Bull Trout Habitat Limiting Factors

For Water Resource Inventory Area (WRIA) 62 (Pend Oreille County, Northeast Washington State)

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ACKNOWLEDGMENTS

In accordance with RCW 77.85.070 (Salmon Recovery Act, previously Engrossed Senate House Bill 2496), a Technical Advisory Committee (TAG) was organized in February 2002 by the Washington Conservation Commission (WCC) in consultation with Pend Oreille (PO) County and the Kalispel Tribe (KNRD), by inviting private, federal, state, tribal and local government personnel with appropriate expertise to participate.

The role of the TAG was to identify the limiting factors for bull trout in WRIA 62 (RCW 77.85.070[3]), a portion of the Pend Oreille Subbasin falling within Washington State. The information was then incorporated into this report to support the Pend Oreille Lead Entity (POLE) Committee in their effort to compile a habitat restoration/protection projects list, establish priorities for individual projects, and define the sequence for project implementation (RCW 77.85.050[1c]).

The TAG membership mailing list was extensive and included the following agencies and individuals:

Name	Agency
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Actual contribution to the development of the report through participation in the TAG meetings and draft document reviews were represented by a smaller, core group:

Pat Buckley	Pend Oreille County Public Utility District
Andrew Scott	Framatome ANP
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Dennis Murray	WA State Department of Ecology

I am greatly appreciative to all the individuals who put whatever effort they could afford into the development of this report. It has been one more task on top of many demands on staff time. However, it is work that was certainly needed and I hope it will serve those of you who continue to work on bull trout recovery and watershed planning efforts in WRIA 62.

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General Information

This report addresses WRIA 62, which is located in the northeastern corner of Washington State and encompasses that portion of the Pend Oreille subbasin that lies within Washington State. WRIA 62 is bordered by Canada to the north, Idaho to the east, and the Chewelah Mountains to the west. It encompasses the Pend Oreille River and its tributaries between the Canada border at RM 16.0 and the Idaho border at RM 87.8. WRIA 62 also includes a small portion of the South Fork Salmo River from RM 8.8 – 13.0, where it dips down into Washington State. The S. Fk. Salmo River is a tributary to the Salmo River which flows into the Pend Oreille River in Canada at RM 13.3. Some headwater portions of tributaries which drain to the Priest River system in Idaho are also captured in WRIA 62. The headwaters of tributaries contained within WRIA 62 that drain into Idaho waters include; Gold Creek, Jackson Creek, Bench Creek, Granite Creek, Kalispell Creek, Lamb Creek, Binarch Creek, Upper West Branch, and Lower West Branch.

The Columbia River Distinct Population Segment of bull trout, which includes the Pend Oreille subbasin populations, was listed under the ESA as "Threatened" on June 10, 1998 (63 FR 31647). The status of the Pend Oreille bull trout stock is identified by WDFW as "Unknown" (WDFW 1998, pg. 415). A rating of "Unknown" is applied when the stock has not been monitored or enumerated over a sufficient period of years to enable a quantitative analysis of its status. Determination of their status for future inventories will require more intensive stock assessment work (WDFW 1998, pg. 25).

Bull trout were once abundant in the Pend Oreille River having been documented as occurring historically in the Pend Oreille River downstream of Albeni Falls and upstream of Z Canyon (RM 19.0; Gilbert and Evermann 1895). Identified by name historically as "char", bull trout have not been conclusively documented as occurring historically in any tributary drainages to the Pend Oreille River other than LeClerc Creek. There is also no evidence to refute bull trout presence within tributaries to the Pend Oreille River system where natural blockages would not have prevented entry into tributary drainages (Lyons 2002). Given the knowledge of salmonid biology and behavior, the historic presence of bull trout in the mainstem Pend Oreille River (Gilbert and Evermann 1895), and a lack of natural barriers at tributary mouths, it is likely bull trout would have entered tributaries within the Pend Oreille River system whenever possible. Once in a river system, the strategy of salmonid species to enter accessible streams whenever possible is seen repeatedly, as with brook trout for example.

Currently, due to factors such as loss of habitat connectivity, habitat degradation, and non-native fish introductions, bull trout observations within WRIA 62 are now rare. Only 33 individual observations of bull trout (including both adults and juvenile sightings) have been documented in WRIA 62 since 1974. These 33 sightings do not include bull trout observations in the South Fork Salmo River, which is a tributary to the Pend Oreille River reach in Canada, and do not include sightings in the Kalispell Creek, Granite Creek, and Hughes Fork drainages which flow into the Priest River system in Idaho. Viable bull trout populations still exist in these drainages. Average densities of bull trout for the entire west side Priest Lake drainage in all habitat types sampled from 1982-1984 were 3.4 fish/100m^2 (Irving 1987, Figure 8). Since 1974, the only documentation of reproducing bull trout in the lower Pend Oreille River tributary drainages located in Washington State has occurred in the LeClerc Creek drainage. In West Branch LeClerc Creek and East Branch LeClerc Creek, a total of 5 juveniles and 2 adults (one a female digging a redd) have been observed since 1993 (T. Andersen, KNRD, pers. comm., 2002; Plum Creek 1993 field notes).

There is some uncertainty in the historical literature as to which, if any, of the falls in the Pend Oreille River were absolute barriers to bull trout migration. Even currently, there are no specific criteria for bull trout passability at natural obstacles based on swimming speeds, jumping abilities and barrier navigation. Gilbert and Evermann (1895) and others (Abercrombie 1896; Rathbun 1895) visited the Pend Oreille River from Albani Falls (RM 90.1) downstream to at least Big Eddy Canyon (Z Canyon; RM 19.0) in the late 1800s. During early August, Gilbert and Evermann (1895) concluded that Albeni Falls, near the outlet of Lake Pend Oreille in Idaho, was not likely to provide a passage barrier to upstream migrating fish, although they did not refer to trout specifically. Rathbun (1895) however, did report trout passing freely up Albeni Falls at the time he observed the falls. Based on observations of Metaline Falls (RM 27.0) in mid-August of 1895, Gilbert and Evermann indicated that even Metaline Falls and Z Canyon could be passable to salmon, though salmon have never been documented to occur upstream of this point. Rathbun, on the other hand, took the position that salmon passage at Metalline falls could not be determined satisfactorily although one of his party felt salmon passage at the falls was not possible under the conditions observed during their visit. It should be noted that characterizations of the Pend Oreille River could vary considerably depending on the time of year observations were made.

Allan H. Smith, however, held a different opinion from Gilbert and Evermann concerning salmon passage in the Pend Oreille River prior to hydropower development. Smith was a well-respected scientist known for his work and personal knowledge regarding northwest Native American cultures and their fisheries in the early and mid-1900's. In a 1993 letter to fellow scientist James W. Mullan, A.H. Smith says,

> "In truth, they [salmon] could not swim upriver beyond the formidable tumbling waters of Z Canyon [historically called "Big Eddy Canyon"] and Metaline Falls near the Canadian boundary. My own Kalispel Indian field data of the 1930's and lots of other evidence testify clearly to this fact" (Smith 1993, a letter to James W. Mullan, USFWS).

Bennett and Falter (1985) also concluded that Z Canyon (RM 19.0) and Metaline Falls at RM 27.0 (Bennett and Falter 1992) probably restricted anadromous chinook salmon and steelhead trout to the lower 27 miles of the Pend Oreille River.

Bull trout, however, exhibiting their various life history forms (fluvial, adfluvial, resident), would most likely have entered the Washington State portion of the Pend Oreille River system from reaches upstream of Albeni Falls dam, including the Lake Pend Oreille and Priest River areas. Regarding passage at Albeni Falls, Gilbert and Evermann (1895, pg. 181) described it this way:

> “The falls were scarcely more than pretty steep rapids and would not interfere at all with the ascent of salmon.” The part to the left of the islands (going downstream), on August 9, 1892, had a total descent of “…probably 10 feet, but as a rapid, not in a vertical fall. During low water the descent would be somewhat greater. The fall on the right side [of the island] is of the same character and presents no greater difficulties. Just below Albeni Falls, the river is perhaps 1,000 feet wide and 20 to 30 feet deep in the channel.”

