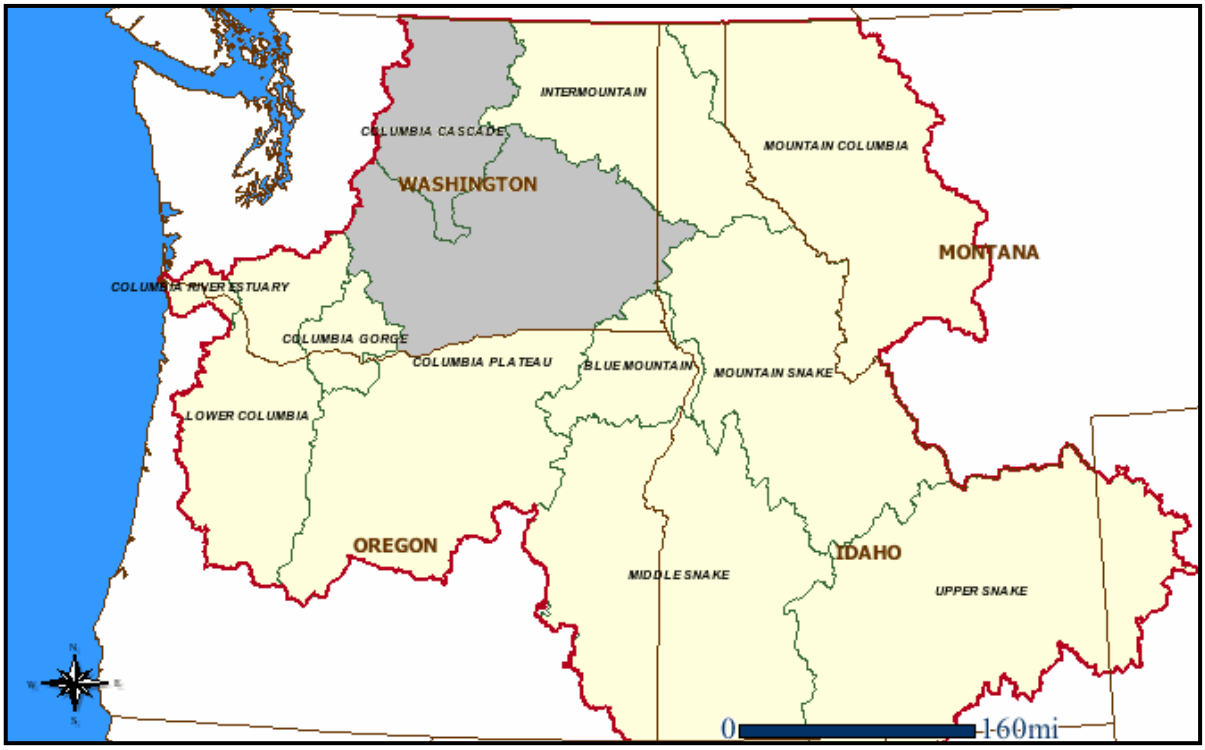
U.S. Fish and Wildlife Service - Pacific Region

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

Final Report

April 2007

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Summary

The U.S. 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 and nine other hatcheries in the Snake River region by the end of 2008.

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) between 1939 and 1942 and are currently operated by the Service with funding from BOR and the Bonneville Power Administration (BPA, 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 or stock within the watersheds affected by each hatchery program: *biological significance, population viability, habitat* conditions, and *harvest* goals or contributions. The Review Team used both short- (10-15 years) and long-term (50–75 years) goals, as identified by the fishery co-managers[3], as a foundation for assessing the benefits and risks of the hatchery programs. Recommendations of the Review Team also reflect short-term and long-term perspectives, with recommendations for current programs addressing short-term needs and recommended alternatives to existing programs addressing long-term goals. Source

[1] *www.hatcheryreform.org*
[2] *www,LLTK.org*
[3] *Comanagers are the Columbia River tribes, Washington Department of Fish and Wildlife, National Marine Fisheries Service (aka NOAA Fisheries), and U.S. Fish and Wildlife Service.*

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.[4]

The Review Team also examined the Master Plan of the Yakama Nation for reintroducing 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 reintroduction 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 at the hatchery include seven wells, Icicle Creek, and supplemental summer releases from Snow and Nada Lakes located in the Alpine Lakes Wilderness within the Icicle Creek watershed. The hatchery hosts the annual Wenatchee River Salmon Festival, an internationally-recognized public outreach and education event held each September. The Leavenworth NFH supports a spring Chinook program and provides facilities for the coho reintroduction program of the Yakama Nation. The operations and maintenance budget for Leavenworth NFH totaled approximately $1.8 million in FY2007.

Spring Chinook Program Overview: This program is intended to operate as a *segregated-harvest* program with only 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 presumed 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 U.S. Endangered Species Act (ESA).

Risks: Water-use and fish passage issues in Icicle Creek are complex and present several problems (see pages 44-54 of main report). The surface water intake pipe for the hatchery is at risk of catastrophic failure. Such a failure places all fish reared on Icicle Creek water at immediate risk of

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

100% mortality. Such a failure would affect both the Service's spring Chinook program and the Yakama Nation's coho reintroduction program. In addition, spring Chinook from the introduced Leavenworth NFH stock pose a genetic risk to ESA listed populations in the upper Wenatchee River via straying and natural spawning. Current management practices increase this risk 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 at Tumwater Dam 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. In addition, passage facilities for upstream-migrating fish around hatchery instream structures 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, although the majority of water is withdrawn by irrigation companies during months of lowest flows.

Recommendations: The Review Team identified 10 specific recommendations to reduce risks and/or improve benefits of the current spring Chinook program. The Review Team was concerned that inter-related water issues for the hatchery and Icicle Creek are being addressed separately and not holistically. The Review Team concluded that a collaborative strategy with stakeholders, similar to the *Project Alternatives Solutions Study* (PASS) process initiated recently by BOR, 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. A specific recommendation of the Review Team is to move promptly to unique marks or tags for Leavenworth NFH and upper Wenatchee River hatchery programs to allow sorting and removal of returning Leavenworth NFH adult spring Chinook at Tumwater Dam. The Team also recommends reducing the rearing densities of juvenile spring Chinook by 25% in raceways at Leavenworth NFH. While these reduced densities will result in reducing the number of smolts released annually, density studies conducted previously at Leavenworth NFH for brood years (BY) 1994-1996 indicate that reduced densities will not decrease the number of returning adults because of increased individual survival.

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 an existing 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 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, Entiat 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. The operations and maintenance budget for Entiat NFH totaled approximately $425,000 in FY2007.

Spring Chinook Program Overview: This program is intended to operate as a *segregated-harvest* program with only 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 reintroduction study by the Colville Confederated Tribes. Over the past several years, up to 50,000 spring Chinook pre-smolts were transferred in October for acclimation and release into Omak Creek, a tributary to the Okanogan River. 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 all returning adults from this program contribute to harvest, primarily in lower Columbia River commercial and recreational fisheries. On the other hand, adult returns to Omak Creek have provided "first salmon ceremonies" to the Colville Confederated Tribes for the first time in decades.

Risks: The absence of a barrier weir results in 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 that the Service use the Entiat NFH for the propagation of Columbia River basin species of high conservation or harvest importance (Alternative 4) including - but not limited to – reintroduction of coho salmon in the Wenatchee and Methow rivers, consistent with the Yakama Nation's Master Plan, and reintroduction of spring Chinook salmon to the upper Columbia and Okanogan rivers consistent with the Colville Confederated Tribe's restoration

plans. Under this recommended alternative, the Entiat NFH would focus on the conservation, recovery, and reintroduction of native fish species in the upper Columbia River to support long-term conservation and harvest goals. These latter goals include use of the spring Chinook stock at the Winthrop NFH to assist with development of a tribal hatchery program and terminal fisheries immediately downstream of Chief Joseph Dam, contingent upon the ability of the spring Chinook program at the Winthrop NFH to first meet its intended goals within the Methow River (see below). Under this recommended alternative, hatchery-origin fish would not necessarily be released into the Entiat River which could serve as a "reference stream" for assessing ESA hatchery recovery efforts elsewhere (e.g. Wenatchee and Methow rivers).

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 Methow 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. The operations and maintenance budget for Winthrop NFH totaled approximately $660,000 in FY2007.

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 historically from natural-origin fish in the Methow River subbasin, but with approximately 25-30% of its current genetic ancestry derived 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 within the Methow River watershed, 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 upstream of Wells Dam on the Columbia River (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 (e.g., endangered ESA status of spring Chinook). 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 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. As an interim measure, natural-origin broodstock could be collected at Wells Dam to reduce domestication risks to the Methow Composite stock. In addition, 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 into designated recovery areas, or spawned and their progeny outplanted, consistent with comanager plans and approved NOAA Fisheries recovery plans. These latter objectives may require development of acclimation release sites and facilities 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 or other suitable location as an 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 WDFW's broodstock program at the Methow SH would focus strictly on recovery objectives within the Methow River watershed while the Winthrop NFH program would focus primarily on harvest objectives 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 to the degree they are not needed to meet in-basin conservation objectives. Fish from this program could then be available for restoration of spring Chinook in the Okanogan River and possibly also for developing a new segregated harvest program in the mainstem Columbia River immediately downstream from Chief Joseph Dam 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, if necessary, to accommodate development of a self-sustaining steelhead broodstock program at the Winthrop NFH but only after spring Chinook conservation needs are met and assuming that one purpose of the steelhead program is to assist with recovery of natural populations (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 pairwise 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), thus resulting in a total smolt release of approximately 420,000 smolts per year into the Methow River.

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. However, beginning with BY 2006, all steelhead released from the Winthrop NFH will receive a coded wire tag. Contribution to recovery of naturally spawning populations is also undocumented, although total returns of natural-origin steelhead intercepted at Wells Dam have recently increased from an average of 368 adults per year (1998-2000) to 836 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. 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 broodstock 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 could increase to approximately 200,000 smolts, thus eliminating the need to release – into the Methow River - progeny of adults trapped at Wells Dam. To accommodate an expanded steelhead program at Winthrop NFH, some reductions in the size of the spring Chinook program may be necessary. However, if conflicts should arise between the spring Chinook and steelhead programs at the Winthrop NFH, the Review Team notes that implementing our recommendations for spring Chinook should have a higher priority than those for steelhead because of the *endangered* listing of the former and their greater harvest value in tribal and non-tribal fisheries.

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 the Entiat NFH should be used to propagate species of high conservation and harvest importance in the mid and upper Columbia River regions, including assisting with reintroduction of coho salmon in the Wenatchee and Methow rivers and reintroduction of spring Chinook to the Okanogan River 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.

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, at the same time, sustaining major fisheries. Uncertainties also exist regarding genetic and ecological interactions between natural- and hatchery-origin fish. Only an objective, collaborative, science-based approach can address these problems in a manner that is both scientifically defensible and accepted by the public.

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

This internal review is modeled after the recent Puget Sound and Coastal Washington Hatchery Reform Project.[5] That project provided a solid template and operational tools (e.g. software spreadsheets, population dynamic models) for reviewing Service hatcheries in the Columbia River Basin. Much of the background information necessary for reviewing hatcheries in the Columbia River Basin has already been compiled in Hatchery and Genetic Management Plans (HGMPs),[6] Comprehensive Hatchery Management Plans (CHMPs),[7] and the Artificial Propagation Review and Evaluation (APRE)[8] database developed by the Northwest Power and Conservation Council (NWPCC).

Based on the recommendations of a Hatchery Review Working Group (Working Group),[9] 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 and 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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[5] *For more information on this project, and for all project publications, see www.hatcheryreform.org.*
[6] *For more information on HGMPs, visit www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/Hatcheries/Hatchery-and-Genetic-Management-Plans.cfm.*
[7] *For more information on CHMPs, visit www.fws.gov/pacific/Fisheries/CHMP.htm.*
[8] *For more information on APRE, visit www.nwcouncil.org/fw/apre/.*
[9] *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 team 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 and coastal Washington hatchery review process.

Review Team members include:

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- **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.
- **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**[10] (Facilitator), Project Director, Long Live the Kings, Seattle, Washington.
- **Michael Schmidt** (Co-Facilitator), Fish Program Coordinator, Long Live the Kings, Seattle, Washington.
- **Amy Gaskill and Cheri Anderson** (Outreach), External Affairs Specialists, USFWS, Pacific Region Fisheries Program, Pacific Regional Office, Portland, Oregon.

[10] *Current address: The Wilderness Society, Seattle, Washington.*

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

The review process began in October 2005 with the Warm Springs National Fish Hatchery (NFH). This hatchery is located on the Warm Springs River, in the Deschutes River watershed/Columbia Plateau province, in Oregon. This review was conducted as a pilot to help the Service test and refine the review process. Fishery 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 for reviewing federal hatcheries in three regions: Mid-Columbia, Lower Columbia, and Lower Snake River. 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); three NFHs in the Snake River region: (Dworshak, Kooskia and Hagerman NFHs), and nine federally-owned hatcheries operated by the states of Washington, Oregon or Idaho as part of the Lower Snake River Compensation Plan (LSRCP). The Service plans to complete reviews of all National Fish Hatcheries by December 2007 and all federally owned facilities in the Snake River region by December 2008.

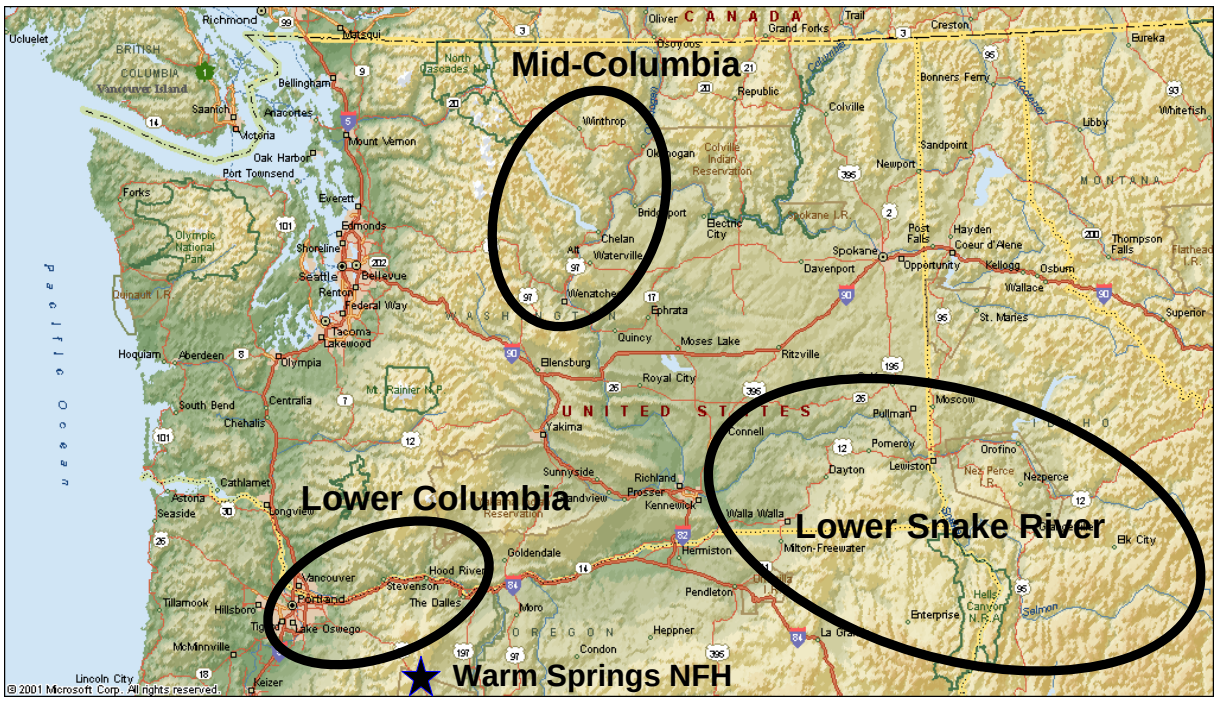

Figure 1. Regions of the Columbia River Basin Hatchery Review Project

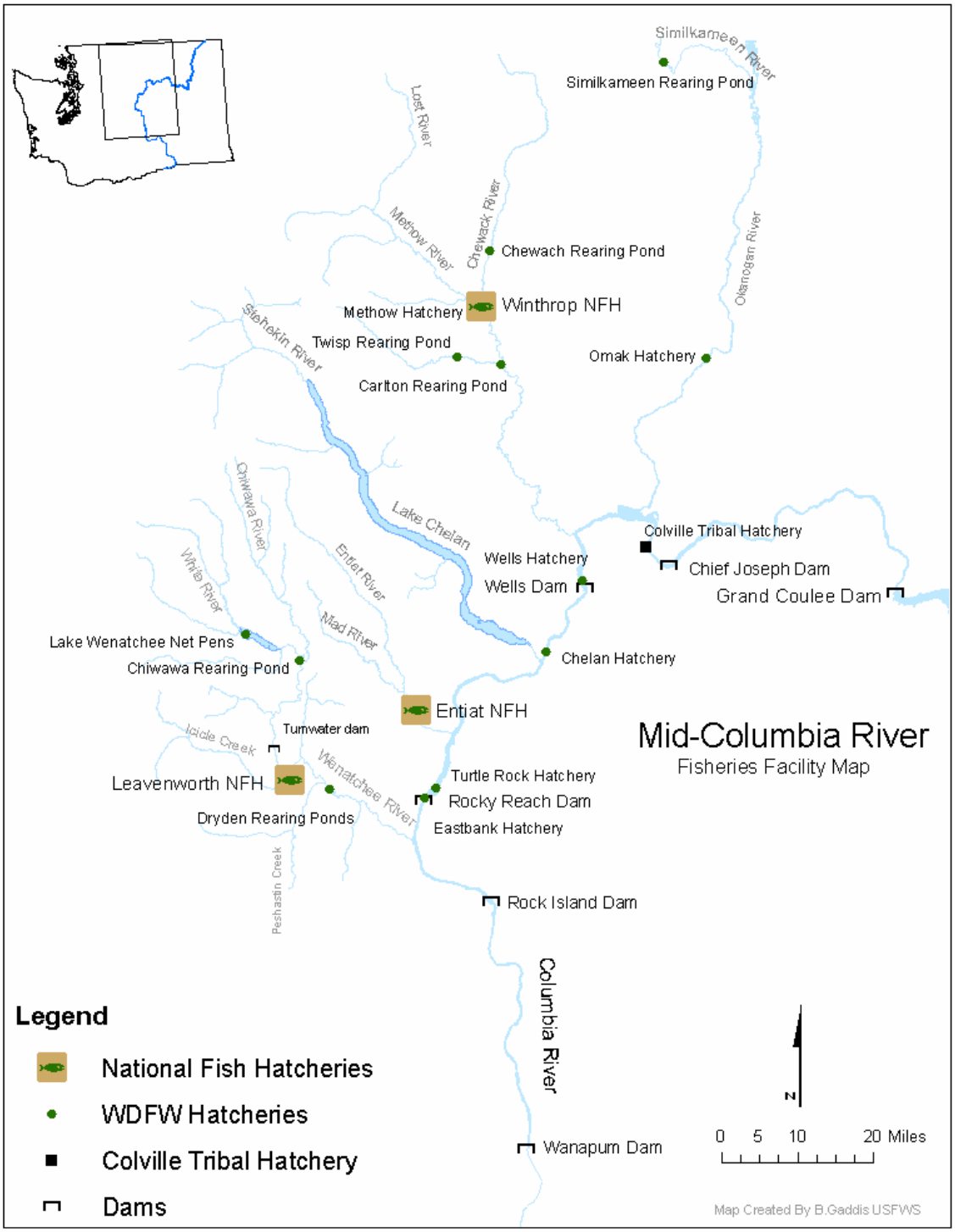

Figure 2. Mid-Columbia Fisheries Facilities

II. Components of this Report

This report provides assessments and recommendations developed from a comprehensive review of current propagation programs at three NFHs in the Mid-Columbia region: Leavenworth, Entiat and Winthrop NFHs (Leavenworth Complex). Recommendations presented herein are based on the best scientific information available at the time of the review. This information includes peer-reviewed scientific information in published works (scientific journals, etc.), agency reports, and pertinent information directly accessible via electronic download. In its review, the Team followed three fundamental principles it adopted from the HSRG (Mobrand et al. 2005[11]): (1) hatchery programs need to have well-defined goals in terms of desired benefits; (2) they must be scientifically defensible; and (3) they need to have programmatic flexibility to respond adaptively to new information.

