CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

Fish and Fish Habitat ____________________________

Water temperature – effects to steelhead

Alternative A - No Action

The reservoir created by Hemlock Dam disrupts the natural pool frequency and creates a very large pool with a surface area of 550,000 ft_ (~13 acres). The average depth of the reservoir is two feet with the flashboards down, ~ six feet flashboards up. Average width to depth ratios for low and high flashboard configuration are 343 to 44 respectively. The large surface area exposed to the sun and shallow depths further increase water temperature maximums which may directly and indirectly kill steelhead. Under the no action alternative, the reservoir pool could directly increase maximum water temperatures by 2º C over pre-dam conditions. During low flow drought years these temperatures could directly and indirectly kill steelhead.

During summer months concentrations of juvenile fish have been observed congregating in the reservoir during low flow/high water temperature periods (Bair 1992 -2003). During these periods juvenile fish tend to concentrate in the deepest portions of the pool and are found to be numerous in the fish ladder (USFS Adult Steelhead Trap Data, 1994 – 2003). The appearance of fish with in the reservoir coincides with recorded maximum water temperatures up-stream of the dam (August-September). It is hypothesized that fish are emigrating downstream from Trout Creek Flats to seek refuge from the stressful water temperatures. However when they arrive within the reservoir water temperatures are even less hospitable exceeding 24°C (80°F) for periods up to 13 hours (Coffin, Hydrology Assessment 2004).

In July 1998 and 1999 snorkel reconnaissance indicated fish were most commonly found in the deeper water at the mouth of the reservoir and to a lesser extent around the bedrock shelf at the observation platform and the deep pool near the traveling screen (Wieman, 2000). Fish appeared to be targeting cooler water in areas deeper than six feet where there was a perceptible thermo-cline. The shallow regions of the reservoir (< 3 feet) were found to be nearly void of fish which may be due to the lack of thermal stratification and or cover. As Coffin discussed in the previous hydrology analysis of the reservoir, deeper areas within the lake can maintain lower water temperatures. These pockets of cooler water may provide thermal refugia for juvenile fish. However these cooler water pockets may concentrate fish which could indirectly make them more vulnerable to predation and disease.

There are no records of observed “fish kills” or direct mortality associated with extreme water temperatures or low dissolved oxygen within the reservoir. Direct and indirect effects of maximum water temperature events on steelhead within the reservoir and downstream are extremely difficult to evaluate. The 1987 Bell study which found that 50% of the steelhead study sample died after 17 hours exposure to 25˚C where confined to tanks within a laboratory where there was no escape. The congregations of fish observed within the reservoir appear to be seeking cool water regions and or migration routes past the dam. During the last 12 years schools of 250 – 1,000 parr and young of the year have been observed within the reservoir during extreme maximum water temperature events (>24˚C). On a spot snorkel survey conducted within Hemlock Reservoir during a peak water temperature event on August 8, 1999 Jezorek and Connolly observed 435 fry or age 0 and 293 parr or 1+ age.

In addition, electro-fishing and snorkel surveys conducted by the USGS 1998-2003 in Trout Creek near the reservoir estimate an average of 2,170 fry and 1,000 parr per river mile in the reaches above the reservoir. Preliminary snorkel surveys conducted below the reservoir during the summer months indicate similar densities (Bair 2003).

Due to the existence of cooler water regions within the reservoir and potentially in the canyon reach below the dam, mortality is not expected to be as high as what was documented by Bell. However due to the extent and duration of maximum water temperature events (13 hours ≥24˚C and 120 hours ≥20˚C continuous) within and downstream of the reservoir, the possibility exist that fish are directly and indirectly being killed from exposure and stress associated with maximum water temperatures during summer months. The percentage of fish dying from maximum water temperature exposure would be highly variable form year to year and extremely difficult to estimate. An estimated 0-10% of parr and fry trapped within the reservoir or inhabiting the reaches downstream of the dam may be killed directly or indirectly by maximum water temperatures.

Based on the above snorkel survey density data, an estimated 4,600 fry and 2,300 parr may be exposed to potentially lethal maximum water temperatures. If 10% of the parr and fry were killed directly or indirectly by maximum water temperatures there would be approximately 120 fewer smolts [13% and 25% fry to smolt survival (Ward et. al. 1976-1998) and 4% smolt to adult survival (personal communication with Dan Rawding, 2004)] which would equate to five fewer adults returning.

Alternative B

Maximum water temperatures would incrementally decrease as a result of removing the dam within the project reach. Decreasing water temperature maximums would directly and indirectly benefit threatened steelhead by reducing stress, disease, predation and mortality.

The effects that sediment deposition may have on water temperature relative to the down stream reaches of the action area are uncertain. Water temperatures within the Columbia and Snake River systems have increased as a result of dam construction. During the period following the construction of Bonneville and Grand Coulee Dams (1941-1956), water temperatures exceeded 20º C at Bonneville Dam for an average of 12 days per year. After the completion of Chief Joseph, McNary, John Day, The Dalles, Ice Harbor, Lower Monumental, Little Goose and Lower Granite Dams were constructed water temperatures exceeded 20º C 48 days per year on average 1976-1993 (EPA, pdf accessed 7/27/2004).

Water temperature maximums within the Wind River below Shipperd Falls have not exceeded 17ºC in recent years (Underwood Conservation District, Water Quality Monitoring Data 199X-200X). The lower water temperatures which exist within the lower reach are significantly influenced by Panther Creek which enters the Wind River at river mile 4.3. Panther Creek is a spring fed system which carries approximately _ of the Wind Rivers discharge during summer months and provides thermal refuge for both fish within the Wind River above Panther Creek and fish migrating up the Columbia River.

The effects of water temperature on salmonid survival or migration at the mouth, where the waters of the Columbia and Wind Rivers mix are not known at this time. Release of sediment and deposition particularly at the mouth may incrementally decrease depth / increase width and water temperature within localized/stagnate areas. These temperature increases are expected to be more directly influenced by the pool/reservoir elevation, Columbia River discharge and wind direction and velocity. Direct and indirect mortality of threatened salmonids associated with maximum water temperatures in the lower river are not expected to occur as a result of this project. In addition, adult or juvenile salmonid migration into the Wind River thermal refuge is not expected to be affected by increased sediment deposition or isolated temperature increases.

Alternative C

Maximum water temperatures would incrementally decrease as described in Alternative B. Decreasing water temperature maximums would directly and indirectly benefit threatened steelhead by reducing stress, disease, predation and mortality.

Potential water temperature increases in the down stream reaches of the action area would be significantly less in the short term relative to Alternative B since the majority of sediment would be removed. The cool water temperatures within the lower Wind River will continue to provide thermal refuge for both fish within the Wind River above Panther Creek and fish migrating up the Columbia River.

Mortality of threatened salmonids associated with maximum water temperatures in the lower river are not expected to occur as a result of this project nor is adult or juvenile salmonid migration into the Wind River thermal refuge is not expected to be affected by increased sediment deposition or isolated temperature increases.

Alternatives D and E

The after the lake is dredged, the depth and capacity would in part be maintained by operation of the sluice gate on an annual basis to move sediments through the system. The sluicing of material would maintain some limited area of deeper water toward the lower end of the lake. The upstream extent of this sluicing effect is unknown and not expected to be large (Coffin, 2004 Hydrology Report).

In the short term, dredging of the lake would likely improve water temperatures within the lake and in downstream reaches of Trout Creek by approximately 0.9C, approximately the same effect as removal of the dam in terms of immediate effects to peak water temperatures (Coffin, 2004). Dredging would also retain and possibly enhance the water temperature refugia currently found in the deeper portions of the lake. However these benefits would be temporary if dredging is not periodically repeated (Coffin, 2004). To retain water temperature decreases gained from dredging, the lake would need to be dredged after every 5 to 10-year flood (BOR, 2004).

Decreasing water temperature maximums would directly and indirectly benefit threatened steelhead by reducing stress, disease, predation and mortality.

The cool water temperature areas within the reservoir are likely to be expanded which would provide fish additional refuge from maximum water temperatures.

Turbidity – effects to steelhead

Alternative A

The dam in its existing condition, does not provide safe passage for ESA listed steelhead, increases maximum water temperatures above lethal levels of salmonids and impedes the natural transport of sediment and organics which reduces the amount of potential spawning gravel and the quality of rearing habitat in downstream reaches.

Alternative B

The concentrations of suspended sediment that have been determined to kill fish over a short time period (hours) typically range from the hundreds to hundreds of thousands of milligrams of sediment per liter, while concentrations which may harm them but not kill them directly (sublethal indirect effects) are often in the tens to hundreds of milligrams of sediment per liter (CMFO, 2001). There are at least 5 ways in which an excessive amount of sediment might be harmful to a aquatic organisms: 1) acting directly on the fish swimming in the water in which solids are suspended, and either killing them or reducing their growth rate, resistance to disease etc., 2) preventing the successful development of fish eggs and larvae 3) modifying natural movements and migrations of fish 4) reducing the abundance of food available to the fish and, 5) affecting the efficiency of methods for catching prey.

The draining of an impoundment such as Hemlock Dam produces negative effects on aquatic communities by, in part, elevating sediment levels. For example, the flushing of British Columbia's Shuswap Falls dam in 1970, resulted in the elevation of suspended sediments. The "stressing" of whitefish, trout, and chinook salmon, and the clogging of gills was evident at suspended sediment levels of 10,000 mg·L -1 (CMFO, 2001). Models that utilize a function of concentration and duration of exposure to predict potential harm (Newcombe and MacDonald 1991; Newcombe and Jensen 1996; Caux et al. 1997; BCMELP 1998; CCME 1999), An assessment of the application of sediment models and relevant literature occurred during the revision of the Yukon Placer Authorization (Government of Canada 1993). This document describes the conditions under which placer mining can occur in the Yukon Territory and the sediment levels that may be discharged to certain streams. For example, as of January 1994 there was to be no increase in the concentration of sediments above background levels in salmon spawning streams, whereas for salmonid rearing streams the permissible increase is less than 200 mg·L -1 . It was recognized that there was some level of risk to aquatic organisms depending upon the sediment levels discharged and the sensitivity of the organisms in the streams where turbidity was increased. After a review of available information, impacts were classified in relation to the levels of risk to which the fish habitat would be subjected. These impacts were found to be best assessed using increases in the concentration of suspended sediment above background levels. The levels of risk and the corresponding concentrations of sediment are shown in the following table:

Table 4-16. Sediment increases in milligrams/liter and risk to fish and aquatic habitat criteria for Yukon Placer Mining Authorization (Government of Canada 1993).

Sediment increase (mg·L-1)	Risk to fish and their habitat
0	No risk
< 25	Very low risk
25 - 100	Low risk
100 – 200	Moderate risk
200 - 400	High risk
> 400	Unacceptable risk

Under Alternative B, turbidity levels in lower Trout Creek and the Wind River downstream of Trout Creek will increase dramatically during project activities, and during subsequent high flow events.

The 2004 BOR report states that after the project area is rewatered at an assumed discharge of 20 cfs (August low flow), suspended sediment concentrations are expected to stabilize downstream at approximately 5,000 mg/L. These concentrations would persist for 20 to 40 days (BOR, 2004). The report goes on to estimate that once flows increase (~200 cfs), additional sediment will be eroded from the lake and sediment concentrations downstream of the dam would be slightly higher, but last only 3 to 4 days. At discharges >2000 cfs, the high sediment concentrations will last no more than one day. After this initial high concentration period is over, the sediment concentrations are expected to return to background levels for subsequent flows (BOR, 2004).

Sediment concentrations in the Wind River are expected to be much lower due to the dilution of flows. During the month of September, the average streamflow of the Wind River above the confluence is approximately 6 times that of the flow in Trout Creek. Therefore the BOR report concludes that sediment concentrations would be approximately 1/6 of that in Trout Creek or 800 mg/L for a period of 20 to 40 days following dam removal and water reintroduction. At the mouth of the Wind River, the concentrations will be further reduced because of the additional flow from Panther Creek and other tributaries such as the Little Wind River. The concentrations at the mouth are approximated to be 500 mg/L at the mouth of the Wind River for a period of up to 40 days (BOR, 2004).

The duration and magnitude of turbidity events generated by channel incision could directly kill fish by suffocation; gills of adult and juvenile steelhead and scuplin would be overwhelmed by suspended fine sediment and clog gills. Fish which are able to escape upstream or reach the Wind River and migrate upstream of the turbidity plume may also indirectly die as a result of gill abrasion and subsequent infections. Filling of pools and covering of substrate with fine sediment will also directly kill macro invertebrates.

Approximately 2/3rds of all adult steelhead migrate past the project area during the months of September, October and November when the majority of sediment and turbidity effects are expected to be the greatest. This would mean that approximately 33 adult steelhead (out of an average run of 50 adults) could be exposed to extreme turbidities which could directly or indirectly kill them by suffocation and gill abrasion or impede migration into Trout Creek. In addition, an estimated 4,200 fry and 2,000 parr occupying Trout Creek below the project area could potentially be directly and indirectly killed by the effects of high turbidity.

As water is slowly reintroduced and turbidities increase, fish are expected to migrate out of the project area and lower reaches to escape the adverse water quality conditions. Adult, parr and fry steelhead occupying the lower reach would most likely descend into the Wind River to seek refuge. Escaping fish would still be exposed to elevated turbidities which could cause gill abrasion and indirect mortality. In a worst case scenario where an early fall freshet overwhelms the diversion structure or immediately follows flow reintroduction, fish could be engulfed in lethal turbidities. During a theoretic catastrophic event where 100% mortality of fry and parr occurred, would mean that 41 potential adult steelhead would not return to Trout Creek in the future. If adult mortalities were also 100%, a total of 74 potential adult spawners could be lost as a result of this alternative.

In addition, adult and juvenile fish occupying the reach below the Wind River / Trout Creek confluence could also suffer direct and indirect mortality associated with high turbidities. September snorkel surveys conducted by WDFW and US Forest Service (1999-2003) estimate that 145 adult steelhead occupy the reach below the confluence of Trout Creek to Shipperd Falls. These fish would also be at risk of indirect and direct mortality associated with increased turbidity.

It is anticipated that the majority of all project related sediment (both coarse and fine substrates) will be transported during the fall and winter high flows as the channel reaches vertical and lateral equilibrium. In total, an estimated 40,000 to 60,000 cubic yards of sediment may be delivered to stream channels downstream of the dam (BOR, 2004). Approximately 360 yd^3 to 16,000 yd^3 of sediment could be stored within Lower Trout Creek and the Wind River.

Coarse sediments delivered to lower Trout Creek (river mile 2.0-0) and the Wind River (river mile 11-0) will help maintain isolated pockets of spawning gravel throughout the confined canyon reaches. Some fine sediment produced by the project will stay in suspension through the canyon reaches of lower Trout Creek and the Wind River. A portion of these finer particles will fall out of suspension and be deposited near the mouth of the Wind River/confluence of the Columbia River.

Since steelhead spawn in the spring (March – May) and the majority of sediment transport/deposition is expected to occur between the months of September – February, impacts to incubating or emerging steelhead are not expected in the short or long term. The amount of available spawning gravel would be increased in the 1.5 mile reach of Trout Creek immediately below dam and incrementally increased in the canyon reach of the Wind River below the confluence of Trout Creek. The impacts to the Trout Creek fan (at the confluence of the Wind River) and immigration are not expected to be affected by additional accumulations of coarse sediment.

Water reintroduction, high turbidity and sediment transport will occur during a time when fall and bright chinook are spawning in the lower Wind River (Tule race September-October, Bright race October – November). Washington Department of Fish and Wildlife spawner survey data has documented runs of 11-1,845 Tule chinook (1967-1991) and 487-1,845 Bright chinook (1988-1991). Suspended sediment concentrations >200mg/L could directly and indirectly impede spawning and harm or kill spawning chinook.