Although the Gilbert and Evermann report (1895) did not refer specifically to bull trout passage at Albeni Falls, they did comment that bull trout were “abundant in the Pend Oreille River.” They also recorded seeing in the possession of an Indian “several fine specimens, the largest of which was 26 inches long, 11 inches in greatest circumference, and weighed 5 pounds and 1 ounce.” Gilbert and Evermann also commented: “the people along the river know this fish [the bull trout] as the ‘char’ ”. A newspaper article in the April 3, 1957 issue of the Metaline Falls Gazette reported that many large Dolly Varden [bull trout] were caught in the Pend Oreille during a 1957 Field and Stream tournament (Ashe and Scholz 1992, pg. 4). These reports help to document the extent of the historical existence of a bull trout fishery in the Pend Oreille River. Knowledge of bull trout biology and habitat use strongly suggests a historic connection to Lake Pend Oreille and to other tributaries in WRIA 62.

This Bull Trout Habitat Limiting Factors Report focuses on habitat conditions in WRIA 62 as they affect the ability of the habitat to sustain naturally-producing bull trout populations. It provides a snapshot in time based on the data and published material available during the development of this report and the professional knowledge of the WRIA 62 Pend Oreille Technical Advisory Group (TAG). Revisions to the report are not currently funded; however, it is the hope of the Washington State Conservation Commission (WCC) that the information and assessment provided here will be utilized and expanded in future subbasin planning efforts designed to promote the restoration of self-sustaining bull trout populations within the WRIA 62 portion of the Pend Oreille subbasin.

Factors Affecting Natural Salmonid Production in WRIA 62.

It is apparent that the habitat of the mainstem Pend Oreille River is no longer suitable for the production of trout [in general] for which it once was know (Ashe and Scholz 1992, pg. 198). It is unknown which bull trout life history stage is currently most limiting to bull trout production in the lower Pend Oreille River system downstream of Albeni Falls and within Washington State. It is also unknown which habitat attribute or combination of habitat attributes negatively impacted by human activities, are most limiting each bull trout life history stage in the Lower Pend Oreille system downstream of Albeni Falls within Washington State. However, several factors are known to be significant in the decline of bull trout populations in the lower Pend Oreille River system within Washington State: habitat degradation on the mainstem and within the tributaries; human-made fish passage barriers into tributaries to the Pend Oreille River; exotic fish species introduction and management; and the construction and operation of three hydroelectric facilities on the mainstem Pend Oreille River (Boundary dam, Box Canyon dam and Albeni Falls dam) . In addition, two more dams were built across the mainstem Pend Oreille River in Canada (Waneta dam and Seven Mile dam). The Northeast Washington Recovery Unit

Team feels that complete recovery of bull trout populations in the Pend Oreille River in Washington is contingent upon reconnection with the Lower Clark Fork Recovery Subunit in Idaho (that habitat upstream of Albeni Falls dam; USFWS 2002, pg. 1 of 26).

Over one hundred years ago, in the late 1880's, European descendents started activities that have impacted salmonids, including bull trout in the Pend Oreille subbasin. Sawmills were built in 1888 and logging began in earnest over the next 20 years as 250 sawmills were built in Pend Oreille County alone from 1900 to 1940. By 1927, the old growth in the county was gone. In place of old growth stands of white and yellow pine, less desirable douglas fir forests now grow. In addition, over 30 significant fires swept over Pend Oreille County from 1907-1939. Railroad levees and flood control dikes were built in Pend Oreille County during 1905 to 1913. Brown trout were introduced in the 1890's with additional fish planting of rainbow trout, brook trout, brown trout and bass (smallmouth and largemouth) occurring from the 1930's through the 1960's. The population in Pend Oreille County has reflected the "boom and bust" economy of the late 1800s and the 1900s in northeast Washington/northern Idaho. In 1905 - 1935 there were 30,000 people. Today the population is 10,000 to 11,000 people with towns that once held 5,000 people now being nothing more than a name on a map. In the 1950's, conversion of the mainstem Pend Oreille River into a series of five reservoirs associated with hydroelectric development began with the construction of Albeni Falls Dam in 1955. All the Pend Oreille River dams were built without fish passage facilities.

Today, for all practical purposes viable bull trout populations appear to have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years. Even given fish passage at Albeni Falls dam, it is not clear from the existing literature whether bull trout populations could be recovered in the Pend Oreille River system downstream of Albeni Falls dam. The USFWS Bull Trout Draft Recovery Plan for Northeast Washington (USFWS 2002, pg. 38) has stated that to reach a recovered condition within the Pend Oreille Core Area within 25 years could require the use of artificial supplementation. Studies to determine the effectiveness and feasibility of using artificial propagation to recover bull trout populations in the Northeast Washington Recovery Unit area are being recommended in the draft USFWS Bull Trout Recovery Plan, Chapter 23 (USFWS 2002, pg. 38). Following restoration of fish passage at Albeni Falls dam, the extent to which exotic fish species, Pend Oreille River habitat as impacted by dam operations, or man-made fish passage barriers and habitat degradation in tributary habitat would immediately preclude bull trout recovery is unknown.

On the Pend Oreille River system in Washington, Box Canyon Dam in Washington and Albeni Falls dam in Idaho have disconnected Lake Pend Oreille and the Priest River system in Idaho from the Pend Oreille River system downstream of Albeni Falls dam. Waneta and Seven Mile dams in Canada, and Boundary Dam just south of the Canada/U.S. border, without fish passage facilities, fragment the bull trout habitat in the very lower Pend Oreille River system downstream of Metalline Falls and Z Canyon. Other dams and water diversion facilities without fish passage facilities were constructed in tributaries to the Pend Oreille River and have further fragmented native populations and reduced connectivity (e.g. Sullivan Creek Dam, Mill Pond Dam, Cedar Creek Dam, Calispell Pumps, the Calispell Duck Club Dam, and the Priest Lake Outlet Dam).

Predation and competition from non-native salmonids and introduced warm-water fish species like largemouth bass, smallmouth bass, northern pike, walleye, and yellow perch, is also a significant limiting factor for bull trout in the mainstem Pend Oreille River and its tributaries within Washington State downstream of Albeni Falls. The extent to which exotic fish species predation and competition may limit bull trout recovery in this portion of WRIA 62, even given fish passage at hydroelectric dams on the Pend Oreille River, is unknown. However, without restoration of fish passage at Albeni Falls dam, no amount of habitat recovery efforts or the elimination of competition from non-native fish species could restore naturally sustainable bull trout populations in the Pend Oreille River system in Washington State downstream of Albeni Falls dam.

Also, the relative effect on bull trout production from the conversion of the Pend Oreille River to a reservoir system has not been adequately evaluated. In a study of fish and habitat conditions in the Boundary Reservoir, McLellan (2002, pg. 119) concluded that there is not a full understanding of all the limiting factors in the Boundary Reservoir system and how they relate to each other. The report concluded that what is known is that the major limiting factors in the Boundary Reservoir reach of the Pend Oreille River were related to water temperature, retention times, and daily water level fluctuations.

Man-caused habitat degradation associated with forest management practices, fire, hydroelectric development, flood control, livestock grazing, road construction, and land use practices associated with agriculture and residential/urban development has also impacted bull trout. Nearly all of the original forests between the major roads east and west of the Pend Oreille River are believed to have been logged or burned at least once since the mid-1800s (POPUD 2000, pg. E1-3). Human-caused habitat degradation presents problems in nearly all drainages; natural and human-made blockages limit available access to suitable habitat in others (Ashe and Scholz 1992, pg. 198-209).

The Priest River drainage bull trout populations are declining as well, even though connectivity to large lakes - where adfluvial bull trout migrate to mature for four to six years before returning to natal streams to spawn - is generally intact and there appears to be available habitat within the drainage for all life stages. There is an impassable barrier, Outlet Dam, at the outlet of the lower-most lake (Priest Lake). This decline in bull trout numbers in the Priest River system has been attributed to healthy lake trout populations in the lake environments that out-compete bull trout for habitat and prey on juvenile bull trout which migrate to the lake environments to mature (J. Dupont, IDFG, pers. comm., August 2002). In the tributary environments of the Priest River drainage, brook trout numbers are contributing to bull trout declines through competition for habitat and hybridization.

