United States Department of the Interior

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In Reply Refer To:
CWFO: 13260-2006-P-0010
HUC:17020011

August 31, 2006

MEMORANDUM

To: Project Leader, Leavenworth National Fish Hatchery Complex
Leavenworth, Washington

From: Supervisor, Central Washington Field Office
Wenatchee, Washington

Mark G. Miller
for Susan B. Martin

Subject: Biological Opinion for the Leavenworth National Fish Hatchery Operation and Maintenance

This correspondence transmits the Ecological Services (ES) Division of the U. S. Fish and Wildlife Service's (Service) biological opinion (Opinion), which is based upon our review of the *Leavenworth National Fish Hatchery Operations and Maintenance Biological Assessment*, for the Leavenworth National Fish Hatchery (Project), located along Icicle Creek in Chelan County, Washington. The attached Opinion and documentation of informal consultation describes the effects of the Project on the bull trout *(Salvelinus confluentius)* and other listed species in accordance with Section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

In the last biological assessment (BA) dated July 10, 2006, you requested concurrence with your determinations of "no effect" from hatchery operations and maintenance activities for the following species: gray wolf (*Canis lupus*), Canada lynx (*Lynx canadensis*), grizzly bear (*Ursus arctos horribilis*), Pacific fisher (*Martes pennanti*), northern spotted owl (*Strix occidentalis caurina*), marbled murrelet (*Brachyramphus marmoratus*), yellow-billed cuckoo (*Coccyzus americanus occidentalis*), Wenatchee Mountains checker-mallow (*Sidalcea oregana var. calva*), Ute ladies' tresses (*Spiranthes diluvialis*), and showy stickseed (*Hackelia venusta*) in accordance with section 7(a)(2) of the Act. You also requested concurrence with your determination of "not likely to adversely affect" bald eagle (*Haliaeetus leucocephalus*).

Concurrence for "no effect" determinations is not required from ES, but we appreciate you notifying us of your determinations. Based on the information provided, ES agrees that no impacts will occur as a result of the proposed action to marbled murrelet, yellow-billed cuckoo, Wenatchee Mountains checker-mallow, Ute ladies' tresses, and showy stickseed (*Hackelia venusta*).

We do not concur with your "no effect" determination for gray wolf, Canada lynx, grizzly bear, Pacific fisher, and northern spotted owl. Ecological Service's opinion is that the Project "may affect but is not likely to adversely affect" gray wolf, Canada lynx, grizzly bear, northern spotted owl, and bald eagle. ES concludes that project implementation "will not jeopardize the continued existence" of the Pacific fisher. Since the fisher is proposed for listing; your responsibility to "conference" is complete.

In the enclosed Opinion, ES has determined that the proposed Project, as described, is "likely to adversely affect" the bull trout; however, the level of anticipated take is not likely to result in "jeopardy" to the species. Critical habitat for the bull trout does not occur within the action area; therefore, the Project will not destroy or adversely modify proposed critical habitat for bull trout.

ES acknowledges and appreciates the patience and participation of the Leavenworth National Fish Hatchery, Fisheries Resource Office, Yakama Nation, and regional office personnel in completing this consultation. Thank you all for providing technical information and cooperation needed to complete this consultation.

If you have questions about this Opinion or your responsibilities under the Endangered Species Act, please contact David Morgan of the Central Washington Fish and Wildlife Office in Wenatchee at (509) 665-3508 x 24 or via e-mail at david_morgan@fws.gov.

Attachment

Cc Sent by Email to:

Brian Cates, Mid-Columbia Fisheries Resource Office, Leavenworth, WA
Jana Grote, Fisheries Resources, Pacific Regional Office, Portland, OR
Mariel Combs, Office of the Regional Solicitor, Portland, OR
Dale Bambrick, National Marine Fisheries Service, Ellensburg, WA
Courtney Taylor, U.S. Department of Justice, Washington, DC
Kurt Beardslee, Washington Trout, Duvall, WA

Biological Opinion

For the

Operation and Maintenance of Leavenworth National Fish Hatchery through 2011
FWS Reference Number 13260-2006-P-0010

Consultation by: U.S. Fish and Wildlife Service
Upper Columbia Fish and Wildlife Office, Spokane, Washington

Issued by: Susan B. Martin Date 08/31/06

Susan Martin, Project Leader

Figures and Tables

INTRODUCTION

This document transmits the Fish and Wildlife Service's (Service or USFWS) biological opinion (Opinion) based on our review of the proposed operations and maintenance of the Leavenworth National Fish Hatchery (LNFH or Project) located in Chelan County, Washington, and its effects on the threatened bull trout (*Salvelinus confluentus)*. This intra-service consultation was conducted in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Your July 10, 2006, request for formal consultation and the final biological assessment (BA; USFWS 2006a) were received that day.

This biological opinion is based on information provided in: the BA and four draft BAs; numerous e-mails and meeting notes about the Project compiled since 2003; National Environmental Policy Act (NEPA) documents pertaining to LNFH; published literature and unpublished reports; the proposed and final rules for listing of the bull trout; the draft *Bull Trout Recovery Plan* (especially the chapter on the upper Columbia River recovery unit); the proposed and final designations of critical habitat for the bull trout; local watershed analysis and field surveys prepared by the U.S. Forest Service; State of Washington limiting habitat factors analysis; Upper Columbia Salmon Recovery Plan and associated analyses; watershed planning documents; and field visits to the project site. A complete administrative record of this consultation is on file at the Service's Central Washington Field Office (CWFO) in Wenatchee, Washington.

Leavenworth NFH Complex was authorized by the Grand Coulee Fish Maintenance Project in 1937 and reauthorized by the Mitchell Act of 1938. The hatchery is one of three mid-Columbia stations (Leavenworth, Entiat, and Winthrop NFHs) constructed by the Bureau of Reclamation (BOR) as fish mitigation facilities for the Grand Coulee Dam, Columbia Basin Project. Construction began in 1939, and funding was provided through a transfer of funds from the BOR to the Service until 1945. From 1945 to 1993, the Service had funding, management, and operation responsibilities for the complex of 3 hatcheries. Beginning in Fiscal Year (FY) 1994 the BOR assumed funding responsibility for the complex while the Service continued to manage and operate the three facilities. In FY 2004 the direct funding agreement between BOR and Service for O&M at the Complex was approximately $3.9 million. Annual funding is projected to average $4.4 million per year for FY07-09 (BPA 2006).

CONSULTATION HISTORY

March 1999: The Moses Lake Field Office issued a memorandum to the LNFH concurring that operations and maintenance of the hatchery may effect, but was not likely to adversely affect bull trout.

April 2003: The Service's Ecological Service's program (ES), LNFH, and the mid-Columbia Fisheries Resource Office (MCFRO) met to discuss new or updated consultations for several activities that would be needed at LNFH over the next few years, including Icicle Creek

Restoration Project Phase II, and the Intake Rehabilitation Project. ES advised LNFH to initiate formal consultation on operations and maintenance (O&M) at LNFH because adverse affects on bull trout were occurring due to O&M at LNFH.

June 2005: LNFH advised ES that it would begin developing a BA for O&M at LNFH.

November 2005: LNFH submitted a draft BA for O&M to ES; ES reviewed draft and requested additional information.

January 2006: LNFH submitted a second draft BA for O&M to ES; ES reviewed draft and requested additional information.

March 2006: LNFH submitted the third and fourth draft BAs.

April 2006: Upon reviewing the BAs, ES recommended modifications to the proposed action in order to reduce project effects on bull trout, and advised that the modifications should be incorporated into the proposed action as an amendment to the final BA.

July 2006: LNFH submitted final BA and requested concurrence on a "may affect, likely to adversely affect for bull trout *(Salvelinus confluentus)*."

INFORMAL CONSULTATION

In July 2006, LNFH requested concurrence with their determinations of "no effect" from O&M for the following species: gray wolf (*Canis lupus*), Canada lynx (*Lynx canadensis*), grizzly bear (*Ursus arctos horribilis*), Pacific fisher (*Martes pennanti*), northern spotted owl (*Strix occidentalis caurina*), marbled murrelet (*Brachyramphus marmoratus*), yellow-billed cuckoo (*Coccyzus americanus occidentalis*), Wenatchee Mountains checker-mallow (*Sidalcea oregana var. calva*), Ute ladies' tresses (*Spiranthes diluvialis*), and Showy stickseed (*Hackelia venusta*) in accordance with section 7(a)(2) of the Act. The LNFH requested concurrence with their determination of "not likely to adversely affect" bald eagle (*Haliaeetus leucocephalus*). Regarding Pacific fisher, this species is proposed for listing and therefore "conference" rather than "consultation" is technically what is required under ESA, but the procedures are the same and that is what will be provided.

The Service (ES) does not provide concurrence for "no effect" determinations. Based on the information provided it appears that no impacts will occur as a result of the proposed action to the flowing species: marbled murrelet (*Brachyramphus marmoratus*), yellow-billed cuckoo (*Coccyzus americanus occidentalis*), Wenatchee Mountains checker-mallow (*Sidalcea oregana var. calva*), Ute ladies' tresses (*Spiranthes diluvialis*), and showy stickseed (*Hackelia venusta*). The habitat for these two bird species at LNFH is unsuitable, and surveys indicate that the plant species do not exist on LNFH grounds.

The Service (ES) does not concur with the LNFH "no effect" determination for gray wolf, Canada lynx, grizzly bear, Pacific fisher, and northern spotted owl. The Service (ES) would concur with a "not likely to adversely affect" determination for listed species as described below. For the candidate species, Pacific fisher, the Service would concur with conclusion of the proposed action and conclude "would not jeopardize the continued existence of" the species.

Gray wolf, Canada lynx, grizzly bear, Pacific fisher

These species have not been observed at LNFH or its facilities for many years. While habitat at the LNFH is generally not suitable due to high road density and human activity, high quality habitat for these species is present in the vicinity of the Snow Lakes. Sightings of wolves, lynx, and grizzlies in the North Cascades in Washington have been sporadic, and in recent years none have occurred within several miles of the Project area. Pacific fisher may be extirpated from Washington. Habitat suitability is low and high levels of human disturbance may preclude use of the lower Icicle. Noise disturbance may minimally and temporarily affect prey species for these carnivores, but due to other human activities in the lower Icicle valley, these species are extremely unlikely to occur in the immediate area. These carnivores could possibly be undetected or transient in the Wilderness Area near Snow Lakes, but their presence during brief Project activities that could affect them (periodic helicopter flights to adjust water releases, workers in the area for a few hours) is unlikely. No habitat effects are anticipated for any of these species. Overall, Project effects to these carnivores are anticipated to be insignificant and discountable based on the presumed low abundance and activity of these species in the Project area, and the limited potential for indirect effects to their habitat and prey base.

Northern spotted owl

The project area lies within the range of the northern spotted owl. One half mile to the south of the LNFH on National Forest lands lies the Boundary Butte Late Successional Reserve (LSR). This LSR was burned over in the 1994 Rat Creek Fire, though it is still managed to protect and enhance conditions of late-successional forest ecosystems and related species. No known or suspected nest or roost sites for spotted owls have been located near the Project area. Most of the hatchery grounds are currently non-habitat for spotted owls. Northern spotted owl surveys were conducted in habitat within one mile of the project area in 2003 and no spotted owls were detected (USFWS 2003a). However, the forested lands adjacent to the project area provide connectivity for spotted owls moving across the landscape from the Swauk and Boundary Butte LSRs to the Icicle and Deadhorse LSRs.

Although spotted owls have attempted to nest at other locations within a few miles of the Project in the past, they have not been observed near the Project area itself. The Service anticipates that disturbance of spotted owls from the Project, including periodic helicopter flights to Snow Lakes, is unlikely to occur based primarily on past patterns of spotted owl habitat use in the area. Project activities will not preclude the future development of suitable or dispersal habitat nor reduce the total area of these habitats available to spotted owls. Therefore, the Service anticipates Project effects to the spotted owl to be discountable and insignificant. Designated critical habitat is not located near or within the Project area and will not be affected.

Bald eagle
Eagle activity in the area appears to be very limited. In 2001 a bald eagle used a winter roost site near the intake, and in 2002 a bald eagle used a winter roost site located approximately one mile upstream of the intake (USFWS 2004). Bald eagles have nested at Fromm's field, within about 0.5 mile of the LNFH, from 2001 to 2005, achieving about a 50 percent rate of fledging. Based primarily on past patterns of bald eagle activity in the area, the Service anticipates that disturbance of bald eagles from the proposed project is unlikely to occur if helicopter flight paths avoid the Fromm's field nest by greater than 800 meters (m). No habitat effects are anticipated. As a result, effects on bald eagle are expected to be discountable.

Conclusion of Informal Consultation and Conference
Based on the information provided in the BA, the Service (ES) concludes that the proposed action "may affect, but is not likely to adversely affect" the gray wolf, Canada lynx, grizzly bear, northern spotted owl, and bald eagle. In addition, the Service concludes that project implementation "will not jeopardize the continued existence" of the fisher. This concludes informal consultation pursuant to regulations implementing the Act. This Project should be reanalyzed if new information reveals that the action may affect listed or proposed species or designated or proposed critical habitat in a manner or to an extent not considered in this consultation; if the action is subsequently modified in a manner that causes an effect to a listed or proposed species or designated or proposed critical habitat that was not considered in this consultation; and/or, if a new species is listed or critical habitat is designated that may be affected by this Project. Effects to these species will not be analyzed further in this Opinion.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The following discussion is a summary of the proposed operation of LNFH; a complete description is contained in the final BA, which is herein incorporated by reference (LNFH 2006).

Leavenworth NFH is located three miles south of Leavenworth, Washington, near the mouth of Icicle Canyon. Most of LNFH's facilities are located on the west bank of Icicle Creek near river mile (rm) 2.8.

The proposed operation of LNFH can be broadly separated into three components: (1) the collection of adult fish (brood); (2) the release of juvenile fish; and (3) the operation of the water supply system. The term of the proposed action is May 2006 through December 2011, at which time a revised operational plan is anticipated to be put into effect following any appropriate formal consultation under section 7 of the ESA.

Collection of Adult Fish

Leavenworth NFH is a single species facility rearing only the "Carson lineage" stock of spring Chinook salmon. The LNFH has not imported eggs or fry for release into Icicle Creek in more than 20 years.

Adult spring Chinook salmon return to the hatchery from May into July (brood collection period). The fish ladder is operated at this time providing returning fish access to the adult holding pond. Adult salmon in excess of brood needs (1,000 adult salmon) support a tribal and sport fishery in Icicle Creek and others may be "surplused" to Native American tribes. In years with large adult returns, the fish ladder is closed periodically to prevent overcrowding in the holding pond. This strategy also allows additional harvest opportunities by sport and tribal anglers. Peak fishing activity in the spillway pool occurs between late-May and mid-June. Any non-target fish (e.g., steelhead, bull trout) encountered in the adult holding pond during sorting are netted and immediately returned back to Icicle Creek under the supervision of hatchery personnel. Sorting takes place at least weekly during the brood collection period. The first spawning date is mid-August and spawning is normally completed by Labor Day.

Since construction in 1939, LNFH has, with few exceptions, blocked adult salmon from accessing areas upstream of LNFH throughout the year. This is done by installing racks and dam boards at the downstream terminus of the historic channel at structure 5 (a.k.a. dam 5; see Figure 1). When racks are installed at structure 5 the radial gates at the upstream terminus of the historic channel at structure 2 (a.k.a dam 2) have been closed to minimize flow through the historic channel. There are several reasons for blocking spring Chinook salmon from accessing upstream areas including the need to assure adequate hatchery brood, facilitation of the sport and tribal fishery, and minimizing the risk of disease inherent with having adult spring Chinook salmon (and/or Coho salmon) in the area of the hatchery water supply.

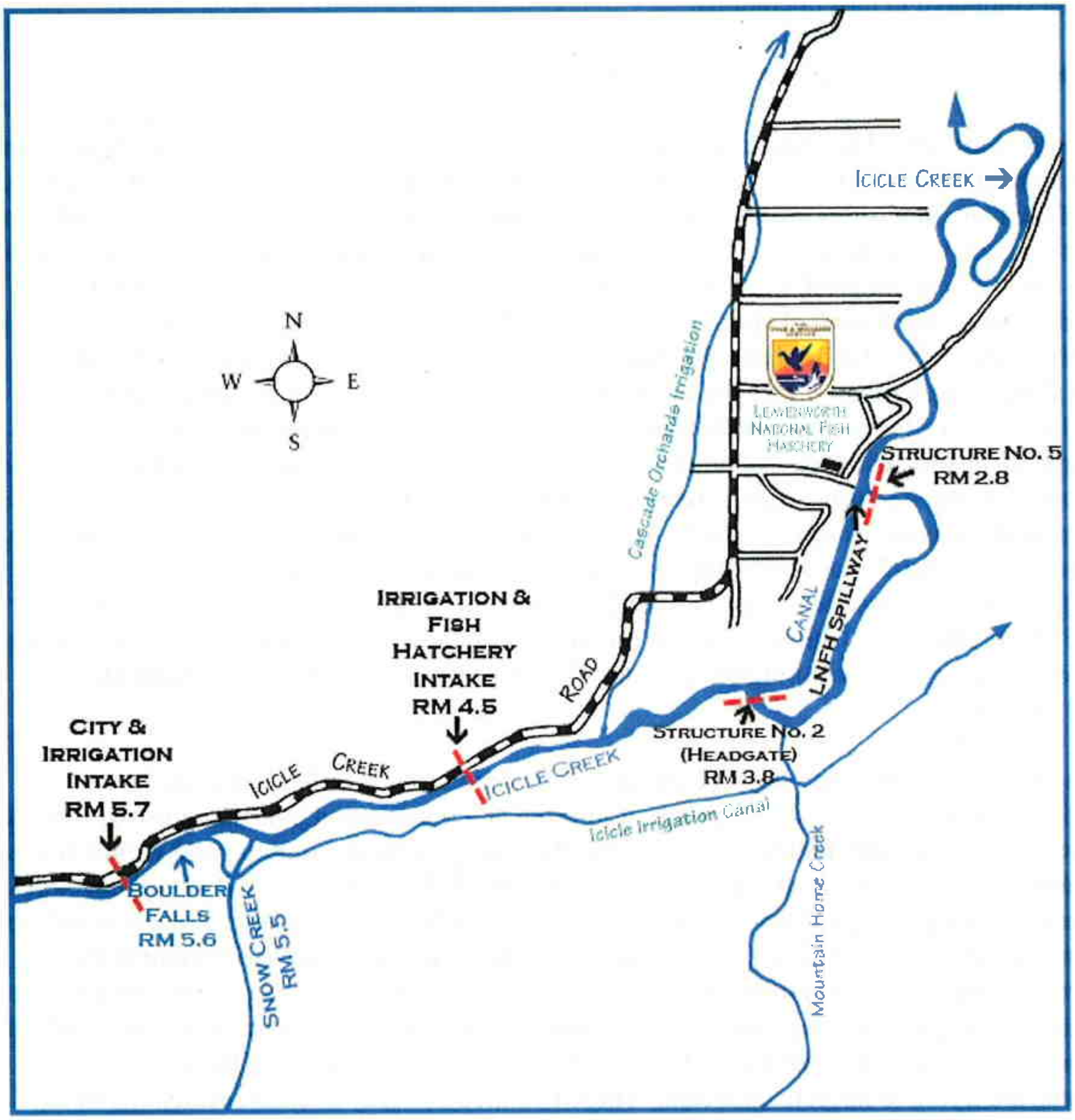


Figure 1. Leavenworth National Fish Hatchery and Vicinity

Figure 1. LNFH and vicinity

The LNFH has been working on long-term fish passage solutions and habitat improvements through the Icicle Creek Restoration Project (see page 8 of the BA). In the meantime however, LNFH has proposed the following changes (see pages 22-24 of the BA) to the operations of the historic channel structures that will improve flow conditions (habitat benefit) and increase passage opportunities for native fish, such as bull trout and steelhead, through the historic channel compared to past operations.

Starting in 2006, LNFH will operate structures 2 and 5 as follows:

During periods when broodstock activities are not occurring (generally 8 July to 30 September, and 1 December to 15 May) all racks and dam boards will be removed at structure 5, and at least one of the two radial gates at structure 2 will be maintained in an open position with a minimum 4-foot opening to promote passage of fish. An adaptive management approach will be used to limit, to the extent practical, the May 15 to July 7 broodstock collection period. LNFH will consider annual run timing of spring Chinook at Columbia River dams (e.g. Priest Rapids, Rock Island) to adjust the May 15 date. For example, early run timing may require installation of racks slightly earlier than May 15 while later run-timing may allow for a slightly later installation. An attempt will also be made to minimize the duration fish passage is blocked through the historic channel. Again, this will require an adaptive management approach. It may be possible to open passage earlier than July 7 when Chinook returns are not excessive and brood and harvest needs have been satisfied. At non-broodstock collection times the radial gates may be operated differently (one open and one closed) to concentrate low flows to benefit fish passage. It is also possible that passage will be blocked for up to two additional weeks after July 7 if more than 500 Chinook are still present in the spillway pool, but these circumstances have only occurred twice during the past decade when returns to LNFH were unusually large (2001 and 2002).

During the May 15 to July 7 broodstock collection period LNFH will use two methods to improve interim passage opportunities by capturing and transporting bull trout upstream of the hatchery. First, all adult bull trout collected in the spring Chinook holding pond will be released upstream of the hatchery at specific locations described below. Second, LNFH will develop and implement a trapping operation at structure 5. Any adult bull trout captured at the trap will be released upstream of the hatchery. The trap at structure 5 has not been tried before and its success at attracting and capturing bull trout is unknown. Very few fluvial sized bull trout are captured in the adult holding pond in a given year--most years none are encountered. Without a genetics baseline LNFH is assuming that bull trout captured with either of the above two methods are trying to migrate upstream. These two methods may facilitate relocation of an unknown number of bull trout to upstream areas which may benefit the Icicle Creek subpopulation.

Adaptive management approaches will also be used to investigate other alternatives to achieve passage in this interim period including such ideas as opening the structures for a short time during the broodstock collection window or capturing and transporting bull trout upstream. Decisions will be based on flow conditions, bull trout return dates and rates, Chinook salmon return dates and rates, tribal fishery needs, disease risks, and habitat conditions.