In addition, The 2004 BOR report estimates that approximately 3" of sediment on average would be deposited at the mouth of the Wind River. Therefore if any chinook spawn in the lower river before the high turbidity events and subsequent to sediment deposition, there is an extremely low probability that any fertilized eggs would survive.

Alternative C

The downstream turbidity and sediment deposition effects on fish and aquatic organisms of this Alternative would be minor in comparison to those described under Alternative B. Because the majority of sediment would be removed, short term negative effects to aquatic resources associated with high turbidity events are expected to be insignificant. Direct mortality of adult and juvenile fish is not expected to occur as a result of high turbidity events. When flows are reintroduced, increased stream turbidity may deposit fine coats of sediment on channel substrate a short distance downstream, encourage fish to move downstream, and alter behavior patterns for a short time. Turbidity levels are not expected to reach levels that would negatively effect steelhead or chinook adults or juveniles in the Wind River below Trout Creek or at the mouth. Therefore no short or long term effects are expect to occur to the lower Wind River chinook populations.

Over time increased material would be moved through the project area and would provide higher sediment inputs to the downstream reaches of Trout Creek and the Wind River. Some of the larger material would be stored temporarily in these reaches, forming bed, bar, and channel margin deposits, but most of the smaller particles would continue to be routed through the system due to channel gradients (Coffin, 2004 Hydrology Report). The increase in substrate within the lower channel reaches would incrementally increase spawning gravel and macro invertebrate production and directly benefit fish by increase food availability.

Alternatives D and E

Compared to alternatives B or C, turbidity levels under alternative D would be much lower in magnitude and duration. Turbidity levels would increase under this Alternative during construction of the fish ladder and water diversion construction. During dredging, the main flow of Trout Creek would be isolated from the work area, and would not reach flowing water. Subsurface water entering the excavation area would be pumped into settling ponds, and the embayment created by the dam. These measures are expected to keep turbidity levels relatively low during construction.

After dredging and flows are returned to the reservoir and Trout Creek, there will be a brief increase in turbidity downstream. The magnitude and duration of this turbidity event is expected to be small and of short duration.

The knife gate on the Northwest side of the dam face is proposed to be seasonally opened during peakflow events to route sediment through the system and maintain reservoir depth and copacity. The gate would be opened during peakflow / high turbidity events during the winter months when adult and juvenile steelhead are typically not migrating. Operation of the knife gate is not expected to result in a measurable increase in turbidity.

Turbidity effects on fish and aquatic organisms of this Alternative would be very low. Direct mortality of adult and juvenile fish is not expected to occur as a result of high turbidity events. When flows are reintroduced, increased stream turbidity may deposit fine coats of sediment on channel substrate a short distance downstream, encourage fish to move downstream, and alter behavior patterns for a short time similar to alternative C.

Operation of the knife gate will allow some material to be moved through the project area and would provide sediment inputs to the downstream reaches of Trout Creek and the Wind River. This alternative would not restore the natural sediment routing relative to alternatives B or C due to the constriction of the knife gate (4'X 4' opening). The relatively small opening is not expected to route the quantity or quality of sediment downstream. In addition, there is a high likely hood that the opening could become clogged with large woody debris and become dysfunctional during the course of the winter. The increase in substrate within the lower channel reaches would incrementally increase macro invertebrate production and fish by increase food availability.

Sediment Routing/Deposition Effects

Alternative A - No Action

Past management activities in the upper watershed have increased the sediment load and accelerated the filling of the reservoir. Hemlock dam impedes the natural transport of large wood and organics, fine and coarse sediment. Past efforts to manage the sediment deposited behind the dam have included dredging the lake and manipulation of the knife gate to flush sediment. These efforts were curtailed in the late 1980's due to concerns relative to downstream impacts on water quality, fish, wildlife and facilities at the mouth of the Wind River. Currently the reservoir is nearly filled to capacity with sediment which has created a shallow pool severely limiting water storage of the dam.

Under the no action alternative, Hemlock dam will continue to impede the natural transport of large wood, organics, fine and coarse sediment. The amount of available substrate for down stream spawning gravel for ESA listed species and insect production will be directly affected for the long term (>10 years). For the most part, large woody debris below the dam plays a minor role in habitat for fish due to the entrenchment and gradient of the canyon reaches below the dam. However, the natural transport of large woody debris and organics delivered to the downstream reaches would indirectly be reduced and incrementally decrease primary production and macro invertebrate production for the short and long term (>50 years).

Alternatives B and C

Natural, unimpeded large woody debris and organic routing past the project area would be restored as a result of this project. The majority of material would be transported to the mouth of the Wind River with minor amounts being deposited in eddy regions of the canyon. The effects to aquatic organisms would be incremntal and in large part deemed as cummulatively beneficial.

Alternatives D and E

Large woody debris and organic routing would impeded by the dam and identical to the existing condition.

Dam Modification Effects

Adult Fish Immigration (Movement of fish Upstream of the Dam via fish ladder)

Alternative A - No Action

Adult fish passage was considered limiting at Hemlock Dam (Orsborn 1994). An assessment of the fish ladder (WSU 1999) identified four principal concerns relative to adult fish passage: 1) attraction flow 2) fish ladder weir configuration 3) ladder flow and resting water 4) adult trap design (WSU 1999).

Attraction flow at fish ladder entrance

The fish ladder entrance was redesigned in 1996 to meet the minimum requirements to attract upstream migrants into the ladder. Restoration efforts met three primary objectives: 1) orient the jet to target concentrations of fish which stage in the spillway 2) produce an attraction flow of approximately 8 fps and 3) redirect the attraction flow jet at a right angle parallel to the dam spill curtain (Wieman and Rueda 1995).

However, the construction of the attraction flow chamber below the dam requires that the normal volume of water in the fish ladder (4.5 cfs) be supplemented with approximately 2-18 cfs in order to meet the prescribed attraction flow requirements. The additional water for the attraction flow chamber is drawn from the fore bay through the screened auxiliary water intake which does not meet NOAA standards and is a documented impingement hazard to juvenile fish.

The adult attraction flow and juvenile passage requirements cannot be met without drawing down the reservoir during low flow periods (July – October) when discharges drop below < 20 cfs. Gage data shows that optimal passage for both life stages will not be met over 50% of the summer or roughly 70 days during the months of July and October without drawing down the reservoir. Reduction in the reservoir volume accelerates water temperature maximums by decreasing depth relative to surface area. The auxiliary flow to the attraction flow chamber is shut off during summer months when adult immigration curtails and juvenile concentrations are high.

The fish screen was modified during the 1996-1997 attraction flow chamber construction to install and allow operation of the new auxiliary waterline valve. These modifications did not compensate for original debris removal design and has resulted in continual maintenance and chronic mechanical failure. When the fish screen is rendered inoperable, debris clogs the openings of the screen and the auxiliary water source for the attraction flow chamber is shut off. Without the auxiliary water from the screened intake there is no attraction flow and may delay migration. The fish screen has had various mechanical failures over the past four years which have rendered the screen inoperable from two weeks to three months a year.

Fish ladder weir configuration and resting conditions

The 1936 ladder design does not meet the NOAA fish standards and guidelines for adult fish passage. The ladder changes from a weir to a slot configuration at the top of the fish ladder. This may result in crowding conditions within the ladder (Orsborn 1987). To provide appropriate resting Conditions in the fish ladder, adequate energy dissipation within each pool is necessary to prevent the carryover of energy to the next downstream pools and to reduce the amount of turbulence and aeration to the area in which fish are trying to rest. Modern weir pools meeting NOAA standards for fish ladders are six feet long, five feet wide and four feet deep. The average chamber within the existing fish ladder is approximately 100 ft^3 less than the optimal resting chamber design (WSU 1999). Water passing through the ladder in excess of 4.5 cfs has the potential to give false jumping signals and creates an unsteady flow regime (Osborne, 1987).

Fish exiting the fish ladder must pass in front of the dam to ascend upstream and are therefore susceptible to fallback (WSU 1999). Fallback rates as high as 28% have been documented for fish exiting the Bradford Island ladder at Bonneville Dam (Bjornn et al. 1998). Fallback subjects fish to additional fall mortality and increases migration times as fish relocate the ladder and reascend the dam. Fallback rates for Hemlock Dam and ladder are approximately 2% (Hemlock Fish Ladder Adult Trap data, USFS & WDFW, 1992-2004).

Alternatives B and C

Removing the dam would restore the historic stream channel and allow fish safe, unimpeded passage to hospitable or productive habitats, shelter and food. Any delay in migration resulting from false attraction flows created by the dam spill or fish ladder would no longer exist. Adult, juvenile and parr steelhead emigrating during summer months would not be trapped or delayed within the reservoir.

Alternative D

Replacing the existing fish ladder may incrementally improve fish passage relative to the existing condition.

Alternative E

Maintaining the existing fish ladder and the dam would have very similar effects to fish migration as described by Alternative A – No Action.

Fish Emigration (Movement of fish Downstream over the Dam and through fish ladder)

Alternative A - No Action

The Hemlock Dam radio telemetry smolt study (Wieman and Adams 1997) showed that 100 % (n = 19) emigrating smolts efficiently passed over the central portion of the dam with the high flow flashboard configuration within 24 hours of release with no apparent mortality. The majority of smolts 59% (11 smolts) migrated past the dam and downstream two miles into the Wind River within 24 hours of release. A smaller percentage, 15% (3 smolts) remained in the spillway immediately below the dam for more than 48 hours, 26 % of the tagged fish (5 smolts) were detected 36 hours or more within the two mile reach below the dam.

Figure 4-22. 2001 Photo of Hemlock Dam with the high flow flashboards in place, Skamania County, Washington.

It is reasonable to assume that kelts, parr, fry and young of the year have similar success migrating downstream past the dam during the late fall, winter and spring months when the high-flow flashboard configuration is setup and flows are relatively moderate.

However drop mortality could result from fish freefalling over the spillway during low and high flow periods. A freefall from the top of the dam produces a velocity of 41 feet per second (WSU, 1999). This rate exceeds the current NOAA Fisheries drop velocity limitation by 16 feet per second. Juveniles striking fixed objects could result in drop mortality or serious injury.

Unlike salmon, steelhead may survive to spawn more than once. Historically, before construction of the Columbia and lower Snake River dams, the proportion of repeat spawning summer steelhead was small, e.g., 3.4% (Long and Griffin 1937). A study of repeat spawners in the Clearwater River (Idaho) showed a 1.6% return (Whitt 1954). Summer steelhead populations that do not pass through any dam or pass through only one (i.e., Wind River steelhead only pass over Bonneville Dam) have approximately 7% and 3% proportions of repeat spawners, respectively (Howell et al. 1985, cited in Busby et al. 1996).

One kelt female steelhead mortality was found below the dam in 1995 and subsequent autopsy determined to have broken her back apparently during the fall over the dam.

Approximately 30 percent of the spillway contains fixed objects hazards (bedrock, pipeline), which may harm fish if they pass over during moderate flows. In higher flows (greater than 100 cfs), the depth of the spillway water elevation is high enough so that the juveniles do not directly strike most hazardous objects (Wieman, 2001). Risk of drop mortality can also be reduced by managing a high flow board configuration which directs the majority of the water into the deepest plunge pool in the spill way.

On average 3,600 parr, pre-smolt and smolts migrate past the dam annually during spring run off (March – June) (1995 -2003 Trout Creek Smolt Trap Data, WDFW). Approximately 55% of these fish are smolts with the remaining 45% either pre-smolt or parr. The majority of emigration during smolt season occurs during the months of March – May when approximately 10% of the flows (10 days/year on average) drop below 100 cfs (Trout Creek Gage Data, 1945 – 1948 & 1995 – 1996).

Under flow conditions from 100 cfs to approximately 600 cfs, flashboard management can be an effective means of directing flow and reducing drop mortality risk. However, when water exceeds 600 cfs (> 1.0 feet of head at dam) the high flow boards are overtopped and fish may be again exposed to unavoidable drop mortality risks. On average emigrants would be at an increased risk of fall related mortality 65 days per year when flows are >600 cfs (Trout Creek Gage Data, 1945 – 1948 & 1995 – 1996). A significant portion of that period occurs during the winter months (December – February) when juvenile steelhead migration is relatively limited due to water temperature and food availability. On average 5 days per year would occur during smolt emigration.

Figure 4-23. Photo of Hemlock Dam with low flashboard configuration, Skamania County, Washington.

In a worst case scenario 4% or on average 160 smolt/pre-smolt steelhead per year could theoretically be exposed to fall hazards (fixed objects and rocks) during extreme low and peak flows which could result in injury or death. This scenario would assume that total number of emigrants (10 fish per day) was spread evenly across the crest of the dam as they dropped over the plunge, 1/3rd of which would be exposed to fall hazards a total of 15 days per year. If the 2% mortality rate observed by Whitney et al. (1997) were applied to Hemlock Dam, 72 smolt/pre-smolt out of 3,600 could be directly and indirectly killed via fall or impingement which would mean that nearly 50% of the 160 fish exposed to hazards previously discussed would die. The Whitney studies were conducted on large main-stem Columbia River Dams with greater fall heights therefore mortality rates would not be expected to be as high. With the high flow flashboard configuration in place, mortality rates for smolts/pre-smolts passing Hemlock Dam would be less than 2% (77-35 of the 160 fish exposed to drop hazards) smolts and pre-smolts per year on average. Losing 35 - 70 smolts per year to drop mortality would translate to approximately 2 – 4 adult steelhead/year that would not be returning. This estimate is based on the assumption that out of basin conditions improve and smolt to adult ratios stabilize near 5%. Risk of drop mortality has been reduced by maintaining a high- flow board configuration during peak flow periods which include the smolt and kelt emigration period (March - June).

During the summer months when the congregations of juvenile steelhead are observed within the reservoir, flashboards are erected at their low-flow configuration which creates an additional four feet of head and potential drop. Juvenile steelhead attempting to emigrate past the dam have three potential escape routes; 1) over the flashboards/dam crest spillway, 2) through the fish ladder or 3) through a submerged orifice on the flashboards. The lack of flow within the reservoir itself and attraction flow to the fish ladder and submerged orifice on the flashboards may make it difficult for juvenile steelhead to find and potentially delay migration. The primary concerns with delaying migration during this period are the length of time that fish are exposed to lethal water temperature maximums, increased risk of impingement on flashboards and screened intake, drop mortality and predation.

The fish ladder appears to be a key route for juvenile fish to emigrate downstream of the dam during the summer low flow period. Numerous parr and young of the year have been documented utilizing the fish ladder during warm water periods (USFS Hemlock Dam Adult Trap Data, 1992 – 2003).

The second means of downstream migration when the flash boards are up is through an adjustable submerged opening in the flashboards (flashboard orfice). There are several adverse affects of operating the flash board orfice system during the summer including 1) impingement against debris and flashboard cracks 2) drop mortality and/ or injury of fish freefalling over the dam into the spillway and 3) draining of the reservoir and reducing pool depth further increases water temperature.

Optimal low flow adult and juvenile passage conditions are only met when the fish ladder is at 4.5 cfs, the juvenile submerged flashboard orifice is at 8.6 cfs and the auxiliary waterline is passing 6 cfs (WSU 1999). This condition can only be sustained during flows of 20 cfs or greater (WSU 1999). Therefore, during the period of summer low flows (<20 cfs), the submerged orifice and adult attraction flow passage facility must be closed. When the instream flows drop to 8 cfs, the lake will drain in 20 hours with the ladder and juvenile bypass in operation. When the auxiliary waterline is shut off and the fish ladder is operating a normal low flow (4.5 cfs) the lake elevation will not be reduced.

