Volume II, Chapter 17
Little White Salmon Subbasin

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17.0 Little White Salmon Subbasin

17.1 Subbasin Description

17.1.1 Topography & Geology

The headwaters of the Little White Salmon River originate just east of the Cascade crest in south central Washington. The basin encompasses approximately 136 square miles and enters the Columbia River at Drano Lake at RM 162. Anadromous fish use is limited in this basin, with only about 500 meters of available habitat in the lower river.

Basin topography varies from gentle slopes formed by lava flows and volcanic cones to steep, rugged landforms (WDW 1990). The basin drains the Indian Heaven Wilderness and the Monte Cristo Range, which lie in the northwest and northeast portions of the basin, respectively. A major feature is the Big Lava Bed, comprising a large area in the western portion of the subbasin. The geology of this area, and the Indian Heaven Wilderness to the north, consists of relatively young quaternary basalt/andesite flows, of which the Big Lava Bed is a recent (8,000 years ago) example. The area in and around the Monte Cristo Range, on the other hand, is made up of older, tertiary deposits of volcanic tuff and pyroclastic flows. This area makes up much of the mainstem of the Little White Salmon and is susceptible to large, deep seated landslides due to decomposition of the older deposits into silts and clays (USFS 1995). Deep soils of glacial origin are present in alluvial deposits in valley bottoms. These soils also tend to be susceptible to deep-seated landslides. Elevation in the basin ranges from 5,300 feet to 50 feet at the mouth. The major tributaries to the Little White Salmon are Rock Creek, Lava Creek, Moss Creek, Wilson Creek, Cabbage Creek, Berry Creek, Homes Creek, Lusk Creek, and Beetle Creek.

17.1.2 Climate

Situated near the Cascade crest, the subbasin has characteristics of both continental and marine climates. Winters are wet and mild, while summers are warm and dry. Mean annual precipitation is 65 inches – 75% of which falls October through March. Most of the basin above 3,000 feet receives winter snowfall.

17.1.3 Land Use/Land Cover

Nearly the entire basin is forested, with timber harvest being the primary land use. The northern 3/4 of the basin is within the Gifford Pinchot National Forest (GPNF). The southern portion is privately owned, with scattered rural residential development and small-scale agriculture. The major population centers are Willard, Cook, and Mill A. The year 2000 population, estimated at 513 persons, is forecasted to increase to 753 by 2020 (Greenberg and Callahan 2002). The southeastern half of the subbasin is within the grand fir/Douglas fir ecological zone; the northwest portion is within the Pacific silver fir zone except for the Big Lava Bed, composed of scattered lodgepole pine, subalpine fir, western white pine, and Douglas fir. Approximately 20% of the basin is in early-seral vegetation.

A long history of fire suppression has resulted in no large (>100 acre) fires since the 1930s. Timber harvest has replaced fire as the dominant disturbance agent affecting basin hydrology (USFS 1995). A breakdown of land ownership and land cover in the Little White Salmon basin is presented in Figure 17-1 and Figure 17-2. Figure 17-3 displays the pattern of landownership for the basin. Figure 17-4 displays the pattern of land cover / land-use.

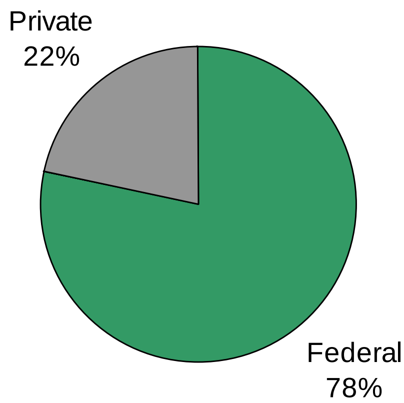


Figure 17-1. Little White Salmon River subbasin land ownership

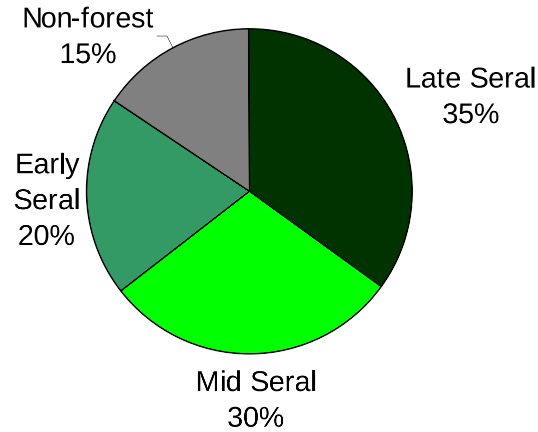


Figure 17-2. Little White Salmon River subbasin land cover

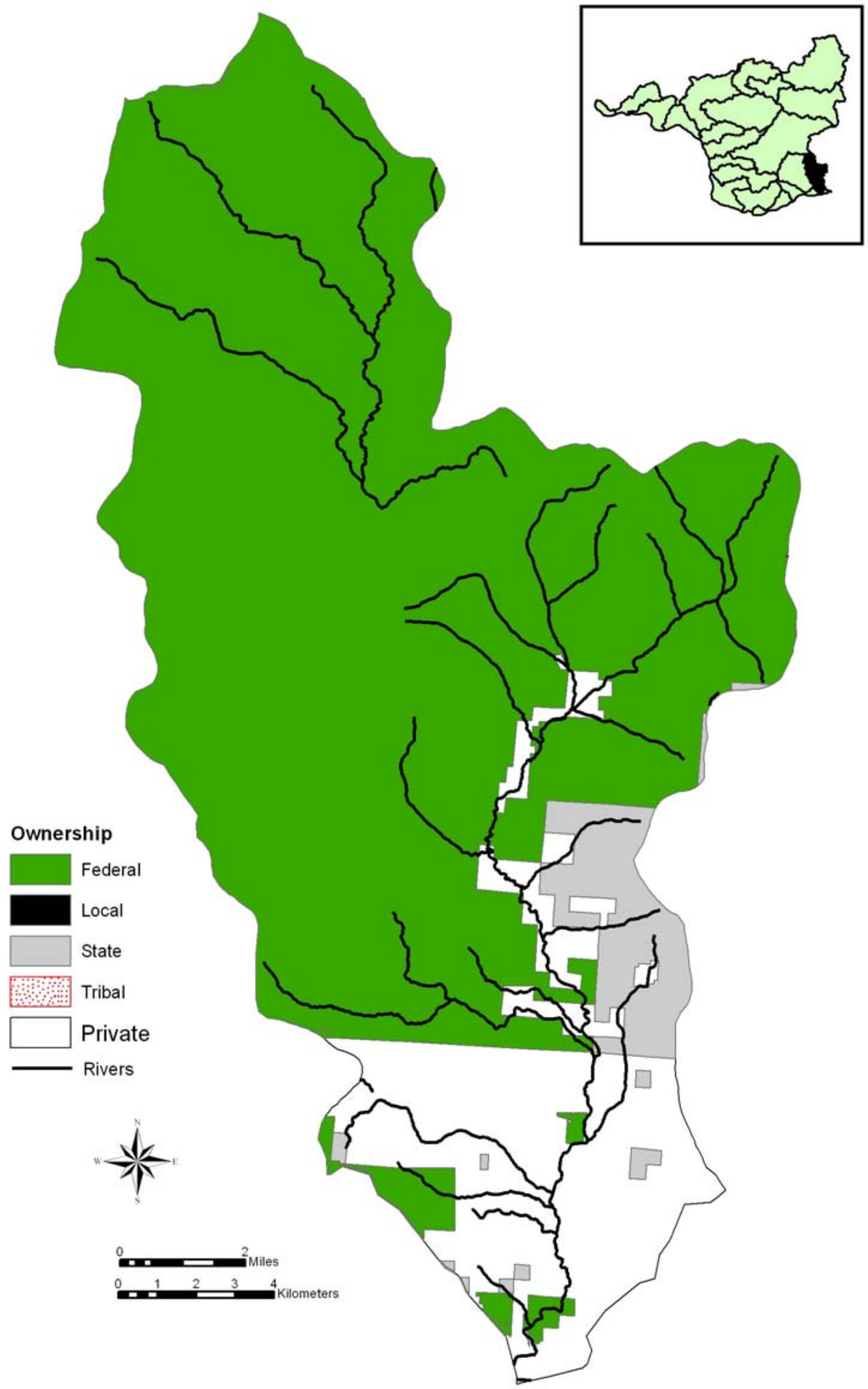


Figure 17-3. Landownership within the Little White Salmon basin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

