had an impact on the river, its tributaries and streamside vegetation. The result has been a reduction in aquatic habitat, riparian vegetation, soil compaction and a decrease in stream bank stability.

The Methow River basin historically supported bull trout, westslope cutthroat trout, rainbow trout, spring Chinook, summer Chinook, steelhead, and coho salmon. The anadromous runs were decimated by the 1930's because of over-fishing in the lower Columbia River fisheries, poor mining practices, grazing, logging, irrigation diversion practices in the watershed, and construction of an impassable hydro-power dam near Pateros on the lower Methow River in 1915.

Currently production of self-sustaining anadromous salmonids is limited by the reduced numbers of returning wild adults to the Methow watershed. The Methow River is a journey of 524 river miles from the mouth of the Columbia River and requires navigating through nine hydroelectric facilities once as smolt and again as adults. Coincident with unfavorable ocean conditions and harvest impacts, the out-of-basin impacts can significantly affect the ability of the Methow watershed to support self-sustaining anadromous salmonids.

Natural environmental conditions also can limit natural production of salmonids in the Methow watershed. Extreme winter conditions, the result of latitude, elevation and the influence of the Cascade mountain range on maritime and artic air masses, combine to create extreme winter conditions which contribute to reduced fish growth and activity. In years when moisture availability is limited by climatic conditions, instream flows become severely reduced resulting in dewatered reaches, winter icing, and higher summertime water temperatures. Depending on the severity of the climatic conditions, the duration and extent of low instream flows and dewatered reaches can expand. These conditions restrict salmonid access to habitat, dewatered redds, and strand juveniles, resulting in direct mortality to salmonids. Catastrophic disturbances are also a natural component of this ecosystem and limit salmonid production. Landslides, floods, and fire create a disturbance regime that cleanses, builds and replenishes the aquatic environment.

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Current Status of Salmonid Stocks

Fishery co-managers have identified eight principal salmonid stocks in the Methow River watershed, three of which have been designated collectively as *Methow River spring Chinook* by the Interior Columbia Technical Recovery Team (ICTRT). Stocks identified by the ICTRT are indicated by asterisks (*) in the list below.

- Methow River spring Chinook (natural)*
    - Methow River spring Chinook (natural + integrated hatchery)
    - Chewuch River spring Chinook (natural + integrated hatchery)
    - Twisp River spring Chinook (natural + integrated hatchery)
- Methow River summer Chinook (natural + integrated hatchery)
- Coho (segregated hatchery, Yakama Tribal program)
- Methow River summer steelhead (natural + integrated hatchery)*
- Methow River bull trout (natural)
- Methow River westslope cutthroat trout (natural)

The following tables summarize the current and future status of those stocks, as identified by the co-managers. More detailed assessments associated with these tables are presented in Appendix A (*AHA* analyses). Qualitative ratings of *biological significance* and *population viability* in the tables are based on the criteria described by the HSRG (Mobrand et al. 2005) and elaborated more fully in Appendix A. More detailed analyses of population viability for ESA listed stocks are currently under development by NOAA Fisheries.

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Table 23. Methow River Spring Chinook

Stock Goals/Management Premises	
ESA Status	*Endangered*.
Biological Significance	*Medium to High*. Spring Chinook in the mainstem Methow River exhibit no unique attributes relative to spring Chinook in the Chewuch River or other watersheds in the mid-Columbia region. This stock has also been influenced genetically by natural spawning of Winthrop-Carson fish and their inclusion with the Methow Composite hatchery stock.
Population Viability	*Low*. From 1960 to 2003, the number of spring Chinook adults in the entire Methow River watershed ranged from 33 to 9,904 adults with a 12-year geometric mean ranging from 480 to 2,231 adults. The geometric mean at the time of listing (1999) was 480 spawners. During the period 1960–99, adult recruits per spawner (R/S) ranged from 0.05–5.21 with a 12-year geometric mean of 0.41–1.02. At the time of listing (1999), the geometric mean R/S was 0.51. Presently, there are too few data to estimate productivity parameters separately for the Chewuch, Twisp and mainstem Methow Rivers. The ICTRT concluded that spring Chinook in the Methow River basin are at a high risk of extinction during the next 100 years. The 12-year geometric mean recovery-delisting goal is 2,000 natural-origin adults per year with a mean R/S > 1.2.
Habitat	*Medium to High* (to be quantified).
Harvest	Incidental in Columbia River mixed stock fisheries. No terminal harvest.
Hatchery Program	
Facilities	Winthrop NFH and Methow SFH, Foghorn Dam trap.
Type	Integrated (Methow Composite stock)
Federal Authorization	*Winthrop NFH:* Grand Coulee Dam Project , 49 Statue 1028, as part of the Rivers and Harbors Act in 1935; Columbia Basin Project Act, 57 Statue 14, in 1943; Fish and Wildlife Coordination Act, 60 Statue 1080, in 1946. *Methow SFH:*
Primary Purpose	Conservation
Secondary Purposes	Long-term: Harvest
Broodstock Origin(s)	Methow River, Chewuch River, Winthrop-Carson stock, Winthrop NFH

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Table 24. Chewuch River Spring Chinook

Stock Goals/Management Premises	
ESA Status	*Endangered*.
Biological Significance	*Medium to High*. This stock does not appear to have any unique biological attributes relative to other spring Chinook populations within the ESU, but it has not been influenced genetically to any known degree by Winthrop-Carson fish.
Population Viability	*Low*. See Methow River spring Chinook.
Habitat	*Low to Medium.*
Harvest	Incidental in Columbia River mixed stock fisheries. No terminal harvest.
Hatchery Program	
Facilities	Methow SFH, Chewuch River adult trap and acclimation pond
Type	Integrated.
Federal Authorization	Authorized and funded by Grant County PUD as partial mitigation for fish losses associated with the operation of Wells Dam.
Primary Purpose	Conservation
Secondary Purposes	Long-term: Harvest
Broodstock Origin(s)	Chewuch River

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Table 25. Twisp River Spring Chinook

Stock Goals/Management Premises	
ESA Status	*Endangered*.
Biological Significance	*High*. Twisp River spring Chinook are distinctive genetically from other populations of spring Chinook in the Methow River Basin and within the upper Columbia ESU.
Population Viability	*Low*. See Methow River spring Chinook.
Habitat	*Low to Medium.*.
Harvest	Incidental in Columbia River mixed stock fisheries. No terminal harvest.
Hatchery Program	
Facilities	Methow SFH, Twisp River trap and acclimation pond.
Type	Integrated.
Federal Authorization	Authorized and funded by Grant County PUD as partial mitigation for fish losses associated with the operation of Wells Dam.
Primary Purpose	Conservation
Secondary Purposes	Long-term: Harvest
Broodstock Origin(s)	Twisp River.

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Table 26. Methow River/Upper Columbia summer Chinook

Stock Goals/Management Premises	
ESA Status	Not listed.
Biological Significance	*Medium*.
Population Viability	*Medium*
Habitat	*Medium* (to be quantified).
Harvest	Columbia River mixed stock fisheries (to be quantified)
Hatchery Program	
Facilities	Wells SF Hatchery and Carleton Ponds
Type	Integrated.
Federal Authorization	text.
Primary Purpose	Conservation.
Secondary Purposes	Harvest.
Broodstock Origin(s)	Natural-origin adults trapped at Wells Dam (Methow and Okanogan Rivers)

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Table 27. Methow River hatchery coho

Stock Goals/Management Premises	
ESA Status	Not listed.
Biological Significance	*Low.* See Wenatchee River coho.
Population Viability	*Low.* See Wenatchee River coho..
Habitat	To be quantified..
Harvest	Intercepted in Columbia River mixed stock fisheries. (To be quantified).
Hatchery Program	
Facilities	Winthrop NFH
Type	Segregated. Will become integrated when a naturally-spawning population is established.
Federal Authorization	Will become integrated when a naturally-spawning population is established
Primary Purpose	Conservation. The long-term goal is to re-establish self-sustaining, natural populations of coho. The short-term goal is to establish a hatchery-propagated run and then slowly transition from a segregated to an integrated program as natural populations become re-established.
Secondary Purposes	Cultural: subsistence and ceremonial. Long-term: Harvest.
Broodstock Origin(s)	Lower Columbia River hatchery stocks, primarily from Willard NFH, Eagle Creek NFH, Cascade SH (ODFW), and Bonneville SH (ODFW). The broodstocks are currently derived primarily from adult returnees back to the Wenatchee River. Fish were first released from this program in 1996. Coho salmon were extirpated from the upper/mid- Columbia River in the early 1900s.