Low flows (< 20 cfs) restrict optimal fish passage on an average 65 days per year (Trout Creek Gage Data 1946-1948 & 1995-1996). During this period juveniles may be delayed and/or subjected to stressful high water temperatures. Passage Conditions are severely restricted on an average of 13 days per year when flows drop to ≤8 cfs. During this period fish may be subjected to lethal and stressful water temperatures.

Alternatives B and C

Direct and indirect fall or drop mortality associated with the dam would no longer exist.

Alternatives D and E

Direct and indirect fall or drop mortality associated with the dam would be similar to the existing condition.

Fish Impingement

Alternative A - No Action

Several juvenile steelhead mortalities from impingement on dam surfaces (e.g. between cracks in flashboards or the screened intake) are observed during yearly maintenance (personal observations). Impingement occurs when water going though a porous object is greater than the fishes swimming ability to overcome the suction force created by the opening. Depending on the mode of operation of the auxiliary waterline feeding the adult attraction flow chamber, the approach velocity may range form 0 – 18 cfs producing an approach velocity of 0 - 0.8 fps. The maximum approach water velocity for fish screens (NMFS, 1995) set for fish is as follows: salmonid fry (60 mm) the maximum approach velocity are not recommended above 0.4 fps and when fry are present down to 30 mm the approach should not exceed 0.1 fps.

Insufficient sweeping velocities and excessive screen opening size are other conditions that are out of compliance with NMFS standards (WSU, 1999). The sweeping velocity is the water velocity component parallel and adjacent to the screen face. By standard, the sweeping velocity must be greater than the approach velocity. The existing screen is vertical and perpendicular to the flow and does not create a sweeping velocity. The dimensions of the screen opening are also ineffective at screening juvenile fish (60 mm or smaller). The existing screen is 0.125 inches and larger than the prescribed 0.0938 inch opening allowed by NMFS. Nursery workers reported fish and crustaceans flushed into the irrigation system and obstructing water sprinkler operations of the former Wind River Nursery (USDA, 1996). Therefore the use of the auxiliary water line to increase attraction flow for adult steelhead increases the potential for fry and parr to become impinged when in operation.

Fish are prone to become impinged between the cracks in flashboards particularly during the summer months. The approach velocity is dependent on the hydraulic head on the dam. For example assuming the reservoir is full (3 feet of head on top of the dam) and a crack develops at the base between the boards and the dam crest this would produce approach velocity of 8.6 fps. A crack just 0.1 feet below the water surface elevation is calculated to produce an approach velocity of 1.75 fps. A layer of impermeable heavy plastic can help reduce the risk of impingement. However it is inevitable that cracks develop producing a high velocity jet of water. Cracks are common on the dam and biologists have observed fish impingement on dam flashboards (USDA, 1996).

Trout Creek has recently (2000-2004) produced approximately 7-30% of the smolts and 5-10% of the adults within the entire Wind River basin. Based on smolt trap data, electrofishing and snorkel counts conducted by the USGS (Connolly et. Al 1999-2003) above and below the reservoir, we estimate that on average 1,500 fry and 3,500 parr steelhead and resident rainbow occupy or migrate past the reservoir during the summer. Again assuming that 1-2% of the fry and parr could be potentially directly or indirectly killed by impingement or fall trauma, would translate into 15-30 fry and 35-70 parr killed.

Alternatives B and C

Dam demolition would remove potential impingement sources and therefore fish would no longer be directly killed by flashboards, the fish screen or other cracks which create suction and impingement sources.

Alternatives D and E

Improvements would also be made to the flashboards and attraction flow screen as a result of the implementation of this alternative. These improvements are expected to incrementally decrease impingement related mortality.

Dam influence on predation

Alternative A - No Action

The confinement or concentration of adult fish within the Hemlock fish ladder and concentration / delay of migration of juvenile steelhead within Hemlock Reservoir increases their vulnerability to predation. Limitations to juvenile downstream movement (see previous section) may increase the risk of juvenile salmonid predation. Biologists have observed a variety of piscivorus animals inhabiting the lake and feeding in and around the fish passage system. Predators such as eastern brook trout (Salvelinus fontinalis) river otters (Lutra canadensis) and mergansers (Mergus merganser) are given a competitive advantage when the dams impede fish movement. In addition, extreme water temperatures resulting from the dam may slow prey avoidance reaction and/or fish congregating near cool water seeps increases their vulnerability to predators.

Adult steelhead are also more vulnerable to predation due to their confinement within the fish ladder which would make escape from predators such as otters difficult. Otters have been consistently observed in the reservoir and below the dam and recently viewed on cameras installed in the fish ladder (2003-2004 Trout Creek Fish Ladder Video Camera Surveillance, Deshong).

Based on smolt and adult trap data (WDFW & USFS 1994-2004) and snorkel and electro-fishing surveys (USGS 1995-2003) an estimated 3,600 smolt, pre-smolt, 1,500 fry, 3,500 parr and approximately 50 adults would migrate past Hemlock Dam or occupy the reservoir per year. If 1-8% of each of the above cohorts were killed by predators as an indirect affect of the dam, 36-288 smolt/pre-smolt, 15-120 fry, 35-280 parr and 1-4 adults could be killed per year as a result of predation.

Alternatives B and C

Advantages provided to predators by the fish ladder and reservoir would no longer exist and therefore predation mortality rates would be expected to be reduced.

Alternatives D and E

Predation may be incrementally decreased in the short term by the additional depth and hiding cover. Otherwise incidence of predation are expected to be similar to what was described in the existing condition.

Recreation and Harassment

Alternative A - No Action

The Hemlock Lake recreation area draws approximately 3500 visitors per year (Wieman? Knutson??). The majority of the use is between July and October. A picnic area, boat launch and waterside walkway attracts a variety water recreationist.

Hemlock lake fish take refuge in the few deepest areas in the lake during the warmest summer months. These areas tend to be coincidental with recreational areas of interest. Public use is often concentrated around jumping into the deep pools at the observation decks, bridge and the in the spillway of the dam. This form of human disturbance may increase stress on juveniles as they try to avoid swimmers and are forced into potentially lethal water temperatures.

Illegal fishing practiced at Hemlock Lake may result in hook mortality or injury. Periodic evidence of fishing gear and personal encounters with anglers indicates that fishing persist at a low level.

Decreased water quality can be attributed to human disturbance. Fine lake bottom sediment is lofted into suspension by human activities creating a plume of suspended sediment. Water quality levels are estimated to be impacted 20-30 days per year with the vast majority of impact coming between August and September. Increased suspended sediment may have an indirect short-term affect on feeding behavior and respiration.

Alternatives B and C

Recreation within the project area is expected to continue however character and frequency of visits are expected to dramatically change. Recreation visits may decrease by as much as 90%

after the dam is removed (Knutson, Recreation Report, 2004). Fish harassment is expected to decline proportionately with recreation use.

Alternatives D and E

Increasing the depth of the reservoir may increase recreation interest and overall use in the short term. However, if dredging is not periodically repeated, any increases in use would diminish. In the long term, increased use is expected as an indirect result of the overall population increase within the Carson / Stevenson Washington area.

Dredging and increasing the depth of the reservoir would provide fish with additional hiding cover. However these benefits are expected to be short term and temporary unless periodic dredging occurs. In the long term, as the local population increases, recreation and harassment of fish will increase.

Fish (Enumeration) Trap

Alternative A

To develop a complete census of the Wind River steelhead population, WDFW has developed a mark-recapture methodology by tagging at Shipherd Falls and recapturing adults in the Trout Creek trap. The total count of wild adult steelhead at Hemlock Dam along with an estimate of smolt production above Hemlock Lake is a unique wild steelhead dataset in that only six comparable high quality trapping facilities exist for steelhead over the entire Pacific Rim from California to Alaska on the West Coast of North America and Russia on the East Coast of Asia (Rawding, 2004). These datasets are extremely important to the overall science and understanding of steelhead biology because counts, not estimates of wild adult steelhead, allows scientist a rare opportunity to study the population dynamics and estimate extinction risk of wild steelhead due to environmental variability without or with small measurement error (Rawding, 2004). Due to the low measurement error, the Governor's Salmon Recovery Office has designated the Wind River as an intensively monitored watershed (Rawding, 2004).

Video cameras were installed in the fall of 2003 to evaluate adult steelhead fish passage and trap efficiency. From September X – XX, 2003, 13 adult steelhead were observed entering the chamber just below the fish trap. Nine of those 13 steelhead were not trapped. As a result of this apparent rejection, the water elevation of the pool below the finger weir of the trap was raised to allow steelhead to swim more freely into the trap. After modifications (November…) 13 out of 19 steelhead entering the last chamber were trapped which raises the trap efficiency from 31% to 69%. A camera was moved from the lower ladder to the trap box so that fish entering the weir can be observed in an effort to improve efficiency to >95%. To date, one fish was observed swimming into the trap relatively effortlessly. Trap avoidance is still a concern due to the potential to redistribution of spawning downstream and overall loss of genetic diversity in Trout Creek.

Alternatives B and C

Before the trap was installed in 1992, WDFW and USFS employed redd surveys to monitor the Trout Creek population of steelhead. These surveys had varied results and somewhat limited success. In some years, heavy snows prevented access to the spawning areas in Trout Creek, until after peak spawning occurred (WDFW and USFS unpublished data). In years when high discharge occurs during peak spawning redds cannot be detected and redd counts are biased low (WDFW unpublished data). Population estimates and confidence intervals for the Wind River basin are based on Trout Creek trapping. Other methods such as redd surveys are less reliable and winter snorkel surveys have proved difficult and dangerous due to high turbid water (Rawding, 2004).

In addition, the Trout Creek adult steelhead trap in unison with the smolt trap is critical to quantitatively evaluating restoration within Trout Creek and Wind River. Without accurate adult population estimates, it will be difficult to evaluate steelhead response to restoration projects.

Removal of the dam would eliminate the existing trap. Unless funding for a weir or other methods of trapping or counting adult steelhead are secured, a unique and internationally significant monitoring data set will be discontinued. In addition, accurate population estimates and monitoring of watershed restoration response will be lost.

Alternatives D and E

The adult fish trap would be operated as it is presently.

Summary of Effects to Federally Listed Fish Species

Alternative A - No Action

Direct mortality of both juvenile and adult steelhead associated with Hemlock Dam and operation has been documented. However the direct mortality and indirect effects of the dam are extremely difficult to quantify or estimate. In the reach between the tailrace of Lower Granite Dam and that of Lower Monumental Dam, the mortality of summer migrants was estimated within a season and for a given season, among years. Weekly estimates of mortality averaged from about 32% to 89%, the highest mortality rates pertaining to releases later in the season, when environmental conditions were relatively poor (e.g., high water temperature, low flow, and low turbidity). Mortality of run-of-the-river subyearling chinook salmon from the tailrace of McNary Dam to the tailrace of John Day Dam was approximately 22% and 59% in 1998 and 1999, respectively.

Reviewing mortality rates observed in studies on the mainstem Columbia River system are useful but not directly applicable due to the differences in scope and operation. Because Hemlock Dam is not currently used for irrigation or electric generation, mortality rates are expected to be substantially lower than what was observed on the Columbia River Dams. The known sources of direct mortality are impingement on flashboards, traveling fish screen, adult trap weirs and from fall impacts. Hemlock Dam may also indirectly kill steelhead by delaying migration and exposing fish to extreme maximum water temperatures and or predators. Indirect affects of the dam and poor water quality conditions may also increase the incidence of disease. The majority of these impacts are thought to occur in the summer months between July and September when stream flow is low, water temperatures are high and the flashboards are in the high stanchion configuration. The negative effects of maximum water temperature highly variable from year to year due to the variances in low flow discharge, precipitation and average ambient air temperature during the summer months. In addition, the spatial distribution, quantity and quality of cool water thermal refuge created by up-welling and seeps within the reservoir and stream channel and the extent to which steelhead utilize these areas are largely unknown at this time.

Estimates of increased mortality rates generated by Hemlock dam and operations for this assessment were made by analyzing existing biological data and reviewing existing literature relative to mortality associated with dams and reservoirs by each freshwater life history stage of steelhead (adult, fertilized egg, fry, parr and smolt). The following survival/mortality rates were used for this section of the analysis: egg to fry survival 6.5% and fry to smolt survival 13% (Ward et. al. 1976-1998), smolt to adult survival 4.0% (personal communication with Dan Rawding, 2004), parr to smolt survival was estimated at 25%, roughly twice the fry-smolt survival, Fry, parr, smolt and kelt emigration fall related mortality (direct and indirect) was estimated at 0-1%, fry and parr impingement 0-2% (Whitney et al. 1997), smolt impingement was estimated at 0-1%, adult, smolt, fry and parr predation/poaching 2-10%, (estimates based on

NMFS 2000), fry and parr direct and indirect mortality associated with maximum water temperature / disease were estimated at 0- 10%.

In addition the following biological data were also used to generate estimates: 1) 50 adult steelhead/year returning to Trout Creek (average adult returns for 2000-2004, USFS / WDFW, Hemlock Adult Fish Trap Data 1992-2004), 2) adult steelhead female/male ratio: 2.1:1 or 67% females (average adult returns for 1992-2002, Hemlock Adult Fish Trap Data 1992-2004), 3) fecundity ~ 4,000 eggs / adult female (personal communication with Rawding/Cochran, WDFW, 2004) 4) 2,000 smolts emigrating past the dam (Unpublished Smolt Trap Data, Rawding/Cochran, WDFW, 2004), and an estimated 3,800 parr (Unpublished Snorkel Survey Data 1998-2003, Jezorek & Connolly and Smolt Trap Data, Rawding/Cochran, WDFW, 2004) and 4,600 fry (Unpublished Snorkel Survey Data 1998-2003, Jezorek & Connolly) estimated to migrate past the dam or occupy the reservoir per year. The following presents the results of this analysis see Tables 4-17 to 4-21.2

Table 4-14. Estimated ranges of indirect and direct Hemlock Dam mortality, survival rates and population data, Trout Creek.

Adult, Smolt, Fry and Parr Predation Mortality	2-8%
Smolt Impingement Mortality	0-1%
Fry & Parr Impingement Mortality	0-2%
Kelt, Smolt, Fry & Parr Fall Mortality	0-1%
Fry & Parr Maximum Water Temp/Disease Mortality	0-10%
Parr Max. Water Temp/Disease	0-10%
Smolt to Adult Survival	4.0%
Egg to Fry Survival	6.5%
Fry to Smolt Survival	13%
Parr to Smolt Survival	25%
Eggs per Female	4000
Adult Females/Total Run	67%
Average Adult Return	50
Average Smolt Emigration	2000
Average Parr Emigration	1500
Avg. Fry Density in Reservoir / Downstream	4600
Avg. Parr Density in the Reservoir /Downstream	2300

Table 4-18. Range of estimated Hemlock Dam mortality by freshwater steelhead life history phase.

Life History Stage	Total Mortality Range
Adults	2-9%
Smolts	2-10%
Fry	2-21%
Parr	2-21%

Table 4-19. Estimated range of direct and indirect Hemlock Dam mortality for adult female steelhead, loss of potential production and returning adults.

50 Adult Steelhead Returning to Trout Creek per Year	2% Mortality	9% Mortality
Number of Female Mortalities	1	5
Potential Eggs	2680	12060
Potential Fry	174	784
Potential Smolts	23	102
Potential Returning Adults	1	5

Table 4-20. Estimated range of direct and indirect Hemlock Dam mortality for emigrating steelhead smolts and loss of potential returning adults.