The Review Team reviewed a large number of background documents, toured the three NFHs and associated habitat features, and received a presentation on a variety of Mid-Columbia salmonid management issues. The Team then met with biologists representing the co-managers and stakeholders to discuss the purpose of the review, hatchery operations, stock goals, and specific issues the co-managers and stakeholders wanted the Review Team to consider. Workshops for gathering that information used the recently-developed All-H Analyzer (AHA) decision support tool[12] to document goals, premises and explore alternatives (Appendix A). All source documents not readily available to the general public are accessible via the Service's hatchery review website[13]. Appendix B of this report summarizes the hatchery information on which the review and recommendations are based.

Based on the information gathered, the Review Team assessed benefits and risks of each hatchery program relative to current or short-term (10-15 years) goals and then drafted a set of preliminary recommendations that would increase or maintain benefits while minimizing or reducing risks, respectively. The Team also examined possible program alternatives at each of the three hatcheries to address long-term (15-50 years or greater) conservation and/or harvest goals. The review concluded with an oral presentation of these findings to the co-managers. The Review Team developed a draft report, circulated it to comanagers for initial comment, and then posted it on the Team's website for one month for public comment. The final report presented here was prepared after written comments on the draft report were received from co-managers and interested stakeholders. Review Team responses to those comments are presented in Appendix C. The complete texts of all written comments received are compiled in Appendix D.

Watershed Overview

The following report contains background overviews of the Wenatchee, Entiat, and Methow river watersheds, respectively. Each overview includes information on geography, fisheries, conservation, habitat, and the current status of each salmonid stock within the respective watershed. Information on the status and hatchery propagation of each stock is summarized in a table for quick reference.

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

[12] *For more information on AHA, see* AHA Technical Discussion Paper *on the Publications page of www.hatcheryreform.org.*

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

Stock Status

An understanding of the current status of each salmonid stock in each watershed was necessary for assessing the benefits and risks associated with each hatchery program. The Review Team summarized the current status of each stock in terms of four population parameters: *biological significance*, *viability, habitat*, and *harvest*. Each of those parameters was given a generalized rating of "high", "medium", or "low" as a foundation for assessing the benefits and risks of each hatchery program. The Review Team also needed to understand the short-term (10–15 years) and long-term (50 years or greater) goals for each salmonid stock within each watershed relative to the four population parameters. However, it was neither the mandate nor the responsibility of the Review Team to perform detailed, scientific assessments of population status. Instead, the Review Team relied on the consensus assessments of the 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 (NMFS, aka NOAA Fisheries), and our own Service biologists. The Review Team also relied on the subbasin plans of the Northwest Power and Conservation Council (NWPCC)[14] and reports of the Interior Columbia Technical Recovery Team (TRT).[15]

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 either *low*, *medium* or *high* biological significance depending on its level of uniqueness and the ability of other stocks to potentially replace it in the occupying habitat if local extirpation were to occur. Stocks with *high* biological significance usually have one or more unique biological characteristics that would be difficult to replace by other stocks of the same species. Consequently, biological significance is not based on the degree to which the stock may be considered essential for recovery or harvest, but rather on its own innate biological attributes within the watershed in which the stock occurs. For example, a particular stock or population may be abundant and productive and, therefore, considered to have high *management* significance for harvest or recovery. However, that stock would not necessarily be considered to have high *biological* significance unless it possessed biological attributes not shared by other stocks of the same species or if all other stocks within the region or DPS/ESU[16] were substantially less viable. This approach thus distinguishes the *evolutionary legacy* of a stock within a particular watershed from co-manager decisions regarding the potential *management value* of that stock. In this context, the *biological significance* rating for each stock described in this report are based on the factors described by Mobrand et al. (2005)[17].

Population viability measures the ability of a stock to sustain itself under current environmental conditions. NOAA Fisheries has assembled several *Technical Recovery Teams* (TRT) to assess viabilities and develop recovery criteria for ESA-listed salmon and steelhead populations throughout the Pacific Northwest. Those assessments involve significant mathematical modeling and attempt to predict extinction probabilities over the next 100 years based on four viability parameters: abundance,

[14] *http://www.nwcouncil.org/fw/subbasinplanning/Default.htm*
[15] *http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Index.cfm*
[16] *Distinct Population Segment (DPS) and Evolutionarily Significant Unit (ESU). ESU is NOAA Fisheries designation for a Distinct Population Segment (DPS) of Pacific Salmon under the U.S. Endangered Species Act. NOAA Fisheries has retained DPS designations for steelhead.*
[17] *Mobrand, L., et al. 2005. Hatchery reform in Washington State: principles and emerging issues. Fisheries 30(6): 11-23.*

productivity, spatial structure, and diversity.[18] Viability estimates for listed salmonid stocks in the mid-Columbia region have recently become available as part of the *Proposed Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan*.[19] Where available, the Review Team relied on those viability estimates, as developed by the Interior Columbia TRT; otherwise, the Review Team relied on the viability criteria of Mobrand et al. (2005)[20]. 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. Estimating the viability of a natural population, including *integrated* hatchery stocks, is difficult and complicated. In contrast, the viability of *segregated* hatchery stocks is relatively simple and is determined primarily by the ability of the stock to sustain itself as a result of hatchery reproduction and the number of adult recruits (R) per adult spawner (S) one generation earlier (R/S).

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 self-sustaining natural populations and genetically *integrated* hatchery broodstocks, including assessment of risks posed by hatchery-origin fish spawning naturally. The productivity and capacity of a watershed are difficult to estimate directly, but 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 enhancements.

Harvest on salmonid fishes occurs at different locations and times and can be assessed by the mean number of adult fish harvested annually in mixed stock ocean fisheries, mainstem Columbia River fisheries, and/or terminal fisheries within the particular sub-basin or watershed under consideration (Appendix A). Harvest parameters can be adjusted in a manner analogous to adjusting habitat parameters (as described above) to identify levels of harvest that are sustainable under a particular set of habitat conditions as measured by productivity and capacity.

Hatchery Programs

Hatchery programs are associated with many salmonid stocks. In general, hatchery programs can be classified according to their type and purpose.

Hatchery programs are classified as either *integrated* or *segregated* according to the genetic goals for the broodstock. Hatchery programs (or broodstocks) are classified as *integrated* if natural-origin fish are systematically included in the broodstock each year with the goal that the natural environment will primarily determine the genetic constitution of hatchery-origin fish. The integrated strategy manages hatchery and wild fish as one population (or one gene pool) that spawns in two different environments

[18] *McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmon populations and the recovery of evolutionary significant units. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-42, Seattle, WA 156pp. Also see www.nwfsc.noaa.gov/trt/trt_Columbia.htm*
[19] *Upper Columbia Salmon Recovery Board, June 2006. Available at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Interior-Columbia/Upper-Columbia/Upper-Col-Plans.cfm*
[20] *Mobrand, L., et al. 2005. Hatchery reform in Washington State: principles and emerging issues. Fisheries 30(6): 11-23.*

but recognizes that the phenotypic performances of hatchery and wild fish can be quite different even when the two components are genetically the same. *Segregated* programs or broodstocks are intended to maintain the hatchery population as a distinct, genetically segregated population via the exclusive use of hatchery-origin adults for broodstock. The segregated 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.

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

Operational Considerations

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

Benefit and Risk Assessment

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

Benefits considered include:

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

Risks considered include:

Genetic Risks

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

Demographic Risks

- Pre-release risks from the hatchery facility and operations on the abundance of the propagated stock including the following: pre-spawning mortality associated with trapping, holding and/or bypassing adults; 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 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 are the same as those outlined above under *Operational Considerations*

Recommendations

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

Considerations. Recommendations for current programs are intended to address short-term goals and needs.

Alternatives

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

III. Wenatchee River Watershed

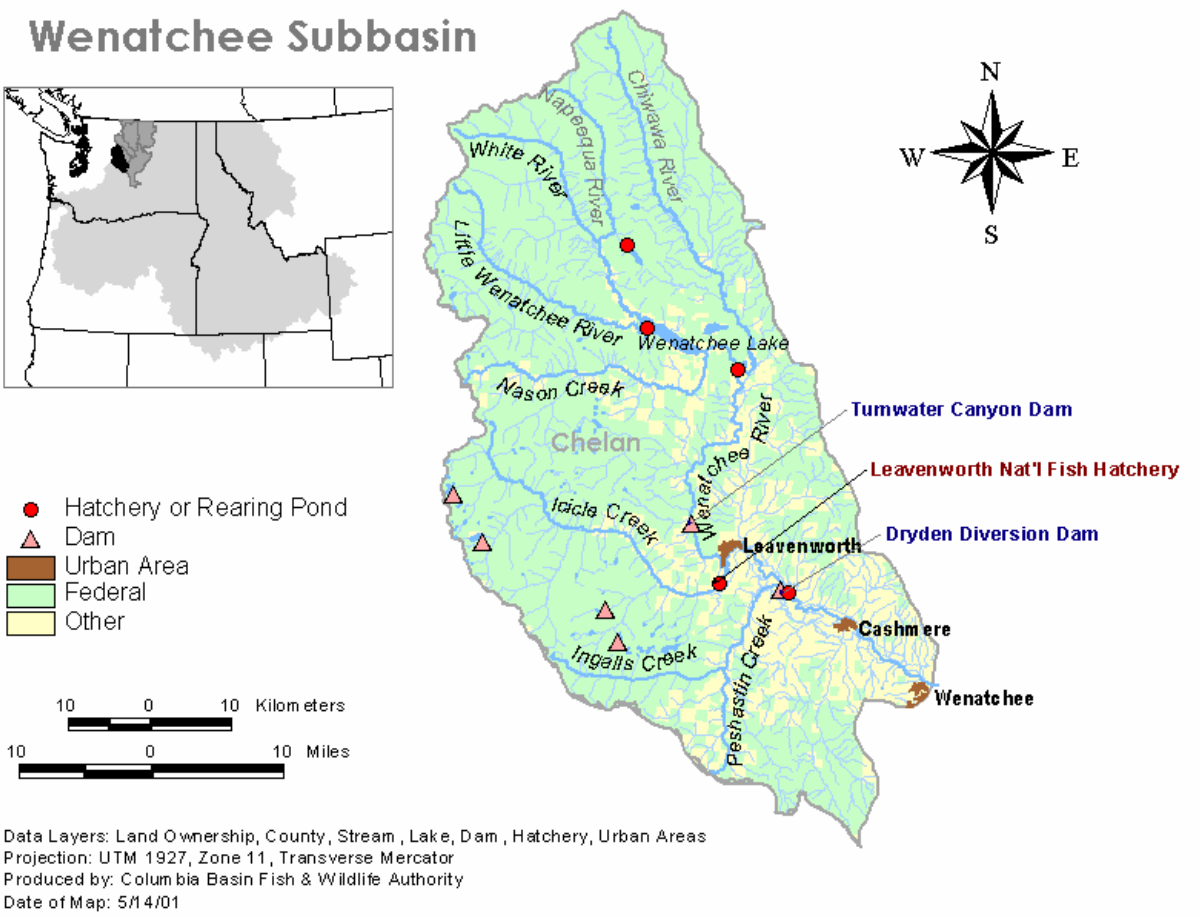

Figure 3. Wenatchee River Watershed Overview Map

Wenatchee River Overview

Watershed Description

The Wenatchee River flows southeasterly off the east slopes of the Cascade Mountains in north central Washington into the Columbia River. The watershed encompasses approximately 1,371 square miles with many 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 Mountain Range. The Little Wenatchee and White Rivers flow into Lake Wenatchee, the source of the Wenatchee River. From the outlet of Lake Wenatchee (RM 54.2), the river descends rapidly through Tumwater Canyon and into a lower gradient section at the town of Leavenworth, where Icicle Creek joins the mainstem. Other major tributaries include Nason Creek, the Chiwawa River, and 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 decreases progressively eastward, resulting in arid conditions near the city of Wenatchee; less than 8.5 inches of precipitation 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. At the present time, the mainstem Wenatchee River is closed to all sport fishing except for mountain whitefish (*Prosopium williamsoni*) downstream from the town of Leavenworth during the winter months (December 1 – March 31). Depending on conditions (see below), limited fisheries on steelhead and sockeye salmon may be allowed on a within-season basis depending on estimated adult returns.

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 support sport and tribal fisheries in 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 in Icicle Creek. 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.[21]

Summer Chinook from the region are harvested in marine and lower Columbia River fisheries. No directed commercial fisheries on upper Columbia summer-run fish have occurred in the mainstem Columbia River 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).

[21] *Cooper (2006).*

Lake Wenatchee sockeye salmon have been harvested incidentally in lower Columbia River fisheries directed at other species. Tribal and non-tribal commercial fisheries for sockeye are allowed when the escapement goal of 75,000 adults at Bonneville Dam has been achieved and sufficient numbers of fish in excess of escapement goals are estimated to be 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 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 *threatened* listing A potential fishery on steelhead may be allowed in the Wenatchee River when (a) the natural-origin steelhead run is predicted to exceed 1,300 fish at Priest Rapids Dam, (b) the total hatchery + wild steelhead run is predicted to exceed 9,550 fish, and (c) the predicted escapement of natural-origin steelhead to the Wenatchee River exceeds 600 fish (WDFW HGMP)

Conservation

The rivers of the mid to upper Columbia River basin were excellent salmonid producing streams historically. Steelhead, spring Chinook, and summer Chinook salmon were formerly abundant in the Wenatchee River subbasin. Sockeye salmon are native to 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 largely decimated because of over-fishing in the lower Columbia River, irrigation diversion practices within the watershed, and habitat degradation related to poor mining practices, grazing, and logging. Bull trout populations were likely fragmented as a result of irrigation diversions dewatering lower reaches of streams and diversion dams creating impassable barriers. The construction of the Grand Coulee Dam in 1939 blocked anadromous salmonids from 1,140 miles of 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 and either used for hatchery brood stock or relocated 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 species is an important management goal in the Wenatchee River watershed. In the short-term, projects designed to treat symptoms of habitat degradation will require long-term salmonid habitat protection and restoration strategies. Anadromous salmonid populations in the Wenatchee River 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, anthropogenic impacts are further affecting habitat quality and quantity. These alterations have occurred primarily 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 residences, water diversion, reduced large woody debris (LWD) recruitment, and flood control measures that include berm construction and stream channelization.

Habitat

Overall habitat functions for salmonid fishes are rated high in the upper Wenatchee River watershed including the Chiwawa River, Little Wenatchee and White rivers. Most habitat concerns within the watershed are focused along transportation and utility corridors (e.g. Nason Creek), and on privately-owned floodplains in lower stream reaches. Maintaining the present level of habitat functionality and connectivity in subbasins of the upper Wenatchee River is considered highly important for sustaining salmonid populations in the watershed.

The mainstem Wenatchee River serves as a migration corridor for spring and summer Chinook, steelhead, sockeye and fluvial bull trout. The mainstem river also maintains connectivity among subbasins within the watershed and to the Columbia River. Changing habitat conditions in the mainstem Wenatchee River (RM 0.0 – 54.2) have the greatest potential to affect the viability of salmonid fishes in the watershed assuming that the level of functionality and connectivity of the upper watershed can be maintained.

Icicle Creek enters the Wenatchee River at the town of Leavenworth and is considered a major tributary; however, Icicle Creek provides only limited spawning habitat to anadromous salmonid fishes. A high gradient boulder field and cascades at RM 5.6, exacerbated by very low water flows during the summer, impedes upstream migration and is believed to be an impassible barrier to Chinook salmon. Instream structures associated with the Leavenworth NFH between RM 2.4 and 4.5 further impede upstream migration, although removal and/or modification of these structures is currently ongoing. A barrier falls exists at RM 24 of Icicle Creek, thus yielding approximately 20 miles of potential anadromous fish habitat upstream of the boulder field. However, the productivity (quality) and capacity (quantity) of this latter habitat for spring Chinook and steelhead have not been quantified and are unknown. Low instream flows and high instream temperatures during the summer months between the boulder field and the mouth of Icicle Creek further inhibit fish productivity.

The subbasins located in the lower portion of the Wenatchee River watershed (e.g., Chumstick, Mission, and Peshastin creeks), downstream from the confluence of Icicle Creek, have been severely altered from their naturally functioning condition and are considered highly fragmented. The estimated abundance of salmon, steelhead and bull trout in those subbasins are believed to be significantly reduced from their presumed historic levels due to land use practices and other management issues, thus reducing their potential to contribute to recovery of naturally spawning populations. Relatively low instream flows in these lower tributaries limit their potential to contribute to improved flows in the mainstem Wenatchee River in support of recovery efforts.

Current Status of Salmonid Stocks

Fishery co-managers have identified eight principal salmonid stocks in the Wenatchee River watershed and four major substocks (spawning aggregations) of *Wenatchee River spring Chinook*:

- Leavenworth NFH spring Chinook (segregated hatchery)
- Wenatchee River spring Chinook (natural)
    - Chiwawa River spring Chinook (natural + integrated hatchery)
    - Little Wenatchee River spring Chinook (natural)
    - Nason Creek spring Chinook (natural)

  - White River spring Chinook (natural + integrated hatchery)
- 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

Tables 1 through 12 summarize the current and desired 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). Recovery significance and criteria for ESA listed stocks are taken from the *Proposed Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan.* Habitat summaries are taken primarily from the Northwest Power and Conservation Council sub-basin plans.

Table 1. Wenatchee River spring Chinook (includes all natural subpopulations)

Stock Goals and Management Premises	
ESA Status	*Endangered. Recovery Significance and Criteria:* Required for recovery of the *Upper Columbia River Spring Chinook ESU*. Wenatchee River spring Chinook includes all natural populations (spawning aggregations) in the watershed (e.g., Chiwawa , White, Little Wenatchee rivers and Nason Creek). These populations must collectively meet abundance/productivity criteria that represent a 5% extinction risk over a 100- year period. The 12-year geometric mean recovery-delisting goal is 2,000 natural-origin adults per year with a mean adult recruit to spawner (R/S) > 1.2.
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. The very low viability of spring Chinook in those other watersheds increases the biological significance of Wenatchee River spring Chinook. Spring Chinook are considered extirpated in the Okanogan River.
Population Viability	*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 ESA listing (1999) was 417 spawners. R/S ranged from 0.06 to 4.59 between 1960 and 1999 with a 12-year geometric mean ranging from 0.31 to 1.19. The 12-year geometric mean at the time of listing (1999) was 0.74 recruits per spawner. Spring Chinook redd counts averaged 637, 564, and 621 per year every ten years between 1958 and 1990. In the 1990s, the mean number of spring Chinook redds dropped to 232 redds per year but has increased to over 1,100 redds/yr. since 2000. The long-term average is 560 redds/yr. over the period 1958-2002. Based on expanded carcass recoveries from spawning ground surveys (2001-2004), spring Chinook from the Leavenworth National Fish Hatchery and other hatchery programs have 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.[22]
Habitat	*Low to High.* The Wenatchee River watershed has an estimated 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 ≈20% increase in downstream survival of juveniles through the hydropower system. Spring Chinook currently spawn and rear in the upper mainstem Wenatchee River and tributaries upstream from the mouth of the Chiwawa River, overlapping with summer Chinook in that area. The primary spawning areas of spring Chinook in the Wenatchee River watershed include Nason Creek and the Chiwawa, Little Wenatchee, and White rivers.
Harvest	*Low.* Incidental harvest in mainstem Columbia River mixed-stock fisheries.