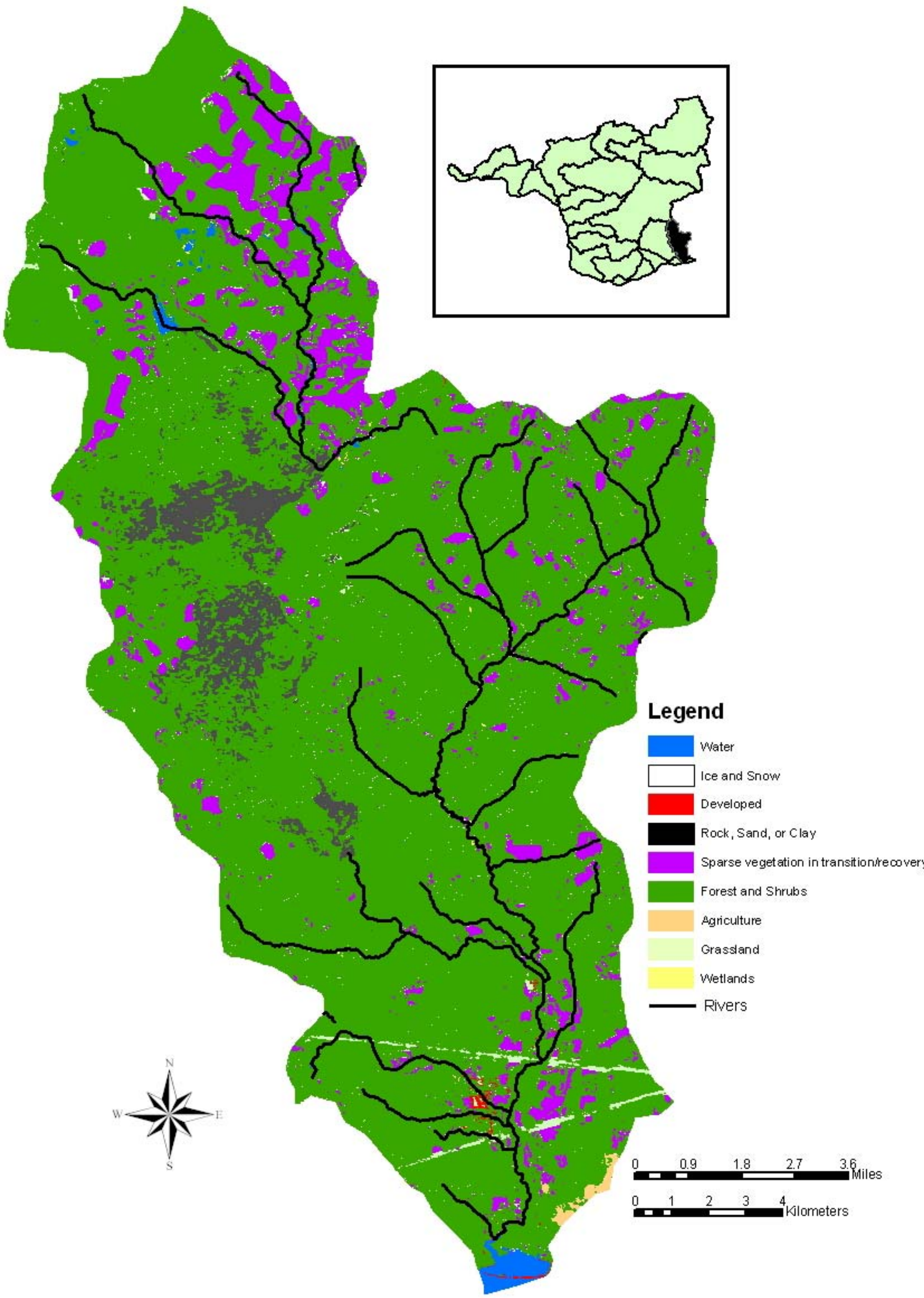
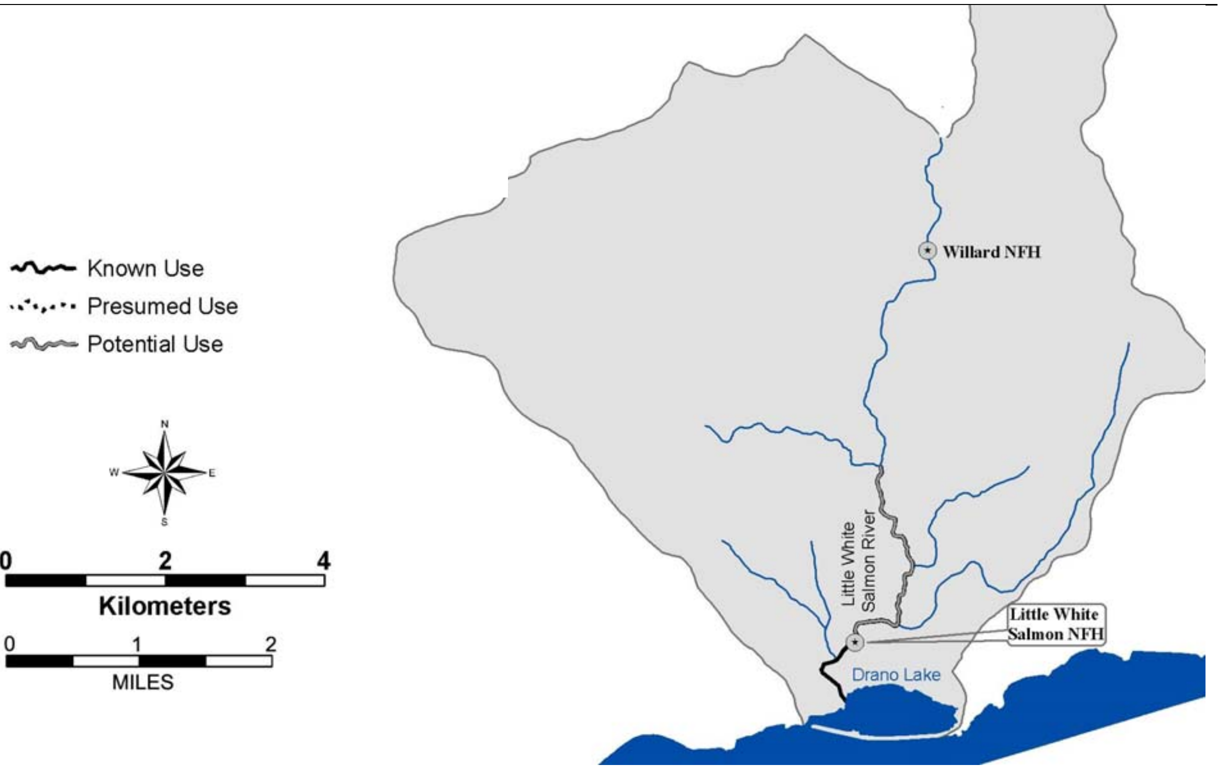


Figure 17-4. Land cover within the Little White Salmon basin. Data was obtained from the National Land Cover Dataset (NLCD).

17.2 Focal Fish Species

17.2.1 Spring Chinook—Little White Salmon Subbasin

ESA: Threatened 1999	SASSI: NA



Distribution

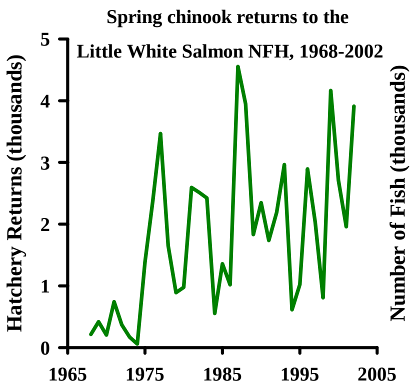
- Historically, few spring chinook were found in the Little White Salmon River basin; spring chinook were limited to the lower river below a barrier falls at about RM 2
- Completion of Bonneville Dam (1938) inundated the primary spring chinook spawning areas in the lower river

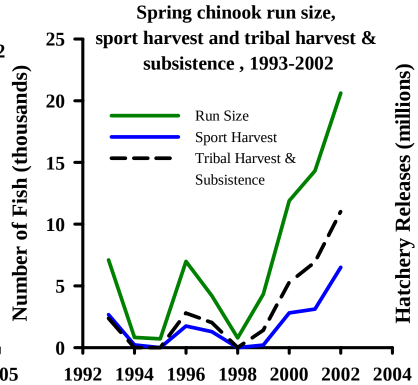
Life History

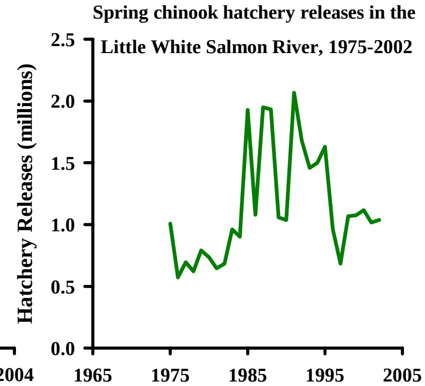
- Spring chinook return to the Little White Salmon River from April through July; spring chinook counts peak at Bonneville Dam in late April
- Natural spawning in the Little White Salmon River is Limited to a small area immediately below the salmon hatchery; spawning at the Little White Salmon Hatchery occurs in July and August
- Age ranges from 3 year old jacks to 6 year old adults, with 4 and 5 year olds usually the dominant age class (averages are 72.0% and 21.9%, respectively)
- No natural fry emergence data are available

Diversity

- One of four spring chinook populations in the Columbia River Evolutionarily Significant Unit (ESU)
- Spring chinook in the Little White Salmon River basin are hatchery fish of mixed origin







Abundance

- In 1936, chinook were reported in the Little White Salmon River during escapement surveys
- Hatchery production accounts for all spring chinook returning to the Little White Salmon River; from 1970-2002, spring chinook total returns ranged from 58 in 1974 to 20,601 in 2002

Productivity & Persistence

- Smolt density model predicted natural production potential for the Little White Salmon River was 32,350 smolts
- Juvenile production from natural spawning is presumed to be low; the run is not considered to be self-sustaining