2,000 Smolts Emigrating Past the Dam	2% Mortality	10% Mortality
Number of Smolt Mortalities	36	252
Potential Returning Adults	2	9

Table 4-21. Estimated range of direct and indirect Hemlock Dam mortality for young of the year steelhead fry and loss of potential returning adults.

4,600 Fry Emigrating Past the Dam or Occupying the Reservoir & Downstream Reaches	2% Mortality	21% Mortality
Number of Fry Mortalities	92	966
Potential Smolts	12	126
Potential Returning Adults	1	5

Table 4-22. Estimated range of direct and indirect Hemlock Dam mortality for 1+ steelhead parr and loss of potential returning adults.

3,800 Parr Emigrating Past the Dam or Occupying the Reservoir & Downstream Reaches	2% Mortality	21% Mortality
Number of Parr Mortalities	76	798
Potential Smolts	19	200
Potential Returning Adults	1	8

Under the existing conditions with average adult returns of 50 fish, potentially 5 to 27 fewer adult steelhead are returning per year which equates to a 10-54% decrease in population size per year respectively. If runs increased to 300 adults, 6,800 smolts, 5,000 fry and 11,900 parr, returns would be decreased by 2-34% or 6 – 103 adult steelhead per year.

Estimates on the low end of the range would represent nearly perfect conditions for passage at Hemlock Dam i.e.; low predator abundance, normal low flow discharge, water temperatures ≤16º C and low incidence of impingement or fall mortality. Estimates on the high end of the range would represent extremely poor passage and water quality conditions within the reservoir/dam; high predator abundance, low flow drought conditions, extreme water temperature maximums with inadequate thermal refuge and high incidence of impingement and fall mortality.

In a separate analysis, Rawding (2004) evaluated the affect dam removal would have on populations of steelhead within the Wind River and Trout Creek. The evaluations were based on expansion of empirical wild steelhead spawning escapement, smolt production, and smolt to adult survival data using a Beverton-Holt spawner curve (Beverton and Holt 1957). Dam removal effects to steelhead were also evaluated using the Ecosystem Diagnosis and Treatment (EDT) model using the scenario builder to develop a working hypothesis for dam removal (Mobrand Biometrics, 2002). For this analysis, hypothetical adult and juvenile passage survival was increased to 100%, the lake was returned to a free-flowing river, and the temperature in the lake and reaches below the lake were reduced to the temperature of incoming flow, and predation, harassment, and sediment attributes in the lake were returned to standard riverine levels. The Beverton / Holt model suggested that the potential increase in steelhead was 16 adult steelhead above the dam. The EDT model suggested a 2% increase in the Wind River steelhead population or 23 adult steelhead without the dam.

When all estimates are averaged (4, 27, 16 and 23), an estimated eighteen adult steelhead would not return per year due to the dam. This would represent a 36% - 18% decrease for runs of 50-100 adult steelhead respectively.

Alternatives B and C

Heavy machinery, used to construct water diversion, may disturb fish residing in the immediate vicinity, encouraging up or downstream movement. Initially machinery will have to cross the stream channel above the reservoir to construct the water diversion and fish may be temporarily displaced by equipment. Equipment crossing the stream will generate a short-term increase in turbidity which may also cause fish to move up or down stream. Direct or indirect mortality is not expected to occur during water diversion construction.

After the water diversion is constructed, flow will be slowly diverted around the project area. On-site fisheries crews will capture stranded fish with seines and dip nets. After the majority of water is drained from the project area, trained electro-fishing crews will shock isolated pockets of water to extract hiding fish. The capture, transport, and release of ESA-listed steelhead, will cause short-term stress and occasional mortality. Effects of stocking captured fish into a new upstream habitat may lead to competitive interactions with fish residing at the site and in some cases can lead to predation on the disoriented fish being released. Both juvenile and adult stages of steelhead may be subjected to short-term stress, but most likely only juveniles would be handled and subject to possible mortality. It is highly unlikely that chinook salmon (stemming from Carson National Fish Hatchery)—juveniles and adults—will be present in the stream during project activities; therefore, these fish should not experience stress or mortality.

Removal of riparian vegetation during temporary access for water diversion and dam removal is expected to be so minimal as to have insignificant effects to floodplain, riparian, and fish habitat functions The construction of a temporary access trails through the riparian zone to the stream's edge, in preparation for construction of a diversion dam will incrementally alter riparian vegetation since access is through the existing boat ramp.

The dewatered site will temporarily reduce the amount of habitat available to fish, and the diversion structure may temporarily block fish passage. In many cases, the diversion structure will act as a continuation of the barrier presented by the dam; therefore, in such cases the diversion structure is expected to cause short term impacts to upstream movement of ESA-listed steelhead. Juvenile fish, which may have hid and stayed in the reservoir/channel substrate during fish capture and transport, will likely suffer mortality upon dewatering.

ESA listed fish and other aquatic organisms will not be affected by the removal, haul and disposal of dam materials at the up-land Carson Guler rock quarry.

ESA listed fish and other aquatic organisms will not be affected by the removal, haul and disposal of excess dredge spoils at the up-land Pacific Crest nursery field. The perimeter of the disposal area will be cordoned off with silt fence until the disposal site is revegetated. The possibility of dredge spoils being eroded and transported into flowing water from this site is very low.

Fill material being excavated to construct the pilot channel followed by contouring of the streambanks and channel bed may lead to minor sediment spills into the dewatered stream channel. Because all actions will be occurring within a dewatered area, there should be no immediate effects to fish species during demolition and pilot channel construction.

In the short term (1-5 years), fish populations within Trout Creek could be adversely impacted by large scale turbidity events generated by channel incision. In the long term (>5 years) fish populations within Trout Creek would potentially directly and indirectly increase by approximately 20-35% as a result of dam removal and associated mortality.

Alternative D

This alternative has the potential to slightly reduce the direct and indirect dam associated mortality and potentially improve fish passage. These benefits to the native populations of fish within Trout Creek and the Wind River would be minor improvements over the existing condition. A slight increase in returning adults could occur as a result of implementing this alternative. However, the majority of these benefits and increases in Trout Creek steelhead would be short term and dependent on future management and oversight of the facility.

Alternative E

This alternative would result in potentially more efficient fish passage. These benefits to survival and increases in populations are expected to be very minor and more than likely not measurable.

Essential Fish Habitat

Magnuson-Stevens Fishery Conservation & Management Act

The Sustainable Fisheries Act of 1996 (Public Law 104-267) amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to require federal agencies to consult with NMFS on activities that may adversely affect "Essential Fish Habitat" (EFH). Essential Fish Habitat is defined in the Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Essential Fish Habitat includes all freshwater streams accessible to anadromous fish, marine waters, and intertidal habitats. Within the action area, this would include the Wind River from RM 10.8 to the mouth of the Wind River RM 0. The mouth of the Wind River enters the Bonneville pool at RM 154, approximately seven miles up-stream of Bonneville Dam which hatchery and stray spring chinook have access to.

Effects Determination for Essential Fish Habitat (EFH)

The Wind River basin is considered to be part of the Essential Fish Habitat for chinook and coho salmon. Because Wind River drains into the Columbia River and these species of salmon are part of the commercial catch within the Columbia River. Chinook salmon EFH is expected to be impacted in the same manner as steelhead habitat, i.e., likely to adversely affect (LAA) in the short term. EFH will be negatively affected for one to three years by the increase in fine sediment and suspended sediment which will be delivered to the downstream reaches. Sediment deposition north and south of the Highway 14 bridge is a natural process and a direct result of the construction of Bonneville Dam and backwatering affect of the associated reservoir. In essence, the river is attempting to rebuild its historic fan approximately one mile up-stream of the historic confluence. Sediment settling out from the Hemlock Dam project will slightly accelerate this process and may incrementally decrease the average depth. Conservation and mitigation measures applied to this project are designed to reduce potential impacts to the fisheries which utilize the action area.

Recreation

Site Capacity and Visitor Use

The Forest Service has not attempted to obtain systematic visitor-use counts at the Hemlock Lake site over the years nor control use when it appeared that use exceeded site capacity. The 1986 Forest Service report titled *Hemlock Lake Sedimentation Analysis* states that the picnic area had a “people-at-one time” capacity of 115 and the swimming area a capacity of 150. The estimated annual use at that time was 20,700 visits: 10,800 for picnicking and 9,900 visits for swimming. The report did not state what this information was based on nor how it was collected

Based on the facilities present today at Hemlock Lake, with 11 picnic tables and 25 parking spaces, the “persons-at-one-time” calculation equates to 105 for the entire site.

Random visitor counts were taken throughout the late spring and summer of 2002, and early summer of 2004, to estimate visitor use. The timing of the counts and number of days that counts were made were purely opportunistic. While not based on a statistical sampling scheme, the counts do reflect the daily seasonal use-patterns of the area and substantiate observations made throughout the years by District employees who manage or are otherwise familiar with the site.

Table 4-23 reflects the 2002 and 2004 daily “persons at one time” summaries from actual visitor counts:

Table 4-23. Daily “Persons at one time” (POAT) counts during peak summer months at Hemlock Lake, 2002 and 2004.

	May	June	July	August	Sept
2002					
Range	7-38	0-134	7-111	5-107	1-38
Average	16	51	38	75	9
#Times >105	0	2	1	1	0
2004					
Range	0-22	0-97	6-143	--	--
Average	8	33	53	--	--
#Times >105	0	0	3	--	--

The random tallies were also used to estimate the *total* use during the peak months of May-September. Figure 4-24 reflects the estimated average monthly person counts at Hemlock Lake Picnic Site from mid-May through mid-September during 2002. The tallies were taken an average of 18 days per month from mid-May through mid-September and expanded to determine an average daily visitor count for each month. The average daily counts were then tripled to reflect the use-turnover that occurs daily at the site. The turnover rate was an estimate, based on years of observations by the Forest Service site manager (Linde 2004). These counts were then expanded to reflect a monthly use count. The chart shows that the use peaks in August during hottest part of the summer with over 7000 visitors, and drops off considerably after Labor Day.

Total use for the 4 month time period is approximately 16,500 visitors. While the number reflects that the use may be equal to or *less* than the annual estimate given in the 1986 report, the site manager's observation over the past x years indicates that use has increased since the 1980s, and that the 1980 figures were probably high.

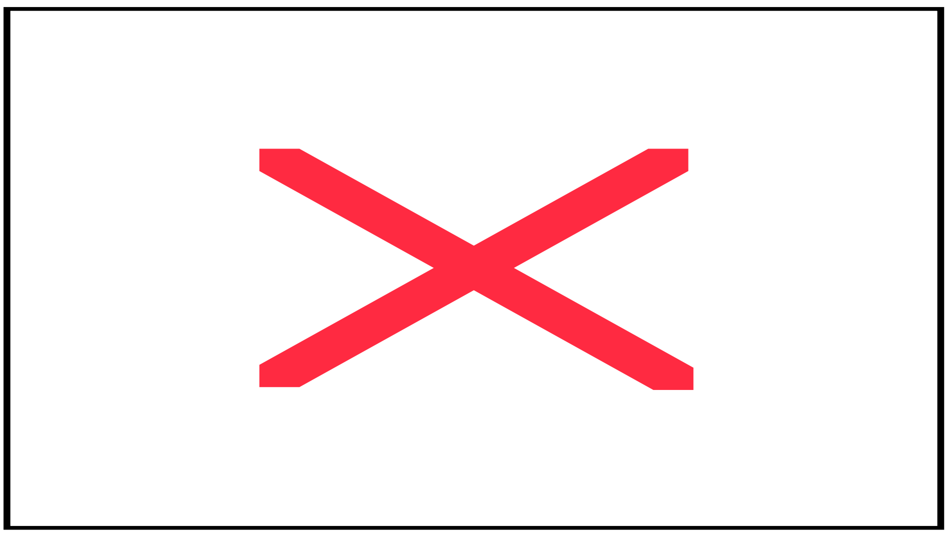

Figure 4-24. Estimated Average Monthly Visitor Counts at Hemlock Lake Day Use Picnic Area, 2002.

Estimated Party Counts

The estimated number of groups —or "parties"— who visit Hemlock will be important in describing economic impacts both to the Forest Service and the local communities. One way to estimate party counts is to apply an average party size to the total estimated visitor counts. The 2000-2001 National Visitor Use Monitoring Survey assessed the average party size recreating on the Gifford Pinchot NF to be 2.5 persons/trip for non-local visitors, and 2.6 for local visitors. Using the 16,500 annual visitor estimate for Hemlock Lake, and the assumption that visitation is split 50%/50% between non-local and local visitors, the total number of parties to visit Hemlock annually is 6,473.

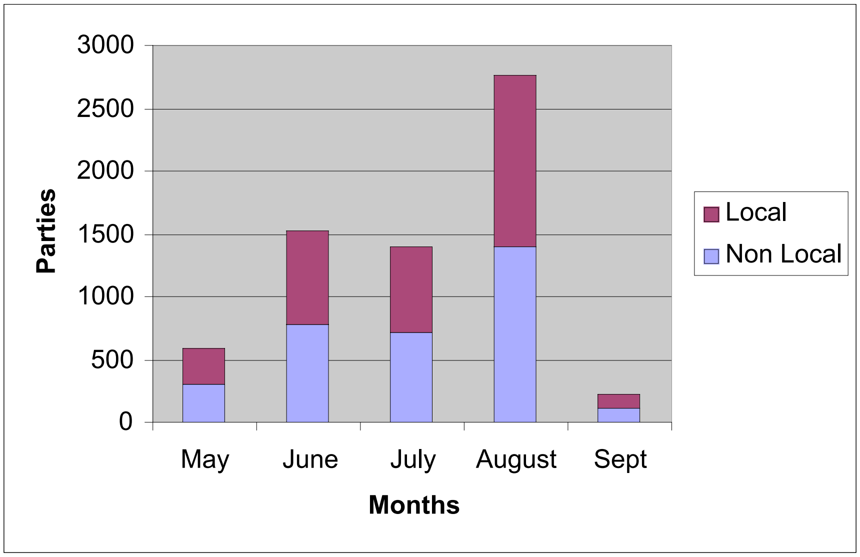

Figure 4-25. Estimated Average Monthly 'Party" Visits to Hemlock Lake, 2002.

Alternative A – No Action

There would be no change in the facilities offered or the availability of Hemlock Lake and the Day-Use Picnic Site for public use. Annual sediment deposits would continue to alter the depth of the water and formation of islands. The dam boards would be installed in June and removed in September to maximize the water depth for both fish and visitors The buoys would remain in place by the bridge to reduce harassment to fish; an additional buoy would be utilized in the deep pool in the southeast portion of the lake to further reduce harassment to fish, eliminating one popular swimming hole from public use.

Visitor use—local and non-local— would most likely increase over time. On peak, hot summer days, site capacity would likely be exceeded at an increased rate over time, resulting in over-crowding of the developed site, and an increase in upstream overflow use.

The area would remain a non-fee site, requiring continued reliance on allocated Forest Service funding to pay for managing the site. Services would continue at the current level—and possibly decline—as budgets decline. The continued low level presence of Forest Service personnel on-site would continue to encourage minor law violations such as drug use, minors in possession of alcohol and dogs off-leash.

Alternatives B and C

The removal of the dam and elimination of the lake would completely change the character of the site, the associated recreation opportunities, and the numbers and type of user. It would also be a devastating loss to members of the local communities who have developed long-term connections with the site, or highly value the irreplaceable recreational opportunities that the lake offers.

There would be no physical changes to the day-use picnic site and parking lot—it would continue to be the only day-use site on the District with flush toilets and potable water. Use of this site, however, would drop significantly—perhaps as high as 90%-- without the attraction of the lake.