Note that during the summer of 2006 LNFH intends to remove the rack structure in front of the north gate which would allow for the opening of the second gate. LNFH will maintain the radial gate(s) in the open position during the non-broodstock collection period unless emergency conditions require gate closure. Emergency conditions which may require a gate closure include:

1) Flood
2) Smolt emigration
3) Canal water recharge
4) Maintenance of flow characteristics into the spillway pool during the broodstock collection period.

Gate closure is necessary under the above conditions and is directly linked to maintaining hatchery operations. These circumstances are expected to last for only a few days, or at most two weeks. If emergency conditions continue LNFH will consult with ES on an emergency basis. These emergency conditions are more fully described in the BA.

During routine operation and maintenance at LNFH bull trout may be encountered and need to be handled to return them to Icicle Creek. To minimize harm associated with handling bull trout several precautions will occur. Prior to handling bull trout hands will be free of sunscreen, lotion, or insect repellent. When practical all bull trout handling procedures will be implemented at times that avoid temperature stress of affected fish. It may be necessary to conduct the activity in the morning or evening on hot summer days to avoid temperature stress to captured fish. If bull trout are held in a tank, a healthy environment for the stressed fish will be provided and the holding time will be minimized. Water to water transfers, the use of shaded, dark containers, and supplemental oxygen will all be considered in implementing fish handling operations. If a bull trout is showing signs of stress or injury, it will only be released when able to maintain itself. It may be necessary to nurture the fish in a holding tank until it has recovered. All dip net or seine mesh netting will be composed of fine mesh (no knot) material.

The release location for a captured bull trout depends on where it was captured and what river conditions prevail at that time. The general procedure is described in the table below:

Capture Location	Release Location
Adult holding pond*	Call ES, Wenatchee Monday of each week during broodstock collection to determine release location
Trap at structure 5	Call ES, Wenatchee Monday of each week during broodstock collection to determine release location
Inside trash rack at intake diversion	Below and near intake diversion dam (rm 4.5)
Screen chamber/sand settling pond	In pool below spillway dam (rm 2.8)
Other	Closest, safe release location in Icicle Creek

*If structure 5 is not impeding fish passage, release fish in the spillway pool.

It also should be noted that the Yakama Nation may collect adult Coho salmon for broodstock at structure 5 from October through November. During this time, dam boards and adult fish traps are installed at structure 5 and the radial gates at structure 2 are operated (only partially opened) to minimize flow into the historic channel to maintain the integrity of the racks and traps at structure 5. Any non-target fish captured are supposed to be released upstream. The Yakama Nation, in conjunction with the Bonneville Power Administration (BPA), initially consulted with NOAA Fisheries and the Service on the Coho Reintroduction Project in 2001 (Service Reference Number 01-I-EO231). Subsequently there have been minor updates and modifications to that consultation in 2001, 2003, and 2006 (on file at CWFO).

Release of Juvenile Fish

A complete description of incubation and rearing operations are included in the BA. The LNFH targets a mid-April release of 1.625 million spring Chinook salmon smolts annually into Icicle Creek at rm 2.8.

All spring Chinook salmon reared and released at LNFH receive an adipose fin clip and up to 50 percent are implanted with a coded wire-tag. Some of the fish released also receive a Passive Integrated Transponder (PIT) tag. Tagging of hatchery fish is done to facilitate evaluation of the program (i.e., identify straying, determine contribution to fisheries, migration rates, survival, etc.).

All smolts are force released directly from the hatchery to Icicle Creek at a size at release of 18 fish/pound. This release time coincides with normal spring smolt migration and spill at Columbia River dams. This size at release results in a fish which is in good health, migrates to the ocean rapidly, and generates adult escapement to sustain the program and provide harvest opportunities. Rapid migration of smolts to the ocean also decreases competition with native fish. Although it has not happened in recent memory, an emergency early fish release could occur at any time (see BA, Appendix E).

Leavenworth NFH also supports the Yakama Nation's Coho Salmon Reintroduction Project by providing rearing space for approximately 750,000 Coho salmon presmolts that are acclimated on station for approximately two to four months prior to release in mid-April.

The Olympia Fish Health Center (FHC) in Olympia, Washington, provides for all aspects of fish health at LNFH. The primary objective of fish health programs at Service hatcheries is to produce healthy smolts that contribute to the program goals of that particular stock. Another equally important objective is to prevent the introduction, amplification or spread of certain fish pathogens that might negatively affect the health of both hatchery and naturally producing stocks.

Water Supply System

A complete description of the water supply system is included in the BA on pages 18-22, 48, 53-55, 57, 63, and 66. In brief, the LNFH withdraws up to 42 cubic feet per second (cfs) of surface flow from Icicle Creek throughout the year at the intake dam located at rm 4.5. During low flow periods (mid-August through September), especially in drier water years, there may be insufficient flow over the water intake dam for adequate fish passage. There is also no fish screening at the intake and entrained fish have to travel approximately a mile of pipe before they are screened and returned back to Icicle Creek. LNFH maintains and operates the intake diversion dam and its associated structures as part of a 1939 contract between the federal government and the Cascade Orchard Irrigation District.

During construction of the hatchery, it was recognized that surface flow and temperatures in Icicle Creek were at times insufficient to meet production demands. A supplementary water supply project in Snow Lake and Nada Lake was therefore developed. Water draining from Snow Lake enters Nada Lake which drains into Snow Creek, a tributary which enters Icicle Creek at rm 5.5, upstream of the hatchery water intake. The LNFH has historically released water from these supplementation lakes from about mid-July through September to maintain water levels and reduce water temperatures in the hatchery water supply. Additional cool water is supplied to the hatchery by a series of wells.

Operation of other upstream water diversions by Icicle/Peshastin Irrigation District (IPID) and the City of Leavenworth (COL) at rm 5.7 also decrease flow and increase water temperatures (during irrigation season) in the stream reach between the IPID/COL dam and the hatchery intake. Operation of LNFH's water delivery system, along with Cascade Orchards Irrigation Company, can decrease flow and increase water temperatures in Icicle Creek between the hatchery intake (rm 4.5) and the hatchery (rm 2.8) where all hatchery-used water is returned to Icicle Creek. However, the hatchery's summertime release of supplemental water from Snow and Nada Lakes, and from its wells, helps minimize this effect, and in fact slightly cools lower Icicle Creek.

The LNFH intends to continue to pursue permanent improvements to the intake structure (screening and passage) and water supply system through the Water Supply System Rehabilitation Project (see page 9 of the BA). In addition, LNFH has proposed the following changes (see BA page 21) to the use of the Snow/Nada Lake Supplementation Water Supply Reservoirs.

Starting in 2006, LNFH will operate water supply reservoirs as follows:

From July 20 through September of 2006, the hatchery will operate the Snow/Nada Lake Supplementation Water Supply Reservoirs to meet its 42 cfs water right in Icicle Creek. This commitment equates to a release of nearly 7,000 acre-feet of storage (70 days at 50 cfs) with an estimated 60 percent probability that inflows to Upper Snow Lake will meet or exceed the released volume. LFNH will also work with other resource agencies (NOAA, other Service programs, WDOE, etc.) to develop and refine a water release plan. This plan will lay out reservoir water release specifics (volumes and times) to minimize LNFH impacts on the environment. The goal would be to assure hatchery water needs, increase summertime stream flows below the LNFH diversion, dilute nutrient loading from LNFH effluent, all while balancing the reservoir recharge (i.e. refill) risk.

Water from the Icicle Creek surface withdrawal and wells used at LNFH is discharged into Icicle Creek at one of four locations: (1) through the open bypass ditch at rm 3.8; (2) at the base of the adult salmon return ladder at rm 2.8; (3) through the adult salmon return fish ladder at rm 2.8; or (4) through the pollution abatement pond at rm 2.7. The majority of river and well water used for hatchery operations returns to Icicle Creek at the base of the adult salmon return ladder except during pond cleaning and maintenance activities when all water is routed through the pollution abatement pond. All of the river and well water used at the hatchery is returned to Icicle Creek, minus any leakage and evaporation. LNFH operates and monitors its water discharge compliance with applicable NPDES permit effluent discharge limitations.

A. Action Area

The implementing regulations for section 7 of the ESA define action area as "…all areas directly or indirectly affected by the proposed Federal action and not merely the immediate area involved in the action" (50 CFR 402.02). For this consultation, the affected area consists of the main LNFH facilities on the west bank of Icicle Creek near rm 2.8, all portions of Icicle Creek from its mouth to the historical barrier near rm 26 (above Leland Creek), and areas affected by water storage in Snow Lakes (Snow and Nada Lakes Basin), and Snow Creek between Snow Lakes and Icicle Creek.

II. STATUS OF THE SPECIES

A. Listing Status

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). The threatened bull trout occurs in the Klamath River Basin of south-central Oregon and in the Jarbidge River in Nevada, north to various coastal rivers of Washington to the Puget Sound and east throughout major rivers within the Columbia River Basin to the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Cavender 1978, Bond 1992, Brewin and Brewin 1997, Leary and Allendorf 1997).

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation and alterations associated with: dewatering, road construction and maintenance, mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels; and introduced non-native species (64 FR 58910).

The bull trout was initially listed as three separate Distinct Population Units (DPSs) (63 FR 31647, 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs, plus two other population segments, into one listed taxon and the application of the jeopardy standard under section 7 of the ESA relative to this species (64 FR 58930):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

Thus, the Service's jeopardy analysis for the proposed Project is done at the scale of the Columbia River DPS.

B. Current Status and Conservation Needs

A summary of the current status and conservation needs of the bull trout within these units is provided below. A comprehensive discussion of these topics is found in the Service's draft recovery plan for the bull trout (USFWS 2002a; 2004a,b).

The conservation and habitat needs of the bull trout are generally expressed as the need to provide the four Cs: cold, clean, complex, and connected habitat. Cold stream temperatures, clean water that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous to local populations. The recovery planning process for the bull trout (USFWS 2002; 2004a,b) has also identified the following conservation needs for the bull trout: (1) maintain and restore multiple, interconnected populations in diverse habitats across the range of each interim recovery unit; (2) preserve the diversity of life-history strategies; (3) maintaining genetic and phenotypic diversity across the range of each interim recovery unit; and (4) establish a positive population trend. Recently, it has also been recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit.

Central to the survival and recovery of the bull trout is the maintenance of viable core areas (USFWS 2002a, 2004a, and b). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat, and in some cases in their use of spawning habitat. Each of the interim recovery units listed above consists of one or more core areas. About 114 core areas are recognized across the United States range of the bull trout (USFWS 2002a; 2004a,b).

As noted above, in recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: (1) Jarbidge River; (2) Klamath River; (3) Columbia River; (4) Coastal-Puget Sound; and (5) St. Mary-Belly River. Each of these segments is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

Jarbidge River

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawners, are estimated to occur within the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, angler harvest, timber harvest, and the introduction of non-native fishes (USFWS 2004a). The draft bull trout recovery plan (USFWS 2004a) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout within the core area; maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area; restore and maintain suitable habitat conditions for all life history stages and forms; and conserve genetic diversity and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. As noted in the draft recovery plan, an estimated 270 to 1,000 spawning fish per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (USFWS 2004a).

Klamath River

This interim recovery unit currently contains 3 core areas and 12 local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (USFWS 2002). Bull trout populations in this unit face a high risk of extirpation (USFWS 2002). The draft bull trout recovery plan (USFWS 2002) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; restore and maintain suitable habitat conditions for all life history stages and strategies; conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. As noted in the draft recovery plan, 8 to 15 new local populations and an increase in population size from about 3,250 adults currently to 8,250 adults are needed to provide for the persistence and viability of the 3 core areas (USFWS 2002).

Columbia River

This interim recovery unit currently contains about 90 core areas and 500 local populations. About 62 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The condition of the bull trout within these core areas varies from poor to good but generally all have been subject to the combined effects of habitat degradation, fragmentation and alterations associated with one or more of the following activities: dewatering; road construction and maintenance; mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species. The draft bull trout recovery plan (USFWS 2002) identifies the following conservation needs for this unit: maintain or expand the current distribution of the bull trout within core areas; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange. Because there are so many individual units they are not all listed here. Recovery criteria for the upper Columbia Recovery Unit (Entiat, Methow, and Wenatchee basins) include the following: the area must contain at least 17 local populations; the area must have estimated abundance between 6,322 and 10,246 migratory fish; the area must have stable or increasing trend for at least two generations at or above the recovered abundance level; and connectivity criteria will be met when specific barriers to bull trout migration in the area have been addressed (USFWS 2004c).

Coastal-Puget Sound

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous, adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this unit. This interim recovery unit currently contains 14 core areas and 67 local populations (USFWS 2004b). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this unit. With limited exceptions, bull trout continue to be present in nearly all major watersheds where they likely occurred historically within this unit. Generally, bull trout distribution has contracted and abundance has declined especially in the southeastern part of the unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, angler harvest, and the introduction of non-native species. The draft bull trout recovery plan (USFWS 2004b) identifies the following conservation needs for this unit: maintain or expand the current distribution of bull trout within existing core areas; increase bull trout abundance to about 16,500 adults across all core areas; and maintain or increase connectivity between local populations within each core area.

St. Mary-Belly River

This interim recovery unit currently contains 6 core areas and 9 local populations (USFWS 2002). Currently, the bull trout is widely distributed in the St. Mary River drainage and occurs in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (USFWS 2002). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (USFWS 2002). The draft bull trout recovery plan (USFWS 2002) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; restore and maintain suitable habitat conditions for all life history stages and forms; conserve genetic diversity and provide the opportunity for genetic exchange; and establish good working relations with Canadian interests because local bull trout populations in this unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

C. Life History

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989, Goetz 1989). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, Goetz 1989), or saltwater (anadromous) to rear as subadults or to live as adults (Cavender 1978, McPhail and Baxter 1996, WDFW et al. 1997). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime), and both repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989, Pratt 1992, Rieman and McIntyre 1996).

The iteroparous reproductive system of bull trout has important repercussions for the management of this species. Bull trout require two-way passage up and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous (fishes that spawn once and then die, and therefore require only one-way passage upstream) salmonids. Therefore, even dams or other barriers with fish passage facilities may be factors in isolating bull trout populations, if they do not provide a downstream passage route or the passage ladder does not accommodate smaller, weaker swimming fish.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length; and migratory adults commonly reach 24 inches or more (Goetz 1989). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

D. Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Goetz 1989; Sedell and Everest 1991; Pratt 1992; Rieman and McIntyre 1993, 1995; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), fish are not expected to simultaneously occupy all available habitats (Rieman et al. 1997).

Cold water temperatures play an important role in determining bull trout habitat. Bull trout are primarily found in colder streams (below 59 degrees Fahrenheit) and spawning habitats are generally characterized by temperatures that drop below 48 degrees Fahrenheit in the fall (Fraley and Shepard 1989, Pratt 1992, Rieman and McIntyre 1993).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992, Rieman and McIntyre 1993, Rieman et al. 1997). Optimum incubation temperatures for bull trout eggs range from 35 to 39 degrees Fahrenheit whereas optimum water temperatures for rearing range from about 46 to 50 degrees Fahrenheit (McPhail and Murray 1979, Goetz 1989, Buchanan and Gregory 1997). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 46 to 48 degrees Fahrenheit, within a temperature gradient of 46 to 60 degrees Fahrenheit. In a study relating bull trout distribution to maximum water temperatures across a landscape, Dunham et al. (2003a) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 52 to 54 degrees Fahrenheit.

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman et al. 1997a). Factors that can influence bull trout ability to survive in warmer rivers include availability and proximity of cold water patches and food productivity (Myrick 2003). In Nevada, adult bull trout have been collected at 63 degrees Fahrenheit in the West Fork of the Jarbidge River and have been observed in Dave Creek where maximum daily water temperatures were 62.8 to 63.6 degrees Fahrenheit (Werdon 2000). In the Little Lost River, Idaho, bull trout have been collected in water up to 68 degrees Fahrenheit; however, bull trout made up less than 50 percent of all salmonids when maximum summer water temperature exceeded 59 degrees Fahrenheit and less than 10 percent of all salmonids when temperature exceeded 63 degrees Fahrenheit (Gamett 1999). In the Little Lost River study, most sites that had high densities of bull trout were in an area where primary productivity increased in the streams following a fire (Gamett, B., pers. comm., USFS, 2002).

Increases in stream temperatures can cause direct mortality, increased susceptibility to disease or other sublethal effects, displacement by avoidance (McCullough *et al.* 2001, Bonneau and Scarnechia 1996), or increased competition with species more tolerant of warm stream temperatures (Rieman and McIntyre 1993; Craig and Wissmar 1993 cited in USDI (1997); MBTSG 1998). Brook trout, which can hybridize with bull trout, may be more competitive than bull trout and displace them, especially in degraded drainages containing fine sediment and higher water temperatures (Selong *et al.* 2001; Clancy 1993; Leary *et al.* 1993). Recent laboratory studies suggest bull trout are at a particular disadvantage in competition with brook trout at temperatures greater than 12° C (McMahon *et al.* 2001; Selong *et al.* 2001).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, Goetz 1989, Sedell and Everest 1991, Pratt 1992, Thomas 1992, Sexauer and James 1997, Watson and Hillman 1997). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, Pratt 1992, Pratt and Huston 1993). Pratt (1992) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August to November during periods of decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, Pratt 1992, Rieman and McIntyre 1996). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992), and after hatching, juveniles remain in the substrate. Time from egg deposition to emergence of fry may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992, Ratliff and Howell 1992).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993; Gilpin 1997; Rieman et al. 1997). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may be reestablished by bull trout migrants. However, it is important to note that the genetic structure of bull trout indicates that there is limited gene flow among populations, which may encourage local adaptation within individual populations and reestablishment of extirpated populations may take a very long time (Spruell et al. 1999, Rieman and McIntyre 1993).

Migratory forms of the bull trout appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes, where foraging opportunities may be enhanced (Frissell 1993). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River in Oregon (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. The benefits of the migratory strategy include greater growth in the more productive waters of larger streams and lakes, greater fecundity resulting in increased reproductive potential, and dispersing the population across space and time so that spawning streams may be re-colonized should local populations suffer a catastrophic loss (Rieman and McIntyre 1993, MBTSG 1998, Frissell 1999). In the absence of the migratory life form, isolated populations cannot be replenished when disturbance makes local habitats temporarily unsuitable, the range of the species is diminished, and the potential for enhanced reproductive capabilities are lost (Rieman and McIntyre 1993).

E. Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987, Goetz 1989, Donald and Alger 1993). Adult migratory bull trout feed on various fish species (Fraley and Shepard 1989, Donald and Alger 1993). In coastal areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) in the ocean (WDFW et al. 1997).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. In the Skagit River system of Washington, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migratory route (WDFW et al. 1997). Anadromous bull trout also use marine waters as migratory corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett, 2003).

As fish grow, their foraging strategy changes, as their food changes in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, mysids and small fish (Shepard et al. 1984, Boag 1987, Goetz 1989, Donald and Alger 1993). Bull trout that are 4.3 inches long or longer commonly have fish in their diet (Shepard et al. 1984), and bull trout of all sizes have been found to eat fish half their length (Beauchamp and Van Tassell 2001).

Migratory bull trout begin growing rapidly once they move to waters with abundant forage that includes fish (Shepard et al. 1984, Carl 1985). As these fish mature they become larger bodied predators and are able to travel greater distances (with greater energy expended) in search of prey species of larger size and in greater abundance (with greater energy acquired). In Lake Billy Chinook in Oregon, as bull trout became increasingly piscivorous with increasing size, the prey species changed from mainly smaller bull trout and rainbow trout for bull trout less than 17.7 inches in length to mainly kokanee for bull trout greater in size (Beauchamp and Van Tassell 2001).

Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Bull trout likely move to or with a food source. For example, some bull trout in the Wenatchee basin were found to consume large numbers of earthworms during spring runoff in May at the mouth of the Little Wenatchee River where it enters Lake Wenatchee (USFWS, in prep.). In the Wenatchee River, radio-tagged bull trout moved downstream after spawning to the locations of spawning Chinook and sockeye salmon and held for a few days to a few weeks, possibly to prey on dislodged eggs, before establishing an overwintering area downstream or in Lake Wenatchee (USFWS, in prep.).

F. Reproductive Biology

Bull trout become sexually mature between 4 and 9 years of age, and may spawn in consecutive or alternate years (Shepard *et al.* 1984; Pratt 1992). Spawning typically occurs from August through December in cold, low-gradient 1^{st}- to 5^{th}-order tributary streams, over loosely compacted gravel and cobble having groundwater inflow (Shepard *et al.* 1984; Brown 1992; Rieman and McIntyre 1996; Swanberg 1997; MBTSG 1998; Baxter and Hauer 2000). Surface/groundwater interaction zones, which are typically selected by bull trout for redd construction, have high dissolved oxygen, constant cold water temperatures, and increased macro-invertebrate production. Spawning sites frequently occur near cover (Brown 1992).

Hatching occurs in winter or early spring, and alevins may stay in the gravel for up to 3 weeks before emerging. The total time from egg deposition to fry emergence from the gravel may exceed 220 days.

Post-spawning mortality, longevity, and repeat-spawning frequency are not well known (Rieman and McIntyre 1996), but lifespans may exceed 10 to13 years (McPhail and Murray 1979; Pratt 1992; Rieman and McIntyre 1993). Adult adfluvial bull trout may live as long as 20 years, and may require as much as 20 months in the lake or reservoir habitat to facilitate adequate energy storage and gamete development before they return to spawn again (67 FR 71236).

Migratory bull trout are highly visible during spawning due to their large size and location in relatively small streams during periods of low flow. Channel complexity and cover are important components of spawning habitat to reduce both predation risk and potential for poaching.

G. Population Dynamics

Bull trout are considered to display complex metapopulation dynamics (Dunham and Rieman 1999). Size of suitable habitat patches appears to play an important role in the persistence of bull trout populations, along with habitat connectivity and human disturbance, especially road density. Analyses of spatial and temporal variation in bull trout redds indicates weak spatial clustering in patterns of abundance through time (Rieman and McIntyre 1996). Spatial heterogeneity in patterns of abundance was high, however, at a regional scale. This combination of patterns suggests that maintenance of stable regional populations may require maintenance of connected patches of high quality habitat where dispersal and demographic support can occur readily among patches (Rieman and McIntyre 1996).