Hatchery

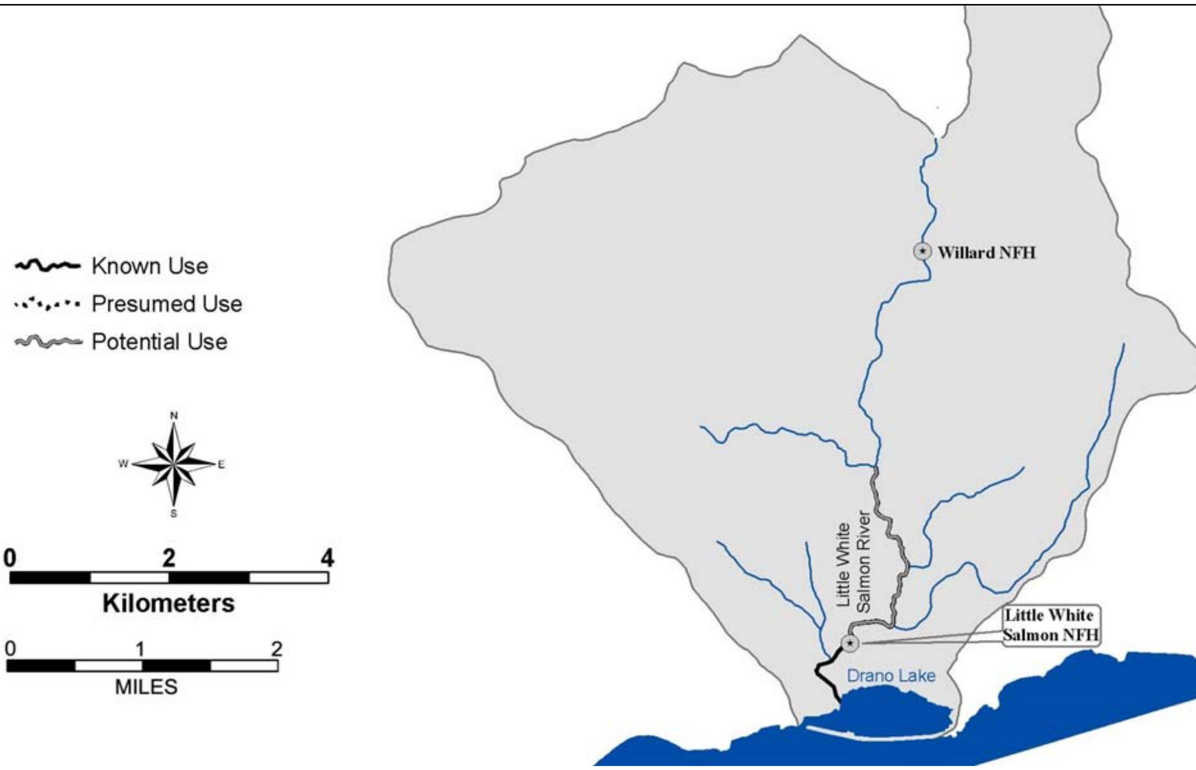
- The Little White Salmon (RM 1) and the Willard National Fish Hatcheries (RM 5) are located in the basin; spring chinook releases began in the 1960s
- Current spring chinook releases into the Little White Salmon River are just over 1 million smolts annually

Harvest

- Spring chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, in addition to Columbia River commercial and sport fisheries
- CWT analysis indicated that upriver spring chinook are impacted less by ocean fisheries than lower Columbia River chinook stocks
- From 1938-1973, about 55% of upriver spring chinook runs were harvested in directed Columbia River commercial and sport fisheries; from 1975-2000 (excluding 1977), no lower river fisheries have targeted upriver stocks and the combined Indian and non-Indian harvest rate was limited to 11% or less
- Beginning in 2001, selective fisheries and abundance based management agreement through *US v. Oregon*, has enabled an increase in Columbia harvest of hatchery spring chinook
- WDF and the Yakama Indian Nation negotiate an annual harvest plan for sharing the Little White Salmon Hatchery surplus between the sport fishery and tribal commercial and subsistence fisheries in Drano Lake
- Sport harvest in Drano Lake from 1993-2002 averaged 1,847, with a record 6,495 harvested in 2002
- Tribal harvest and hatchery subsistence distributions have averaged 3,175 during 1993-2002

17.2.2 Fall Chinook—Little White Salmon Subbasin

ESA: Threatened 1999 **SASSI: NA**



Distribution

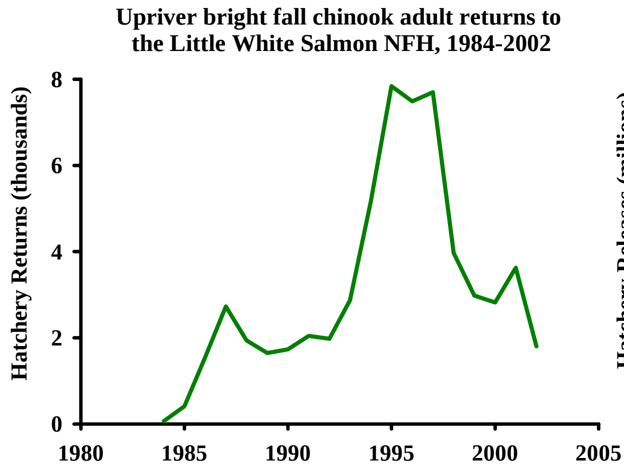
- Historically, fall chinook were limited to the lower river below a barrier falls at about RM 2; currently, very limited natural production occurs in this area
- Completion of Bonneville Dam (1938) inundated the primary fall chinook spawning areas in the lower river

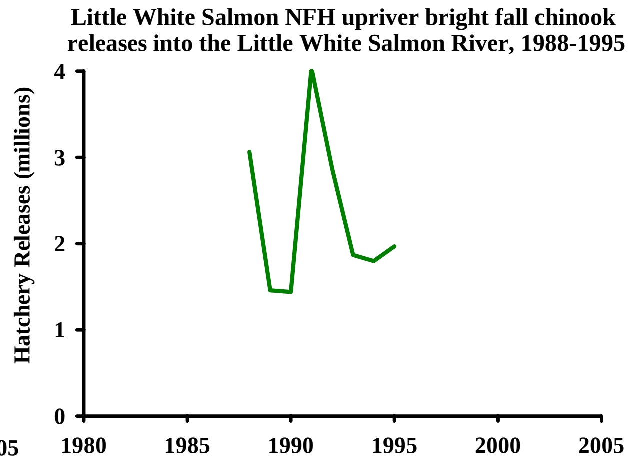
Life History

- Mid Columbia bright fall chinook upstream migration in the Columbia River occurs from August to October; peak counts at Bonneville Dam occur around September 4-9
- Spawning of bright fall chinook at the Little White Salmon National Fish Hatchery occurs in November; natural spawning timing in the Little White Salmon River occurs in late October and November
- Historically, the Little White Salmon fall chinook population was earlier spawning tule stock and was substantial, but the population has not persisted
- Age ranges from 2-year-old jacks to 5-year-old adults, with dominant adult ages of 3 and 4 (averages are 46.1% and 46.1%, respectively)
- Emergence and emigration timing of naturally produced fry is unknown; hatchery fry emerge in March; emigration timing is based on hatchery release timing

Diversity

- Considered an upriver bright stock in the lower Columbia River ESU
- Current bright fall chinook production is a result of hatchery strays





Abundance

- Fall chinook eggs taken from the Little White Salmon River between 1897 and 1920 (as high as 40 million) indicate a very large historical abundance of naturally produced early spawning tule fall chinook
- In the late 1930s, fall chinook were reported in the Little White Salmon River during escapement surveys
- Fall chinook returns to the Little White Salmon NFH ranged from 238-2,653 from 1979-83 (average 981)

Productivity & Persistence

- A smolt capacity model estimated that 73,652 fall chinook fingerlings could be produced in the Little White Salmon River basin
- The White Salmon River tule fall chinook stock is currently produced at Spring Creek NFH

Hatchery

- The Little White Salmon (RM 1) and the Willard National Fish Hatcheries (RM 5) are located in the basin; hatchery production began in 1896
- Annual hatchery egg take of fall chinook during 1897-1920 were typically 10-30 million and as high as 40 million
- Hatchery production shifted from tules to upriver bright (URB) late fall chinook as part of the John Day Dam mitigation and a *US v. Oregon* Agreement in 1988
- The current Little White Salmon Hatchery fall chinook program includes 5.4 million URB fall chinook, with 2.0 million released into the Little White Salmon River and the remainder transferred to Ringold Hatchery, Yakima River, and Priest Rapids Hatchery as part of John Day Dam mitigation

Harvest

- Fall chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, in addition to Columbia River commercial gill net and sport fisheries
- URB fall chinook migrate farther North in the ocean than lower Columbia chinook, with most ocean harvest occurring in Alaska and Canada
- URB fall chinook are also an important sport fish in the mainstem Columbia from the mouth upstream to the Hanford Reach, and an important commercial fish from August-early October

- Fall chinook originating upstream of Bonneville Dam are subject to Federal Court Agreements regarding Indian and non-Indian harvest sharing
- CWT data analysis of the 1989-1994 brood years suggests that the majority of the URB fall chinook harvest occurred in Alaska (24%), British Columbia (23%), and mainstem Columbia River (42%) fisheries
- Columbia River harvest of URB fall chinook is limited to 31.29% (23.04% Indian/ 8.25% non-Indian) based on by ESA limits for Snake River wild chinook
- Fall chinook that pass Bonneville Dam are also harvested in Treaty Indian commercial and subsistence fisheries in August and September
- Sport harvest in the Little White Salmon River averaged 45 fall chinook annually from 1985-1987

17.3 Potentially Manageable Impacts

In Volume I of this Technical Foundation, we evaluated factors currently limiting Washington lower Columbia River salmon and steelhead populations based on a simple index of potentially manageable impacts. The index incorporated human-caused increases in fish mortality, changes in habitat capacity, and other natural factors of interest (e.g. predation) that might be managed to affect salmon productivity and numbers. The index was intended to inventory key factors and place them in perspective relative to each other, thereby providing general guidance for technical and policy level recovery decisions. In popular parlance, the factors for salmon declines have come to be known as the 4-H's: hydropower, habitat, harvest, and hatcheries. The index of potentially manageable mortality factors has been presented here to prioritize impacts within each subbasin

- Loss of tributary habitat quantity and quality is an important relative impact on all species, while estuary habitat impacts appear to be of lesser importance.
- The impact of hydrosystem access and passage is one of the more important factors for chum and fall chinook. Hydrosystem effects on chum are substantial enough to minimize the relative importance of all other potentially manageable impact factors.
- Harvest has relatively high impacts on fall chinook, while harvest impacts to steelhead and coho salmon are moderate. The relative impact of harvest on chum is minor.
- Hatchery impacts are relatively moderate for coho salmon and summer steelhead. Hatchery impacts on chum salmon, fall chinook, and winter steelhead are low.
- Impacts of predation are moderate for winter steelhead, summer steelhead, and coho salmon, but are low for fall chinook and chum.