An accessible interpretive display would depict the history of the site, from its prehistoric use through its use for irrigation for the Wind River Nursery, as well as its long-term use as a popular recreation site. It would serve as a companion barrier-free interpretive site to the nearby

Whistlepunk Trail. The existing viewing platforms would remain in place and continue to serve as barrier-free access points from which to view Trout Creek.

Overall use of the site would be highly dependent on whether or not there are pools in Trout Creek that would provide swimming opportunities. Once the dam is removed and Trout Creek has stabilized, a loop trail approximately 1200 feet in length would be constructed from the existing picnic area to the stream; the new trail would tie into the existing barrier-free trail adjacent to Hemlock Lake. Vegetation would be planted between the picnic area to and along Trout Creek to provide additional streamside shade. If there are swimming opportunities—deep pools—along the trail then it's expected that the site would receive a fair amount of use—perhaps has high as 50% of current use. The overall setting and experiences would be quite different, however, from what they are today.

Without swimming opportunities, most visitors would likely walk the trail but spend relatively little time at Trout Creek compared to current lake use. Some visitors would likely disperse along the stream, as they currently do upstream from the picnic site when the "beach" is crowded. Eventually, the streamside and in-steam conditions would not be too dissimilar from the existing conditions upstream of the day-use area and would provide similar experiences for visitors.

A segment of the current users may move to other nearby undeveloped stream-side sites along the Wind River and Trout Creek with swimming holes. These sites already receive a fair amount of use; additional use could result in "over-use" of these sites, leading to less-than-desirable experiences for all users. Recreation use at these sites would also result in an increase in garbage and human waste, user-created trails causing streambank erosion, and impacts to riparian vegetation. None of these alternative sites offer the experiences that Hemlock Lake offers.

Public scoping inferred that the improved habitat created by dam removal would elevate returning steelhead numbers sufficiently to allow fishing of wild steelhead on Trout Creek or the Wind River. Washington Department of Fish and Wildlife maintains a closure on fishing in Trout Creek and a closure on wild steelhead within the Wind River due to the small population size. While dam removal would improve water quality and habitat resulting in a small total increase in the steelhead population, the fishing closures on Trout Creek and the Wind River would most likely remain in effect in the short and near term and not result in an increase in recreational fishing opportunities. The State ultimately makes the decision.

Alternatives D and E

Similar to the No Action alternative, there would be no change in the availability of Hemlock Lake and the Day Use Picnic Site for public use. Initial dredging would temporarily increase the depth of the lake, possibly resulting in lower lake temperatures, though any changes would be minimal and short-term. Over time, the sediment deposits would alter the depth of the water and formation of islands. The dam boards would be installed in June and removed in September to maximize the water depth for both fish and visitors The buoys would remain in place by the bridge to reduce harassment to fish; an additional buoy would be utilized in the deep pool in the southeast portion of the lake to further reduce harassment to fish.

The Day Use Picnic Site would become a fee site, as part of the Forest Service's Fee Demonstration Program. Users would need to purchase either an annual Northwest Forest Pass for $30, or purchase a day-use Washington -- Oregon Recreation Pass for $5. Average fee compliance at other Forest Service fee sites is 70%. The collections would be used to help pay for the annual operations and maintenance of the site; limiting use on peak-days to comply with maximum site capacity (persons at one time); and enforcement of fee-compliance. Include Table

For most users accustomed to free use of the site, the fee would probably be an inconvenience, at least the first year of implementation, but not likely a hardship. For very low-income families an annual fee of $30 may be a hardship. A decrease in use due to fee requirements would be expected to be negligible due to the popularly of the site.

Economic Benefit to the Communities

Public use of the Hemlock site undoubtedly provides economic benefits to the local communities—particularly the Stabler Country Store, which is within 2 miles of the Hemlock site, at a key intersection of the Wind River Highway and Hemlock Road. The proprietor of the Stabler Country Store estimated that 30% of his summertime business was related to Hemlock Lake visitors (personal communication, 2004). The Wind River Market in Carson, Washington , as well as businesses in Stevenson are also likely to benefit from a portion of the 16,500 estimated annual visitors of Hemlock.

DO WE NEED A MAP?

To assess the economic benefits to local businesses associated with recreational day-use of Hemlock, two commonly purchased items associated with recreation trips are assessed: groceries and gas/oil. The 2000-2001 National Visitor Use Monitoring (NVUM) assessed, in part, expenditures for a variety of items associated with local and non-local day-use trips. For this analysis, the NVUM national expenditure values in Table 4-24 are used:

Table 4-24: Expenditures, $ per party per day trip

	Local	Non-Local
Groceries	$3.93	$6.20
Gas/Oil	$10.97	$10.97

A number of assumptions have been made:

Local parties (3,173 annually)

Local parties include trips originating from a 30-mile radius of Hemlock, and typically include visitors from Stabler, Carson and Stevenson, Washington

Hemlock is their specific destination and is not associated with other stops on the Forest

All local -parties purchase groceries in association with their trip to Hemlock

75% of local parties purchase gas/oil in association with their trip to Hemlock

Non-local parties (3,300 annually)

Hemlock is not their specific destination, but rather a side trip on their visit to the Forest

All non-local parties purchase groceries associated with their side trip to Hemlock

None of the parties purchase gas specifically for a trip to Hemlock

Based on the figures and assumptions provided above, the 16,500 visitors to Hemlock, grouped into local and non-local parties, currently contribute approximately $80,000 annually to the local businesses. The economic program, Quicksilver, was used to calculate the economic data in this Statement. Outputs of the analysis are provided in the Analysis File.

Alternative A

Forest Service Costs

The estimated annual cost to maintain and operate the site is $8,200. Costs include daily maintenance (garbage pickup and disposal, restroom cleaning); daily site checks and law enforcement actions; annual installation and removal of the dam boards; and annual maintenance of the facilities (restroom, picnic tables, viewing platforms, trail). Over a ten-year period, with the same level of services (albiet with a likely increase in use) and lack of fees to off-set costs, the present net value would be -$94,917.

Economic Benefit to Local Businesses

There would be no change—$80,000—to the recreationists annual contribution to local businesses associated with their trips to Hemlock. Over a ten-year period, the present net value would equate to $649,400.The assumptions that contribute to these values are presented in Chapter III; the outputs of the Quicksilver economic analysis are in the Analysis File.

Alternatives B and C

Forest Service Costs

The estimated annual cost to maintain and operate the site would be approximately $6400. Eliminating the need to install and remove the dam boards and a reduction in the quantity of garbage to dispose of would constitute the two largest decreases in maintenance costs. There would be a slight increase in the enforcement issues associated with likely increase in use of nondeveloped sites on the Forest by displaced recreationists. Over a ten year period, the present net value would be approximately -$37,900.

Economic Benefit to Local Businesses

From the public scoping letters it is clear that the loss of Hemlock Lake would be a huge loss to the community. What is not known is to what extent the site would continue to be used for picnics or stream-related recreation activities. Nor is it known to what extent users would find substitute places to recreate and still contribute to local businesses through purchases of groceries and gas. The intent is to estimate the net loss of economic benefit associated with dam removal.. For this assessment, it's assumed that there would likely be a substantial decrease in the trips to Hemlock by both local and non-local users but the extent of losses to the local businesses is uncertain. Because there are so many unknowns, this analysis assesses a range of potential economic impacts associated with dam removal. The following assumptions were used in the economic analysis: (Reviewers: only one set of assumptions presented here; I'll include a range for printing of draft)

- 25% reduction of day trips to the Hemlock (and the Forest) by local parties who would no longer purchase groceries or gas; the remaining local visitors who visit would purchase groceries
- 75% of the remaining local visitors would purchase gas in association with their trip to the Forest (including Hemlock)
- 75% reduction in side trips to Hemlock by non-local parties who would no longer purchase groceries; the remaining non-local visitors would purchase groceries in association with their trips to Hemlock

The annual benefit to the local businesses would be approximately $46,200, a decrease of $33,800 from the current situation. Over a ten-year period, the present net value would equate to $374,500 a decrease of $274,900 from the current situation. The Analysis File contains Quicksilver output reports of this analysis.

Alternatives D and E

Forest Service Fee Collections and Costs

With this alternative, fee collection would bring in approximately $11,500. This assumes that approximately 50% of the parties would have an annual Northwest Forest Pass and would not purchase a pass specifically for Hemlock; fee collections from the annual pass are not included in the above figure. The remaining parties would purchase the $5.00 daily Washington & Oregon Recreation Pass. With fee compliance an average of 70% on the District, this assessment assumes that approximately 70% of 3300 parties, (2310) purchase the pass, equating to the $11,500 figure.

The estimated annual cost to maintain and operate the site would be approximately $11,800. The daily and annual maintenance costs would be similar to the existing situation (and No Action Alternative). The increase is due to the additional time needed to to handle Fee collection and compliance. compliance and r to Costs include daily maintenance (garbage pickup and disposal, restroom cleaning); daily site checks and law enforcement actions; annual installation and removal of the dam boards; and annual maintenance of the facilities (restroom, picnic tables, viewing platforms, trail). Over a ten-year period, with the same level of services (albeit a likely increase in use) and lack of fees to off-set costs, the present net value would be -$94,917

Economic Benefit to Local Businesses

There would be no change--$80,000—to the recreationist's annual contribution to local businesses associated with their trips to Hemlock. Over a ten-year period, the present net value would equate to $649,400.

Importance of Hemlock Lake as a Recreation Site

It is very clear from letters and comments from the public in response to the proposal to remove Hemlock Dam, that many members in the local community have a strong attachment to Hemlock Lake and do not want to see it change. To begin to understand the individual and community connections, scoping letters were assessed and categorized by the type of comment made and their mailing address. While not a statistical sample, it will give a flavor of the connections that commenters have in relationship to Hemlock Lake and form a frame of reference to later assess the impacts that management actions may have.

In total, 45 letters, comment forms, e-mails and meeting notes were reviewed to assess the importance that Hemlock Lake recreation plays in the lives of the commenters. If an individual or organization commented more than one time, their comments were only included once.

The comments were grouped into five categories. Three of the categories reflect commenters who mentioned recreation by either expressing a long-term connection to Hemlock Lake; an interest in Hemlock Lake as a special or important place for recreation, or acknowledging a loss of current recreation opportunities with dam removal and stating a need or opportunity for alternative experiences. A fourth category of commenters expressed strong support for dam removal and that fish should not be sacrificed for recreation. The fifth category expressed support for dam removal with no comment on recreation. Excerpts from some of the letters and comments are provided for each category.

Expressed a long-term connection to Hemlock Lake

"The reservoir created by Hemlock Dam has provided a fine recreational resource for families of Skamania County for more than sixty years, and more recently, it has attracted folks from out of the area…The youth from the Stabler area still depend highly on Hemlock Lake for recreation" (Misner, 2001)

"I have been a resident of Stabler for 27 years. My husband grew up there and was a lifeguard at Hemlock lake when he was a teenager. While my children were growing up we spent almost every summer day there. My children have wonderful memories of playing, swimming and canoeing with their friends…If man can go to the moon, the Forest Service can think of a way to save this lake for the use of generations to come" (Larson 2001).

"Hemlock Lake, before it became silted in, was a beautiful recreation area that our whole family enjoyed" (Gay 2001).

Expressed interest in Hemlock Lake as a special or important place for recreation

"Hemlock Lake is the only local free swimming and picnic area with fresh water available to the public of Skamania County. It is the only accessible swimming and picnic area for handicaps like myself and the elderly. It is the only water that gets warm enough to swim in" (Sweeney 2001).

"I respect the desire to maintain the steelhead species but that is only one small piece of a much larger picture. Hemlock Lake and the wetlands present opportunities for recreation and natural life that are much needed. One of the reasons we bought and built here was Hemlock Lake, not the steelhead run. Our children and grandchildren profit from the recreational opportunity provided by Hemlock" (Wyffels 2001).

"Hemlock Lake should be maintained. It is a unique recreational opportunity. Certainly a significant "cost" to the removal option is the loss of a valuable recreation resource. There simply is no other safe place for swimming. The Wind River and Trout Creek don't have such great swimming "holes" as this one" (Wyffels, 2001).

Acknowledged loss of current recreation opportunities with dam removal and the need for alternate opportunities

"…the Gifford Pinchot Task Force is aware that some communities are opposed to dam removal because the area behind the dam provides a recreational swimming location. We do not discount this important use of Forest Service lands. However, we believe that there are options for replacing this use" (Brown 2001).

"Since the lake has silted in so greatly, it is no longer the recreational site it was intended to be. Trails along a new/recreated streambed could provide fine alternative recreational opportunities" (Musche 2001).

"If the dam is removed, it seems only right that a permanent recreation pond should be built to take care of the people as the return of the wild river would take care of the fish" (Jacobs 2001).

Expressed strong support for dam removal and that fish should not be sacrificed for recreation

"I feel too much emphasis is put on recreation and not enough on the health of the damaged Trout Creek System" (Hildenbrand, 2001).

"Please take this dam out. The watershed about near Layout Creek and Trout Hill have tremendous potential for fish. Hemlock Lake is silted in and not useful—Kayakers, fisherman, recreators, wildlife viewers should all support this action" (Hunter 2001).

"I say take it out! There are plenty of places to swim, boat, picnic, etc. It is a ridiculous issue to put above nature" (Rose 2001).

Expressed strong support for dam removal with no comment on recreation

"I encourage removal of the dam because any mitigation measures leaving the dam in place will simply defer the problem" (Ford, 2001).

"Complete dam removal and upstream rehabilitation is the lowest-risk- highest-return restoration strategy. We feel this alternative is the most cost effective, biologically sound, and socially acceptable approach for the long-term health and recovery of Trout Creek/Wind River steelhead" (Mantua/Wild Steelhead Coalition, 2001).

"I fully support the Forest Service's efforts to take this dam out. The massive proliferation of dams throughout our waterway over the course of the past century have seriously impacted the ecological health of our streams and rivers" (Huber, 2004).

Table 4-25, tabulates the number of comments per the five categories, and notes the city included in the return address (letter or e-mail). The commenter's city of origin is important to understand how communities may be impacted by dam removal. All of the commenters who expressed a long-term connection to Hemlock Lake were submitted by publics from Stabler and Carson, Washington; and all commenters citing Hemlock Lake as an important recreation facility were from Carson or Stevenson: the common thread is that all commenters in these two categories are from Skamania County. Those expressing support for dam removal with no comments on recreation were submitted from the broadest geographical range: California, Nevada, Oregon and Washington.

Table 4-25. Tabulation of comments expressed in terms of importance of Hemlock Lake as a recreation site. Comments referenced by city of origin; numbers in parentheses indicate the number of comments received per city/per comment category.

Expressed a Long-Term Connection to Hemlock Lake	Expressed Interest in Hemlock Lake as a Special or Important Place for Recreation	Acknowledged Loss of Current Rec Opportunities and the Need For Alternate Opportunities	Expressed Support for Dam Removal and That Fish Should Not Be Sacrificed for Recreation	Expressed Support For Dam Removal With No Comment On Recreation
Carson, Wa (2)	Carson, WA (1)	Bellingham, WA (1)	Portland, OR (1)	Davis, CA (1)
Stabler, WA (5)	Stevenson, WA (3)	Naselle, WA (1)	Carson, WA (1)	Walnut Creek, CA (1)
		Olympia, WA (1)	Stevenson, WA (1)	Lund, NV (1)
		Portland, WA (1)	Underwood, WA (1)	Cascade Locks, OR (1)
		Vancouver, WA (1)	Vancouver, WA (1)	Lake Oswego, OR (1)
		Yacolt, WA (1)		Portland, OR (4)
		US Congress (1)		Amboy, WA . (1)
				Bothel, WA (1)
				Kirkland, WA (1)
				La Center, WA (1)
				Pullman, WA (1)
				Seattle, WA (3)
				Vancouver, WA (3)
				White Salmon, WA (1)

The residents and businesses of Skamania County, particularly those in vicinity of the Stabler and Carson areas, are the ones most likely to be affected by the future of Hemlock Dam with respect to changes in recreation opportunities, or changes in business income associated with changes in recreation use.