The importance of maintaining the migratory life-history form of bull trout, as well as migratory runs of other salmonids that may provide a forage base for bull trout, is repeatedly emphasized in the scientific literature (Rieman and McIntyre 1993; MBTSG 1998; Dunham and Rieman 1999; Nelson *et al.* 2002). Isolation and habitat fragmentation resulting from migratory barriers have negatively affected bull trout by: (1) reducing geographical distribution (Rieman and McIntyre 1993; MBTSG 1998); (2) increasing the probability of losing individual local populations (Rieman and McIntyre 1993; MBTSG 1998; Nelson *et al.* 2002; Dunham and Rieman 1999); (3) increasing the probability of hybridization with introduced brook trout (Rieman and McIntyre 1993); (4) reducing the potential for movements in response to developmental, foraging, and seasonal habitat requirements (MBTSG 1998; Rieman and McIntyre 1993); and (5) reducing reproductive capability by eliminating the larger, more fecund migratory form from many subpopulations (MBTSG 1998; Rieman and McIntyre 1993). Therefore, restoring connectivity and restoring the frequency of occurrence of the migratory form will reduce the probability of local and subpopulation extinctions. Remnant populations, that lack connectivity due to elimination of migratory forms, have a reduced likelihood of persistence (Rieman and McIntyre 1993; Rieman and Allendorf 2001).

The bull trout has multiple life-history strategies, including migratory forms, throughout its range (Rieman and McIntyre 1993). Migratory forms appear to develop when habitat conditions allow movement between spawning and rearing streams and larger rivers or lakes, where foraging opportunities may be enhanced (Frissell 1997). For example, multiple life-history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem of the Snake River. Such multiple life-history strategies help to maintain the stability and persistence of bull trout populations in the face of environmental changes. Migratory bull trout may enhance persistence of metapopulations due to their high fecundity, large size, and dispersal across space and time, which promotes recolonization should resident populations suffer a catastrophic loss (Frissell 1997; Rieman and McIntyre 1993; MBTSG 1998).

Barriers to migration are an important factor influencing patterns of genetic variability in bull trout (Spruell *et al.* 2003; Costello *et al.* 2003). Although barriers increase the vulnerability of isolated populations to stochastic factors, they also insulate these populations from the homogenizing effects of gene flow. If isolated populations were founded by ancestors with rare alleles, genetic drift, unimpeded by gene flow, can lead to fixation of locally rare alleles. These populations may subsequently serve as reservoirs of rare alleles, and downstream migration from isolated populations may be important in maintaining the evolutionary potential of metapopulations (Costello *et al.* 2003).

Lakes and reservoirs provide important refugia for bull trout that display the adfluvial life-history strategy. In general, lake and reservoir environments are relatively more secure from catastrophic natural events than stream systems (67 FR 71236). They provide a sanctuary for bull trout, allowing them to quickly rebound from temporary adverse effects to spawning and rearing habitat. For example, if a major wildfire burns a drainage and eliminates most or all aquatic life (a rare occurrence), bull trout sub-adults and adults that survive in the lake may return the following year to repopulate the burned drainage. This underscores the need to maintain migratory life forms and habitat connectivity in order to increase the likelihood of long-term population persistence.

For bull trout, a subpopulation is considered to be a reproductively isolated group that spawns within a particular area of a river system. The spatial scale of bull trout subpopulations corresponds roughly to geographic sub-basins. The Service analyzed data on bull trout relative to subpopulations because fragmentation and barriers have isolated bull trout throughout their current range, and most monitoring data is compiled at the subpopulation scale. The Service recognizes 141 subpopulations of bull trout in the Columbia River DPS within Idaho, Montana, Oregon, and Washington, and notes that additional subpopulations occur in British Columbia (USDI 1998b).

The Service rated each subpopulation as either “strong,” “depressed,” or “unknown” using criteria from Rieman *et al.* (1997a) with some modifications. A subpopulation was considered “strong” if 5,000 individuals or 500 spawners were likely to occur in the subpopulation, abundance appears stable or increasing, and all currently present life-history forms are likely to persist. A "depressed" subpopulation has less than 5,000 individuals or 500 spawners, abundance appears to be declining, or a life-history form historically present has been lost. If information about abundance, trend, and life-history information was insufficient to classify the status of a subpopulation as either "strong" or "depressed", the status was considered "unknown" (USDI 1998b).

Generally, where status is known and population data exist, bull trout subpopulations in the Columbia River DPS are declining (Thomas 1992; Pratt and Huston 1993; Schill 1992). Bull trout in the Columbia River basin occupy about 45 percent of their estimated historic range (Quigley and Arbelbide 1997). Quigley and Arbelbide (1997) considered bull trout populations strong in only 13 percent of the occupied range in the interior Columbia River basin. Rieman *et al.* (1997a) estimated that populations were strong in 6 to 24 percent of the sub watersheds in the entire Columbia River basin. The few bull trout subpopulations that are considered "strong" are generally associated with large areas of contiguous habitats such as portions of the Snake River basin in central Idaho, the upper Flathead Rivers in Montana, and the Blue Mountains in Washington and Oregon. Approximately 21 percent of the bull trout populations in the Columbia River DPS are threatened by the effects of poaching (USDI 1998a).

The Service also identified subpopulations at risk of extirpation from naturally occurring events. At-risk subpopulations were: (1) unlikely to be reestablished by individuals from another subpopulation; (2) limited to a single spawning area; (3) characterized by low individual or spawner numbers; or (4) comprised primarily of a single life-history form. In the Columbia River DPS, approximately 79 percent of all subpopulations are unlikely to be reestablished if extirpated and 50 percent are at risk of extirpation from naturally occurring events due to their depressed status (USDI 1998b). Many of the remaining bull trout subpopulations occur in isolated headwater tributaries, or in tributaries where migratory corridors have been lost or restricted. The listing rule characterizes the Columbia River DPS as generally having isolated subpopulations, without the migratory life form to maintain the biological cohesiveness of the subpopulations, and with trends in abundance declining or of unknown status. Recolonization of habitat where isolated bull trout subpopulations have been lost is either unlikely to occur (Rieman and McIntyre 1993) or will only occur over extremely long time periods.

H. Genetic and Phenotypic Diversity

Genetic diversity promotes both short-term fitness of populations and long-term persistence of a species by increasing the likelihood that the species is able to survive changing environmental conditions. This beneficial effect can be displayed both within and among populations. Within a genetically diverse local population of bull trout, different individuals may have various alleles that confer different abilities to survive and reproduce under different environmental conditions (Leary *et al.* 1993; Spruell *et al.* 1999; Hard 1995). If environmental conditions change due to natural processes or human activities, different allele combinations already present in the population may be favored, and the population may persist with only a change in allele frequencies. A genetically homogeneous population that has lost variation due to inbreeding or genetic drift may be unable to respond to the environmental change and be extirpated. The prospect of local extirpation highlights the importance of genetic diversity among local populations. Recolonization of locations where extirpations have occurred may be promoted if immigrants are available that possess alleles that confer an advantage in variable environmental conditions. Extending this reasoning to the entire range of the species, reduction in rangewide genetic diversity of bull trout through the loss of local populations can reduce the species ability to respond to changing conditions, leading to a higher likelihood of extinction (Rieman and McIntyre 1993; Leary *et al.* 1993; Spruell *et al.* 1999; Hard 1995; Rieman and Allendorf 2001).

The amount of genetic variation necessary for a population to adapt to a changing environment can be estimated using the concept of effective population size (N_e). Effective population size is the average number of individuals in a population which are assumed to contribute genes equally to the succeeding generation. Effective population size provides a standardized measure of the amount of genetic variation that is likely to be transmitted between generations within a population.

Specific benchmarks for bull trout have been developed concerning the minimum N_e necessary to maintain genetic variation important for short-term fitness and long-term evolutionary potential. These benchmarks are based on the results of a generalized, age-structured, simulation model, called VORTEX (Miller and Lacy 1999), used to relate effective population size to the number of adult bull trout spawning annually under a range of life histories and environmental conditions (Rieman and Allendorf 2001). Using the estimate that N_e for bull trout is between 0.5 and 1.0 times the mean number of adults spawning annually, Rieman and Allendorf (2001) concluded that (1) an average of 100 adults spawning each year would be required to minimize risks of inbreeding in a population, and (2) an average of 1,000 adults is necessary to maintain genetic variation important for long-term evolutionary potential. This latter value of 1,000 spawners may also be reached with a collection of local populations among which gene flow occurs.

Bull trout populations tend to show relatively little genetic variation within populations, but substantial divergence among populations (e.g., Spruell *et al.* 2003). For example, Spruell *et al.* (1999) found that bull trout at five different spawning sites within a tributary drainage of Lake Pend Oreille, Idaho, were differentiated based on genetic analyses (microsatellite DNA), indicating fidelity to spawning sites and relatively low rates of gene flow among sites. This type of genetic structuring indicates limited gene flow among bull trout populations, which may encourage local adaptation within individual populations (Spruell *et al.* 1999; Healey and Prince 1995; Hard 1995; Rieman and McIntyre 1993).

Current information on the distribution of genetic diversity within and among bull trout populations is based on molecular characteristics of individual genes. While such analyses are extremely useful, they may not reflect variability in traits whose expression is dependent on interactions among many genes and the environment (Hard 1995, Reed and Frankham 2001; but see Pfrender *et al.* 2000). Therefore, the maintenance of phenotypic variability (e.g., variability in body size and form, foraging efficiency, and timing of migrations, spawning, and maturation) may be best achieved by conserving populations, their habitats, and opportunities for the species to take advantage of habitat diversity (Healey and Prince 1995; Hard 1995).

Local adaptation may be extensive in bull trout because populations experience a wide variety of environmental conditions across the species' distribution, and because populations exhibit considerable genetic differentiation. Thus, conserving many populations across their range is essential to adequately protect the genetic and phenotypic diversity of bull trout (Hard 1995; Healey and Prince 1995; Taylor *et al.*1999; Rieman and McIntyre 1993; Spruell *et al.* 1999; Leary *et al.* 1993; Rieman and Allendorf 2001). If genetic and phenotypic diversity is lost, changes in habitats and prevailing environmental conditions could increase the likelihood of bull trout suffering reductions in numbers, reproductive capacity, and distribution.

Based on this information about the life history and conservation needs of bull trout, the Service concludes that each subpopulation or local population is an important genetic, phenotypic, and geographic component of its respective DPS. Adverse effects that compromise the persistence of a bull trout subpopulation or local population can reduce the distribution, as well as the phenotypic and genetic diversity of the DPS.

III. ENVIRONMENTAL BASELINE

This section analyzes the current condition of the bull trout in the action area, the factors responsible for that condition, and the role of the action area in the intended conservation function of the Columbia River interim recovery unit.

The action area is part of the Wenatchee River core area for the bull trout. For context, the status of the bull trout within the core area is discussed first followed by a discussion of bull trout status in the action area.

A. Wenatchee River Core Area

The Wenatchee River Basin encompasses approximately 1,371 square miles (mi^2) in central Washington (NPPC 2001c, USFS 1999a, WSCC 2001). Major tributaries are the White and Little Wenatchee Rivers, which drain into Lake Wenatchee (source of the Wenatchee River), the Chiwawa River, and Nason Creek. Additional tributaries to the Wenatchee River include Icicle Creek, Peshastin Creek, and Mission Creek.

Seven migratory local populations of the bull trout are known within this core area; they are located in: (1) the Chiwawa River (including Chikamin, Phelps, Rock, Alpine, Buck and James creeks); (2) the White River (including Canyon and Panther creeks); (3) the Little Wenatchee River (below the falls); (4) Nason Creek (including Mill Creek); (5) Chiwaukum Creek; (6) Peshastin Creek (including Ingalls Creek); and (7) Icicle Creek (De La Vergne, J., pers. comm., USFWS, 2002).

Adfluvial, fluvial, and resident forms of the bull trout currently exist in the Wenatchee River Core Area (WDFW 1998). The majority of spawning and fry-rearing habitat is within U.S. Forest Service lands, including the Glacier Peak and Alpine Lake Wilderness areas. Data collection for bull trout redds has become standardized across the Core Area since about 2000, and since then the total number of redds detected in the Wenatchee Core Area has fluctuated between about 300 and 600. The 10-year average is 405 redds (unpublished data compiled by the USFWS CWFO 2006). It is important to note that these numbers reflect redds made by migratory fish. There may be a small number of resident fish that make redds which are difficult to detect. Because resident bull trout are small, and fecundity and survival is directly related to size, the Service believes that redd counts for migratory spawners are a useful way to track changes in bull trout population abundance over time, and that this method provides an accurate estimate of the population at the Core Area scale.

The Chiwawa River local population complex is the stronghold for bull trout in the upper Wenatchee River Basin (WDFW 1998). Rock Creek represents the strongest population in the Chiwawa. Since 1995 annual surveys have documented between 250 and 440 redds in the Chiwawa. The 10-year average is 335 redds (unpublished data compiled by USFWS CWFO 2006).

The combined Little Wenatchee River and White River redd counts have been between 20 and 125 since 2000. Below Lake Wenatchee additional spawning areas in the Wenatchee River Core Area include Nason, Chiwaukum, and Peshastin creeks. Limited redd surveys have detected up to 15 redds in Nason Creek and its tributary Mill Creek, 25 to 40 redds in Chiwakum Creek, and up to 10 in Peshastin Creek (unpublished data compiled by USFWS CWFO 2006).

The Icicle Creek population of the bull trout is the smallest of all seven populations in the core area, and it is the only local population that is reproductively isolated from the metapopulation. Bull trout redds have not been detected in Icicle Creek. However, multiple age classes of resident-sized fish have been observed in upper Icicle Creek indicating that bull trout successfully spawn in Icicle Creek. All reproduction in the Icicle Creek local population depends on what appears to be a small, resident-only population. Migratory fish that stage in the lower Icicle Creek are unable to access upstream spawning habitats in upper Icicle Creek due to year-round barriers at LNFH, and, during certain times of year, barriers at other locations in lower Icicle Creek upstream of LNFH. Large migratory bull trout are frequently observed below the spillway dam at LNFH throughout the year. Some of these fish likely belong to other spawning populations (Kelly-Ringel, B., USFWS, pers comm., 2006). The Service believes it is unlikely that these fish spawned in lower Icicle Creek because the habitat is unsuitable. In 2002 four migratory-size bull trout (approximate lengths: 26", 22", 19", and 13"), and a fifth in 2004 (20") were seen at approximately rm 6, above all diversion dams and the boulder area (De La Vergne, J., pers. comm., USFWS, 2002; personal observation 2004). It is unknown whether these fish spawned in mid or upper Icicle Creek.

Resident bull trout are known to occur in upper Icicle Creek in low densities in Jack and French Creeks (USFWS 1997). An unspecified number of juvenile bull trout were located in Eightmile Creek by the USFS and WDFW (Brown 1992a). There is a single record of a bull trout in Leland Creek near the headwaters of Icicle Creek (Merritt, G., pers. comm., WDOE, 2002). The status and distribution of these resident bull trout are poorly understood. In September of 2004, night snorkel surveys of the mainstem of upper Icicle Creek and Jack Creek found more resident bull trout than previous daytime surveys of these areas, possibly because night surveys are more effective (Thurow et al 2006). Jack Creek may be an important refugium for bull trout in the Icicle Creek watershed (USFWS 2005c).

B. Factors Affecting the Bull Trout's Current Condition in the Wenatchee River Core Area

The current condition of the bull trout in the Wenatchee River core area is attributed to several factors: dams, forest management activities, agricultural practices (including water withdrawals for irrigation), mining, residential development, and fisheries management activities. Connectivity among local populations has been impacted by dams, agricultural practices, roads, and dikes. Maintenance of life history diversity is likewise compromised by the factors that fragment populations. Bull trout genetic and phenotypic diversity is in peril and their abundance has declined due to all of the above factors.

Dams and Agricultural Practices

Numerous small dams within the core area continue to limit bull trout migratory movements and impact habitat quality due to associated water withdrawals and affects on fluvial processes. The most significant remaining passage barriers are dams on Icicle Creek. The LNFH has blocked upstream fish passage in Icicle Creek at rm 2.8 and at other locations since 1941. A boulder field upstream of the hatchery at rm 5.5 was previously thought to be a natural barrier to fish passage. However, several migratory-size bull trout were observed during a snorkel survey above the boulder area on September 15, 2002, indicating that this obstacle is passable under some conditions (De La Vergne, J., pers. comm., USFWS, 2002). On September 9, 2004, during a brief spot-check of the same area, another migratory-sized bull trout was observed (D. Morgan, USFWS, pers. obs. 2004). The Service believes this area is only a barrier to upstream passage during certain flow conditions, and that it is passable when stream flow is moderate.

Irrigation diversions can result in passage barriers by creating structural blockages, reducing in-stream flow or even dewatering streams, and increasing water temperatures. Decreased stream flow and high temperatures can create barriers to upstream habitat and poor habitat conditions. High temperatures can result in negative effects to foraging and migration patterns. Irrigation diversions not directly located in bull trout spawning streams can remove in-stream flow and may impact important foraging and high water refuge habitat. Recent and ongoing improvements to diversion dams for fish passage have improved habitat access in the Wenatchee River core area (Peshastin Creek diversion).

Within Icicle Creek, diversions for irrigation, hatchery operations, and municipal use remove significant portions of water during August, September, and October (USFWS 1992). Low flows in the lower reach are the result of natural conditions compounded by water diversions for municipal water supply, agricultural irrigation, and the LNFH (WDFW 1998).

Adequate fish protection devices and structures are lacking at Icicle Creek diversions. The Icicle/Peshastin Irrigation District operates an irrigation diversion dam on Icicle Creek above LNFH that presents a temporary barrier to summer and fall migration when low flows trickle over the crest of the dam, which has no fish ladder. In low water years during late summer, the stream is essentially dewatered for 100-feet directly downstream of the diversion, completely blocking all fish passage (USFS 1998c). The fish exclusion screens at the Icicle/Peshastin Irrigation District diversion do not currently meet NOAA Fisheries and Service criteria. BOR initiated the process to chose the best option to upgrade this facility in the summer of 2006, and will likely design a solution within the next year or two (Kolk, S., pers. comm., BOR, 2006). The water diversion dam for the LNFH and the Cascade Orchards Irrigation District intake blocks fish passage at low flows and is improperly screened (USFWS 2002b). During some drought years, the stream has been nearly dewatered from the diversion downstream to the fish hatchery.

In Peshastin Creek the diversion in the lower river, which was a barrier during low flows, was modified in late 2005 to improve passage during summer.

Within the upper Wenatchee River, there are several water diversions and a diversion dam; it is unknown whether these diversions meet NOAA Fisheries and Service screening criteria (USFS 1999). The Chiwawa Irrigation District water diversion is located at rm 3.6 on the Chiwawa River and can divert up to 33.3 cfs, but more commonly diverts 12 to 16 cfs (USFS 1999). The diversion is screened (updated in the mid 1990's), but it is unclear if the screen meets the NOAA Fisheries and Service fish screen criteria, or how the altered flow regime may affect rearing or sub adult bull trout. The U.S. Forest Service and the Chiwawa Irrigation District currently monitor flows and temperatures above and below the diversion to determine impacts to aquatic habitat.

A diversion in the upper Chiwawa River in Phelps Creek is located within bull trout spawning and rearing habitat (USFS 1999). The Trinity water diversion is located approximately 0.75 miles upstream of the 8-foot high natural falls at rm 1.0, which blocks upstream fish passage. Bull trout have not been found in the area of the diversion headgate structure, but have been located spawning within the return channel from the settling ponds and in Phelps Creek below the falls. The Trinity diversion is currently being relicensed by the Federal Energy Regulatory Commission. It is unknown how these changes in in-stream flows affect rearing and spawning bull trout downstream in Phelps Creek.

Forest Management

Both direct and indirect impacts from timber harvest have altered habitat conditions in portions of the core area. Impacts from timber harvest management include the removal of large woody debris, reduction in riparian areas, increased water temperatures, increased erosion, and simplification of stream channels (Quigley and Arbelbide 1997). Bull trout are less likely to use streams for spawning and rearing in areas with high road densities and were typically absent at mean road densities above 1.7 miles per mi^2 (Quigley and Arbelbide 1997).

In the Wenatchee River, natural channel complexity and riparian conditions have been altered over time by past timber-related activities (WSCC 2001). These activities have resulted in reduced riparian and wetland connectivity, reduced high flow refuge habitat, reduced sinuosity and side channel development, increased bank erosion, reduced large woody debris, and reduced pool frequency. Road construction associated with timber harvest adjacent to streams or rivers has resulted in the straightening of stream channels (channelization), alteration of stream gradients, and an overall change in habitat type (USFS 1999).

High road densities within certain portions of U.S. Forest Service lands in the Wenatchee River Basin may contribute to habitat degradation. Areas of special concern where road densities are high include: Lower Chiwawa River, Middle Chiwawa River, Lake Wenatchee, Lower White River, Lower Little Wenatchee, Upper Little Wenatchee, Lower Nason Creek, Upper Nason Creek, the headwaters of Nason Creek, Wenatchee River (Upper, Middle, and Lower portions), Lower Icicle Creek drainage, and Peshastin Creek (USFWS 2002b).

Road culverts in watersheds with bull trout can block or impede upstream passage (WSCC 1999, 2000, 2001; NPPC 2001a,b,c). Culverts may preclude bull trout from entering a drainage during spawning migrations, emigration of juveniles, and foraging activities, and may also limit access to refuge habitat needed to escape high flows, sediment, or higher temperatures. Specific culverts have been identified as passage barriers in the Wenatchee River Core Area including Mill Creek and Peshastin Creek (USFWS 2002b).

Mining

Mining can degrade aquatic habitats used by bull trout by altering water chemistry (e.g., pH); altering stream morphology and flow; and causing sediment, fuel, and heavy metals to enter streams (Nelson et al. 1991, Spence et al. 1996). The U.S. Forest Service has issued a special use permit in the upper Chikamin Creek drainage for an exploratory mining operation. Bull trout spawn just downstream in Chikamin Creek and hold within the Chiwawa River for most of the year. Small-scale recreational gold mining occurs at placer claims in other the Wenatchee River core area, particularly in the Peshastin watershed.