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Table 28. Methow River summer steelhead

Stock Goals/Management Premises	
ESA Status	*Threatened*. Upgraded from endangered in 2006.
Biological Significance	*High*. Methow River steelhead represent some of the furthest upstream populations of steelhead currently inhabiting the Columbia River.
Population Viability	*Low*. Escapement of natural-origin steelhead in the Methow watershed ranged from 1 to 587 adults between 1967 and 2002 with a 12-year geometric mean ranging from 36 to 242 adults. The geometric mean the year before listing (1996) was 205 adults. Assuming hatchery fish do not contribute to returning natural-origin adults, then the number of recruits per spawner (R/S) ranged from 0.08–8.65 adults since 1978 with a 12-year geometric mean ranging from 0.82–2.28 based on run reconstruction estimates derived from counts at Wells Dam. The geometric mean at the time of listing (1997) was 0.84. The "true" productivity of Methow River steelhead is less depending on the extent that hatchery-origin steelhead reproduce successfully and thus inflates the number of natural-origin recruits. The Interior Columbia TRT has concluded that Methow River steelhead have a moderate to high risk of extinction over the next 100 years. The 12-year geometric mean recovery-delisting goal is 1,000 natural-origin adults per year with a mean R/S > 1.1. (Upper Columbia Recovery Plan)
Habitat	The current estimated maximum productivity is 1.25 recruits per spawner, with a long-range goal of 1.90 recruits per spawner. The current recruit capacity is 1,963 adults, with a long-range goal of 2,864 recruits. (AHA spreadsheet).
Harvest	The mean terminal harvests on steelhead are estimated to be 2% and 20% on natural- and hatchery-origin adults, respectively. (AHA spreadsheet).
Hatchery Program	
Facilities	Winthrop NFH and Wells SFH
Type	Integrated.
Federal Authorization	Grand Coulee Fish Maintenance Project in 1937, Mitchell Act in 1938, Fish and Wildlife Coordination Act, 1946, U.S. Bureau of Reclamation. Operator: USFWS
Primary Purpose	Conservation
Secondary Purposes	Harvest
Broodstock Origin(s)	Upper Columbia River populations upstream of Wells Dam

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Table 29. Methow River bull trout

Stock Goals/Management Premises	
ESA Status	*Threatened*.
Biological Significance	*Medium*. Bull trout inhabiting the Methow River basin are not known to have any unique or distinctive biological attributes.
Population Viability	*Medium*. Bull trout are currently listed as threatened range-wide under the ESA. Redd counts for the years 2000 to 2004 ranged from 127 to 195 which translates into 254 to 546 adults based on 2.0–2.8 adults per redd. Overall, the number of counted redds has been fairly stable since 2000, although they are highly variable in the Twisp and upper Methow Rivers with a decreasing trend since 2000. The 12-year geometric mean recovery-delisting goal is 1,234–1,728 natural-origin adults based on redd count expansions.
Habitat	*Medium to High.* An AHA dataset with estimated EDT productivity and capacity parameters has not been developed.
Harvest	A fishery on bull trout occurs in the Lost River. (Draft Recovery Plan)

Table 30. Methow River westslope cutthroat trout

Stock Goals/Management Premises	
ESA Status	*Not listed.*. Special concern.
Biological Significance	*High*.
Population Viability	*Medium.*
Habitat	*Medium to High*.
Harvest	Minor in recreational fisheries..

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Other Species of Concern

Table 31. Expected fish species present in Methow River[42]

Salmonid Species	Scientific Name	Non-salmonid Species	Scientific Name
Spring Chinook salmon	*Oncorhynchus tshawytscha*	Longnose dace	*Rhinichthys cataractae*
Summer Chinook salmon	*O. tshawytscha*	Mottled sculpin	*Cottus bairdi*
Sockeye salmon	*O. nerka*	Largescale sucker	*Catostomus macrocheilus*
Coho salmon	*O. kisutch*	Bridgelip sucker	*C. columbianus*
Summer steelhead	*O. mykiss*	Pacific lamprey	*Lampetra tridentata*
Westslope cutthroat trout	*O. clarki lewisi*	Northern pikeminnow	*Ptychocheilus oregonensis*
Redband trout	*O. mykiss gairdneri*	Redside shiner	*Richardsonius balteatus*
Bull trout	*Salvelinus confluentus*		
Brook trout	*S. fontinalis*		
Mountain whitefish	*Prosopium williamsoni*		

Other species of concern in the Methow River include sockeye salmon (*O. nerka*), resident rainbow (redband) trout (*O. mykiss*), mountain whitefish (*Prosopium williamsoni)*, Pacific lamprey (Lampetra *tridentata*) and various sucker species (*Catostomus* sp.). Effects on these species from the Winthrop NFH program are unknown, but thought to be minimal. Predation and possible disease transmittance within the facility is a problem caused by Great Blue herons (*Ardea herodias),* Mallard ducks (*Anas platyrhynchos),* wood ducks *(Aix sponsa)* and mink (*Mustela vison)*

Salmon and Steelhead Hatcheries in the Watershed and Vicinity[43]

Winthrop National Fish Hatchery (U.S. Fish and Wildlife Service)

The Winthrop NFH is located near Winthrop, Washington at RM 44.8 of the Methow River, a tributary to the Columbia River at RM 524. Rearing facilities at Winthrop NFH include 34 nursery tanks, 46 raceways, and 16 Foster-Lucas ponds. Water sources include two wells, the Methow River, and one natural spring water source. No barrier weir is present in the Winthrop River to collect broodstock or preclude hatchery-origin adults from migrating upstream into natural spawning areas. However, a passable boulder dam (Foghorn Dam) impounds water for the hatchery intake and provides some adult trapping capability. The Winthrop NFH supports a spring Chinook program and a steelhead program. It also provides facilities for the coho reintroduction program of the Yakama Nation. Adult fish returning to the Winthrop NFH must migrate 569 miles upstream and pass over nine Columbia River hydropower dams.

[42] *From WNFH-HGMP Page 11*
[43] *See Figure 3.*

Methow State Fish Hatchery (Washington Department of Fish and Wildlife)

The Methow hatchery is located along the Methow River upstream from the confluence of the Chewuch River near the town of Winthrop, Washington. The hatchery is approximately one mile upstream of the Winthrop NFH. The Methow State Hatchery includes 12 covered concrete raceways, 24 indoor nursery troughs, three adult holding ponds and three lined acclimation and release ponds. The hatchery uses well water for incubation, a combination of well water and Methow River water for fish rearing, and river water for acclimation prior to release. The facility includes adult traps and an asphalt-lined acclimation and release pond in each of the Chewuch and Twisp sub-basins. The Methow Hatchery began operating in 1992 to mitigate for fish losses caused by the construction and operation of Wells Dam.

The hatchery was built to propagate and help recover three naturally spawning stocks of spring Chinook in the Methow River basin: Methow, Chewuch, and Twisp River stocks. The goal was to increase the abundance of natural-origin Spring Chinook adults in all three sub-basin. The release objective is 246,000 yearling smolts to each area. Trapping natural-origin adults for broodstock to meet program objectives has been an ongoing problem within all three sub-basins. Foghorn Dam, a passable boulder dam that provides a small water impoundment for intake by the Winthrop NFH and Methow SH, provides some adult trapping capability in the mainstem Methow River.

Wells State Hatchery (WDFW, Douglas County PUD, Yakama Nation)

Wells State Hatchery is located at the base of Wells Dam at RM 517 (RKm 830) on the Columbia River. The Wells Hatchery includes one adult holding pond, 12 concrete raceways, 3 rearing ponds, and egg incubation facilities. In addition, adult trapping facilities exist at Wells Dam at the tops of the east and west fish ladders, respectively. The hatchery is intended to mitigate for fish losses caused by Wells Dam.

The hatchery is used for adult collection, incubation, and rearing of summer Chinook and summer steelhead. It may also be used to trap coho for the Yakama Nation's coho restoration program. At the present time, Wells Dam and Hatchery are the trapping site of adults and the source of eyed eggs, respectively, for the steelhead program at the Winthrop National Fish Hatchery. Juvenile steelhead and summer Chinook released into the Methow and Okanogan Rivers are all the progeny of adults trapped at Wells Dam.

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Winthrop NFH Spring Chinook

Operator: U.S. Fish and Wildlife Service
Cooperator: Methow State Fish Hatchery, WDFW

Summary of Current Program

Goals

- ***Harvest goal:*** The hatchery program has no specific harvest goal at the present time. The program changed recently (in 2001) from a segregated-harvest program, using a Carson NFH derived stock (*Winthrop-Carson* stock), to an integrated conservation program using the *Methow Composite* stock developed at the Methow State Fish Hatchery. Providing fish for harvest is a desired goal in partial fulfillment of mitigation responsibilities. The current endangered ESA status of spring Chinook in the mid-Columbia region inhibits harvest opportunities on hatchery-origin fish.

- ***Broodstock goal:*** Trap a minimum 400 spring Chinook (hatchery +wild) adults and spawn a minimum of 360 adults to yield a smolt release of 600,000 yearling smolts.

- ***Conservation goal:*** Assist with the recovery of listed spring Chinook in the Methow River. A short-term goal is to assist with upgrading the Upper Columbia Spring Chinook ESU from endangered to threatened ESA status. All *Methow Composite* hatchery-origin adults in excess of broodstock needs are allowed to spawn naturally in the Methow River.

- ***Escapement goal, natural-origin adults:*** The program has no specific escapement goal for natural-origin adults other than to allow all natural-origin adults and Methow Composite adults in excess of broodstock needs to spawn naturally.

- ***Education/outreach/cultural goal:*** Provide the public with quality aquatic interpretation and education, customer service and comprehensive outreach to enhance public understanding, participation and support of Service and Winthrop NFH programs.

Objectives

- Trap a minimum of 400 adult spring Chinook.