Alternative A

Sense of Place: Impacts to Communities and Individuals

Surveys to specifically assess sense of place were not conducted for this assessment. But from the letters and comments received, the long-term residents of the local communities have formed a strong attachment to Hemlock over decades of use. Other users, local and non-local, who have a more recent connection with the site also value the experiences Hemlock offers, and they, too, may have formed emotional bonds with the site. For all of these residents/visitors, these attachments would remain intact with the No Action Alternative.

Respondents who expressed value in the site as a place to remove a dam to restore habitat for the threatened fishery, may experience a more abstract loss of an opportunity for restoration than a specific desire to transform Hemlock.

Alternatives B and C

It is clear from the scoping letters and comments that the elimination of Hemlock Lake would be a devastating and irreplaceable loss to members of the local communities. This would be true to residents of Stabler and Carson whose comments reflect a long-term emotional connection to the area, as well as those from Stevenson, who comments reflect a strong tie to the specific recreational opportunities provided at the site.

The Hemlock site has experienced an increase in use from non-local visitors in recent times. It is not known to what extent these users may have also developed attachments to Hemlock, but it is likely that some have given the unique experiences the lake offers. These users, too, would feel a sense of loss, though not on the same scale as local residents, some of who have experiences with the site that span more than 50 years.

There are no substitutes for Hemlock. If there were similar lake-related opportunities in the area, four essential items associated with sense of place (Ryden, 1993) —personal memory, community history, physical landscape appearance, and emotional attachment—would be lacking, and the substitute areas would not fulfill the emotional bond that Hemlock provides.

Respondents who support dam removal viewed the site as a place that, restored, would contribute to the recovery of the threatened fishery. Removal of the dam would fulfill this sense of place.

Alternatives D and E

The effects would be similar to the No Action Alternative. Implementing fees could negatively affect ones' experiences, at least initially, particularly for local residents who have used the site free-of-charge since the dam was constructed in the 1930s. Negative visitor reaction to past implementation of fees on the Forest is typically high the first year, but tapers off in subsequent years. And t knowledge that the likely tradeoff is dam removal—would probably minimize the negative reaction to fees.

Cultural Resources

Direct impacts to an historic structure

Alternative A - No Action

This alternative will have no impacts on historic structures.

Alternative B

Direct and indirect effects

This action will result in the destruction of an historic property. This meets the criteria of adverse effect as defined in 36 CFR 800.5. In order to partially mitigate these adverse effects, the fish ladder will be left in place for interpretive purposes. The dam and fish ladder will be documented using the accepted format of the Historic American Building Survey/Historic American Engineering Record (HABS/HAER). Documentation will include structural plans and 35 mm black and white photographs of the dam and fish ladder and its surroundings. Photographs will be labeled according to HABS/HAER standards. Oral history information will also be included as part of the written report, which will be submitted to Washington State Office of Archaeology and Historic Preservation, Advisory Council on Historic Preservation, and National Park Service.

Cumulative effects

The dam and fish ladder were modified in 1995, with the addition of a concrete wall extending out from the downstream end of the fishway, towards the face of the dam. The lowest weir of the fish ladder had its weir wall replaced with a wall and slot. A waterline was installed to transport water to the base of the fish ladder. This consisted of an 24" polyethylene pipe, originating at the concrete enclosure for the traveling screen. A 26" diameter hole was drilled in the enclosure wall downstream of the screen, and the waterline was attached to the upstream face of the dam. Another 26" diameter hole was drilled near the south end of the dam, and the waterline was taken through the dam at this point, where it can spill out over the end of the fishway. The traveling screen was also modified. These modifications were determined to an effect on the dam and fish ladder that was not adverse.

A legislated land conveyance in 2000 resulted in effects to the Wind River Administrative Site Historic District. Prior to the conveyance, this historic district contained 24 historic structures and three historic landscapes. As a result of the conveyance, six historic buildings were transferred out of federal ownership, along with portions of two historic landscapes. The conveyance also included the location of 17 former structures, which were also transferred out of federal ownership.

Alternative C

Direct and indirect effects

This action will result in the destruction of an historic property. This meets the criteria of adverse effect as defined in 36 CFR 800.5. In order to partially mitigate these adverse effects, the fish ladder and abutments will be left in place for interpretive purposes. The dam and fish ladder will be documented using the accepted format of the Historic American Building Survey/Historic American Engineering Record (HABS/HAER). Documentation will include structural plans and 35 mm black and white photographs of the dam and fish ladder and its surroundings. Photographs will be labeled according to HABS/HAER standards. Oral history information will also be included as part of the written report, which will be submitted to Washington State Office of Archaeology and Historic Preservation, Advisory Council on Historic Preservation, and National Park Service.

Cumulative effects

The dam and fish ladder were modified in 1995, with the addition of a concrete wall extending out from the downstream end of the fishway, towards the face of the dam. The lowest weir of the fish ladder had its weir wall replaced with a wall and slot. A waterline was installed to transport water to the base of the fish ladder. This consisted of an 24" polyethylene pipe, originating at the concrete enclosure for the traveling screen. A 26" diameter hole was drilled in the enclosure wall downstream of the screen, and the waterline was attached to the upstream face of the dam. Another 26" diameter hole was drilled near the south end of the dam, and the waterline was taken through the dam at this point, where it can spill out over the end of the fishway. The traveling screen was also modified. These modifications were determined to have an effect on the dam and fish ladder that was not adverse.

A legislated land conveyance in 2000 resulted in effects to the Wind River Administrative Site Historic District. Prior to the conveyance, this historic district contained 24 historic structures and three historic landscapes. As a result of the conveyance, six historic buildings were transferred out of federal ownership, along with portions of two historic landscapes. The conveyance also included the location of 17 former structures.

Alternative D

Direct and indirect effects

Although the dam is not proposed for removal under this alternative, modifications to the dam will take place. Some modifications, such as installing a bypass pipe or chute to route fish from the screen to below the dam, could result in effects to this historic property.

Replacement of fish ladder and construction of new ladder will result in an adverse effect to an historic property.

Cumulative effects

The dam and fish ladder were modified in 1995, with the addition of a concrete wall extending out from the downstream end of the fishway, towards the face of the dam. The lowest weir of the fish ladder had its weir wall replaced with a wall and slot. A waterline was installed to transport water to the base of the fish ladder. This consisted of an 24" polyethylene pipe, originating at the concrete enclosure for the traveling screen. A 26" diameter hole was drilled in the enclosure wall downstream of the screen, and the waterline was attached to the upstream face of the dam. Another 26" diameter hole was drilled near the south end of the dam, and the waterline was taken through the dam at this point, where it can spill out over the end of the fishway. The traveling screen was also modified. These modifications were determined to have an effect on the dam and fish ladder that was not adverse.

Alternative E

Direct and indirect effects

Although the dam is not proposed for removal under this alternative, modifications to the dam would take place. Some modifications, such as installing a bypass pipe or chute to route fish from the screen to below the dam, could result in effects to this historic property. These effects would probably not be adverse. The historic fish ladder would be retained.

Cumulative effects

The dam and fish ladder were modified in 1995, with the addition of a concrete wall extending out from the downstream end of the fishway, towards the face of the dam. The lowest weir of the fish ladder had its weir wall replaced with a wall and slot. A waterline was installed to transport water to the base of the fish ladder. This consisted of an 24" polyethylene pipe, originating at the concrete enclosure for the traveling screen. A 26" diameter hole was drilled in the enclosure wall downstream of the screen, and the waterline was attached to the upstream face of the dam. Another 26” diameter hole was drilled near the south end of the dam, and the waterline was taken through the dam at this point, where it can spill out over the end of the fishway. The traveling screen was also modified. These modifications were determined to have an effect on the dam and fish ladder that was not adverse.

Direct impacts to historic and prehistoric archaeological sites.

Alternative A - No Action

This alternative will result in no impacts to documented archaeological sites.

Alternative B

Direct and indirect effects

Heavy equipment needed for dam removal and dredging would impact portions of the Trout Creek archaeological site. Damage to the Trout Creek site as a result of heavy equipment use and access constitutes an adverse effect to the site as defined in 36 CFR 800.5. Three equipment access points have been identified within the boundaries of the site, and although each of these areas has been previously disturbed to some degree, it is likely that further disturbance will occur as a result of this project. These three areas include the existing access road to the pumphouse, the area adjacent to the concrete bridge, and the existing boat launch at the western end of the picnic area. This area equates to 540 m^2, or 0.2% of the site (approximately 180 m^2 of this area has already been modified).

There is a potential for direct effects to remains of Wind River Lumber Company’s splash dam. Although it was replaced by the concrete dam in 1935, portions of the structure have been found intact along the north shoreline, and it is possible that additional portions of the structure remain in the reservoir itself. Dredging activities could result in impacts to these remains.

Rehabilitation and revegetation of the shoreline could result in disturbance of portions of the Trout Creek site which have been inundated since dam construction. Recontouring of the shoreline could result in burial of site deposits.

The dewatering pipe will be buried in the vicinity of the boat launch, and depending on its proximity to the shoreline, could impact currently inundated site deposits.

There is a potential for direct effect to portions of the Wind River Administrative Site Historic District. Historic archaeological remains of the earliest Ranger Station structures were located near what is now the southern approach to the concrete bridge. Depending on depth of disturbance, heavy equipment access along the southern shore could result in impacts to this site.

There is a potential for indirect effects to an archaeological site as a result of dredge material disposal. Material will be disposed of in the Pacific Crest nursery fields, immediately adjacent to the site 45AS221. The dredge disposal material will be placed outside the boundary of site 45SA221, although the presence of heavy equipment and people in the area could result in impacts to the site.

Cumulative effects

Numerous ground-disturbing activities have occurred within the boundaries of the Trout Creek site. Within the last ten years, new developments at the Hemlock Lake picnic area included construction of barrier-free trails, a viewing deck, a picnic shelter, a boat launch, an information kiosk, a new site sign, and buried concrete piers for picnic tables. This resulted in effects to approximately 31% of the site’s area. Removal of modular buildings and subsequent construction of walkways in 1995 resulted in effects to approximately 1% of the site's area. A legislated land conveyance in 1999 resulted in the conveyance of 18% of the site out of federal ownership.

Alternative C

Direct and indirect effects

Heavy equipment needed for dam removal and dredging would impact portions of the Trout Creek archaeological site. Damage to the Trout Creek site as a result of heavy equipment use and access constitutes an adverse effect to the site as defined in 36 CFR 800.5. Three equipment access points have been identified within the boundaries of the site, and although each of these areas has been previously disturbed to some degree, it is likely that further disturbance will occur as a result of this project. These three areas include the existing access road to the pumphouse, the area adjacent to the concrete bridge, and the existing boat launch at the western end of the picnic area. This area equates to 540 m^2, or 0.2% of the site (approximately 180 m^2 of this area has already been modified, as a result of utilities, etc.).

There is a potential for direct impacts to remains of Wind River Lumber Company's splash dam. Although it was replaced by the concrete dam in 1935, portions of the structure have been found intact along the north shoreline, and it is possible that additional portions of the structure remain in the reservoir itself. Dredging activities could result in impacts to these remains.

Rehabilitation and revegetation of the shoreline could result in disturbance of portions of the Trout Creek site which have been inundated since dam construction. Recontouring of the shoreline could result in burial of site deposits.

The dewatering pipe will be buried in the vicinity of the boat launch, and depending on its proximity to the shoreline, could impact currently inundated site deposits.

There is a potential for direct effect to portions of the Wind River Administrative Site Historic District. Historic archaeological remains of the earliest Ranger Station structures were located near what is now the southern approach to the concrete bridge. Depending on depth of disturbance, heavy equipment access along the southern shore could result in impacts to this site.

There is a potential for indirect effects to an archaeological site as a result of dredge material disposal. Material will be disposed of in the Pacific Crest nursery fields, immediately adjacent to the site 45AS221. The dredge disposal material will be placed outside the boundary of site 45SA221, although the presence of heavy equipment and people in the area could result in impacts to the site.

Cumulative effects

Numerous ground-disturbing activities have occurred within the boundaries of the Trout Creek site. Within the last ten years, new developments at the Hemlock Lake picnic area included construction of barrier-free trails, a viewing deck, a picnic shelter, a boat launch, an information kiosk, a new site sign, and buried concrete piers for picnic tables. This resulted in effects to approximately 31% of the site's area. Removal of modular buildings and subsequent construction of walkways in 1995 resulted in effects to approximately 1% of the site's area. A legislated land conveyance in 1999 resulted in the conveyance of 18% of the site out of federal ownership.

Alternative D

Direct and indirect effects

Access for dredging equipment at the boat launch would result in direct effects to the prehistoric component of the Trout Creek site. This area equates to 150 m^2, or 0.05% of the site. Damage to the Trout Creek site as a result of heavy equipment use and access constitutes an adverse effect to the site as defined in 36 CFR 800.5.

There is a potential for direct effects to remains of Wind River Lumber Company's splash dam. Although it was replaced by the concrete dam in 1935, portions of the structure have been found intact along the north shoreline, and it is possible that additional portions of the structure remain in the reservoir itself. Dredging activities could result in impacts to these remains.

There is a potential for indirect effects to an archaeological site as a result of dredge material disposal. Material will be disposed of in the Pacific Crest nursery fields, immediately adjacent to the site 45AS221. The dredge disposal material will be placed outside the boundary of site 45SA221, although the presence of heavy equipment and people in the area could indirectly result in vandalism to the site.

Cumulative effects

Numerous ground-disturbing activities have occurred within the boundaries of the Trout Creek site. Within the last ten years, new developments at the Hemlock Lake picnic area included construction of barrier-free trails, a viewing deck, a picnic shelter, a boat launch, an information kiosk, a new site sign, and buried concrete piers for picnic tables. This resulted in effects to approximately 31% of the site's area. Removal of modular buildings and subsequent construction of walkways in 1995 resulted in effects to approximately 1% of the site's area. A legislated land conveyance in 1999 resulted in the conveyance of 18% of the site out of federal ownership.

Alternative E

Direct and indirect effects

Access for dredging equipment at the boat launch will result in direct effects to the prehistoric component of the Trout Creek site. This area equates to 150 m^2, or 0.05% of the site. Damage to the Trout Creek site as a result of heavy equipment use and access constitutes an adverse effect to the site as defined in 36 CFR 800.5.

There is a potential for indirect effects to remains of Wind River Lumber Company's splash dam. Although it was replaced by the concrete dam in 1935, portions of the structure have been found intact along the north shoreline, and it is possible that additional portions of the structure remain in the reservoir itself. Dredging activities could result in impacts to these remains.

There is a potential for indirect effects to an archaeological site as a result of dredge material disposal. Material will be disposed of in the Pacific Crest nursery fields, immediately adjacent to the site 45AS221. The dredge disposal material will be placed outside the boundary of site 45SA221, although the presence of heavy equipment and people in the area could indirectly result in vandalism to the site.