Residential Development

Numerous areas within this core area are experiencing a shift from an economy based on natural resources (agriculture, forestry, and mining) to an economy more dependent on industries associated with tourism, recreation, and general goods and services. Some increased population growth has occurred within the core area.

As described in the draft bull trout Recovery Plan (USFWS 2002b), the Wenatchee River core area is affected by residential development. Areas and habitat concerns include the following: the Wenatchee River downstream of Leavenworth (loss of side channels, bank revetment, and floodplain development); the Wenatchee River through the communities of Plain and Ponderosa (degraded water quality due to improperly functioning septic systems); Peshastin Creek (below the Ingalls Creek confluence, the natural channel and floodplain function has been disturbed due to channel constriction and confinement); Icicle Creek (lower portion of the river has been impacted from loss of riparian vegetation, bank hardening, and residential development); Nason Creek (lower Nason Creek has been impacted by channel confinement, removal of riparian vegetation, and reduction in large woody debris recruitment); the White River (below Panther Creek there has been loss of riparian and large woody debris recruitment); and Lake Wenatchee (shoreline development and associated loss of riparian vegetation, increased nutrient loading, and inadequate sewage treatment from old septic systems).

Fisheries Management

Fisheries management can affect bull trout through stocking of non-native species, harvest management, and effects on prey base. Problems with non-native species in the Wenatchee River Core Area are primarily brook trout (WSCC 1999, 2000, 2001). In the Wenatchee River, brook trout are present in the Chiwawa River including Chikamin and Big Meadow creeks

(USFS 1999). The introduction of brook trout into Schaefer Lake in the 1940's was most likely the source population. Efforts to eradicate brook trout from Schaefer Lake have been unsuccessful. Brook trout are also present in upper Icicle Creek (USFWS 1997).

Fisheries management can also impact bull trout by promulgating fishing regulations that lead to the incidental harvest of bull trout and trampling of bull trout redds by wading anglers. Injury and mortality from incidental catch of bull trout and harvest as a result of misidentification still continues under existing fishing regulations (e.g., only 44 percent of surveyed Montana anglers correctly identified bull trout; Schmetterling and Long 1999). In experimental tests, a single wading event just before hatching can result in up to 43 percent mortality of eggs (Roberts and White 1992). Harvest of bull trout is currently prohibited on all stocks in the core area. However, many other species are targeted in sport and tribal fisheries in the area where bull trout may overlap.

C. Summary of Bull Trout Status in the Wenatchee River Core Area

- In the Wenatchee River core area there is good connectivity between most local populations (USFWS 2005b). However, low flow and physical barriers exist in Icicle Creek, Peshastin Creek, and Mill Creek. The population of resident bull trout in upper Icicle Creek has been isolated by man-made barriers at LNFH since about 1940 (Brown 1992a, USFWS 2005c, WDFW 1998). Barriers in Mill and Peshastin Creeks are scheduled for replacement or have recently been modified to address these problems.

- In the Wenatchee River core area, diverse life histories are expressed in most local populations (unpublished data compiled by USFWS CWFO 2006). There are migratory fish (fluvial and/or adfluvial) throughout the system, although they are distributed unevenly. The exception to this is Icicle Creek, where only resident fish are known to be reproducing (USFWS 2005c). Resident fish are the least fecund and most vulnerable life history form (Rieman and McIntyre 1993).

- Lake Wenatchee in the upper basin may provide opportunities for greater life history diversity for local populations in the Chiwawa, Little Wenatchee, Nason, and White rivers compared to lower basin populations in the Chiwaukum, Icicle, and Peshastin creeks (USFWS 2005b). The Chiwaukum and Peshastin populations include large migratory fish that use other habitat outside of their headwater spawning areas to feed and grow, and these fish can return to the natal stream to spawn; the Icicle Creek population does not.

- Analysis of genetic samples from bull trout populations in the Wenatchee River core area is underway, but results are not available yet. All the local populations in the core area, except the Chiwawa River population, are at risk of deleterious genetic effects associated with small populations (Rieman and Allendorf 2001). The Icicle Creek population is the smallest in the core area.

- Genetic exchange is assumed to occur infrequently, based on genetic analyses from other core areas. There is no direct evidence of current genetic exchange between the Wenatchee River and other core areas; however migration monitoring suggests this may be possible (USFWS 2005b). Genetic exchange at this scale it is assumed to be less frequent than gene flow among local populations within the Wenatchee core area.

- The short-term population trend for the Wenatchee River core area is stable with high interannual variation; the Chiwawa River population represents a stronghold for the bull trout. The Chiwawa River population may drive the population trend for this core area (unpublished data compiled by CWFO 2006).

D. Bull Trout Status in the Action Area

Icicle Creek enters the Wenatchee River at town of Leavenworth. The watershed is 214 mi^2 in size (136,960 acres) and is 87 percent National Forest land, with 74 percent of the watershed located in the Alpine Lakes Wilderness. The USFS manages their portion of the watershed as a Tier 1 Key Watershed under the Northwest Forest Plan (USFS 1994a). Key watersheds are described in the North West Forest Plan Record of Decision:

> "Key watersheds [are] a system of large refugia comprising watersheds that are crucial to at-risk fish species and stocks and provide high quality water (page B-12). Refugia are a cornerstone of most species' conservation strategies. They are designated areas that either provide, or are expected to provide, high quality habitat. A system of Key Watersheds that serve as refugia is crucial for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. These refugia include areas of high quality habitat as well as areas of degraded habitat. Key Watersheds with high quality conditions will serve as anchors for the potential recovery of depressed stocks. Those of the lower quality habitat have a high potential for restoration and will become future sources of high quality habitat with the implementation of a comprehensive restoration program (page B-18)."

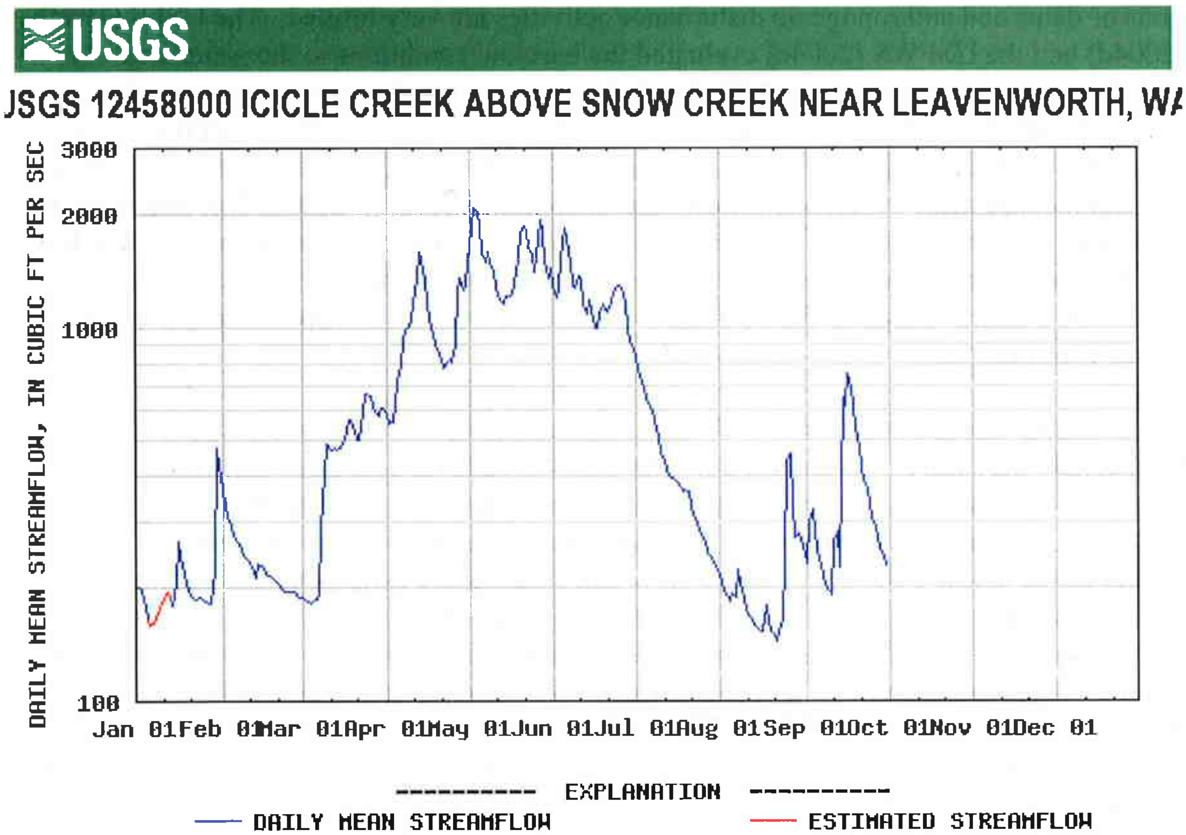
Icicle Creek is the largest sub watershed of the Wenatchee River, and provides 19 percent of low season flows (second only to the White River basin). It is 31.8 miles long from its headwaters at Lake Josephine, elevation 4,681 feet, near Stevens Pass to its confluence with the Wenatchee River in the town of Leavenworth, elevation 1,200 feet. The geology of the watershed controls the hydrologic processes. The area was glaciated, with steep slopes of cirque headwalls and failure escarpments that have very little water storage capacity. The storage capacity exists in the high elevation basins and in glacial till in the valley bottoms. Precipitation ranges from 120 inches near the Cascade crest to 20 inches near the mouth. Tributary streams in the watershed are generally very steep Rosgen A-type channels (USFS 1994a).

Wildfires are common in portions of the drainage. There have been three large fires in the past 11 years (1994, 2001, 2004) that have burned approximately 15 percent of the Icicle Creek watershed. The USFS determined that these fires and suppression activities did not change the environmental baseline in the action area (USFS 2004, USFWS 2004c). Roughly 5 percent of the watershed has been impacted by logging (USDA 1994a).

Water is stored and released from several high elevation lakes, and later diverted from lower Icicle Creek for irrigation, the LNFH, and city drinking water. These water withdrawals contribute to low stream flow and high water temperatures during the summer in the lower reaches of Icicle Creek. Rain-on-snow events are common in fall, and the hydrograph is typical of snow melt systems, with the peak runoff in late spring. Mean, minimum, and maximum flows in Icicle Creek at the USGS gaging station at rm 5.8 are 614, 44, and 14,100 cfs, respectively for the period of record from 1937 to 2005.

A sample hydrograph from the 2004 water year (the most recent data available from USGS) is shown below (Figure 2). Note the rapidly decreasing flows in July as snowmelt runoff ends and the river transitions to baseflow conditions. This is typical of most hydrographs over the last decade. The increase in August and September is unusual; most years this did not happen until October when fall rains began.

Figure 2. 2004 Icicle Creek hydrograph upstream from all diversions.



Fish habitat on National Forest lands throughout the majority of the watershed is in excellent condition. Upper Icicle Creek, where bull trout spawn, is unaltered by human activity (WDFW 1998). According to the USFS Watershed Analysis, the majority of the fish habitat in the watershed is "in pristine state and very capable of producing fish" (USFS 1994a). There are localized areas where the USFS access road and campgrounds impinge on the stream corridor and consequently stream shade, large woody debris (LWD), or pool frequency is reduced. As a percentage of total length of Icicle Creek, these areas are very small. The access road and campgrounds are located on the north side of the river. Due to the aspect of the valley (the river flows from west to east), these impacted areas have little effect on stream shade. Compared to other wilderness areas, the backcountry of the Alpine Lakes Wilderness Area is heavily used. Most of this activity is limited to July, August, and September, and occurs in areas that are far from bull trout habitat. Rock climbing is a popular recreation activity along the access road.

Passage is blocked by dams at LNFH near rm 2.8, 3.8, and 4.5 which prevent most or all migratory-sized fish from accessing most of the watershed (see Figure 1). The historical fish barrier in Icicle Creek is located near the headwaters (Bryant and Parkhurst 1950). There is a distinct difference between habitat quality in the upper and lower basin at rm 5.7, just above the uppermost irrigation diversion (Andonaegui, 2001). Upstream of this point there are no water diversions or dams and anthropogenic disturbance activities are very limited. The USFS (1994b, 2000, 2004d) and the USFWS (2004c) evaluated the baseline conditions in the watershed. In general, habitat indicators were rated as "properly functioning" in the watershed above the USFS boundary at about rm 5. There were some instances where, for example stream temperature (too high) or quality pool habitat (too low) did not meet the standards and guidelines in all places at all times, but most of these departures reflect natural conditions (USFS 2000). It is important to note that virtually all watersheds in the area, even those where anthropogenic impact is very low (White River) or those that are prolific fish producers (Chiwawa River) include some indicators that are not 100 percent "properly functioning". Yet these watersheds support healthy and diverse fish communities.

Based on substrate and gradient, there is abundant spawning habitat available in upper Icicle Creek, especially between rm 18 and rm 25. The USFWS (2001a) estimated that sufficient gravel exists in this reach to support nearly 2,000 spawning pairs of bull trout (based on total area of suitable substrate divided by average redd size). There is no known bull trout spawning in lower Icicle Creek below LNFH, and due to flow and temperature conditions that habitat is generally not suitable for bull trout spawning during the appropriate time of year. Stream temperature in upper Icicle Creek is suitable for spawning and rearing, but that cold water also limits growth rate, size at maturity, and fecundity of fish that exhibit the resident life-history phenotype (Rieman and McIntyre 1993). All of these factors limit the reproductive potential for the resident-type bull trout in Icicle Creek. Migratory fish would not have these same limitations and can move to more productive habitats where rapid growth is possible.

The fish community in Icicle Creek has been affected by both extirpation of native species, severe reductions in abundance of some species, and introduction of exotic species. Salmonid species present in the watershed include hatchery spring Chinook salmon, hatchery Coho salmon, steelhead, bull trout, non-native brook trout, westslope cutthroat trout (*O. clarki lewisi)*, redband trout (*O. mykiss gairdneri)*, and Mountain whitefish (*Prosopium williamsoni)*. There are also native and non-native non-salmonids in Icicle Creek including dace (*Rhinichthys* spp.), lamprey (*Lampetra* spp.), sculpin (*Cottus* spp.), suckers (*Catostomus* spp.), and others. Recorded historical data from upper Icicle Creek prior to about 1930 is limited, which is about 60 years after the peak of Columbia River salmon runs (based on cannery output; see Lichatowich 1991). It is likely that the extirpation of anadromous and migratory salmonid life forms in upper Icicle Creek have affected nutrient dynamics in the watershed and predator prey relationships within the fish community, resulting in reduced primary and secondary productivity.

E. Bull Trout Distribution and Abundance

The bull trout is a permanent resident in the action area. Icicle Creek is the smallest local population in the Wenatchee River core area (USFWS 2005c). It contains both resident and migratory fish, but only the former have access to spawning areas in upper Icicle Creek, and the latter does not reproduce in Icicle because it cannot migrate back to natal areas. In this way it is different than all others in the Wenatchee basin. It is one of two bull trout populations in the lower Wenatchee River Basin about which little is known. Other than the Peshastin Creek local population, which is also located below Tumwater Canyon, all other bull trout populations in the Wenatchee River core area spawn and rear in the upper basin tributaries, most of which are several tens of miles upstream, where there is more diverse habitat and a larger prey base. Both of the lower basin populations are very small. Since 1940 and the completion of dams at LNFH, the Icicle Creek population has been the only bull trout population in the Wenatchee River basin where only the resident life-history form can reproduce.

Snorkel surveys and radio telemetry monitoring revealed that migratory-sized bull trout use the lower portions of both Icicle and Peshastin creeks (unpublished data compiled by USFWS CWFO). Limited spawning by migratory bull trout has been detected in Ingalls Creek (Peshastin Basin), and resident-size fish have been detected in nearby Negro Creek (Haskins, J., pers. comm., USFS, 2005). No redd surveys have been conducted in Icicle Creek. Habitat conditions in Icicle Creek and Peshastin Creek are different than those in the upper basin where other local populations of bull trout exist. These differences include the absence of local lacustrine refugia and other selection pressures such as the lack of anadromous prey. These factors may have led to genetic and other differences between these two small populations and the other five local populations in the Wenatchee River core area.

There has been very little survey effort to locate bull trout in Icicle Creek above LNFH. In 1937, prior to the construction of LNFH, 12 juvenile bull trout were captured during surveys for anadromous fish in a downstream migration trap operated intermittently in the Icicle and Peshastin Canal at rm 5.7 (just upstream of the boulder area) from May through early October (Brennan 1938). In 1994 and 1995, day snorkel surveys in the Icicle watershed found 11 resident bull trout (generally 8" to 12" in length) in dispersed locations in Icicle Creek above the LNFH spillway and in the lower end of Jack Creek, an upper Icicle Creek tributary. Bull trout comprised less than 0.2 percent of all fish detected, and were found up to rm 24 (USFWS 1997). In 2002, one small bull trout was observed in Leland Creek, an upper Icicle Creek tributary (Merritt, G., pers. comm., WDOE, 2002). Fieldwork by Brown (1992) located a few juvenile bull trout in French and Eightmile creeks, which are upper and mid-Icicle Creek tributaries, respectively.

The only survey that specifically attempted to locate small resident bull trout in Icicle Creek was a night snorkel survey in 2004, which found 22 resident bull trout (generally 8" to 12" in length) scattered throughout upper Icicle Creek as far downstream as rm 14, and in lower Jack Creek (USFWS 2005c). There have been a few opportunistic surveys as well. During a site visit in August 2005, one bull trout about 6" long was seen from the bank at the trash rack located at the water intake at rm 4.5 (D. Morgan, USFWS, pers. obs. 2005). During a day snorkel survey of the historic channel in June 2005, one bull trout about 8" in length was seen immediately downstream of dam 2 at rm 3.8 (D. Morgan, pers. obs. 2005). In 2001 and 2005, a total of four dead bull trout were found on the trash rack at the LNFH intake at rm 4.5, two of which were 14" long (2006 BA).

These observations suggest that most resident or immature fish are rearing in upper Icicle Creek, presumably near the spawning area(s), but some immature individuals are rearing and emigrating at least as far downstream as the historic channel, even in summer. Immature bull trout are known to move long distances both upstream and downstream (Muhlfeld and Marotz 2005). The Service assumes that there are more immature bull trout present in lower Icicle Creek during cooler months, because water temperature in summer is higher in this area than bull trout typically prefer, and emigration may be more common in spring and fall (Fraley and Shepard 1989). The Service estimates that during summer months, which is when LNFH activities are most likely to affect bull trout due to reduced flow, increased temperature, and passage barriers, there would be a maximum of 10 immature bull trout present between rm 2.8 (dam 5 and the spillway pool) and rm 4.5 (the water intake).

Many large migratory bull trout are commonly observed in the large pool in Icicle Creek just below the LNFH canal spillway from July through November. This pool is the location of the Yakama Nation Fishery for LNFH Chinook salmon. According to the BA, most angling here occurs between late-May and mid-June. The BA indicates that most snorkeling and bull trout observations in the spillway pool occur in August. However, in late spring and early summer high flows and the tribal fishery at LNFH limit opportunities to snorkel survey the pool, which results in a data gap for bull trout activity in the area. The BA indicates that the most bull trout observed on a single day was 125 in August 2004 (specific date unknown). Telemetry studies have shown that migratory bull trout have moved from the spillway pool to the Wenatchee and Columbia rivers (De La Vergne, J., pers. comm., USFWS, 2005; Bio Analysts 2002 and 2003). The Service assumes that when very large numbers of bull trout are present in the spillway pool, the majority of these fish are from other local populations in the Wenatchee basin, and they may be holding in the area due to cool water and depth cover. Based on limited telemetry data and direct observation while snorkeling, the Service estimates that up to 20 of the large migratory fish located in the spillway pool are likely part of the Icicle Creek local population.

It is not known where resident bull trout spawn in Icicle Creek. Based on detections of multiple age classes of bull trout in upper Icicle Creek and tributaries such as Jack Creek, it is assumed that spawning is probably limited to these areas and nearby French and Leland Creeks (WDFW 1998). The number of spawning individuals is unknown, but given the low density of bull trout observed during a week of night snorkel surveys specifically designed to locate bull trout (USFWS 2005c), the effective population size is assumed to be very small (<50).

Larger, more fecund migratory bull trout cannot spawn in Icicle Creek because passage above LNFH is generally impossible. There is no known bull trout spawning in Icicle Creek below LNFH. Habitat below LNFH is not suitable for successful bull trout spawning and incubation due to elevated temperatures and other degraded habitat factors.

F. Role of the Action Area in the Persistence of the Wenatchee River Core Area Population of the Bull Trout

The majority of bull trout in the Wenatchee River core area occur in the Chiwawa River local population. Like all watersheds in the core area, the Chiwawa River Basin is subject to natural disturbance events, such as large fires, that could adversely affect the reproduction, numbers, and distribution of the bull trout population and its resiliency in that watershed. This in turn would reduce the prospects for persistence of bull trout at the core area scale.

To ensure bull trout persistence in core areas, the draft recovery plan for the bull trout identifies four conservation needs: (1) maintain the current distribution of the bull trout and restore its distribution in previously occupied areas; (2) maintain stable or increasing trends in the abundance of the bull trout; (3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies; and (4) conserve genetic diversity and provide opportunities for genetic exchange (USFWS 2002).

The action area plays an important role in the conservation of the bull trout because it includes one of only seven local populations of the bull trout in the Wenatchee River core area. Six of these populations are currently at an increased risk of extirpation due to their small size, which makes them less resilient to environmental change and increases the potential for deleterious genetic effects.

The spatial distribution of these populations is such that most of them occur in the upper basin. Icicle Creek is one of only two populations in the lower basin. This may have resulted in distinct genotypic or phenotypic variation in this population, and it could insulate this population from disturbances in the upper basin that would affect most of the others. For example, radio telemetry suggests that migratory fish from these lower basin populations are likely to use the lower Wenatchee and Columbia Rivers as overwinter habitat (USFWS 2005c). In contrast, Lake Wenatchee is heavily utilized by populations in the upper basin where fish from several local populations congregate as they overwinter, and changes in that habitat could affect all of those populations simultaneously. This would decrease the long-term stability of bull trout in the Wenatchee core area, which a population in the lower basin that does not rely on the lake could help to buffer.