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

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

Stock Goals and Management Premises	
ESA Status	Not listed. Not included with the *Upper Columbia River Spring Chinook ESU*.
Biological Significance	*Low*. This is an introduced hatchery stock. The very low viabilities of natural populations of spring Chinook in the Wenatchee River could increase the potential biological significance of this stock within the watershed if the current viability of natural populations of spring Chinook decline.
Population Viability	*High*. The hatchery spawns approximately 1,000 adults per year with a mean R/S > 7.0 (BY1990-1999).
Habitat	*Low.* Icicle Creek has an estimated capacity to produce 200 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	*High.* For the period 1999-2003, the mean estimated 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 per year returning to the hatchery were provided directly to Columbia River tribes and food banks.[23] Expanded coded-wire tag recoveries for brood years 1986-98 indicate that harvest of this stock ranged from 14 to 6,132 fish per brood year (BY), averaging 1,464 fish/BY in the Columbia River and tributaries.[24]
Hatchery Program	
Facilities	Leavenworth NFH.
Type	Segregated.
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). Spring Chinook propagated at the Little White Salmon NFH are derived from the Carson NFH stock; hence, the current stock propagated at the Leavenworth NFH is primarily of Carson NFH ancestry. Adult broodstock are currently obtained from returnees back to the Leavenworth NFH.

[23] *Cooper (2006).*
[24] *Pastor (2005)*

Table 3. Chiwawa River spring Chinook (subpopulation)

Stock Goals and Management Premises	
ESA Status	Endangered. *Recovery Significance and Criteria:* See Table 1.
Biological Significance	*High*. See Table 1.
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.[25]
Habitat	*Medium-High.* The Chiwawa River is a cold stream originating from snowfields and glaciers. Eleven percent of the watershed is privately owned. Of the 89% public ownership, approximately 31% is designated as wilderness. The upper Chiwawa River provides some of the best spring Chinook habitat in the Wenatchee River subbasin although habitat alterations have taken place. The lower Chiwawa River is considered fair for riparian condition. Habitat in the watershed above Chikamin Creek (RM 13.7) is largely pristine and provides 90% of the spring Chinook spawning. According to redd counts, the middle reach of the Chiwawa River between Chikamin (RM 13.7) and Phelps (RM 30.7) creeks supports the strongest spring Chinook spawning population in the Wenatchee River subbasin (44.16% of spring Chinook redds in the Wenatchee River watershed from 1958 to 1999; Nason Creek provided 28.23% during the same period).
Harvest	*Low.* Incidental harvest in mainstem Columbia River mixed-stock fisheries.
Hatchery Program	
Facilities	Chiwawa River Acclimation Facility and trap, Eastbank Hatchery.
Type	Integrated.
Authorization	Chelan County PUD as mitigation for fish losses associated with Rock Island Dam. Mid-Columbia Habitat Conservation Plan. Operator: WDFW.
Primary Purpose	Conservation. Assist with recovery of endangered upper Columbia spring Chinook.
Secondary Purposes	Long-term: 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.

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

Table 4. White River spring Chinook (subpopulation)

Stock Goals and Management Premises	
ESA Status	*Endangered*. *Recovery Significance and Criteria:* see Table 1.
Biological Significance	*High*. This is the most genetically distinct population of spring Chinook within the *Upper Columbia River Spring Chinook ESU*. See also Table 1.
Population Viability	*Very Low*. 80 redds in White River in 2005.
Habitat	*Medium.* The White River originates in alpine glaciers and perennial snow fields, and is a major tributary to Lake Wenatchee. Two large tributaries to the White River, Napeequa (RM 11.0) and Panther (RM 13.1) creeks, support anadromous salmonids. Of the total acreage in the drainage, 78% is in public ownership and 22% in private ownership (all private land is below Panther Creek). Over half of the watershed is contained within wilderness. Stream channels, floodplain, and riparian function in the lower White River below Panther Creek, the most altered area in the watershed, are in fair to good condition. The mainstem below White River Falls is a key spawning and migration corridor for spring Chinook. Land development in the lower mainstem has reduced some floodplain function. The greatest future threat to salmonid populations is additional floodplain development. The White River has the coldest stream monitored in the Wenatchee River watershed with no apparent concerns regarding summer waters temperatures.
Harvest	*Low.* Incidental harvest in mainstem Columbia River mixed stock fisheries.
Hatchery Program	
Facilities	Aquaseed, Inc. (Rochester, WA), Little White Salmon and Willard NFHs.
Type	Integrated.
Authorization	Grant County Public Utility District No. 2 (PUD) as mitigation for fish losses associated with Priest Rapids Dam. This recovery program has been incorporated into the mitigation responsibilities of Grant County PUD through their Biological Opinion (dated May 3, 2004).
Primary Purpose	Conservation. Captive broodstock program to prevent extinction and assist with recovery.
Secondary Purposes	None.
Broodstock Origin(s)	Eyed eggs from pumped redds in the White River.

Table 5. Nason Creek spring Chinook (subpopulation)

Stock Goals and Management Premises	
ESA Status	*Endangered*. *Recovery significance and criteria: See Table 1.*
Biological Significance	*Medium-High.* Adult strays from the hatchery program for Chiwawa River spring Chinook may reduce the biological significance of the Nason Creek subpopulation within the Wenatchee River watershed. No unique attributes have been identified. (See also Table 1).
Population Viability	*Low*. Chinook redd counts have fallen sharply since the 1950s with a greater downward trend than in neighboring watersheds. (See also Table 1).
Habitat	*Low.* The Nason Creek drainage was formed by glacial scour dominated by steep bedrock and rocky slopes. All spring Chinook spawning and rearing habitat occurs below RM 16.8 where Gaynor Falls creates a natural barrier to upstream passage for Chinook salmon. The Nason Creek watershed has been altered significantly by human activities including railroad line development, road building (e.g. state highway 2), channelization, logging, and private development. Channelization and constriction of Nason Creek for highway and railroad placements have led to changes in peak flow timing and duration, and down cutting of the streambed in the lower reach. The baseline condition of Nason Creek watershed indicates significant environmental degradation. The lower 15 miles of the mainstem contains all of the spring Chinook spawning habitat within the Nason Creek watershed and is in the poorest condition. Much of the floodplain of the lower mainstem is privately owned, has experienced substantial development, and is likely to see further development in the future. This lower reach contains high amounts of fine sediment with little large woody debris. Elevated stream temperatures during summer in Nason Creek create poor fish habitat downstream of Whitepine Creek.
Harvest	*Low.* Incidental harvest in mainstem Columbia River mixed stock fisheries.

Table 6. Little Wenatchee River spring Chinook (subpopulation)

Stock Goals/Management Premises	
ESA Status	*Endangered*. *Recovery Significance and Criteria: See Table 1*.
Biological Significance	*High*. Treated by WDFW as a separate stock from White River spring Chinook (see Table 4).
Population Viability	*Low*. Chelan PUD spring Chinook redd counts from 1958 to 1999 showed the watershed contained 7% of the total number of redds counted in the Wenatchee River subbasin for that period.
Habitat	*Medium-High.* The Little Wenatchee River is one of two major tributaries to Lake Wenatchee. Headwaters of the Little Wenatchee River are at a lower elevation than the White River with more lakes and fewer glaciers. Spring Chinook spawn and rear in the mainstem river upstream to a falls at RM 7.8, with spawning occurring primarily between RM 2.7 and RM 7.8. Only 3% of the watershed is in private ownership, all within the lower three stream miles. Most of the land in the watershed is designated wilderness. The lower 1.3 miles of the river are influenced by back water effects of Lake Wenatchee. The Little Wenatchee River is considered one of the healthiest watersheds in the Columbia River basin. Most of the habitat concerns occur in and below areas of extensive logging. No anthropogenic fish passage barriers are present in the Little Wenatchee River watershed.
Harvest	*Low.* Incidental harvest in mainstem Columbia River mixed stock fisheries.

Table 7. Wenatchee River summer Chinook

Stock Goals and Management Premises	
ESA Status	*Not listed*. *The Upper Columbia River Summer/Fall-Run Chinook ESU was* reviewed on March 9, 1998 and determined to not warrant ESA listing.
Biological Significance	*High* Although summer Chinook in the Wenatchee River are not known to possess any unique biological characteristics relative to those of other summer Chinook stocks in the region, the substantially lower viabilities of summer Chinook in other watersheds upstream of Rock Island Dam (Entiat, Methow, and Okanogan rivers) increases the biological significance of the Wenatchee River stock.
Population Viability	*Medium-High.* Between the mid 1980s and late 1990s, summer Chinook numbers declined at Rock Island, Rocky Reach, and Wells dams. The magnitude of the decline increased with increasing distance upstream, suggesting that the abundance of Wenatchee River summer Chinook remained high or increased, while populations upstream of Rocky Reach Dam declined. The abundance of summer Chinook in the Wenatchee River has steadily increased since redd counts began in 1960. Estimated natural spawning escapements of summer Chinook during the period 1980-2001 ranged from 3,937 adults (1983) to 12,764 adults (1989), composed primarily of natural-origin fish based on carcass sampling.
Habitat	*Low-Medium.* Summer Chinook salmon spawn in the Wenatchee River between RM 1.0 and Lake Wenatchee (RM 54). The distribution of redds has changed since the early 1960s such that redd counts have decreased downstream from Dryden Dam (RM 17.5), where habitat quality is lowest, but increased upstream from Tumwater Dam (RM 32.7). The Wenatchee River has an estimated habitat capacity to produce ≈13,000 natural-origin adults with a maximum productivity ≈4.2 recruits/spawner.
Harvest	*Medium.* Hatchery-origin adults contributed an average of approximately 1,400 adults per year to harvest (1991-1999) with approximately 70-75% of the annual harvest occurring in Alaska and Canadian marine fisheries.
Hatchery Program	
Facilities	Dryden Dam trap and acclimation pond, Tumwater Dam trap, Eastbank SFH.
Type	Integrated.
Authorization	Chelan and Douglas county PUDs as mitigation for fish losses associated with Rocky Reach and Rock Island dams. *Anadromous Fish Agreement and Habitat Conservation Plans* for Rocky Reach and Rock Island Hydroelectric Projects, FERC License No. 2145 and No. 943, respectively, with Chelan PUD.
Primary Purpose	Harvest.
Secondary Purposes	Conservation.
Broodstock Origin(s)	Natural-origin summer Chinook from the Wenatchee River. Program began in 1989. Adults are trapped for broodstock at Dryden Dam.

Table 8. Lake Wenatchee sockeye

Stock Goals and Management Premises	
ESA Status	*Not listed*. The *Lake Wenatchee Sockeye Salmon ESU* was reviewed on March 10, 1998 and determined to not warrant ESA listing. Classified currently as a "Species of Concern".
Biological Significance	*High*. Lake Wenatchee supports one of only two remaining viable sockeye populations within the Columbia River Basin (the other is Okanogan Lake). This population is considered one of the strongest remaining sockeye populations in the lower 48 states. Historically, Lake Wenatchee contributed less than 10% of all adult sockeye returning to the Columbia River, with the largest proportion headed to Arrow Lakes in Canada, but those latter sockeye populations were extirpated by Grand Coulee Dam. Extirpations of sockeye populations throughout the Columbia River Basin (e.g., Yakima River, Wallowa River) increase the biological significance of Lake Wenatchee sockeye.
Population Viability	*Medium.* The current abundance, productivity, diversity, and distribution of Lake Wenatchee sockeye are all rated as "moderate" in the Wenatchee River Sub-Basin Plan. Productivity is limited by the oligotrophic nature of Lake Wenatchee (see *Habitat* below). Sockeye abundance in Lake Wenatchee has increased since the 1940's. Beginning in the late 1980's, estimated five-year annual escapement averages were 30,915 (1989-1993), 6,928 (1994-1998) and 13,776 (1999-2003) adults, respectively. The current population is considered "stable" with an annual escapement goal of 23,000 adults. Viability is largely determined by passage survival in the Columbia River and marine trophic conditions.
Habitat	*Medium.* The primary spawning occurs in the lower five miles of the White River and lower four miles of the Little Wenatchee River. Some fish spawn in the Napeequa River, a tributary to the White River. Fry enter Lake Wenatchee at its western shore where minimal development exists currently. Spawning habitat does not appear to be limiting; rather, the oligotrophic nature of Lake Wenatchee is considered to be the primary factor limiting productivity. As a result, sockeye production may never have been high in the Wenatchee River sub-basin compared to other systems of the upper Columbia River region.
Harvest	*Low*. Incidental harvests in lower Columbia River fisheries targeting other species. Tribal and non-tribal commercial fisheries for sockeye can occur when the escapement goal of 75,000 fish at Bonneville Dam has been achieved and sufficient surplus is available for fisheries. Commercial harvest of sockeye has not occurred since 1988 except for small fisheries in 2000 and 2004. Directed sport fisheries in Lake Wenatchee have been allowed in years when the surplus escapement goal of 27,000 was expected to be met or exceeded. Recreational fisheries for sockeye occurred in Lake Wenatchee during the 1980s and early 1990s, and most recently during the 2001 and 2004 return seasons.
Hatchery Program	
Facilities	Tumwater Dam adult trap, Eastbank SFH, Lake Wenatchee net pens.
Type	Integrated.
Authorization	Chelan County PUD as mitigation for fish losses associated with Rock Island Dam. *Mid-Columbia Mainstem Conservation Plan, Anadromous Fish Agreement and Habitat Conservation Plan Rock Island Hydroelectric Project FERC License No. 943* with Chelan PUD.

Primary Purpose	Harvest.
Secondary Purposes	Conservation.
Broodstock Origin(s)	Lake Wenatchee, Little Wenatchee and White rivers. Adults are trapped for broodstock at Tumwater Dam. Program began in 1989.

Table 9. Wenatchee River steelhead

Stock Goals and Management Premises	
ESA Status	*Threatened*. Upgraded from endangered in 2006. *Recovery Significance and Criteria:* Required for recovery of the *Upper Columbia River Steelhead DPS*. Wenatchee River steelhead must meet abundance/productivity criteria that represent a 5% extinction risk over a 100- year period. The 12-year geometric mean recovery-delisting goal is 1,000 natural-origin adults/year with a mean R/S > 1.1 (Upper Columbia River Recovery Plan).
Biological Significance	*Medium to High*. The Interior Columbia TRT has not identified any unique or distinctive stocks within the Upper Columbia River Steelhead DPS. However, the very low viability of other steelhead populations within this DPS 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 reproduce successfully, 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 adult counts at Priest Rapids Dam. The geometric mean R/S 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 produce natural-origin recruits. The Interior Columbia TRT concluded that Wenatchee River steelhead have a moderate to high risk of extinction over the next 100 years. A total of 475 steelhead redds were observed upstream of Tumwater Dam in 2003, with most of them found in the Wenatchee River. Recent R/S estimates suggest that Wenatchee River steelhead were not replacing themselves in most years until brood years of the late 1990s.
Habitat	*Medium to High*. Steelhead inhabit all major tributaries of the Wenatchee River. Surveyed spawning areas in order of importance are the Wenatchee River between the Chiwawa River and Lake Wenatchee, Nason Creek, Chiwawa River, and Icicle Creek. Tributaries not surveyed include the Little Wenatchee and White rivers, Chiwaukum, Peshastin, and Mission creeks, but are believed to be used by steelhead for spawning and rearing. 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 those parameters to ≈1,600 and ≈2.7, respectively, via habitat improvements.
Harvest	*Low*. An incidental mixed-stock harvest occurs in the mainstem Columbia River.
Hatchery Program	
Facilities	Dryden and Tumwater Dam traps, Eastbank SFH,
Type	Integrated.
Authorization	Chelan PUD as mitigation for fish losses from Rock Island and Rocky Reach dams.
Primary Purpose	Conservation. Contribute to recovery of the *Upper Columbia River Steelhead DPS*. Fish were first released from this program in 1998.
Secondary Purposes	Harvest.

Broodstock Origin(s)	Natural-origin adults trapped at Dryden Dam and Tumwater Dam.

Table 10. Wenatchee River hatchery coho

Stock Goals and Management Premises	
ESA Status	*Not listed*. Coho were extirpated from the Wenatchee River in the early 1900's and are currently the subject of a reintroduction program by the Yakama Nation.
Biological Significance	*Low*. This is an introduced hatchery stock to restore coho salmon to the Wenatchee River. If restoration succeeds, the biological significance of this stock is expected to increase as self-sustaining, naturally reproducing populations become established.
Population Viability	*Low*. The viability of this stock is expected to increase. The first generation of naturally produced coho smolts (n ≈ 17,000) emigrated from the Wenatchee River basin in 2002. In 2003, approximately 36,700 natural origin coho smolts emigrated from the Wenatchee River. The Wenatchee River currently has an estimated capacity to return ≈1,800 adults with a maximum productivity of ≈1.5 adult recruits per spawner. The long-range goal is to increase abundance and productivity to >3,000 adults and ≈1.7, respectively, via habitat improvements. Approximately 6,000-7,000 adult coho are estimated to have spawned historically in the Wenatchee River watershed.
Habitat	*Low.* Information regarding the historic distribution of coho salmon within the Wenatchee River basin is limited. Based on affidavits from 'old-time' residents, Nason Creek was likely an important spawning area, and nearly all smaller creeks are believed to have supported coho salmon. Coho currently spawn in the main stem Wenatchee River (Cashmere to Lake Wenatchee), Nason Creek, Beaver Creek, Icicle Creek, Peshastin Creek, Mission Creek, and possibly Chiwakum Creek. Current productivity is affected by loss or degradation of habitat in spawning and rearing areas, All tributary creeks are in need of habitat restoration to increase productivity and capacity for coho.
Harvest	*Low.* An incidental mixed-stock harvest of ≈2,800 adults per year is estimated to occur in marine and lower Columbia River fisheries. No terminal fisheries.
Hatchery Program	
Facilities	Leavenworth NFH and Dryden Dam adult trap.
Type	Segregated. Will transition to an integrated hatchery stock when a naturally-spawning population is established.
Authorization	Northwest Electric Power Planning and Conservation Act of 1980; Bonneville Power Administration, U.S. Fish and Wildlife Service, NOAA Fisheries, Columbia River Fishery Management Plan (*U.S. vs. Oregon*)
Primary Purpose	Conservation. The long-term goal is to re-establish self-sustaining, natural populations of coho salmon. Fish were first released from this program in 1996.
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.

Table 11. Wenatchee River bull trout

Stock Goals and Management Premises	
ESA Status	*Threatened*. *Recovery significance and criteria:* The 12-year geometric mean recovery-delisting goal is 1,612-2,257 natural-origin adults based on redd count expansions. These are preliminary recovery goals that may be revised and will most likely include other criteria (e.g., habitat connectivity) when the Bull Trout Recovery Plan is finalized.
Biological Significance	*Medium.* Bull trout inhabiting the Wenatchee River are not known to have any unique or distinctive biological attributes but consist of fluvial, adfluvial and resident populations.
Population Viability	*Medium*. Adult spawning surveys were conducted from 2000–2004. 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 the Little Wenatchee River, Nason, Ingalls and Chiwaukum creeks are very low. There are no known spawning areas in Icicle Creek, although multiple size classes of bull trout have been observed. Since 1989, the highest concentration of redds within the Wenatchee River subbasin occurred in the Chiwawa River watershed, averaging over 300 redds per year and showing a steady increase in abundance. Lesser numbers of redds have also been observed within the Peshastin and Nason creek drainages and upper mainstem Wenatchee River. Overall, redd counts within the Wenatchee River watershed have shown a steady increase since the surveys began in 1989,
Habitat	*Medium to High.* Bull trout subpopulations occur in the Chiwawa River including Chikamin, Phelps, Rock, Alpine, Buck and James creeks, the White River including Canyon and Panther creeks, the Little Wenatchee River (below the falls), Nason Creek including Mill Creek, Chiwaukum Creek, and Peshastin Creek including Ingalls Creek. The spawning populations of bull trout in the Chiwawa River watershed are among the most abundant in the mid Columbia River region. The adfluvial form matures primarily in Lake Wenatchee and ascends the White and Little Wenatchee rivers and the Chiwawa River to spawn where the resulting offspring reside for one to three years. There may also be non-migratory (resident) subpopulations within some of those streams. Bull trout also inhabit Icicle Creek.
Harvest	*Low.* Incidental in resident trout fisheries. No directed harvest occurs on bull trout.