Within the Priest River system, bull trout observations are limited in the lower two-thirds of the drainage which includes Priest Lake and its tributaries, including Granite Creek which originates in Washington (Panhandle Basin Bull Trout TAT, 1998, pg. 9) and the East River which drains into the Priest River from the east at RM 23.0. In the East River drainage, which flows into the lower Priest River about 22 miles south of Priest Lake, the Idaho Department of Fish and Game (IDFG) is currently conducting a bull trout telemetry study with a limited number of tagged bull trout from the East River drainage. As of the time of writing of this report, the East River tagged bull trout have been traced downstream to Lake Pend Oreille. The strongest remaining bull trout populations in the Priest River system are found in the upper portion of the Priest River drainage, in Upper Priest Lake and its tributaries like Hughes Fork, although in declining numbers (Panhandle Basin Bull Trout TAT, 1998, pg. 9; IDFG redd surveys 1992 – 2001; Irving 1987). The headwaters of tributaries to Hughes Fork lie within Washington in WRIA 62: Gold, Jackson and Bench creeks. The IDFG experimented in the summer of 2002 with using strobe lights in the Thorofare (the connecting body of water between Priest Lake and Upper Priest Lake) to deter the movement of lake trout from the lower to the upper lake. The IDFG hope to be able to continue the use of strobe lights in 2003.

The survey efforts and assessment of habitat productivity within the Lower Pend Oreille and Priest River Northwest Power Planning Council (NPPC) Planning Areas of the Pend Oreille Subbasin is fragmented and not coordinated (Table 1). After determining which bull trout life history stage habitat type (i.e. adult holding, juvenile rearing, incubation, juvenile overwintering) is most limited in the lower Pend Oreille planning area, bull trout productivity needs to be evaluated at a broader geographic scale than at just the reservoir reach or watershed level. An assessment of bull trout limiting factors at a broader geographic scale in the lower Pend Oreille River system is needed to facilitate more effective information gathering and exchange to develop a scientifically defensible restoration strategy. At a minimum scale, the assessment must take into account the relative importance of Lake Pend Oreille and the Priest River portions of the Pend Oreille Subbasin to bull trout recovery in the lower Pend Oreille River system.

Table 1: Project Comparisons in WRIA 62

Stream Name	Tributary To:	Known Bull Trout Distribution (WCC mapping)	Individual Observation only (WCC mapping)	Kalispel Resident Fish Project (KNRD)	Resident Fish Stock Status Project (WDFW)	Contains USFWS proposed Critical Habitat (2002b)
Waneta Reservoir, Canada (RM 0.2) - Teck Cominco						
Seven Mile Reservoir, Canada (RM 9.0) - B.C. Hydro						
Salmo River (RM 13.3)	Pend Oreille River	**X**				
S. Fk. Salmo River (RM 7.4)	Salmo River	**X**				
Boundary Dam (RM 17.0) - Seattle City Lights / 1967						
Pend Oreille River	Columbia River	**X**			**X**	**X**
Lime Creek (RM 18.0)	Pend Oreille River				**X**	
Pewee Creek (RM 19.0)	Pend Oreille River				**X**	
Slate Creek (RM 22.2)	Pend Oreille River				**X**	**X**
Flume Creek (RM 25.8)	Pend Oreille River				**X**	
Sullivan Creek (RM 26.9)	Pend Oreille River		**X** (below Mill Pond only)		**X**	**X**
Sweet Creek (RM 30.9)	Pend Oreille River		**X** (below the falls only)		**X**	
Sand Creek (RM 31.6)	Pend Oreille River				**X**	

Box Canyon Dam (RM 34.5) - Pend Oreille PUD / 1956						
Pend Oreille River	Columbia River	**X**		**X**		**X**
Cedar Creek (RM 37.7)	Pend Oreille River		**X** (just upstream of the dam)	**X**		**X**
Ruby Creek (RM 52.0)	Pend Oreille River					**X**
LeClerc Creek (RM 56.2)	Pend Oreille River			**X**		**X**
W. Br. LeClerc Creek (RM 1.0)	LeClerc Creek	**X**				**X**
Mineral Creek (RM 10.4)	W. Br. LeClerc Creek			**X**		
Whiteman Creek (RM 8.85)	W. Br. LeClerc Creek			**X**		
E. Br. LeClerc Creek (RM 1.0)	LeClerc Creek	**X**				**X**
Fourth of July Creek (RM 2.8)	E. Br. LeClerc Creek	**X** (up to RM 0.25 steep gradient)		**X**		**X**
Mill Creek (RM 58.3)	Pend Oreille River		**X** (lower 0.5 mile)	**X**		**X**
Cee Cee Ah Creek (RM 66.29)	Pend Oreille River			**X**		
Tacoma Creek (RM 66.3)	Pend Oreille River					**X**
Calispell Creek (RM 69.6)	Pend Oreille River					**X**
Smalle Creek (RM 2.5)	Calispell Creek					**X**
E. Fk.Smalle Creek	Smalle Creek					**X**
Indian Creek (RM 81.2)	Pend Oreille River		**X** (at the mouth)	**X**		**X**

Albeni Falls Dam (RM 90.1) - U.S. Army Corps of Engineers / 1955						
Priest River (RM 96.6)	Pend Oreille River	**X** (below East R. Confl. only)				
Lower W. Br. Priest River (RM 5.0)	Priest River					
East River (RM 23.0)	Priest River	**X**				
Upper W. Br. Priest River (RM 35.3)	Priest River					
Binarch Creek (RM 42.0)	Priest River					
Priest Lake (RM 45.0)	Priest River	**X**				**X**
Lamb Creek (RM 0.1)	Priest Lake					
Kalispell Creek (RM 4.5)	Priest Lake	**X**				**X**
Granite Creek (RM 10.0)	Priest Lake	**X**				**X**
S. Fk. Granite Crk. (RM 10.7)	Granite Creek	**X**				**X**
N. Fk. Granite Crk. (RM 10.7)	Granite Creek	**X**				**X**

Albeni Falls Dam (RM 90.1) - U.S. Army Corps of Engineers / 1955						
Tillicum Creek	N. Fk. Granite Creek	**X** (up to Highrock Crk. confl. only**)**				
Thorofare (RM 64.5)	Priest Lake	**X**				**X**
Upper Priest Lake (RM 67.2)	Thorofare	**X**				**X**
Upper Priest River (RM 70.2)	Upper Priest Lake	**X**				**X**
Hughes Fork (RM 0.5)	Upper Priest River	**X**				**X**
Gold Creek (RM 5.25)	Hughes Fork	**X**				**X**
Muskegon Crk.	Gold Creek	**X**				
Jackson Creek (RM 9.25)	Hughes Fork	**X**				
Bench Creek (RM 10.5)	Hughes Fork	**X**				

Summary of Habitat Conditions by WAU

The following is a summary of habitat conditions by WAU that have been identified by the TAG during development of the report. A more detailed discussion of habitat conditions for each watershed can be found in the chapter titled: "Salmonid Habitat Conditions by WAU". Past and existing efforts to maintain and restore bull trout habitat as well as other watershed management needs, are identified in the Draft Pend Oreille Subbasin Summary (KNRD 2001) compiled for the Northwest Power Planning Council (NPPC), and in the USFWS draft Bull Trout Recovery Plans for the Northeast Washington and the Clark Fork River Recovery Units (USFWS 2002; USFWS 2002a).

Mainstem Pend Oreille River.

The portion of the mainstem Pend Oreille River included in the habitat limiting factors assessment extends from Boundary Dam (RM 17.0), located in Washington State one mile south of the Canada/United States border, upstream to Albeni Falls Dam (RM 90.1) in Idaho (2.3 miles east of the Idaho/Washington border). Five hydroelectric facilities have been constructed on the Pend Oreille River from its confluence with the Columbia River in Canada to Albeni Falls. None of these dams has fish passage facilities. Reestablishing the historic connection with Lake Pend Oreille (RM 115) in Idaho is essential for recovery of the Pend Oreille core area population in Washington (USFWS 2002). Dams on the Pend Oreille River downstream of Lake Pend Oreille have negatively impacted the connectivity for fluvial and adfluvial bull trout migratory life forms in areas where natural blockages did not occur, by isolating bull trout subpopulations, eliminating individuals from subpopulations, and reducing or eliminating genetic exchange (KNRD 2001, pg. 84; R2 Resource Consultants 1998, pg. 5-2). In addition to providing bull trout passage at Albeni Falls, the ability of the mainstem Pend Oreille River to sustain bull trout populations in the WRIA 62 also lies in reducing competition from non-native fish species to some as yet unknown level; providing fish passage at human-made barriers both on the Pend Oreille River and its tributaries; and restoring habitat conditions degraded by human activities to naturally support the maintenance of healthy bull trout populations.