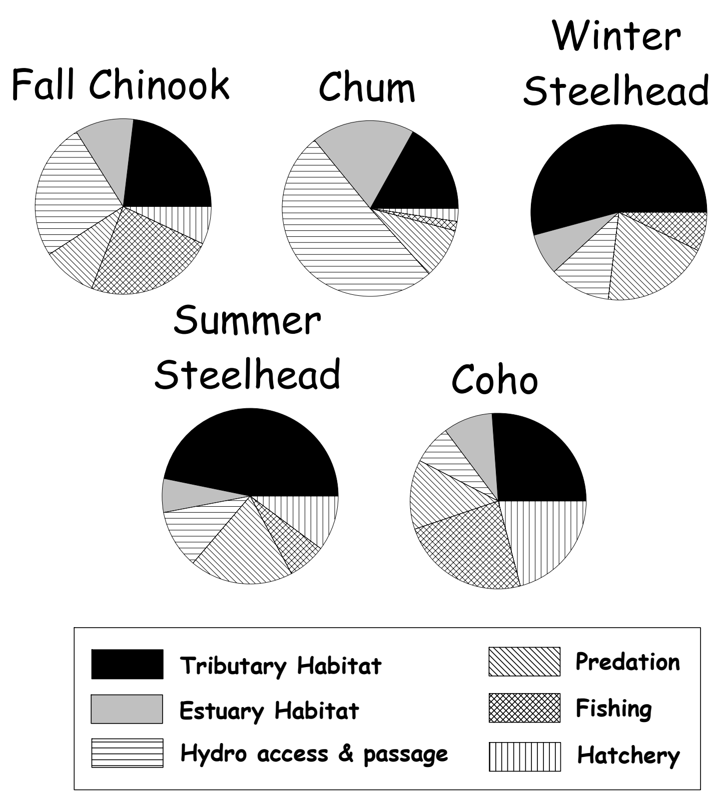


Figure 17-5. Relative index of potentially manageable mortality factors for each species in the Upper Gorge subbasin.

17.4 Hatchery Programs

The Little White Salmon River basin has two hatcheries: the Little White Salmon NFH, constructed in the late 1800s, is located above RM 1 and the Willard NFH, constructed in 1952, is located above RM 5. The two hatcheries coordinate efforts and are referred to as the Little White Salmon River Hatchery Complex. The hatchery complex produces upriver bright fall chinook, spring chinook, and coho salmon; annual production goals are 2 million fingerling fall chinook, 1 million yearling spring chinook smolts, and 1 million yearling coho smolts for release in the Little White Salmon River (Figure 17-6). The hatchery also rears 350,000 spring chinook for release into the Umatilla River and 1.0 million coho for release into the Yakima River (500,000) and the Wenatchee River (500,000) as part of tribal restoration programs.

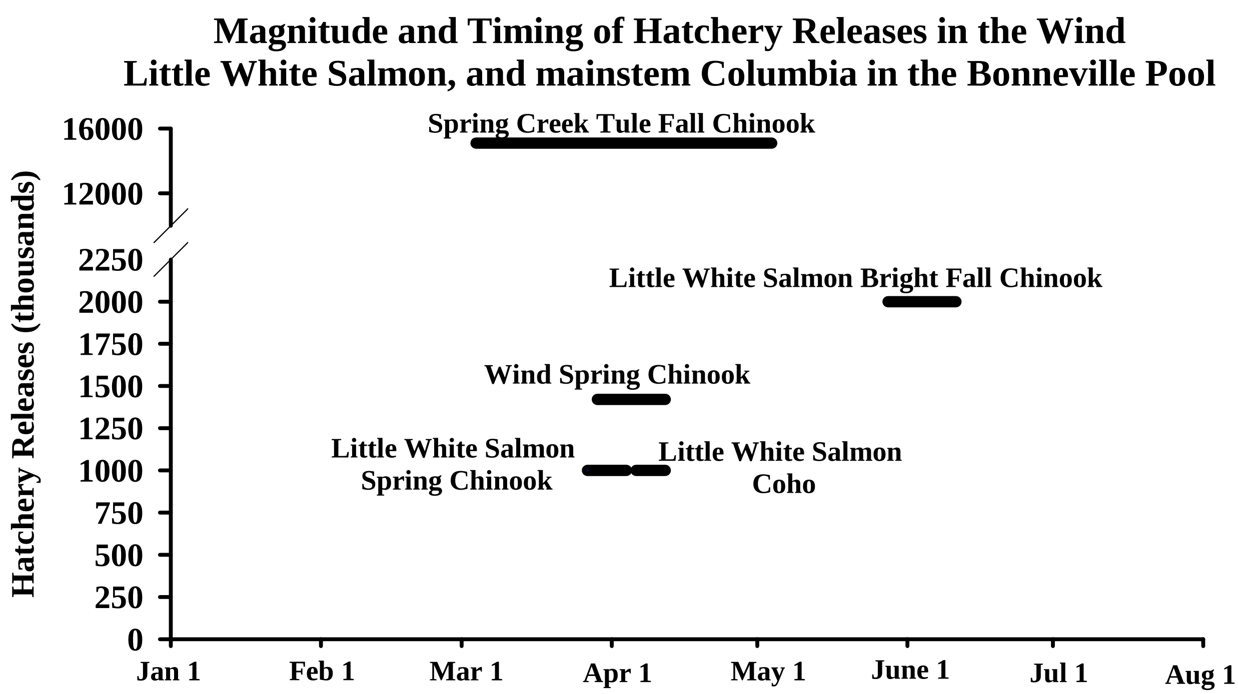


Figure 17-6. Magnitude and timing of hatchery releases in the Wind and Little White Salmon rivers and mainstem Columbia by species, based on 2003 brood production goals.

Fall chinook releases in the basin began in the late 1890s; the program historically produced tule fall chinook, with egg takes as high as 40 million. The fall chinook program shifted to upriver bright fall chinook production in 1988 as part of the John Day Dam mitigation program and the *US v. Oregon Columbia River Fish Management Plan*. The spring chinook hatchery program in the Little White Salmon River basin began in 1967. The coho hatchery program in the Little White Salmon River began in 1919 with unsuccessful attempts to rear late-run coho. During the 1930s–1950s, coho rearing efforts focused on early-run coho, which finally established a consistent run by the mid-1960s.

Genetics—The upriver bright fall chinook broodstock originated from Bonneville Hatchery stocks. Current broodstock is from fall chinook adults returning to the hatchery complex. In years when hatchery returns do not satisfy hatchery complex production goals, stocks are transferred from other hatcheries producing upriver bright fall chinook. The only recent egg transfers to the hatchery complex occurred in 1998 with 2,054,000 from the Bonneville Hatchery, 200,000 from the Umatilla Hatchery in Oregon, 1,213,000 from the Klickitat Hatchery, 600,000 from the Priest Rapids Hatchery, and 13,168 from the Lyons Ferry Hatchery in Washington.

Spawning of spring chinook occurred at the hatchery complex in 1967 when fish of unknown origin returned to the Little White Salmon River. These fish could have been strays or from previous attempts to rear fish in the basin. Multiple out-of-basin spring chinook stocks have been released in the Little White Salmon River, including Willamette stock (Eagle Creek NFH), South Santiam Hatchery stock, Klickitat River stock, Ringold Springs stock, Carson NFH stock, McKenzie River stock, and Salmon River stock. The Little White Salmon spring chinook stock is considered a derivative of the Carson stock. Current broodstock comes from adults returning to the hatchery complex, except for 1995 when part of the brood included adult fish trapped on the Big White Salmon River (Carson stock progeny).

Initial attempts to rear early run coho in the Little White Salmon River basin included stocks from the Quinault, Quilcene, Dungeness, and Toutle rivers. The stock that eventually was successfully developed was derived from Toutle River coho. Adults collected at the hatchery complex are the current source of broodstock, although transfers occur in years of hatchery production shortfalls. In the last 5 years, early-run coho stock transfers from the following facilities have occurred based only on availability: Lower Kalama Hatchery and Speelyai Hatchery in Washington and Cascade Hatchery, Bonneville Hatchery, and Eagle Creek NFH in Oregon.

Interactions—An impassable falls lies just upstream of the Little White Salmon NFH. Historically, anadromous salmonids spawned and reared in habitat from the falls to the mouth of the river, but this habitat was inundated by Bonneville Pool. There is very little, if any, spawning or rearing habitat available to anadromous salmonids below the hatchery barrier and any production in the basin is expected to be from the hatchery programs. The magnitude of hatchery releases in the basin is similar among the three hatchery programs. Based on these conditions, ecological interactions between wild and hatchery fish are expected to be similar for fall chinook, spring chinook, and coho salmon in the Little White Salmon River and are discussed collectively.