Table 12. Wenatchee River westslope cutthroat trout

Stock Goals and Management Premises	
ESA Status	*Not listed*. Classified as a "Species of Concern".
Biological Significance	*High*. Populations on the east slope of the Cascade Mountain Range are isolated from the main geographic range of the subspecies in the Rocky Mountain region.
Population Viability	*Medium.* Westslope cutthroat trout sustain themselves within the Wenatchee River watershed in 82 streams (175 miles) and 83 alpine lakes (1,462 acres). The distribution of westslope cutthroat trout has been expanded as a result of stocking alpine lakes. There are no known estimates of current abundance within the Wenatchee River subbasin.
Habitat	*Medium to High.* Westslope cutthroat trout are fairly widespread within the Wenatchee River subbasin. They are found mostly in headwater and higher elevation streams, primarily on private lands and wilderness areas with excellent habitat.
Harvest	*Low.* Minor in resident trout fisheries.

Other Species of Concern

Table 13. Expected fish species present in Icicle Creek[26]

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

Mountain sucker and Umatilla dace are Washington state priority habitat species within the Wenatchee River watershed and have state candidate listings.

Salmon and Steelhead Hatcheries in the Watershed and Vicinity[27]

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

[26] *From LNFH –HGMP page 16.*
[27] *See Figure 3.*

Chiwawa Acclimation Facility and adult weir/trap (WDFW)

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 state 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 Fish Hatchery is located on the east bank of the Rocky Reach Dam tailrace. This facility is funded by Chelan PUD, and has an incubation building containing 44 vertical incubator stacks and eight 1,600 ft. vinyl raceways. Fall and winter temperatures often reach 17.7^0 C which precludes the use of this facility for egg and fry rearing. Water supply for the Annex is 6.2 cubic feet per second (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 Facility where 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 Chelan 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 connect 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 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 currently intercepted at Tumwater Dam, enumerated, and sampled 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. They are also used to 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 containing 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 water.

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 harvested 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 annually to produce 1.625 million yearling spring Chinook juveniles for direct release into Icicle Creek.

- ***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:*** Very few unmarked spring Chinook are trapped at the hatchery. When they are trapped, they are included in the broodstock under the presumption that they are hatchery-origin fish that escaped marking or are the natural-origin progeny of hatchery fish that spawned successfully in Icicle Creek. A boulder field/cascade blocks Chinook salmon from migrating upstream approximately three miles upstream of the hatchery. 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 annually.

- 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. 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 NFHs. Genetic analysis indicates that the current stock is more

closely related to the Carson NFH stock than the natural population in the Wenatchee River. However, Leavenworth NFH has not imported eggs or fry from the Carson NFH for more than 20 years. All fish spawned for broodstock represent volunteers to the facility. Adult fish swim up the collection ladder and into one of two holding ponds. 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.

More fish enter the hatchery than are needed for broodstock in most years. From 1980 to 2005, an average of 5,649 adult spring Chinook from the Leavenworth NFH returned to the Wenatchee River Basin. The hatchery was unable to achieve its broodstock goal of 1,000 adult fish in only one of twenty-six years (1995). Total smolt-to-adult returns of spring Chinook to the Wenatchee Rive basin have averaged 0.404% and overall adult productivity has averaged 7.2 adult recruits per spawner (BY 1990-1999).

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 the ancestry of the current stock. Between 1974 and 1985, Leavenworth NFH imported spring Chinook eggs from other Columbia River hatcheries, primarily Carson NFH, but also Cowlitz and Little White Salmon NFHs. Fish and/or eggs have not been imported to Leavenworth NFH since 1985, and the broodstock has consisted entirely of adult fish that volunteered into the hatchery ladder since that time. Based on broodstock records and supplemental genetic studies, the ancestry of the current hatchery stock is derived primarily from the Carson NFH stock. This latter stock was developed in the late 1950's and early 1960's from upstream-migrating adult spring Chinook trapped at Bonneville Dam.

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

- ESA-listed bull trout and steelhead are occasionally trapped during broodstock collection. These fish are handled according to a USFWS and NOAA ESA Section 7 permits and are released immediately upstream of the headgate to the Icicle Creek bypass canal.

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 approximately 60% to 40% in favor of 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). Spawning protocols and the number of adults spawned exceed minimal genetic standards.

- 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 spring Chinook are allowed to pass upstream into the upper Wenatchee River basin.

- For the period of 2001-2003, an average of 2.6% (SD = 0.6%) of all returning Leavenworth NFH adults strayed to the upper Wenatchee River upstream of Tumwater Dam 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. Closure of Structure 5 to fish passage May 15 through July 7 facilitates broodstock collection at the hatchery and the terminal fishery downstream from the hatchery ladder. When Structure 5 is opened for fish passage after July 7, the boulder field at RM 5.6 (see below) is largely impassible to bull trout because of low water flows. Beginning in 2007, Leavenworth NFH will attempt to address this timing and passage problem by installing a trap at Structure 5 (May 15 – July 7) and, if successful, bull trout will be released upstream of Structure 2 when water flows in Icicle Creek are still sufficient for bull trout to surmount the boulder area.

- Unmarked spring Chinook rarely enter the adult holding pond. The current protocol would be to include those fish in the broodstock under the presumption that they would most likely be hatchery fish that escaped marking prior to release or are natural-origin progeny of hatchery fish that successfully spawned in Icicle Creek.

- 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 reported 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 (BKD). This treatment helps control mortality in adults and reduces vertical transmission of *Renibacterium. salmoninarum,* the causative agent of BKD, from parents to progeny via eggs.

- Each female adult is sampled at spawning to enable identification and culling of eggs from females with moderate and high levels of *R. salmoninarum,* as measured by the enzyme-linked immunosorbent assay (ELISA). These procedures have significantly reduced the prevalence of BKD among spring Chinook reared on station.

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

- Trapped adult spring Chinook excess to broodstock 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

- Fertilized eggs from each adult pair are incubated separately until eyed to allow for culling or segregation of eggs from female parents with moderate to high levels of *Renibacterium salmoninarum*, the vertically transferred agent of BKD. These practices have reduced the incidence of this disease.

- 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 beginning with brood year 1991. Reduced production numbers appears to have contributed to a decline of incidence of BKD.

- Only the upper bank of raceways receives single pass fresh well water. There is a need to plumb well water 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 Structure 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 for the WDFW Chiwawa River spring Chinook program; these fish have not been accepted due to space and water limitations.

Release and Outmigration

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

- Smolts are 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 in the migration corridors of the Wenatchee and Columbia rivers. There is evidence that fully-smolted hatchery fish outmigrate rapidly, and available information indicates that hatchery-origin juveniles do not 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 (between 1939 and 1942). 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 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.[28] 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 augment flows and temperature of Icicle Creek 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^{o} C cooler than Icicle Creek.

- Water temperatures in Icicle Creek range widely between winter and summer (0-17^{o} C.) with upper summer temperatures approaching upper thermal tolerances of salmonid fishes.

- The amount of available Icicle Creek water is limited during the irrigation withdrawal season, and the viability of the existing well field as a groundwater source is uncertain because water flows through the Icicle Creek bypass channel help recharge the shallow well aquifer. Summer flows in Icicle Creek are supplemented by water from Snow Lake, which also cools water temperatures. Supplemental flows from Snow Creek range from 45–60 cfs and enter Icicle Creek one-mile upstream of the hatchery's intake system.

- Increasing the hatchery's water right has been considered but is unlikely because water is already over-appropriated in the watershed. In addition, the hatchery's wells rely on Icicle Creek water for recharge.

- 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[29] 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 transfer by helicopter is required to reach these structures.

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

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[28] *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.*
[29] *Anadromous Salmonid Passage Facility Guidelines and Criteria, National Marine Fisheries Service, Northwest Region, Portland, Oregon (Draft, 31 January 2004).*

- 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 the Wild Fish Conservancy (formerly Washington Trout) are very concerned about passage issues for ESA listed bull trout and summer steelhead at the lower most structure in Icicle Creek (Structure 5) and at the water 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 proposed 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.

- BOR has recently initiated a *Project Alternatives Solutions Study* (PASS) with comanagers and stakeholders to collaboratively explore solutions to water and fish passage issues for Icicle Creek, Leavenworth NFH, and other water users.

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.

- 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 (I&E) 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.

- 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,[30] the Review Team identified the following principal 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 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 majority of spring Chinook returning to the Wenatchee River annually. An annual average of 5,649 adult spring Chinook salmon returned to Icicle Creek and the Leavenworth NFH, 1980-2005.

- The current Leavenworth NFH stock could potentially be used as a "reintroduction stock" if the endangered, Upper Columbia River Spring Chinook ESU became functionally extinct in the future. The Leavenworth NFH stock is viable with adult returns exceeding broodstock needs in most years.

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

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 that are surplus to 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,[31] the Review Team identified the following principal 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 a Segregated Harvest Program based on Carson NFH-derived stock of spring 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 allows for an intensive tribal and recreational terminal 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.

[31] *Ibid.*

- Research benefit to ESA listed stocks by providing surplus fish 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,[32] the Review Team identified the following principal 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 passage of adult spring Chinook upstream of the hatchery, 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 National Pollution Discharge Elimination System (NPDES) standards.

- 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 an inadequate protection alarm system.

- 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.

[32] *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 and species in a watershed,[33] the Review Team identified the following principal risks from the hatchery program:

Genetic Risks

- Genetic risk from hatchery-origin fish straying to the upper Wenatchee watershed and potentially spawning with ESA-listed, natural-origin spring Chinook. Current management practices increase this risk 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 at Tumwater Dam into the upper Wenatchee River to spawn naturally and assist with recovery. Based on estimates derived from expanded coded-wire tag recoveries 2001-2003, 34.6% of all naturally spawning spring Chinook in the upper Wenatchee River watershed upstream of Tumwater Dam were composed of adults from the Leavenworth NFH. Adult spring Chinook from the Leavenworth NFH composed a combined average of 9% of the natural spawners (i.e. carcass recoveries) in the Chiwawa River, Chickamin Creek and Rock Creek, 53% of the natural spawners in the Little Wenatchee River, 18% of the natural spawners in Nason Creek , 3% of the natural spawners in the White River, Napeequa Creek and Panther Creek, and 89% of the natural spawners in 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 areas upstream of Tumwater Dam because of the very low abundance of natural-origin adults.

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 (January 31, 2004 external review draft).

- 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).

[33] *Ibid.*

- Demographic risk to upstream migration of several species (including ESA-listed bull trout and steelhead) from inadequate fish passage at the hatchery and the impediment of natural stream functions associated with water flows, gravel recruitment, and deposition of large woody debris.

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 a major irrigation withdrawal of Icicle Creek water.

- 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.

Recommendations for Current Program[34]

Recommendations are subdivided into two categories: those for current programs and those for potential alternative programs. Recommendations for the current program are presented here and are intended to address short-term or present goals. Recommendations for alternative programs are presented in the following "Alternatives" section and are intended to address long-term or future goals.

The Review Team considered all the benefits and risks outlined in the preceding section. The recommendations outlined below, in addition to potentially increasing benefits towards achieving program goals, address risks 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.

Programs Goals and Objectives

The Review Team did not identify any issues associated with program goals and objectives.

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 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*

[34] *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.*

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 Wenatchee River basin, and to reduce harvest risks on listed Chiwawa River hatchery spring Chinook.

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

Recommendation LE1c: Conduct a study comparing the survival and return rates of the Chiwawa River hatchery stock to the Leavenworth NFH stock when fish of both stocks are reared at Leavenworth NFH and released into Icicle Creek. This would be a preliminary study to assess the feasibility of potentially transitioning to the Chiwawa River stock at Leavenworth NFH (see Alternative 3). This study should be initiated as soon as possible (BY2007) if the Service plans to accept the Review Team's recommended alternatives for Leavenworth NFH (see below).

Hatchery and Natural Spawning, Adult Returns

Issue LE2: Limited locations for terminal fisheries 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, and possibly the Wenatchee River, if potential by-catch of ESA-listed fish can be minimized via differential marks or tags.

Issue LE3: Latter portion of the spring Chinook run may be thermally precluded from entering Icicle Creek because of warm water temperatures during the summer. *This potential thermal exclusion would make those 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 earlier return timing to reduce straying of hatchery fish when they may be thermally deterred from Icicle Creek. However, a preferred approach to this potential problem would be to increase instream flows in Icicle Creek during the summer months (see recommendations for Facility and Operations below).

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 when 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. Polychlorinated-biphenyl (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 can occur 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. The Review Team concluded that the fish health margin of safety is currently too low.*

Recommendation LE6a: Modify the water distribution system to allow the possibility of providing single pass well 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 without significantly reducing total adult returns, as indicated by density studies conducted previously at Leavenworth NFH (BY1994, BY1995, BY1996). Concurrent with these lowered densities in most raceways, fish could also be raised in some raceways at current densities (D.I. ≈ 0.20) to test predictions from those previous studies. Lowered densities are also expected to provide an increased margin of safety against a water supply system that depends on summer releases from Snow and Nada lakes 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 and 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.

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; (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) at RM 5.7 on Icicle Creek upstream of the hatchery intake by the Icicle-Peshastin Irrigation District.

The above-listed issues have been raised in several other forums and reports including an Environmental Impact Statement[35], Environmental Assessment (USFWS 2003), several letters and a report from the Wild Fish Conservancy (formerly Washington Trout)[36] including a meeting with the Review Team in 2006, Wenatchee Watershed Management Plan, and BOR sponsored "PASS" meetings in the Fall of 2006 that included representatives from BOR, Washington Department of Ecology, USFWS Ecological Services, Leavenworth NFH, Mid-Columbia Fishery Resource Office (USFWS), NOAA Fisheries, WDFW, Wild Fish Conservancy, and the Yakama Nation. In addition, 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"[37]) 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 14 and 15). 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

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[35] *U.S. Fish and Wildlife Service. 2002. Icicle Creek Restoration Project, Final Environmental Impact Statement, January 2002. U.S. Fish and Wildlife Service, 911 N.E. 11th Avenue, Portland, OR 97232-4181.*

[36] *Washington Trout. 2006. Return to Icicle Creek, p.16-20. In: Washington Trout Report, Vol 16(1), Spring 2006 (www.Washingtontrout.org).*

[37] *Sverdrup Civil, Inc. 2000. Icicle Creek Fish Passage Restoration and Intake Alternative Study at the Leavenworth National Fish Hatchery. Final Report, April 21, 2000. Available from: Svedrup Civil, Inc., 600 108th Avenue N.E., #700, Bellevue, WA 98004.*

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 flows in Icicle Creek.[38] 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.

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. One of these alternatives includes 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.**

[38] *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 pipe on existing private property easement. • Intake screen and sediment sluice replaced.	Construction: $3.72 M Operations: $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.	Construction: $4.94 M Operations: $73.1 K/yr
D	Abandon intake system and use only well 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.	Construction: $5.86 M Operations $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.	Construction: $6.41 M Operations: $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.	Construction: $10.5 M Operations: $252.6 K/yr

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.	Construction: $10.1M Operations: $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.	Construction: $9.4 M Operations: $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.	Construction: $9.9 M Operations: $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.	Construction: $2.1 M Operations: $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.	Construction $8.6 M Operations: $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.	Construction $9.3 M Operations: $126 K/yr

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 could 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, USFWS 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.

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

For the purpose of developing specific infrastructure recommendations, the Review Team used 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, allowing continued use of the Icicle Creek bypass canal and including construction of a permanent fishway bypass, to maintain optimal rearing and passage conditions 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 and bypass canal 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 headgate was the simplest solution for providing fish passage.

The Review Team then examined the 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 should consider (see below). Consequently, as part of its discussions dealing with passage and intake, the Review Team identified several 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 eventually 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.

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 Environmental Impact Statement [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 guidelines identified above and the two possible locations for a new fish sorting facility. The three alternatives, described below, have the following four common features:

1. Fish passage is improved by modifying existing instream structures and/or reducing the number of instream structures from the current number of three structures.

2. 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.

3. 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.

4. 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).

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 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 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.

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 LE10: 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[39]

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 at levels 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.
- Provides more efficient use of water and facilities and improves cost efficiency.
- Improves 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.
- Reduces suspended solids, etc. in effluents.

Cons

- May reduce relative 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

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

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 were 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.
- New ESA Section 7 (and/or Section 10) permits would be needed from NOAA Fisheries to allow a direct take (harvest) in Icicle Creek on hatchery-origin fish that are included with an ESA listed ESU.
- May reduce harvested numbers of spring Chinook in Icicle Creek.

**Alternative 3: Integrated two-stage "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 (Figure 4).

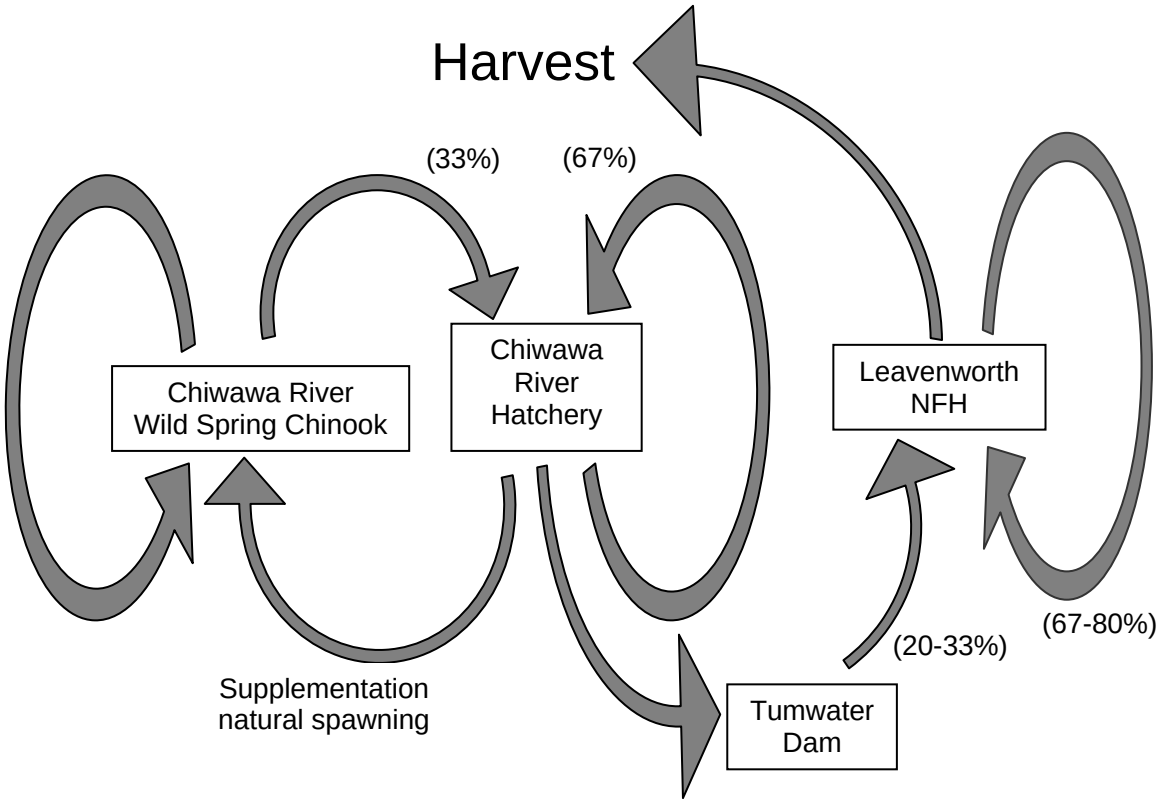

Figure 4. Stepping stone" gene flow diagram for a new Leavenworth NFH broodstock that is integrated genetically with the Chiwawa River hatchery broodstock. The Chiwawa River Hatchery broodstock serves as a genetic "stepping stone" for maintaining gene flow between a naturally spawning population and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

- New ESA Section 7 (and/or Section 10) permits would be needed from NOAA Fisheries to allow a direct take (harvest) in Icicle Creek on hatchery-origin fish that are included with an ESU 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 hatchery 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

- Replaces the highly-valued spring Chinook fishery in Icicle Creek with a fishery considered to have less value.
- 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.
- 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 would require new ESA Section 7 (and/or Section 10) permits from NOAA Fisheries to allow a terminal harvest.
- May 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 continued trapping of summer Chinook broodstock at Dryden Dam if hatchery-origin adults are thermally precluded from entering Icicle Creek and volunteering into the hatchery.
- Reduces the highly-valued spring Chinook fishery in Icicle Creek.
- Would 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.
- 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. However, the U.S. Bureau of Reclamation does not consider this issue a problem in the broad scope of mitigation for Grand Coulee Dam (Appendix 4).
- 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.