South Salmo WAU (15,956 acres).

The South Salmo WAU encompasses only that portion of the Salmo River drainage located in Washington State. This includes the South Salmo River from RM 8.8, where it flows south into the United States, upstream to RM 13.5 where it continues into Idaho. The South Salmo River is a tributary to the Salmo River and has its confluence in Canada. The Salmo River is a tributary to the Pend Oreille River joining it in the Seven Mile Reservoir in Canada. The entire South Salmo WAU lies within the Salmo Priest Wilderness Area (USFS 1999bb, pg. 1).

The factor most limiting bull trout populations in the Salmo River drainage and its tributaries had been legal harvest of bull trout up until 1999 (J. Baxter, Baxter Environmental, 2002, pers. comm.). Presently, hydroelectric development on the Pend Oreille and Columbia rivers may also be negatively affecting bull trout populations in the Salmo River watershed by eliminated spawning, rearing, and overwintering habitat while eliminating genetic exchange among bull trout populations using the Salmo River drainage. Even prior to the construction of Boundary

Dam, fish from the Salmo River system would not have been able to migrate upstream beyond Metaline Falls on the Pend Oreille River. Access to Pend Oreille River tributaries in Washington State downstream of Metalline falls is naturally limited to the Slate Creek drainage to the extent that passage is possible upstream of the natural cascades at RM 0.75 on Slate Creek. Fish from the Pend Oreille River upstream of Metalline Falls potentially could have migrated downstream to contribute to the fish stocks in the Salmo drainage, but there would have been no means for them to return to the Pend Oreille River and Lake Pend Oreille. Degraded habitat conditions have not been identified as a concern in the Salmo River watershed. The habitat quality of the S. Fk. Salmo River within Washington State is such that reaches of the river can be used as reference reaches for comparative purposes to assess the condition of managed reaches of similar land and channel type. The land classification for the South Salmo WAU is wilderness status throughout those portions of the South Fork Salmo River within Washington State (USFS 1999bb, pg. 1).

Slate Creek WAU (46,803 acres).

The Slate Creek WAU captures the Pewee, Lime, Slate, and Threemile creek drainages which enter the Boundary Reservoir reach of the Pend Oreille River. Both Pewee and Threemile creeks are naturally disconnected from the Pend Oreille River by falls at the mouths, and instream temperatures in Lime Creek naturally exceed the tolerance level for bull trout fry and juveniles. On Slate Creek, the extent to which natural cascades/falls/chutes beginning at RM 0.75 impede fish passage further into the drainage is uncertain. The extent to which bull trout could have successfully utilized Slate Creek habitat historically is not clear based on existing information. Bull trout have not been documented as occurring currently in the Slate Creek WAU. In the Slate Creek WAU only the Slate Creek drainage has been identified by the TAG as containing "Suitable" bull trout habitat.

Human-caused factors that are limiting the sustainability of bull trout populations in Slate Creek can be tied to occurrences outside the Slate Creek drainage. Habitat in the Slate Creek drainage is largely unimpacted by human activities. Instream conditions of managed stream reaches in Slate Creek are near the upper range of natural variability when it comes to pool frequency and large woody debris (LWD). Historic instream habitat conditions are represented by the lower reaches of Slate Creek

Out-of-drainage human alterations to the Pend Oreille River system that are limiting bull trout populations in the Slate Creek drainage include the modification of the Pend Oreille River from riverine to reservoir habitat. Assuming bull trout passage at Z Canyon, the construction of Boundary and Seven Mile and Waneta dams has isolated populations of fish and eliminated the fluvial and adfluvial life history form of bull trout in the lower Pend Oreille River system. The introduction of non-native fish into the reservoir and tributaries has also negatively affected the viability of bull trout in the Boundary Reservoir reach of the Pend Oreille River system by introducing increased competition with and possibly predation upon bull trout.

Sullivan Creek Watershed (91,445.2 acres).

Together, the Sullivan Creek WAU (58,685 acres) and Harvey Creek WAU (32,760 acres) make up the Sullivan Creek watershed and encompass all tributaries draining into Sullivan Creek.

Sullivan Creek ultimately drains into the Boundary Reservoir portion of the Pend Oreille River. Habitat capable of supporting strong and significant populations of native salmonids exists throughout the Sullivan Creek watershed, however there is disagreement over the extent to which the natural cascades and chute at RM 0.6 and 0.65 on Sullivan Creek currently block fish passage into the Sullivan Creek watershed. Bull trout have not been documented as occurring upstream of the uppermost natural cascades/chute at RM 0.65. The extent to which bull trout could have successfully utilized Slate Creek habitat historically is unknown.

Given natural fish passage at the lower cascades and chute, currently the Mill Pond dam and the Sullivan Lake dam block fish passage between the majority of habitat in the Sullivan Creek watershed and the mainstem Pend Oreille River system. Fish passage into North Fork Sullivan Creek is blocked by a natural falls just downstream of the N. Fk. Sullivan Creek dam (RM 0.25). The N. Fk. Sullivan Creek dam does not have fish passage. Fish passage up into Sullivan Creek is blocked at RM 3.25 by Mill Pond dam. Fish passage into Sullivan Lake and the Harvey Creek WAU is blocked 0.5 miles upstream from the confluence with Sullivan Creek. Outlet Creek flows into Sullivan Creek at RM 5.3.

Existing operations of Sullivan Lake dam and the Mill Pond dam have altered the channel equilibrium of lower Sullivan Creek. The Sullivan Creek habitat below Mill Pond Dam lacks LWD and gravels due to interception of upstream sources at the dam. Water temperatures also tend to be above the tolerance level for bull trout fry and juveniles during some summer months in this habitat below Mill Pond dam (USFS 1999ce, pg. 10). Sediment is not considered to be a serious problem in the watershed (USFS 1999ce, pg. 8, 9). Non-native salmonid species also occur in the watershed. The extent to which brown trout and brook trout may limit the recovery of bull trout populations in the Sullivan Creek watershed is unknown.

Box Canyon WAU (56,172 acres).

The Box Canyon WAU captures the Flume, Sweet, Sand, and Cedar creek drainages. Flume, Sweet, and Sand creeks all drain into the Boundary Reservoir reach of the Pend Oreille River, located between Boundary Dam (RM 17.0) and Box Canyon Dam (RM 34.4); Cedar Creek drains into the Box Canyon Reservoir, located between Box Canyon Dam (RM 34.4) and Albeni Falls Dam (RM 90.1). Drainages within the Box Canyon WAU have been surveyed for habitat conditions to varying degrees using varying methodologies. This makes it difficult to evaluate the resulting data using any one set of habitat rating criteria.

Flume, Sweet, and Sand creeks offer limited access to habitat for migratory life history forms of bull trout due to natural barriers in close proximity to the mouths of the drainages (river miles 0.0, 0.6, and 1.25, respectively). Cedar Creek, draining into the Pend Oreille River upstream of Box Canyon Dam, has no natural barriers precluding access by migratory bull trout into the drainage. However the Cedar Creek municipal dam at RM 1.5 is currently a full barrier to fish passage, although in 1995, an 18-19 inch adult bull trout was observed just upstream from the Cedar Creek dam by KNRD/WDFW snorkelers (KNRD and WDFW 1997b, pg. 43). Based on habitat and fish survey efforts on Mill, Cee Cee Ah, LeClerc, Indian, and Cedar creeks (all emptying into the Box Canyon Reservoir), KNRD and WDFW (1997b, pg. 45) concluded that Cedar Creek may represent the best habitat conditions of all the streams in the Box Canyon reach of the Pend Oreille River. KNRD and WDFW (1997b, pg. 45) observed that Cedar Creek exhibited the least degraded habitat of the streams assessed, especially in the upper reaches, and that the amount of consecutive stream reaches exhibiting quality habitat was unequaled. The extent to which bull trout could have successfully utilized habitat historically within the tributary drainages contained in the Box Canyon WAU is unknown. Individual observations of bull trout have been documented currently in the Box Canyon WAU; two observations in Sweet Creek and one observation in Cedar Creek. Limited "Suitable" bull trout habitat has been identified by the TAG in both Flume and Sand creeks. "Recoverable" bull trout habitat has been identified by the TAG in the Cedar Creek drainage.