Natural spawning has not been observed recently in the Little White Salmon River, except for some minor fall chinook spawning activity (Figure 17-7). Because very little suitable spawning habitat exists, natural production is minimal if it is successful at all. The fall chinook natural spawners are hatchery strays from the Little White Salmon NFH. Hatchery fish returning to the Little White Salmon River volitionally enter the fish collection facility, so substantial numbers of hatchery fish could remain in the river below the barrier dam. However, because no wild fish are thought to be present, interaction between wild and hatchery adults is not a concern. Hatchery fish surplus to broodstock needs are not returned to the river above the falls to promote natural production.

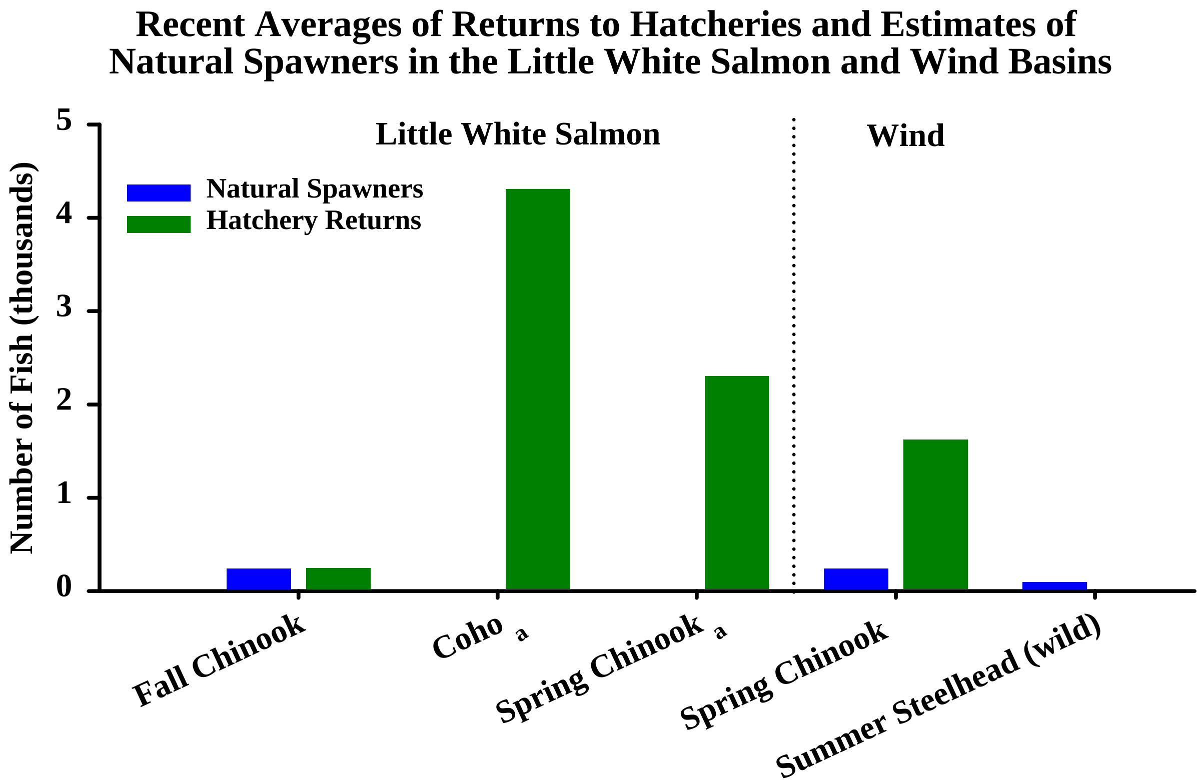


Figure 17-7. Recent year average hatchery returns and estimates of natural spawning escapement in the Wind and Little White Salmon River basins by species.

Juvenile hatchery fish in the Little White Salmon River are released as smolts and are assumed to migrate through the system quickly. Competition impacts are assumed to be greatest in the spawning and nursery areas at the point of release, but because there is no documented natural production in the Little White Salmon River, no anticipated competition or predation by hatchery smolts on wild juvenile salmonids within the basin is expected.

The potential for genetic introgression from straying adults is a possible interaction issue unique to upriver bright fall chinook hatchery fish from the Little White Salmon River. Upriver bright fall chinook from the hatchery complex are colonizing the nearby Wind and Big White Salmon rivers. However, the potential for genetic introgression with existing tule fall chinook populations in the Wind and Big White Salmon rivers is reduced by the separation in the spawn timing of the two stocks. The tule populations in the Wind and Big White Salmon rivers spawn in mid-September to early October and upriver brights spawn in late October through November. Also, the tule populations on the Wind and Big White Salmon Rivers have been heavily influenced by hatchery strays, likely from the Spring Creek NFH. The naturally spawning tule fall chinook are considered part of the listed LCR chinook salmon ESU, whereas the upriver bright fall chinook are not. There is a concern that upriver bright fall chinook can impact tule fall chinook by spawning on top of tule fall chinook redds.

Water Quality/Disease—The Little White Salmon River NFH has a total water right of 33,868 gpm from the Little White Salmon River, a small well, and springs. Eggs are incubated at this facility until the eye-up stage, then transferred to the Willard NFH; water use during production ranges from 11,221 to 28,232 gpm; most comes from the Little White Salmon River.

A water re-use system built at the facility in 1967 was used to supplement water supplies during low water years but has not been used in recent years because of concerns with disease transmission.

The Willard NFH utilizes water from three sources; water rights include 22,440 gpm from the Little White Salmon River and 500 and 1,000 gpm from two separate water wells. Incubation and early rearing are done primarily with well water while river water is used for outside rearing. Both hatcheries monitor facility effluent, which remains in compliance with the complex's NPDES permit.

The Lower Columbia River FHC provides fish health care for the Little White Salmon River hatchery complex under guidance of the Fish and Wildlife Service Manual, the Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries, and the Co-Managers Salmonid Disease Control Policy. A pathologist from the FHC examines fish at various times throughout the hatchery operation. Adult certification examinations are performed at spawning; adult fish tissues are collected to ascertain viral, bacterial, and parasite infections and to provide a brood health profile for the progeny. During holding for broodstock collection, spring chinook are injected with 10 mg/kg erythromycin to prevent mortality by BKD; formalin treatments at 167 ppm for 1 hour, 3-5 times per week are used to control fungus and external parasites during the holding period. To prevent the growth of fungus during incubation at the Little White Salmon River NFH, eggs of all species are treated with 1,667 ppm formalin for 15 minutes, 3-5 times per week. At the Willard NFH, egg trays are opened regularly and dead eggs are removed; formalin is not administered. A ponding examination for viral infections is performed on newly hatched fish when approximately 50% of the fish are beyond the yolk-sac stage and begin feeding. Randomly-chosen rearing fish are examined monthly to determine general health. These exams generally include a necropsy with detailed external and internal exams and tests for bacterial and viral infections. Diagnostic exams are performed on rearing fish as needed, depending on unusual fish behavior or higher than normal mortality. Spring chinook are given prophylactic medicated feedings once in July at a rate of 100 mg erythromycin/kg fish/day for 21 days; this treatment appears to control outbreaks of BKD later in the rearing cycle. Pre-release examinations are performed before fish are released or transferred from the hatchery; these exams focus on testing for listed pathogens.

Disease outbreaks in Willard NFH coho salmon have included BKD, BCWD, and sunburn (steatites). BKD and BCWD have successfully been treated with antibiotics or changes in fish culture practices and have not resulted in significant losses, except for one instance. In 1993, Speelyai coho from the North Toutle Hatchery were transferred to the Willard NFH because of low adult returns. These fish developed epizootic levels of BKD, with monthly mortalities up to 3.4%. The disease could not be controlled by reducing densities and this lot of fish was destroyed—rather than released—to prevent possible transmission of the disease.

Mixed Harvest—At the Little White Salmon River hatchery complex, the upriver bright fall chinook program provides fish production for harvest opportunity to mitigate for federal hydroelectric construction and other development in the Columbia River basin. The upriver bright fall chinook program contributes to fisheries along the West coast of the US and Canada. Upriver bright fall chinook migrate further north than other Columbia River chinook stocks and are more prevalent in Alaska and Canada fisheries; they are also very important to Columbia River commercial, sport, and tribal fisheries. CWT recoveries of Little White Salmon NFH upriver bright fall chinook since the 1980 brood indicate that approximately 42% are accounted for in escapement, 21% are harvested in Columbia River commercial gill-net fisheries (treaty

Indian and non-Indian), 17% are harvested in Alaska commercial fisheries, and 13% are harvested in British Columbia commercial fisheries; the remaining percentage of tag recoveries are distributed among numerous sport and commercial fisheries from Alaska to California. Hatchery and wild fall chinook harvest rates remain similar but are constrained by ESA harvest limitations.