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 potentially become established in the Wenatchee River watershed, thus providing additional abundance and spatial diversity towards achieving VSP[40] 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 conveyance issues (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 marking or 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 marking or 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 water intake construction. Reduced smolt releases also lessens ecological risks to listed spring Chinook via reduced competition.
- 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 fish health risks and improved water quality are expected to increase individual

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

survival and smolt-to-adult return rates. Based on density studies conducted at Leavenworth NFH for brood years 1994, 1995, and 1996, 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, phase out the existing spring Chinook stock 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. After the water intake system is replaced, we anticipate that the transition to a new broodstock would require five to ten years depending on the number of upper Wenatchee brood fish available each year and the desire to maintain total smolt releases at 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 NOAA Fisheries 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.

- 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.

IV. Entiat River Watershed

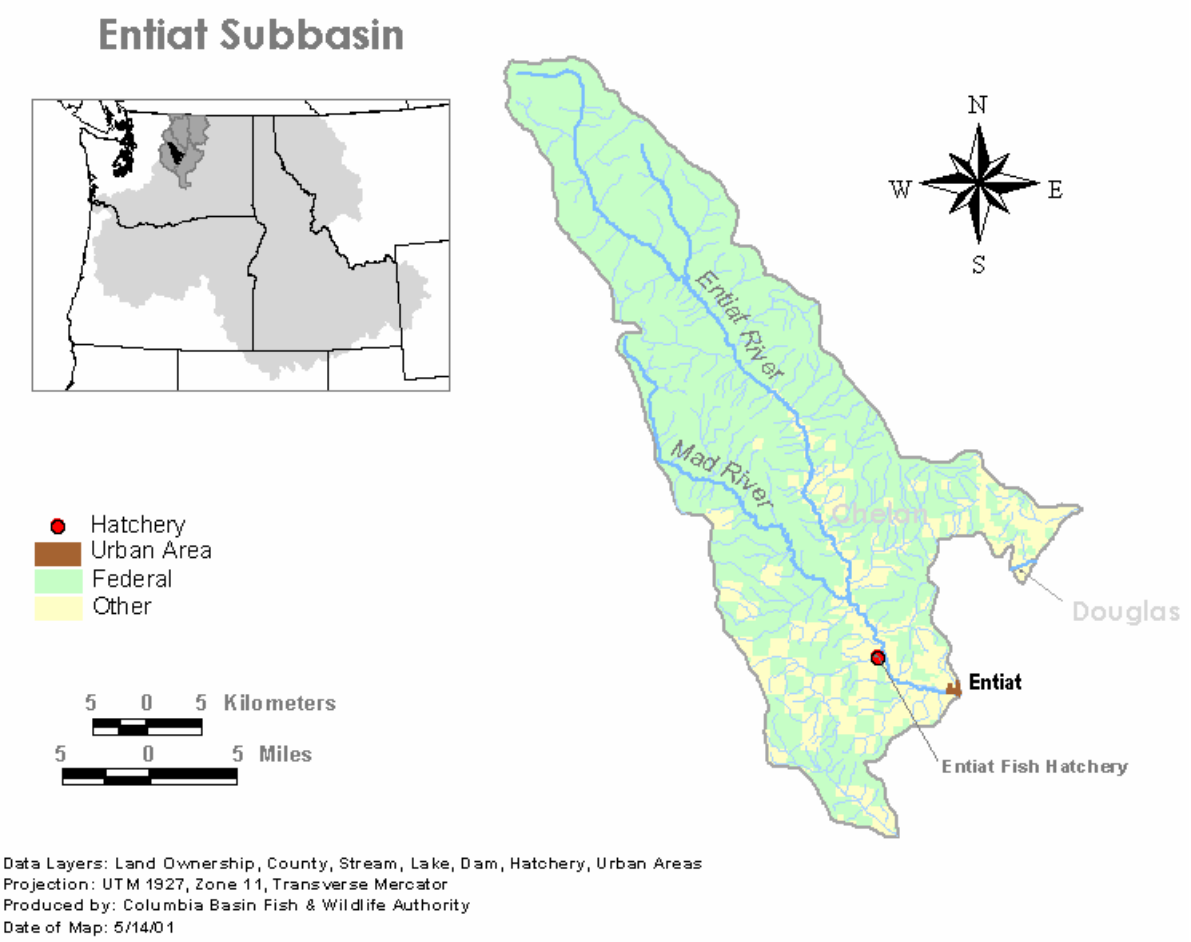

Figure 5. Entiat River Watershed Overview Map

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 River. The topography is extremely steep and dissected by Mt. Furnow, the highest elevation in the watershed (9,249 feet). The lowest elevation in the watershed (approximately 700 feet) occurs at the confluence with the Columbia River (RM 484). The Mad River is a major tributary to the Entiat River. Soils within the watershed 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. Approximately 1,300 acres of orchard land occur in the lower valley, much of it classified as prime agricultural land.

Mean annual precipitation in the Entiat River 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 water temperatures in the lower watershed usually range between 60 and 70 degrees F., decreasing into the 50 degree temperature range at higher elevations.

Fisheries

Many species of anadromous and non-anadromous fish reside in the Entiat and Mad river watersheds. Some fish found in the subbasin are currently listed under the ESA: spring Chinook (endangered), summer steelhead (threatened), and bull trout (threatened). Other salmonid species include summer Chinook,, sockeye salmon, coho salmon, westslope cutthroat trout, rainbow trout (nonanadromous *O. mykiss*), mountain whitefish, and brook trout. Brook trout are not native to the Entiat River.

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) which is impassible to anadromous fish.

Conservation

Sustainable natural reproduction of trout, salmon, and steelhead is an important conservation goal in the Entiat River. Spring Chinook from the Entiat NFH is the only species of fish released in the basin, but those fish represent an introduced stock and are not included with the current endangered listing under the ESA. Some fishery managers have expressed a desire to manage the Entiat River as a non-hatchery "reference" stream where no fish would be released, thus providing a control for evaluating the contribution to ESA recovery of hatchery supplementation programs in other basins (e.g., Wenatchee and Methow rivers). Currently, bull trout found in the mainstem Entiat and Mad rivers are considered to be two distinct local populations or spawning aggregations.

Habitat

Native Americans used the Entiat River valley for hunting and gathering prior to its use by Euro-American trappers and settlers. Trapping in the 1880's was the first anthropogenic activity to occur in the Entiat watershed by Euro-Americans. 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. Fruit production has always been very important to the local economy, and continues in that capacity to present day.

Logging within the valley has had a rich and varied history. The first log mill was established in 1892 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.

The Entiat River valley has been shaped in large part by a history of natural disturbance events such as wildfires, 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 1994 collectively 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 characterize sub-watersheds and ecosystem conditions within the Entiat River watershed. Those zones can also be used to define the distribution of salmonid fishes as they relate to geology and hydrology. These three zones are briefly described below.

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

Transitional Zone (McCrea Creek to Entiat Falls): Historic and current management practices have significantly influenced this region. The current aquatic habitat represents a 30 to 60% loss of pools in the mainstem Entiat River relative to the historical condition. The current trend in habitat conditions is variable and uncertain. The highest quality fish habitat in this zone (fair to excellent) is inhabited 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 and rearing habitat for anadromous fishes in the Entiat River watershed. Most (90%) of anadromous spawning and rearing habitat lies outside the Forest Service boundary on private land. The zone is utilized by spring Chinook, late-run (summer) 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 have burned over 60% of the watershed over the past 50 years. The lower 10 to 15 miles of the Entiat River is channelized to aid in flood control, with little within-stream diversity (e.g., riffle-glide-pools) to sustain both adult and juvenile salmon.

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)[41]
- Entiat River summer steelhead (natural)*
- Entiat River bull trout (natural)
- Entiat River westslope cutthroat trout (natural)

Tables 16 through 21 summarize the current and desired 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). Recovery significance and criteria for ESA listed stocks are taken from the *Proposed Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan.* Habitat summaries are taken from the Northwest Power and Conservation Council sub-basin plans.

[41] *Recent spawning surveys indicate that approximately 30% of naturally spawning summer Chinook in the Entiat River are hatchery-origin fish that have strayed from mainstem Columbia River hatcheries and release sites.*

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

Stock Goals and Management Premises	
ESA Status	*Not listed*. Not included in the *Upper Columba River Spring Chinook ESU*.
Biological Significance	*Low*. An introduced hatchery stock, primarily of Carson NFH ancestry.
Population Viability	*Medium*. The hatchery spawns approximately 300 adults per year with a mean R/S ≈5.5 (BY1990–99).
Habitat	*Low*. The introduced hatchery stock is not intended for natural reproduction. See Table 17 for habitat summary for spring Chinook.
Harvest	*Low*. The program provides very little direct harvest. The current endangered listing for natural populations of spring Chinook and the presence of primarily private land downstream from the 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 per year return to the hatchery (1999-2003) and were provided to Columbia River tribes.
Hatchery Program	
Facilities	Entiat NFH.
Type	Segregated.
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). Broodstock are obtained currently from adult returnees back to the Entiat NFH.

Table 17. Entiat River spring Chinook

Stock Goals and Management Premises	
ESA Status	*Endangered*. *Recovery Significance and Criteria:* Required for recovery of the *Upper Columbia River Spring Chinook ESU*. Entiat River spring Chinook must meet abundance and productivity criteria that represent a maximum 5% extinction risk over a 100- year period. 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).
Biological Significance	*Low to 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, 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 R/S = 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.
Habitat	*Low-Medium*. Several factors have reduced habitat diversity, connectivity, water quantity and quality, and riparian function in many stream reaches in the Entiat River subbasin. However, the subbasin contains headwater areas that are in relatively pristine condition and serve as "strongholds" for ESA listed species. Productivity and capacity for spring Chinook in the Entiat River could increase if habitat problems within the lower subbasin were rectified. Increasing off channel habitat, increasing habitat diversity and structural complexity, moderating extreme water temperatures, and restoring riparian areas and function in the lower Entiat River would increase adult holding and juvenile rearing habitat and - to a lesser degree - could increase spawning habitat. Nevertheless, because of its relatively small size and natural barriers, creating or restoring more habitat may not significantly increase overall production by a large degree, but it will increase spatial diversity and potential genetic diversity within the region. The Entiat River currently has an estimated capacity to return ≈350 adult spawners per year with a maximum productivity of ≈2.0 recruits per spawner. The long-range goal is to increase these parameters to greater than 550 adults and 2.3 recruits per spawner, respectively, via habitat improvements.
Harvest	*Low.* Incidental harvest in mainstem Columbia River mixed stock fisheries.

Table 18. Entiat River summer Chinook

Stock Goals and Management Premises	
ESA Status	*Not listed*. See Table 7.
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 currently are hatchery-origin strays from Turtle Rock and Wells Dam hatchery programs on the mainstem Columbia River. Whether natural-origin summer Chinook represent a historical population or are the descendants of hatchery-origin adults is unknown.
Population Viability	*Low to medium*. The presence of hatchery-origin strays from mainstem Columbia River hatchery programs confounds the viability of this population.
Habitat	*Low.* Loss of riparian areas, absence of large woody debris, and natural geo-fluvial processes have reduced the abundance of pools in the lower Entiat River basin. Mortality, stress and potential displacement of spawning adults is likely greatest in the lower Entiat River where summer Chinook may have predominantly spawned historically compared to the Middle Entiat River. Adult spawning may have also been displaced by the pool behind Rocky Reach Dam on the mainstem Columbia River. Summer Chinook viability in the Entiat River could increase if habitat problems within the lower river were corrected. Increases of off channel habitat and riparian areas in the lower Entiat River would increase productivity and abundance by increasing potential rearing and adult holding habitat, and – as a consequence - genetic, spatial, and life history diversity within the region.
Harvest	*Medium.* Harvested in marine and Columbia River mixed stock fisheries. No terminal harvest.

Table 19. Entiat River summer steelhead

Stock Goals and Management Premises	
ESA Status	*Threatened*. Upgraded from endangered in 2006. *Recovery Significance and Criteria:* Required for recovery of the *Upper Columbia River Steelhead DPS*. Entiat River steelhead must meet abundance and productivity criteria that represent a 5% extinction risk over a 100-year period. The 12-year geometric mean recovery-delisting goal is 500 natural-origin adults per year with a mean R/S > 1.2. (Upper Columbia River Recovery Plan)
Biological Significance	*Medium*. This stock has been proposed by the co-managers as a reference population for comparison to hatchery-supplemented populations in the Wenatchee and Methow rivers.
Population Viability	*Low*. Between 1967 and 2003, escapement of naturally produced steelhead in the Entiat River watershed ranged from 9 to 366 adults with a 12-year geometric mean ranging from 24 to 118 adults. Estimated R/S values 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.
Habitat	*Low*. Several factors have reduced habitat diversity, connectivity, water quantity and quality, and riparian function in many stream reaches in the Entiat River subbasin. However, the subbasin contains headwater areas that are in relatively pristine condition and serve as "strongholds" for listed species, including steelhead. Steelhead production in the Entiat River could increase if habitat problems within the lower basin were rectified. Preservation of quality spawning and rearing habitat in the Mad and Middle Entiat rivers is important to maintain naturally reproducing populations. Increases of off-channel habitat and riparian areas in the lower Entiat River would increase potential rearing habitat and life history diversity. Creating or restoring habitat are expected to increase steelhead productivity and abundance by a modest degree, and also increase the spatial and potential life history diversity within the Entiat River.
Harvest	*Low*. Incidental mixed stock fisheries in Columbia River. No terminal harvest.

Table 20. Entiat River bull trout

Stock Goals and Management Premises	
ESA Status	*Threatened*. *Recovery significance and criteria:* The 12-year geometric mean recovery-delisting goal is 298 to 417 natural-origin adults based on redd count expansions. These are preliminary recovery goals that may be revised and will most likely include other criteria (e.g., habitat connectivity) when the Bull Trout Recovery Plan is finalized.
Biological Significance	*Medium.* Bull trout inhabiting the Entiat River basin are not known to have any unique or distinctive biological attributes. Most of the bull trout in the Entiat River watershed are believed to be fluvial fish, with perhaps a resident form in the upper reaches of the Mad River drainage.
Population Viability	*Low to Medium*. The U.S. Forest Service has conducted spawning surveys for bull trout redds 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, respectively. 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 River watershed have increased since first counted in 1989, suggesting an increasing trend in viability.
Habitat	*Low-Medium*. Bull trout occur in both the Mad and Entiat rivers. Natural waterfalls currently restrict the distribution of migratory bull trout in the Entiat River watershed. Several factors have reduced habitat diversity, connectivity, water quantity and quality, and riparian function in many stream reaches. However, the subbasin contains headwater areas that are in relatively pristine condition and serve as "strongholds" for listed species. Conservation of high functioning habitat in natal tributaries and restoration of riparian and geofluvial processes in or near juvenile rearing areas will have the highest likelihood of increasing survival of juvenile bull trout. Preservation or restoration of naturally occurring geofluvial function insures that the proper spawning and rearing habitat is available. Recent studies suggest that bull trout from the Entiat River use the mainstem Columbia River for overwintering habitat and foraging.
Harvest	*Low.* Incidental in resident trout fisheries upstream of Entiat Falls. No directed harvest allowed.

Table 21. Entiat River westslope cutthroat trout

Stock Goals and Management Premises	
ESA Status	*Not listed*. Classified as a "Species of Concern".
Biological Significance	*High.* Populations on the east slope of the Cascade Mountain Range are isolated from the main geographic range of the subspecies in the Rocky Mountain region.
Population Viability	*Low-Medium*. Self-sustaining populations occur throughout 80 miles of watershed within 16 streams and 140 acres in eight lakes. Concerns include genetic introgression from introduced rainbow trout, competition with introduced brook trout, and depressed or fragmented populations. No estimates of abundance or productivity currently exist within the Entiat River Basin.
Habitat	*Low-Medium.* Several factors have reduced habitat diversity, connectivity, water quantity and quality, and riparian function in many stream reaches in the Entiat River subbasin. However, the subbasin contains headwater areas that are in relatively pristine condition and serve as "strongholds" for listed species. Conservation of high functioning habitat in natal tributaries, restoration of riparian and geofluvial processes in or near known and potential juvenile rearing areas will have the highest likelihood of increasing survival.
Harvest	*Low.* Recreational trout fisheries occur upstream of Entiat Falls.

Other Species of Concern

Table 22. Expected fish species present in Entiat 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*		

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

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

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. 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.

Chelan State Fish Hatchery

Chelan Hatchery is located on the west side of 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

[42] *From Entiat NFH-HGMP page 17.*
[43] *See Figure 3.*

spawning channels, and incubation facilities. Chelan Hatchery began operation in 1965 as mitigation for fish losses caused by 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 for fish losses caused by 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 (see section on Wenatchee River watershed) 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

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.

Program Description

The Entiat NFH spring Chinook salmon program is intended to function as a mitigation-harvest program. The Entiat NFH stock is not included in the ESA-listed Upper Columbia River Spring Chinook Salmon ESU. The Entiat NFH began operations in 1942. The original brood stock was initiated with adults trapped at Rock Island Dam in the early 1940's .Those fish represented an unknown mixture of commingled stocks and destined for the upper Columbia Basin). The original hatchery stock was never developed fully because no spring Chinook were released from the Entiat NFH from 1945 to 1975. The current spring Chinook program was initiated in 1974 with the first releases in 1976. Egg sources and subsequent yearling releases have been from several sources, but primarily from the Carson, Little White Salmon, Leavenworth and Winthrop NFHs. All these hatcheries propagate spring Chinook of Carson NFH ancestry. Brood stock is currently obtained entirely from adults returning to the hatchery. The hatchery 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-to-adult return rate (harvest plus escapement back to the hatchery and Entiat River) has averaged 0.302% for Entiat NFH with a mean of 5.5 recruits per spawned adult. The average adult return to Entiat NFH for the past 25 years has been just over 600 adults. Over the past several years, up to 50,000 spring Chinook pre-smolts were transferred in October to the Colville Confederated Tribes for acclimation and release into Omak Creek, a tributary to the Okanogan River. Recent adult returns to Omak Creek provided "first salmon ceremonies" to the Colville Tribes for the first time in decades.

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 Salmon 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.

