Appendix C

Additional Aquatic Resource Information

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Supplemental Aquatic Resources Information

Section 1 Fish Distribution Above and Below Barrier Falls

Where local names are commonly applied to existing waterfalls by kayakers, rafters, fishermen, and local residents, they will be used. River miles (RM) will be placed in parenthesis after waterfalls, barriers, and stream locations mentioned in this report. Where needed to identify locations, such as waterfalls and barriers to fish migration, RM will be placed in parenthesis after the location. Tributaries that flow directly into the White Salmon River will be identified by the RM (in parenthesis) where they join the river. Tributaries that do not flow directly into the White Salmon River will be identified in parenthesis by the name and RM or the tributary they flow into.

White Salmon River

An 8-foot waterfall at the RM 2.6 (Chapman et al. 1990) below Condit Dam may represent a barrier to the upstream migration of juvenile salmonids. Husum Falls (RM 7.6) has been estimated to be about 15 feet high before the completion of Condit Dam (Chapman et al. 1990). Dynamiting reduced the height of Husum Falls to approximately 8 to 10 feet (depending upon flows) after the completion of Condit Dam to facilitate construction of a highway bridge over the falls (LLA 1981). Before dynamiting, Husum Falls was a barrier to juvenile salmonids, resident trout, and coho salmon (*Oncorhynchus kisutch*) passage and probably a partial or complete barrier to the passage of Chinook salmon (*O. tshawytscha*). Steelhead would have been able to pass over the falls. Husum falls is still likely a barrier to upstream juvenile salmonid passage, but resident trout, salmon, and steelhead can pass over the Husum Falls during all but the highest or lowest flows.

BZ Falls (RM 12.4) is about 15 to 17 feet high and presents a passage problem for anadromous salmonids (Chapman et al. 1990). BZ Falls blocks upstream passage of juvenile salmonids and resident salmonids and (depending upon flows) is likely a barrier to upstream passage for all salmonids except steelhead trout (*O. mykiss*) and possibly spring-run Chinook salmon. Modification of BZ Falls to allow better passage is unlikely due to the reach between Buck Creek (RM 5.0) and Gilmer Creek (RM 12.7) being within a designated wild and scenic classification area (Chapman et al. 1990). Chapman et al. (1990) considered the two falls at RM 16.2 to be a complete block to all anadromous fish passage at all times. The upper falls (Big Brother) has a drop of 21 feet and the lower falls (Little Brother) has a drop of 16.5 feet (Chapman et al. 1990). The height of the drops, lack of resting spots for intermediate jump starts, and shallow plunge pools present an insurmountable obstacle to all upstream migrating fish species except perhaps Pacific lamprey (Chapman et al. 1990). Historic reports of steelhead occurring above Big Brother Falls (LLA 1981) appear to have been due to observers mistaking large resident rainbow trout (*O. mykiss*) for steelhead (Chapman et al. 1990, Bair et al. 2002). There are also numerous falls over 4 feet in height between Husum and Big Brother Falls that limit the upstream migration of juvenile and all but the largest resident trout (LeMier and Smith 1955).

Resident rainbow trout are the dominant salmonid documented to occur in the mainstem White Salmon River below Big Brother Falls, with small numbers of brook trout (*Salvelinus fontinalis*) and coastal cutthroat trout (*O. clarki clarki*) documented to occur below Husum Falls. During spring redd counts of the White Salmon River conducted during the spring (March to June) of 2001, two redds were observed at RM 9.4 and five redds were found immediately below the first riffle at the confluence of the White Salmon River with Northwestern Lake (Bair et al. 2002). These would have been wild trout because the only hatchery fish currently being planted in the basin are Goldendale strain rainbow trout, which spawn between October and January (Weinheimer 2005, Crawford 1979). Hatchery rainbow trout (catchables, fry, and broodstock) planted in Northwestern Lake are quickly caught by the sport fishery with very few carryovers from year to year and have not established reproducing populations (Weinheimer 2005). The brook trout is an introduced species that was introduced into many of the tributaries of Trout Creek (a tributary of the upper White Salmon River above RM 16.2) where it has become locally abundant. Occasional brook trout "drop-downs" may occur in the White Salmon River below the confluence of Trout Creek, but brook trout are most commonly encountered in the vicinity of the confluence of Spring Creek (RM 6.6). Based on surveys of tributary streams, shorthead sculpin (*Cottus confusus*), longnose dace (*Rhinichthys osculus*), western brook lamprey (*Lampetra richardsoni*) may occur in reaches of the mainstem of the White Salmon River. With the exception of the Trout Creek subbasin, native resident rainbow (found throughout the basin) are the dominant salmonid in the upper White Salmon River basin above RM 16.2, with the trout becoming progressively smaller and less abundant as the elevation increases.

Rattlesnake Creek (RM 7.5)

There are two sets of barrier falls in Rattlesnake Creek, which enters the White Salmon River a few hundred yards downstream from Husum Falls. The lower waterfall on the mainstem of Rattlesnake Creek at RM 1.5 is composed of three individual drops, with the middle one being the largest (about 11.8 feet in total height, but with a step and 4.5 foot pocket at 6.8 feet) (Allen et al. 2003). This lower fall (RM 1.5) is most likely a barrier to resident fish (including trophy size resident rainbow trout), but may not have been a barrier to large salmonids, such as salmon and, particularly, steelhead (Allen et al. 2003, Connolly 2005a, 2005b). The upper falls at RM 10.6 has two separate drops of about 72 to 82 feet each to form a complete barrier to the upstream migration of fish. A total of 2.2 miles of the lower 9 miles of Rattlesnake Creek were surveyed by electroshocking methodology (primarily single pass) in 2001 and 2002 (Allen et al. 2003). The average gradient in surveyed reaches of Rattlesnake Creek varied from 1.3 to 2.7 percent and the maximum temperatures measured varied from 68.5ºF in the highest reach measured to 75.4ºF in the lower reaches.

Six species of fish (rainbow trout, coastal cutthroat trout, brook trout, shorthead sculpin, longnose dace, and western brook lamprey) have been captured in Rattlesnake Creek below the lower water fall (RM 1.5). A single brook trout captured in Rattlesnake Creek below the lower fall is the sole representative of this species captured in the Rattlesnake Creek watershed during continuing studies between 2001 and 2002 (Connolly 2005b, 2005c). Because of the issue of bull trout (*Salvelinus confluentus*) in the White Salmon River watershed, a tissue sample from the brook trout was collected for genetic analysis, but results are not available at this date. Brook trout occur in small numbers in the White Salmon River below Husum Falls, but no 0 age brook trout have been collected in the Rattlesnake Creek watershed during intensive sampling for over two years and it is not believed that a reproducing population of brook trout exists in the Rattlesnake Creek basin (Allen et al. 2003). Only rainbow trout, longnose dace, and shorthead sculpin are found above the lower waterfall on Rattlesnake Creek, with all three species found as far upstream as the lower 9 miles of the stream that were surveyed. A Pacific giant salamander (*Dicamptodon tenebrosus*) was collected in the reach immediately above the lower set of waterfalls.

Although resident rainbow trout were relatively robust throughout Rattlesnake Creek, the biomass of longnose dace was approximately double that of salmonids and longnose dace generally outnumbered salmonids by an order of magnitude. Age 0 salmonids were far more numerous than older salmonids throughout Rattlesnake Creek. The maximum size of rainbow trout sampled in summer was less than 7 inches in fork length (FL) below the lower waterfall at RM 1.5 and as high as 10 inches immediately above the lower waterfall. A continuing survey of resident rainbow trout tagged with PIT tags in Northwestern Lake, the White Salmon River and Rattlesnake Creek subbasin became operational in 2001 (Jezorek and Connolly 2003). A companion study was conducted with radio tagged rainbow trout that were collected in the White Salmon River. A total of 64 fish received radio tags (Connolly 2005c). A portion of the rainbow trout tagged above the lower waterfall on Rattlesnake Creek were observed to migrate downstream into the lower reach of Rattlesnake Creek and into the White Salmon River (Jezorek and Connolly 2003, Connolly 2005a, 2005b). Most of the tagged resident rainbow trout from the White Salmon River that have been detected at the site were from the section of the White Salmon River within 220 yards upstream (below Husum Falls) and 660 yards downstream of the confluence with Rattlesnake Creek. Over 600 PIT tags in 2001 and 900 PIT tags in 2002 were inserted in fish from the mainstem White Salmon River and the Rattlesnake Creek watershed. The study is ongoing and fish are still being collected and tagged in Northwestern Lake, the White Salmon River and the Rattlesnake Creek watershed. Although 139 fish have been tagged in the White Salmon River outside of the half mile section at the confluence of Rattlesnake Creek, very few have been detected in Rattlesnake Creek (Jezorek and Connolly 2003, Connolly 2005a, 2005b). The length and growth of recaptured rainbow trout in Rattlesnake Creek below the lower falls showed annual growth, but a lack of growth during the summer months. Virtually no movement of Rattlesnake Creek trout was recorded in July, August, or September. Rattlesnake downstream migrants were recorded in all other months except February. White Salmon River migrants were recorded in Rattlesnake Creek during the months of December, February, March, and April. During redd surveys, large rainbow trout were observed on redds in Rattlesnake Creek below the lower falls (Connolly 2005c). These fish are much larger than those observed during population surveys conducted in the summer and are believed to be fish from the White Salmon River that use Rattlesnake Creek for spawning. Large resident wild rainbow trout that were tagged in the White Salmon River have been recorded spawning in both Rattlesnake Creek below the lower waterfall and in Indian Creek above the lower road culvert (Connolly 2005a, 2005b, 2005c). During the spring of 2001, a large wild rainbow trout radio tagged in Northwestern Lake was observed spawning in Rattlesnake Creek below the lower falls (Bair et al. 2002, Connolly 2005a, 2005b, 2005c).

Indian Creek is a tributary of Rattlesnake Creek, entering at RM 0.5. There is a culvert less than 0.1 mile from the mouth of Indian Creek that was thought to be a potential barrier to fish migration (Allen et al. 2003). Resident rainbow and coastal cutthroat trout captured and tagged in the White Salmon River and Rattlesnake Creek below the lower falls have since been recorded in Indian Creek above the lower road culvert (Connolly 2005a, 2005b, 2005c). This indicates that Indian Creek is used by spawning fluvial-adfluvial rainbow and coastal cutthroat trout from the White Salmon River. Resident trout occur in Indian Creek at least as far upstream as permission to survey has been granted (1.9 miles). A total of 1.1 miles of Indian Creek was surveyed by single pass electroshocking methodology in 2001 and 2002 (Allen et al. 2003). Over 81 percent of the age 1 or older salmonid population collected were coastal cutthroat trout, with the rest of the salmonids composed of rainbow trout. All but one trout captured in the upper 0.6 miles of surveyed stream were coastal cutthroat trout. The upper 0.6 miles of surveyed stream was above 2 road culverts that apparently restrict access by spawning rainbow trout from Rattlesnake Creek and the White Salmon River to the upper reaches of Indian Creek. The only other fish documented in Indian Creek were shorthead sculpin, which occurred throughout the surveyed reaches. The average gradient of Indian Creek varied from 2.8 percent in the lower surveyed reach to 4.7 percent in the upper surveyed reach and the maximum temperature measured during the summer was 71.2ºF. During a survey of the lower 0.5 mile of Indian Creek in August, rainbow trout had a maximum of 6 inches FL and coastal cutthroat trout had a maximum of 8 inches FL. The majority of rainbow collected were age 0 fish, while the majority of coastal cutthroat collected were age 1 or older fish.