- Spawn a minimum of 360 adults. If an insufficient number of *Methow Composite* and natural-origin adults are trapped for broodstock, then additional adults representing the progeny of *Winthrop-Composite* x *Methow Composite* adults are spawned to meet fishery mitigation responsibilities. Progeny of these latter crosses, referred to as *Met-Comp II* fish, are not intended to contribute to recovery and are given an adipose fin clip prior to release to provide harvest opportunities as returning adults.

- Release 600,000 yearling smolts directly from the Winthrop NFH into the Methow River. Methow Composite fish are ESA listed and are 100% tagged with coded wire tags (CWT). Met-Comp II fish are not ESA listed and are 100% adipose fin clipped with no CWTs.

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Program Description

Historically, Winthrop NFH operated as a segregated harvest augmentation program. Prior to 1999, the spring Chinook stock propagated at this hatchery was derived from the Carson NFH ("Winthrop-Carson stock"). This stock was not listed under the ESA. When Upper Columbia River spring Chinook were listed in 1999, the broodstock was transitioned to the listed Methow Composite stock and the goal of the program became recovery of ESA-endangered spring Chinook in the Methow River, while maintaining mitigation responsibilities. The last complete release of Winthrop-Carson stock occurred in 2000 (brood year 1998), though some "mixed" releases (Carson stock crossed with Methow Composite stock, known as MetComp 2, have occurred since BY 2001. These fish were treated as non-listed, w/ 100% adipose fin clips. Broods previous to 2000 were also adipose fin clipped.

Winthrop NFH has annually averaged 660 (SD = 798, +/- 120% of average) returning adults to the Methow River Basin and failed to meet the minimum broodstock goal of 400 adults in twelve of twenty-six years (1980-81, 1989-1992, 1994-1998 or 12/26 = 46%). For the brood year period of 1990-1999 the total smolt-adult return has averaged 0.267% for Winthrop NFH and total recruits per spawned adult (RPS) has averaged 4.8. A critical limitation to achieving conservation goals has been difficulties trapping wild adults for broodstock, particularly in the mainstem Methow River.

Assessment of Current Program

Operational Considerations

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

- Beginning in 1998, the Methow Composite stock (Chewuch and Methow River origin) program was developed, and the Winthrop NFH management objectives were modified to support conservation of localized stocks. In 2001, all Winthrop-Carson stock on station (brood years 1999 and 2000) were transferred out of basin as part of an interagency agreement. However, broodstock records at the Methow State Hatchery indicate that the Methow Composite stock has been genetically influenced by the Winthrop-Carson stock with an estimated 28-30% of its ancestry (BY2001-2005) derived from unmarked hatchery-origin Winthrop-Carson fish that had been inadvertently included with the broodstock during the 1990's, with70-72% of its ancestry derived from natural-origin fish in the Methow River subbasin. One broodstock goal is to continually reduce the percentage of Winthrop-Carson ancestry by including natural-origin adults in the broodstock annually.

- Although the intent for this program is for it to operate as genetically integrated with the naturally-spawning population, low numbers of natural-origin adults and a limited ability to efficiently trap these adults have precluded the inclusion of adequate numbers of natural-origin adults in the broodstock.

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- In collaboration with WDFW's Methow Fish Hatchery, Winthrop NFH has continued the process of transitioning from the out-of-basin stock to the ESA-listed Methow Basin Composite stock. Prioritized spawning is expected to return increasingly pure Methow Composite stock to the facility in the future.

- Only since 2003 has the hatchery been able to return to operating its fish ladder and collect fish returning to the hatchery as the pure Carson stock were no longer in the river system.

- During years where large adult returns are expected, a weir is installed in the lower section of the outfall channel and opened and closed periodically. This strategy allows the facility to collect fish from throughout the run, encourages excess listed fish to leave the shallow channel and seek out natural spawning locations in the Methow River system, and reduces the number of excess fish handled by hatchery personnel.

- Adults are injected with erythromycin at 30 days and again at 14 days prior to spawning, to control bacterial kidney disease. Adults are generally treated three days per week with formalin to control external parasites.

- Fish are randomly selected and mated as close to a 1:1 male/female ratio as possible. Typically, the sex ratio for the returning spring Chinook adults is skewed 60:40 in favor of the females.

- If brood stock numbers are insufficient to meet hatchery production objectives, the hatchery will rear fewer fish.

- In case of a natural or man-made disaster, spring Chinook stock may be obtained from Methow SFH, numbers permitting.

Hatchery and Natural Spawning, Adult Returns

- Excess adult returns to Winthrop NFH from 2001 onward have been encouraged to spawn naturally in the Methow River.

- There is no barrier dam in the Methow River at the hatchery. This is significant because the Methow River watershed upstream of the hatchery is an important spawning and rearing area for native spring Chinook salmon, summer steelhead trout, and bull trout (all ESA listed).

- Coded-wire tag recoveries indicate that returning adults of Winthrop NFH origin have a high fidelity to the Methow River system.

Incubation and Rearing

- The Methow River source is the main supply for the outside rearing units during the winter months, and is very susceptible to temperature swings with seasonal fluctuations from as low as 32–33 degrees F in December to as high as 67 degrees F in August. Since the river water contains the most pathogens, use of this source is usually avoided during early rearing of all salmonids.

- Beginning with brood year 2000, rearing space has been managed so that density indices (the ratio of weight of fish to rearing unit volume and fish length) at no time exceed 0.11 for spring Chinook salmon.

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Release and Outmigration

- Smolts are mass-released directly into the outfall channel (leading to the Methow River) at a size of 16–18 fish per pound, to minimize interactions with other fish populations.

- It is likely that the fish are functional or near functional smolts at the time of release, as evidenced by their rapid migration to the Rock Island smolt trap and detection of PIT tagged fish at McNary and Bonneville Dams' bypass facilities

Facilities and Operations

- The Foghorn diversion dam on the Methow River is a rock and boulder structure which backs up the river in order to divert multi-purpose water to the Foghorn Ditch. The structure has existed in some form for irrigation purposes long before the construction of the hatchery in 1938. Adjacent to the dam on the south shoreline a diversion structure serves to collect water for the Foghorn Ditch and provides fish passage around the dam by means of a fish ladder. The structure also has an adult salmon trap built in for the purpose of collecting wild adult salmon; however this trap has proven to be ineffective since the dam is really not a fish barrier during most of the year.

- In 1989, a change in the Methow River Water Right was negotiated with the Washington Department of Ecology. The negotiation allows the Washington Department of Fish and Wildlife hatchery to use up to 7 cfs of water in the event of an emergency water shortage at the State facility, provided the flow is <u>not</u> required at the Winthrop NFH.

- The Winthrop NFH fish screen has been recently reconstructed to meet strict requirements developed by NOAA Fisheries and the Washington Department of Ecology Both screens are rotary type drum screens which guide fish into a bypass channel which runs behind the hatchery and returns wild fish to the Methow River.

- The adult holding facility has been identified in the BOR RAX (Replacements, Additions, and Extraordinary Maintenance) document as a high priority for modification.

Research, Education, and Outreach

- All listed spring Chinook have been coded-wire tagged (CWT), and will continue to be in the future. Starting with brood year 2000, listed stocks did not receive a fin clip along with the CWT, while unlisted stocks continued to receive fin clips in order to help differentiate listed and unlisted stocks

- The Leavenworth National Fish Hatchery Complex houses one of the most comprehensive Information and Education Outreach Departments in the National Fish Hatchery System, serving Leavenworth, Entiat and Winthrop National Fish Hatcheries and many partners in the private sector, schools, tribes and local, city, state and federal government agencies.

- Winthrop NFH accommodates visitors on a regular basis, and provides a comfort station and picnic area with gazebo. The Methow Valley Sports Trail Association uses a portion of the hatchery grounds for a cross country ski trail.

- The main public event at Winthrop NFH is Kid's Fishing Day. This popular event draws 400 to 500 people each year.

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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,[44] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- No terminal harvest benefit is being derived from this program. These fish do make a small contribution to lower Columbia River gillnet and sport fisheries. Five percent or less than of returns from this program are harvested.

Conservation Benefits

- Conservation benefit from propagating an ESA-listed spring Chinook stock intended to assist with recovery of naturally-spawning populations in the Methow River, thereby boosting its demographic abundance.

Research, Education, Outreach and Cultural Benefits

- Educational benefit from school groups visitations.
- Research benefit from providing a study population for conventional versus NATURES (natural) rearing.

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 in a watershed,[45] the Review Team identified the following benefits of this program:

Conservation Benefits

- Conservation benefit from nutrients added to ecosystem by both carcass outplants and natural spawning of hatchery-origin adults.

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:

[44] *See Components of This Report for a description of these potential benefits and risks.*
[45] *Ibid.*
[46] *Ibid.*

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Genetic Risks

- Genetic risk from domestication effects on the ESA-listed Methow River population, due to an insufficient number of natural-origin adults in the hatchery broodstock versus the proportion of hatchery-origin adults spawning naturally.

Demographic Risks

- Demographic risk from pathogen amplification (monitoring is ongoing).

- Demographic risk from over-sizing the supplementation program based on hatchery production capacity, rather than the biological needs of the stock and capacity of the habitat. (i.e., too many hatchery fish allowed to spawn naturally)

Ecological Risks

- Ecological risk from all returning hatchery-origin adults not retained for broodstock spawning naturally in the Methow River, most within the immediate vicinity of Winthrop NFH. This may be inhibiting the potential recovery opportunity of these adults (versus outplanting into other possible habitats). (too many hatchery-origin adults concentrated in a very small area).