- 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 at 60 days and at 30 days prior to spawning to control bacterial kidney disease (BKD). Erythromycin injections of brood stock helps control pre-

spawning mortality of adults and reduces vertical transmission of *Renibacterium salmoninarum* from adults to progeny via eggs.

- The spawning protocol is pairwise mating of males and females, but the sex ratio of returning adults is typically skewed 60% to 40% in favor of females.

- In recent years, jacks have been used in the broodstock in the same proportion as they occur in the run, which has been as high as 20%. The Service protocol for spring Chinook is to cap the use of jacks at five percent of the total number of males spawned.

- Kidney tissue from each female adult is sampled at spawning to enable identification and culling of eggs from females with moderate and high levels *of R. salmoninarum* as measured by the enzyme-linked immunosorbent assay (ELISA). These procedures have significantly reduced the prevalence of BKD among spring Chinook reared on station.

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 .

- Hatchery-origin fish composed an average of 45% of all naturally spawning spring Chinook in the Entiat River from 2000-2005, with partial contributions from the Entiat NFH (31.4%), 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. (2004)[44], "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 hatchery-origin fish from critical habitat for listed spring Chinook salmon.

- An agreement between the Service and the Bureau of Indian Affairs allows adult fish collected in excess of broodstock 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 to assist with reintroduction.

[44] *Ford, M.J., T.A Lundrigan, and P.C. Moran. 2004. Population genetics of Entiat River spring Chinook salmon. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-NWFSC-60, 45p. Available at: www.nwfsc.noaa.gov/.*

Incubation and Rearing

- Eggs are incubated in low pathogen spring or well water. River water is not used because of the presence of a *Myxosporidian* parasite.
- Fertilized eggs from each adult pair are incubated separately until eyed to allow for culling or segregation of eggs from female parents with moderate to high levels of *Renibacterium salmoninarum*, the vertically transferred agent of BKD. These practices have reduced the incidence of this disease.
- Fry are reared on first pass well or spring water to avoid exposure to a *Myxosporidian* parasite that is present in the Entiat River.
- 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.

Release and Outmigration

- Yearlings (smolts) are force released directly from the raceways and adult holding ponds into the Entiat River
- River conditions and fish 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 well and spring water replaced Entiat River water as the primary production water source. Although spring and well water are limited, especially in July and August, they provide a higher quality water source and are free from the presence of a detrimental *Myxosporidian* parasite that occurs temporally in the Entiat River.
- 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 outdoor ponding of subyearling fry 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 because 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 well 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 tagged with *Passive Integrative Transponder* (PIT) tags at Entiat NFH by the Columbia River Fisheries Program Office (USFWS, Vancouver, WA) 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 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.

- 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 NFHs 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 in support of community outreach.

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,[45] the Review Team identified the following principal 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.

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

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 that are 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,[46] the Review Team identified the following principal 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.

Research, Education, Outreach, and Cultural Benefits

- Research benefit from the use 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,[47] the Review Team identified the following principal risks of the hatchery program:

Demographic

- Demographic risk from the lack of available river water for rearing spring Chinook necessitates reuse and chilling of available well or spring water. Reuse 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 over outdoor raceways.

- Demographic risk from lack of broodstock protection alarm systems.

[46] *Ibid.*
[47] *Ibid.*

- Demographic risk from pathogen amplification.

Ecological

- Ecological risk from use of well 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 of adult fish, therapeutic use of medicated feeds for hatchery-reared fish, and potential presence of antibiotics in effluent water.
- 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,[48] the Review Team identified the following principal risks from the hatchery program:

Genetic

- Genetic risk from hatchery-origin fish spawning in the upper Entiat River 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 within the Entiat River 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).

[48] *Ibid.*

Recommendations for Current Program[49]

Recommendations are subdivided into two categories: those for current programs and those for potential alternative programs. Recommendations for the current program are presented here and are intended to address short-term or present goals. Recommendations for alternative programs are presented in the following "Alternatives" section and are intended to address long-term or future goals.

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). Formation of an implementation team may be desirable to ensure conflicts for space or water between different programs do not occur.

Alternatives to Current Program[50]

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. As noted above, continuation of the current spring Chinook program was not considered a viable alternative. The last alternative is the "no hatchery" option which the team considers for each program under review. Following these descriptions of alternatives, the Review Team has identified a recommended alternative (or alternatives).

**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.

[49] *The Review Team believes that the Entiat NFH 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.*
[50] *Alternatives with asterisks (*) were favored by the Review Team relative to alternatives without asterisks.*

- 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, although fish from the Methow Composite stock would be preferred relative to genetic straying risks.

Cons

- May 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 Nation with a hatchery base of operation. This may require a cooperative agreement with the Yakama Nation similar to the one between 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.

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. However, the U.S. Bureau of Reclamation does not consider this issue a problem in the broad scope of mitigation for Grand Coulee Dam (Appendix 4).

- 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 fish 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 concern, including - but not limited to – reintroduction of coho salmon in the Wenatchee and Methow rivers (Yakama Nation's Master Plan) and reintroduction of spring Chinook to the upper Columbia and Okanogan rivers (Colville Tribe's restoration plan), and restoration of upper Wenatchee River spring Chinook populations.

Pros

- Hatchery would propagate species of greatest conservation need.

- The Entiat NFH could rear Methow Composite stock spring Chinook that exceed the capacity of the Winthrop NFH for release below Chief Joseph Dam or in the Okanogan River. At the present time, surplus hatchery-origin adults returning to the Winthrop NFH are excluded from the hatchery and forced to spawn in the Methow River (see following section dealing with Winthrop NFH).

- Would assist with restoration and recovery of extirpated stocks.
- Gives the hatchery flexibility to respond to changing priorities and mandates (e.g. potential reintroduction of coho salmon or recovery of ESA-listed spring Chinook 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 harvest 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 some of 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.

- Operation of a weir on the Entiat River would be desirable, 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

In its draft recommendations, the Review Team proposed that the existing segregated spring Chinook program be discontinued as soon as possible and replaced with an integrated summer Chinook harvest program. Although comanagers and stakeholders endorsed the Team's recommendation to discontinue the spring Chinook program, they voiced little support for a summer Chinook program at Entiat NFH (Appendix D). Accordingly, the team modified its recommended alternative in the final report presented here.

Recommendation: Implement Alternative 4.

Discontinue existing segregated spring Chinook program as soon as feasible and use the Entiat NFH for propagation of upper Columbia River basin species of high conservation or harvest concern.

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

- Provide back-up rearing capability for the spring Chinook program at Leavenworth NFH as needed during the reconstruction of the Icicle Creek water intake structure.

- Collaborate with the Winthrop NFH, as necessary, and use the Methow Composite stock, as available, to support reintroduction of spring Chinook to the Okanogan River, and development of 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).

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

Facility Improvements

- Construct covers for the fish rearing ponds.

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

- Consider an adult weir and bypass facility at the Entiat NFH, if needed, to 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.

V. Methow River Watershed

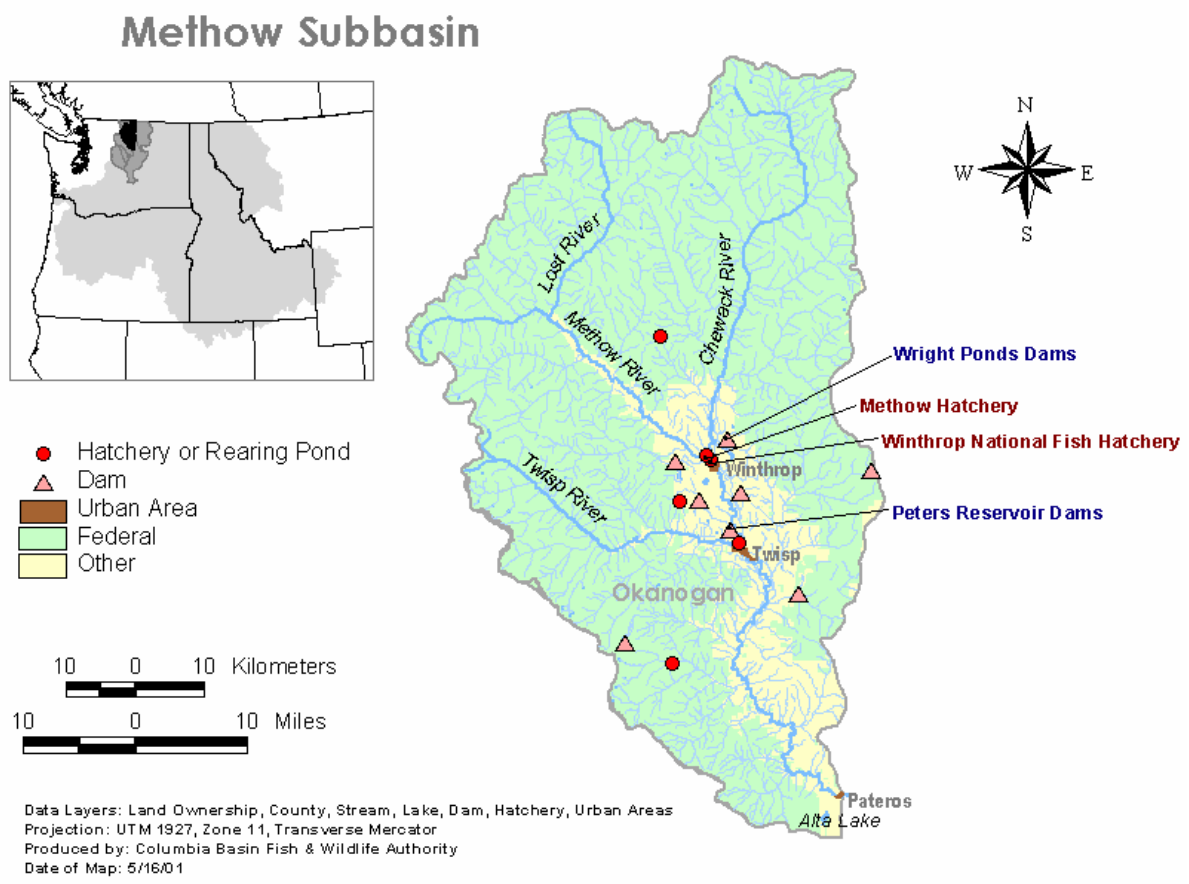

Figure 6. Methow River Watershed Overview Map

Overview of Methow River

Watershed Description

The Methow River enters the Columbia River 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 along the crest of the Cascade Mountains and the Canadian border. The Methow River drains roughly a 1,800 square mile watershed, extending approximately 86 river miles from its mouth to its headwaters. 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 at the confluence with the Columbia River. 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 River 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 but are considered strays from other watersheds (e.g., Okanogan River). Coho salmon were once abundant in the Methow watershed but are now considered extinct. The Yakama Nation is currently attempting to re-introduce coho salmon in the mid and upper Columbia River Basin. Important resident 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 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.

Conservation

Sustainable natural reproduction of resident trout, salmon, and steelhead is an important fisheries management goal in this watershed.

Although summer steelhead are listed as threatened under the ESA, those released from the Winthrop NFH and outplanted by WDFW into the Methow River watershed are allowed for harvest in the Methow and Columbia Rivers. These steelhead have an adipose fin-clip, which denotes them as hatchery fish. A fishery on adipose fin-clipped steelhead depends on meeting a minimum tributary escapement level of natural origin steelhead. This management strategy is intended to protect and promote natural reproduction. Combined with protection and restoration of habitat, these actions are intended to contribute to the recovery of the steelhead population in the Methow basin.

ESA listed spring Chinook salmon are propagated at both Winthrop NFH and Methow State Fish Hatchery. Current management of these stocks is directed at assisting with recovery of natural populations; therefore, no harvest is allowed.

In 1998, seventeen bull trout/Dolly Varden stocks were identified in the Methow River watershed. The status of all bull trout stocks in the Methow River watershed has been classified as unknown, except for the Lost River population 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. Coho salmon were historically the most abundant salmonid species in the watershed but were extirpated in the early 1900s. Washington Water Power blocked the Methow River at Pateros with a low-rise hydropower dam that prevented all upstream fish passage between 1915 and 1929. When the dam was removed in 1930, coho salmon were extirpated, Chinook were nearly extirpated, and steelhead persisted largely as resident rainbow trout. The anadromous runs were further decimated by the 1930's because of over-fishing in the lower Columbia River, poor mining practices, grazing, logging, and water diversions for irrigation within the watershed.

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 524 river miles from the mouth of the Columbia River and requires fish to navigate twice through nine hydroelectric facilities, once as smolts and again as adults. Hydropower conditions, ocean conditions and harvest impacts can significantly affect the ability of anadromous salmonid fishes to maintain self-sustaining populations in the Methow River watershed.

Interannual variations in weather conditions also can limit natural production of salmonids in the Methow River watershed. Extreme winter conditions - the result of latitude, elevation, and the

influence of the Cascade mountain range on maritime and artic air masses - contribute to reduced fish growth and productivity. In years with less than normal precipitation, instream flows become severely reduced resulting in dewatered reaches, winter icing, and high water temperatures during summer. Catastrophic disturbances such as landslides, floods, and wildfires are a natural component of this ecosystem but limit salmonid production.

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)[51]
- Methow River summer steelhead (natural + integrated hatchery)*
- Methow River bull trout (natural)
- Methow River westslope cutthroat trout (natural)

Tables 23 through 30 summarize the current and desired 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). Recovery significance and criteria for ESA listed stocks are taken from the *Proposed Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan.* Habitat summaries are taken from the Northwest Power and Conservation Council sub-basin plans.

[51] *Currently managed as a segregated population, but the long-term goal is to re-establish a naturally spawning population and transition to an integrated hatchery program.*

Table 23. Methow River Spring Chinook

Stock Goals and Management Premises	
ESA Status	*Endangered*. *Recovery Significance and Criteria:* Required for recovery of the *Upper Columbia Spring Chinook ESU*. Spring Chinook throughout the Methow River watershed, including Chewuch and Twisp rivers, must meet abundance/productivity criteria that represent a 5% extinction risk over a 100-year period. The 12-year geometric mean recovery-delisting goal for the Methow River watershed is 2,000 natural-origin adults per year with a mean adult recruits per spawner (R/S) > 1.2.
Biological Significance	*Medium*. 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, R/S ranged from 0.05–5.21 with a 12-year geometric mean of 0.41 to 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.
Habitat	*Medium to High.* Diking, conversion of riparian areas to agriculture and residential uses, and removal of large woody debris have resulted in loss of side-channel access, riparian vegetation, and habitat complexity in the Methow River mainstem. However, much of the watershed remains undeveloped, and large tracts of high quality fish habitat remain within middle and upper elevations. These latter areas are contained in lands held largely in public ownership, and include several thousand acres managed as wilderness or roadless areas. Primary spawning areas include upper Methow River, Wolf Creek, North Fork Gold Creek, Early Winters Creek and Lost River. Approximately 40% of spring Chinook spawning occurs in the mainstem Methow River between Winthrop and the Lost River.
Harvest	*Low.* Incidental harvest occurs in mainstem Columbia River mixed stock fisheries. No terminal harvest at present. Long-term goal: recover natural populations and allow terminal fisheries.
Hatchery Program	
Facilities	Winthrop NFH, Methow SFH, Foghorn Dam trap, Wells Dam trap if needed.
Type	Integrated (Methow Composite stock).
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:* Douglas County PUD to mitigate for fish losses associated with Wells Dam: *Anadromous Fish Agreement and Habitat Conservation Plan for Wells Dam Hydroelectric Project, FERC License No. 2149*.
Primary Purpose	Conservation.

Secondary Purposes	Long-term goal: Harvest.
Broodstock Origin(s)	Natural origin spring Chinook from the Methow and Chewuch rivers, Winthrop-Carson stock (Winthrop NFH)

Table 24. Chewuch River Spring Chinook

Stock Goals and Management Premises	
ESA Status	*Endangered*. *Recovery Significance and Criteria:* See Table 23.
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 Table 23.
Habitat	*Medium.* Approximately 95% of the drainage is managed by the U.S. Forest Service, with nearly 34% falling within the Pasayten Wilderness. The majority of human impact has occurred in the lower half of the drainage, with the upper 50% remaining generally undisturbed. Major wildfires have occurred in recent years. Low flows in late summer through winter reduce quantity of rearing habitat in the lower Chewuch River. Road density, road placement, past logging activities, grazing, wildfires, and highly erodible soils have led to chronic sediment delivery to streams. These conditions are aggravated by low levels of large woody debris, loss of mature riparian habitat, and channelization in the alluvial fans of numerous tributaries, including Twentymile and Boulder creeks. Extensive riprap for flood control associated with residential development has also occurred on the lower eight miles of the Chewuch River. Primary spawning area: lower mainstem Chewuch River up to Thirtymile Creek.
Harvest	*Low.* Incidental harvest occurs in mainstem Columbia River mixed stock fisheries. No terminal harvest.
Hatchery Program	
Facilities	Methow State Fish Hatchery, Chewuch River adult trap and acclimation pond.
Type	Integrated.
Authorization	Douglas County PUD as partial mitigation for fish losses associated with Wells Dam: *Anadromous Fish Agreement and Habitat Conservation Plan for Wells Dam Hydroelectric Project, FERC License No. 2149*.
Primary Purpose	Conservation.
Secondary Purposes	Long-term: Harvest.
Broodstock Origin(s)	Natural-origin spring Chinook from the Chewuch River.

Table 25. Twisp River Spring Chinook

Stock Goals and Management Premises	
ESA Status	*Endangered*. *Recovery Significance and Criteria:* See Table 23.
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 River Spring Chinook ESU.*
Population Viability	*Low*. See Table 23.
Habitat	*Low to High.* Nearly 95% of the subwatershed is federally managed, and of that, approximately 50% lies within the Lake Chelan-Sawtooth Wilderness. Spring Chinook salmon spawn and rear in the Twisp River for nearly its entire length. Most human activity and related habitat changes have occurred within the lower 15 miles of the Twisp River, reflecting reduced levels of large woody debris, road placement, diking, bank hardening, and conversion of riparian areas to agriculture and residential uses. Seven irrigation diversions occur on the Twisp River. The Twisp River from its mouth to Buttermilk Creek has been diked and rip-rapped, resulting in a highly simplified channel and disconnected side channels and associated wetlands. Little Bridge Creek contributes large amounts of sediment to the Twisp River, due largely to historic logging activities. Logged areas in the Poorman and Newby creek drainages also contribute excessive amounts of sediment to the lower Twisp River.
Harvest	*Low.* Incidental harvest occurs in mainstem Columbia River mixed stock fisheries. No terminal harvest.
Hatchery Program	
Facilities	Methow State Fish Hatchery, Twisp River trap and acclimation pond.
Type	Integrated.
Authorization	See Table 24.
Primary Purpose	Conservation.
Secondary Purposes	Long-term: Harvest
Broodstock Origin(s)	Natural-origin spring Chinook from the Twisp River.

Table 26. Methow River/Upper Columbia River summer Chinook

Stock Goals and Management Premises	
ESA Status	Not listed. See Table 7.
Biological Significance	*Medium*. Methow River summer Chinook are considered to be genetically part of a much larger gene pool that includes all populations upstream of Rocky Reach Dam.
Population Viability	*Low*. Considered "depressed" by WDFW.
Habitat	*Low to Medium.* The mainstem Methow River downstream from Winthrop is the primary spawning area. Diking, conversion of riparian areas to agriculture and residential uses, and removal of large woody debris have resulted in loss of side channel access, riparian vegetation, and overall habitat complexity. The Methow Valley Irrigation District diverts water to its east canal about five miles north of Twisp (RM 44.8). The highest percent diversion (approximately 13%) occurs in September. The lower portion of the Methow River is agricultural, primarily field crops, cattle, and orchards.
Harvest	*Medium.* Marine and mainstem Columbia River mixed stock fisheries No terminal fisheries.
Hatchery Program	
Facilities	Wells State Fish Hatchery and Carleton Ponds.
Type	Integrated.
Authorization	Chelan County PUD and Douglas County PUD to mitigate for fish losses associated with Rock Island, Rocky Reach, and Wells dams. *Anadromous Fish Agreement and Habitat Conservation Plans for Wells* (Douglas Co. PUD), *Rocky Reach* (Chelan PUD), *and Rock Island* (Chelan Co. PUD) *Hydroelectric Projects, FERC Licenses No. 2149, No. 2145, and No. 943, respectively.*
Primary Purpose	Harvest.
Secondary Purposes	Conservation. Supplemental natural spawning by hatchery-origin summer Chinook is intended to support conservation goals for summer Chinook in the Methow River.
Broodstock Origin(s)	Hatchery and natural-origin adults trapped at Wells Dam.