Mill Creek is a tributary of Rattlesnake Creek entering at RM 8.7. It was surveyed from its mouth to 0.6 mile upstream and for 196 yards starting at a point 1.6 miles upstream (Allen et al. 2003). It contained resident rainbow trout and shorthead sculpin in the lower surveyed reach and only rainbow trout in the upper surveyed reach. The average gradient of Mill Creek was 8.1 percent and the maximum water temperature measured during the summer was 60.3ºF. During a survey in October, resident rainbow trout up to 7.3 inches FL were collected in the lower 0.6 mile of Mill Creek. The majority of trout collected were age 1 or older fish.

Spring Creek (RM 6.6)

A private hydro dam at RM 0.7 is a complete barrier to fish passage (Chapman et al. 1990). Coastal cutthroat have been documented in Spring Creek above the dam (Rawding 2005, Blakley et al. 2000). Resident rainbow trout were documented below the dam during snorkel surveys on August 13, 2001 (Thiesfeld et al. 2001). Water temperature during the surveys was recorded as 53ºF and the average gradient was 1.2 percent. Spring Creek had a rainbow trout density of 13.79 fish per 100 $yards^2$. A few brook trout (1.11 fish per 100 $yards^2$) and sculpin (*Cottus* sp.) were seen during night snorkeling.

Buck Creek (RM 5.0)

A diversion dam at RM 1.9 (Chapman et al. 1990) is a partial barrier to fish passage. U.S. Forest Service biologists observed fish attempting to jump over this structure and noted that trout over approximately 9 inches in length were able to pass over the structure (Bair et al. 2002). Another diversion dam located at RM 3.8 is a complete barrier to fish passage (Chapman et al. 1990, Thiesfeld et al. 2001). Snorkel surveys were conducted on June 26, 2001 at RM 1.4, above the diversion dam at RM 3.9, and in the Middle Fork at RM 0.1 (which enters Buck Creek at RM 4.9). Water temperatures of 50.5ºF (lower site), 54.0ºF (upper site), and 47ºF (Middle Fork) were recorded (Thiesfeld et al. 2001). Average gradients were 3.0 percent (lower Site), 4.1 percent (upper site), and 12.5 percent (Middle Fork). Buck Creek had a rainbow trout density of

9.34 fish per 100 yards^2 at RM 1.4 and 9.07 fish per 100 yards^2 at RM 3.9. A few sculpin (*Cottus* sp.) were present at RM 1.4, Pacific giant salamanders were found at both RM 1.4 and RM 3.9, while tailed frog (*Ascaphus truei*) tadpoles were found at only RM 3.9. No fish were observed in the Middle fork, but tailed frog tadpoles and Pacific giant salamanders were observed. Rainbow trout were the only salmonids observed in Buck Creek and they were found up to the end of the mainstem of Buck Creek at the confluence of the North and Middle Forks (RM 5.0), RM 0.4 of the North Fork, and RM 0.6 of the South Fork (Thiesfeld 2005).

The temperature of Buck Creek during a walking survey on June 28, 2000 was 46.9ºF (Bryne et al. 2001). Redd surveys conducted on the lower portion of Buck Creek during the spring (March to June) of 2001 counted 49 trout redds between the confluence with Northwestern Lake and the 4 foot high diversion dam at RM 1.9 (Bair et al. 2002, Connolly 2005c). Twelve of the 64 rainbow trout fitted with radio tags were found in Buck Creek during this period and all returned to Northwestern Lake after the spawning season (Bair et al. 2002). Although Buck Creek is within the distribution range of coastal cutthroat in the White Salmon River watershed, rainbow trout are the only salmonid documented in the watershed.

Mill Creek (RM 4.0)

Mill Creek drains into Northwestern Lake. A 5-foot-high natural falls at RM 0.8 probably limits upstream migration of salmon, but steelhead should be able to pass (Chapman et al. 1990). The falls would also prevent upstream migration by resident trout, but rainbow trout are found at least as far upstream as RM 1.7 and may occur as far upstream as RM 2.6. Chapman et al. (1990) considered the stream up to RM 1.05 marginal salmon habitat. Approximately 800 feet of stream channel is inundated by Northwestern Lake and covered by up to 50 feet of granular sediments (Vestra 1990, Squier 1994). Based on depth profiles of the 1927 river bottom and 1990 lake bed (Vestra 1990) and a lake sediment sampling study by Squier Associates (1994), it is estimated that the new Mill Creek stream channel would have an average gradient of about 7 percent and, unless a bedrock barrier fall forms, would not be a barrier to upstream salmonid migration.

A delta has formed at the mouth of Mill Creek where it enters the Mill Creek Arm of Northwestern Lake. During a site visit to Northwestern Lake, a URS geologist estimated the delta at it's mouth to be approximately 200 feet long and 78 feet wide (Burk 2005). The depth of sediment near the mouth is unknown; however, it was speculated that it could be 10 feet deep. Bedrock was present at both streambanks and the stream flow was approximately 10 to 15 cfs. The sediments in the delta appeared to be primarily in the 0.5 to 1.0 inch range, armored with 4 to 6 inch cobble. After dam breaching, Mill Creek would be expected to begin down-cutting through the sediments and a head-cut would form where Mill Creek enters the new channel of the White Salmon River. A portion of the lake sediments covering the original channel of Mill Creek would be flushed away through the drain tunnel at the time of dam breaching. Over time, this head-cut would move upstream and eventually reach the top of the delta formed at the mouth of Mill Creek. Until this process is finished, the area of active head-cutting is likely to represent either a velocity barrier to salmonid migration or create an actual barrier fall. It is unlikely that the normal flow regime of Mill Creek generates sufficient stream power to transport bedload quickly enough to drive the area of active head-cutting all the way to the head of the current delta and create a stable channel within the three to five years previously estimated to create stable stream channels in the lakebed. After a stable channel forms in the former lakebed, it is estimated that approximately 0.95 mile of stream habitat below the 5-foot barrier fall would be available for salmon (primarily coho), steelhead, fluvial-adfluvial and resident rainbow trout, and resident or sea-run coastal cutthroat trout. Between 0.9 and 1.8 miles of additional stream habitat would become available above the falls for steelhead and resident rainbow trout.

Mill Creek was electroshocked at RM 1.7 on September 20, 2001 (Thiesfeld et al. 2001). Four age classes of rainbow trout up to 6.9 inches FL were the only fish species captured and they were abundant. The sample site had a low gradient and a water temperature of 53.6ºF. Coastal cutthroat trout, rainbow trout, and rainbow/cutthroat hybrids have been documented to occur downstream from the barrier fall (Johnson 2005, Connolly et al. 2002). Redds were observed in Mill Creek during a spring (March to June) 2001 spawning survey, but they appeared to be much smaller than redds observed in Buck Creek and the White Salmon River (Bair et al.2002). This may be due to the redds being made by smaller resident coastal cutthroat trout.

Little Buck Creek (RM 3.5)

Little Buck Creek drains into Northwestern Lake. Chapman et al. (1990), state that spawning habitat extends upstream to about RM 0.5 and that potential steelhead rearing habitat extends further upstream. Approximately 400 feet of stream channel is inundated by Northwestern Lake and covered by 20 to 25 feet of fine sediments (Vestra 1990, Squier 1994). Based on depth profiles of the 1927 river bottom and 1990 lake bed (Vestra 1990) and a lake sediment sampling study by Squier Associates (1994), it is estimated that the new Little Buck Creek stream channel would have an average gradient of about 24 percent. It is likely that the new channel would either be a velocity barrier to salmonid migration or contain waterfalls that would prevent the upstream passage of salmon. Considering the narrowness of the White Salmon River Canyon at this point, it is unlikely that enough floodplain exists near the river for a very short lower gradient channel to form near Little Buck Creek’s mouth.

A delta has formed at the mouth of Little Buck Creek where it enters a small bay of Northwestern Lake formed by the valley of the stream. During a site visit to Northwestern Lake, a delta similar to the delta formed at the mouth of Mill Creek, but on a smaller scale, was observed. The sediments in the delta appeared to be primarily in the 0.5 to 1.0 inch range, armored with 4- to 6-inch cobble. After dam breaching, Little Buck Creek would be expected to begin down-cutting through the fine lakebed sediments and a head-cut would form where Little Buck Creek enters the new channel of the White Salmon River. A portion of the lake sediments covering the original channel of Little Buck Creek would be flushed away through the drain tunnel at the time of dam breaching. Over time, this head-cut would move upstream and eventually reach the top of the delta formed at the mouth of Little Buck Creek. Even with an average gradient of approximately 24 percent, the normal flow regime of Little Buck Creek may not generate sufficient stream power to transport the bedload quickly enough to drive the area of active head-cutting all the way to the head of the current delta and create a stable channel within the 3-5 years estimated time required to create stable stream channels in the lakebed. Until the stream cuts down to the original bedrock channel, erosional processes would continue to deliver substantial quantities of fine sediments to the White Salmon River during storm runoff.

Little Buck Creek was electroshocked during a bull trout population assessment conducted by the Washington Department of Fish and Wildlife (WDFW) and found to contain a robust population of coastal cutthroat trout (Thiesfeld 2005). Tailed frogs and Pacific giant salamanders were noted during the survey. Although due to its steep gradient, it is unlikely that anadromous or fluvial-adfluvial salmonids will be able to utilize Little Buck Creek, the steep gradient should protect a population of resident coastal cutthroat from introgression with resident rainbow trout and steelhead trout. In addition, portions of the channel exposed after dam breaching should create additional stream habitat for the coastal cutthroat population.

Spring Creek (RM 3.45)

Spring Creek drains into Northwestern Lake. The stream is spring fed and water temperatures are cool the year around, but a steep gradient and high water velocities limit its potential for salmonid production (Chapman et al. 1990). The portion of the Spring Creek channel inundated by Northwestern Lake is similar in gradient and sediment depths to that of Little Buck Creek. Erosion of the fine sediments in the new channel would continue to deliver fine sediments to the White Salmon River during storm runoff until the stream cuts down to the original bedrock channel.

Based on the distribution of salmonids in Mill Creek and Little Buck Creek, it is possible that a population of coastal cutthroat trout exist in Spring Creek. Although due to its steep gradient, it is unlikely that anadromous or fluvial-adfluvial salmonids will be able to utilize Spring Creek, the steep gradient should protect any existing population of resident coastal cutthroat from introgression with resident rainbow trout and steelhead trout. In addition, portions of the channel exposed after dam breaching should create additional stream habitat for resident trout.

Potential Anadromous Salmonid Stream Habitat

Based on the above information, Chinook salmon are only likely to utilize the 9.1 miles of new main channel habitat below BZ Falls at RM 12.4 and may use habitat in the lower portions of Buck Creek (1.9 miles), Rattlesnake Creek (1.5 miles), and Spring Creek at RM 6.6 (0.7 miles) for spawning, rearing, and refuge. It is also possible that a small amount of Chinook salmon habitat may be provided in the lower reaches of Mill Creek (RM 4.0).

Coho salmon are only likely to utilize the 4.3 miles of new main channel habitat below Husum Falls at RM 7.6 because there is no accessible tributary spawning habitat above Husum Falls and juvenile cohos are unlikely to be able to pass over Husum Falls. Coho salmon should be able to utilize all of the tributary habitat listed above for Chinook salmon and may be able to utilize additional tributary habitat.

Steelhead should be able to utilize the full 12.9 miles of new main channel habitat, but potential usage above Husum Falls and BZ Falls may become progressively less due to the lack of spawning tributaries and scarcity of spawning gravel in the river and difficulty for juvenile steelhead to ascend upstream past many of the falls and cascades in the river. Cold water temperatures will be limiting factors for steelhead production above Husum Falls, with the resident rainbow trout phenotype likely to be the dominant form (Cramer et al.2003, Nielsen 2005).

Steelhead should be able to reach much of the available tributary habitat, either as spawning adults or as rearing juveniles (McMichael et al. 2000, Hubble 1992, Zimmerman and Reeves 2002, Cramer et al.2003 and 2005, Nielsen 2005, Everest 1973). Usage will be determined by summer water temperatures and flows, with steelhead primarily produced in the warmer streams with the lowest stream flows (Hubble 1992, Cramer et al. 2003, Nielsen 2005).