- Ecological risk from not taking into account competition for food and space on fish from this program from existing flora and fauna that have occupied this habitat formerly occupied by salmonids.

- Ecological risk from antibiotic resistance in bacterial flora within naturally-spawning component from erythromycin injections and therapeutic use of medicated feeds for hatchery-reared fish, and antibiotics in effluent.

- Ecological risk of pathogen transmission if carcass outplants are still occurring (We did not see any information regarding pathogen analyses of carcasses if outplanting is occurring).

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:

Ecological Risks

- Ecological risk from not taking into account competition for food and space from fish from this program on existing flora and fauna that have occupied this habitat formerly occupied by salmonids. (too many hatchery fish allowed to spawn naturally in a concentrated area).

- Ecological risk from using the effluent pond for kids' trout fishing derby (makes cleaning the pond more difficult, may reduce water quality, may amplify pathogen transmission).

- Ecological risk of pathogen transmission if carcass outplanting is still occurring.

[47] *Ibid.*

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- Ecological risk from non-treatment of wastewater, although cleaning effluent water is discharged into a settling pond and meets most recent NPDES standards.

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.

Broodstock Choice and Collection

Issue WT1: The existing facilities for collecting natural-origin adults for broodstock (at the hatchery and at Foghorn Dam) are inadequate to meet the conservation objectives for the broodstock.

Issue WT2: The proportion of natural spawning spring Chinook composed of hatchery-origin adults is unknown upstream of Foghorn Dam, thus posing an unknown genetic risk to the naturally spawning population.

Recommendation WT1: Improve adult collection at Foghorn Dam or create a new facility, to: (a) trap natural-origin adults for broodstock; and (b) allow biosampling, enumeration, and control of natural and hatchery-origin adults passed upstream for natural spawning in the upper Methow River.

Recommendation WT2: Use the improved adult collection facility to remove hatchery-origin adults surplus to supplementation and natural-spawning goals, thus providing additional opportunities for supplementation spawning elsewhere (e.g., Okanogan River).

Hatchery and Natural Spawning, Adult Returns

Issue WT3: Hatchery-origin Methow Composite spring Chinook (identified by the presence of an unclipped adipose fin and a coded-wire tag) in excess of broodstock needs are either returned directly to the river or are blocked from entering the Winthrop NFH. Uncontrolled numbers of these fish can spawn naturally within the immediate vicinity of the hatchery.

[48] *The Review Team believes that the Winthrop Hatchery Evaluation Team—as a whole, in task teams and/or with outside assistance and expertise—will be the logical body to implement most of the following recommendations.*

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Recommendation WT3: Trap all returning hatchery-origin spring Chinook at Winthrop NFH and outplant all ESU Methow Composite fish - in excess of broodstock needs - into areas designated for restoration and supplementation in the upper Methow River, consistent with approved NOAA Fisheries recovery plans and comanager management plans for spring Chinook. Outplant adults in the Okanogan River and other sites in return years that exceed supplementation needs in the Methow River.

Incubation and Rearing

The Review Team did not identify any incubation or rearing issues for spring Chinook at the Winthrop NFH.

Release and Outmigration

Issue WT4: No specific mechanism is in place to use hatchery-origin fish to help restore or supplement spring Chinook to the upper Methow River and tributaries (e.g., Early Winters Creek and Lost River).

Recommendation WT4: Create acclimation and release sites in the upper Methow watershed consistent with approved NOAA Fisheries recovery plans and comanager management plans for spring Chinook.

Facilities and Operations

Issue WT5: Insulation is falling from the ceilings of the raceway covers into water with fish, creating a potential fish and human health hazards.

Recommendation WT5: Repair insulation in ceilings of raceway covers.

Issue WT6: The "A" and "C" banks of ponds are deteriorated and lack permanent covers.

Recommendation WT6: Reconstruct ponds as raceways and construct covers.

Issue WT7: Adult collection, holding and spawning facilities are inadequate, and partially completed adult holding facility is unusable.

Recommendation WT7 - Rehabilitate and reconstruct existing adult collection, holding, and spawning facilities to meet hatchery program needs. Hatchery staff have proposed a modification that should be considered.

Issue WT8: The effluent pond has not been cleaned for several years, is difficult to clean because of the earthen bottom, and is used as a rainbow trout pond for Kid's Fishing Day (see outreach recommendations below)*. A new NPDES permit may impose additional requirements.*

Recommendation WT8a - Continue to work with EPA to complete the NPDES permitting process.

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Recommendation WT8b - Build a lined, easily cleanable settling pond for the effluent.

Research, Monitoring, and Accountability

Issue WT9: Although the Winthrop NFH was established in the 1940s as part of the mitigation package for fish losses due to Grand Coulee Dam, it is unclear how the current program is addressing mitigation responsibilities. The current program lacks defined goals for meeting mitigation responsibilities and providing quantifiable harvest benefits.

Recommendation WT9 - Work with other salmonid managers to review mitigation goals and objectives to ensure that mitigation activities are consistent with current conditions in the Methow River and mid-Columbia region. Include newly-developed goals and objectives into a new *Hatchery and Genetic Management Plan* (HGMP) for this program. . As part of this HGMP, an M&E program should be developed for monitoring progress towards meeting the mitigation goals and objectives of the program. Improve coordination of M&E among salmonid managers in the watershed.

Issue WT10: Implementation of the mitigation responsibilities of the Winthrop NFH need to be consistent with the conservation and recovery of upper Columbia spring Chinook. However, specific goals and objectives for the program's contribution to the conservation effort have not been identified. Moreover, the potential contribution of the existing program to that effort is not readily apparent.

Recommendation WT10 - Work with other salmonid managers to create specific goals and objectives for this stock's contribution to the conservation and recovery of upper Columbia spring Chinook. These goals should be quantified including number of adults needed for broodstock; proportion and number of hatchery-origin fish on the spawning grounds; number of progeny to be released in defined locations; etc. Use these goals and objectives as the basis for a new HGMP for this program. As part of this HGMP, an M&E program should be developed for monitoring progress towards meeting the conservation goals and objectives of the program.

Education/Outreach

Issue WT11: The Leavenworth National Fish Hatchery Complex houses one of the most comprehensive Information and Education Outreach Departments in the National Fish Hatchery System. However, the outreach office is located at the Leavenworth NFH.

Recommendation WT11a - Continue, and look for opportunities to expand educational and outreach activities at the Winthrop NFH. Evaluate the benefits and outcomes of those activities.

Recommendation WT11b - Seek additional opportunities to coordinate with tribal youth training programs to enhance fishery training opportunities for tribal members at the Winthrop NFH.

Issue WT12: Maintaining rainbow trout in the effluent pond to support Kids' Fishing Derby is a concern and may present a future liability risk.

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Recommendation WT12: Move kids fishing derby to another location, either at this facility or offsite, or build a lined, easily cleanable settling pond for the effluent and leave the present pond for kid's fishing.

Alternatives to Current Program[49]

The Review Team considered the benefits and risks of the existing spring Chinook program at the Winthrop NFH 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 a recommended alternative (or alternatives).

**Alternative 1: Current program with recommendations*

Maintain existing spring Chinook program with full implementation of all recommended changes. Continue rearing 600,000 Methow Composite stock spring Chinook**.** Develop and implement conservation goals based on integrated broodstock strategies.

Pros

- Consistent with ESA concerns for spring Chinook in the Methow River and previous comanager agreements.

Cons

- Does not make a distinction between the management goals for the Winthrop NFH from those for the Methow State Hatchery.
- Produces and releases hatchery-origin fish that substantially exceed conservation goals and objectives, and existing carrying capacities for spring Chinook in the Methow River.
- Provides no defined or potential harvest benefit.
- The number of natural-origin spring Chinook returning to the Methow River each year is, most likely, insufficient to meet genetic integration guidelines for both the Methow State Hatchery and the Winthrop NFH, even if a weir were constructed in the mainstem Methow River to trap adults for broodstock.
- Precludes potential opportunities to develop a self-sufficient hatchery program for steelhead that would be sufficiently large to meet minimum desired numbers of adult broodstock each year and would require that some eyed eggs would continue to be obtained from adults trapped and spawned at Wells Dam to meet minimum, desired numbers of parents contributing to steelhead juveniles released from the Winthrop NFH.

[49] *Alternatives with asterisks (*) were favored by the Review Team relative to alternatives without asterisks.*

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**Alternative 2: Integrated "stepping stone" spring Chinook conservation and harvest program*

Adopt the facility and infrastructure recommendations for the current spring Chinook program but work with WDFW and the Methow State Hatchery to develop a "stepping stone" broodstock strategy that would not require direct take of wild fish for broodstock, but would allow the Winthrop stock to be genetically integrated with the Methow Composite stock propagated at Methow SFH. Such an approach would contribute demographically towards conservation and harvest objectives for spring Chinook in the mid-Columbia region (e.g. Colville Tribe's Master Plan), while potentially providing harvest opportunities after special permitting. It would also provide a stock more genetically similar to the natural-spawning population for restoring spring Chinook to the Okanogan River and would reduce straying risks (e.g. compared to Carson-strain hatchery stocks from the Leavenworth and Entiat NFHs). See figure on following page.