Muddy Creek WAU (39,151 acres).

The Muddy Creek WAU captures the Little Muddy, Big Muddy, Maitlen and Renshaw creek drainages which enter the Box Canyon Reservoir of the Pend Oreille River. The existing habitat has been modified somewhat by human activities and bull trout are not known to currently occur in the WAU. It is unclear from the literature which human-caused actions are contributing in what degree to limiting potentially sustainable bull trout populations in the Muddy Creek WAU. The riparian habitat is degraded, streambed substrate is embedded, there are low numbers of instream wood, the quality of pool habitat is degraded, and temperature levels are elevated. There are also well distributed populations of brook trout within the WAU.

There are no known natural blockages to prevent fish passage from the Pend Oreille River into drainages within the Muddy Creek WAU, however the box culvert under State Hwy. 31 at the mouth of Big Muddy Creek is identified as a partial, man-made barrier to fish passage. Also, at RM 1.2 on Big Muddy Creek, the County Rd. 2705 (Greenhouse Rd.) culvert is identified as a fish passage barrier. The extent to which bull trout could have successfully utilized habitat historically within the Muddy Creek WAU is unknown. Bull trout have not been documented as occurring currently in the Muddy Creek WAU although both Little and Big Muddy creeks have been identified as containing "Recoverable" habitat.

Ruby Creek WAU (45,213 acres).

The Ruby Creek WAU includes the Lost and Ruby creek drainages which feed into the Box Canyon Reservoir portion of the Pend Oreille River. The existing habitat in the WAU has been modified somewhat by human activities and bull trout are not known to currently occur in the WAU. In the Ruby Creek drainage, the high level of embeddedness of the substrate, high water temperatures, low numbers of deep pool habitat for winter rearing, and well distributed populations of brook trout are limiting factors for the bull trout. It is unclear from the literature which human-caused actions are contributing in what degree to limiting potentially sustainable bull trout populations in the WAU.

There are no known natural blockages to prevent fish passage from the Pend Oreille River into either Lost Creek or Ruby Creek. The extent to which bull trout could have successfully utilized Ruby Creek WAU habitat historically is not clear based on existing information. Bull trout have not been documented as occurring currently in the Ruby Creek WAU. The TAG has identified "Recoverable" bull trout habitat in the Ruby Creek drainage and "Suitable" bull trout habitat in S. Fk. Lost Creek of the Lost Creek drainage.

LeClerc Creek WAU (64,285 acres).

The LeClerc Creek WAU encompasses the entire LeClerc Creek watershed, which drains into the Box Canyon Reservoir reach of the Pend Oreille River. High sediment loading from high road density and poorly constructed roads are contributing to degradation of instream habitat conditions, specifically by pool filling and fining of spawning gravels. Many of the references to sediment loading related to road maintenance issues noted in this habitat limiting factors assessment report are referenced from the 1997 WDNR LeClerc Creek Watershed Analysis. In the interim 5+ years since the 1997 WDNR watershed analysis, Stimson has developed a Sediment Reduction and Road Maintenance and Abandonment Plan (RMAP) for the LeClerc Creek WAU and begun its implementation to correct or mitigate issues identified in the 1997 WDNR watershed analysis.

Brook trout occur throughout the WAU presenting a high degree of potential competition with bull trout for habitat needs. Riparian areas with a central brushy corridor are typical in the WAU and instream LWD levels are lacking for a majority of fish-bearing streams. However, evidence of groundwater influence in both the West Branch and East Branch LeClerc creeks, the low incidence of natural fish passage barriers within the LeClerc Creek drainage, "Suitable" and "Recoverable" bull trout habitat, and confirmed observations of both adult and juveniles life stages, strongly suggest beneficial conditions exist in the LeClerc Creek drainage for bull trout, especially if sediment input can be decreased.

There are no known natural blockages to prevent fish passage from the Pend Oreille River into LeClerc Creek. Historic use of the LeClerc Creek drainage by bull trout (called "char" historically) has been documented (Smith 1983). Generally, fish distribution in the LeClerc Creek drainage is naturally limited by increased gradients and diminished discharge in headwater reaches, with the exception of Fourth of July Creek and West Branch LeClerc Creek. Some steep gradient reaches occur at RM 0.25 on Fourth of July Creek, potentially limiting upstream bull trout passage. On West Branch LeClerc Creek, dewatering reaches have been identified as occurring at RM 1.5. There are some known human-made fish passage barriers in the WAU that preclude access to a portion of "Suitable" and "Recoverable" habitat.

Middle Creek WAU (29,270 acres).

The Middle Creek WAU encompasses both the Middle Creek and Mill Creek drainages. The Middle and Mill creek drainages feed into the Box Canyon Reservoir portion of the Pend Oreille River. The stream habitat in Middle Creek appears to be impacted from high volumes of sediment. Generally, the impacts have resulted in limited winter and spawning habitat for fish populations in Middle Creek. In Mill Creek, the existing habitat has been modified by human activities within the watershed. The high level of embeddedness of the substrate, low numbers of deep pool habitat for winter rearing, summer water temperatures near the expected tolerance levels and well distributed populations of brook trout are limiting factors for the species. Portions of the instream habitat appear to be of poor to fair quality throughout most of the Mill Creek drainage.

The extent to which bull trout could have successfully utilized habitat within the Middle Creek WAU historically is unknown. A steep-gradient reach starting at RM 0.25 is a potential natural barrier to upstream fish passage on Middle Creek; on Mill Creek, a natural falls at RM 1.3 is a barrier to upstream fish passage. To date, a single observation of a bull trout in Mill Creek in 1995 is the only documented occurrence of bull trout within the WAU. "Recoverable" bull trout habitat has been identified by the TAG in both the Mill and Middle creek drainages; "Suitable" bull trout habitat has been identified by the TAG in the Middle creek drainage.

Cee Cee Ah Creek WAU (27,050 acres).

The Cee Cee Ah Creek WAU encompasses the entire Cee Cee Ah Creek drainage and small tributaries draining into the Pend Oreille River from the east between Mill Creek and Skookum Creek. The existing habitat has been modified by human activities within the watershed. The high level of embeddedness of the substrate, low numbers of deep pool habitat, summer water temperatures near the expected tolerance levels of bull trout, and well distributed populations of brook trout are limiting factors for the species. The degraded habitat conditions limit overwinter and spawning habitat. Large woody debris levels on USFS land are unknown, however LWD recruitment is thought to be adequate. Portions of the instream habitat appear to be of poor to fair quality throughout most of the Cee Cee Ah Creek drainage.

The extent to which bull trout could have successfully utilized habitat historically within the Cee Cee Ah Creek WAU is not clear based on existing information. Other than the natural barrier at RM 2.5 on Cee Cee Ah Creek, there are no known natural blockages to prevent fish passage from the Pend Oreille River into Browns Creek or up to RM 2.5 on Cee Cee Ah Creek. Both Cee Cee Ah Creek and Browns Creek have been identified as containing "Suitable" bull trout habitat.

Tacoma Creek WAU (62,887 acres).

The Tacoma Creek WAU encompasses both the Cusick and Tacoma creek drainages which feed into the Box Canyon Reservoir portion of the Pend Oreille River, entering from the west. The existing habitat has been modified somewhat by human activities within the WAU. In the Tacoma Creek drainage, low numbers of LWD, low numbers of deep pool habitat for winter rearing, summer water temperatures above the expected tolerance levels for the species, and well distributed populations of brook trout are limiting factors. In the Cusick Creek drainage, the high level of embeddedness of the substrate, low numbers of deep pool habitat for winter rearing, summer water temperatures near the expected tolerance levels for the species, and well distributed populations of brook trout are limiting factors.

The extent to which bull trout could have successfully utilized Tacoma Creek WAU habitat historically is not clear based on existing information. There are no known natural blockages to prevent fish passage from the Pend Oreille River into Cusick or Tacoma creeks. Bull trout have not been documented as occurring currently in the Tacoma Creek WAU; presently the State Hwy. 20 culvert at RM 0.5 on Cusick Creek is a full barrier to fish passage. There are no known man-made barriers on Tacoma Creek. Both the Cusick and the Tacoma creek drainages have been identified by the TAG as containing "Recoverable" bull trout habitat.