Fluvial-adfluvial populations of rainbow and coastal cutthroat trout will not be able to access Mill Creek above RM 0.8, Rattlesnake Creek above RM 1.5 (or Mill Creek in the Rattlesnake Creek watershed), and, with the exception of large fish, Buck Creek above RM 1.9. However, PIT tagging studies in the Rattlesnake Creek watershed would seem to indicate that resident populations of trout above barrier falls are contributing to the population of fluvial trout that are resident in the White Salmon River (Allen et al. 2003, Jezorek and Connolly 2003, Connolly 2005a, 2005b, 2005c).

Section 2. Fish Resources

This section updates the status of non-federally-listed state priority species likely to be found in the White Salmon River.

Resident Rainbow Trout

Rainbow trout native to the White Salmon River basin are assumed (Kostow 1995) to belong to the coastal subspecies of rainbow trout (*O. mykiss irideus*) (Behnke 1992 and 2002, Wydoski and Whitney 2003). Steelhead from the 3 federally listed steelhead evolutionarily significant units (ESUs) likely to enter the White Salmon River basin belong to the interior redband subspecies of rainbow, *O. mykiss gairdneri* (Phelps et al. 1994, Behnke 1992 and 2002, Wydoski and Whitney 2003). Genetic analysis of summer-run steelhead collected from the White Salmon River below Condit Dam indicated that they are *O. m. gairdneri* (Phelps et al. 1994) and are genetically distinct from resident rainbow trout collections from above Condit Dam (Larson and Bowdon 1995). Stocking of hatchery rainbow trout in the White Salmon River basin began as early as 1934 (Bair et al. 2002), but no hatchery rainbow trout alleles were detected during genetic analysis of five collections of resident rainbow trout from the White Salmon River (Phelps et al. 1990, Phelps et al. 1995, Weinheimer 2005).

Resident coastal rainbow appear to be native and distributed throughout the White Salmon River watershed (Bair et al. 2002, Bryne 2001, Allen et al. 2003, Connolly 2005a, Jezorek and Connolly 2003, Thiesfeld et al. 2001). Native resident rainbow trout are found above many existing natural barriers to fish passage (Connolly 2005a) in the White Salmon River watershed and occur far into the headwaters of many of the tributaries (Thiesfeld 2005). Resident rainbows likely coexisted in the White Salmon River basin with the andromous ecotype (steelhead before the construction of Condit Dam as far upstream as RM 16.2 (Cramer et al. 2003, Nielsen 2005). Based on their present distribution, small resident rainbow trout were probably distributed throughout the headwater streams (Thiesfeld et al. 2001, Allen et al. 2003, Bryne 2001). Large fluvial-adfluvial rainbow trout probably were and still are found in the mainstem of the White Salmon River as far upstream as RM 16.2 and perhaps as far upstream as the Trout Lake area (LLA 1981). Because of the prevailing temperature regimes in the river and its tributaries, the number and size of fluvial-adfluvial rainbow trout diminished as a function of temperature and channel size and flow in the mainstem, with trout becoming smaller in upstream reaches (Cramer et al. 2003 and 2005, Nielsen 2005, Bair et al.2002, Connolly 2005a and 2005b). Although substantial movements are possible, large fluvial-adfluvial rainbow trout in the White Salmon tend to spawn within a mile of their holding and foraging habitat in the mainstem of the river. They will frequently utilize tributaries for spawning when they are close by because gravel is relatively scarce in the main channel of the river.

It is difficult to reconstruct the historic steelhead runs or spawning and rearing habitat available to steelhead before the construction of Condit Dam, but steelhead spawning in the middle Columbia River tributary rivers tends to occur primarily in warmer tributaries, lower in the basins, where low summer flows and high water temperatures limit growth (McMichael et al. 2000, Hubble et al. 1992, Zimmerman and Reeves 2002, Cramer et al. 2003 and 2005, Nielsen 2005, Everest 1973). Steelhead juveniles utilize intermittent reaches, moving down or upstream to perennial reaches or holding in pools (Cramer et al. 2003, 2005, Zimmerman and Reeves 2002, Hubble et al. 1992, Nielsen 2005). While segregated spatially in some basins (Hubble et al. 1992, Zimmerman and Reeves 2000, 2002), the ranges of resident and anadromous ecotypes of both coastal and interior redband rainbow trout often overlap, both spatially and temporally (McMichael et al. 2000, Cramer et al. 2003 and 2005, Nielsen 2005). Under these conditions the resident and anadromous ecotypes of rainbow trout frequently interbreed (McMichael et al. 2000, Cramer et al. 2003, Zimmerman et al. 2003, Nielsen 2005). In some river basins, shifts from one ecotype to another have occurred when habitat conditions change (Marshall et al. 2004, Nielsen 2005).

Coastal Cutthroat Trout

On July 5, 2002, the USFWS withdrew the proposed rule to list southwestern Washington/Columbia River distinct population segment (DPS) of the coastal cutthroat trout as threatened (USFWS 2002b). The coastal cutthroat trout in the White Salmon River basin is now considered a species of Concern by the USFWS (USFWS 2005a). Coastal cutthroat trout populations in the White Salmon River basin are near the end of their interior range and their distribution within the watershed reflects a species near the edge of their range (Rawding 2005, Connolly 2005a).

Cutthroat trout were sampled from Mill Creek (RM 4.0), a tributary of Northwestern Lake, for genetic analysis by NMFS (Johnson 2005, Connolly et al. 2002, Connolly 2005a, Rawding 2005, Campton 2005). The collection took place in Mill Creek between Northwestern Reservoir and the lowest road crossing (Rawding 2005), where 40 trout were selected for their close resemblance to the coastal cutthroat phenotype. Allozyme analysis suggested that the White Salmon coastal cutthroat were relatively similar to cutthroat trout in the Washougal subbasin but, collectively, the White Salmon/Washougal River cutthroat trout were genetically distinct from coastal cutthroat trout elsewhere in the lower Columbia River basin (Connolly et al. 2002). Because of the distinct differences between the White Salmon/Washougal and other populations of coastal cutthroat trout in the lower Columbia River basin, the data was reexamined to determine if this was an artifact of introgression with rainbow trout (i.e., the specimens represent a cutthroat/rainbow trout hybrid swarm) (Connolly et al. 2002, Campton 2005). Analysis of the sample data determined that 16 of the trout were coastal cutthroat trout, 20 were cutthroat/rainbow hybrids, and four were pure rainbow trout (Johnson 2005, Campton 2005).

Coastal cutthroat trout were also collected from Spring Creek (RM 6.6) at the pond behind a private dam at RM 0.7 (Rawding 2005, Blakley et al. 2000). Little Buck Creek was electroshocked during a bull trout population assessment conducted by the WDFW and found to contain a robust population of coastal cutthroat trout (Thiesfeld 2005). The Rattlesnake Creek (RM 7.5) drainage was electroshocked during surveys conducted in 2001 and 2002. Coastal cutthroat trout were found in the lower reaches of Rattlesnake Creek below the lower waterfall (RM 1.5) and throughout the sampled reaches of Indian Creek (a tributary of Rattlesnake Creek, entering at RM 0.5) (Allen et al. 2003). Fluvial-adfluvial cutthroat trout have been observed spawning in these reaches of Rattlesnake and Indian Creeks (Connolly 2005a, 2005b, 2005c).

Coastal cutthroat trout have been observed in the White Salmon River between Husum Falls and Northwestern Lake, but not above Husum Falls. Some of these fish have been documented to spawn in Rattlesnake and Indian Creeks (Connolly 2005a, 2005b, 2005c). Buck Creek is the only surveyed tributary of the White Salmon River between Condit Dam and Husum Falls that hasn't been documented to contain a population of coastal cutthroat trout. While coastal rainbow trout appear to be native and distributed throughout the White Salmon River watershed, coastal cutthroat trout appear to be native to the White Salmon River and its tributaries from Husum Falls (RM 7.6), downstream (with spawning populations in at least 5 tributaries) (Connolly 2005a, 2005b, Thiesfeld 2005). It is not known why they haven't been detected between Husum Falls and BZ Falls (RM 12.4). This may be because appropriate spawning habitat is not available for them above Husum Falls. Coastal cutthroat primarily spawn in steeper gradient reaches of tributary streams (Trotter 1987, 1997). There are no spawning tributaries between Husum and BZ Falls. In addition, Chapman et al. (1990) documented Husum Falls to be about 15 feet high before the completion of Condit Dam. Dynamiting reduced the height of Husum Falls to 8-10 feet after the completion of Condit Dam to facilitate construction of a highway bridge over the falls (LLA 1981). At 15 feet in height, Husum Falls would probably have been a barrier to migration for coastal cutthroat trout and even after dynamiting, the lack of suitable spawning habitat may have prevented coastal cutthroat trout from colonizing the White Salmon River between Husum and BZ Falls.

The lack of sea-run cutthroat trout below Condit Dam may be related to the absence of suitable spawning tributaries below Condit Dam. In this case, since a fluvial-adfluvial life history has been documented to currently exist above Condit Dam, it is possible that a portion of this population of coastal cutthroat trout may assume an anadromous life history. There are anecdotal reports of sea-run resident coastal cutthroat trout in the White Salmon River and native sea-run and resident populations occur in the Hood River, Oregon, which enters the Columbia River a short distance upstream of the mouth of the White Salmon River (Blakley et al. 2000, Johnson et al. 1999, Hall et al. 1997).

Hatchery cutthroat westslope cutthroat trout (*O. clarki lewisi*) have been planted in the White Salmon River basin between 1936 and 1941 (Connolly et al. 2002), but extensive surveys throughout the basin for bull trout have not detected the presence of any reproducing populations (Thiesfeld et al. 2001, Byrne 2001, Connolly 2005a). The only other records of cutthroat trout stocked in the White Salmon River basin were plants from the Vancouver hatchery that were stocked in 1966 and 1967 (Connolly et al. 2002). These fish were probably coastal cutthroat trout because Vancouver maintained two strains of coastal cutthroat broodstock (Beaver Creek and Alsea River) at that time for planting in lower Columbia River tributaries in Washington

State (Crawford 1979). Its possible that these plants are the source of some of the White Salmon coastal cutthroat populations, but enough genetic samples have been collected that the native status of White Salmon River basin populations could be determined by comparing them to the two hatchery stocks.

Bull Trout

Two sightings of bull trout have been reported above Condit Dam, both by WDFW biologists. One fish (10.75 inches FL) was captured in a gill net set in the spring of 1986 in Northwestern Lake (WDFW 1998, Weinheimer 2005). The other fish (about 12 inches long) was checked in the opening day creel census in April 1989 (WDFW 1998, Weinheimer 2005). Two reliable sightings were reported by sport anglers below Condit Dam in recent years (WDFW 1998, Weinheimer 2005). The bull trout seen below Condit Dam are not believed to reproduce in the White Salmon River and electroshocking in the lower river has not turned up any juvenile bull trout (WDFW 1998). WDFW fisheries biologists believe the bull trout in the lower White Salmon River below Condit Dam are "dip-ins' from the Hood River in Oregon, which contains a small population of bull trout (WDFW 1998).