Table 27. Methow River hatchery coho

Stock Goals and Management Premises	
ESA Status	Not listed. Coho were extirpated from the Methow River in the early 1900s.
Biological Significance	*Low.* This is an introduced stock to restore coho salmon to the Methow 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 if a self-sustaining, naturally reproducing population becomes established.
Population Viability	*Low.* See Wenatchee River hatchery coho (Table 10).
Habitat	*Low.* Currently, coho salmon returning to the Methow Basin are spawning in the mainstem Methow River and small tributaries such as Gold Creek. Low levels of large woody debris in low gradient tributary areas may limit rearing habitat for juveniles. As the reintroduction program continues, reestablishment of naturally spawning populations is expected to contribute to dispersal and recolonization.
Harvest	*Low.* Marine and mainstem Columbia River mixed stock fisheries. No terminal fisheries.
Hatchery Program	
Facilities	Winthrop NFH. Wells Dam can be used to trap adults for broodstock in low return years.
Type	Segregated. Program will transition to an integrated broodstock when a naturally-spawning population is established.
Authorization	Northwest Electric Power Planning and Conservation Act of 1980; Bonneville Power Administration, U.S. Fish and Wildlife Service, NOAA Fisheries, Bonneville Power Administration, Columbia River Fishery Management Plan (*U.S. vs. Oregon*).
Primary Purpose	Conservation. The long-term goal is to re-establish self-sustaining, natural populations of coho salmon. The short-term goal is to establish a hatchery-propagated run and then 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 returning adults back to the Methow River. Fish were first released from this program in 1996.

Table 28. Methow River summer steelhead

Stock Goals and Management Premises	
ESA Status	*Threatened*. Upgraded from endangered in 2006. *Recovery Significance and Criteria:* Required for recovery of the *Upper Columbia Steelhead DPS*. Methow River steelhead must meet abundance/productivity criteria that represent a 5% extinction risk over a 100-year period. 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).
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 reproduce successfully, R/S ranged from 0.08 to 8.65 adults since 1978 with a 12-year geometric mean ranging from 0.82 to 2.28 based on 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 increase 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.
Habitat	*Low to High.* 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). The highest quality habitat occurs in the upper Methow, upper Twisp, upper Chewuch, and Lost rivers, and in Goat Creek, Little Boulder Creek, and Squaw Creek. Upstream distribution of steelhead is limited by coldwater streams with low heat budgets.
Harvest	*Low.* The mean terminal harvests on steelhead are estimated to be 2% and 20% on natural- and hatchery-origin adults, respectively (AHA database).
Hatchery Program	
Facilities	Winthrop NFH and Wells SFH.
Type	Integrated.
Authorization	Grand Coulee Fish Maintenance Project in 1937, Mitchell Act in 1938, Fish and Wildlife Coordination Act, 1946, U.S. Bureau of Reclamation. Douglas and Grant Count PUDs to mitigate for fish losses associated with Wells Dam.
Primary Purpose	Conservation.
Secondary Purposes	Harvest.
Broodstock Origin(s)	Upper Columbia River populations upstream of Wells Dam. Hatchery and natural-origin adults are currently trapped for broodstock at Wells Dam.

Table 29. Methow River bull trout

Stock Goals and Management Premises	
ESA Status	*Threatened*. *Recovery Significance and Criteria:* The 12-year geometric mean recovery-delisting goal is 1,234–1,728 natural-origin adults based on redd count expansions. These are preliminary recovery goals that may be revised and will most likely include other criteria (e.g., habitat connectivity) when the Bull Trout Recovery Plan is finalized.
Biological Significance	*Medium*. Bull trout inhabiting the Methow River basin are not known to have any unique or distinctive biological attributes, but consist of fluvial, adfluvial and resident populations. Adfluvial populations occur in the Lost River and Lake Creek; fluvial populations occur throughout the subbasin; and resident populations occur in many other streams including areas upstream of natural barriers.
Population Viability	*Low to Medium*. Bull trout are currently listed as threatened range-wide under the ESA. The Methow River Basin has eight local populations (USFWS). Of these, only the Lost River is considered healthy. 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.
Habitat	*Medium to High.* Spawning habitat is limited to cold water reaches, primarily in the east and west forks of Buttermilk Creek (Twisp River), Chewuch River, Crater Creek, Goat Creek, Wolf Creek, Lost River, Early Winters Creek, Cedar Creek, Monument Creek (Lost River) and Reynolds Creek (Twisp River). An AHA dataset with estimated productivity and capacity parameters has not been developed.
Harvest	*Low.* A recreational fishery on bull trout occurs in the Lost River as part of the general trout daily limit.

Table 30. Methow River westslope cutthroat trout

Stock Goals and Management Premises	
ESA Status	*Not listed.* Classified as a "Species of Concern".
Biological Significance	*High*. Populations on the east slope of the Cascade Mountain Range are isolated from the main geographic range of the subspecies in the Rocky Mountain region.
Population Viability	*Medium.* Westslope cutthroat trout viability in the Methow River watershed is classified as "strong" in the NWPCC sub-basin plan.
Habitat	*Medium to High*. WSCT inhabit many of the smaller streams within the Methow River Basin, primarily in the upper reaches of higher order streams and some Alpine lakes. Much of this area is in national forest or wilderness areas. Habitat factors affecting status include channelization, sediment loading, irrigation withdrawal, wildfires, flash flooding, erosion, and timber harvest.
Harvest	*Low*. Minor harvest in resident trout fisheries.

Other Species of Concern

Table 31. Expected fish species present in Methow River[52]

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*		

Coho salmon are believed to have been more abundant historically in the Methow River than Chinook salmon or steelhead (NWPCC Methow River Sub-Basin Plan) but were largely extirpated by the early 1900's due to a small hydropower dam in the lower Methow River at Pateros, WA. Coho salmon are currently being reintroduced to the Methow River by the Yakama Nation, with cooperation from the Service and WDFW.

Salmon and Steelhead Hatcheries in the Watershed and Vicinity[53]

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. 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 Methow 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.

[52] *From Winthrop NFH-HGMP Page 11*
[53] *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 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 183,000 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 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, three rearing ponds, and egg incubation facilities. In addition, adult trapping facilities exist at Wells Dam at the east and west fish ladders. 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.

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 all 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 the number of *Methow Composite* and natural-origin adults trapped for broodstock is less than the broodstock goal, then additional adults representing the progeny of *Winthrop-Composite* x *Methow Composite* adults are spawned separately to produce additional fish for partially meeting fishery mitigation responsibilities. Progeny of these latter crosses, referred to as *Met-Comp II* fish, are not intended to contribute to recovery or future broodstock, 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, are released unmarked, but 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.

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), although some "mixed" releases (Winthrop-Carson stock crossed with Methow Composite stock, known as Met-Comp II), have occurred since BY 2001. These latter fish were not ESA-listed and were 100% adipose-fin clipped. Winthrop-Carson fish were also 100% adipose-fin clipped for brood years 1994-2000. Brood years prior to 1994 were not adipose-fin clipped which led to some of those fish inadvertently included with the Methow River stock during its inception in the early 1990's.

Winthrop NFH has annually averaged 660 spring Chinook adults back 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). For the brood year period of 1990-1999, the total smolt-to-adult return rate averaged 0.267% for spring Chinook released Winthrop NFH with a mean of 4.8 adult recruits per spawned adult. A critical limitation to achieving conservation goals has been difficulty with 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) 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 strayed into the Methow State Hatchery during the early 1990's and were inadvertently included with the broodstock. At the present time, approximately 70-72% of the Methow Composite stock's genetic ancestry is believed to have been derived from natural-origin fish in the Methow River subbasin. One goal for the Methow Composite stock 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 those adults have precluded the inclusion of adequate numbers of natural-origin adults in the broodstock to meet genetic management guidelines.

- In collaboration with WDFW's Methow 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 Methow Composite stock with decreasing genetic influence from the Winthrop-Carson stock in the future.

- The hatchery has been able to return to operating its fish ladder and collect fish returning to the hatchery for broodstock only since 2003 when Winthrop-Carson stock were no longer returning to the Methow River.

- During years where large adult returns are expected, a weir is installed in the lower section of the outflow 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 14 days prior to spawning to help control bacterial kidney disease (BKD). Erythromycin injections of brood stock helps control pre-spawning mortality and reduces vertical transmission of *Renibacterium salmoninarum* from parents to progeny via eggs. Adults are generally treated three days per week with formalin to control external parasites.

- Each female adult is sampled at spawning to enable identification and culling of eggs from females with moderate and high levels of *R. salmoninarum* as measured by the enzyme-linked immunosorbent assay (ELISA). These procedures have significantly reduced the prevalence of BKD among spring Chinook reared on station.

- Fish are randomly selected and spawned pairwise as close to a 1:1 female:male ratio as possible. Typically, the sex ratio for the returning spring Chinook adults is skewed 60% to 40% in favor of 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 may be obtained from the Methow State Hatchery, numbers permitting.

Hatchery and Natural Spawning, Adult Returns

- Excess adult returns to Winthrop NFH since 2001 have been precluded from entering the hatchery to spawn naturally in the Methow River.

- There is no barrier dam or weir in the Methow River at the hatchery to collect broodstock or separate hatchery and natural origin fish. This is significant because the Methow River watershed

upstream of the hatchery is an important spawning and rearing area for spring Chinook, steelhead, and bull trout (all ESA listed).

- Coded-wire tag recoveries indicate that spring Chinook adults from the Winthrop NFH origin have a high homing fidelity to the Methow River system.

Incubation and Rearing

- Well water is used for egg incubation and initial rearing in nursery tanks.

- The Methow River is the main water source for outside rearing units and is very susceptible to temperature swings with seasonal fluctuations from as low as 32–33^0 F. in December to as high as 67^0 F. in August. Since the river water contains the most pathogens, use of this source is usually avoided during early rearing of all salmonids.

- Fertilized eggs from each adult pair are incubated separately until eyed to allow for culling or segregation of eggs from female parents with moderate to high levels of *Renibacterium salmoninarum*, the vertically transferred agent of BKD. These practices have reduced the incidence of this disease.

- Beginning with brood year 2000, rearing space has been managed so that density indices never exceed 0.11 for spring Chinook salmon.

Release and Outmigration

- Smolts are mass-released directly into the outflow channel leading from the hatchery to the Methow River at a size of 16–18 fish per pound.

- Spring Chinook released from the Winthrop NFH are believed to be 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 Dam on the Methow River is a rock and boulder structure which backs up and diverts river water to the Foghorn Ditch and, subsequently, to the Winthrop NFH and Methow State Hatchery. The structure has existed in some form for irrigation purposes long before the construction of the hatchery in 1938. A diversion structure adjacent to the south side of the dam collects 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 for 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 Methow State Hatchery to use up to seven cubic feet per second of water in the event of an emergency water shortage at the state facility, provided the water is <u>not</u> required at the Winthrop NFH.

- The water intake fish screen for the Winthrop NFH fish was reconstructed recently to meet strict requirements developed by NOAA Fisheries and the Washington Department of Ecology. Two

rotary type drum screens 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 U.S. Bureau of Reclamation's RAX (Replacements, Additions, and Extraordinary Maintenance) document as a high priority for modification.

Research, Education, and Outreach

- All ESA-listed spring Chinook released from the Winthrop NFH are coded-wire tagged (CWT). Starting with brood year 2000, listed fish did not receive a fin clip along with the CWT, while unlisted stocks receive fin clips to help distinguish 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.

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

Harvest Benefits

- No terminal harvest benefit is being derived currently from this program. Spring Chinook released from the Winthrop NFH do make a small contribution to lower Columbia River gillnet and sport fisheries. Less than 5% of returning adults are harvested.

Conservation Benefits

- The conservation benefit from this program is unknown. Propagation of the current ESA-listed stock is intended to increase the abundance of natural-origin spring Chinook and assist with recovery of the Upper Columbia Spring Chinook ESU in the Methow River.

Research, Education, Outreach and Cultural Benefits

- Educational benefit from school groups visitations.

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

- 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,[55] the Review Team identified the following principal benefits of this program:

Harvest Benefits

- None identified.

Conservation Benefits

- Conservation benefit to natural populations of salmonid fishes from nutrients added to the Methow River ecosystem after natural spawning of hatchery-origin spring Chinook.

Research, Education, Outreach and Cultural Benefits

- None identified.

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

Genetic Risks

- Genetic risk from domestication effects to the Methow Composite stock and the ESA-listed Methow River population due to an insufficient number of natural-origin adults in the hatchery broodstock and the potentially large proportion of naturally spawning fish composed of hatchery-origin fish.

Demographic Risks

- Demographic risk from pathogen amplification in the hatchery.

- Demographic risk to the ESA-listed Methow River population from over-sizing the supplementation program based on the production capacity of the hatchery rather than the biological needs of the naturally-spawning population and capacity of the habitat. Forcing all surplus hatchery-origin spring Chinook to spawn naturally in an uncontrolled manner risks can potentially overwhelm the reproductive output of natural-origin fish.

[55] *Ibid.*
[56] *Ibid.*

Ecological Risks

- Ecological risk to natural-origin spring Chinook via competition from large numbers of hatchery-origin adults spawning naturally in the Methow River, most within the immediate vicinity of Winthrop NFH. The practice of excluding surplus hatchery-origin adults from the hatchery may be inhibiting their potential recovery opportunity elsewhere (e.g., via outplanting into other areas within the watershed).

- Large numbers of hatchery-origin spring Chinook spawning naturally poses an indirect ecological risk to the natural population of spring Chinook by not considering competition for food and space from other fish and aquatic species that now occupy habitat and niches formerly occupied by previously-abundant salmonids.

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

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

Ecological Risks

- Ecological risk from hatchery-origin spring Chinook on existing flora and fauna that now occupy habitat formerly occupied by salmonids, thus resulting in unpredicted competition effects.

- Ecological risk to Methow River from using the effluent pond for kids' trout fishing derby, thus inhibiting regular cleaning of the pond, because of the presence of trout, with a consequential reduction in water quality and potential pathogen amplification.

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

[57] *Ibid.*

Recommendations for Current Program[58]

Recommendations are subdivided into two categories: those for current programs and those for potential alternative programs. Recommendations for the current program are presented here and are intended to address short-term or present goals. Recommendations for alternative programs are presented in the following "Alternatives" section and are intended to address long-term or future goals.

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.

Programs Goals and Objectives

Issue WT1: 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 or conservation benefits.

Recommendation WT1 - Work with other salmonid managers to review mitigation goals and objectives for spring Chinook salmon to ensure that mitigation activities are consistent with current conditions in the Methow River and mid-Columbia region. Use these newly-developed goals and objectives as the basis for a new *Hatchery and Genetic Management Plan* (HGMP) for this program. A comprehensive habitat and fishery management plan for the Methow River basin should be developed. This plan should redefine the roles of the Winthrop NFH and the Methow State Hatchery.

Issue WT2: 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 WT2 - Work with other salmonid managers to create specific goals and objectives for the contribution of the Methow Composite stock 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. Include these goals and objectives as part of the new HGMP for this program.

[58] *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.*

Broodstock Choice and Collection

Issue WT3a: 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, thus posing a domestication risk to the Methow Composite stock.

Issue WT3b: 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 WT3a: Improve adult collection capabilities 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 WT3b: 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).

Recommendation WT3c: As an interim measure, natural-origin spring Chinook could be collected at Wells Dam to reduce domestication risks to the Methow Composite stock if sufficient numbers of natural-origin broodstock cannot be collected from adults trapped in the Methow River.

Hatchery and Natural Spawning, Adult Returns

Issue WT4: Hatchery-origin Methow Composite spring Chinook, identified by the presence of an unclipped adipose fin and 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, thus posing genetic, ecological, and demographic risks to the natural population.

Recommendation WT4: Trap all returning hatchery-origin spring Chinook at Winthrop NFH and either outplant all ESU Methow Composite fish - in excess of broodstock needs - into areas designated for restoration and supplementation in the upper Methow River, or spawn surplus adults and outplant their progeny consistent with approved NOAA Fisheries recovery plans and comanager management plans for spring Chinook. In years when the number of returning adults exceed supplementation spawning needs in the Methow River, outplant adults or progeny in the Okanogan River and other sites

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 WT5: 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 WT5: Create acclimation and release sites in the upper Methow watershed (i.e., upstream of Foghorn Dam) consistent with approved NOAA Fisheries recovery plans and comanager management plans for spring Chinook. This recommendation is similar to those of those of the Washington Department of Fish and Wildlife and is considered necessary for achieving hatchery supplementation goals.

Facilities and Operations

Issue WT6: Insulation is falling from the ceilings of the raceway covers into water with fish, creating potential fish and human health hazards.

Recommendation WT6: Repair insulation in ceilings of raceway covers.

Issue WT7: The "A" and "C" banks of ponds are deteriorated and lack permanent covers.

Recommendation WT7: Reconstruct "A" and "C" banks of ponds as raceways and construct covers.

Issue WT8: Adult collection, holding and spawning facilities are inadequate, and the partially completed adult holding facility is currently unusable.

Recommendation WT8 - 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 WT9: 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 WT9a - Continue to work with EPA to complete the NPDES permitting process.

Recommendation WT9b - Build a lined, easily cleanable settling pond for the effluent.

Research, Monitoring, and Accountability

Issue WT10: Development of new mitigation goals and a new HGMP for this program (Recommendations WT1 and WT2) will mandate the development of new performance standards and indicators to assess achievement of program objectives and success towards harvest and conservation goals.

- Winthrop NFH Spring Chinook -

Recommendation WT10: In collaboration with other comanagers, develop a new monitoring and evaluation (M&E) program for spring Chinook in the Methow River watershed as part of the new HGMP. This new M&E program should be a collaborative effort of comanagers for monitoring progress towards meeting both harvest and conservation mitigation goals and objectives of the program. Improve coordination of M&E among salmonid managers in the watershed.

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.

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[59]

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). With the exception of Alternative 1, all alternatives would require renegotiation of the U.S. vs. Oregon agreement related to tribal fishing rights and opportunities.

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

**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 and those for the Methow State Hatchery.
- Produces and releases hatchery-origin fish that 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 broodstocks at 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 at Winthrop NFH that would be sufficiently large to meet minimum desired numbers of adult spawners each year (see potential alternatives for steelhead program). Consequently, steelhead eyed eggs would continue to be obtained from adults trapped and spawned at Wells Dam.

**Alternative 2: Integrated two-stage "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- and upper Columbia regions (e.g. Colville Tribe's Master Plan), while potentially providing harvest opportunities. Under this alternative, the Methow State Hatchery would focus on conservation objectives within the Methow River watershed while the Winthrop NFH would focus on harvest and reintroduction objectives (Figure 7). Winthrop NFH spring Chinook would then be adipose-fin clipped prior to release to increase their potential future harvest contribution.

Pros

- Does not require a direct take on ESA endangered *natural-origin* adults for inclusion of adult fish in the broodstock at Winthrop NFH.

- Defines the roles of the Methow State Hatchery (conservation) and the Winthrop NFH (harvest and reintroduction) consistent with recommendations WT1 and WT2.