Calispell Creek Drainage (92,523 acres).

Together the Winchester Creek WAU (49,073.5 acres) and Tenmile Creek WAU (43,449.7 acres) make up the Calispell Creek watershed. The Winchester Creek WAU and the Tenmile Creek WAU encompass all tributaries draining into Calispell Creek which ultimately drains into the Box Canyon Reservoir segment of the Pend Oreille River.

The fish passage barrier presented by the pumping station at RM 0.5 on Calispell Creek is the most limiting factor to sustaining bull trout populations in the Calispell Creek watershed. If passage were provided at the pump station however, degraded habitat conditions on Calispell Creek from the mouth upstream to Calispell Lake may act in combination to create seasonal barriers for migration to and from the Pend Oreille River (DE&S 2001b, pg. 2). Some tributaries to Calispell Creek could provide habitat for resident and adfluvial bull trout life history forms given access to the Pend Oreille River, however several major barriers restrict access into tributaries within the watershed. In particular, bull trout passage into the entire N. Fk. Calispell Creek tributary system is naturally precluded by barrier falls and cascades in Power Creek downsteam of Power Lake (POPUD 2000b, pg. 10; DE&S 2001b). Sediment delivery to streams from mass wasting events, harvest activities, agricultural sources, stream channel instability, and roads is insignificant compared to the natural background rate of erosion in the watershed and nearly all sediment transport in the South Fork Calispell Creek and Winchester and Dorchester creeks is eventually captured in Calispell Lake. Most of the North Fork Calispell sediment load is captured in Power Lake. Below Calispell Lake, the flow and natural gradient are not sufficient during most of the year to move existing sediment loads (DE&S 2000). The extent to which the dikes and flood control management in the Calispell Creek floodplain affect sediment transport, if at all, is not known. Competition from non-indigenous populations of brook trout also presents a significant limiting factor to bull trout recovery in the Calispell Creek watershed.

The extent to which bull trout could have successfully utilized Calispell Creek watershed habitat historically is not clear based on existing information. There were no known full, natural blockages historically to prevent fish passage between the Pend Oreille River and the Calispell Creek watershed. There is historical documentation that the Calispell drainage was one of the main tribal fisheries sites in the lower Pend Oreille River where great numbers of trout (although not char by name) and small fish were documented as being captured there annually, both in summer and fall. Bull trout have not been documented as occurring currently in the Calispell Creek watershed. The TAG has identified “Recoverable” bull trout habitat in the Calispell Creek watershed. The only “Suitable” bull trout habitat identified by the TAG in the Calispell Creek watershed is a 0.2 mile reach at the mouth of Power Creek.

Skookum Creek WAU (59,340 acres).

The Skookum Creek WAU encompasses the Skookum, Indian, Marshall, and Exposure creek drainages. The drainages of the Skookum Creek WAU feed into the Box Canyon Reservoir portion of the Pend Oreille River. Animal keeping practices on land adjacent to Skookum Creek results in the most adverse impacts on this stream, specifically in the form of fecal coliform levels, riparian impacts, and bank destabilization. Spring activity in Skookum Creek is known to provide cooler water temperatures than the reservoir during summer months. Radio-tagged brown trout were observed moving up into Skookum Creek from the Pend Oreille River as reservoir temperatures reached 18 - 20°C. Currently the lower reaches of Indian Creek have potentially fish-blocking culverts and lack structure and channel complexity, a result of land use practices. The main human-caused habitat limiting factors to sustaining bull trout in Indian Creek are possible fish-blocking culverts and secondly the lack of pool habitat. Eastern brook trout and brown trout are found in Skookum Creek and are very abundant in Indian Creek with nearly all age classes present.

The extent to which bull trout could have successfully utilized habitat within the Skookum Creek WAU historically is unknown. Bull trout have been currently documented as occurring in the Skookum Creek WAU with one bull trout having been located in Indian Creek. Both Skookum Creek and Indian Creek have been identified as containing "Recoverable" bull trout habitat.

Deer Valley WAU (33,763 acres).

The Deer Valley WAU encompasses the Davis, Bracket, Kent, and McCloud creek drainages, all of which feed into the Box Canyon Reservoir portion of the Pend Oreille River. There is a possibility of impacts from increasing development in the drainages of the Deer Valley WAU, however relatively little information is available in the literature on existing aquatic habitat conditions or human-caused alterations to stream function. The POCD collected baseline data monthly from September 1999 to September 2000 for some water quality parameters (POCD 2001c). The limited data showed problems with turbidity in Kent Creek and problems with temperatures above the criteria levels for "good" for some life history stages of bull trout.

The extent to which bull trout could have successfully utilized habitat within the Deer Valley WAU historically is unknown. Bull trout have not been documented as occurring currently in the Deer Valley WAU. Both Kent Creek and McCloud Creek drainage have been identified as containing "Recoverable" bull trout habitat.

Priest River Tributaries

Priest River WAU (20,432 acres).

The Priest River WAU encompasses the upper reaches of the Lower West Branch drainage. From its headwaters in Washington State, the Lower West Branch flows 25.3 miles southeastward into Idaho toward its confluence with the Priest River. It is unknown if bull trout inhabited Lower West Branch historically nor have bull trout been observed currently in the drainage. A complete fish migration barrier exists on the mainstem Lower West Branch at Torelle falls (RM 8.2) in Idaho. The Lower West Branch is a large and complex watershed system with a long history of extensive development and land uses. Elevated instream temperatures in the Lower West Branch from its confluence with the Priest River upstream to Torelle Falls, and continuing upstream of the falls, are believed to be the primary factor limiting bull trout use in the Lower West Branch (J. Cobb, M. Davis, USFS, pers. comm., 2002). Lack of canopy coverage to provide thermal regulation, along with a negatively impacted stream channel morphology, appear to be the mechanisms contributing to elevated instream temperatures (J.

Cobb, M. Davis, USFS, pers. comm., 2002). The destabilized channel morphology is being driven by elevated sediment loads and a low level of functional LWD in the system. Large woody debris recruitment is also limited. Brook trout occur in the drainage, but densities were low when the mainstem Lower West Branch was surveyed. Man-made fish passage barriers also exist in the drainage upstream of Torelle Falls.

Analyses and field survey data indicates that excessive sediment loading is and has been chronic in the drainage for a long period of time. The mainstem of the Lower West Branch has been adversely impacted by frequent introductions of large volumes of bedload, historic ditching of channels, past filling of wetlands, and altering of natural drainage patterns with road construction. The stream channel will not likely move towards stability until large scale rehabilitation projects are successfully implemented.

Kalispell Creek WAU (49,402 acres).

The Kalispell Creek WAU encompasses the upper drainages of the Upper West Branch, Binarch, Lamb, and Kalispell creeks within Washington State. The remainder of the drainages is located in Idaho State. The Upper West Branch and Binarch Creek flow into the mainstem of the Priest River; Kalispell and Lamb creeks flow into Priest Lake. From the Lamb Creek drainage south (including the Lower West Branch drainage in the Priest River WAU), tributaries to the Priest River drainage represent some of the more highly altered landscapes in the Priest River system. The headwater areas of drainages within the Kalispell Creek WAU are negatively impacted to a lesser extent than the rest of the drainage and are still functioning within the natural range of variability. The remaining areas of the drainages have multiple habitat degradation concerns.

In the drainages of the Kalispell Creek WAU, only Kalispell Creek has documented sightings of bull trout but the last reported observation of bull trout in Kalispell Creek was in 1984. There were no known natural blockages historically, nor are there presently, to prevent fish passage from the Priest River system into Binarch Creek, Lamb Creek, Kalispell Creek, or Upper West Branch.

Granite Creek WAU (40,582 acres).

Granite Creek WAU encompasses the North and South Forks of the Granite Creek drainage in their entirety. The remainder of the drainage is located in Idaho. Granite Creek is a major tributary to Priest Lake. The eastern boundary of the WAU, which is also the Washington/Idaho state line, bisects the Granite Creek drainage about ¼ mile upstream of the point where Granite Creek splits into the North and South forks. There were no known natural blockages historically, nor are there presently, to prevent fish passage from the Priest River system into the Granite Creek WAU. Currently, bull trout occur in Granite Creek in low densities.