The main purpose of the spring chinook program at the complex is to provide fish production for harvest opportunity to mitigate for federal hydroelectric construction and other development in the Columbia River basin. The spring chinook program contributes to commercial and recreational fisheries from Oregon to Alaska; however, Carson stock spring chinook are impacted less by ocean fisheries than are other lower Columbia River chinook stocks. CWT recoveries of Little White Salmon NFH spring chinook since the 1980 brood indicate that approximately 78% are accounted for in escapement, 16% are harvested in Columbia River sport fisheries, and 5% are harvested in Columbia River treaty Indian fisheries. The majority of harvest occurs in sport and tribal fisheries occurring in Drano Lake, the inundated lower end of the Little White Salmon River

The coho salmon program at the complex provides fish production for harvest opportunity to mitigate for fish losses resulting from federal hydroelectric construction and other development in the Columbia River basin. The coho salmon program contributes to fisheries along the West Coast of the US and Canada, including Columbia River commercial, recreational, and tribal fisheries. CWT recoveries of Willard NFH coho salmon since the 1980 brood indicate that approximately 59% are accounted for in escapement, 13% are harvested in Washington sport fisheries, 10% are harvested in Oregon sport fisheries, and 7% are harvested in Columbia River commercial gill-net fisheries; the remaining percentage of tag recoveries is distributed among numerous sport and commercial fisheries from British Columbia to California. Until recently, the harvest of wild and hatchery coho salmon likely was similar among the various fisheries. Currently all coho releases at the hatchery are externally marked with an adipose fin-clip to allow for selective fisheries on hatchery fish while minimizing wild fish harvest. Many ocean fisheries use selective fishery regulations. Hatchery-selective fishery regulations have been in effect for Columbia River and tributary sport and commercial fisheries since 1998.

Passage—The adult collection facility at the Little White Salmon NFH consists of a barrier dam across the Little White Salmon River that leads fish toward a fish ladder and trap. Fish enter the fish ladder volitionally and are kept in holding ponds; they are moved from pond to pond and into an anesthetic tank using hydraulically operated mechanical crowders. If fish are able to escape the barrier dam, they encounter a barrier falls shortly upstream of the hatchery facility, so there is no fish access to the watershed above about RM 2.

Supplementation—Supplementation is not the goal of the upriver bright fall chinook, spring chinook, or coho salmon hatchery programs on the Little White Salmon River.

17.5 Fish Habitat Conditions

17.5.1 Passage Obstructions

Anadromous fish passage is naturally blocked on the mainstem by a falls at river mile (RM) 1.5; however, a few fish are believed to ascend to a larger falls at RM 2.5. Most natural anadromous spawning occurs in only approximately 400-500 meters of river habitat that is available downstream of the falls and above Drano Lake. High temperatures and other conditions in Drano Lake might affect passage. Two dams restrict passage in the basin. One is located near the mouth of the Little White Salmon, at the Little White Salmon Fish Hatchery, and the other is located on Lost Creek (north) adjacent to a diversion intake. A culvert survey in 1995 revealed that 15 of 26 culverts presented barriers to resident fish, though more information is needed (USFS 1995).

17.5.2 Stream Flow

Peak flows in the subbasin are typically related to winter rain and rain-on-snow events. The USGS has periodically monitored streamflows in the basin. The stream gage near Cook, Washington has the longest period of record (1957-1977). High flows in 1972 (9,250 cubic feet per second [cfs]), 1974 (8,120 cfs), and 1978 resulted in some large changes to stream channels in the basin (USFS 1995). The hydrology of the northwest portion of the subbasin is not well understood, including the Big Lava Bed. Small streams in this area disappear into the quaternary basalts and subsurface water routing has not been quantified (Welch et al. 2002). Despite the lack of information, it is assumed that the Big Lava Bed provides some level of buffering of stormflows (USFS 1995). Another unique hydrologic feature is the loss of subsurface water to the White Salmon basin due to seepage through eastward dipping geological features (USFS 1995).

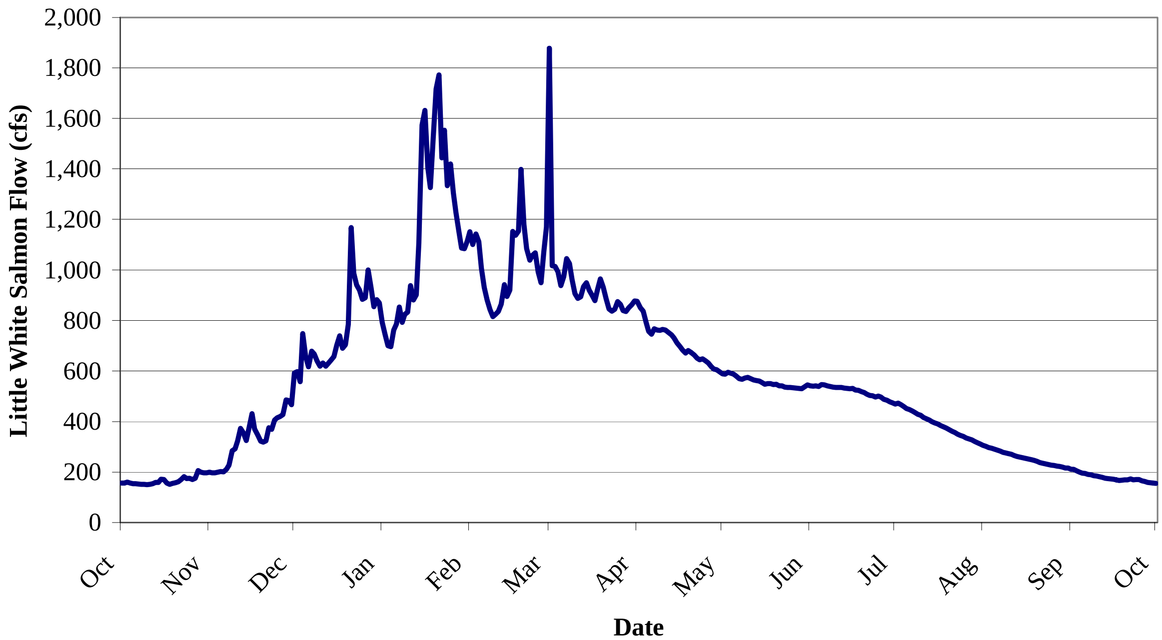


Figure 17-8. Little White Salmon River hydrograph (1968-1977). Peak flows are primarily related to winter rain-on-snow events, with a slight rise in flows due to snowmelt in late May and June. USGS Gage #14125500. Little White Salmon River near Cook, Wash.

Investigations conducted as part of the 1995 watershed analysis (USFS 1995) determined that approximately 19% of the subbasin was hydrologically immature, meaning that these areas had the potential to increase peak streamflows. Using Washington's hydrologic change module, which estimates peak flow changes from changes to vegetation cover, over a 10% increase in the 2-year peak flow was estimated for 11 of the 24 USFS subwatersheds (USFS 1995). The extensive road network may also serve to alter the timing and magnitude of peak flows. The overall road density is approximately 3 mi/mi^2, considered moderately high by most standards. Five of the 24 subwatersheds have road densities greater than 4 mi/mi^2 (USFS 1995).

Hydrologic (runoff) impairment was evaluated as part of IWA watershed process modeling, which is presented in greater detail later in this chapter. The Little White Salmon subbasin did not have the same extent and format of data available to run the hydrology assessment as was done for other portions of the lower Columbia region. Due to the absence of data, hydrology impairment was estimated using USFS data (USFS 1995). Based on vegetation conditions and road densities, the following IWA subwatersheds were estimated as "moderately impaired" with respect to conditions that influence sediment supply: Little White Salmon Headwaters, middle Little White Salmon/Cabbage Creek, middle Little White Salmon/Berry Creek, and the 2 lowermost mainstem subwatersheds. All remaining subwatersheds were estimated as "functional".

Low flows may also be of concern in the basin, with annual minimums of less than 25 cfs recorded at the Little White Salmon near Willard gage in the 1940s. The mean monthly flow for October over the period of record at the Cook gage is 160 cfs (Welch et al. 2002). A total of approximately 152 cfs is allocated for water rights in the basin; however, the estimated reduction of the minimum summer low flow due to these rights was less than 1% (Greenberg and Callahan 2002). A flow diversion on Lost Creek (north) directs flow into the Coyote Ditch, which transports as much as 5 cfs over to the Trout Lake Creek basin (White Salmon watershed) for livestock watering. This diversion can reduce the flow in lower Lost Creek by one-third during low flow periods (USFS 1995).

17.5.3 Water Quality

Water temperature monitoring from the 1970s into the 1990s on the mainstem near Willard (USFS), and at the Little White Salmon National Fish Hatchery at the mouth (USFWS), indicated no exceedances of the state water temperature standards of 61°F (16°C) for Class AA streams or 64°F (18°C) for Class A streams. However, monitoring in the upper basin in 1994 recorded a temperature of 64°F (18°C) in the mainstem (USFS 1995). More recent water temperature monitoring using continuously recording thermographs has provided greater information on water temperature conditions.

Since 1995, thermographs have been placed in Berry Creek, Cabbage Creek, Dry Creek, East Fork and West Fork Goose Lake Creek, Lost Creek, Lusk Creek, and at several locations on the mainstem. Exceedances of the 61°F (16°C) standard on these streams have occurred on Dry Creek, the mainstem above 201 Road, the mainstem above Lusk Creek, the mainstem at Berry Creek, and the mainstem above Moss Creek. The highest temperatures were measured at the mainstem above Moss Creek site, where 74 days exceeded 61°F (16°C) in 1998 and the maximum recorded temperature was 68°F (20°C) (USFS unpublished data).

USFS monitoring recorded some high lake water temperatures in the 1990s. The highest was 24°C (76°F) (in Forlorn Lake #4), though temperatures are expected to naturally be high due to shallow morphology.