All seven local populations in the Wenatchee River core area, including Icicle Creek, need to be conserved to ensure the long-term persistence of bull trout in the core area. With the exception of the Chiwawa River, these local populations are currently at an increased risk of extirpation due to their small size. Icicle Creek is the smallest population, and based on the limited information available, appears to be the most imperiled of these local populations. Maintenance and expansion of the Icicle Creek local population is dependent, in part, on restoring the migratory life history form, which is likely to enhance the viability of this local population by reducing demographic, distributional, and genetic risks.

Bull trout populations are genetically more highly differentiated than populations of other salmonids. This may be due to local adaptation or genetic drift. Whatever the cause, genetic diversity is higher between, and lower within, local populations of bull trout. If one local population were lost, it is likely that new recruits into a watershed would posses a significantly different genotype, reflecting a different set of selection pressures or history of genetic drift, which makes its long-term survival under the new environmental regime less certain. It may be very difficult to establish a new population of bull trout in a watershed once the native population is lost.

G. Factors Affecting the Species' Environment in the Action Area

Migration Barriers

The LNFH operates four structures that are impediments or barriers to fish migration in Icicle Creek: (1) a spillway at rm 2.8 which is the terminus of a canal that conveys most of the flow of Icicle Creek across the LNFH grounds; (2) a weir (referred to as dam 5) on the historic channel of Icicle Creek adjacent to the canal spillway; (3) a headgate (dam 2) at rm 3.8 that splits the flow between the LNFH canal and the historic channel of Icicle Creek; and (4) the LNFH water diversion intake dam at rm 4.5 (see Figure 1). The operation of these structures is described in detail, in the order they occur from downstream to upstream, in the following paragraphs.

The canal spillway is at the downstream end of the canal, and immediately upstream from the LNFH ladder. The canal was dug when LNFH was built in about 1939 so that the natural channel could be regulated and used for fish culture.[1] In order to accommodate Icicle Creek's higher flows, and to avert "blow-out" of those structures, the canal was built to convey most of Icicle's flow and to bypass the facilities installed in the historic channel. The spillway provides grade control; the length of the canal is shorter than the historic channel. The spillway is a smooth concrete ramp, roughly 20-feet high and 120-feet long. At its base the water surface elevation is again equal to the natural channel of Icicle Creek. There is a deep pool (referred to as "the spillway pool") at its base where water from the canal and water in the historic channel merge. Icicle Creek continues as a single-thread channel from this point downstream. Upstream fish passage is currently impossible at the spillway dam.

Just upstream from the spillway pool, in the historic channel of Icicle Creek, LNFH operates a second structure (dam 5) that traverses the historic channel. This structure is a weir, and in recent years it has blocked all fish passage both upstream and downstream for about 6 to 8 weeks every spring between March and the end of April when the pool upstream of this weir is used to acclimate Coho salmon pre-smolts.[2] Thereafter pickets are removed from this structure, allowing

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[1] In 1979, artificial production was discontinued in the historic channel. Instead, the main fish ladder into LNFH was built that year, and artificial production was transferred to ponds and raceways on the floodplain where they exist today.

[2] In 2005 and 2006, Coho were not acclimated in the side channel, and therefore passage was not barred in the early spring as it was in the past. Per an agreement (March 2006) between BPA, the Service, and the Yakama Nation, in the future Coho salmon will be acclimated in ponds and not in the channel, thus ensuring fish passage at Dam 5 in the spring until mid-May when it is erected for LNFH's Chinook salmon broodstock collection.

fish passage. In a slightly different configuration pickets are installed later in May, and kept in place for about two months, removed in mid-summer, and then replaced for two or three months in the fall. For the first part of the interval this weir blocks all large fish during LNFH spring Chinook salmon broodstock collection, which also facilitates the Yakama Nation fishery, and in the second interval it blocks and/or traps all large fish during Coho broodstock collection.

Continuing up the historic channel one mile to rm 3.8, the headgate (dam 2) is also a barrier to fish migration. This headgate is primarily operated to control the flow that is split between the historic channel of Icicle Creek and the LNFH canal. Originally the headgate was needed to protect the fish culture facilities in the historic channel that were later abandoned and partially removed. Currently it continues to affect the morphology of the historic channel because it restricts the amount of water that can flow in the historic channel. The rest is conveyed by the canal. An analysis done by the BOR suggests that the maximum flow that can be passed through dam 2 and into the historic channel is about 2,600 cfs (Montague, S., pers. comm., BOR, 2006), which is generally slightly less than the normal spring freshet. The 2,600 cfs assumes that both doors on the headgate are fully open. Since only one door is currently used, the maximum flow that can be passed is about 1,300 cfs. According to the USGS gage at rm 5.9, on May 18, 2006, flow peaked at about 6,000 cfs. Thus, nearly 80% of the high flow in 2006 went through the canal.

Based on numerous personal observations (D. Morgan, USFWS) between April 2003 and June of 2005, fish passage at the headgate was generally impossible because the gates are kept nearly closed, and the concrete structure at the base creates impassable hydraulic conditions when the gates are in that position. When the gate is opened only slightly or when the creek is high and water leaks around the gates even when they are closed, it is possible for fish to jump at the attractor flow, but they cannot pass. For example, when the gate was only open slightly during the summer of 2004, salmonids were observed repeatedly jumping and hitting the metal gate and/or concrete walls without passing through (D. Morgan, USFWS). One fish is known to have landed on a "shelf" in the gate door above the water surface where it lodged and died (Rieman, D., local resident, pers comm., 2006). In 2001, a few days after the gate was opened wide in early July, bull trout and other fish were observed swimming through the gate at dam 2 (USFWS 2006a). According to the BA, the gate was also opened for part of the summers of 1993, 1997, and 2005 and large adult fish including bull trout passed through and moved upstream (USFWS 2001b; Bambrick, D., pers. comm., NMFS, 2005). Other than these four times, any other opportunities for fish passage are believed to have been very rare for several decades.

The fourth and final structure at LNFH that affects fish movement is the intake dam at rm 4.5. This structure is approximately 6-feet high and spans Icicle Creek from bank to bank, which is about 75-feet at this location. Since the dam is a chevron shape, it is actually about 150-feet across. This structure is known to pass large fish during higher flows (USFWS 2001c), but for most of the year it prevents or inhibits upstream fish passage. In recent years, no fish ladder was in place because the original design filled with sediment. As of August 2006, LNFH was in the process of retrofitting weirs to the dam to improve passage. It is unknown whether this will be effective. Although the dam itself is not higher than fish can jump under certain circumstances, there is no pool area along the face of the dam to facilitate a jump over it. A concrete footing extends downstream. At moderately low flows, this footing appears to prevent hydraulic conditions needed to facilitate a big leap over the dam crest. During very low flow, the dam crest is "checked up" by LNFH using tarps and other methods to ensure enough water is diverted until flow increases.

Phase 1 of the Icicle Creek restoration project, completed in the summer of 2003, removed dams 3 and 4, which were located in the historic channel between dams 2 and 5. Removing dams 3 and 4 allowed some natural sediment transport to occur in the area where these dams used to be, and has initiated a beneficial response in channel morphology, primarily by reducing the width to depth ratio of the stream (D. Morgan, USFWS, pers. obs. 2006). However, the removal of these dams did not affect fish passage because they were already filled with sediment and did not cause barriers to fish movement.

Since 1940, migratory bull trout have generally been limited to the lower 2.8 miles of Icicle Creek due to dams at LNFH that block all or nearly all upstream fish passage in Icicle Creek at the hatchery. Based on a stream survey in 1935 (described in Bryant and Parkhurst 1950), anadromous fish had access to 24 miles of Icicle Creek.[3] In 1937, juvenile steelhead/rainbow trout, "dolly varden", and Pacific lamprey were captured in a trap on the Icicle Irrigation District irrigation ditch near rm 5.7 (Brennan 1938). This report does not provide a clear indication whether this meant that anadromous fish were accessing the area or not. These "dolly varden" were what we now call bull trout. This trap was operated only briefly in the spring and summer of 1937. Nevertheless it caught 12 bull trout between 6" to 10" long. This is more than we would expect to find at this location today.

In 2001, shortly after dam 2 was intentionally opened for a few weeks during an experiment by LNFH, 8 migratory-sized bull trout (12" to 24" long) were found during a snorkel survey between dam 2 and the boulder area (USFWS 2001b). In 2002 and 2004, a total of 5 migratory-size bull trout were found above the boulder cascades in a large pool near rm 5.9. These fish were 26", 22", 20", 19", and 13" in length. The larger individuals were very large-bodied (i.e. muscular, not cigar-shaped) and colorful, similar to migratory bull trout seen elsewhere in the Wenatchee basin (De La Vergne, J., pers. comm., USFWS, 2006). The observations of migratory-size bull trout above the boulder area were both opportunistic samples. No systematic efforts have been attempted to look for migratory fish in the middle reaches of Icicle Creek above the boulder areas. Apparently under some conditions fish passage is possible at both the dams in the historic channel at LNFH (dam 5 at rm 2.8 and dam 2 at rm 3.8), plus the intake dam at rm 4.5, as well as the boulder area near the Snow Lakes parking lot near rm 5.6. The boulder area appears to be a combination of natural substrate (worn, rounded, presumably native river rock) plus side-cast material from the adjacent road which was built in the 1930s and improved

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[3] The text and map in this survey do not agree on the barrier location. The map places the barrier at ~RM30 (just above the Leland Creek confluence). A USFS survey (1994b) concluded: "Bedrock canyon at approximate RM 26.4 is a series of chutes/falls and cascades with an average gradient of 28 percent. Believe this is the historical barrier to anadromy where previous reports have located it at RM 24." If this is correct, this barrier eliminated or nearly eliminated migratory access to about 23.5 miles of habitat.

in the 1960s (angular, car-sized boulders, some with drill holes as if from blasting activity). Visually it appears to be a barrier for most of the year, beginning in mid-summer as flow decreases, which occurs generally sometime in July. The Service assumes it is only passable during relatively high flows in late spring and early summer, and possibly during rain-on-snow runoff that occur periodically at other times.

The LNFH suggests that the large fish observed in 2002 and 2004 were very large resident fish, not migratory, and refers to an article (Boag and Hvengaard 1997) to validate this hypothesis. However, based on our analysis of the article, the Service believes it presents some uncertainties. For example:

1. The authors acknowledge that their trapping period, beginning in mid- to late-August, was later than the time when migratory bull trout were most likely to be present;
2. The authors found "few fish greater than 300mm" (about 12"), added that migratory fish are typically longer and larger, and concluded, in part due to their small size, that they had collected many resident-type fish;
3. The authors presented data in a table indicating that a small number of large fish up to 600mm (about 24") were present in this system, and in the text they did not comment on these fish at all, or indicate that they had grown that large in this small stream.

The Service acknowledges that it is impossible to simply look at an individual bull trout that is greater than roughly 12" long (the rule-of-thumb cut-off above which bull trout are assumed to be migratory) and know with certainty whether it is indeed a migratory fish. For the following reasons the Service believes that the large fish seen in Icicle Creek above the boulder area in 2002 and 2004 were migratory individuals:

- All bull trout populations in the Wenatchee River basin, except Icicle Creek, include migratory fish. These large fish have been seen during redd surveys in all spawning areas except Icicle Creek.
- Bull trout have not been stocked in Icicle Creek. They were able to migrate to upper Icicle at some point in the past, or they would not exist there today.
- Based on local radio-telemetry studies, all of the large bull trout that have been tagged locally migrate long distances to places like Lake Wenatchee, the lower river, or the Columbia; it appears that migratory access to these habitats is essential for that kind of growth; they do not spend their entire lives in smaller tributaries such as Icicle Creek.
- We are not aware of any resident fish in the Upper Columbia Recovery Unit that rival migratory fish in size. There are some resident bull trout populations in the Methow basin including Bluebuck Creek, Early Winters Creek, and Lost River. The former do not grow as large as the fish observed in Icicle Creek in 2002 and 2004, and the latter are either much smaller, or have access to Cougar Lake (i.e. they are likely adfluvial migrants) (Molesworth, J., pers comm., USFS, 2006).
- The 1950 report by Bryant and Parkhurst includes a narrative based on a 1935 survey which singled out rm 24 as "a series of impassable falls" in Icicle Creek. The map specifically refers to an "impassable waterfall" at a location near Leland Creek (actually near rm 30). The map specifically does not label the mainstem Icicle up to

that point as "stream of no value to salmon", (which is how nearly all its steep tributaries which are not accessible due to gradient were labeled). The map also labels the IPID diversion at rm 5.7 as "passable to fish". The narrative adds that IPID is "usually a barrier during irrigation season" (as it remains today). The Service believes it is reasonable to conclude that a detailed report like this one would not have overlooked the boulder area at rm 5.6 if it was a barrier.

- LNFH has generally blocked upstream fish passage since 1940.
- The 1992 Mullan report issued by MCFRO refers to the historic anadromy barrier at rm 24.
- The 1994 USFS survey of Icicle Creek noted a waterfall at approximately rm 26, mentioned that it matched the narrative description included in the 1935 survey, and commented that it appeared to be the historic limit of anadromy as described in that survey.
- It is common to see dozens of bull trout in the pool below the LNFH barriers, including some very large individuals. Radio-telemetry studies have tracked tagged fish in that pool.
- Some local bull trout in the Wenatchee basin have surmounted impressive cascades, chutes, and waterfalls (such as Nason Creek cascades near Whitepine, which is below where migratory bull trout spawn in Mill Creek).
- In 2001, LNFH conducted a limited exercise in alternative operations at dams 2 and 5 and as a result, large numbers of migratory salmonids including bull trout passed above LNFH.
- The following year, for the first time in recent history, a USFWS fish biologist saw large, colorful bull trout above the Snow Creek boulder area, including some that were about twice as large as any resident fish in the Wenatchee basin.

The MCFRO attempted to evaluate fish movement in Icicle Creek, including the boulder area at rm 5.6, using radio telemetry (USFWS 2001c). In 1999 and 2000, the MCFRO radio-tagged about 15 spring Chinook and 20 steelhead each year. In 2000, 5 bull trout were also radio-tagged. All anadromous fish were collected in the ladder system at LNFH. Bull trout were collected in the spillway pool at rm 2.8 using hook and line. All fish were released above the main spillway dam. No fish were detected above the boulder area.

All of the Chinook salmon and nearly all of the steelhead were produced at LNFH (only four steelhead had adipose fins). It is possible that these fish would have little inclination to move above LNFH infrastructure; instead they would be more likely to home in on and return to the ladder at LNFH where they were originally collected, or perhaps to Snow Lakes attractor flow. The five bull trout were not tagged or released until mid to late-August which coincides with the period when flows in Icicle Creek are very low. Indeed, none of the bull trout moved above the LNFH intake structure at rm 4.5, which is known to be a passage barrier during low flow, as was the case for most of August that year.

The final feature known to affect upstream fish migration in Icicle Creek is the IPID/City irrigation diversion just above the boulder area at rm 5.7. According to the BA, the IPID was built in 1915. In 1935 this structure was identified as a barrier during irrigation season (Bryant and Parkhurst 1950). Based on site visits since 2003, the 1935 survey appears to be accurate, and that it would be passable at high flows, similar to the LNFH diversion dam (Morgan D., pers. comm., USFWS, 2006). Most of the time since 1940, migratory fish were unable to access this area due to LNFH dams downstream.

Typical operations at the spillway and at dams 2 and 5 greatly limit the potential for fish passage into upper Icicle Creek. Generally, with the exception of 2005 and a few other limited instances when it was opened more than usual practice, dam 2 has rendered passage out of the upper end of the historic channel impossible most of the year. Generally, dam 5 blocks all adult fish passage for portions of the year. Other areas in Icicle Creek just upstream from LNFH become seasonal barriers to upstream migration once river flow drops (generally sometime in July; see Figure 2). Therefore, determining whether a bull trout can successfully migrate from lower to upper Icicle Creek and potentially spawn with its source population that same year depends on the following three factors: (1) Was the fish able to pass upstream at dam 5, dam 2, and the intake dam at LNFH?; (2) If so, did passage occur during the spring/summer reproductive migration period?; and (3) If so, did passage at LNFH dams happen prior to low summer flows which "activate" other barriers in Icicle Creek just upstream from LNFH?

Because no information about the timing of bull trout migration in Icicle Creek is available, the likely timing of spawning migration is inferred based on the behavior of bull trout in nearby local populations. Tumwater Dam, located on the Wenatchee River about 5 river miles upstream from Leavenworth, provides a reasonable surrogate. Like the dams at LNFH, Tumwater Dam is located in the lower Wenatchee River basin, and is near the mouth of a canyon that provides a bull trout migratory corridor to spawning habitat many miles upstream. LNFH and Tumwater Dam are about 3 air miles apart. The hydrograph patterns for both Icicle Creek near LNFH and the Wenatchee River near Tumwater are similar.

There is a strong correlation between stream discharge and fish passage at Tumwater Dam. Bull trout upstream migration consistently peaks about one month after the peak of the hydrograph, which varied between early May and late June during the period of record (1998-2005) (unpublished data available from the USFWS, CWFO). It is a reasonable assumption that bull trout at LNFH and Tumwater would naturally move past these locations at roughly the same time of year. Additional evidence supporting this assertion is found in the bull trout technical literature (Rieman and McIntyre 1993) and known movement patterns in the lower Wenatchee basin, (Bio Analysts 2004, USFWS 2005b). In many systems, some migratory bull trout are known to move out of lower basin locations in the spring, well before spawning occurs in late summer and early fall.

Spawning migration is the most critical movement necessary for the survival of bull trout populations. Although the precise timing and location of spawning are unknown in Icicle Creek, in other spawning areas in the Wenatchee River Basin, peak activity occurs in mid- to late September. It is uncertain whether fish typically move directly from overwinter habitat to spawning areas, whether some intermediate location is used as holding habitat, or whether this is highly variable. We assume that the phenology of the Icicle Creek bull trout population is similar to others in the Wenatchee River core area, meaning that most upstream migrant fish would attempt to move past LNFH primarily between late May and early September, with a distinct peak in the migration about one month after peak runoff. During this period, spawning migration past LNFH is precluded by current operations of dams 2 and 5. By mid- to late-summer as river flow drops, it appears that the boulder area at rm 5.7 and the IPID diversion just upstream of it are impassable because insufficient flow remains in the river to surmount them. Note that the pattern at Tumwater Dam shows that, during most years since 1998 when record keeping began, most bull trout moved past this structure before July 7. This reflects the correlation between passage and discharge (i.e. the hydrograph generally peaks in mid to late-May). It is only during years with unusually late spring runoff (1999, 2002) that there were still large numbers of bull trout moving upstream after July 7.

Small bull trout from the upstream resident population can emigrate freely from Icicle Creek via the spillway at the end of the LNFH canal, but these individuals, were they to survive and grow to migratory size in the lower Wenatchee or Columbia Rivers, could not return to the source population. The importance of maintaining the migratory life-history form of bull trout, as well as the presence of migratory runs of other salmonids that may provide a forage base for bull trout, is emphasized in the scientific literature (USDI 2005b). The ability to migrate is important to the persistence of local bull trout populations (Rieman and McIntyre 1993; Rieman and Clayton 1997; Rieman *et al.* 1997a). Bull trout rely on migratory corridors to move from spawning and rearing habitats to foraging and overwintering habitats and back. Migratory bull trout become much larger than resident fish in the more productive waters of larger streams and lakes, leading to increased reproductive potential (McPhail and Baxter 1996). Migratory corridors are also essential for movement between local populations, as well as within populations. Local populations that have been extirpated by catastrophic events may become reestablished as a result of movements by bull trout through migratory corridors (Rieman and McIntyre 1993; MBTSG 1998). Corridors that allow such movements can support the eventual recolonization of unoccupied areas or otherwise play a significant role in maintaining genetic diversity and metapopulation viability.

One final element related to migration barriers that likely impacts bull trout in the action area is the fishery at LNFH for fish produced by the hatchery, which peaks between mid-May and early-June. This is also the time of year when bull trout are commingled with the salmon targeted by the fishery in the spillway pool. The Chinook that are the target of the fishery are concentrated here because of the attractor flow from the LNFH fish ladder in this pool, and because they cannot migrate upstream. There is a very high concentration of fish (dozens to hundreds) and fishermen (up to half a dozen) in this small area. Although the anglers indicated that bull trout have never been caught (Parker, S., pers. comm., YIN, 2006), it is likely that some bull trout are hooked and injured or killed in this fishery. The number of individuals directly affected in this manner is unknown. The Service assumes that all or nearly all bull trout are released, but it likely some of these fish die later from hooking injury. The Service is unaware of independent or systematic attempts to obtain information about the effects on bull trout that likely result from the fishery at LNFH for hatchery-produced fish.

Reductions in Flow

There are two water diversions in Icicle Creek that influence fish access to upper Icicle Creek, one at rm 5.7 and another at rm 4.5. Both diversions restrict fish passage because of their physical structure and water withdrawal.

Water in Icicle Creek is over allocated. Four water users divert up to 174 cfs from lower Icicle Creek (see Tables 1 and 2 below). Water rights at the diversion at rm 5.7 total just over 120 cfs. The Icicle and Peshastin Irrigation Districts (IPID) use their water right of just over 117 cfs generally from mid April through late September or October. The City of Leavenworth diverts from a separate intake on the opposite bank its water right of about 3 cfs year-round. The other diversion is at rm 4.5, where total water rights at two diversions equal 54 cfs. The LNFH uses 42 cfs of water year-round while Cascade Orchard Irrigation Company uses 12 cfs of water generally from May through September. Thus, year-round, up to 45 cfs are withdrawn, and generally from May through September up to 174 cfs may be withdrawn.

It appears that less than the full water right of 117 cfs is actually diverted at IPID (USGS 1992) because the canal is not big enough. Data collected in the early 1990s indicated that IPID diverted a maximum of about 100 cfs (Montgomery Water Group, Inc. 2004b). There is a small amount of water added to baseflow below the USGS gage (see discussion below). Flows are typically very low in lower Icicle Creek for several months each year. In 7 of the last 8 years, the total amount of water in Icicle Creek as measured (often well under 100 cfs) just upstream from these diversions is less than the sum of these water rights (174 cfs) for at least a portion of the late summer irrigation period. In 2005, flow was exceptionally low. During late September measured flow at the USGS gage above all intakes was as low as 60 cfs (provisional data provided by USGS; available from CWFO).