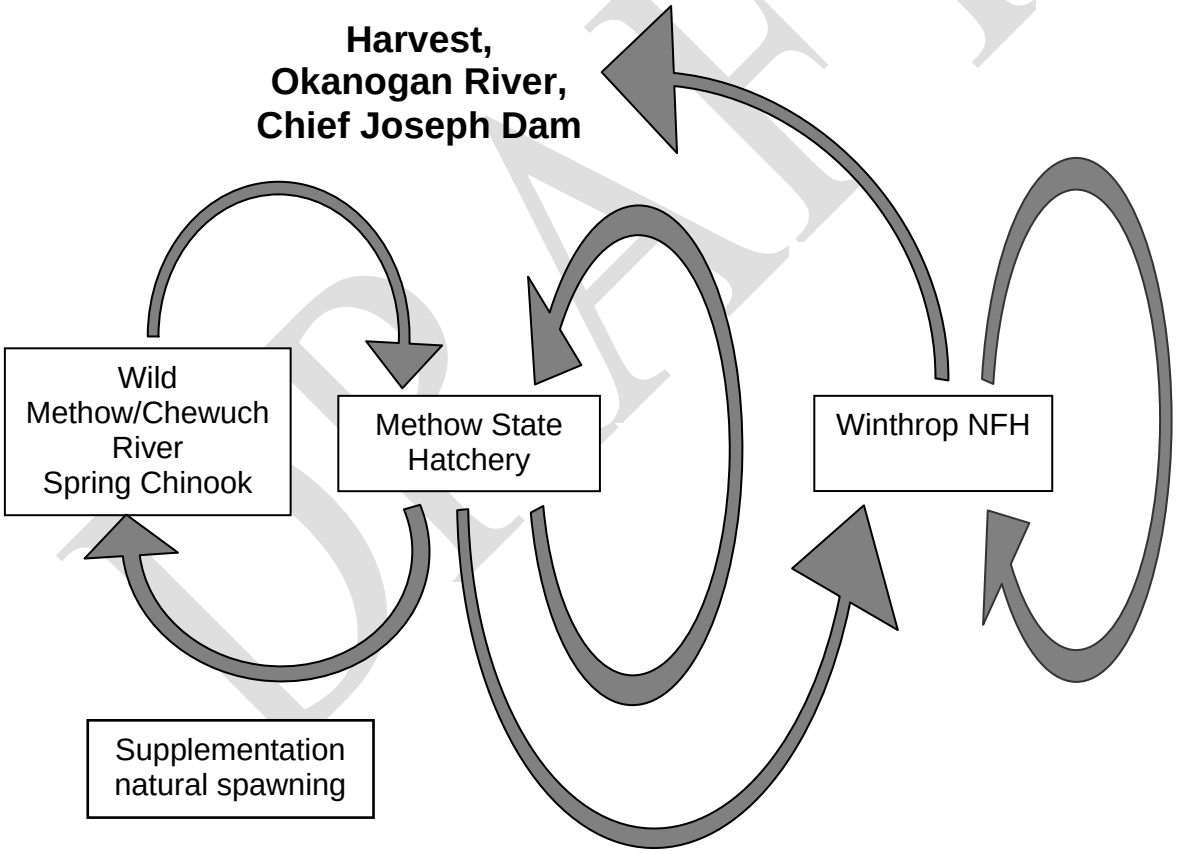

Figure 7. "Stepping stone" gene flow diagram for the spring Chinook broodstock at the Winthrop NFH integrated genetically with the Methow State Hatchery Composite stock. All fish released from the Winthrop NFH fish would be adipose-fin marked and available for harvest. This scenario requires a weir in the mainstem Methow River so that natural-origin fish could be trapped for the Methow broodstock.

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Pros

- Does not require a direct take on ESA endangered *natural-origin* adults for inclusion of adult fish in the broodstock.
- Allows the Methow State Hatchery to focus on conservation objectives within the Methow River subbasin and the Winthrop NFH to focus on harvest objectives and restoration objectives outside the subbasin (e.g. Okanogan River).
- Winthrop NFH broodstock provides an annual outlet for surplus Methow Composite fish (adult broodstock or juveniles) from the Methow State Hatchery that exceed broodstock or supplementation needs in the Methow River.
- Allows the size of the Methow Composite stock and the number of hatchery-origin fish allowed to spawn naturally to be adjusted proportionately to the capacity of the habitat and the number of natural-origin adults spawning naturally.
- Provides a scientifically defensible, legal mechanism for NOAA-Fisheries to permit a direct harvest (take) on listed, hatchery-origin spring Chinook in the mainstem Columbia River upstream of the confluence of the Methow River with little harvest risk to natural origin ESA-listed spring Chinook in the Methow River subbasin.

Cons

- Special permits from NOAA Fisheries may be needed to allow a direct harvest (take) on hatchery-origin fish that are listed as endangered under the ESA.
- Requires construction of a weir in the mainstem Methow River to provide natural-origin adults for the Methow Composite broodstock. However, such a weir is necessary under all alternatives if the Methow Composite broodstock is to meet its inherent objectives.

Alternative 3: Alternative 1, but with reduced releases in the Methow River to provide releases in the upper Columbia region.

Adopt the facility and infrastructure recommendations for the current spring Chinook program but reduce juvenile releases of spring Chinook into the Methow River and transfer the non-released fish for a segregated harvest program in the mainstem Columbia River below Chief Joseph Dam and/or a natural population restoration program in the Okanogan River Basin consistent with the Master Plan of the Colville Confederated Tribes.

Pros

- Provides an immediate source of spring Chinook for potential harvest by the Colville Tribe.
- Could be combined with most of the other alternatives (e.g. Alternative 2), particularly in years when the number of adult returns back to the Winthrop NFH exceed broodstock requirements.

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- Alleviates straying concerns associated with the use of Carson-strain spring Chinook from the Entiat and Leavenworth NFHs for restoring spring Chinook populations and fisheries in the Okanogan River and below Chief Joseph Dam, respectively.

Cons

- Special permits from NOAA Fisheries may be needed to allow a direct harvest (take) on hatchery-origin fish that are listed as endangered under the ESA.

- Would need to be renegotiated under U.S. vs. Oregon. (This is true for most alternatives)

Alternative 4: Collect spring Chinook broodstock at Wells Dam

Replace current broodstock with spring Chinook broodstock collected from natural-origin fish at Wells Dam in the same manner that summer Chinook and steelhead hatchery programs are currently maintained by the Washington Department of Fish and Wildlife.

Pros

- Provides a ready-source of natural-origin adults for the Winthrop NFH broodstock so that the goals of genetic integration can be attained.

- Focuses the mission of the Winthrop NFH on conservation and recovery of endangered spring Chinook salmon as part of its overall mitigation responsibility.

- Substantially reduces broodstock domestication risks in the near term until adequate adult trapping facilities on the mainstem Methow River can be developed.

Cons

- Leads to genetic mixing of multiple subpopulations (Twisp, Chewuch, Methow rivers) and precludes restoration and development of a locally-adapted population in the Okanogan River.

- Essentially replaces one risk (domestication) with another risk (loss of between-population genetic diversity).

- Inconsistent with comanager desires to develop and maintain separate trapping and broodstock programs for the Methow, Chewuch, Twisp, and Okanogan rivers.

- Inconsistent with comanagers desires for steelhead and summer Chinook, which are to develop separate trapping and broodstock programs for the Methow and Okanogan rivers.

**Alternative 5: Alternative 2 with reduced program size to accommodate a larger steelhead program.*

Adopt Alternative 2, but reduce size of spring Chinook program and increase size of steelhead program at Winthrop NFH.

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Pros

- Same pros as Alternative 2.
- Reduces number of released spring Chinook that are currently in excess of the supplementation needs and carrying capacity the Methow River.
- Allows a local broodstock for steelhead to be developed consistent with conservation objectives (see program Alternatives for steelhead).

Cons

- Same cons as Alternative 2.

Alternative 6: Integrated coho restoration program

Phase out or reduce the existing spring Chinook program and replace with a tribal integrated coho restoration program.

Pros

- Emphasizes the need to restore a natural salmonid ecosystem as part of the overall conservation and recovery of anadromous salmonid fishes in the Methow River.
- Distinguishes the missions of the Methow SH and the Winthrop NFH, with the Methow SH focusing on endangered spring Chinook and the Winthrop NFH focusing on restoration of coho salmon in the Methow River.
- Would reduce numbers of hatchery-origin spring Chinook released into the Methow River; these releases currently exceed supplementation needs and the estimated carrying capacity of the Methow River.

Cons

- Coho salmon was not identified as a "mitigation" species under the federal acts that authorized mitigation for fish losses imposed by Grand Coulee Dam.
- Replaces an ESA listed species with an unlisted species, which may be inconsistent with the ongoing federal court remand process and the need for hatchery programs to receive "credit" for their contribution to conservation and recovery of listed species.
- Master Plan of the Yakama Nation for restoring coho salmon to the mid-Columbia region may need modification under this alternative.

Alternative 7: Integrated sockeye conservation and harvest program plus an integrated summer Chinook harvest program.

Terminate existing spring Chinook program and initiate an integrated harvest and conservation program for sockeye salmon, derived from the Okanogan Lake stock, with acclimation and release

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sites in the Okanogan River basin. In addition, develop a Summer Chinook integrated harvest program.