Turbidity monitoring was conducted at 11 locations by the USFS from 1974 to 1975 in response to sediment accumulations at the fish hatcheries during a 1968 flood event. In general, turbidity levels were found to be high throughout the mainstem and in Lusk Creek, and were attributed primarily to bank cutting on the mainstem. Other turbidity monitoring by the USFS is spotty and not very useful for analysis. The USFWS, however, has collected total suspended solid (TSS) data every two weeks since 1975. A general downward trend in TSS is evident over the sampling period. Comparison of this data to estimated streamflow data suggests that the downward trend is attributable more to decreased flow magnitudes than to a true decrease in basin sediment supply (USFS 1995). The 1999 Limiting Factors Analysis identified turbidity problems in the upper basin related to timber harvests (see WCC 1999).

USFS pH monitoring between 1974 and 1987 on the mainstem revealed levels lower than the state standard and the stream was listed on Washington's 303(d) list. However, data collection methods are believed to be suspect (USFS 1995).

17.5.4 Key Habitat

Stream habitat surveys have only been conducted on the Little White Salmon (mainstem), Lost Creek (north), and Goose Lake Creek. Pools per mile were greatest in the mainstem (44.2) and lowest in Goose Lake Creek (10.1). The Range of Natural Conditions (RNC) for this area is 40-60 pools per mile. Width-to-depth ratios in the mainstem were very high (23:1), though conditions were rated good for Goose Lake Creek (5:1) (USFS 1995).

17.5.5 Substrate & Sediment

Information is lacking on substrate conditions in the subbasin. USFS stream surveys revealed that 8.3 of 12.6 surveyed miles of the mainstem (66%) were affected by scour and deposition. In Lost Creek and Goose Lake Creek the rates were 39% and 14%, respectively. Flood related sediment production in the 1970s in Lusk Creek, which followed riparian harvests, increased sediment loading in the mainstem Little White Salmon (USFS 1995).

The same conditions that can alter runoff conditions (i.e. immature vegetation, high road densities) can also alter basin sediment dynamics. The percentage of early-seral vegetation (20%), moderately high road densities (3 mi/mi^2), and the natural instability of the eastern portion of the basin may result in elevated rates of sediment production and delivery to stream channels. Poor road construction has caused numerous shallow landslides and debris flows, especially in steep regions with poor soil conditions. Blocked culverts have also created road erosion, with large volumes of sediment delivered to stream channels in some cases. During a rain-on-snow event in 1968, large volumes of sediment (300 cubic yards) were deposited in the settling basin at the Willard Hatchery. Sediment accumulations created problems in the raceways and similar problems were experienced at the Little White Salmon Hatchery at the mouth. The USFWS suggested that the problems were related to roads, undersized culverts, clear-cut harvesting along streams, and logging debris in stream channels. The USFS subsequently began a turbidity monitoring program to pinpoint the source of sediment. The mainstem Little White and Lusk Creek stood out as the main sources. Despite these concerns, the Little White Salmon basin is considered one of the most stable in the GPNF (USFS 1995).

Sediment supply conditions were evaluated as part of IWA watershed process modeling, which is presented later in this chapter. In summary, the IWA rated 5 of the 13 IWA subwatersheds as "moderately impaired" with respect to landscape conditions that influence sediment supply. The remaining 8 subwatersheds were rated as "functional". The greatest impairments are located in the lower 2 subwatersheds and in the upper western portion of the subbasin (Lava Creek drainage).

Sediment production from private forest roads is expected to decline over the next 15 years as roads are updated to meet the new forest practices standards, which include ditchline disconnect from streams and culvert upgrades. The frequency of mass wasting events should also decline due to the new regulations, which require geotechnical review and mitigation measures to minimize the impact of forest practices activities on unstable slopes.

17.5.6 Woody Debris

Recruitment potential of large wood debris (LWD) has been reduced by past forest practices that allowed harvest up to stream channels. Once thought to be an impediment to fish passage, instream LWD was removed from channels during timber harvest operations (USFS 1995). Current LWD levels are low throughout the basin.

Stream surveys in the mainstem, Lost Creek (north), and Goose Lake Creek indicated very poor instream LWD levels. The lowest level was in Goose Lake Creek (6.1 pieces per mile) and the greatest was in Lost Creek (14.5 pieces per mile). Less than 40 pieces per mile is considered poor according to the Columbia River Anadromous Fish Policy Implementation Guide (USFS 1995).

17.5.7 Channel Stability

As part of the 1995 Watershed Analysis (USFS 1995), an air photo investigation was used to assess changes to stream channel conditions since the 1960s. Only a limited number of stream reaches were evaluated due to availability of time and air photos. Large changes including bar development and channel widening were observed in the late 1960s and late 1970s, with conditions recovering in the 1980s. Reaches with the largest changes also tended to have the greatest riparian timber harvest impacts.

Lusk Creek experienced dramatic widening and channel straightening during 1970s peak flow events that followed 1960s clear-cutting of riparian areas. By 1989, vegetation and shade conditions had improved, though channel recovery may take considerably longer. Other streams that experienced bar development and channel widening are Berry Creek, Lost Creek (north), and several reaches of the mainstem, particularly below the southernmost Forest Road 18 crossing.

17.5.8 Riparian Function

Riparian areas have been impacted by past forest practices that allowed harvest of trees up to stream channels. Road building and livestock grazing have also impacted riparian forests. Currently, 21% of the riparian areas are in early-seral vegetation, with nine of the 23 subwatersheds falling outside the “range of natural conditions” (USFS 1995).

Air photo and field review of the upper mainstem has revealed that much of the stream channel is exposed to direct solar radiation during the summer, likely impacting stream temperatures. This is attributed to lack of adequate riparian forests, the presence of unvegetated gravel bars, and high width-to-depth ratios (USFS 1995).

Riparian function is expected to improve over time on private forestlands. This is due to the requirements under the Washington State Forest Practices Rules (Washington Administrative Code Chapter 222). Riparian protection has increased dramatically today compared to past regulations and practices.

17.5.9 Floodplain Function

There are very few natural floodplain areas in the subbasin and the bulk of historical floodplain habitats for anadromous species would have been limited to the lower reaches of the mainstem, which are now inundated by the Bonneville Pool (Drano Lake).

17.6 Fish/Habitat Assessments

No Fish/Habitat Assessments have been completed for the Little White Salmon River subbasin.

17.7 Integrated Watershed Assessment (IWA)

Collectively, the Little White Salmon watershed covers approximately 95,700 acres (79 mi/sq mi). The watershed also includes two smaller drainages, Dog Creek to the west and an unnamed tributary to the east. The majority of this watershed (79%) is in public ownership, with approximately 75% in USFS lands and 4% in state forest lands managed by the WDNR. Private forest, rangelands, agriculture, and residential lands cover the rest of the drainage. The watershed comprises fifteen subwatersheds ranging from 4,200 to 9,300 acres. Major tributaries to the Little White Salmon River include Rock Creek, Lava Creek, Lusk Creek, and Cabbage Creek. A prominent feature of the watershed is the Big Lava Bed, a large, relatively recent (8,000 years old) basaltic lava flow, covering and area of approximately 12,000 acres.

The Little White Salmon River watershed is in a transitional zone between marine and continental climate lying along the Cascade Crest, and comprised primarily of mountainous and high meadow terrain. The majority of the watershed is in the snow dominated or rain-on-snow-zone, with rain-dominated areas limited to the river bottoms and low-lying areas near the mouth. Natural erodability rates in the watershed are low to moderately low, ranging from 2-30 on a scale of 0-126.

17.7.1 Results and Discussion

IWA results were calculated only for sediment conditions for subwatersheds in the Little White Salmon River watershed. Geospatial data was unavailable for assessing hydrologic and riparian conditions, however, hydrologic ratings have been inferred from the 1995 USFS watershed analysis. IWA results are calculated at the local level (i.e., within subwatershed, not considering upstream effects) and the watershed level (i.e., integrating the effects of the entire upstream drainage area as well as local effects). A summary of the results is shown in Table 16-1. The local and watershed level results are also shown in Figure 17-9 and Figure 17-10, respectively.

Table 16-1. Summary of IWA results for the Little White Salmon watershed.

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
00501	M*	M	ND	ND	M	00101, 00102, 00201, 00202, 00203, 00204, 00205, 00301, 00302, 00401, 00402, 00502
00502	M*	M	ND	ND	M	00101, 00102, 00201, 00202, 00203, 00204, 00205, 00301, 00302, 00401, 00402
00401	M*	F	ND	ND	F	00301, 00302, 00402
00402	M*	F	ND	ND	F	00301, 00302
00301	F*	F	ND	ND	F	00302
00302	M*	F	ND	ND	F	—
00201	F*	F	ND	ND	F	00101, 00102, 00202, 00203, 00204, 00205
00202	ND	M	ND	ND	F	00101, 00102, 00203, 00204, 00205
00203	ND	F	ND	ND	F	00101, 00102, 00204, 00205
00204	ND	M	ND	ND	M	—
00205	ND	F	ND	ND	F	00102
00101	ND	F	ND	ND	F	—
00102	ND	M	ND	ND	M	—

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170701051#####.

[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows:

- F: Functional
- M: Moderately impaired
- I: Impaired
- ND: Not evaluated due to lack of data
- *: Rating was qualitatively derived from available sources of data for the watershed (USFS 1995).

[c] IWA results for watershed processes at the watershed level (i.e., considering upstream effects). These results integrate the contribution from all upstream subwatersheds to watershed processes and are used to identify the probable condition of these processes in subwatersheds where key reaches are present.

[d] Subwatersheds upstream from this subwatershed.