Table 1. Diversion rates from lower Icicle Creek in cfs.

	Diversion Timing			
Water User	**Year-round**	**Irrigation Season (Apr – Oct)**	**Diversion Location (rm)**	**Maximum Diversion Rate**
LNFH	42		4.5	
IPID		117	5.7	
City of Leavenworth	3		5.7	
COID		12	4.5	
Total	45	129	n/a	174

Table 2. Average monthly flows in Icicle Creek for the period of record (water years 1936-1971 and 1994-2004) measured at USGS gage 12458000 in cfs.

Month	**CFS**
January	276
February	293
March	289
April	669
May	1,693
June	1,910
July	881
August	268
September	162
October	240
November	376
December	338

Some of the water taken out of Icicle Creek is supplemented by water released from Snow Lakes, (actually three impounded natural lakes). LNFH has a water right for 16,000 acre-ft from the Snow Lakes. That water enters Icicle Creek via Snow Creek at rm 5.4. This confluence is between the IPID diversion and LNFH's diversion, and it is downstream of the USGS stream gage located at rm 5.9. The period of record for flow data from Snow Lakes is 1998-2005, but data are incomplete for most years. Based on the raw flow data, releases from Snow Lakes varied between 15 and 45 cfs. Generally releases were less than 30 cfs. The initial date of water release varies from late June to early September, and releases end from late September to mid-October. This contrasts with the natural runoff pattern for Snow Lakes, which would be a snowmelt pattern with peak discharge in late spring followed by a gradual decrease. The natural baseflow of Snow Lakes appears to be about 3-5 cfs (unpublished flow data). Water released from Snow Lakes provides less water to Icicle Creek during most of the year than what would occur under a natural regime (as the Snow Lakes are filling up and storing water). However the water released augments flow in lower Icicle Creek with more than the natural flow for the short reach before it is taken out at LNFH's intake at rm 4.5 during a time of year when flows are critically low (USFWS 2004b, 2005d). IPID also releases water (generally less than 5,000 acre-feet per year) from storage reservoirs similar to Snow Lakes, but all or nearly all of that water enters Icicle Creek upstream of the USGS gage at rm 5.9.

Water temperature is generally inversely related to flow. Therefore, diversions probably lead to increased stream temperature during the summer months. Icicle Creek is on the 1998 Washington State Clean Water Act section 303(d) list for flow alteration (it has too little in-stream flow), and for exceeding water temperature standards (it is warmer than 15 degrees Celsius). Water temperatures may exceed this standard in Icicle Creek, even above all LNFH facilities. Limited temperature data were provided in the BA, particularly for the upper basin. Generally temperatures are warmer where flow is reduced (such as in the historic channel when dam 2 restricts inflow), and water temperature is greater at downstream locations. However, LNFH adds water from Snow Lakes on a seasonal basis. Based on data collected in 2005, Snow Lakes water decreases Icicle Creek water temperature in August by about 2 degrees Celsius between rm 5.5 (Snow Creek confluence) and rm 4.5 (LNFH water intake). This cooling effect slowly dissipates below the diversion. However, water released at the main hatchery facilities near rm 2.8 lowers Icicle Creek water temperature by about 3 degrees Celsius, compared to the lower historic channel (USFWS 2006c). The lower end of the historic channel is probably warmer than normative due to the flow restrictions at dam 2 and the high width to depth ratio caused by dam 5 (discussed in detail in section IV).

Species Interactions

Brook trout are present in the Icicle Creek watershed as well as other areas in the Wenatchee River watershed. The stocking programs for brook trout were discontinued several years ago. The presence of brook trout suggests that hybridization with the bull trout as well as increased competition for habitat and forage may occur (Rieman and McIntyre 1993). It is unknown whether this is the case in Icicle Creek, but during a snorkel survey biologists found bull trout and brook trout in close proximity, suggesting that hybridization is a risk (USFWS 1997).

Icicle Creek was also stocked with rainbow trout. It is unknown whether stocking continues. Direct competition between rainbow and bull trout could limit the latter, because when they overlap in areas where temperatures are not ideal for bull trout, rainbow trout are dominant (Dunham, Rieman, and Chandler 2003a; Haas 2001). This situation could apply in the lower and middle sections of Icicle Creek where, during midsummer, water temperature can exceed the thermal optimum for bull trout for several weeks. In the upper portion of the watershed, where most resident bull trout have been found in Icicle Creek, water is slightly cooler, and in these areas rainbow dominance is less likely to be a problem. For example, water temperatures recorded during surveys in 1995 and 2004 in upper portions of the watershed generally had lower minimum and maximum daily temperatures than areas several miles downstream (USFWS 1997, USFWS 2005c). Rainbow trout density was still higher than bull trout in these areas, but bull trout are generally outnumbered by other species in all systems; and in this system, bull trout are limited to resident-only life history, which inhibits population growth (Rieman and McIntyre 1993).

Follow-up work is needed to test these hypotheses and to assess how stocking brook trout and rainbow trout in upper Icicle Creek may have affected bull trout in that watershed. It is important to note that many river systems in the Wenatchee basin have been affected by brook trout and rainbow trout stocking. Nevertheless in some of those areas bull trout are numerous, for example, in the Chiwawa River, which appears to be the local stronghold for bull trout. In Icicle Creek the local population of the bull trout is very small, so that demographic and genetic risks are already very high even without the stress of competition from other trout species. Because this population is currently physically and genetically isolated from all other bull trout populations in the core area, the threat posed by brook trout and high-densities of rainbow trout in Icicle Creek is heightened compared to other drainages with more robust populations of bull trout.

H. Summary of Environmental Baseline for the Bull Trout

Most of the upper Icicle Creek watershed is a Wilderness Area, where management activities are very limited and conditions mimic natural processes, or those activities have no appreciable effect on bull trout habitat. There are a few locations where the Icicle Road impinges on the creek. Recent fires and suppression actions that occurred in the upper watershed were not sufficient in intensity or extent to significantly change the condition of bull trout habitat. In contrast, the lower Icicle Creek watershed is degraded as a direct result of management actions and other human activities, including those associated with the operation and maintenance of the LNFH which prevents or restricts fish migration at three structures in the lower Icicle Creek.

The bull trout is a permanent resident in the action area. Based on limited information, it appears that Icicle Creek supports the smallest local population in the Wenatchee River core area. Maintenance and expansion of the Icicle Creek local population is largely dependent on restoring the migratory life history form, which is likely to enhance the viability of this local population by reducing competition, demographic, distributional, and genetic risks.

Icicle Creek contains both resident and migratory fish, but only the former has consistent access to spawning areas in upper Icicle Creek. It is not known where resident bull trout spawn in Icicle Creek. Based on detections of multiple age classes of bull trout in upper Icicle Creek and tributaries such as Jack Creek, it is assumed that spawning is limited to these areas and nearby French and Leland Creeks. The number of spawning individuals is unknown, but is assumed to be very small (<50). Inbreeding depression, genetic drift, and other consequences of very small population size are a significant concern for this population.

Larger, more fecund migratory bull trout cannot spawn in Icicle Creek because passage above LNFH is generally impossible. There is no known bull trout spawning in Icicle Creek below LNFH since habitat below LNFH is not suitable for successful bull trout spawning and incubation due to elevated temperatures and other factors. Due to the management activities and water management structures controlled by the LNFH, about 23 miles of high-quality bull trout habitat is not available to migratory bull trout.

IV. Effects of the Action

The Service regulations for implementing the ESA define "effects of the action" as "the direct and indirect effects of an action on the species together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline" (50 CFR 402.02). "Indirect effects" are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur. Both discretionary and non-discretionary components of the proposed federal action are considered in evaluating the effects of the action on listed species.

The proposed O&M of LNFH is likely to have the following effects on the bull trout:

A. Fish passage past LNFH

As discussed above under the *Environmental Baseline* section, the passage of most migratory bull trout through the reach of Icicle Creek where the LNFH is located is likely to occur during June and early July. This period corresponds with proposed hatchery operations that involve the placement of racks at dam 5. The Service estimates that these racks will block access for about 20 migratory bull trout that would otherwise ascend Icicle Creek past the LNFH, where about 23.5 miles of historically accessible habitat exists upstream of the hatchery, including several miles of high quality spawning and rearing habitat in upper Icicle Creek. The estimate of 20 fish is approximately 20 percent of the maximum number of bull trout that have been detected at Tumwater (a surrogate for Icicle Creek) during the time of year when bull trout passage is blocked outright by dam 5 at LNFH, or delayed long enough that passage elsewhere in Icicle Creek is not possible that year.

Typically LNFH blocked the historic channel at dam 5 from mid-May through late July during Chinook broodstock collection, and, to a lesser extent, at other times of year. Under the proposed action, during periods when brood stock activities are not occurring (generally July 8 through September, and December to May 15) all racks and dam boards will be removed at dam 5 (unless 500 or more Chinook salmon are present in the spillway pool). At least one of the two radial gates at dam 2 will be opened so that bull trout passage through the hatchery reach of Icicle Creek is possible provided flows are sufficient. However, beginning shortly after July 7, flows in Icicle Creek are likely to be too low for bull trout to pass the LNFH intake dam and the boulder area at rm 5.6. In most years, the Icicle Creek hydrograph drops very rapidly in July (Figure 2). By mid-July, stream flow is generally only 10 percent to 30 percent of the peak flow occurring just a few weeks earlier. In years with normal runoff timing and normal snowpack, there should be a very brief window (several days to a couple of weeks) after July 7 when bull trout could swim through the historic channel past LNFH and then reach the boulder area before flows diminish to the point that this area becomes impassable. In years with early runoff and/or minimal snowpack, by the time bull trout can pass LNFH it will probably be too late to pass the boulder area that year. In years with late runoff and/or heavy snowpack, there should be a longer window of opportunity for bull trout to migrate past both LNFH and the boulder area.

For the above reasons, the proposed action is likely to preclude demographic and genetic contributions by migratory bull trout to the small known resident bull trout population in Icicle Creek, unless they are able to access the 1.7 miles of habitat between dam 5 (rm 2.8) and the intake dam (rm 4.5) after dam 5 is opened, survive in this area until the following spring, and then move upstream. The likelihood of bull trout accessing and holding in this reach is low because most of this reach is subject to high water temperatures and low water depth during late summer, which will adversely influence the survival of any migratory bull trout that hold in this area. The area immediately below the Snow Lakes Creek confluence, which is cooled by midsummer release of Snow Lakes water, and has at least one deep pool, is an exception to this general condition.

See Figure 3 for a summary of passage effects.

B. Fish trapping at LNFH

Previously LNFH removed bull trout that ascended the main ladder and arrived in the adult holding ponds, and returned them to the spillway pool below dam 5. These fish were thus unable to migrate past LNFH by dam 5 and/or dam 2. Under the proposed action, LNFH will return these fish to Icicle Creek above these dams. But according to the BA, "most years none [bull trout] are encountered". Therefore this change in operations is unlikely to result in significant numbers of bull trout passing LNFH. LNFH will attempt to operate their ladder more often to attract fish to enter it. Due to logistical reasons related to limited space in the adult holding ponds, and the antibiotics administered to the Chinook that are held there prior to spawning, there is limited flexibility in what can be done to achieve the goal of attracting more bull trout into the adult ponds and thence passing them upstream (Collier, T., pers. comm., LNFH, 2006).

Previously LNFH installed pickets all the way across dam 5. Under the proposed action a trap or traps will be adapted and fitted to this structure in an effort to collect bull trout here and place them above LNFH. LNFH has never tried to trap bull trout at this structure before and its effectiveness cannot be predicted with certainty. However, in order to continue collecting adult broodstock via the main hatchery ladder, a trap at dam 5 will not be operated so that it is so attractive that it diverts fish away from the ladder. Dam 2 will generally be clamped down during broodstock collection to keep as much flow as possible in the canal and as many Chinook as possible in the spillway pool, which thereby makes the trap less effective. If more flow were released at dam 2 to create increased attractor flow into the trap at dam 5, there is the possibility that many (dozens or perhaps hundreds) of Chinook will crowd it. The large numbers of Chinook, which are twice the length and many times the body weigh of large bull trout, are likely to discourage bull trout from entering the trap.

Bull trout may simply avoid the trap, regardless of other fish in the area, as they have been known to do at a similar trap and weir on the lower Chiwawa River (USFWS 2005b). Of the approximately 25 fish tracked at the Chiwawa trap, only 8 used it. All the others passed when the trap was down. That trap is operated on a four-days-on and-three-days-off schedule. Some radio tagged bull trout have been located holding just below it during the days it is up, and passing quickly through it once it is lowered, indicating that a fish trap may exclude certain individuals by altering their migratory behavior.

Trapping and hauling fish is also problematic because handling fish creates the potential for death or injury. Due to passage and flow issues in Icicle Creek, moving and releasing fish could contribute to other concerns, such as stranding and poaching. However, if fish are handled and released appropriately, adverse effects can be effectively minimized. Based on best available information and professional judgment, for purposes of this analysis, at least one bull trout per year will be assumed to ascend the ladder and the trap at dam 5.

C. Incidental Harvest

Treaties and other agreements allow a tribal Chinook fishery at the LNFH spillway pool. Adult returns to LNFH generally exceed the number of broodstock needed (approximately 1,000), under the current production regime. Approximately 1.6 million smolts are released each year. Once approximately 1,000 adult Chinook sampled from different portions of the run have entered the hatchery, the ladder is closed for the season. Often there are hundreds of salmon in the spillway pool that cannot ascend the ladder, exit the spillway pool, or move upstream because of dam 5. Sometimes there are several anglers actively fishing all day. This activity lasts for six or eight weeks every year, with peak activity occurring about the first half of the season (mid-May through early-July). The Service is unaware of any bull trout being caught in the spillway pool, but steelhead have been caught (Craig, J., pers. comm., USFWS, 2006), so it is assumed that bull trout may be caught as well.

In 2000, the Service caught 25 bull trout for research purposes in Lake Wenatchee using hook and line in three days of effort. One died from injuries caused by hooking. In 2002, the Service caught 11 bull trout for research purposes in the spillway pool using hook and line in two days of effort. Snorkel surveys in the spillway pool have not detected hook scarring in bull trout, but this would be difficult to observe due to poor water clarity and the difficulty of getting close enough for thorough inspection. Considering the intensity of fishing activity, the confined area, and the fact that bull trout are co-mingled with Chinook salmon, the potential for bull trout to be caught and released is high, and some of these fish are likely to be injured or killed. The number of bull trout potentially caught during the 5-year term of the proposed action cannot be estimated based on currently available information; to date, this fishery is not monitored, and the anglers are not required to report captures of bull trout.

Opening dam 5 on or about July 7 is expected to slightly reduce the risk of bull trout being captured, injured, or killed incidental to the salmon fishery in the spillway pool by giving bull trout other places to hold upstream, where fishing pressure is minimal. This change is likely to produce a small benefit to bull trout because by July 7 fishing in the spillway pool is greatly reduced. Most of the tribal fishing occurs during the first part of the Chinook run when more fish are present in the pool, and flesh quality and fishing success is high.

D. Historic Channel Habitat Quality

Dams 5 and 2 are situated at opposite ends of the historic channel. They have various effects on bull trout habitat elements in the historic channel, and also in the lower Icicle River below LNFH. These effects are summarized below.

Dam 2 is operated to restrict the volume of flow that enters the historic channel, and dam 5 traps sediment. This inhibits flushing flows and alters channel morphology, effectively increasing the width to depth ratio. The channel is therefore wider, shallower, and a great percentage of the wetted width lacks shade cover, all of which contribute to elevated water temperature, particularly near dam 5. Nearer to dam 2 the channel is narrower and has more shade; fish habitat and wetland conditions in this upper portion are better than at the opposite end. Overall, these conditions influence the water temperature conditions caused by the water withdrawals just upstream (see Figure 1). Icicle Creek is on the Clean Water Act section 303(d) list for exceeding maximum allowable temperature.

Under the proposed action, habitat conditions should be slightly improved compared to past operations because dam 2 will allow more water to enter the historic channel, particularly in the summer when temperature becomes a limiting factor for fish. However, the proposed action will continue to maintain degraded conditions by elevating stream temperature in the historic channel. Elevated stream temperatures will likely reduce the survival of bull trout and their prey base in the historic channel because it will reduce the amount of suitable habitat and crowd fish into remaining pockets of colder water (e.g., the spillway pool and the pool below dam 2). These locations subject fish to higher predation risk, particularly for juvenile prey fish which rear in the historic channel. This adverse temperature effect may be somewhat offset due to the input of cold water released at Snow Lakes during a portion of the summer.

Restricting the volume of Icicle Creek flow at dam 2 impacts substrate composition and embeddings by reducing water volume and current velocity in this reach. Sixty-five years of flow regulation at dam 2 has changed much of the substrate in the historic channel. A thick deposit of sand (up to several feet deep) has settled in the areas behind several old dams in that reach, and those particles are not transported out of the system except during high flows (Lorang and Aggett 2005). Dam 2 is operated to direct most high flows into the canal, and to prevent them from entering the historic channel, so effective flushing flows do not occur. The proposed action is an improvement compared to past O&M, but it will continue to maintain a degraded habitat by maintaining artificially high substrate embeddedness. Proposed operation of dam 2 will reduce interstitial hiding cover, particularly for juvenile fish, which have been observed in the upper end of the historic channel in spring when water temperature is still cool (Morgan, D., pers. comm., USFWS). This would reduce the survival of the bull trout prey base in the historic channel.

Dam 2 does not pass large woody debris (LWD) because water cannot spill over the crest. Water is forced through small openings that are generally submerged and through which only small debris can pass. There is also a rack just upstream from the dam from which debris is periodically removed. Given how the gradient changes at this location, as Icicle Creek emerges from the canyon upstream, this area probably used to accumulate LWD that was flushed from the upper basin. The resulting lack of LWD in the historic channel inhibits pool development, limits hiding cover, and restricts habitat complexity downstream. LWD from upper Icicle Creek is "blown out" of the system via the canal and over the spillway, and does not remain in the reach that flows past LNFH in the canal or the historic channel. Under the proposed action, these conditions will not change.

Due to development at LNFH and on other lands in the lower Icicle Creek area, there is very little accessible floodplain. Floodplain access provides refugia for fish during floods, and contributes to groundwater storage, increased stream flow, and moderates stream temperatures.

The LNFH canal has high berms, which generally contain all flood flows, and prevent water from spreading out as it emerges from the naturally confined Icicle Canyon immediately upstream. This channel morphology exacerbates bank erosion and other adverse habitat conditions downstream. Some intact floodplain remains in the historic channel, but dam 2 is adjusted to keep most of the water out of this area. Even if it was opened all the way, its maximum capacity is inadequate to convey flood flows, so most water is forced into the canal (Montague, S., pers comm., BOR, 2006). Several reports have identified current floodplain development as one of the main habitat limiting factors in lower Icicle Creek (Andonaegui et al 2001; NPPC 2001c; WSCC 2001). The proposed action will not change floodplain accessibility. Habitat for bull trout and their prey base will continue to be maintained in a degraded condition because floodplain access will continue to be limited by the proposed action.

Near the bottom of the historic channel, dam 5 spans the channel, restricts flow, and creates a backwater, especially during spring flows. This leads to a wider, shallower channel and more sediment deposition (especially sand), and compounds the temperature and deposition issues described immediately above. The simplified habitat conditions created by dam 5 extend several hundred yards upstream. Under the proposed action this condition will not change. This habitat provides very little benefit to bull trout and their prey base because it lacks cover and has a high width to depth ratio. Streamside deciduous vegetation, which is abundant, is not tall enough to cast shade far from the banks. A snorkel survey of the historic channel in June 2005 found very few juvenile salmonids in the lower half of the historic channel. In contrast, many Coho salmon which had emerged from the gravel a few weeks before were observed in the upper end of the historic channel where pools and cover were present (Morgan, D., pers. comm., USFWS, 2005).

Immature bull trout may be rearing in the historic channel year-round. Based on limited information, collected in periodic snorkel surveys, the numbers are believed to be low, especially in summer. The Service estimates that up to 5 immature bull trout will be present in the historic channel depending on the time of year, with fewer expected in late summer when water temperature is highest.

E. Alteration of In-stream Flows

LNFH withdraws 42 cfs from Icicle Creek during a time of year when the total of all water rights on Icicle Creek exceeds total streamflow, sometimes by a factor of two or three (see Tables 1 and 2). As noted above, Icicle Creek can go dry or nearly so in a few areas near the diversions. Water is added to Icicle Creek from releases to Snow Creek at rm 5.5, removed at rm 4.5, and piped about 1.7 miles to LNFH, where it is returned back to Icicle Creek at rm 2.8. Under the proposed action, beginning in 2006, LNFH will annually release 50 cfs from the Snow Lakes reservoir system between July 20 and September 30. Unusual events such as equipment malfunction or consecutive years of very limited snowpack could alter water storage and release. Several effects on bull trout habitat in the reach between rm 5.5 and 2.8 are likely to occur.

By accounting for 100% of its surface water consumption via Snow Lakes releases during a critical time period, it is likely that water temperatures will be slightly decreased in this reach.

Snow Lakes water is 2 or 3 degrees Celsius colder than Icicle Creek at this time. Previously this reach had extremely low flow and elevated water temperature during late summer. Some of the causes, both natural and anthropogenic, will still exist, so the problems will not disappear. Due to the proposed action, the current negative conditions are expected to be ameliorated. Generally, in mid-July, stream flow in Icicle Creek is dropping rapidly, and is still above base flow. At about this time, the Snow Lakes release will begin. As Icicle Creek base flow drops through the rest of the summer, Snow Lakes water will provide habitat benefits (flow and temperature) through September. By early October, Icicle Creek stream flow generally increases due to a combination of irrigation diversion shutdown upstream of LNFH, plus natural weather patterns (precipitation).

Most of the year Snow Lakes will be storing water, and thus Snow Lakes Creek will not augment Icicle Creek flow. However, since Snow Lakes Creek baseflow is less then 5 cfs, and since most of its snowmelt would normally runoff in late spring when flow in Icicle Creek is high (at least several hundred cfs), compared to its unimpounded natural state, the negative effects of storage are expected to be slight.