Pros

- Same pros as Alternative 6 with respect to substantially reducing releases of spring Chinook in excess of habitat capacities and different defined missions for the Methow State Hatchery and Winthrop NFH
- Sockeye was included in the Grand Coulee mitigation agreement.
- A sockeye program could be phased-out if a new hatchery facility is developed in the Okanogan area to meet mitigation goals for this species.
- Summer Chinook are not listed under the ESA and could provide immediate harvest benefits in the lower Methow, upper Columbia, lower Columbia and/or other areas.
- Both summer Chinook and sockeye could be trapped at Wells Dam.

Cons

- Replaces an ESA listed species with unlisted species, which may be inconsistent with the ongoing federal court remand process and the need for hatchery programs to receive "credit" for their contribution to conservation and recovery of listed species.
- Rearing sockeye at Winthrop NFH would increase on-station disease risks substantially.
- Current status of sockeye salmon in the Okanogan River may not necessitate a hatchery program for conservation purposes at the present time.

Alternative 8: Decommission hatchery

Terminate existing spring Chinook program and decommission hatchery in favor of alternative mitigation strategies such as habitat restoration, removal or bypass of barriers that impede upstream migration, and construction of a new hatchery elsewhere.

Pros

- Would substantially reduce large excesses of released spring Chinook that are currently in excess of the supplementation needs and carrying capacity the Methow River.
- Would eliminate straying of returning hatchery-origin adults between the Methow State Hatchery and the Winthrop NFH.
- Allows conservation efforts for spring Chinook in the Methow River to be concentrated at one facility

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Cons

- Provides no direct conservation or harvest benefit.
- A weir would still need to be developed on the Methow River to meet the hatchery program needs of the Methow State Hatchery.
- Inconsistent with Congressionally-authorized mitigation responsibilities, and alternate hatchery sites are very limited and expensive to develop.

Recommended Alternative

Implement Alternative 5 by developing a "stepping stone" spring Chinook Methow River broodstock at the Winthrop NFH that is integrated genetically with the naturally-integrated conservation-oriented Methow Composite broodstock propagated at the Methow State Hatchery. This alternative includes reducing the size of the spring Chinook program at the Winthrop NFH from the current release level of 600,000 yearling smolts to approximately 400,000 smolts to accommodate a new, "local" Methow River steelhead broodstock program at the Winthrop NFH (see Alternative 2 and recommendations for steelhead program at the Winthrop NFH).

- Hatchery-origin spring Chinook that are surplus to program needs (eggs, juveniles, or adults) should be used to develop a segregated harvest program in the mainstem Columbia River below Chief Joseph Dam and/or a restoration program in the Okanogan River Basin consistent with mitigation responsibilities of BOR, the ESA, and the Master Plan of the Colville Confederated Tribes.
- Continue to provide facilities for coho reintroduction program consistent with the Yakama Nation's Master Plan.
- A long-term goal would be to assist with recovery of spring Chinook in the mid-Columbia region and implement a fully integrated program at some time in the future when sufficient numbers of natural-origin adults are available to fully integrate the Winthrop NFH broodstock with the naturally-spawning population in the Methow River.

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Winthrop NFH Steelhead

Operator: US Fish and Wildlife Service
Cooperator: Wells State Fish Hatchery, Washington Dept. of Fish and Wildlife

Summary of Current Program

Goals

- ***Harvest goal:*** Support recreational and tribal harvests in the Methow River as part of Wells State Fish Hatchery program for steelhead upstream of Wells Dam. The goal of the steelhead program was modified after the stock was listed as endangered in 1997, from strictly harvest augmentation using conventional hatchery techniques to conservation recovery via supplemental natural spawning by hatchery-origin adults.

- ***Broodstock escapement goal:*** The Winthrop NFH has no broodstock escapement goal back to the hatchery because all broodstock collection occurs at Wells Dam by WDFW. However, approximately 56 adults would be necessary to achieve the current program objectives of 125,000 eyed eggs and100,000 yearling smolts.

- ***Conservation goal:*** Assist with recovery of ESA threatened steelhead in the Methow River via supplemental natural spawning by hatchery-origin adults. All hatchery-origin adults returning to the hatchery are precluded from entering the facility and are allowed to spawn naturally in the outflow channel from the hatchery and in the Methow River.

- ***Escapement goal, natural-origin fish:*** The Winthrop NFH has no specific escapement goal for natural-origin steelhead in the Methow River. No natural-origin adults are trapped in the Methow River for broodstock, and all hatchery-origin fish are allowed to spawn naturally.

- ***Education/outreach/cultural goal:*** Same as Winthrop NFH spring Chinook program

Objectives

- Obtain 125,000 eyed steelhead eggs annually from the Wells State Fish Hatchery. Adult steelhead are spawned at the Wells SFH in the ratio of 2:1 hatchery-origin to natural-origin adults to yield approximately two-thirds wild x hatchery (WxH, HxW) and one-third hatchery x hatchery (HxH) progeny. At the present time, all eye eggs transferred to the Winthrop NFH are the progeny of WxH and HxW crosses.

- Volitionally release 100,000 yearling smolts, at an average size of 6.5 fish/pound, from the Winthrop NFH directly into the Methow River from mid-April to mid-May. Juvenile steelhead are 100% adipose fin-clipped but coded wire tags are not applied.

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Program Description

Winthrop NFH is the only Leavenworth Complex facility currently producing steelhead. Winthrop NFH steelhead are part of an integrated hatchery program incorporating wild origin adults into the brood each year. The Winthrop NFH program utilizes adults captured from the upper Columbia River run at large at the Wells Hatchery or Wells Dam collection facilities. Adults are held, spawned, and eyed eggs are transferred to Winthrop NFH for incubation, rearing, and final release from the facility to the Methow River after 15 months of on station rearing. The current status of steelhead in the mid-upper Columbia River region has led NMFS to conclude in their ESA-listing determination regarding steelhead that the Wells Hatchery broodstock presently used by WDFW for supplementation in the region is essential for recovery of the Upper Columbia River Steelhead ESU.

On average 118,400 yearling juveniles (SD = 16,745) have been released from 1996-2005 at an average size of 6.5 fish per pound (SD = 1.1). The USFWS has explored the possibility of developing a unique Methow River steelhead stock as adults can and do return to the hatchery. However, this program would require two-years of on station rearing to mimic the natural production cycle of this stock. Unfortunately, this is not possible given the limited water and rearing space available under Winthrop NFH's current production programs.

Assessment of Current Program

Operational Considerations

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

- Collection of adults for this program is conducted by WDFW at Wells Dam.
- The broodstock collection goal for Methow and the Okanogan River system is 373 fish (452 fish initially, but has been adjusted); and in recent years, 5-12% of the steelhead captured at Wells Dam have been of natural-origin fish (WDFW 1997).
- ESA Section 10 Permit #1395 authorizes WDFW to retain up to 395 adult steelhead for broodstock purposes.
- Recent revisions (BY 04) in the broodstock protocols target a 33% natural origin component (maximum of 123 NOR adults) within the broodstock.
- Broodstock are collected from the east and west fish ladders at Wells Dam between August and November.
- The USFWS has explored the possibility of developing a unique Methow River steelhead stock as adults can and do return to the hatchery. For the past several years, numerous steelhead adults (hatchery and wild) returned to and spawned in the channel that connects the adult collection

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ladder (WNFH) to the Methow River. A current issue is whether steelhead adults should be collected at Winthrop NFH for the current program.

- However, a local broodstock program would require two-years of on station rearing to mimic the natural production cycle of this stock. Unfortunately, this is not possible given the limited water and rearing space available under Winthrop NFH's current production programs.

- In past years, eyed eggs transferred to Winthrop NFH were the progeny of hatchery x hatchery (HxH) crosses

- The increase in proportion of natural origin fish in the broodstock from a proportion equal to the run (4-12%) to 33% provided a 100% HxW parental cross for the 2004 Brood Year for the Methow River releases. The program will target 100% HxW progeny for recovery in the Methow River Basin

Hatchery and Natural Spawning, Adult Returns

- The hatchery outfall channel has been enhanced for natural spawning adult steelhead that return to Winthrop NFH.

- Spawning surveys and redd counts are conducted each spring on the channel by Service personnel for inclusion in watershed-wide steelhead spawning surveys.

- Adult steelhead returning to Winthrop NFH are blocked from entering the facility and allowed to move back out to the Methow River and its tributaries to spawn naturally.

- Smolt to adult survival evaluations on steelhead released from Winthrop have been limited to only a few years of differential marking. The first year of the program (1995), all steelhead were right ventral fin clipped and the second year all fish were blank-wire tagged. Returns were quite poor throughout the basin during these years and the data collected from these marking schemes suggested SARs in the range of 0.12–0.24%.

Incubation and Rearing

- Eyed eggs are received from Wells SFH in January or February

- All incubation takes place in 47°–50° F ground water

- Formalin treatments are not necessary during incubation.

- The density index is maintained at or below 0.20 lbs/cu.ft./in. throughout the rearing cycle.

Release and Outmigration

- Smolts are volitionally released directly into the outfall channel at a size of 6–8 fish per pound to minimize interactions with other fish populations. Detection of PIT tagged fish at McNary and Bonneville Dams' bypass facilities provides evidence of rapid movement of smolts released from Winthrop NFH.