Sediment levels in lower Granite Creek are the most limiting factor to sustaining bull trout populations in the drainage. Sediment delivery is from mass failures associated with roads. Second to elevated sediment levels in Granite Creek, stream channel confinement and riparian habitat degradation limit bull trout populations. The lower portion of the Granite Creek drainage (downstream of the Zero Creek confluence) transitions from the high integrity landscapes of the upper drainage to landscapes at higher risk and with multiple ecological restoration needs. Of the streams flowing into Priest Lake from the west, Granite Creek is likely one of the most important stream in regards to maintaining bull trout persistence in this portion of the Priest River system. Overall, the ecological functions for the portion of upper Granite Creek drainage lying upstream of the Zero Creek confluence are consistently high.

Gold Creek WAU (15,339 acres).

The Gold Creek WAU encompasses the upper reaches and headwaters of tributaries to Hughes Fork; the tributaries are Gold, Jackson, and Bench creeks, as well as the small, eastward draining tributaries to the very upper reaches of Hughes Fork. The remainder of the Hughes Fork drainage is located in Idaho. Hughes Fork flows into Upper Priest River in Idaho, just upstream of the northern tip of Upper Priest Lake. Only a very small portion of the Jackson and Bench Creek drainages are located in Washington.

The Hughes Fork drainage is considered critical to the viability of native fish species in the Priest River drainage, including bull trout. In the early-to-mid 1980s, Irving (1987, pg. 84) found bull trout throughout the upper Priest River drainage but reported that they were most abundant in tributaries of Upper Priest Lake with the highest densities being found in Bench (32 fish/100 m^2) and Jackson (14 fish/100 m^2) creeks, tributaries to Hughes Fork. The strongest remaining bull trout populations in the Priest River drainage are now found in association with Upper Priest Lake, although in declining numbers (Panhandle Basin Bull Trout TAT, 1998, pg. 9; IDFG redd surveys 1992 – 2001; Irving 1987). The decline in bull trout numbers has been attributed to healthy lake trout populations in the lake environments that out-compete bull trout for habitat and prey on juvenile bull trout that arrive as juveniles in Upper Priest Lake to mature (J. Dupont, IDFG, pers. comm., August 2002). Brook trout have been documented in Hughes Fork, Gold Creek, Jackson Creek, and Bench Creek. There were no known natural blockages historically, nor are there presently, to prevent fish passage from the Priest River system into Hughes Fork.

The Bench Creek and Jackson Creek drainages are relatively un-influenced by management activities with the exception of the Ledge Creek (a tributary to Jackson Creek) and the first quarter-mile of Jackson Creek. The remainder of the Jackson Creek drainage has not seen a fire since 1910 and has only been harvested using helicopters so there was no associated road building (USFS 1998c; J. Cobb, USFS, 1/29/03 final draft review comments, February 2003). Gold Creek has been adversely impacted by land use disturbances, primarily roads, and is one of the more heavily harvested and roaded drainages in the Hughes Fork watershed.

WRIA 62 Inventory and Assessment Data Gaps

Listed below are the overriding WRIA-level inventory and assessment data gaps for WRIA 62. Obtaining this information will enable the public and technical staff to make natural resource management decisions at the WRIA-level with a higher degree of confidence in the outcomes. Data gaps at the WAU-level are listed in the "Salmonid Habitat Conditions by WAU" chapter of the report.

- A comprehensive fish passage barrier inventory and assessment, including private lands, with database and GIS coverage. The work should incorporate existing data from USFS, POPUD, KNRD, McLellan (2001), SSHEAR/WDFW, and DNR data. A comprehensive fish passage inventory and assessment should capture tributaries to the Pend Oreille River from their confluence with the Pend Oreille River upstream to their headwaters, where appropriate;

- Comprehensive surveys are needed in all tributaries to Upper Priest Lake and Priest Lake to determine the distribution and abundance of brook trout to better define native fish restoration options (KNRD 2001, pg. 148);

- Tributaries to the Pend Oreille River that have not yet been surveyed to determine bull trout presence or absence or the presence of suitable habitat, should be surveyed using accepted methodologies;

- Comprehensive fish management plan (POPUD 1/29/03 draft report review comments, March 2003).

INTRODUCTION

Habitat Limiting Factors Background

The successful recovery of naturally spawning salmonid (i.e. salmon, trout, char) populations depends upon directing actions simultaneously at harvest, hatcheries, habitat and hydroelectric facilities, the "4H's". Since salmonid recovery issues are distinctly different in every watershed, an understanding of what those issues are and how they interact is critical to successfully recovering and ultimately delisting, salmonid populations. The 1998 Washington State legislative session produced a number of bills aimed at salmon recovery. This report was written pursuant to Engrossed Substitute House Bill (ESHB) 2496 as codified in RCW 77.85, the Salmon Recovery Act, a key piece of the 1998 Legislature's salmon recovery effort. It represents a compilation of information regarding known bull trout habitat conditions in Water Resource Inventory Area (WRIA) 62, which is a Washington State designation (Figure 1).

Chapter 77.85 RCW in part:

- directs the Conservation Commission in consultation with local government and the tribes to invite private, federal, state, tribal and local government personnel with appropriate expertise to act as a technical advisory group (section 070, subsection 1, RCW 77.85);

- directs the technical advisory group to identify limiting factors for salmonids to respond to the limiting factors relating to habitat pursuant to section 060 subsection 2(a) of this RCW (section 070, subsection 3, RCW 77.85);

- defines limiting factors as "conditions that limit the ability of habitat to fully sustain populations of salmon." (section 010, subsection 5, RCW 77.85);

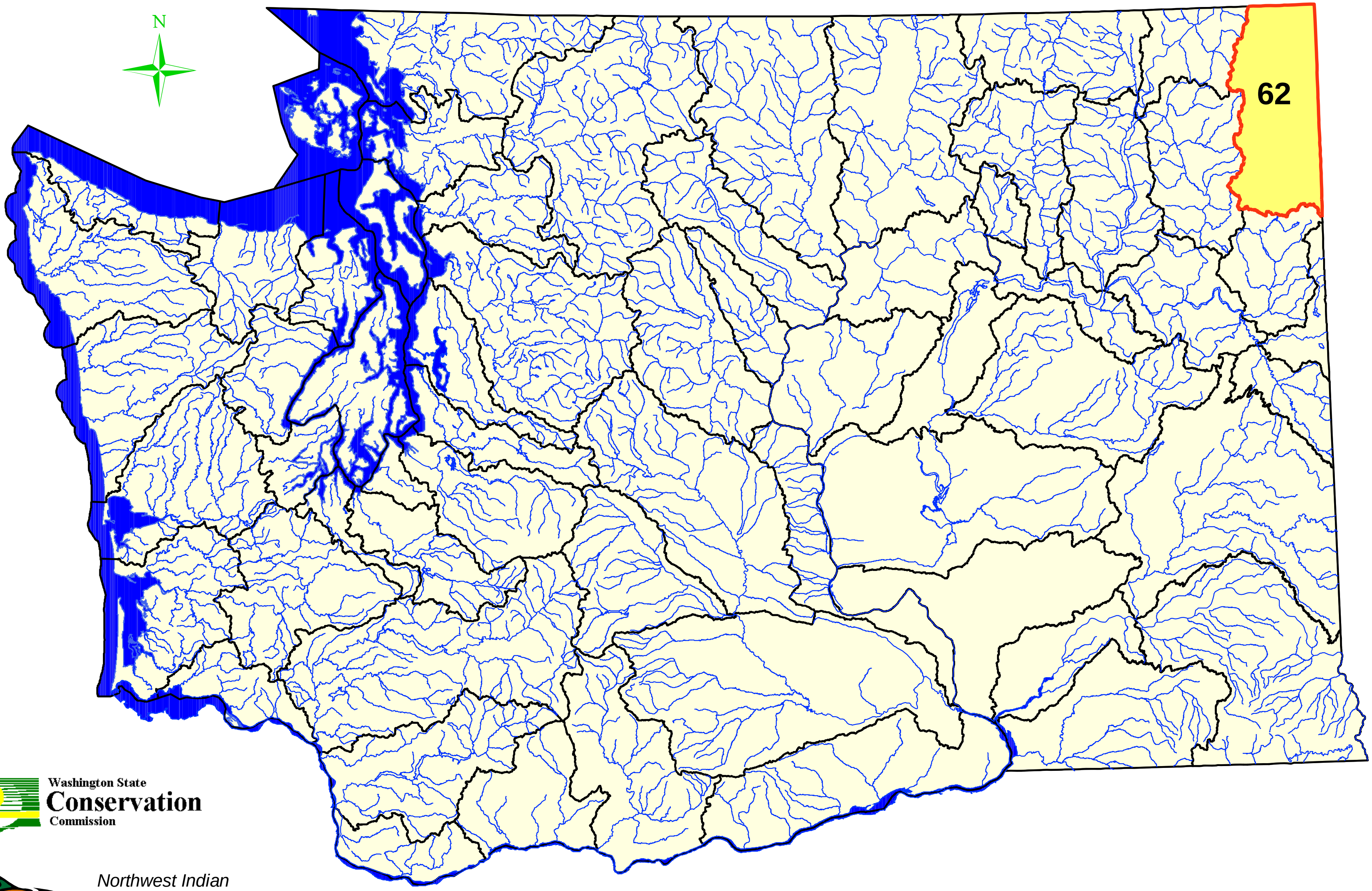
    - defines salmon as "all members of the family Salmonidae which are capable of self-sustaining, natural production." (section 010, subsection 7, RCW 77.85).