Cumulative effects

Numerous ground-disturbing activities have occurred within the boundaries of the Trout Creek site. Within the last ten years, new developments at the Hemlock Lake picnic area included construction of barrier-free trails, a viewing deck, a picnic shelter, a boat launch, an information kiosk, a new site sign, and buried concrete piers for picnic tables. This resulted in effects to approximately 31% of the site's area. Removal of modular buildings and subsequent construction of walkways in 1995 resulted in effects to approximately 1% of the site's area. A legislated land conveyance in 1999 resulted in the conveyance of 18% of the site out of federal ownership.

Wildlife

Bald Eagle (Threatened)

Alternative A – No Action

The No Action alternative would have no new effect on bald eagles, however the opportunity to increase the available prey base would be lost. The ability for eagles to forage at Hemlock Lake would be maintained in the short-term. If the lake fills with sediment in the long-term, the ability to forage there would be lost.

Alternative B

Direct and Indirect Effects

This alternative would return Trout Creek to a free-flowing system that hasn't existed for about 102 years. It is likely that steelhead populations in the creek and in Wind River would increase as more adult fish access spawning habitat above the dam site and more juveniles are able to safely make their way downstream. An increase in the steelhead populations would increase potential prey for bald eagles. Since the steelhead population in the Wind River Watershed is controlled by many different variables beyond the watershed, it is impossible to predict the magnitude of the effect of removing the dam.

Approximately 200 truck loads would be required to move the dredge spoils and 29 truck loads to move the dam materials. Due to the low likelihood of bald eagles being in the area of Hemlock Lake, they are not likely to be disturbed during the process of dismantling the dam and hauling the dam and dredge spoil material to the storage areas.

Because of the negligible potential to disturb bald eagles during the process of dismantling the dam and transporting the spoils material this alternative **may affect but is not likely to adversely affect** bald eagles.

Cumulative Effects

The beneficial effect of increased prey base is cumulative to other habitat restoration projects that have been planned and accomplished in the Wind River Watershed that have improved spawning and rearing habitat for steelhead. These projects include the Mining Reach and the planned Upper Trout projects.

Alternative C

Direct and Indirect Effects

This alternative would have essentially the same effects as Alternative B. The difference is that the number of truck loads of dredge spoils to be moved would be 1,700 to 2,900 dump truck loads. Due to the low likelihood of bald eagles being in the area of Hemlock Lake, they are not likely to be disturbed during the process of dismantling the dam and hauling the dam and dredge spoil material to the storage areas.

Because of the negligible potential to disturb bald eagles during the process of dismantling the dam and transporting the spoils material this alternative **may affect but is not likely to adversely affect** bald eagles.

Cumulative Effects

Cumulative effects would be the same as with Alternative B.

Alternative D

Direct and Indirect Effects

This alternative would improve deficiencies in the dam that make it difficult for fish to pass upstream and downstream. It is possible that these improvements would result in increased numbers of fish in Trout Creek and Wind River that would increase the potential prey base for bald eagles. Since the steelhead population in the Wind River Watershed is controlled by many different variables beyond the watershed, it is impossible to predict the magnitude of the effect of removing the dam.

The lake would be dredged and approximately 1,700 truck loads of dredge spoils would transported to the nursery field. Due to the low likelihood of bald eagles being in the area of Hemlock Lake, they are not likely to be disturbed during the process of hauling the dredge spoil material to the storage areas.

Because of the negligible potential to disturb bald eagles during the process of dismantling the dam and transporting the spoils material this alternative **may affect but is not likely to adversely affect** bald eagles.

Cumulative Effects

If this alternative results in increased steelhead population in Trout Creek, the effects would be cumulative to other habitat restoration projects in the Wind River Drainage, including the Mining Reach and the Upper Trout Creek project.

Alternative E

Direct and Indirect Effects

The effects of this alternative would be essentially the same as Alternative D.

Because of the negligible potential to disturb bald eagles during the process of dismantling the dam and transporting the spoils material this alternative **may affect but is not likely to adversely affect** bald eagles.

Northern Spotted Owl and Northern Spotted Owl Habitat (Threatened)

Alternative A – No Action

The No Action Alternative would have no new effects on spotted owl.

Alternative B

Direct and Indirect Effects

Implementation of this alternative would not result in any loss of suitable habitat or affect Critical Habitat Unit WA-41. In the long term, the amount of suitable habitat in the project area may increase slightly as the former lake is reclaimed, and large trees re-establish on the site.

There is a potential to affect spotted owls due to noise disturbance. Relatively constant noise that would be produced by removal of the dam and dredging the lake would be above ambient levels. If explosives are used to demolish the dam, the noise effects could extend out a mile around the work site. The effects of noise produced by jackhammers and rock drills would extend out 60 yards and noise produced by heavy equipment would extend out 35 yards from the work site. Since the suitable nesting habitat stand near the dam and lake is at least 150 yards from where work would occur, limited operating periods are not required for the use of heavy equipment, or jackhammers and rock drills. In addition, blasting using charges less than 2 pounds would not require a limited operating period. Blasting using more than 2 pounds of explosives however, would be prohibited from March 1 to June 30.

Approximately 200 dump truck loads of dredge spoils would be transported to the old nursery field and dumped. Only a minor amount of suitable habitat that is along the edge of the nursery field is within 35 yards of the field. State permit requirements would require that the dredging and spoil transport take place after June 30, so the work would happen outside of the early nesting period. This would minimize the potential to disturb nesting spotted owls.

Due to the creation of noise above ambient levels in the vicinity of spotted owl habitat, and the negligible potential to disturb spotted owls, this alternative **may affect but is not likely to adversely affect** spotted owls.

Cumulative Effects

This alternative would not cause a reduction in suitable habitat, for this reason there would be no cumulative effects.

Alternative C

Direct and Indirect Effects

Implementation of this alternative would remove the dam, and dredge all sediments from the lake. Implementation of this alternative would not result in any loss of suitable habitat or affect Critical Habitat Unit WA-41. The difference from Alternative B is that the number of truck loads of dredge spoils to be moved would be 1,700 to 2,900 dump truck loads. State permit requirements would require that the dredging and spoil transport take place after June 30, so the work would happen outside of the early nesting period. This would minimize the potential to disturb nesting spotted owls.

Due to the creation of noise above ambient levels in the vicinity of spotted owl habitat, and the negligible potential to disturb spotted owls, this alternative **may affect but is not likely to adversely affect** spotted owls.

Cumulative Effects

This alternative would not cause a reduction in suitable habitat, for this reason there would be no cumulative effects.

Alternative D

Direct and Indirect Effects

This alternative would leave the dam in place while dredging sediments from the lake bottom. Dredging would require about 1,700 truck loads to transport the material to the storage site. There would be no reduction in suitable habitat, and no affect to Critical Habitat Unit WA-41. State permit requirements would require that the dredging and spoil transport take place after June 30, so the work would happen outside of the early nesting period. This would minimize the potential to disturb nesting spotted owls.

Due to the creation of noise above ambient levels in the vicinity of spotted owl habitat, and the negligible potential to disturb spotted owls, this alternative **may affect but is not likely to adversely affect** spotted owls.

Cumulative Effects

This alternative would not cause a reduction in suitable habitat, for this reason there would be no cumulative effects.

Alternative E

Direct and Indirect Effects

The effects of this alternative would be essentially the same as Alternative D.

State permit requirements would require that the dredging and spoil transport take place after June 30, so the work would happen outside of the early nesting period. This would minimize the potential to disturb nesting spotted owls.

Due to the creation of noise above ambient levels in the vicinity of spotted owl habitat, and the negligible potential to disturb spotted owls, this alternative **may affect but is not likely to adversely affect** spotted owls.

Cumulative Effects

This alternative would not cause a reduction in suitable habitat, for this reason there would be no cumulative effects.

Cascade Torrent Salamander, Cope's Giant Salamander (Sensitive)

Alternative A – No Action

This alternative would have no new effects on these salamanders. The opportunity to improve connectivity within the Trout Creek sub-watershed would be forgone.

Alternative B

Direct and Indirect Effects

Hemlock Lake is not suitable habitat for these species, especially during the warm summer months. Due to the large size of Trout Creek below the dam, it is unlikely that either of these salamander species is a resident there. They may utilize Trout Creek as a corridor to access smaller tributary streams, and removal of the dam would reconnect habitat above and below the dam. In addition, movement of large wood down Trout Creek past the current dam site would improve habitat in the lower portion of Trout Creek. It is unknown how common it is for these species to disperse along Trout Creek, so the beneficial effect could be minor.

With this alternative, the majority of the sediment behind the dam would be allowed to erode downstream. If there were salamanders in the creek below the dam, this flush of sediment would likely cover habitat elements such as cobble at the edge of the water. Due to the low likelihood of these species inhabiting Trout Creek below the dam, this alternative **may impact individuals, but would not lead to a trend toward federal listing or a loss of species or population viability**.

Cumulative Effects

Sediment produce by other upstream projects would be cumulative to this alternative. The Upper Trout fisheries restoration project would produce minor amounts of sediment. Most of this work will likely be completed before implementation of this alternative, so the cumulative effects would be negligible.

Alternative C

Direct and Indirect Effects

This alternative would remove the dam and reconnect habitat as in Alternative B. The difference would be that the majority of the accumulated sediment would be removed and stored at an upland site. Since there would be little sediment produced, this alternative would have **no impact** on these salamanders.

Cumulative Effects

There would be cumulative effects.

Alternative D

Direct and Indirect Effects

This alternative would leave the dam in place so the opportunity to reconnect habitat would be forgone. Annual routing of sediment during high flow periods would simulate natural conditions, and would not affect these species. Since there would be no new effects to these salamanders, this alternative would have **no impact** to these species.

Cumulative Effects

There would be no cumulative effects.

Alternative E

Direct and Indirect Effects

The effects from this alternative would be the same as with Alternative D.

Cumulative Effects

There would be no cumulative effects.

Townsend's Big-Eared Bat (Sensitive)

Alternative A – No Action

Direct and Indirect Effects

There would be no new impacts with this alternative.

Alternatives B and C

Direct and Indirect Effects

These alternatives would return the system to a riverine system. Since this bat forages along forest and stream edges, foraging conditions may be improved as the former lake bed revegetates. Since there are no known populations in the area, any improvement would not likely affect this species. These alternatives would have **no impact** on Townsend's big-eared bat.

Cumulative Effects

There would be no cumulative effects.

Alternative D and E

Direct and Indirect Effects

These alternatives would leave the lake in place. Since the lake surface is probably not a suitable foraging area, the opportunity to improve foraging conditions would be forgone. However, since there are no known populations in the area, these alternatives would have **no impact** to this species.

Cumulative Effects

There would be no cumulative effects.

Common Loon (Sensitive)

Alternatives A, B, C, D and E

Based on the low likelihood of loons being present at the lake at any time of the year, there would be no impact to this species.

Larch Mountain and Van Dyke's Salamanders (Sensitive)

Alternatives A, B, C, D, and E

Neither of these species was detected during surveys, so they are not likely to exist in the project area. In addition, the nursery field where dredge material would be deposited is not suitable habitat for these species. For these reasons the project would have **no impact** on either of these salamanders.

Mollusks (Sensitive)

Alternatives A, B, C, D, and E

None of these species was detected during surveys, so they are not likely to exist in the project area. In addition, the nursery field where dredge material would be deposited is not suitable habitat for these species. For these reasons the project would have **no impact** on any of these mollusks.

Deer and Elk Biological Winter Range (BWR) (Management Indicator Species)

Alternatives A, B, C, D, and E

Neither removing the dam nor leaving it in place would affect elk and deer habitat. Covering a portion of the old nursery field with dredge spoils may reduce forage on five to ten acres, however since the field is fenced with an eight-foot mesh fence, no grazing currently occurs there.

Wood Duck (Management Indicator Species)

Alternative A – No Action

Direct and Indirect Effects

This alternative would result in no new short-term impacts to wood ducks. However, continued sediment deposition, reducing the depth of the lake would reduce the habitat suitability in the long-term. Eventually, the lake would not be suitable habitat.

Cumulative Effects

Due to the Riparian Reserve provisions in the Northwest Forest Plan, it is unlikely that additional suitable nesting habitat would be affected by future projects. There would be no cumulative effects with this project.

Alternatives B and C

Direct and Indirect Effects

Removal of the dam would likely remove nesting habitat for at least one pair of wood ducks. Suitable habitat would remain in other parts of the District, but it is not known what percent of the population is represented by this one pair. Since wood ducks are not known to nest at Hemlock Lake, the effect of these alternatives would be negligible.

Cumulative Effects

Due to the Riparian Reserve provisions in the Northwest Forest Plan, it is unlikely that additional suitable nesting habitat would be affected by future projects. There would be no cumulative effects with this project.

Alternatives D and E

Direct and Indirect Effects

These alternatives would leave the dam in place and contain provisions to route sediment during the high flow periods. Habitat for one breeding pair of wood ducks would be maintained in the long-term. Since wood ducks are not known to nest at Hemlock Lake, the effect of these alternatives would be negligible.

Cumulative Effects

There would be no cumulative effects with these alternatives.

Barrow's Goldeneye Duck (Management Indicator Species)

Alternative A – No Action

Direct and Indirect Effects

This alternative would result in no new short-term impacts to Barrow's goldeneye duck. However, continued sediment deposition, reducing the depth of the lake would reduce the habitat suitability in the long-term. Eventually, the lake would not be suitable habitat.

Cumulative Effects

Due to the Riparian Reserve provisions in the Northwest Forest Plan, it is unlikely that additional suitable nesting habitat would be affected by future projects. There would be no cumulative effects with this project.

Alternatives B and C

Direct and Indirect Effects

Removal of the dam would remove nesting habitat for about one pair of goldeneye ducks. Suitable habitat would remain in other parts of the District, but it is not known what percent of the population is represented by this one pair.

Cumulative Effects

Due to the Riparian Reserve provisions in the Northwest Forest Plan, it is unlikely that additional suitable nesting habitat would be affected by future projects. There would be no cumulative effects with this project.

Alternatives D and E

Direct and Indirect Effects

These alternatives would leave the dam in place and contain provisions to route sediment during the high flow periods. Habitat for one breeding pair of goldeneye ducks would be maintained in the long-term.

Cumulative Effects

There would be no cumulative effects with these alternatives.

Osprey (Management Indicator Species)

Alternative A – No Action

The No Action alternative would have no new effect on osprey, however the opportunity to increase the available prey base would be lost. The ability for osprey to forage at Hemlock Lake would be maintained in the short-term. If the lake fills with sediment in the long-term, the ability to forage there would be lost.

Alternative B

Direct and Indirect Effects

This alternative would return Trout Creek to a free-flowing system that hasn't existed for about 102 years. It is likely that steelhead populations in the creek and in Wind River would increase as more adult fish access spawning habitat above the dam site and more juveniles are able to safely make their way downstream. An increase in the steelhead populations would increase potential prey for osprey. The opportunity to forage in the lake would be lost, but these birds cold forage in Trout Creek where there is sufficient canopy opening. However, based on observations, the osprey probably forage more in the Wind River.

Since the steelhead population in the Wind River Watershed is controlled by many different variables beyond the watershed, it is impossible to predict the magnitude of the effect of removing the dam.

Approximately 200 truck loads would be required to move the dredge spoils and 29 truck loads to move the dam materials. Due to the low likelihood of osprey being in the area of Hemlock Lake, they are not likely to be disturbed during the process of dismantling the dam and hauling the dam and dredge spoil material to the storage areas. If the nest was occupied, State permit requirements to conduct the dredging and spoil transport after June 30th would minimize the potential to affect nesting ospreys. The expected noise disturbance occurring during the latter part of the nesting season is not likely to cause the adults to abandon the nest.

Cumulative Effects

The beneficial effect of increased prey base is cumulative to other habitat restoration projects that have been planned and accomplished in the Wind River Watershed that have improved spawning and rearing habitat for steelhead. These projects include the Mining Reach and the planned Upper Trout projects.