Bull trout populations in the White Salmon River were assessed by WDFW surveys conducted in 2000 and 2001 (Bryne et al. 2001 and Thiesfeld et al. 2001). In 2000, Bryne et al. (2001) conducted night and day snorkel surveys of the White Salmon River between Husum Falls and Northwestern Lake. They did not survey Spring Creek (RM 6.6), but conducted walking surveys along Buck and Rattlesnake Creeks. They conducted day snorkel surveys of about 4.2 miles and night snorkel surveys of 2 quarter mile reaches of the White Salmon River above RM 36.9. Morrison Creek (RM 32.5) and Cascade Creek (RM 36.9) were surveyed by night snorkeling and Ninefoot Creek (36.2) was day snorkeled. No fish were observed in Morrison Creek and only rainbow trout were observed in the upper White Salmon River, Cascade Creek and Ninefoot Creek. It was determined that Buck Creek was too small to snorkel and no habitat or snorkel surveys were conducted in Rattlesnake Creek because it was considered unsuitable for bull trout due to low flows and high temperatures. No bull trout were observed during day and night snorkel surveys of the White Salmon River below Husum Falls, but many large trophy rainbows (14 to 24 inches in total length) were observed. Although no bull trout were observed, additional areas of cold-water habitat remain to be surveyed (Bryne et al. 2001). The reaches of the White Salmon River between Husum Falls and the upper reaches of the White Salmon River that were surveyed remain to be surveyed (Bryne et al. 2001). The White Salmon River is supplied by glacial run-off and cold groundwater seeping from the canyon walls and bottom. It was concluded that these canyon areas and Spring Creek (RM 6.6) above the private hydro project at RM 0.7 should be investigated as possible bull trout habitat (Bryne et al. 2001, Bryne 2005).

During 2001, Thiesfeld et al. (2001) snorkeled or electroshocked cool water tributaries between RM 4.0 and RM 6.6 (Mill, Buck, Middle Fork Buck, and Spring Creeks) along with tributaries of the White Salmon River above the upper limits of anadromous fish migration at Big Brother Falls (Beaver, Croften, Elmer Canyon, Lost, Smokey, Cultus, Little Goose, Meadow, and Mosquito Creeks and six unnamed tributaries of the White Salmon River headwaters). Only rainbow and brook trout were detected and no bull trout were found during the course of these surveys.

Additional surveys were conducted in 2002 and 2004 and reports (including a final report) for both seasons were written but have not been published (Bryne 2005). The upper reaches of Spring Creek (RM 6.6) were not surveyed due to lack of access on private land, while difficult access and safety concerns prevented surveys of the White Salmon River between RM 7.6 and RM 32.5. The bull trout surveys were unable to locate or identify spawning areas, although a small population of bull trout may exist in the basin above Condit Dam at a very low population density (Bryne 2005).

Although suitable spawning areas for bull trout are limited in the tributaries of the White Salmon River below RM 16.2 and only limited spawning gravel exists in the mainstem of the White Salmon River, the mainstem channel of the White Salmon River does contain excellent cold-water habitat for bull trout. Juvenile bull trout spend much of the daylight hours in the substrate. The high frequency of falls in the mainstem of the White Salmon River also presents a barrier to upstream migration of bull trout, limiting their options for seeking suitable rearing habitat. Although Northwestern Lake provides an excellent source of lacustrine habitat for a lacustrine-adfluvial population of bull trout to have developed since the construction of Condit Dam, it is possible that the limited amount of tributary spawning habitat and scarcity of gravel in the mainstem to provide spawning for adult bull trout and refuge for juvenile bull trout, combined with limits on upstream juvenile migration, have combined to limit the population density of bull trout below a threshold of detectability by any practicable level of surveying.

Nonsalmonid fish

Three species of nonsalmonid fish that are likely to occur in the Bonneville Pool, and potentially in the lower White Salmon River below Condit Dam, were not documented in the 1996 FEIS (FERC 1996) or 2002 FSFEIS (FERC 2002) for the Condit Hydroelectric Project. These are the leopard dace (*Rhinichthys falcatus*), mountain sucker (*Catostomus platyrhynchus*), and river lamprey (*Lampetra ayresi*). All three of these species are Washington state Candidate species. If these species occur in the White Salmon River, they most likely are found in the large pool at the in-lieu site.

Three species of nonsalmonid fish, longnose dace, western brook lamprey, and shorthead sculpin have been documented to occur in the White Salmon River above Condit Dam (Allen et al. 2003).

Section 3 Freshwater Mussels

California Floater (*Anodonta californiensis)*

The California floater is a Washington state Candidate Species. In the Draft White Salmon River Subbasin Summary prepared for the Northwest Power Planning Council by the WDFW, Dan Rawding (2000) states, “Freshwater mussels are known to inhabit certain portions of the basin; however, the current species assemblages, distribution, and status are unknown.” The priority species status review by the WDFW documents their presence in the Columbia River about 20 miles upstream from the mouth of the White Salmon River. This is the closest known survey for benthic invertebrates to the project area. Molly Hallock, a WDFW biologist, stated in a phone conversation that she was unaware of any mollusk surveys that have been conducted by WDFW or USFWS in the White Salmon River Basin (Hallock 2005).

Terrence Frest, one of the malacologists most familiar with Columbia Basin mollusks, stated that he wasn't aware of any surveys conducted in this portion of the Bonneville Pool. He also acknowledged that suitable habitat was likely present, that the project site was within the historic range of the species, and that a survey would be required to document its absence from the site (Frest 2003, 2004).

The lower reaches of the White Salmon River and Columbia River in the vicinity of the project contains suitable historic habitat for California floaters. Management Recommendations for Washington State priority invertebrate species (Larsen et al. 1995) state that baseline surveys are required to adequately monitor, manage, and mitigate for losses of the California floater and/or its habitat and that this species should be considered when projects are planned which might cause erosion, siltation, or bedload movements in streams. Pending survey/inventory data from the project area documenting the absence of California floaters, documentation from WDFW or USFWS to the effect that baseline inventories of freshwater mussels in the project area have established the absence of California floaters, it is impossible to determine that project-related impacts to California floaters will not occur (Strayer and Smith 2003).

Section 4 Threatened and Endangered Fish Species

The status of all federally listed, proposed, or candidate Chinook salmon, chum salmon (*O. keta*), coho salmon, steelhead trout, and coastal cutthroat trout likely to be found in the White Salmon River has been reevaluated since the June 2002 publication of the FSFEIS for the Condit Hydroelectric Project. In addition, critical habitat has been withdrawn and proposed for six of the listed Pacific salmon and steelhead ESUs and critical habitat for the Columbia River bull trout DPS has been designated.

On February 11, 2002, the National Marine Fisheries Service (NMFS) published a notice of findings for six petitions to delist 15 ESUs of Pacific salmon and steelhead (*Oncorhynchus* spp.) (NMFS 2002). NMFS determined that a status review was warranted for 14 of the petitioned ESUs and added 10 additional listed ESUs as well as a candidate ESU [Lower Columbia River/Southwestern Washington Coho Salmon (*O. kisutch*)] for a total of 25 ESUs to be updated. ESUs likely to be found in the White Salmon River that were reviewed included the Snake River Spring/Summer Chinook Salmon, Snake River Fall Chinook Salmon, Lower Columbia River Chinook Salmon, Upper Columbia River Spring Chinook Salmon, Lower Columbia/Southwest Washington Coho Salmon, Columbia River Chum Salmon, Upper Columbia River Steelhead, Middle Columbia River Steelhead, and Snake River Basin Steelhead. On June 14, 2004, NMFS published proposed listing determinations for 27 ESUs of west coast salmonids (NMFS 2004a). The proposed listing determinations included two additional ESUs, the Snake River Sockeye (likely to be found in the Bonneville Pool) and the Southern California Steelhead. The status of all 10 listed Pacific salmon and steelhead ESUs likely to be found in the White Salmon River has been reviewed and new listing determinations proposed.

On June 28, 2005, NMFS published the final listing determination for 16 ESUs of West Coast Salmon and final 4(d) protective regulations for threatened salmonid ESUs (NMFS 2005a), finalizing the listing determinations for Snake River Spring/Summer Chinook Salmon, Snake River Fall Chinook Salmon, Lower Columbia River Chinook Salmon, Upper Columbia River Spring Chinook Salmon, Lower Columbia/Southwest Washington Coho Salmon, Snake River Sockeye, and Columbia River Chum Salmon.

On June 28, 2005, NMFS published a 6-month extension of the final listing determination for 10 ESUs of West Coast *Oncorhynchus mykiss* (NMFS 2005b), extending the date for the listing determinations of Upper Columbia River Steelhead, Middle Columbia River Steelhead, and Snake River Basin Steelhead for six months. One of the primary issues concerns determining whether resident rainbow trout populations should be included in the ESUs.

On April 30, 2002, the U.S. District Court for the District of Columbia approved an NMFS consent decree withdrawing critical habitat designation for 19 salmon and steelhead populations on the west coast (USDC 2002). Critical habitat designation was withdrawn for the 19 ESUs listed in the final rule published on February 16, 2000 (NMFS 2000). Critical habitat designations for the Upper and Lower Columbia River Spring Chinook, Columbia River Chum, Snake River Steelhead, and Upper and Middle Columbia River Steelhead likely to be found in the White Salmon River were included among the 19 ESUs, but critical habitat determinations for the Snake River Spring/Summer and Fall Chinook Salmon and Snake River Sockeye were allowed to remain in effect. The final rule to remove critical habitat designations for these ESUs plus the Northern California Steelhead ESU was published on September 29, 2003 (NMFS 2003). On December 14, 2004 critical habitat designations were proposed for 13 salmonid ESUs, including the six listed ESUs likely to be found in the White Salmon River for which critical habitat was reviewed (NMFS 2004b). Final critical habitat designations were published on September 2, 2005 for 12 salmonid ESUs, including the six listed ESUs likely to be found in the White Salmon River for which critical was reviewed (NMFS 2005c). No changes from the proposed critical habitat designations were made for in the project area.

On April 21, 2000, NMFS and the USFWS published a notice transferring jurisdiction for coastal cutthroat trout from NMFS to the USFWS (NMFS and USFWS 2000). All coastal cutthroat trout ESUs were redesignated as DPSs. On July 5, 2002, the USFWS withdrew the proposed rule to list southwestern Washington/Columbia River DPS of the coastal cutthroat trout as threatened (USFWS 2002b)

On November 29, 2002, designation of critical habitat for the Columbia River bull trout DPS was proposed and the availability of a draft recovery plan for the Columbia River bull trout DPS was announced (USFWS 2002a). Critical habitat for the Columbia River bull trout DPS was proposed on June 25, 2004 (USFWS 2004a) and a final rule published on October 6, 2004 (USFWS 2004b). USFWS published a revised final rule for critical habitat of bull trout in the coterminous United States on September 15, 2005 (USFWS 2005b). The new final rule designated critical habitat for all bull trout DPSs in the lower 48 states, including the Columbia River, Klamath River, Jarbridge River, Coastal-Puget Sound, and St. Mary and Belly River DPSs.

The status by ESU/DPS of federally listed threatened and endangered fish species and proposed and candidate species likely to be found in the White Salmon River is updated below.

Snake River Sockeye Salmon

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) gives a description of the origin, life history, critical habitat designation and ESA listing determination of Snake River sockeye salmon in the White Salmon River and Columbia River/Bonneville Pool as of June 2002. On February 11, 2002 the ESA listing determination of endangered came under review (NMFS 2002). On December 14, 2004, it was proposed that the ESA listing of endangered be continued (NMFS 2004a) and the determination was finalized in a notice published on June 16, 2004 (NMFS 2005a).

Snake River Spring/Summer-Run Chinook Salmon

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) gives a description of the origin, life history, critical habitat designation and ESA listing determination of Snake River spring/summer-run Chinook salmon in the White Salmon and Columbia River/Bonneville Pool River as of June 2002. On February 11, 2002 the ESA listing determination of threatened came under review (NMFS 2002). On December 14, 2004, it was proposed that the ESA listing of threatened be continued (NMFS 2004a) and the determination was finalized in a notice published on June 16, 2004 (NMFS 2005a).