Because slightly more water will be released under the proposed action than will be diverted, somewhat more habitat area will be available to bull trout in the reach between the LNFH intake at rm 4.5 and the fish ladder at rm 2.8, where most LNFH water returns to Icicle Creek. The amount will vary depending on channel morphology, and will be most noticeable in reaches where there are shallow margins near a narrow thalweg. For example, in the relatively narrow reach adjacent to the RV park near rm 4.2, additional shallow margin habitat is likely to remain submerged due to the approximately 8 cfs added to this reach during the low flow period. This may benefit bull trout prey, such as young-of-year juvenile salmonids, which have been observed in these margins in the past (D. Morgan, pers. obs., August 2004). In contrast, where the width to depth ratio is very high, such as immediately upstream of dam 5, there will be little difference in habitat available.

Additional water over the crest of the intake dam may slightly improve passage for both upstream and downstream bull trout migrants, particularly if the retrofit to the ladder, which began as this document was being completed in August 2006, is effective.

Figure 3. Map of LNFH area and summary of effects of the proposed action on migratory bull trout passage.

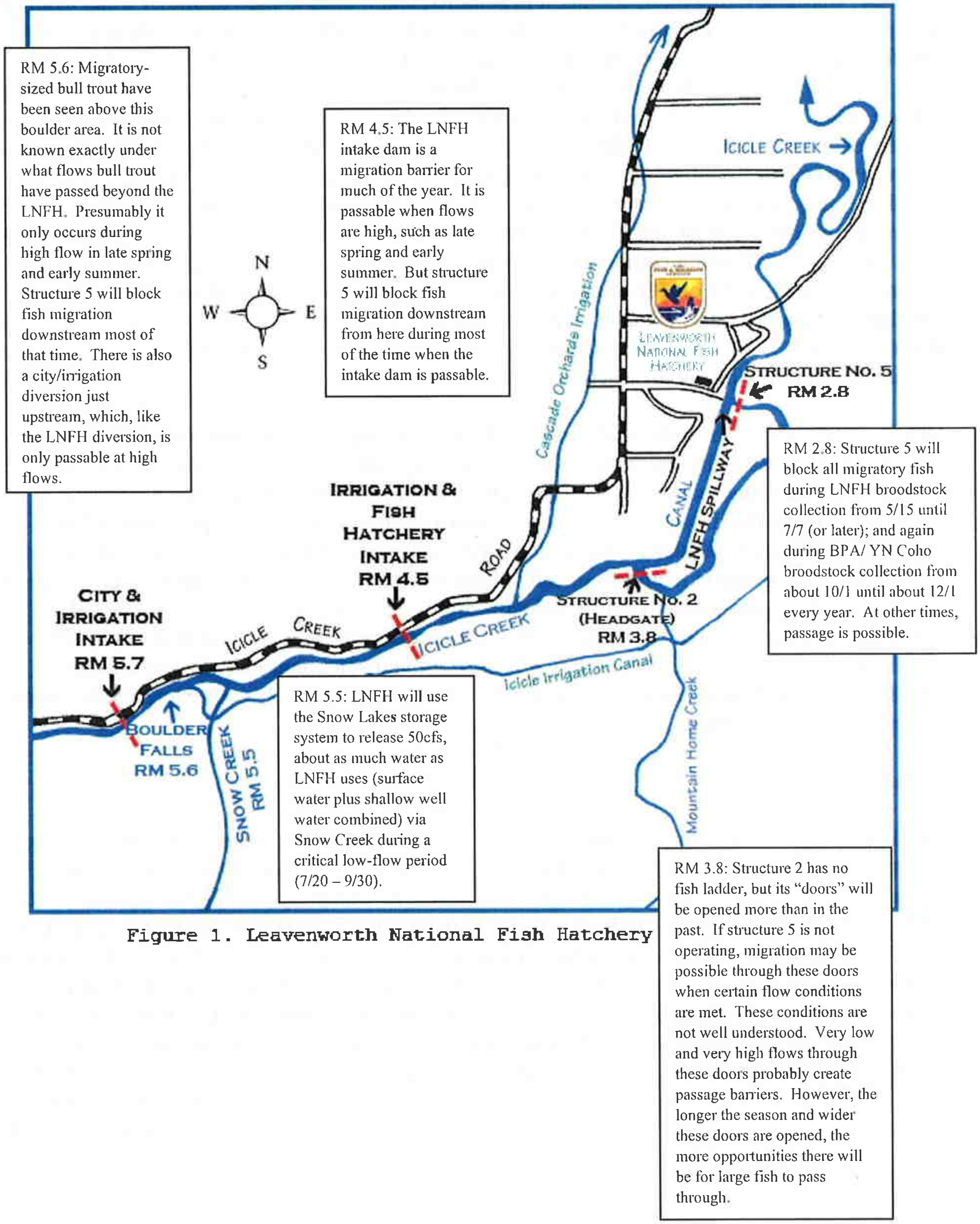

Figure 1. Leavenworth National Fish Hatchery

F. Groundwater Pumping

LNFH has a well system component of its water supply system that is used in conjunction with its surface water diversion. Well water moderates the temperature of the water used in the hatchery, warming it in winter, cooling it in summer, and it adds to the volume of water available for operations. The system involves 7 wells. One of these wells draws completely from the deep aquifer, and has no influence on the shallow aquifer. A second well can draw from both. The other 5 wells draw water from the shallow aquifer only, which influences and is influenced by surface water. These 5 wells pull water that percolates into the ground from the canal and the historic channel (which has a higher elevation than the historic channel). Due to this connection between surface flow and groundwater, typically only two or three wells are used simultaneously, and it is necessary to rotate wells because as water levels drop, pumping at a given well becomes unsustainable. Wells are given several weeks to recharge and then they are used again. The maximum combined sustainable yield from all wells is roughly 6,000 gallons per minute (gpm), or 13 cfs (GeoEngineers, Inc. 1995). Of this amount, about 11 cfs comes from the shallow aquifer. Based on the connection between these wells and stream flow, it is assumed that this amount is affecting Icicle Creek between approximately rm 3.8 (where the well field begins) and rm 2.8 (the outfall where water is retuned to Icicle Creek).

Habitat conditions in the historic channel are likely to be degraded by pumping of the shallow aquifer because this is the stream reach that is hydrologically connected to the well field and groundwater pumping reduces surface flow. Elevated water temperature and reduced water depth are expected from well use. These conditions are interrelated with operations at dam 2 because that structure regulates surface flow into the historic channel. The negative effects of groundwater pumping on temperature and volume of habitat for bull trout and their prey base are similar to, and compounded by, the effects of activities at dam 2 discussed previously. It is possible that water released from Snow Lakes (in excess of the amount LNFH diverts) will ameliorate somewhat the in-stream flow effects of groundwater pumping. Downstream of LNFH, below the historic channel, groundwater pumping will slightly cool Icicle Creek during summer (USFWS 2006c).

G. Screening

The LNFH water intake system consists of miles of pipes, and several chambers, ponds, screens, and valves where as recently as 2005, bull trout have been found dead. Once fish enter the system at rm 4.5, there is no way to return to Icicle Creek except by passing through most or all of the network, and emerging at the downstream end at rm 3.8, if the fish return is operating, or more likely, via one of two water outfalls in the spillway pool at rm 2.8, or thought the pollution abatement pond at rm 2.6. For a variety of reasons (including a lack of automated cleaning, approach velocity distribution issues, fish bypass malfunctions, and other problems), the intake system does not comply with NOAA Fisheries or WDFW regulatory criteria, and does not minimize fish death and injury. The intake system was designed 65 years ago before there were effective standards for fish protection. Under the proposed action, this will not change. Up to two small bull trout per year are likely to be killed outright on the screens near the intake based on hatchery records. Small fish that approach the intake may be unable to swim free of its influence once they are too close. Because larger, migratory bull trout are strong swimmers, the Service does not anticipate that these fish will be at significant risk of death or injury in the water intake system.

The sand settling basin is located between the intake and the raceways. This is where the underground pipeline emerges and Icicle Creek water is briefly contained in a pool upstream of the rearing facilities. Live juvenile trout have been observed here in the past (Croci, S., pers. comm., USFWS, 2006). These fish were likely entrained at the intake and carried through the pipe about one mile to this location. Normally this pond is drained and sediment removed once every year. It is not known how many trout are present here or how long they remain in the basin. LNFH currently has no procedure for checking or removing them. These fish are likely swept over the overflow weir where they go back into an underground pipe and into the raceways (D. Morgan, pers. obs., 2006), or they may exit the basin via another set of pipes that lead to the spillway pool. A small number of sub-adult bull trout emigrating from Icicle Creek are likely to be affected every year. Under the proposed action, this will not change.

H. Salmon Surplus/Excess

When more adult Chinook enter the ladder at LNFH than needed for the annual artificial production quota (about 1000 fish), the extra fish are given to receiving groups including local Native American tribes or Trout Unlimited. These extra fish are considered Federal property and are excessed to the Bureau of Indian Affairs as part of a 1982 interagency agreement (S. Aiken, pers. comm. 2006). Chinook and any other species that ascend the ladder at that time of year, including bull trout, are confined in a series of two holding ponds at LNFH. With so many Chinook in the pond, it may not be possible to isolate and remove a bull trout prior to processing the Chinook. The water is drawn down, the fish are crowded and one or two people enter the pond. Chinook are caught by hand and killed with a blow to the head or other means. Generally the receiving groups conducting this activity are under the supervision of LNFH personnel, who attempt to remove bull trout and steelhead as they encounter them, and return them to Icicle Creek. To date, LNFH has not kept records of bull trout presence or absence during the surplus/excess operations. According to earlier drafts of the BA, "few if any" bull trout are present in the pond in any given year. On one occasion a bull trout was killed with a blow to the head (Croci, S., pers. comm., USFWS, 2006). Under the proposed action, LNFH staff will attempt to remove bull trout from the pond prior to surplus/excess activities. Assuming that it is unusual for bull trout to be present in the holding pond in any given year and that they would be handled and released appropriately beforehand, or failing that, that LNFH staff will closely supervise the public when they are killing excess Chinook, no significant adverse effects to the bull trout are anticipated from this activity.

I. Release of Effluent into Icicle Creek

Under the proposed action, the LNFH will continue to use about 100,000 pounds of fish food every year. It takes about 1.1 pounds of food to create 1 pound of fish body mass. Based on empirical data (Casteldine 1986; Westers 1993, cited in Idaho Department of Environmental Quality (IDEQ), no date) and assuming a conversion rate of 1.2, each pound of fish feed will generate about 0.3 pounds of solids. Therefore 100,000 pounds of feed annually would produce the following waste products in a year: 30,000 pounds of Total Suspended Solids (TSS) and Settleable Solids (SS); 3,830 pounds of ammonia; 760 pounds of total phosphorus; and other wastes not listed here.

Much of the solid matter settles in the pollution abatement pond at LNFH and is eventually removed and spread out on dry land at LNFH[4]. Liquid and dissolved material passes through the pond and is released into Icicle Creek. The effectiveness of pollution abatement ponds like the one at LNFH can vary depending on pond volume, flow-through rate, cleaning schedule, and many other factors. Although there are no requirements in Washington, the state of Idaho suggests that minimum harvest frequency for off-line settling ponds like that at LNFH should be every six months (IDEQ no date). The more frequently the solids are removed, the less opportunity there is for solids to break down and release dissolved nutrients into receiving waters (Freeborn, P., pers. comm., WDOE, 2006). The LNFH pond was last cleaned in 1998.

LNFH operates under a National Pollutant Discharge Elimination Permit (NPDES), and it measures TSS and SS as required by Environmental Protection Agency (EPA) under that permit. The values were not included in the BA. It is assumed that LNFH complies with the regulatory standards set by EPA under the terms of that permit. LNFH applied for a new permit in November 2005, and is currently working with EPA to update its permit. The Service anticipates that the NPDES permit will limit effluent discharges to the extent that adverse effects on bull trout would be minimal.

The specific biological effects of this effluent discharge at LNFH are unknown. According to Washington Department of Ecology (WDOE) eutrophication is a concern in the lower Wenatchee basin, because it can lead to dissolved oxygen (DO) and pH fluctuations that harm aquatic life. According to WDOE, regulatory standards may be lowered soon for lower Icicle Creek for DO, pH, and temperature (Carroll, P., pers. comm., WDOE, 2006). Under their permit, the LNFH discharges nitrogen and phosphorus. LNFH is the source of 90 percent of the phosphorous in Icicle Creek (P. Carroll, WDOE). WDOE measured a phosphorus concentration of 13 ug/ L at the LNFH outfall in 2002. According to WDOE (1989) that concentration has been reported in the literature as likely to cause eutrophication, and the assimilative capacity of Icicle Creek may require that the level released at the LNFH outfall must be less then 5 ug/ L (WDOE 2005). A final report will be issued soon and it is expected to be consistent with the 2005 draft (Carroll, P., pers. comm., WDOE, 2006).

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4 Future cleaning of and disposal of sediments from the pollution abatement pond is not part of the proposed action. That action will require a separate section 7 consultation.

A small number of water quality samples have been collected in Icicle Creek for PCBs and similar compounds. Some of these chemicals are detectable in very low concentrations (generally below the most conservative standards used anywhere in the US), and in some instances detections were registered both upstream and downstream of LNFH. Paint applied to fish holding tanks, which were taken off-line in 2005, had elevated levels of polychlorinated biphenyls (PCBs). Samples collected from the top layer of sediments in the pollution abatement pond at LNFH did not have significantly elevated levels of PCBs (USFWS 2005e). The fish food used at LNFH is a source of very small amounts of PCBs. Because fish feed is derived from marine sources it is impossible to completely eliminate all PCBs. The levels found in the feed used today are not expected to cause bioaccumulation problems (Hansen, J., pers. comm., USFWS, 2006).

Antibiotics, formalin and other chemicals used in fish culture at LNFH are administered in accordance with pertinent FDA and EPA regulations. Use of approved chemicals is not expected to cause toxicity in receiving waters when applied according to directions (WDOE 1989).

J. Bull Trout Prey Base in the Historic Channel

Numerous juveniles (mostly age 0 Coho) of several fish species that are known prey of the bull trout have been observed during a spring snorkel survey in the upper end of the historic channel when water temperatures were cool (D. Morgan, pers. obs. 2005). It is unknown what happens to these fish when temperatures in the historic channel become elevated. The combination of elevated water temperature, reduced flow in the historic channel, and simplified habitat in the lower end of the historic channel, likely reduces bull trout prey base in the historic channel, particularly in late summer. Releases from Snow Lakes under the proposed action are likely to contribute to cooler water temperatures in the historic channel during a portion of the year, which may help reduce this effect. These ongoing effects are expected to continue under the proposed action.

Under the proposed action, dam 5 will not be operated in the spring (mid-March through April), which will help steelhead migration and allow them to spawn in the historic channel, and potentially throughout suitable habitat in the upper Icicle Creek watershed. Since it is unclear exactly how dam 2 will be operated, or whether fish can pass through the velocity barrier at this dam in the spring when flows may be very high, it is uncertain whether steelhead will be able to access most of Icicle Creek. If not, this would maintain a lower distribution and abundance of bull trout prey in Icicle Creek.

Fish released from LNFH may temporarily provide prey for migratory bull trout. However, since these smolts rapidly migrate to the ocean, with most presumably leaving the area as soon as they are released, they are expected to provide little benefit as a prey source. For example, in 2004 and 2005, travel time for smolts migrating from LNFH to Bonneville Dam (about 350 miles downstream) took about 35 days. Assuming a steady speed, the smolts moved 10 miles per day, which would mean that these fish are only in Icicle Creek and the lower Wenatchee River for a few days at most.

K. Hatchery/ Wild Interaction Effects on Bull trout Prey Base

There are five general categories of effects or impacts on wild salmonids that may be caused by hatchery produced fish on a system-wide scale throughout the Columbia River basin and Pacific Ocean (Witty et al 1995). These include competition, disease, predation, straying, and harvest.

Witty et al (1995) determined that competition for space due to crowding at dams and in mainstem Columbia River reservoirs was unlikely to have a large effect on survival of wild salmonids. Competition in the estuary was considered likely to negatively affect growth and survival of wild salmonids, in part because estuary habitat is severely reduced compared to historic levels, and in part because large numbers of hatchery fish were vying for the same limited space, particularly in spring when estuary productivity is low. Of the five kinds of salmonid species considered, yearling Chinook, such as LNFH produces and which arrive in the estuary in the spring, was considered to have the second highest negative impact on wild fish.

Fish released from hatcheries are generally larger than their wild counterparts because increased size is believed to equate to increased survival. The extent to which LNFH smolts out compete wild smolts during their early freshwater phase has not been evaluated, but it has been demonstrated in the Yakima basin that the presence of hatchery Chinook salmon negatively impacted the growth of wild Chinook (Pearsons *et al* 1996). This could have long-term implications for the bull trout prey base because the smolt to adult return rate is generally much higher for wild fish (Waples 1991).[5]

The natural productivity of the ocean, and its ability to support large numbers of hatchery fish, in addition to wild counterparts, is also not known. Although ocean conditions vary in ways that affect the numbers of fish that return to the Columbia River basin (Beamish 1993), the numbers of fish released by LNFH (and most hatcheries) do not fluctuate in ways that would reflect cyclical changes in ocean conditions.[6] Whether this affects wild populations, and whether it affects the long-term stability of the bull trout prey base, is unknown. Witty et al (1995) indicated that since food production varies in the ocean in time and space, it was reasonable to conclude that competition between hatchery and wild salmonids would be most acute during periods of low ocean productivity, especially in near shore areas.

Witty et al. (1995) concluded that disease transmission from hatchery fish to wild fish was likely to be a problem, particularly at crowding locations such as collection and transportation facilities at mainstem dams. LNFH samples its fish prior to release and follows protocols to help minimize the risk of spreading disease to wild fish. No disease effects relative to the bull trout are anticipated with implementation of the proposed action.

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5 Fish released as smolts from LNFH do not linger in rivers post-release, but instead they move rapidly to the ocean, and therefore do not provide much opportunity as prey for bull trout. In contrast, wild juveniles reside in smaller streams for about 18 months before smolting, and provide a long-lasting prey base for bull trout.

6 LNFH currently releases about 1.625 million smolts per year, which is a relatively large number compared to most hatcheries. The total number of smolts released by all hatchery programs in the Wenatchee River basin is about 5 million, and for the Columbia River basin, about 85 million.

Witty et al (1995) separated predation risk into two categories: hatchery fish on wild fish, and the response by salmonid predators on all wild fish, when hatchery fish increased the prey base and thus the density of predators. For spring Chinook like LNFH's, the former was believed to be minor. The latter was believed to be significant, especially near mainstem dams.

As previously mentioned, LNFH stock is largely derived from an admixture of upper and lower Columbia River stocks, and is not native to the Wenatchee basin. Recent data indicate that the relative number of LNFH straying to Nason Creek and the Little Wenatchee River, where the number of wild spawners is low, is high enough that NOAA Fisheries and WDFW are concerned that LNFH "Carson-lineage stock" may be interbreeding in significant numbers in these tributaries with native, ESA-listed stock (Petersen, K., NOAA Fisheries and Murdoch A., WDFW, respectively, pers. comm. 2006). Based on preliminary data, for 2001-2003 an average of roughly 50 percent of the spawning population in the Little Wenatchee River and 20 percent in Nason Creek were strays from LNFH (USFWS 2006b). From a theoretical perspective, there are so many LNFH fish returning to the basin (primarily because LNFH releases so many smolts every year) that a small percentage of this large number could inundate the smaller population of wild fish, particularly if straying is concentrated in vulnerable areas, as may be happening here. In the long run, this interbreeding could reduce survival and recovery of the ESA-listed stock on which bull trout will depend on for prey base.

According to Witty et al (1995), artificial production stimulates increased harvest effort, and that could lead to increased catch of wild fish in mixed-stock fisheries. On the other hand, if harvest regulations restrict fishing, the opposite result could occur. Therefore the implications of LNFH operations related to harvest of wild fish is not clear.

L. Sedimentation

Periodically LNFH removes sediment from the head of the water intake canal using a crane and truck to haul it away for upland disposal, or by removing some flashboards in the canal and intake house (not the flashboards on the dam itself) and flushing the material downstream. This activity is performed nearly every year and is necessary to maintain adequate surface water supply. The material that is mobilized during these activities is native material from Icicle Creek which settled in the margins near the intake after high flow events. Therefore this activity is not introducing new sediment to the system. The associated turbidity increase is brief (usually a few hours spread out over a day or two) and is probably insignificant.

Similarly, adjustments to dams are expected to cause minor and brief sediment disturbance and increased turbidity. Some of these activities include the following kinds of actions:

- adjusting tainter gates at dam 2
- installing or removing pickets at dam 5
- installing or removing flashboards at the intake dam
- cleaning, moving, or removing trash racks at all of these structures

The BA included some data about suspended sediment monitoring in the vicinity of dams 2 and 5. Based on those data, turbidity sample values collected about 300-feet downstream from the work activity were generally similar to sample values collected about 100-feet upstream of the work activity. Most samples were less than 10 Nephelometric Turbidity Units (NTUs); a few were about 20 NTUs. It appears that the higher readings were related to ambient conditions more than the work activities. Regardless, the NTUs were generally low. Comparing the highest values provided to information summarized by Waters (1995) indicates that this turbidity is too low to harm fish. Furthermore, it is reasonable to assume that these kinds of activities cause only brief pulses of turbidity, therefore have little effect on primary productivity.

V. Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Diversions

Upstream from the LNFH intake there is a non-Federal water diversion at rm 5.7 which is likely to continue to adversely affect in-stream flow and fish passage, particularly during low flows. The irrigation districts have a water right to nearly 118 cfs of Icicle Creek water between approximately mid-March and mid-October, but usually diversion does not begin quite that early. Data collected in the early 1990s indicated that IPID diverted a maximum of about 100 cfs (Montgomery Water Group, Inc. 2004b). The municipal water intake at the same location (opposite bank along the same dam) takes 3 cfs year-round. The irrigation districts supplement in-stream flow above the point of diversion using alpine lakes fitted with small dams, but the amount of water stored (about 10,000 ac/ft) and released (about 5,000 ac/ft per season) is much less than the amount diverted. That amount of water diverted often exceeds the total flow of Icicle Creek measured by a USGS gage just upstream from this location, which in late September of 2005 was as low as 60cfs. This water is carried by a long open canal to areas downstream in the lower Wenatchee valley as far east as Monitor. Carrying water is returned to the Wenatchee River at several locations along the way. The diversion dam does not pass fish during low flow. It is unknown whether this diversion is screened adequately to prevent fish from entering the diversion canal which operates from April to October. Given that ¾" gravel was observed impinged on the screen itself (Kolk, S., pers. comm., BOR, 2006), it is likely that fish are at high risk of the same. At the time of this Opinion (summer 2006), the BOR was beginning a process to update and replace the screen, and possibly to address fish passage and other concerns. For example, this diversion also has a fish return that shunts fish out of the canal, over a rock ledge, and drops them about 15-feet directly onto a boulder that is not submerged for most of the irrigation season. Any bull trout that pass through this return when flows are low (August and September) are likely to be injured or killed.

Residential Development and Recreation

As the human population in Washington State continues to grow, residential growth and demand for dispersed and developed recreation is likely to occur, including areas within the lower Icicle Creek watershed. This trend is likely to result in increasing habitat degradation from riparian road construction, levee building, bank armoring, and campsite development on private lands in the lower watershed. Despite some local permitting requirements and regulations, experience indicates that these activities tend to remove riparian vegetation, disconnect rivers from their floodplains, interrupt groundwater-surface water interactions, reduce stream shade (and increase stream temperature), reduce off-channel rearing habitat, and reduce the opportunity for large woody debris recruitment.

Each subsequent action by itself may have only a small incremental effect, but taken together they may substantively degrade the watershed's environmental baseline and undermine the improvements in habitat conditions necessary for listed species to survive and recover. Watershed assessments and other education programs may reduce these adverse effects by continuing to raise public awareness about the potentially detrimental effects of residential development and recreation on salmonid habitats and by presenting ways in which a growing human population and healthy fish populations can co-exist.

The above effects may further degrade in-stream conditions for migratory bull trout ascending Icicle Creek below the LNFH. As discussed above, most of the upper Icicle Creek watershed is on Federal lands designated as Wilderness, which adequately protects bull trout habitat in that portion of the watershed.

VI. Conclusion

The Service has reviewed the current status of the bull trout, the environmental baseline, the effects of the proposed Project, and cumulative effects. Based on this review, it is the Service's biological opinion that the Project, as proposed, is not likely to jeopardize the continued existence of the Columbia River distinct population segment of the bull trout.

The environmental baseline for the Recovery Unit indicates that although bull trout are widely distributed, abundance is generally low and productivity highly variable. The Wenatchee core area is heavily dependent on a single local population in one sub-watershed in the upper basin, which contributes over three-quarters of the total reproduction in the core area. Numerous historic and ongoing factors continue to limit the potential for population recovery within the Recovery Unit. In the Icicle Creek watershed, most habitat pathways are "functioning appropriately" in the upper watershed, which is mostly land managed by the US Forest Service as Wilderness, and most are "functioning at risk" or "functioning at unacceptable risk" in the lower watershed, which is mostly private land. The Icicle Creek local population of bull trout is the smallest and most vulnerable to extirpation of all populations in the Wenatchee core area.

Bull trout occupy the action area year round. Direct effects are expected and may lead to injury and mortality. Indirect effects are expected to include impacts on habitat quality that will impede bull trout migration and reduce survival of bull trout and their prey. However, the anticipated amount of injury and mortality over the 5-year term of this Opinion is not expected to appreciably change the likelihood of survival or recovery of bull trout in terms of their numbers, reproduction, and distribution. The duration of the proposed action is equivalent to about one generation of bull trout. Every year about 150 individuals are anticipated to be affected, up to 10 lethally. In the short term, reproduction for resident fish is not likely to be measurably impacted because it takes place many miles upstream of LNFH. The long-term population effects of blocking migratory fish from reproducing in Icicle Creek would be significant at the core area scale, but the duration of this action is limited to 5 years, and that blockage at LNFH has existed since 1940. Bull trout distribution is not anticipated to be affected by the proposed action.

INCIDENTAL TAKE STATEMENT

I. Introduction

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the LNFH so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The LNFH has a continuing duty to regulate the activity covered by this incidental take statement. If the LNFH fails to assume and implement the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the LNFH must report the progress of the action and its impact on the species to the Service as specified in this Incidental Take Statement [(50 CFR §402.14(i)(3)].

II. Anticipated Amount or Extent of Take of Bull Trout

In the "Effects of the Action" section of the accompanying biological opinion, the Service estimated the anticipated incidental take from this Project after making several simplifying assumptions. The rationale for these assumptions is also presented in the "Effects of the Action" section. These assumptions necessarily decrease the accuracy and precision of this incidental take estimate.

The primary mechanisms of incidental take where it is possible to quantify the number of bull trout involved are 1) handling fish that enter LNFH facilities, 2) killing fish in the water intake system, and 3) killing fish in the surplus / excess protocol. Incidental take will also occur in other ways where meaningful quantification is not possible, and these will include 1) blocking 23.5 miles of historically accessible habitat above LNFH, 2) altering in-stream flow via surface water storage, release, and groundwater pumping, and 3) habitat alteration in the historic channel. Note that the Effects Section in this document estimates the number of individuals which the Service believes will be affected by the proposed action, but that is not necessarily the same as the number expected to be taken (i.e.- not all of these fish will be harmed, harassed, killed, etc).

The Service determined amount of incidental take expected to occur as a combination of project effects and the number of bull trout exposed to them:

- Sublethal exposure to handling when it is necessary to remove fish from LNFH facilities including the adult holding pond, the sand settling basin, and the trap at dam 5 (10 individuals per year).
- Lethal exposure to components of water intake system (10 individuals per year)
- Lethal exposure to the surplus/excess protocol (1 individual per year)

Other possible incidental take of bull trout is difficult to detect for the following reasons: (1) low density of individuals in the action area for most of the year; (2) primarily nocturnal activity patterns; (2) tendency to hide in or near the substrate; (3) small body size; (4) cryptic coloration and behavior of juvenile and sub-adult fish; (5) the need to use snorkeling techniques to detect bull trout; (6) low likelihood of finding an injured or dead individual in the relatively complex habitats in the action area; (7) high rate of removal of injured individuals by predators or scavengers; and (8) uncertainty of volitional movement by migratory-size fish; therefore we cannot quantify any other forms of take. Reports of any detections of incidental take are valuable in enabling the Service to further refine estimates of incidental take for future projects of a similar nature in similar contexts.

III. Effect of the Take

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

IV. Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measures (RPM) are necessary and appropriate to minimize take of bull trout.

RPM 1. Minimize the impacts of incidental take from handling and release of bull trout encountered at hatchery facilities.

RPM 2. Minimize the impacts of incidental take from entrainment into the water delivery system.
RPM 3. Minimize the impacts of incidental take resulting from the surplus/excess protocol.
RPM 4. Minimize the impacts of incidental take from operations of structures 2 and 5.
RPM 5. Minimize the impacts of incidental take associated with water withdrawal.

V. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the LNFH must comply with the following terms and conditions, which implement the reasonable and prudent measures described above, and are designed to minimize impacts to bull trout. These terms and conditions are mandatory.

To implement RPM 1:

T&C 1. Prior to conducting activities that may involve handling bull trout, ensure that hands are free of sunscreen, lotion, or insect repellent.

T&C 2. To the extent possible all handling and observation methods shall be implemented to avoid temperature stress of affected fish. It may be necessary to conduct the activity in the morning or evening on hot summer days to avoid temperature stress to captured fish.

T&C 3. If bull trout are held in a tank, a healthy environment for the stressed fish must be provided and the holding time must be minimized. Water to water transfers, the use of shaded, dark containers, and supplemental oxygen shall all be considered in designing fish handling operations.

T&C 4. If a bull trout is showing signs of stress or injury, it shall only be released when able to maintain itself. It may be necessary to nurture in a holding tank until the fish has recovered.

T&C 5. Collect fish statistics (estimated length and weight, sex, scale sample, marks, condition/health, angling injury, etc.) from bull trout prior to release.

T&C 6. All dip net or seine mesh netting shall be composed of fine mesh (no knot) material.

T&C 7. The release location for a captured bull trout depends on where it was captured and what river conditions prevail at that time. The intent is to choose a release location where the habitat is favorable for the fish, and is above LNFH barriers, which, depending on those conditions, may include dam 5, dam 2, and the intake dam. Therefore LNFH must call USFWS CWFO Monday of each week during broodstock collection to discuss the likely release location for that week. If a fish is captured, LNFH must call USFWS CWFO again prior to release to finalize the specific release location. Barring something unforeseen, fish will not be released above the confluence of Snow Creek. The general procedure is described below:

Capture location	Release location
Adult holding pond	If dam 5 has the racks in place, or if passage at dam 2 appears to be impossible based on flow and gate settings, fish will be released upstream of dam 2 near Sleeping Lady. But if flow is too low at that location the pool below the bridge at the Snow Lakes trail bridge (rm ~5.5) will be used instead. If dam 5 does not have the racks in, and if passage at both dam 2 and the intake dam appear possible, fish will be released in the spillway pool.
Trap at dam 5	Fish will be released upstream of dam 2 near Sleeping Lady, but if flow is too low at that location the pool below the bridge at the Snow Lakes trail bridge (rm ~5.5) will be used instead. If passage at both dam 2 and the intake dam appear possible, fish release in the historic channel above dam 5 may also be considered.
Inside trash rack at intake diversion	Below and near intake diversion dam
Screen chamber/sand settling pond	In pool below spillway dam
Other	Closest, safe release location in Icicle Creek

T&C 8. Keep written records of when the gate at the bottom of the fish ladder was opened and closed. Include this information in the annual report (see next section) to ES.

To implement RPM 2:

T&C 9. Monitor all areas of the water intake system where fish have been found in the past, every day, once in the morning and once in the afternoon, at a minimum.

T&C 10. If a bull trout is found anywhere in the water intake system downstream of the trash rack, refer to T&C 7.

T&C 11. Keep written records of each instance when other fish species and/ or significant debris were found in the system. Provide ES with an annual report (see next section).

T&C 12. Do not operate the fish return opposite dam 2 unless it is modified so that it does not strand fish.

T&C 13. Once every week initially, remove and release bull trout from the sand settling basin using a crowder net and/ or dip nets. If the initial weekly removal efforts demonstrate that no fish are present, the interval between removal efforts may be extended to monthly instead of weekly. The frequency of this activity may vary by time of year. For example, more frequent removal efforts may be needed in spring and fall. Provide ES with an annual report describing when this work was done and the numbers and types of fish observed (see next section).

T&C 14. Install a screen or other device to prevent fish from exiting the sand settling basin via the overflow weir. Monitor this location to ensure that fish are not impinged. Provide ES with an annual report describing what was installed and whether it appears to meet the objectives (see next section).

To implement RPM 3:

T&C 15. Attempt to remove bull trout prior to allowing public into the area. LNFH staff must adequately supervise the excess operation unless they are absolutely certain that no bull trout are present. If any bull trout are killed during surplus / excess protocol, ES must be contacted for reinitiation of consultation as soon as possible. Keep written records of this activity and include it in the annual report to ES (see next section).

To implement RPM 4:

T&C 16. By November 17, 2006, the LNFH will convene a group of federal, state, and tribal co-managers to begin development of an adaptive management strategy that addresses future passage of bull trout above the hatchery. In addition to the immediate efforts to pass bull trout outlined in the BA, this strategy will define additional research, data collection and analysis necessary to further address and refine bull trout passage during the time of spring Chinook salmon returns and the concurrent tribal fishery. The adaptive management strategy and its associated research and investigation shall lead to the development of a comprehensive bull trout passage plan for the Icicle Creek basin. The plan will take into account annual flow conditions, bull trout return rates and dates, production potential of the watershed, Chinook salmon return dates and rates, consideration of changing conditions of such elements as habitat quality and access, tribal fishery needs, and potential disease risks that may result at the hatchery from passing spring Chinook salmon above the facility. This plan shall be consistent with Service defined bull trout recovery goals as defined for this watershed and bull trout distinct population segment as well as other Service legal obligations for mitigation and tribal fishery needs. The strategy will be completed by March 9, 2007 with annual progress reports on its implementation made to Service managers and external co-managers. The plan will be modified as needed through 2011, or until this consultation is superseded.

T&C 17. Keep written records of all adjustments at dams 2 and 5. Include staff gage readings at dam 2 and include that information in the annual report to ES (see next section).

T&C 18. Keep the fish ladder open at LNFH as much as possible when pickets are installed at dam 5. Include this information in the annual report to ES.

T&C 19. When dam 5 does not have the racks installed, operate dam 2 so it is open as wide as possible, except when necessary to achieve the following: (1)

groundwater recharge for shallow wells; (2) flood control; (3) smolt emigration; (4) conditions that facilitate upstream passage during periods of low discharge (*e.g.*, open one gate instead of two); and (5) maintenance of desired spillway pool characteristics (attractor flow near the fish ladder), during broodstock collection.

T&C 20. Remove the remaining portion of the trash rack at dam 2 on the north side.

T&C 21. The annual default period for pickets to be installed at dam 5, and flow reduced at dam 2 (*i.e*,- fish passage will not be possible), shall be May 15 until July 7. The LNFH may adjust the default period based on input from the USFWS (ES, MCFRO, and LNFH), NOAA Fisheries, the Yakama Nation, and the Washington Department of Fish and Wildlife fishery co-managers, who will meet each year, as needed to review in-season information on spring Chinook run timing, environmental conditions, and other factors likely to affect spring Chinook and bull trout movements in the action area. Annual shifts in the default period shall be valid for that year only and are intended to maximize fishery benefits, address disease and water quality and quantity concerns, and provide safe, timely, and effective bull trout passage into the upper Icicle basin.

T&C 22. Install and operate the traps at dam 5 so that some passage might be possible during Chinook broodstock collection. Check traps a minimum of two times every day (once AM, once PM). Release bull trout consistent with T&C 7. Include this information in the annual report to ES.

T&C 23. When adjusting dam 2 use flow ramping rates of 1" per hour to minimize potential stranding of juvenile fish in the historic channel. Survey the historic channel area to confirm ramping rates work. If the surveys confirm absence of fish stranding within the historic channel then subsequent surveys would not be necessary. Survey the canal area if gate adjustments decrease water in the canal.

To implement RPM 5:

T&C 24. Release the equivalent of 50cfs from the Snow Lakes reservoir system between July 20^{th} and September 30^{th}.

T&C 25. If it appears that snowpack will be inadequate to provide 50 cfs from Snow Lakes reservoir, in the spring of that year, notify ES as soon as possible to report this information and possibly gain advice for further action.

T&C 26. Keep written records of water release from Snow Lakes. Include dates when changes were made, plus valve settings and/or Snow Creek staff gage information. Include this information in the annual report to ES (see next section).

T&C 27. Remove sediment from the fish return below the water intake, using hand tools as needed, so that surface flow persists all the way from the building to Icicle Creek.

T&C 28. During the low flow conditions (generally mid- to late July through late September) remove at least one flashboard from near the apex of the intake dam, or operate the old fish ladder in order to increase upstream and downstream fish passage opportunities.

VI. Reporting Requirements

In order to monitor the impacts of implementation of the reasonable and prudent measures, the LNFH shall prepare a report describing the progress of the proposed Project, including implementation of the associated terms and conditions, and impacts to the bull trout (50 CFR § 402.14(i)(3)). Annual reports described in the Terms and Conditions section above, shall be submitted by February 1 to the Central Washington Field Office (CWFO) at:

US Fish and Wildlife Service
Central Washington Field Office
215 Melody Lane, Suite 119
Wenatchee, WA 98801
509-665-3508 phone
509-665-3509 FAX

Regarding RPM 1, contact CWFO at 509-665-3508 (David Morgan, Judy DeLaVergne, or Karl Halupka in that order) before a bull trout is handled or moved in LNFH facilities. There may be circumstances when it is not possible to contact CWFO before it is necessary to move a bull trout, in which case contact should be made as soon as possible afterward.

Upon locating a dead, injured, or sick endangered or threatened species specimen, initial notification must be made to the nearest Service Law Enforcement Office (Bellingham, Washington; telephone 360-733-0963). Care should be taken in handling sick or injured specimens to ensure effective treatment and care, or in the case of handling dead specimens, to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured listed species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiating of consultation and review of the reasonable and prudent measures provided. The LNFH must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Furthermore the Service' conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends that the LNFH:

Data Needs

CR 1. Coordinate and cooperate with other agencies and entities to collect information on the abundance, genetics, life history, and temporal and spatial distribution of bull trout throughout the Icicle Creek watershed. The methods and techniques should be applicable to account for various life stages and distributions and could include radio telemetry, snorkeling, walking, angling, tagging, marking, and genetic analysis.

CR 2. Evaluate what flow conditions are needed for fish passage at structure 2 and the intake dam in their current form.

CR 3. Once in the next five years, after the pollution abatement pond is excavated, sample and monitor the sediment in the settling pond, above the hatchery intake, and below the hatchery outfall for PCB and pesticide contamination, using methods identified in FWS (2005). Future work would essentially duplicate the 2005 work, and would include a new search for potentially applicable contaminant benchmarks, criteria, or standards.

CR 4. Work together with the CWFO's bull trout recovery lead on FONS proposal(s). One specific goal should be to establish the genetic baselines in the area that are essential for a complete understanding of bull trout interactions and population dynamics.

Tribal Fisheries Effects

CR 5. Collaborate with the Yakama Nation to increase monitoring of the tribal fishery at LNFH and document incidental impacts to non-target species. Investigate opportunities to fund the tribe to do this work.

CR 6. In addition to maintaining the high-quality tribal fishery in the spillway pool, investigate opportunities to provide additional locations for a tribal fishery upstream of the spillway pool, so that the fishery does not rely on blocking all fish in the spillway pool. Possible additional locations for good fishing could include the pool below dam 2 or near the LNFH diversion dam.

Fish Passage

CR 7. For a long-term solution at dam 5, commission a team to investigate options for replacing dam 5 with a new design which minimizes habitat disturbance; consider an inflatable or hydraulic weir if needed to collect adult broodstock which would essentially disappear when not in use. This would improve not only passage opportunities but also habitat conditions in the area.

CR 8. For a long-term solution at dam 2, commission a team to investigate options for fish passage year-round; the design should be appropriate given site conditions where juvenile presence is well-known; the design should accommodate all swimming life stages of native species under a range of flow conditions.

CR 9. Improve upstream and downstream fish passage at the LNFH point of diversion. Some options to consider include relocating the water intake structure to a new location closer to LNFH, using more well water, combining the point of diversion with other entities, and withdrawing water using a pump system instead of a gravity diversion.

CR 10. Explore options to coordinate with BPA and YN to use the hatchery ladder and other facilities at LNFH for Coho broodstock collection so that it is not necessary for dam 5 to block Icicle Creek for as long each fall. For example, installation of the racks at dam 5 could be removed sooner under some scenarios. Annual circumstances (projected run size, flow conditions, disease concerns, etc.) should determine what is feasible, and in some years this may not be possible.

CR 11. Continue to provide BPA and YN an alternative (such as an unused pond at LNFH) so Coho smolt acclimation is not necessary in the side channel, which will eliminate the associated barrier and improve passage for wild fish.

CR 12. Explore opportunities to create windows of opportunity for natural passage (i.e.- not reliant on traps or ladders) for bull trout past LNFH dam 2 and dam 5 during the Chinook broodstock collection period.

Habitat Improvement

CR 13. Work with appropriate agencies and entities to develop a water management plan for LNFH which minimizes impacts to listed species and the environment. The plan should consider additional water releases from Snow/Nada Lakes, releasing progressively more water as the summer proceeds, flow in the historic channel and hatchery canal, and passage at structure 2 and the intake diversion (which are influenced by flow).

CR 14. Explore the potential of providing the irrigation districts with hatchery return water to meet irrigation needs, reduce nutrient loads, and improve in-stream flow in Icicle Creek.

CR 15. Provide for a more normative hydrograph in the historic channel to restore natural conditions and transport sediment when broodstock collection is not underway. Use spring runoff and high flow events in the fall to simulate natural events. If peak discharge through dam 2 is reduced overall for safety reasons or potential flooding concerns, verify that it is indeed necessary to restrict flow in order to avoid overbank flow downstream; develop a model and compare floodplain elevations if needed.

CR 16. If LWD is lodged on the upstream side of dam 2, place it downstream of dam 2 in the historic channel provided it is save for personnel to do so.

Contaminants

CR 17. After the pond is cleaned of its current material, ensure that in the future the pollution abatement pond is cleaned frequently enough that it adequately protects water quality, regardless of whether it is physically full or not. This effort should not contradict any instructions or requirements that may be included by EPA in the NDPES permit. Guidance how to calculate efficiency of a pollution abatement pond, when to clean it, and other considerations can be found at:

http://www.deq.state.id.us/water/prog_issues/waste_water/pollutant_trading/aquaculture_guidelines.pdf

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests written notification of the implementation of any conservation recommendations.

RE-INITIATION NOTICE

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR §402.16, reinitiating of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiating.

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Attachment A:
Projects subject to prior section 7 consultation that may have had effects on bull trout in the Icicle Creek watershed*.

Project Name	FWS Reference	Date
Leavenworth National Fish Hatchery Fuels Reduction project	1-9-2003-I-W0222	May 6, 2003
Eightmile Salvage	1-3-1995-I-824	
Icicle Campground Vegetation Management	1-3-1998-I-256/IC-257	
Mid-Columbia Coho Reintroduction	1-9-2001-F-E0231	
Icicle Creek Dredging	1-9-2001-F-E0456	
Icicle Creek Restoration	9-2002-F-E0081	
Eightmile and Mountaineer Bridge Replacements	1-9-2002-I-0852	
Minor activities covered under the forest-wide programmatic	1-3-1997-I-600	
Leavenworth National Fish Hatchery Interim Operations	05-0153	May 16, 2005
Fire Emergency Consultation for Fisheries		February 2, 2004

* This list does not include projects that were determined to have "no effect" on bull trout or their habitat or projects that were covered under programmatic consultations.