- 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. Fish from the Winthrop NFH would be available to assist with recovery of spring Chinook in the Methow River, if needed.

- Would provide the most appropriate stock for reintroducing spring Chinook to the Okanogan River and establishing a hatchery broodstock at Chief Joseph Dam compared to a Carson-strain hatchery stock from Leavenworth or Entiat NFHs, thus minimizing straying risks to the Methow River.

- Provides a scientifically defensible mechanism for NOAA-Fisheries to permit a direct harvest (take) on ESA 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

- New ESA Section 7 (and/or Section 10) permits would be needed from NOAA Fisheries to allow a direct harvest (take) on hatchery-origin fish that are included with an ESU 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.

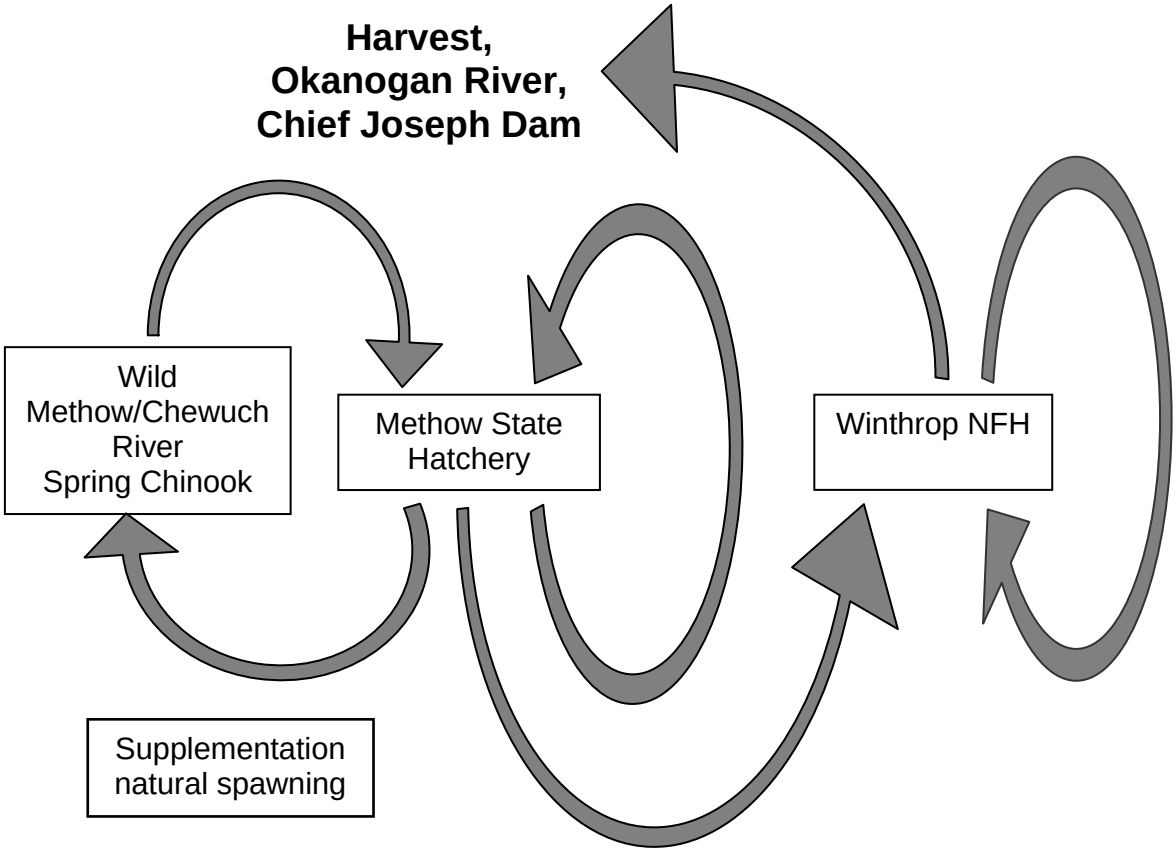

Figure 7. "Stepping stone" gene flow diagram for the spring Chinook broodstock at the Winthrop NFH integrated genetically with the Methow State Hatchery Composite stock. All fish released from the Winthrop NFH fish would be adipose-fin marked and available for harvest. This scenario requires a weir in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

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.

- 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

- ESA permits from NOAA Fisheries would be needed to allow a direct harvest (take) on hatchery-origin fish that are included with the endangered listing of the Upper Columbia River Spring Chinook ESU.

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 long-term goals of comanagers to develop and maintain separate trapping and broodstock programs for the Methow, Chewuch, Twisp, and Okanogan rivers.

- Inconsistent with long-term comanagers' goals to develop and maintain separate trapping and broodstock programs in the Methow and Okanogan rivers for both spring Chinook and steelhead.

**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 (see alternatives for steelhead program at Winthrop NFH). Winthrop NFH spring Chinook would be adipose-fin clipped prior to release to increase their potential future harvest contribution as in Alternative 2.

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 Methow River 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 (consistent with recommendations WT1 and WT2).
- 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. However, the U.S. Bureau of Reclamation does not consider this issue a problem in the broad scope of mitigation for Grand Coulee Dam (Appendix 4).
- 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 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.
- Several large summer Chinook hatchery programs already exist in this region.
- Terminal fishery benefits in the Methow River could be relatively small because the majority of fish would be harvested in marine or lower Columbia River fisheries.

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

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 (i.e., Alternative 2 but at reduced program size) by developing a two-stage "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. Winthrop NFH spring Chinook would be adipose-fin clipped prior to release to increase their potential future harvest contribution. 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). However, surplus adults could be trapped and spawned to provide eyed eggs for hatching and rearing elsewhere (e.g., see recommended alternative for Entiat NFH).

- Hatchery-origin spring Chinook surplus to program needs (eggs, juveniles, or adults) would be used to develop a segregated harvest program in the mainstem Columbia River below Chief Joseph Dam and/or for reintroducing spring Chinook to 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.

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 and inclusion of natural-origin fish in the hatchery broodstock.

- ***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 and 100,000 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 at the Winthrop NFH or in the Methow River for broodstock, and all hatchery-origin fish returning to the Methow River 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 eyed 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 were not applied prior to BY2006. Beginning with BY2006, all steelhead released from the Winthrop NFH will receive coded wire tags.

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 broodstock each year. The Winthrop NFH program utilizes adults captured from the upper Columbia River run at large at Wells Hatchery or Wells Dam collection facilities. Adults are held and spawned at Wells Hatchery, and eyed eggs are transferred to Winthrop NFH for incubation, rearing, and final release from the facility into the Methow River after 15 months of on station rearing. NOAA Fisheries has concluded that the Wells Hatchery broodstock is currently essential for recovery of the ESA-threatened Upper Columbia River Steelhead DPS.

On average. 118,400 yearling juveniles were released from the Winthrop NFH, 1996-2005, at an average size of 6.5 fish per pound. The Service has explored the possibility of developing an endemic Methow River steelhead broodstock as adults do return to the hatchery. However, this program would most likely require two-years of on station rearing to produce smolt-size fish and mimic the natural life cycle of steelhead in the Methow River. However, a two-year steelhead program is not possible at this time given the limited water and rearing space currently available at the Winthrop NFH relative to other programs (e.g., spring Chinook).

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 subsequently). In recent years, 5-12% of the steelhead captured at Wells Dam have been natural-origin fish.
- ESA Section 10 Permit (No. 1395) authorizes WDFW to retain up to 395 adult steelhead for broodstock purposes.
- Recent revisions (BY 2004) 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.
- A current issue is whether steelhead adults should be collected at Winthrop NFH for the current program rather than as eyed eggs from adults trapped at Wells Dam. For the past several years, numerous steelhead adults (hatchery and wild) returned and spawned in the outflow channel that connects the adult collection ladder at the hatchery to the Methow River.

- 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 at the present time because of 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 objective is to transfer 100% HxW (and WxH) eyed egg progeny to the Winthrop NFH for hatch, grow-out, and subsequent release in the Methow River.

Hatchery and Natural Spawning, Adult Returns

- The hatchery outflow channel has been enhanced for natural spawning of adult steelhead that return to Winthrop NFH. Gravel bars were installed every 3 to 5 channel widths from the discharge area at the hatchery down to the ski trail bridge (approximately 200 meters). This section of the channel did not have any shallow spawning areas prior to construction of the gravel bars. The gravel is held in place by large log structures with root wads and large boulders.

- 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 smolt-to adult recruit rates (SARs) in the range of 0.12–0.24%.

Incubation and Rearing

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

- All incubation takes place in 47°–50° F well water pumped from three infiltration galleries.

- Formalin treatments are not necessary during incubation.

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

Release and Outmigration

- Smolts are volitionally released directly into the outflow channel at a size of 6–8 fish per pound. Detection of PIT tagged fish at McNary and Bonneville Dams' bypass facilities indicate rapid downstream movement of smolts released from Winthrop NFH.

- A small percentage of steelhead are detected migrating downstream approximately one year after release during the following spring. Those juvenile steelhead are apparently residing in the river system an additional year before emigrating to sea. The Service has concluded that those *residualized* hatchery-origin steelhead pose little or no threat to natural populations of steelhead because they (a) represent the same stock (ESU) as the natural population that is listed as threatened under the ESA and (b) constitute less than one percent of all outmigrants detected downstream.

- WDFW releases a target of 100,000 Wells Hatchery steelhead smolts in each of the upper Methow, Chewuch, and Twisp Rivers (maximum of 320,000 smolts total). These releases are in addition to the 100,000 smolt release from Winthrop NFH.

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

Harvest Benefits

- Harvest benefit to recreational fishers in the Methow and upper Columbia rivers. Hatchery-origin steelhead in the Methow River is one of only two consistent recreational fishing opportunities for anadromous salmonids in mid-Columbia River tributaries.[61] The other opportunity is the spring Chinook recreational fishery in Icicle Creek immediately downstream from Leavenworth NFH.

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

Conservation Benefits

- Conservation benefit from increasing the demographic abundance and spatial distribution of this ESA-listed population. The actual conservation benefit and contribution to recovery of naturally spawning populations is undocumented, although total returns of natural-origin steelhead intercepted at Wells Dam has recently increased from an average of 368 adults per year (1998-2000) to 836 adults per year (2001-2005).

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

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

[61] *According to WDFW's Sport Fishing Rules for 2006-2007, steelhead in the Methow River (and Chewuch River) are "catch-and-release" only.*

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.

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

Genetic

- Genetic risk to natural populations of steelhead from preventing local adaptation and development of between-population genetic diversity by collecting broodstock at Wells Dam (e.g., between Methow and Okanogan rivers).
- Genetic risk to Methow River steelhead if eyed eggs transferred to Winthrop NFH are not representative of the temporal distribution of returning adults trapped at Wells Dam. This risk is present because data for the specific parents of the transferred eyed eggs are unavailable.
- Genetic domestication risk to Methow River steelhead if less than one-third of the broodstock in the future is derived from natural-origin fish.
- Demographic risk to the natural population in the Methow River 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 to the natural population in the Methow River 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 surplus hatchery-origin adults versus outplanting those adults, or their hatchery-produced progeny, into other locations and habitats.
- Demographic risk to one or more natural populations by removing natural-origin fish of undetermined upriver destination at Wells Dam for broodstock.
- Demographic risk from pathogen amplification.

[62] *Ibid.*

Ecological

- Ecological risk to released fish and their natural-origin progeny from not considering competition for food and space from existing flora and fauna that now occupy habitat and niches formerly occupied by anadromous salmonids (e.g., steelhead niche may need to be re-established in upstream rearing areas).

- Ecological risk to natural-origin steelhead in the Methow River if juveniles from this hatchery program are competing with and/or preying on those fish.

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

Ecological

- Ecological risk to other aquatic species in the Methow River from not considering competition for food and space from hatchery-origin steelhead on existing flora and fauna that now occupy habitat and niches formerly occupied by anadromous salmonids.

- Ecological risk to anadromous salmonid fishes in other watersheds due to uncertainties resulting from inadequate monitoring to assess levels of straying and potential natural spawning by hatchery-origin steelhead.

- Ecological risk to aquatic species in the Methow River from lack of regular cleaning of effluent settling pond and non-treatment of hatchery outflow water, although cleaning effluent water is discharged into a settling pond and meets the most recent NPDES standards.

[63] *Ibid.*

Recommendations for Current Program[64]

Recommendations are subdivided into two categories: those for current programs and those for potential alternative programs. Recommendations for the current program are presented here and are intended to address short-term or present goals. Recommendations for alternative programs are presented in the following "Alternatives" section and are intended to address long-term or future goals.

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.

Programs Goals and Objectives

Issue WT13: One intent of the Winthrop NFH summer steelhead program is to contribute to restoration and recovery of naturally spawning populations in the Methow River. However, specific goals and objectives for this stock's contribution to that restoration effort have not been identified.

Issue WT14: 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.

Recommendation WT13: Work with other salmonid managers to create specific goals and objectives for the contribution of hatchery-origin steelhead to the restoration of natural populations and recovery of the Upper Columbia River Summer Steelhead DPS. These goals should be quantified, including the 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 summer steelhead in the Methow River.

Recommendation WT14: 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 for this program.

[64] *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.*

Broodstock Choice and Collection

Issue WT15: 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 in the Methow and Okanogan rivers, including the establishment of natural population structure within each watershed.*

Issue WT16: 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 steelhead inhibits development of locally-adapted natural populations.*

Recommendation WT15: 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 WT16a: Develop a local broodstock at Winthrop NFH and ensure that steelhead of Wells Dam origin are not released above Foghorn Dam.

Recommendation WT16b: Use the improved adult collection facility to remove hatchery-origin adults that exceed supplementation goals.

Issue WT17: The relatively small number of adults needed for broodstock (n= 54 adults) to achieve a release of 100,000 smolts may not be sufficient to adequately represent genetic diversity of steelhead in the Methow River.

Recommendation WT17 - Use a minimum of 100 adults for broodstock to increase the effective number of breeders per year. In the near term, spawning and egg incubation protocols at Wells Dam should ensure that the eyed eggs transferred to the Winthrop NFH represent the progeny of at least 100 adult steelhead. In the long-term, the genetic effective number of breeders spawned at the Winthrop NFH should be at least 100 adults per year to avoid *Ryman-Laikre effects*.

Incubation/Rearing

Issue WT18: Effluent pond does not have a current permit and permitting standards may be changing.

Recommendation WT18 - Continue to work with EPA to complete the NPDES permitting process.

Issue WT19: 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 increases fish health risks relative to producing one-year smolts.*

Recommendation WT19 - Rear two-year steelhead smolts if space becomes available at Winthrop NFH 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 WT20: WDFW currently releases 100K Wells Hatchery summer steelhead smolts near Mazama, well upstream of Foghorn Dam, to provide recreational fishing opportunities and assist with hatchery supplementation of natural populations. They also release 100K smolts in the Chewuch River approximately 10 miles upstream of the confluence with the Methow River.

Recommendation WT20: The Service should 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 WT21: All hatchery-origin steelhead returning to the Winthrop NFH are blocked from entering the hatchery and spawn naturally within the vicinity of the hatchery.

Recommendation WT21: Trap returning hatchery-origin steelhead at Winthrop NFH and outplant them into areas designated for restoration and supplementation in the upper Methow River and other sites in return years that exceed supplementation needs in the Methow River. Some or all these fish can be used for broodstock in future years after Recommendation 16a is implemented.

Facilities and Operations

(See Winthrop spring Chinook program for additional recommendations)

Issue WT22: 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 WT22: Convert the unused "B" bank Foster-Lucas ponds to covered raceways, and plumb a water line from infiltration gallery No. 2 to provide isolated well water and maintain the ability to mix river and well water. (Note: The well water line from gallery No. 2 is already close to the "B" bank Foster-Lucas ponds.

Research, Monitoring, and Accountability

Issue WT23: There is a general lack of information about distribution, contribution to fisheries, survival and stray rates for steelhead released from Winthrop NFH.

Recommendation WT23a: Mark all released fish 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 WT23b: The Service should work with comanagers to expand, coordinate, and improve M&E programs for steelhead in the Methow River. Catch and release data on marked and unmarked fish could provide valuable data on the viability and abundance of natural populations within the watershed.

Education and Outreach

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

Alternatives to Current Program[65]

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 a Methow River broodstock. This alternative assumes no reduction in the size of the current spring Chinook program at Winthrop NFH.

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.

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

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. This alternative first requires implementation of recommendations WT13 and WT14 to establish adult habitat capacities for supplementation spawning by hatchery-origin steelhead. In addition to the 100,000 steelhead yearlings currently released from Winthrop NFH, WDFW currently releases up to 320,000 Wells Hatchery steelhead smolts into the Methow River watershed, equally divided among the upper Methow, Chewuch, and Twisp rivers. The potential implementation of Alternative 2 would require reassessment of the overall supplementation goals and habitat capacities for adult steelhead in the Methow River watershed as part of a new HGMP for the new program proposed under Alternative 2.

Pros

- Same pros as Alternative 1.
- Expansion of steelhead program increases the effective number of breeders, thus reducing genetic swamping risks (e.g., "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.
- May promote increased recreational fisheries for steelhead in the Methow River, which may provide increased 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

- Requires improved adult collection facilities at Foghorn Dam, or a new facility, to trap natural-origin adults for broodstock (Recommendation WT15).
- 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 of age.

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.

Pros

- Could provide a local conservation benefit by eliminating potential ecological interactions between hatchery and natural origin steelhead in the Methow River in the immediate vicinity of the Winthrop NFH.

Cons

- Provides no harvest benefit.

- 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 and a release objective of 200,000 smolts 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.

- If conflicts should arise between the spring Chinook and steelhead programs at the Winthrop NFH, the Review Team notes that our recommendations for spring Chinook should have a higher priority than those for steelhead.

VI. Conclusions

The spring Chinook program at the Leavenworth NFH is the only program of the four federal hatchery 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. 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. 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 Leavenworth NFH adults to ESA listed natural populations of spring Chinook in the Wenatchee River would be to differentially mark or tag spring Chinook released from state and federal hatcheries so that adult fish from the Leavenworth NFH could be identified and selectively removed at Tumwater Dam as part of ongoing fish trapping and biosampling operations.

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 would also allow the complete removal of the water diversion structure at the current site of the water intake if outflow water from the hatchery or other downstream water withdrawal 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, as exemplified by the recently initiated PASS process, could greatly facilitate resolution of several inter-related water and fish passage issues in Icicle Creek, especially in light of the ESA 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. The Review Team concluded that the Entiat NFH should be used to assist with the conservation, recovery, and reintroduction of species with high conservation and harvest importance in the mid and upper Columbia River regions. This role would be consistent with the long-term goals of the comanagers and Service and would include assisting with reintroduction of coho salmon in the Wenatchee and Methow rivers, in accordance to the Master Plan of the Yakama Nation, and reintroduction of spring Chinook to the Okanogan River in collaboration with the Colville Confederated Tribes. The Review Team concluded that the Entiat NFH could 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 regions, including the establishment of terminal fisheries for spring Chinook immediately downstream from Chief Joseph Dam.

Termination of the current spring Chinook program would also free up space for the Entiat NFH to potentially serve as an emergency back-up rearing station for Leavenworth NFH during construction of a new water intake delivery system.

The Review Team concluded that the Winthrop NFH offers significant potential to achieve both short-term and long-term 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 State Hatchery and Winthrop NFH will not achieve their intended long-range 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. Those revised spring Chinook and steelhead hatchery programs may also require development of acclimation-release sites and ponds in natural-rearing areas of the Methow River . 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 initial successes. Because of those 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. If those efforts are successful, then other species of anadromous salmonids (e.g., steelhead, spring Chinook) could potentially benefit via substantial inputs of carcass nutrients and increased ecological stability and complexity of the respective salmonid ecosystems.

Appendices

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/

Appendix E: Leavenworth NFH Complex Operations and Maintenance Costs Summary

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

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The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people.

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