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- A small percentage of steelhead are seen migrating downstream approximately one year later, the following spring. These juvenile steelhead are apparently residing in the river system an additional year before being physiologically ready to migrate to sea. Since these fish are a listed stock and the percentage is less than one percent, it is likely there is very minimal competition with wild fish in the river system.

Facilities and Operations

- See Winthrop NFH spring Chinook section.

Research, Education, and Outreach

- See Winthrop NFH spring Chinook section.

Benefit and Risk Assessment

BENEFITS CONFERRED TO 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,[50] the Review Team identified the following benefits of this hatchery program:

Harvest Benefits

- Harvest benefit from the recreational fishery in the Methow and upper Columbia rivers. This is one of only two recreational harvest opportunities for anadromous salmonids in mid-Columbia River tributaries. The other opportunity is the spring Chinook recreational fishery in Icicle Creek immediately downstream from the Leavenworth NFH.

- Harvest benefit from treaty and non-treaty mixed stock fisheries in the lower Columbia River is assumed.

Conservation Benefits

- Conservation benefit from increasing the demographic abundance and spatial distribution of this ESA-listed population.

- Conservation benefit from ensuring a relatively large effective number of breeders for broodstock by trapping broodstock at Wells Dam.

Research, Education, Outreach, and Cultural Benefits

- Research benefit from providing a population for a study comparing volitional versus forced releases.

- Educational benefit from school groups visitations.

- Cultural benefit from Kids Fishing Day.

[50] *See Components of This Report for a description of these potential benefits and risks.*

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BENEFITS CONFERRED TO OTHER STOCKS, SPECIES, AND COMMUNITIES

The Review Team did not identify any benefits in this category from the current steelhead program.

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 and local community,[51] the Review Team identified the following risks of the hatchery program:

Genetic

- Genetic risk from preventing local adaptation and between-population genetic diversity (for example, between Methow and Okanogan steelhead) by collecting broodstock at Wells Dam.
- Genetic risk if broodstock sent to Winthrop are not representative of temporal distribution of the run at Wells Dam. (Broodstock history of parents unknown).
- Genetic domestication risk from creating a life history strategy (release and outmigration at one year) that does not mirror natural steelhead populations. (Could be a minor risk).

Demographic

- Demographic risk from sizing the supplementation program based on the size of the harvest program it replaced at Leavenworth NFH, rather than the biological needs of the stock and capacity of the habitat.
- Demographic risk from removing natural-origin fish of undetermined upriver destination at Wells Dam for broodstock.
- Demographic risk from pathogen amplification.

Ecological

- Ecological risk from not taking into account competition for food and space on fish from this program from existing flora and fauna that have occupied this habitat formerly occupied by salmonids. (Steelhead niche may need to be re-established).
- Ecological risk if juveniles from this program are competing with and/or preying on natural-origin summer steelhead.
- Ecological risk from all returning hatchery-origin adults not retained for broodstock spawning naturally in the Methow River, most within the immediate vicinity of Winthrop NFH. This may be inhibiting the potential recovery opportunity of these adults (versus outplanting into other possible habitats).

[51] *Ibid.*

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, species, and communities,[52] the Review Team identified the following risks from the hatchery program:

Ecological

- Ecological risk from not taking into account competition for food and space from fish from this program on existing flora and fauna that have occupied this habitat formerly occupied by salmonids.
- Ecological risk and uncertainty from inadequate monitoring to assess levels of straying and spawning by these fish to other watersheds, including lower Columbia River tributaries.
- Ecological risk from non-regular cleaning of effluent settling pond and non-treatment of hatchery outflow water, although cleaning effluent water discharged into the settling pond meets the most recent NPDES standards.

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Recommendations for Current Program[53]

The Review Team considered all the benefits and risks outlined in the preceding section. The Team concluded that many 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 address those risks or potential problems considered by the Review Team to warrant a potential modification or adjustment to the current program, as well as to maximize benefits. Preceding each numbered recommendation is a brief summary of the issue.

Broodstock Choice and Collection

Issue WT13: Fertilized eggs for this program comes from adults captured at Wells Dam, rather than adults returning to the Methow River. *The collection of broodstock at Wells Dam prevents development of locally-adapted stocks to the Methow and Okanogan rivers, including the establishment of natural population structures within each watershed.*

Issue WT14: The proportion of natural spawners composed of hatchery-origin adults on spawning grounds upstream of Foghorn Dam is unknown and uncontrolled. *The uncontrolled natural spawning of hatchery-origin adults prevents development of locally-adapted natural populations.*

[52] *Ibid.*
[53] *The Review Team believes that the Winthrop Hatchery Evaluation Team—as a whole, in task teams and/or with outside assistance and expertise—will be the logical body to implement most of the following recommendations.*

Recommendation WT13: Improve adult collection at Foghorn Dam, or create a new facility, to: (a) trap natural-origin adults for broodstock; and (b) allow biosampling, enumeration, and control of natural and hatchery-origin adults passed upstream for natural spawning in the upper Methow River. **Recommendation WT14a:** As part of this strategy to develop a local broodstock at Winthrop NFH, ensure that steelhead of Wells Dam origin are not released above Foghorn Dam.

Recommendation WT14b: Use this improved facility to remove hatchery-origin adults surplus to supplementation goals.

Issue WT15: Small number of adults used for broodstock (54 adults, to achieve a release of 100,000 smolts) may not adequately represent the genetic diversity of the source population.

Recommendation WT15 - Use a minimum of 100 adults for broodstock, to increase the effective number of breeders per year (assuming natural returns can support this; e.g. 50 natural-origin and 50 hatchery-origin adults/year).

Incubation/Rearing

Issue WT16: Effluent pond does not have a current permit and permitting standards may be changing.

Recommendation WT16 - Continue to work with EPA to complete the NPDES permitting process.

Issue WT17: Trapping adults for broodstock at the Winthrop NFH may require a two-year smolt release program because adults would be trapped later and held in colder water than what currently occurs at Wells Dam. *Therefore, the rearing season for progeny is shorter than occurs currently, precluding the ability of steelhead juveniles to achieve smoltification at one year of age. Current facilities and programming at Winthrop NFH do not allow rearing two-year smolts (which also more closely mimics natural steelhead life history). However, rearing two-year smolts creates increased fish health risks relative to producing one-year smolts.*

Recommendation WT17 - Rear two-year steelhead smolts if space becomes available at the facility through program or facility modifications and/or explore the use of heated water or other environmental manipulations to produce one-year smolts if collecting and spawning adults from throughout their temporal range of availability would otherwise result in two-year smolts. Monitor and evaluate the benefits and risks of rearing two-year smolts versus one-year smolts to determine the optimum rearing protocols for maintaining a broodstock and rearing program for steelhead at the Winthrop NFH.

Release/Outmigration

Issue WT18: WDFW currently releases 100K Wells Hatchery summer steelhead smolts near Mazama, well upstream of Foghorn Dam, to provide harvest opportunities and assist with hatchery supplementation of natural populations. They also release 100K smolts in the Chewuch about 10 miles upstream of the confluence with the Methow River.

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Recommendation WT18: Work with the comanagers to develop local broodstock and replace Wells Hatchery steelhead smolts with Winthrop NFH smolts for upstream releases in the Methow and Chewuch Rivers. This may include development of acclimation and release facilities in the upper Methow watershed.

Hatchery and Natural Spawning, Adult Returns

Issue WT19: Most hatchery-origin summer steelhead blocked from Winthrop NFH spawn naturally within the vicinity of the hatchery.

Recommendation WT19: Trap returning hatchery-origin steelhead at Winthrop NFH and outplant them into areas designated for restoration and supplementation in the upper Methow River (and in other sites in return years that exceed supplementation needs in the Methow).

Facilities and Operations

(See Winthrop spring Chinook program for additional recommendations)

Issue WT20: The "B" bank of Foster-Lucas ponds are now unused, but could provide needed rearing space for steelhead if a local broodstock program is developed.

Recommendation WT20: Convert the unused "B" bank Foster-Lucas ponds to covered raceways, and plumb a water line from infiltration gallery #2 to provide isolated ground water and maintain the ability to mix river and ground water. (Note: The groundwater line from gallery #2 is already close to the "B" bank Foster-Lucas ponds.

Research, Monitoring, and Accountability

Issue WT21: Lack of information about distribution, contribution to fisheries, survival and stray rates on these fish.

Recommendation WT21a: Mark all releases from this program with a coded wire tag or representative mark. Conduct creel surveys to recover CWTs and determine contribution of these fish to harvest.

Recommendation WT21b: Expand and improve M&E programs; they are critical to assuring that the hatchery program is maximizing benefits and minimizing risks. Improve coordination of M&E among salmonid managers in the watershed.

Issue WT22: Winthrop NFH summer steelhead are playing a role in the restoration of upper Columbia summer steelhead. However, specific goals and objectives for this stock's contribution to that restoration effort have not been identified.

Issue WT23: Winthrop NFH was established in the 1940s as part of the mitigation package for Grand Coulee Dam. It is unclear how the current steelhead program is addressing mitigation responsibilities.