Alternative C

Direct and Indirect Effects

This alternative would have essentially the same effects as Alternative B. The difference is that the number of truck loads of dredge spoils to be moved would be 1,700 to 2,900 dump truck loads. Due to the low likelihood of osprey being in the area of Hemlock Lake, they are not likely to be disturbed during the process of dismantling the dam and hauling the dam and dredge spoil material to the storage areas. If the nest was occupied, State permit requirements to conduct the dredging and spoil transport after June 30th would minimize the potential to affect nesting ospreys. The expected noise disturbance occurring during the latter part of the nesting season is not likely to cause the adults to abandon the nest.

Cumulative Effects

Cumulative effects would be the same as with Alternative B.

Alternative D

Direct and Indirect Effects

With this alternative the ability of ospreys to forage at the lake would be maintained. However based on past observations, the lake is probably not an important foraging area. If improvements to the dam and fish ladder, and annual sediment routing result in more large fish in the Wind River and in Trout Creek, foraging conditions would be improved.

Approximately 1,300 truck loads of dredge spoils would be hauled to the nursery field. Due to the low likelihood of osprey being in the area of Hemlock Lake, they are not likely to be disturbed during the process of dismantling the dam and hauling the dam and dredge spoil material to the storage areas. If the nest was occupied, State permit requirements to conduct the dredging and spoil transport after June 30th would minimize the potential to affect nesting ospreys. The expected noise disturbance occurring during the latter part of the nesting season is not likely to cause the adults to abandon the nest.

Cumulative Effects

Minor improvements to fish habitat and increased ability of fish to pass the dam are cumulative to other habitat improvement projects in the Wind River Watershed.

Alternative E

Direct and Indirect Effects

With this alternative the ability of ospreys to forage at the lake would be maintained. However based on past observations, the lake is probably not an important foraging area. If improvements to the dam and annual sediment routing result in more large fish in the Wind River and in Trout Creek, foraging conditions would be improved.

Approximately 1,700 truck loads of dredge spoils would be hauled to the nursery field. Due to the low likelihood of osprey being in the area of Hemlock Lake, they are not likely to be disturbed during the process of dismantling the dam and hauling the dam and dredge spoil material to the storage areas. If the nest was occupied, State permit requirements to conduct the dredging and spoil transport after June 30th would minimize the potential to affect nesting ospreys. The expected noise disturbance occurring during the latter part of the nesting season is not likely to cause the adults to abandon the nest.

Cumulative Effects

Uncertain benefits to steelhead, and resulting population increases mean that this alternative would have no cumulative effects.

Neo-Tropical Migratory Birds

Alternative A – No Action

This alternative would have no new impacts on neotropical migrant birds. There would be no cumulative effects.

Alternatives B and C

Direct and Indirect Effects

These alternatives would have no effect on nesting habitat for Vaux's swift or pileated woodpecker. Loss of the lake surface would reduce foraging area for swallows and swifts in the long-term. Without the lake, the former lake bed will be revegetated and eventually large trees will probably dominate the site. Since the nursery fields in the project area are large open areas where these birds could forage, the loss of the lake surface is not significant.

Storing dredge spoils in the old nursery field will temporarily reduce nesting habitat for savannah sparrow, but in the short-term, it may provide suitable new nesting habitat for common nighthawk, and spotted sandpipers. These birds nest on the ground in areas with sparse vegetation cover. These effects would probably only last for one to three seasons. Nesting habitat for savannah sparrow is not limited in the area.

Cumulative Effects

If the old nursery fields are eventually reclaimed with trees, loss of foraging habitat for swallows and swifts over the lake would be cumulative to loss of other openings in the area.

Alternatives D and E

Direct and Indirect Effects

These alternatives would have no effect on nesting habitat for Vaux's swift or pileated woodpecker. Foraging opportunity for swifts and swallows over the lake surface would be maintained.

Storing dredge spoils in the old nursery field will temporarily reduce nesting habitat for savannah sparrow, but in the short-term, it may provide suitable new nesting habitat for common nighthawk, and spotted sandpipers. These birds nest on the ground in areas with sparse vegetation cover. These effects would probably only last for one to three seasons. Nesting habitat for savannah sparrow is not limited in the area.

Cumulative Effects

Since the lake surface would be maintained, there would be no cumulative effects.

Beaver

Alternative A – No Action

The No Action alternative would have no new impacts on beavers. There would be no cumulative effects.

Alternatives B and C

Direct and Indirect Effects

These alternatives would remove the dam and cause the removal of the accumulated sediment behind the dam. The lake would be lost and the gradient of the remaining stream would be increased. Due to the relatively wide floodplain that would remain, the site may still remain suitable for occupation by beavers if they could construct and maintain a dam. Due to the high winter and spring flows however, it is not likely that beavers could reoccupy the site. Removal of the dam would reduce the capability of Trout Creek to support beavers by up to one pair.

Beavers would continue to be able to occupy the Trout Creek flats area, and removal of the dam may facilitate dispersal of beavers into and out of Trout Creek.

Cumulative Effects

These effects would be cumulative to other implemented and future projects that would reduce beaver habitat suitability in Trout Creek. Implementation of timber sales in the sub-basin would follow requirements of the Northwest Forest Plan with regards to Riparian Reserves. These projects are unlikely to affect the quality of beaver habitat. The upper Trout Creek fisheries restoration project would increase large wool levels in the creek and plant hardwood shrubs and trees, improving habitat for beavers as well.

For these reasons, implementation of these alternatives would not have a cumulative effect on beavers in the watershed.

Alternatives D and E

Direct and Indirect Effects

These alternatives would retain the dam and a result in a deeper lake. The capability to support beavers would be maintained. There would be no new effects. The opportunity to improve dispersal ability by removing the dam would be lost.

Beaver habitat could be improved at the lake by reducing the amount of canary reedgrass on the western half of the lake, and planting deciduous tree and shrub species in this area.

Cumulative Effects

There would be no cumulative effects.

Botany

Environmental Justice

Alternative A – No Action

Environmental Justice assesses whether there would be disproportionate impacts to minority or low-income groups By retaining the dam, there would be no impacts to minority groups or low income groups.

Alternatives B and C

The loss of a Hemlock as a free day-use site would be felt at some level across all economic and racial boundaries due to its unique character. There simply is no alternative close by that even individuals and families of financial means could go to for similar experiences. But those who do not have the physical or financial means to travel to an off-Forest site (for instance, Lost Lake on the Mt. Hood NF) for a similar lake-related experience would feel the impacts to a greater extent than those with the ability to travel some distance and incur greater expenses.As gas prices increase, this disparity would increase. The Environmental Justice section in Chapter III displayed poverty-by-race for the Wind River and Stevenson CCDs. The figures are summarized below, in Table 4-26.

Table 4-26. Low Income and Minority Groups Likely To Be Affected By Hemlock Dam Removal.

Poverty by Race (Individuals) for Wind River and Stevenson CCCs			
	Wind River CCD	Stevenson CCD	% of County
	Number / %	Number / %	% of County
White	573 / 14%	326 / 21%	10%
Black	0/0	2 / 100	.06%
American Indian And Alaska Native	57 / 37	22 / 28	36%
Other Race	7 / 15	2 / 12	.04%
2 or more races	20 / 21	7 / 11	12%
Hispanic Or Latino	56 / 24	2 / 7	15%
White not Hispanic	542 / 14	324 / 21	10%

Based on the figures in Table x, the "White" individuals below poverty would be impacted in the greatest numbers; the American Indian and Alaska Natives would be the racial group with the highest percentage of individuals affected, followed by Hispanic or Latio.

Alternatives D and E

By retaining the dam, there would be no impacts to minority groups as a whole. Implementing the use-fee could affect low income groups below poverty--white and other races-- unable to purchase either a $5.00 day pass or a $30 annual pass.

Economics

This analysis compares the financial costs and returns over a 20-year period for each alternative in the EIS. Costs were estimated for each action item under each of the alternatives considered in the EIS. The cost estimates used in this analysis are not highly refined, but represent an appraisal-level evaluation of potential costs. More detailed, design-level costs for each of the alternatives would have been financially impractical for this analysis because of the wide range of alternatives being considered, and the uncertainty about which alternative would be selected for implementation. Once a decision has been reached on which alternative is to be implemented, additional design and cost estimation will be done on the selected alternative.

Analysis Process

Cost estimates developed for each alternative were analyzed using Quicksilver, a project analysis tool developed by Mike Vasievich of the US Forest Service. A 20-year period was used as the planning horizon for the project. This was based primarily on the length of time required to implement the most time-intensive alternative analyzed in the EIS (i.e. dam removal). Because it would likely require several years to complete designs and engineering, to acquire funding, implement the project, and complete followup work and monitoring, a 10-year window was considered potentially limiting. Moreover, planning for work associated with the dam that extended beyond 20 years was considered too speculative.

Structural analysis of the dam conducted by Chambers et al (1992) found the dam to be in good shape, and predicted that it would be functional "for an indefinite period of time". A more recent structural analysis completed by the US Army Corps of Engineers and QUEST Structures found the dam withstood modeling of the maximum credible earthquake and Probable Maximum Flood. These findings indicate that there is no discrete time yet identified at which the dam must be removed from a stability standpoint, unless changes are found during subsequent inspection and monitoring of the dam. As a result, outyear dam removal is not considered in this financial analysis for the alternatives that leave the dam in place (Alternatives A, D and E). Nonetheless, at some future point, the dam will presumably need to be removed or have significant repair work done. Neither of these long-term costs are included in the analysis below, because of the uncertainty with the timing of their occurrence.

Annual Costs

Under each of the alternatives in which the dam remains in place, there are annual costs associated with maintaining the dam and its appurtenances including the fish ladder, screen, trap, and flashboards. Daily inspections of the dam, fish ladder, and traveling screen to check and clear debris are currently undertaken by the District, and will be continued under all dam retention alternatives. These are required by Washington State laws for fish passage. Flashboards are installed each summer to increase the lake storage and improve the recreational experience. These would continue under all dam retention alternatives.

Unscheduled Repairs

In addition to regularly scheduled maintenance, various parts associated with the dam wear out and need repair and/or replacement. In the past five years, approximately $4900 has been spent on repairs to: knife gate shaft, attraction flow screen, motors and gearboxes associated with the traveling screen. The total cost of these repairs was used to estimate the annual share of repair costs.

Fish Passage Improvements

There are a number of known shortcomings in the existing fish passage system at the dam. These were documented in Perkins and Barber (1999), and are described in the Fisheries section of this report. For alternatives in which the dam remains in place, it is likely that the more significant of the fish passage concerns will need to be rectified by upgrading or improving the existing facility. The specific requirements for improvement are as yet unknown, but expected to arise through the consultation process with NOAA Fisheries.

For Alternatives D and E, cost estimates were developed for the fish passage improvements that would be most likely to be required. Although these same requirements would likely be imposed under Alternative A, this alternative was analyzed under a true "no action" scenario, and as such includes no improvements to the existing fish passage facilities at the dam. Cost estimates for the fish passage improvements are based on actual costs of other projects that have been planned or are completed, and that have readily available implementation cost figures.

Dam Removal

Dam removal is considered under both Alternatives B and C. Each of these alternatives includes some level of sediment management associated with removal of the dam. In addition, each of these alternatives would require some level of site rehabilitation following removal, including treatment of invasive weeds, revegetation of the exposed and remaining sediments in the lake area, tree planting, slope stabilization, and establishment of ground cover on sediments disposed of in the nursery fields.

Alternative C would also include costs for construction of a stream channel through the area now occupied by the lake. Under both Alternative B and C, an additional cost was added to account for unforeseen mitigation required during or following project implementation. The types of work this might cover include evaluation of the historic splash dam, if it is found to still be in place just upstream of the dam, dealing with unforeseen issues with sediment or fish passage that may arise, and other unknowns. Since this cost is entirely unknown, the level of confidence in this figure is low.

Findings

Figure 4-26 summarizes the present net value for each of the alternatives. Values are shown in positive terms, even though the actual present net values are negative for each alternative (i.e. under each alternative, the dam and appurtenances—including the recreational facility—cost more money than they generate). The analysis assumes that the Forest Service would pay all costs, however in reality it may be difficult to get sufficient funding for any of the alternatives from within the agency, so grant monies will be sought.

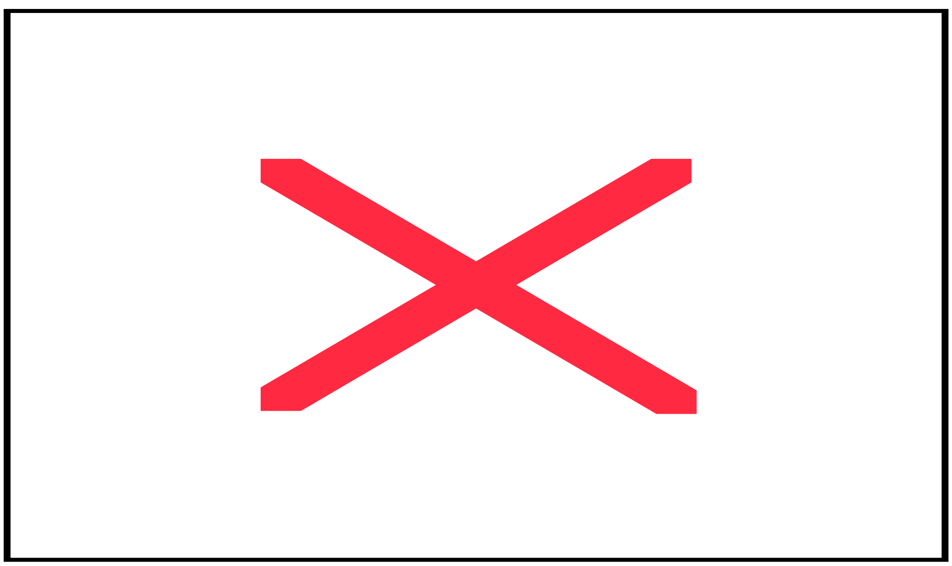

Figure 4-26. Present net value of each alternative over a 20-year period (shown in positive terms, although actual PNV's are negative for every alternative).

The analysis shows that the present net value of Alternative A (no action) would be lowest of all alternatives over a 20-year period. This alternative is lower than the next lowest cost alternative by approximately $500,000. However, it is likely that this alternative would not be feasible due to the existing conditions for fish passage at the dam, and the likelihood of requirements being made on the Forest Service to upgrade the existing facilities.

Among the action alternatives, the proposed action (Alternative B) has the lowest present net value at approximately $816,000. This is some $500,000 lower than the next lowest alternative (Alternative C), which is valued at near $1.4 million. The highest present net value is under Alternative D, in which the fish ladder is rebuilt, and other improvements are made to existing fish passage facilities. This alternative would have a present net value of approximately $1.1 million higher than the proposed action. As noted in previous sections of this analysis, under both Alternatives D and E, future dam decommissioning costs or significant repairs of the dam (at whatever time they should occur) are not included here, so must be taken into account in interpreting these results.

Short-term Uses and Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Unavoidable Adverse Effects

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

CHAPTER 5. CONSULTATION AND COORDINATION

Preparers and Contributors

The Forest Service consulted the following individuals, Federal, State, and local agencies, tribes and non-Forest Service persons during the development of this environmental assessment:

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FEDERAL, STATE, AND LOCAL AGENCIES:

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Distribution of the Environmental Impact Statement

This environmental impact statement has been distributed to individuals who specifically requested a copy of the document In addition, copies have been sent to the following Federal agencies, federally recognized tribes, Sate and local governments, and organizations representing a wide range of views regarding …

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