Snake River Fall-Run Chinook Salmon

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) gives a detailed description of the origin, life history, critical habitat designation and ESA listing determination of Snake River fall-run Chinook salmon in the White Salmon River and Columbia River/Bonneville Pool as of June 2002. On February 11, 2002 the ESA listing determination of threatened came under review (NMFS 2002). On December 14, 2004, it was proposed that the ESA listing of threatened be continued (NMFS 2004a) and the determination was finalized in a notice published on June 16, 2004 (NMFS 2005a).

At the publication of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) it was assumed that fall-run Chinook salmon juveniles in the Snake River basin adhered strictly to an ocean-type life history characterized by saltwater entry at age 0 and first-year wintering in the ocean. Recent research has shown that some fall-run Chinook salmon juveniles in the Snake River basin spend their first winter in a reservoir and resume seaward movement the following spring at age 1 (Connor et al. 2005). This newly discovered ecotype has been defined as a “reservoir-type” juvenile. Ocean-type juveniles average 4.4 to 5.5 inches FL, while reservoir-type juveniles average 8.7 to 8.8 inches FL. The large size of reservoir-type juveniles suggests a high potential for ocean survival.

Upper Columbia River Spring-Run Chinook Salmon

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) gives a description of the origin, life history, critical habitat designation and ESA listing determination of Upper Columbia River spring-run Chinook salmon in the White Salmon River and Columbia River/Bonneville Pool as of June 2002. On February 11, 2002 the ESA listing determination of endangered came under review (NMFS 2002). On December 14, 2004, it was proposed that the

ESA listing of endangered be continued (NMFS 2004a) and the determination was finalized in a notice published on June 16, 2004 (NMFS 2005a).

The U.S. District Court for the District of Columbia approved an NMFS consent degree on April 30, 2002 (USDC 2002), withdrawing the critical habitat designation and the final rule removing the critical habitat designation was published on September 29, 2003 (NMFS 2003). An assessment of critical habitat was prepared by the NOAA Fisheries critical habitat analytical review team (NOAA 2004) and on December 14, 2004 a new critical habitat designation was proposed designating Upper Columbia River spring Chinook critical habitat to include the Columbia River (including Bonneville Pool) (NMFS 2004b). Critical habitat was defined as including the stream channel within the proposed stream reach, including a lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent is defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series. Critical habitat in lake areas is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of ordinary high water, whichever is greater. The Columbia River is defined as a freshwater migration corridor with the following primary constituent elements: free of obstruction and excessive predations, with water quantity and quality conditions and natural cover supporting juvenile and adult mobility and survival. Final critical habitat designations were published on September 2, 2005 (NMFS 2005c). No changes from the proposed critical habitat designations were made in the project area.

Lower Columbia River Chinook Salmon

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002), along with Section 4.3.1.2 and Appendix E of the FEIS for the Condit Hydroelectric Project (FERC 1996) give a detailed description of the origin, life history, critical habitat designation and ESA listing determination of Lower Columbia River Chinook salmon in the White Salmon River and Columbia River/Bonneville Pool as of June 2002. On February 11, 2002 the ESA listing determination of threatened came under review (NMFS 2002). On December 14, 2004, it was proposed that the ESA listing of threatened be continued (NMFS 2004a) and the determination was finalized in a notice published on June 16, 2004 (NMFS 2005a).

The U.S. District Court for the District of Columbia approved an NMFS consent degree on April 30, 2002 (USDC 2002), withdrawing the critical habitat designation and the final rule removing the critical habitat designation was published on September 29, 2003 (NMFS 2003). An assessment of critical habitat was prepared by the NOAA Fisheries critical habitat analytical review team (NOAA 2004) and on December 14, 2004 a new critical habitat designation was proposed designating Lower Columbia River Chinook critical habitat to include the White Salmon River from the base of Condit Dam to its mouth (NMFS 2004b). Critical habitat was defined as including the stream channel within the proposed stream reach, including a lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent is defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series. Critical habitat in lake areas is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of ordinary high water, whichever is greater. The White Salmon River contains the following primary constituent elements: 1) freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; 2) freshwater rearing sites with floodplain connectivity, forage supporting juvenile development, and natural cover; and 3) a freshwater migration corridor with the following primary constituent elements: free of obstruction and excessive predations, with water quantity and quality conditions and natural cover supporting juvenile and adult mobility and survival. Final critical habitat designations were published on September 2, 2005 (NMFS 2005c). No changes from the proposed critical habitat designations were made in the project area.

Columbia River Chum Salmon

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) gives a description of the origin, life history, critical habitat designation and ESA listing determination of Columbia River chum salmon in the White Salmon River and Columbia River/Bonneville Pool as of June 2002. On February 11, 2002 the ESA listing determination of threatened came under review (NMFS 2002). On December 14, 2004, it was proposed that the ESA listing of threatened be continued (NMFS 2004a) and the determination was finalized in a notice published on June 16, 2004 (NMFS 2005a).

The U.S. District Court for the District of Columbia approved an NMFS consent degree on April 30, 2002 (USDC 2002), withdrawing the critical habitat designation and the final rule removing the critical habitat designation was published on September 29, 2003 (NMFS 2003). An assessment of critical habitat was prepared by the NOAA Fisheries critical habitat analytical review team (NOAA 2004) and on December 14, 2004 a new critical habitat designation was proposed designating Columbia River chum salmon critical habitat to include the White Salmon River from the base of Condit Dam to its mouth (NMFS 2004b). Critical habitat was defined as including the stream channel within the proposed stream reach, including a lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent is defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series. Critical habitat in lake areas is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of ordinary high water, whichever is greater. The White Salmon River contains the following primary constituent elements: 1) freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; 2) freshwater rearing sites with floodplain connectivity, forage supporting juvenile development, and natural cover; and 3) a freshwater migration corridor with the following primary constituent elements: free of obstruction and excessive predations, with water quantity and quality conditions and natural cover supporting juvenile and adult mobility and survival. Final critical habitat designations were published on September 2, 2005 (NMFS 2005c). No changes from the proposed critical habitat designations were made in the project area.

The decision to include the White Salmon River from the base of Condit Dam to its mouth was based on spawning ground surveys conducted on the mainstem Columbia River and its tributaries in 2002 (NMFS 2005d, Ehlke and Keller 2003). It's likely the actual spawning escapement upstream from Bonneville Dam is actually less than the dam counts. Of the 188 adult chum salmon observed passing Bonneville Dam in 2002, five salmon were trapped and tagged in November through Thanksgiving and the fish released upstream from the trap (Ehlke and Keller 2003). Two fish were detected downstream from Bonneville Dam and one in the Dalles Dam ladder entrance. Historical counts of chum salmon passing over Bonneville Dam have most likely been underestimated because visual counting at Bonneville was usually terminated on November 15 (Ehlke and Keller 2003). However, video tape studies have shown only about half of the chum salmon passing Bonneville Dam pass through the ladder by mid-November during normal counting periods. Video counts conducted in 2004 from April 1 though October 31 indicate only 21 of the 188 fish (11%) had passed the dam by November 15 (Ehlke and Keller 2003).

The White Salmon River was the only Washington tributary of the Columbia River in which chum salmon were detected (Ehlke and Keller 2003). A total of one male and one unspawned female chum salmon were observed in the White Salmon River during three surveys conducted between November 6 and November 20 of 2000 (Ehlke and Keller 2003). Considering the fact that the majority of chum salmon passed Bonneville Dam after November 15, it is reasonable to assume that more than two chum salmon may have spawned in the White Salmon River during the fall of 2002.

Snake River Basin Steelhead

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) gives a description of the origin, life history, critical habitat designation and ESA listing determination of Snake River basin steelhead in the White Salmon River and Columbia River/Bonneville Pool as of June 2002. On February 11, 2002 the ESA listing determination of threatened came under review (NMFS 2002). On December 14, 2004, it was proposed that the ESA listing of threatened be continued (NMFS 2004a) and the date for determination was extended six months on June 16, 2004 (NMFS 2005b).

The U.S. District Court for the District of Columbia approved an NMFS consent degree on April 30, 2002 (USDC 2002), withdrawing the critical habitat designation and the final rule removing the critical habitat designation was published on September 29, 2003 (NMFS 2003). An assessment of critical habitat was prepared by the NOAA Fisheries critical habitat analytical review team (NOAA 2004) and on December 14, 2004 a new critical habitat designation was proposed designating Snake River basin steelhead critical habitat to include the Columbia River (including Bonneville Pool) (NMFS 2004b). Critical habitat was defined as including the stream channel within the proposed stream reach, including a lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent is defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series. Critical habitat in lake areas is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of ordinary high water, whichever is greater. The Columbia River is defined as a freshwater migration corridor with the following primary constituent elements: free of obstruction and excessive predations, with water quantity and quality conditions and natural cover supporting juvenile and adult mobility and survival. Final critical habitat designations were published on September 2, 2005 (NMFS 2005c). No changes from the proposed critical habitat designations were made in the project area.

Unpublished data from adult tracking studies conducted by Peery and Keefer at the University of Idaho suggests that significant numbers of “drop-in” steelhead hatchery-strays from other basins move into the Deschutes River temporarily, then return downstream to the Columbia and continue to other watersheds (Cramer et al. 2003). Steelhead collected at Bonneville Dam were outfitted with transmitters. These fish were later detected in the Deschutes River at RM 0.3 and RM 43 (Sherars Falls). Approximately 60-70% of the steelhead detected within the mouth of the Deschutes were later detected in other watersheds, and 30-40% of steelhead detected near Sherars Falls were later detected in other watersheds. Up to 25% of the radio-tagged steelhead known to have traveled as far upstream as Sherars Falls were later found in the Snake River. Although these “drop-in” steelhead are primarily hatchery steelhead from the Snake River basin, the lower portion of the Deschutes was famous in the 1950s for sports catches of large wild B-run steelhead trout of 20 pounds or more (Migdalski 1962) that were likely “drop-in” fish from the Snake River basin. Based on this information, it is likely that “drop-in” steelhead (and other andromous salmonids) from Columbia River and Snake River ESUs upstream of the White Salmon River will utilize pools for refuge from high summer water temperatures in the Bonneville Pool throughout the reaches of the White Salmon River that become accessible after the removal of Condit Dam.

Although Snake River steelhead are not residents of the White Salmon River, adults are attracted to and stray into the cooler waters of the White Salmon River during the summer. The lower White Salmon River provides an excellent thermal refuge for summer steelhead migrating upstream in the Columbia River (Rawding 2000), and the Peery and Keefer research presented in Cramer et al. (2003) indicates that Snake River basin steelhead will likely utilize thermal refuge as far upstream as RM 16.2 after dam removal.

Upper Columbia River Steelhead

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) gives a description of the origin, life history, critical habitat designation and ESA listing determination of Upper Columbia River steelhead in the White Salmon River and Columbia River/Bonneville Pool as of June 2002. On February 11, 2002, the ESA listing determination of endangered came under review (NMFS 2002). On December 14, 2004, it was proposed that the ESU be down-listed to an ESA determination of threatened (NMFS 2004a) and the date for determination was extended six months on June 16, 2004 (NMFS 2005b).

The U.S. District Court for the District of Columbia approved an NMFS consent degree on April 30, 2002 (USDC 2002), withdrawing the critical habitat designation and the final rule removing the critical habitat designation was published on September 29, 2003 (NMFS 2003). An assessment of critical habitat was prepared by the NOAA Fisheries critical habitat analytical review team (NOAA 2004) and on December 14, 2004 a new critical habitat designation was proposed designating Upper Columbia River steelhead critical habitat to include the Columbia River (including Bonneville Pool) (NMFS 2004b). Critical habitat was defined as including the stream channel within the proposed stream reach, including a lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent is defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series. Critical habitat in lake areas is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of ordinary high water, whichever is greater. The Columbia River is defined as a freshwater migration corridor with the following primary constituent elements: free of obstruction and excessive predations, with water quantity and quality conditions and natural cover supporting juvenile and adult mobility and survival. Final critical habitat designations were published on September 2, 2005 (NMFS 2005c). No changes from the proposed critical habitat designations were made in the project area.