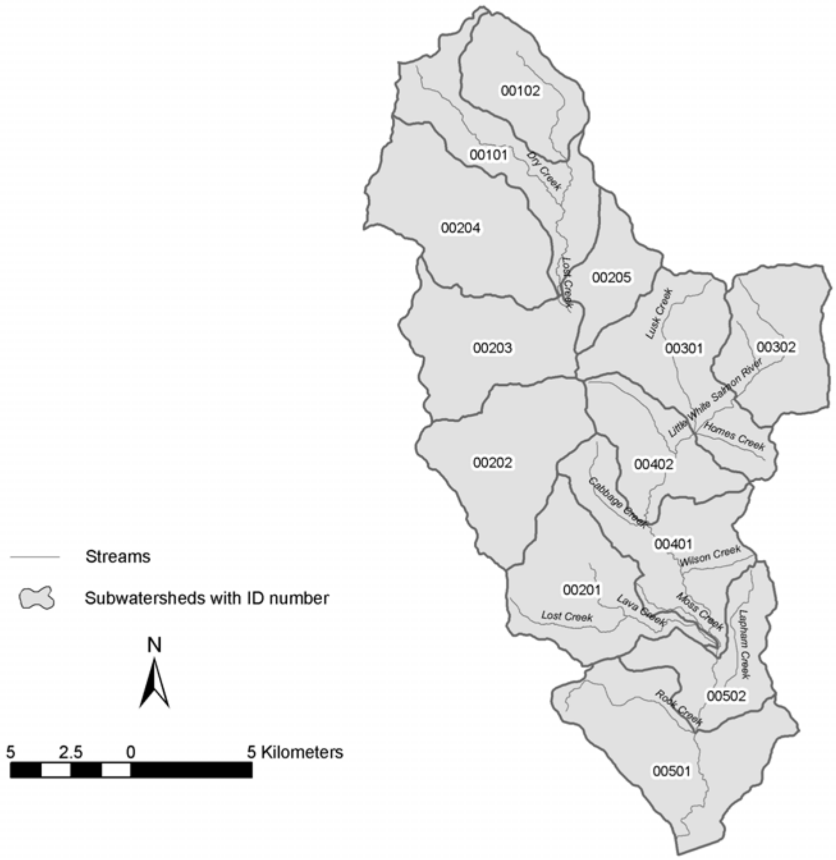


Figure 17-9. Map of the Little White Salmon basin showing the location of the IWA subwatersheds

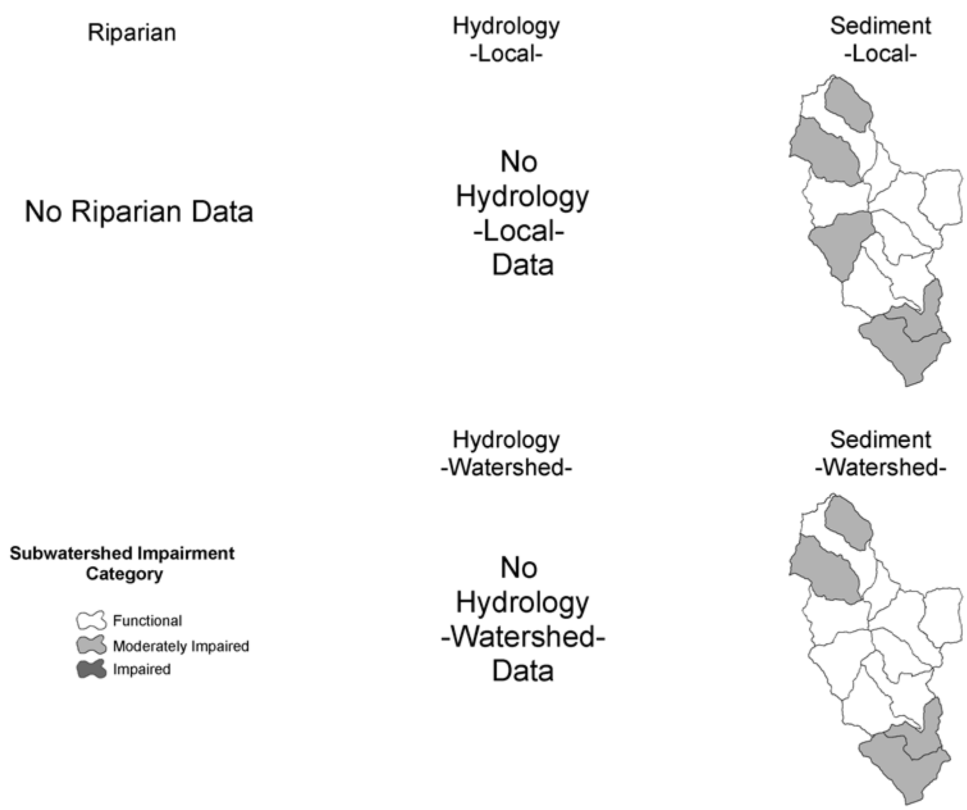


Figure 17-10. IWA subwatershed impairment ratings by category for the Little White Salmon basin

17.7.1.1 Hydrology

IWA results were not developed for hydrologic conditions in the Little White Salmon watershed because of a lack of GIS based data for forest cover.

However, ratings for local hydrologic conditions can be derived from available sources of information. The 1995 watershed analysis conducted by the USFS indicates that 19% of the subbasin features hydrologically immature forest cover. The USFS watershed analysis divided the watershed into 24 subwatersheds (USFS 1995), which is not compatible with the 15 LCFRB recovery planning subwatersheds. Based on the USFS results, all subwatersheds appear to have hydrologically mature vegetation in excess of 50% of the total area. With the IWA method, percent immature hydrologic vegetation and road density are used to rate likely hydrologic condition where impervious surface information is not available. As a result of generally uniform coverage with hydrologically mature vegetation, road densities would be the determinant of hydrologic conditions in the IWA method. The Little White Salmon headwaters (00302), middle Little White Salmon/Cabbage Creek (00401), middle Little White Salmon/Berry Creek, and the lowermost mainstem subwatersheds (00501 and 00502) have road densities in excess of 3 mi/sq mi). These subwatersheds would all be rated as moderately impaired at the local level. All remaining subwatersheds have road densities below 3 mi/sq mi and would be rated as locally functional.

These ratings must be considered against the complex hydrology of the watershed. Much of the surface flow in the Lost Creek drainage and subwatersheds 00204, 00203 and 00202 flows subsurface into the Big Lava Bed and other porous basaltic geology, buffering the hydrology of Lava Creek and the lower Little White Salmon River and resulting in functional hydrology conditions in these portions of the watershed. In addition, some of the subsurface flows in the watershed appear to route to the east, resurfacing in the White Salmon watershed (USFS 1995).

17.7.1.2 Sediment Supply

Local sediment conditions were rated as functional in eight of 15 subwatersheds, with the remaining seven subwatersheds rated as moderately impaired. Watershed level sediment conditions were rated as functional in nine subwatersheds, with six rated as moderately impaired. There are no subwatersheds with impaired sediment conditions at the local or watershed level.

Functional sediment conditions at the local level are distributed throughout the middle subwatersheds while the headwater areas of the Little White Salmon River are rated as functional or moderately impaired. Sediment conditions in these subwatersheds are generally rated functional because of moderate road densities (3 mi/sq mi) and lower concentrations of roads in sensitive areas. These subwatersheds include the Lava Creek drainage (00201) and the subwatersheds along the mainstem, including Cabbage Creek (00401), Berry Creek (00402), Lusk Creek (00301), and streams in the Salmon Creek headwaters (00302). Streamside road densities average less than 1 mile/stream mile in these subwatersheds. Over 90% these subwatersheds are in federal or state lands. Despite the functional ratings, some turbidity problems have been identified as associated with extensive past logging activities in the upper watershed (WCC 1999).

Local sediment conditions in the headwaters of Lost Creek are rated as moderately impaired. Additionally, moderately impaired subwatersheds are concentrated at the downstream end of the watershed and the independent drainages to the east and west.

The distribution of watershed level sediment conditions is similar to the local conditions, with moderately impaired sediment ratings concentrated in the headwaters of the Lost Creek drainage and in subwatersheds at the downstream end of the watershed. It is important to note that moderately impaired sediment ratings in the headwaters of the Lost Creek drainage (00102, 00101) are in subwatersheds that drain to marshlands which feed subsurface flows in the Big Lava Bed. Therefore, sediment conditions in headwaters of the Lost Creek drainage subwatersheds are effectively disconnected from the mainstem Little White Salmon and do not contribute to downstream watershed level sediment conditions.

17.7.1.3 Riparian

IWA results were not developed for hydrologic conditions in the Little White Salmon watershed because of a lack of GIS based data for forest cover.

17.7.2 Predicted Future Trends

17.7.2.1 Hydrology

The predicted trend for Lava Creek, Lost Creek, and the lower Little White Salmon River is for conditions to remain stable or slowly improve based on recovering vegetative cover and the high degree of subsurface flows, which moderate flow variation. Given the large percentage of the watershed that is in public ownership, hydrologic conditions in middle mainstem and headwater areas are predicted to trend towards improvement as vegetation matures.

17.7.2.2 Sediment Supply

Given the coverage of public lands ownership, moderately low erodability, and moderate road densities, sediment conditions in the headwaters and middle mainstem subwatersheds are predicted to trend stable, with turbidity conditions improving over the next 20 years as vegetation matures.

17.7.2.3 Riparian Condition

Riparian conditions in the Little White Salmon River were not analyzed in the IWA analysis because of a lack of available GIS based data.

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