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Recommendation WT22: Work with other salmonid managers to create specific goals and objectives for this stock's contribution to the restoration of upper Columbia summer steelhead. These goals should be quantified including number of adults needed for broodstock; proportion and number of hatchery-origin fish on the spawning grounds; number of progeny to be released in defined locations; etc. Use these goals and objectives as the basis for a new HGMP on this program.

Recommendation WT23: Work with other salmonid managers to review mitigation goals and objectives, to ensure that mitigation activities are consistent with current conditions and meeting obligations. Include these goals and objectives in the new HGMP on this program.

Education and Outreach

See Winthrop NFH spring Chinook program for issues and recommendations regarding education and outreach.

Alternatives to Current Program[54]

The Review Team considered the benefits and risks of the existing steelhead program at the Winthrop NFH and developed three 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 a recommended alternative (or alternatives).

**Alternative 1: Current steelhead program with recommendations*

Maintain existing program of 100,000 yearling steelhead with full implementation of all recommended changes including transition to upper Methow broodstock (assumes no reduction in size of current spring Chinook program).

Pros

- Promotes development of a locally-adapted Methow River broodstock that could potentially meet conservation objectives.
- Allows returning, hatchery-origin adults to be trapped for broodstock and removed from the Methow River, thus decreasing potential natural spawning of hatchery-origin adults not intended for supplementation.

[54] *Alternatives with asterisks (*) were favored by the Review Team relative to alternatives without asterisks.*

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Cons

- May require rearing of steelhead juveniles to two years of age prior to release to produce smolts.
- Number of adult spawners necessary for producing 100,000 yearling smolts may be insufficient to meet minimal, genetic effective population size guidelines for integrated programs where supplementation natural spawning of hatchery-origin adults may be desired, either presently or in the future.

**Alternative 2: Increase size of steelhead program*

Implement all recommendations associated with Alternative 1 but increase size of summer steelhead program at Winthrop NFH, to approximately 200,000 smolts (minimum of 100 adult spawners), coupled with reduction in size of existing spring Chinook program.

Pros

- Same pros as Alternative 1.
- Expansion of steelhead program increases the effective number of breeders, thus reducing genetic swamping risks ("Ryman-Lykre effects") associated with supplemental natural spawning of hatchery-origin adults.
- May allow termination of direct outplants of steelhead from the Wells Dam hatchery into Methow River tributaries, thus promoting spatial structure and increased diversity for naturally spawning aggregations of steelhead in the Methow River (spatial structure and diversity are two VSP recovery parameters).
- May promote increased sport fisheries for steelhead in the Methow River, which may provide increased recreational and economic benefits to the local community.
- Provides additional hatchery-origin adults for supplementation natural spawning in the upper watershed, thus potentially contributing to conservation and recovery of summer-run steelhead in the Methow River.

Cons

- May require rearing steelhead juveniles to two years of age prior to release to produce smolts.
- May increase disease risks if two-year smolts are required, or may require heated water to yield smolts in one year.

Alternative 3: Terminate steelhead program

Terminate existing summer steelhead program in favor of alternative mitigation strategies such as habitat restoration, removal or bypass of barriers that impede upstream migration, and construction of a new hatchery elsewhere.

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Pros

- The Review Team did not identify any potential benefits, other than economic, of terminating the steelhead program.

Cons

- Provides no direct conservation or harvest benefit.
- A weir would still need to be developed on the Methow River to meet the hatchery program needs of the Methow State Hatchery for spring Chinook.
- Inconsistent with Congressionally-authorized mitigation responsibilities, and alternate hatchery sites are very limited and expensive to develop.

Recommended Alternative

Implement Alternative 2 and develop a local steelhead broodstock at the Winthrop National Fish Hatchery based on a minimum broodstock size of 100 adults per year (200,000 smolts released per year).

- Coordinate implementation of Alternative 2 with the recommendations for spring Chinook at the Winthrop NFH.
- Continue to provide facilities for coho reintroduction program consistent with the Yakama Nation's Master Plan.

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VI. Conclusions

The spring Chinook program at the Leavenworth NFH is the only program of the four programs reviewed here that is providing significant, documented fishery benefits in the mid-Columbia region. The benefits are especially valuable to the Yakama Nation and recreational fishers in Icicle Creek and need to be preserved to the greatest extent possible. However, the current stock of spring Chinook propagated at the Leavenworth NFH is introduced and, thus, provides no direct conservation benefit. Instead, it poses risks to ESA-listed natural populations. Consequently, the Review Team recommends transitioning to a native Wenatchee River broodstock as a long-term goal.

However, the Review Team concluded that transitioning to a native spring Chinook broodstock should not occur until after the failing water intake delivery system at the Leavenworth NFH is replaced. Any native broodstock of spring Chinook propagated at Leavenworth would be included in the current ESA listing, and the present risk of a catastrophic water failure would be unacceptable for an ESA listed stock. In the meantime, the highly beneficial tribal and recreational fishery on spring Chinook in Icicle Creek is at risk due to the failing water intake pipe at the hatchery. Consequently, the Review Team concluded that replacing the water intake system at the Leavenworth NFH should be the Service's highest priority for its hatcheries in the mid-Columbia region at this time.

In the near term, the quickest and easiest way to reduce ESA straying risks of the current broodstock at Leavenworth would be to differentially mark or tag spring Chinook released from state and federal hatcheries so that "straying" adults from the Leavenworth NFH could be identified and selectively removed from the Wenatchee River. This selective removal could occur at Tumwater Dam as part of an ongoing fish trapping and sorting operation.

With respect to replacing the water intake system at the Leavenworth NFH, the Review Team concluded that two options - a gravity feed system at the present location or relocating the intake to a location downstream onto hatchery property - both had merit. The former method would be the simplest operationally and similar to the present system. However, relocating the water intake system downstream also has merit because such a relocation would alleviate the need to retain a pipeline easement across private property. This latter approach also offers the opportunity to completely remove a significant instream structure at the current site of the water intake, particularly if outflow water from the hatchery could be provided directly for irrigation consistent with an existing water rights agreement. In this context, the Review Team concluded that a collaborative effort between the federal agencies (Service and BOR) and stakeholders, similar to the recently initiated PATH process, could greatly facilitate resolution of several inter-related water and fish passage issues in Icicle Creek, particularly with respect to implementing the ESA in Icicle Creek for three listed salmonid species and other federal mandates.

In contrast to the spring Chinook program at the Leavenworth NFH, the spring Chinook program at the Entiat NFH provides little or no measurable benefits, and the Review Team recommends its termination. This termination would free up space for the Entiat NFH to serve as an emergency back-up rearing station for the Leavenworth NFH during construction and other periods of high risk until a new water delivery system at Leavenworth is operational. The Review Team further concluded that an integrated summer Chinook hatchery program at the Entiat NFH offered the greatest potential to provide direct fishery benefits in the Entiat River - and adjacent regions of the Columbia River - in partial fulfillment of federal mitigation responsibilities. The Review Team concluded that the Entiat NFH could also play an important supporting role to the Winthrop NFH for assisting with restoration and recovery of spring Chinook and other imperiled species in the mid and upper Columbia River

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regions (e.g. Okanogan River). These latter objectives include the establishment of terminal fisheries for spring Chinook immediately downstream from Chief Joseph Dam.

The Review Team concluded that the Winthrop NFH offers significant potential to achieve both conservation and fishery objectives for ESA-listed spring Chinook and steelhead in the Methow River and elsewhere (e.g., between Wells and Chief Joseph dams on the Columbia River), but those roles need to be redefined with explicit goals and objectives. Much collaboration will be necessary with state, tribal, and other federal entities – including public utility districts that operate mainstem dams on the Columbia River – for conservation and harvest goals to be achieved. For example, the Review Team concluded that the current spring Chinook programs at the Methow SH and Winthrop NFH will not achieve their intended goals unless capabilities to trap and monitor natural-origin adults in the Methow River are developed. Otherwise, the current programs will simply develop and maintain domesticated hatchery stocks that will pose increasing risks to natural populations. The Review Team further concluded that the Service and the Winthrop NFH should work with the Colville Confederated Tribes to implement the Tribes' Master Plan for spring Chinook in the Okanogan River and the upper Columbia River immediately downstream from Chief Joseph Dam.

Finally, although not directly reviewed here, the Review Team had significant opportunity to examine the Yakama Nation's coho reintroduction program for the mid-Columbia region, including their Master Plan. The Review Team was impressed with this program and its very significant, early successes. Because of those early successes, the Review Team recommends that the Service continue to assist – to the greatest extent possible - the Yakama Nation with their efforts to restore coho salmon to the mid-Columbia region. If those efforts are successful, then other species of anadromous salmonids (e.g. steelhead, spring Chinook) could potentially benefit also via substantial inputs of carcass nutrients and increased ecological stability and complexity of the respective salmonid ecosystems.

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Appendices

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Appendix A: All-H Analyzer (AHA) output for salmon and steelhead stocks in the mid-Columbia Region

(Available from the Columbia Basin Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/)

Appendix B: Mid-Columbia NFHs Briefing Document

Available from the Columbia Basin Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

Appendix C: Comments on Draft Report and Review Team Responses

Available from the Columbia Basin Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

Appendix D. Complete Text of Comment Letters Received from Stakeholders

Available from the Columbia Basin Hatchery Review website, www.fws.gov/pacific/fisheries/hatcheryreview/reports.html/

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