Unpublished data from adult tracking studies conducted by Peery and Keefer at the University of Idaho suggests that significant numbers of “drop-in” steelhead hatchery-strays from other basins move into the Deschutes River temporarily, then return downstream to the Columbia and continue to other watersheds (Cramer et al. 2003). Steelhead collected at Bonneville Dam were outfitted with transmitters. These fish were later detected in the Deschutes River at RM 0.3 and RM 43 (Sherars Falls). Approximately 60-70% of the steelhead detected within the mouth of the Deschutes were later detected in other watersheds, and 30-40% of steelhead detected near Sherars Falls were later detected in other watersheds. Up to 25% of the radio-tagged steelhead known to have traveled as far upstream as Sherars Falls were later found in the Snake River. Although these “drop-in” steelhead are primarily hatchery steelhead from the Snake River basin, the lower portion of the Deschutes was famous in the 1950s for sports catches of large wild B-run steelhead trout of 20 pounds or more (Migdalski 1962) that were likely “drop-in” fish from the Snake River basin. Based on this information, it is likely that “drop-in” steelhead (and other andromous salmonids) from Columbia River and Snake River ESUs upstream of the White Salmon River will utilize pools for refuge from high summer water temperatures in the Bonneville Pool throughout the reaches of the White Salmon River that become accessible after the removal of Condit Dam.

Although Upper Columbia River steelhead are not residents of the White Salmon River, adults are attracted to and stray into the cooler waters of the White Salmon River during the summer. The lower White Salmon River provides an excellent thermal refuge for summer steelhead migrating upstream in the Columbia River (Rawding 2000), and the Peery and Keefer research presented in Cramer et al. (2003) indicates that Upper Columbia River steelhead will likely utilize thermal refuge as far upstream as RM 16.2 after dam removal.

Middle Columbia River Steelhead

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002), along with Section 4.3.1.2 and Appendix E of the FEIS for the Condit Hydroelectric Project (FERC 1996) give a detailed description of the origin, life history, and status of steelhead in the White Salmon River. On February 11, 2002 the ESA listing determination of threatened came under review (NMFS 2002). On December 14, 2004, it was proposed that the ESA listing of threatened be continued (NMFS 2004a) and the date for determination was extended six months on June 16, 2004 (NMFS 2005b).

The U.S. District Court for the District of Columbia approved an NMFS consent degree on April 30, 2002 (USDC 2002), withdrawing the critical habitat designation, and the final rule removing the critical habitat designation was published on September 29, 2003 (NMFS 2003). An assessment of critical habitat was prepared by the NOAA Fisheries critical habitat analytical review team (NOAA 2004) and on December 14, 2004 a new critical habitat designation was proposed designating Middle Columbia River steelhead critical habitat to include the White Salmon River from the base of Condit Dam to its mouth (NMFS 2004b). Critical habitat was defined as including the stream channel within the proposed stream reach, including a lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent is defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series. Critical habitat in lake areas is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of ordinary high water, whichever is greater. The White Salmon River contains the following primary constituent elements: 1) freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; 2) freshwater rearing sites with floodplain connectivity, forage supporting juvenile development, and natural cover; and 3) a freshwater migration corridor with the following primary constituent elements: free of obstruction and excessive predations, with water quantity and quality conditions and natural cover supporting juvenile and adult mobility and survival. Final critical habitat designations were published on September 2, 2005 (NMFS 2005c). No changes from the proposed critical habitat designations were made in the project area.

Bull Trout

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) gives a description of the origin, life history, critical habitat designation and ESA listing determination of the Columbia River bull trout DPS in the White Salmon River and Columbia River/Bonneville Pool as of June 2002. On November 29, 2002, designation of critical habitat for the Columbia River bull trout DPS was proposed and the availability of a draft recovery plan for the Columbia River bull trout DPS was announced (USFWS 2002a). Critical habitat for the Columbia River bull trout DPS was proposed on June 25, 2004 (USFWS 2004a) and a final rule published on October 6, 2004 that designated critical habitat in the project area to include the White Salmon River from Big Brother Falls at RM 16.2 downstream to its mouth, but only for non-federal lands that have greater than ½ mile of river frontage (USFWS 2004b). USFWS is expected to publish a revised final rule for critical habitat of bull trout in the coterminous United States sometime after September 15, 2005 . The new final rule is to designat critical habitat for all bull trout DPSs in the lower 48 states, including the Columbia River, Klamath River, Jarbridge River, Coastal-Puget Sound, and St. Mary and Belly River DPSs.

Critical habitat was defined as including the stream channels within the defined stream reachs indicated on the maps in the critical habitat designation, including a lateral extent from the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge which generally has a recurrence interval of 1 to 2 years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line shall be used to determine the lateral extent of critical habitat. Critical habitat in lake areas is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of ordinary high water, whichever is greater. The White Salmon River contains the following primary constituent elements: 1) water temperatures ranging from 36 to 59ºF with adequate thermal refugia available for temperatures at the upper end of this range; 2) complex stream channels; 3) substrates that ensure success of egg and embryo survival and fry to juvenile survival; 4) a natural hydrograph or, if regulated a hydrograph that minimizes daily and day-to-day fluctuations and departures from the natural flow cycles; 5) subsurface water connectivity to contribute to water quality and quantity; 6) migratory corridors with minimal impediments between spawning, rearing, overwintering, and foraging habitats; 7) an abundant food base; 8) few or no nonnative predatory, interbreeding, or competitive species present; and 9) permanent water of sufficient quantity and quality for normal reproduction, growth and survival. Critical habitat also excludes non-Federal lands regulated under the Washington Forest Practice Act (RCW Ch. 76.09).

Southwest Washington/Columbia River Cutthroat Trout

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002) gives a description of the origin, life history, and status of Southwest Washington/Columbia River cutthroat trout in the White Salmon River and Columbia River/Bonneville Pool as of June 2002. On April 21, 2000, NMFS and the USFWS published a notice transferring jurisdiction for coastal cutthroat trout from NMFS to the USFWS (NMFS and USFWS 2000). All coastal cutthroat trout ESUs were redesignated as Distinct Population Segments (DPSs). On July 5, 2002, the USFWS withdrew the proposed rule to list the southwestern Washington/Columbia River DPS of the coastal cutthroat trout as threatened (USFWS 2002b). The coastal cutthroat trout in the White Salmon River basin is now considered a species of concern by the USFWS (USFWS 2005a).

Lower Columbia River/Southwest Washington Coho Salmon

Section 3.4.5 of the FSFEIS for the Condit Hydroelectric Project (FERC 2002), along with Section 4.3.1.2 and Appendix E of the FEIS for the Condit Hydroelectric Project (FERC 1996) give a detailed description of the origin, life history, and status of coho salmon in the White Salmon River. On February 11, 2002 the candidate Lower Columbia River/Southwest Washington Coho Salmon ESU was added to a list of 25 west coast salmon and steelhead ESUs to have their status updated (NMFS 2002). On December 14, 2004, it was proposed that the ESU candidate status be changed to an ESA determination of threatened (NMFS 2004a) and the determination was finalized in a notice published on June 16, 2004 (NMFS 2005a).

Section 5 Potential Impact of Anadromous Salmonids on Resident Rainbow Trout

Where there is a strong out-migration of age 1 resident trout from a spawning stream (particular warmer tributaries with low summer flows), the potential exists for a landlocked resident population of rainbow trout to select for an anadromous ecotype when the barrier to migration is removed or habitat conditions change to favor the anadromous ecotype (Marshal et al. 2004).

The following key was developed by Cramer et al. (2003) for determining where in a stream basin trout are most likely to develop anadromous or resident ecotypes

Stream key for anadromy vs residency

Resident rainbow streams

Streams draining to a river with summer base flow 500–1,000 cfs and mean August temperature of 50-59ºF. Migratory habits of rainbow in the tributary network of the main river would be expected as follows.

- Tributaries with August temperature > 59ºF. Rainbow fluvial to main river.
- Tributaries with summer base flow < 150 cfs. Rainbow fluvial to main river.
- Tributaries with August temperature < 59ºF, and summer base flow > 150 cfs. Rainbow rearing through adulthood, with some fluvial to main river.
- Tributaries with August temperature > 59ºF and summer base flow < 150 cfs. May produce steelhead if abundance of competitors in main stem is high and average survival during smolt migration to the ocean is high.

Anadromous rainbow streams

These are all other streams, most with mean August temperature > 59ºF. Theoretically, there could be a zone of overlap between resident and anadromous populations, but environmental gradients are sharp enough that no clear examples of zones were both types are common were analyzed.

The general assumption among the public and many professional biologists that streams in western Washington never contained significant populations of resident trout is erroneous when it applies to larger streams at low to moderate elevations. In the first half of the 20th century, the Grays River, a tributary of the lower Columbia River, contained an abundance of 16 to 22 inch resident trout (Burns 1953). This was attributed to the remoteness of the river and lack of fishing pressure. Large resident rainbow occurred in the canyon reach of the Puyallup River between Anderson Creek and the Electron Powerhouse in a period from the 1960s through the 1980s (Nielsen 2005). They also occurred during that period in the Nisqually River for several miles below LaGrande Dam and several spring creeks in the Puyallup River valley (Nielsen 2005). Snorkel surveys of the upper Washougal River that has been closed to fishing for decades (McMillian 1985, 1986) and in the more inaccessible areas of the Wind River Canyon (McMillan and Nawa 1985, McMillan 1988) have found that substantial numbers of resident fluvial rainbow are present in mature breeding ages as estimated by their large size (15 to 22 inches). Limited bank access and catch restrictions was also one of the factors that has enabled the McKenzie River (a westside river) to sustain a trophy fishery for resident coastal rainbows. Limited access or catch restrictions have almost always played a major role in creating or maintaining trophy fisheries in northwestern rivers. The relative lack of trophy rainbow trout (or trophy coastal cutthroat trout and bull trout) in larger western Washington streams is primarily an artifact of regulations that have allowed too high a harvest of larger resident trout (Nielsen 2005).

The potential exists that the genotype for anadromy continues to exist in the resident population of rainbow trout above Condit Dam, particularly the fluvial-adfluvial population spawning in the Rattlesnake and Buck Creek watersheds. The removal of Condit Dam may allow over time for the selection of an anadromous ecotype (Bilby et al. 2005, Sanderson et al. 2004, Nielsen 2005). The genetic traits necessary for anadromy have been documented to persist for decades in landlocked steelhead populations (Thrower et al. 2004a, 2004b). However, genetic drift can cause a loss of fitness for the anadromous ecotype. This can manifest as a reduced survivability during freshwater and particularly marine migrations (Bilby et al. 2005, Sanderson et al. 2004, Nielsen 2005).

If selection for the anadromous phenotype doesn't occur fast enough to be practical, it may be possible to create a native anadromous broodstock by trapping and raising outmigrants (Phelps et al. 2001). Since interbreeding has been documented to occur between anadromous and resident ecotypes of rainbow trout (McMichael et al. 2000, Cramer et al. 2003, Zimmerman et al. 2003, Nielsen 2005), maintaining a close genetic link between the two ecotypes helps to prevent any loss of survival traits that have been selected for in a native population.

Potential for adverse impacts resulting from ecological interactions among wild resident rainbows and hatchery steelhead is greatest when (McMichael et al. 2000, Nielsen 2005 Pearsons et al. 1996):

- Hatchery fish do not emigrate quickly
- Water temperatures are over 8ºC (Hillman et al. 1992)
- Hatchery fish are larger than the wild rainbows
- Habitat and/or food is limiting

Ecological interactions of hatchery steelhead with wild resident rainbows can be minimized by releasing (McMichael et al. 2000, McMichael 1994, McMichael et al. 1994, Pearsons et al. 1996, Nielsen 2005):

- Only actively migrating smolts (no residuals)
- Smolts using an acclimation pond and stop releases when emigrants no longer exhibit smolt characteristics (Viola and Schuck 1995)
- No hatchery steelhead after June 1 (likely to become residuals)
- Fish reared at low density (less than half of traditionally accepted loading densities) (Banks 1994, Ewing and Ewing 1995).
- Hatchery fish of a size that minimizes interaction potential (smaller than wild fish: mean size < 7 inches FL)
- The minimum number necessary to meet management objectives

- Fish that do not exhibit counter-productive and inappropriate behaviors (e.g. less likely to engage wild fish in agonistic encounters)

- When water temperatures are relatively cold (less than 46ºF)

- Hatchery fish at dusk or shortly thereafter (McMichael et al. 1992)

To minimize risks of adverse ecological interactions, hatchery steelhead should only be released in areas where (McMichael et al. 2000).

- Coexisting wild salmonid populations are either absent or abundant and healthy

- Limitations to wild populations exist due to a density-independent pre-smolt stage bottleneck

- Habitat diversity is complex

In situations where hatchery residuals remain in a stream, remove in a way that does not adversely impact wild resident fish. Angling regulations could be adopted that encourage the harvest of hatchery steelhead residuals marked with clipped fins. In addition to angling regulations targeting residual hatchery steelhead, Martin et al. (1993) also recommended releasing hatchery steelhead smolts in locations that were easily accessible to anglers. A season on marked hatchery steelhead can be timed to occur after the period of active smolt migration (June 1). In any case, incidental mortality to wild fish is possible when undersized or unmarked fish are hooked and released (Ferguson and Tufts 1992, McMichael et al. 2000).

References:

Allen, M.B., P.J. Connolly, and K. Martens. 2003. Characterization of flow, temperature, habitat conditions, and fish populations in the Rattlesnake Creek watershed. *In* Assess current and potential salmonid production in Rattlesnake Creek associated with restoration efforts, 2002 Annual Report, Editor, P.J. Connolly. Contract# 00005068, Project# 2001-025-00. Prepared by U.S. Geological Survey, Western Fisheries Research Center, Columbia River Research Laboratory, Cook, Washington for Bonneville Power Administration, Environment, Fish and Wildlife Division, Portland, Oregon.

Bair, B., D. Grover, and P. Powers. 2002. Effects of the proposed Condit Dam removal on fish populations and habitat in the White Salmon Wild and Scenic River. U.S Forest Service, March 15, 2002.

Banks, J.L. 1994. Raceway density and water flow as factors affecting spring Chinook salmon (*Oncorhynchus tshawytscha*) during rearing and after release. *Aquaculture* 119:201-217.

Behnke, R.J. 1992. Native trout of western North America. *American Fisheries Society Monograph* 6, American Fisheries Society, Bethesda, Maryland.

———. 2002. *Trout and Salmon of North America.* The Free Press, New York, New York.

Bilby, R.E., P.A. Bisson, C.C. Coutant, D. Goodman, S.Hanna, N. Huntly, E.J. Loudenslager, L. McDonald, D.P. Philip, B. Riddell, J. Olsen, and R. Williams. 2005. Viability of ESUs containing multiple types of populations. Independent Scientific Advisory Board for the Northwest Power and Conservation Council, Columbia River Basin Indian Tribes, and NOAA Fisheries, Portland, Oregon.

Blakley, A., B. Leland, and J. Ames (editors). 2000. 2000 salmonid stock inventory, coastal cutthroat trout. Washington Department of Fish and Wildlife, Olympia, Washington.

Burk, RobertL. 2005. Principal Geologist, URS Corporation, Seattle, Washington. E-mail communication with Rob Nielsen, URS. May 2, 2005.

Burns, E. 1953. *Advanced Fly Fishing.* Stackpole Books, Harrisburg, Pennsylvania.

Byrne, J., R. McPeak, and B. McNamara. 2001. Bull trout population assessment in the Columbia River Gorge, FY-2000 Annual Report. BPA Report DOE/BP-00004474-1. Bonneville Power Administration, Portland, Oregon.

Campton, Don. 2005. Fisheries Biologist, U.S. Fish and Wildlife Service, Aberdeen Station, Washington. Phone conversation with Rob Nielsen, URS. May 16, 2005.

Chapman, D.W., W.S. Platts, and M. Hill. 1990. Evaluation of introduction of anadromous salmonids upstream from Condit Dam in the White Salmon River, Washington. Prepared for PacifiCorp Electric Operations by Don Chapman Consultants, Inc. Boise, Idaho. December 20, 1990.

Connolly, P.J. 2005a. Fisheries Biologist, U.S. Geological Survey, Western Fisheries Research Center, Columbia River Research Laboratory, Cook, Washington. Phone Conversation with Rob Nielsen, URS. May 11, 2005.

———. 2005b. Fisheries Biologist, U.S. Geological Survey, Western Fisheries Research Center, Columbia River Research Laboratory, Cook, Washington. Phone Conversation with Rob Nielsen, URS. June 1, 2005.

———. 2005c. Fisheries Biologist, U.S. Geological Survey, Western Fisheries Research Center, Columbia River Research Laboratory, Cook, Washington. Phone Conversation with Rob Nielsen, URS. June 7, 2005.

Connolly, P.J., C.S. Sharpe, and S. Sauter. 2002. Evaluate status of coastal cutthroat trout in the Columbia River basin above Bonneville Dam, 2001 Annual Report. Contract# 00005678, Project# 2001-007-00. Prepared by U.S. Geological Survey, Western Fisheries Research Center, Columbia River Research Laboratory, Cook, Washington and Washington Department of Fish and Wildlife, Kelso, Washington for Bonneville Power Administration, Environment, Fish and Wildlife Division, Portland, Oregon.

Connor, W.P., J.G. Sneva, K.F. Tiffan, R.K. Steinhorst, and D. Ross. 2005. Two alternative juvenile life history types for fall Chinook salmon in the Snake River basin. *Transactions of the American Fisheries Society* 134: 391-304.

Cramer, S.P., D.B. Lister, P.A. Monk, B.J. Pyper, and K.L. Witty. 2005. Viability of the Middle Columbia Steelhead ESU. Prepared for the Yakima Basin Joint Board, Yakima, Washington by S.P. Cramer & Associates, Inc., Gresham, Oregon. http://www.spcramer.com/spcramer.html (Reports, 2004).

Cramer, S.P., D.B. Lister, P.A. Monk, and K.L. Witty. 2003. A review of abundance trends, hatchery and wild fish interactions, and habitat features for the Middle Columbia Steelhead ESU. Prepared for Mid Columbia Stakeholders by S.P. Cramer & Associates, Inc., Sandy, Oregon. http://www.spcramer.com/spcramer.html (Reports, 2003).

Crawford, B.A. 1979. The origin and history of the trout brood stocks of the Washington Department of Game. Washington State Game Department, Olympia, Washington.

Ehlke, R.D. and K. Keller. 2003. 2002 chum salmon spawning ground surveys on the mainstem Columbia and its Washington Tributaries, annual report. BPA Contract Number 00004287, WDFW Contract Number 33032084, PSMFC Contract Number 528.03. Prepared by the Pacific States Marine Fisheries Commission, Vancouver, Washington for the Bonneville Power Administration, Portland, Oregon.

Everest, F.H. 1973. Ecology and management of summer steelhead in the Rogue River. *Fisheries Research Paper* 7, Oregon State Game Commission, Portland.

Ewing, R.D. and S.K. Ewing. 1995. Review of the effects of rearing density on survival to adulthood for Pacific salmon. *The Progressive Fish-Culturist* 57:1-25.

Federal Energy Regulatory Commission (FERC). 1996. Final Environmental Impact Statement, Condit Hydroelectric Project, Washington. FERC Project No. 2342-005. Federal Energy Regulatory Commission, Washington, DC.

———. 2002. Final Supplemental Final Environmental Impact Statement, Condit Hydroelectric Project, Washington. FERC Project No. 2342. Federal Energy Regulatory Commission, Washington, DC.

Frest, T.J. 2003. Some recent and historical records for northwestern U.S. Unionoids. In Workshop on the freshwater mussels of the Pacific northwest, Wednesday, February 19, 2003, Vancouver Water Resources Center, Vancouver, WA: Workshop Report. U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, Vancouver, Washington.

Frest, Terrence. 2004. Malacolgist, Deixis, Seattle, Washington. Phone conversation with Rob Nielsen, URS.

Hall, J.D., P.A. Bisson, and R.E. Gresswell, editors. 1997. Sea-run cutthroat trout: biology, management, and future conservation. Oregon Chapter, American Fisheries Society, Corvallis, Oregon.

Hallock, Molly. 2005. Fisheries Biologist, Washington Department of Fish and Wildlife, Olympia, Washington. Phone conversation with Rob Nielsen, URS. May 16, 2005.

Hillman, T.W., J.W. Mullan, and J.S. Griffith. 1992. Accuracy of underwater counts of juvenile Chinook salmon, coho salmon, and steelhead. *North American Journal of Fisheries Management 1*2(3):598-603.

Hubble, J.D. 1992. A study of the summer steelhead in several intermittent tributaries of the Satus Creek basin, Washington. M.S. Thesis, Central Washington University, Ellensburg, Washington.

Jezorek, I.G. and P.J. Connolly. 2003. Instream PIT-tag detection system. *In* Assess current and potential salmonid production in Rattlesnake Creek associated with restoration efforts, 2002 Annual Report, Editor, P.J. Connolly. Contract# 00005068, Project# 2001-025-00. Prepared by U.S. Geological Survey, Western Fisheries Research Center, Columbia River Research Laboratory, Cook, Washington for Bonneville Power Administration, Environment, Fish and Wildlife Division, Portland, Oregon.

Johnson, Orlay. 2005. Fisheries Biologist, National Marine Fisheries Service, Seattle, Washington. E-mail communication with Rob Nielsen, URS. May 16, 2005.

Johnson, O.W., M.H. Ruckelshaus, W.S. Grant, F.W. Waknitz, A.M. Garrett, G.J. Bryant, K. Neely, and J.J. Hard. 1999. Status review of coastal cutthroat trout from Washington, Oregon, and California. Technical Memo NMFS-NWFSC-27. National Marine Fisheries Service, Seattle, Washington.

Kostow, K. editor. 1995. *Biennial Report on the Status of Wild Fish in Oregon.* Oregon Department of Fish and Wildlife, Salem, Oregon.

Lane and Lane Associates (LLA). 1981. The White Salmon River Indian Fisheries and Condit Dam. Prepared by Lane and Lane Associates with Douglas Nash. Department of the Interior, Bureau of Indian Affairs, Portland, Oregon.

Larsen, E.M., E. Rodrick, and R. Milner, Editors. 1995. Management Recommendations for Washington's Priority Species, Volume I: Invertebrates, California Floater, *Anodonta californiensis*. Washington Department of Fish and Wildlife, Olympia, Washington.

LeMier, E.H. and W.E. Smith. 1955. Biological appraisal of the Big White Salmon River. Washington Department of Fisheries, Olympia, Washington.

McMichael, G.A. 1994. Effects of parentage, rearing density, and size at release of hatchery-reared steelhead smolts on smolt quality and post-release performance in natural streams. In *In* T.N. Pearsons, G.A. McMichael, S.W. Martin, E.L. Bartrand, M. Fischer, and S.A. Leider, editors. Yakima River species interactions studies, Annual Report 1993. BPA Report DOE/BP-99852-2. Bonneville Power Administration, Portland, Oregon.

McMichael, G.A., J.P. Olson, E.L. Bartrand, N. Fisaher, J.N. Bindman, S.A. Leider. 1992. Yakima River species interactions studies, annual report 1991. BPA Report DOE/BP-01483-2. Bonneville Power Administration, Portland, Oregon.

McMichael, G.A., T.N. Pearsons, and S.A. Leider. 1994. The effects of releases of hatchery-reared steelhead on wild salmonids in natural streams. *In* T.N. Pearsons, G.A. McMichael, S.W. Martin, E.L. Bartrand, M. Fischer, and S.A. Leider, editors. Yakima River species interactions studies, Annual Report 1993. BPA Report DOE/BP-99852-2. Bonneville Power Administration, Portland, Oregon.

McMichael, G.A., T.N. Pearsons, and S.A. Leider. 2000. Minimizing ecological impacts of hatchery-reared juvenile steelhead on wild salmonids in a Yakima basin tributary. *In* Knudson, E.E., C.R. Steward, D.D. MacDonald, J.E. Williams, D.W. Reiser, editors. *Sustainable fisheries management: Pacific salmon.* Lewis Publishers, CRC Press LLC, Boca Raton, Florida.

McMillan, B. 1988. The Clark-Skamania Flyfishers' snorkel surveys of Wind River (1987). Clark-Skamania Flyfishers, Vancouver, Washington.

McMillan, B. and R. Nawa. 1985. The Clark-Skamania Flyfishers' snorkel surveys of Wind River (1983-85). Clark-Skamania Flyfishers, Vancouver, Washington.

Marshall, A.R., M. Small, and S. Foley. 2004. Genetic relationships among anadromous and non-anadromous *Oncorhynchus mykiss* in Cedar River and Lake Washington – implications for steelhead recovery planning. Washington Department of Fish and Wildlife, Fish Program, Science Division and Fish Management Division, Region 5, Olympia and Mill Creek, Washington.

Martin, S.W., A.E. Viola, and M.L. Schuck. 1993. Investigations of the interactions among hatchery reared summer steelhead, rainbow trout, and wild spring Chinook salmon in southeast Washington. Washington Department of Wildlife, Olympia, Washington.

Migdalski, E.C. 1962. *Fresh Water Sport Fishes.* The Ronald Press Company, New York, New York.

National Marine Fisheries Service (NMFS). 2000. Designated critical habitat: critical habitat for 19 evolutionarily significant units of salmon and steelhead in Washington, Oregon, Idaho, and California. Federal Register. Vol. 65, No. 32, 7764-7787. February 16, 2000.

National Marine Fisheries Service (NMFS). 2002. Findings on petitions to delist Pacific salmonid ESUs. Federal Register. Vol. 67, No. 28, 6215-6220. February 11, 2002.

———. 2003. Advance notice of Proposed rulemaking to designate critical habitat for 20 listed evolutionarily significant units of Pacific salmon and steelhead. Federal Register. Vol. 68, No. 188, 55926-55932. September 29, 2003.

———. 2004a. Proposed listing determination for 27 ESUs of west coast salmonids. Federal Register. Vol. 69, No. 113, 33102-33179. June 14, 2004.

———. 2004b. Designation of critical habitat for 13 evolutionarily significant units of Pacific salmon (*Oncorhynchus* spp.) and steelhead (*O. mykiss*) in Washington, Oregon, and Idaho; proposed rule. Federal Register. Vol. 69, No. 239, 74572-74820. December 14, 2004.

———. 2005a. Final listing determinations for 16 ESUs of West Coast Salmon, and final 4(d) protective regulations for threatened salmonid ESUs. Federal Register. Vol. 70, No. 123, 37160-37204. June 28, 2005.

———. 2005b. 6-month extension of the final listing determinations for ten Evolutionarily Significant Units of West Coast Oncorhynchus mykiss. Federal Register. Vol. 70, No. 123, 37219-37220. June 28, 2005.

———. 2005c. Designation of critical habitat for 12 evolutionarily significant units of west coast salmon and steelhead in Washington, Oregon, and Idaho; final rule. Federal Register. Vol. 70, No. 170, 52630-52858. September 2, 2005.

———. 2005d. Appendix F, CHART assessment for the Columbia River chum salmon ESU. In Final Assessment of NOAA fisheries critical habitat analystical review teams for 12 evolutionarily significant units of west coast salmon and steelhead. NOAA Fisheries Protected Resources Division, Portland, Oregon.

National Marine Fisheries Service and United States Fish and Wildlife Service (NMFS and USFWS). 2000. Notice of change of jurisdiction for coastal cutthroat trout. Federal Register. Vol. 65, No. 78, 21376-20123. April 21, 2000.

Nielsen, R.G. 2005. A review of issues associated with and expected interactions between reestablished anadromous *Onchorynchus mykiss* populations and existing resident salmonids. In Press.

NOAA Fisheries (NOAA). 2004. Initial assessment of NOAA Fisheries' critical habitat analytical review teams for 13 evolutionarily significant units of Pacific salmon and *O. mykiss*. NOAA Fisheries, Protected Resources Division, Portland, Oregon.

Pearsons, T.N., G.A. McMichael, S.W. Martin, E.L. Bartrand, J.A. Long, and S.A. Leider. 1996. Yakima River species interactions studies, Annual report 1994. BPA Report DOE/BP-99852-3. Bonneville Power Administration, Portland, Oregon.

Phelps, S.R., B.M. Baker, P.L. Hulett, and S.A. Leider. 1994. Genetic analysis of Washington steelhead: Initial electrophoretic analysis of wild and hatchery steelhead and rainbow trout. *Report* #94-0. Washington Department of Fish and Wildlife, Fisheries Management Program, Olympia, Washington.

Phelps, S.R., J.M. Hiss, and R.J. Peters. 2001. Genetic relationships of Elwha River *Oncorhynchus mykiss* to hatchery-origin rainbow trout in Washington steelhead. Prepared for the National Park Service, Olympic National Park, Port Angeles, Washington by Washington Department of Fish and Wildlife, Olympia, Washington and U.S. Fish and Wildlife Service, Western Washington Office, Division of Fisheries and Watershed Assessment, Lacey, Washington.

Phelps, S.R., S. Leider, P. Hulett, B. Baker, and T. Johnson. 1995. Electrophoretic characterization of five rainbow trout collections from the White Salmon River, Washington and determination of their genetic similarities to four hatchery strains. Unpublished document. Washington Department of Fish and Wildlife, Olympia, Washington.

Phelps, S.R., N. Switzler, and B. Ingram. 1990. Electrophoretic characterization of five rainbow trout collections from the White Salmon River. Unpublished document. Washington Department of Fish and Wildlife, Olympia, Washington.

Rawding, D. 2000. Draft White Salmon River subbasin summary. Prepared for the Northwest Power Planning Council by the Washington Department of Fish and Wildlife, Olympia, Washington.

Rawding, Dan. Fisheries Biologist, Washington Department of Fish and Wildlife, Vancouver, Washington. Phone conversation with Rob Nielsen, URS. May 16, 2005.

Sanderson, B., J. Travis, R. Lande, M. Mangel, R.A. Myers, P. Peterson, M. Power, D. Simberloff. 2004. Report for the meeting held December, 2004. National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, California.

Squier Assoicates (Squier). 1994. Northwest Lake Sediment Sampling Study. Squier Associates, Lake Oswego, Oregon.

Strayer, D.L. and D.R. Smith. 2003. A guide to sampling freshwater mussel populations. American Fisheries Society Monograph 8, American Fisheries Society, Bethesda, Maryland.

Thiesfeld, Stephen L. 2005. Fisheries Biologist, Washington Department of Fish and Wildlife, Vancouver, Washington. Phone conversation with Rob Nielsen, URS. June 7, 2005.

Thiesfeld, S.L., R.H. McPeak, B.S. McNamara, and I. Honanie. 2001. Bull trout population assessment in the White Salmon and Klickitat Rivers, Columbia Gorge, Washington, Fiscal Year 2001 Annual Report. BPA Contract# 00004474-00001, Project# 1999-024-00. Bonneville Power Administration, Portland, Oregon.

Thrower, F., C. Guthrie III, J. Nielsen, and J. Joyce. 2004a. A comparison of genetic variation between an anadromous steelhead, *Oncorhynchus mykiss*, population and seven derived populations sequestered in freshwater for 70 years. *Environmental Biology of Fishes* 69:111-125.

Thrower, F.P., J.J. Hard, and J.E. Joyce. 2004b. Genetic architecture of growth and early life-history transitions in anadromous and derived freshwater populations of steelhead. *Journal of Fish Biology* 65 Supplement A:286-307.

Trotter, P.C. 1987. *Cutthroat, Native Trout of the West.* Colorado Associated University Press, Boulder, Colorado.

———. 1997. Sea-run cutthroat trout: Life history profile. *In* J.D. Hall, P.A. Bisson, and R.E. Gresswell, editors. Sea-run cutthroat trout: biology, management, and future conservation. Oregon Chapter, American Fisheries Society, Corvallis, Oregon.

United States District Court (USDC). 2002. National Association of Home Builders et al., Plaintiffs, v. Donald L. Evans, Secretary of Commerce, et al., Defendants, Civil Action No. 00-2799 (CKK), Memorandum Order (April 30, 2002). United States District Court, District of Columbia.

United States Fish and Wildlife Service (USFWS). 2002a. Proposed designation of critical habitat for the Klamath River and Columbia River distinct population segments of bull trout. Federal Register. Vol. 67, No. 230, 71236-71284. November 29, 2002.

———. 2002b. Withdrawal of proposed rule to list the southwestern Washington/Columbia River distinct population segment of the coastal cutthroat trout as threatened. Federal Register. Vol. 67, No. 129, 44934-44961. July 5, 2002.

———. 2004a. Proposed designation of critical habitat for populations of bull trout. Federal Register. Vol. 69, No. 122, 35768-35857. June 25, 2004.

———. 2004b. Designation of critical habitat for the Klamath River and Columbia River populations of bull trout. Federal Register. Vol. 69, No. 193, 59996-60076. October 6, 2004.

———. 2005a. Endangered, threatened, proposed, and candidate species, critical habitat, and species of concern in western Washington. http://westernwashington.fws.gov/se/splisttableMar05.pdf.

———. 2005b. to come from Rob N.

Vestra Resources (Vestra). 1990. Depth profiles of Northwestern Lake. Vestra Resources, Redding, California.

Viola, A.E. and M.L. Schuck. 1995. A method to reduce the abundance of residual hatchery steelhead in rivers. *North American Journal of Fisheries Management* 15:488-493.

Washington Department of Fish and Wildlife (WDFW). 1998. 1998 Washington salmonid stock inventory, bull trout/Dolly Varden. Washington Department of Fish and Wildlife, Fish Program, Olympia, Washington.

Weinheimer, J. 2005. Fisheries Biologist, Washington Department of Fish and Wildlife, Vancouver, Washington. Phone Conversation with Rob Nielsen, URS. June 17, 2005.

Wydoski, R.S. and R.R. Whitney. 2003. *Inland Fishes of Washington.* Second edition. American Fisheries Society, Bethesda, Maryland and University of Washington Press, Seattle, Washington.

Zimmerman, C.E., K.V. Kuzishchin, M.S. Gruzdeva, D.S. Pavlov, J.A. Stanford, and K.A. Savvaitova. 2003. Experimental determination of the life history strategy of the Kamachatka Mykizha *Parassalmo mykiss* (Walb.) (Salmonidae, Salmonidformes) on the basis of analysis of the Sr/Ca ratio in otholiths. *Doklady Biological Sciences* 389:138-142.

Zimmerman, C.E. and G.H. Reeves. 2000. Population structure of sympatric anadromous and non-anadromous *Oncorhynchus mykiss*: evidence from spawning surveys and otolith microchemistry. *Canadian Journal of Fisheries and Aquatic Sciences* 57:2152-2162.

———. 2002. Identification of steelhead and resident rainbow trout progeny in the Deschutes River, Oregon, revealed with otolith microchemistry. *Transactions of the American Fisheries Society* 131(5):986-993.