The overall goal of the Conservation Commission's limiting factors project is to identify habitat factors limiting production of salmonids in Washington State. It is important to note that the responsibilities given to the Conservation Commission in ESHB 2496 do not constitute a full limiting factors analysis. The hatchery, hydro and harvest segments of identifying limiting factors are being dealt with in other forums. This report identifies conditions limiting the ability of habitat to fully sustain populations of bull trout in WRIA 62.

For the purpose of presenting the information in this report, WRIA 62 is divided into Washington Administrative Units (WAUs), a Washington State designation (Figure 2). The WAUs of WRIA 62 are; South Salmo, Slate Creek, Sullivan Creek, Harvey Creek, Box Canyon, Muddy Creek, Ruby Creek, LeClerc Creek, Middle Creek, Cee Cee Ah Creek, Tacoma Creek, Winchester Creek, Tenmile Creek, Skookum Creek, Deer Valley, Priest River, Kalispell Creek, Granite Creek, and Gold Creek. Since the mainstem Pend Oreille River is not captured within any WAU, it is presented in this report as the "Mainstem Pend Oreille River".

For reference, Table 2. River Miles for Landmarks in WRIA 62 and Vicinity, provides river miles for various tributaries and landmarks in WRIA 62, in the Priest River drainage, and along the Columbia River downstream Chief Joseph Dam. River miles provided in the Washington Stream Catalogue (Williams et al. 1975) are used where available. When not available, river miles were derived from routed GIS coverages, global positioning system (GPS) coordinates, or pulled from published documents where available, and are therefore also approximate.

Figure 1: Location of WRIA 62 in Washington State



Washington State Conservation Commission

Northwest Indian Fisheries Commission

Location of WRIA 62 outlined in Red

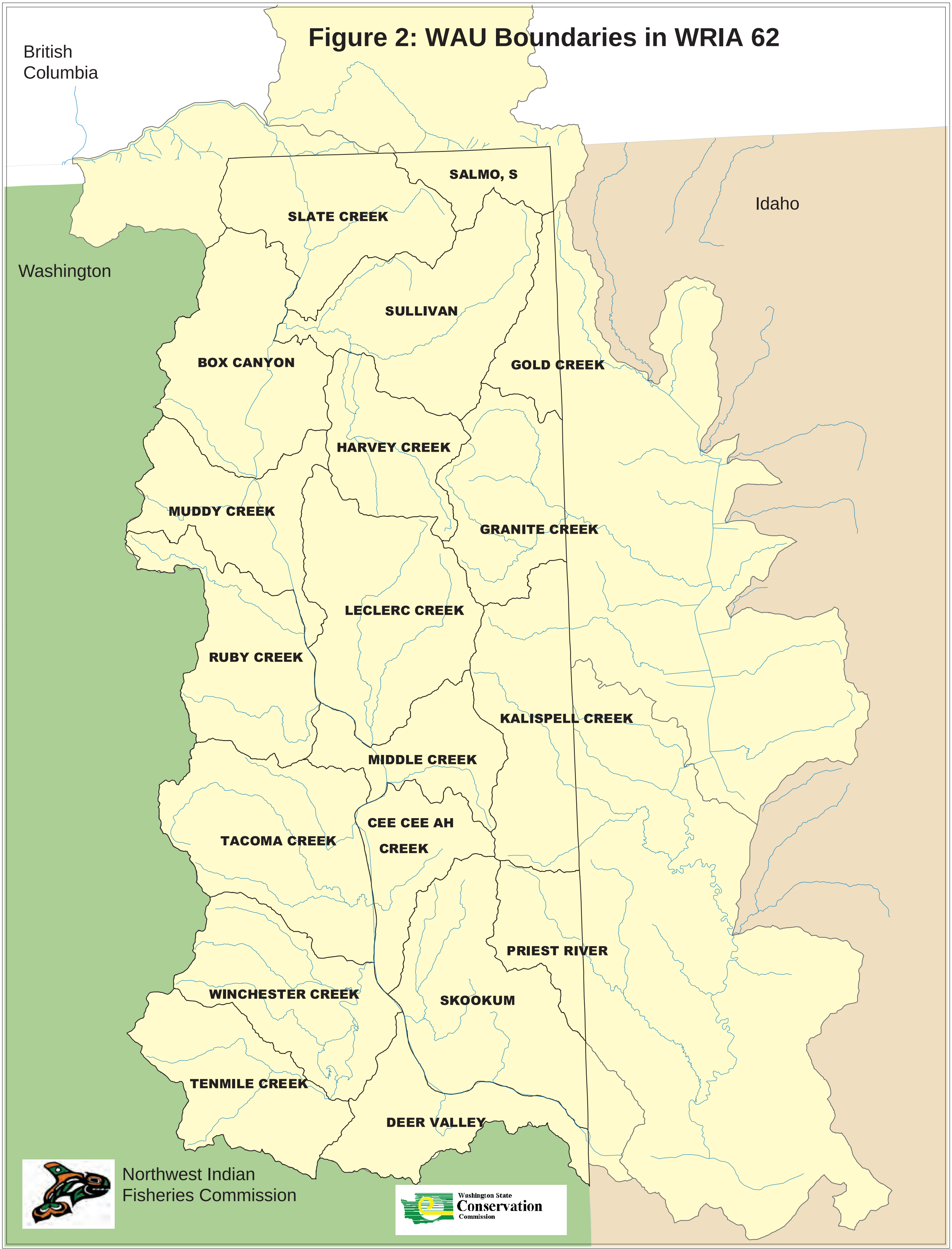


Figure 2: WAU Boundaries in WRIA 62

Table 2. Rivermiles for landmarks in WRIA 62 and vicinity

Landmark	Columbia River (*RM)	Pend Oreille River (*RM)	Tributary (*RM)	Tributary (*RM)
Chief Joseph Dam	545.1			
Grand Coulee Dam	596.6			
Spokane River	639.0			
Colville River	699.5			
Kettle River	706.0			
Pend Oreille River	745.5			
Waneta Dam		0.2		
Seven Mile Dam		9.0		
Salmo River		13.3		
S. Fk. Salmo River			7.4	
Canada/U.S. Border		16.0		
Boundary Dam		17.0		
Z Canyon (Big Eddy Canyon)		19.0		
Slate Creek		22.2		
Flume Creek		25..8		
Metaline Falls		26.5		
Sullivan Creek		26.9		
N. Fk. Sullivan Creek			2.35	
N. Fk. Sullivan Creek Dam				0.25
Mill Pond Dam			3.25	
Outlet Creek			5.3	
Sullivan Lake				0.5
Noisy Creek				3.8
Harvey Creek				4.0
Sweet Creek		30.9		
Sand Creek		31.6		
Box Canyon Dam		34.5		
Cedar Creek		37.7		
Ione Municipal dam			1.5	
Town of Ione		37.8		
Little Muddy Creek		38.0		
Big Muddy Creek		38.0		
Lost Creek		47.8		
S. Fk. Lost Creek			0.1	
Ruby Creek		52.0		
LeClerc Creek		56.2		
W. Br. LeClerc Creek			1.0	
E. Br. LeClerc Creek			1.0	
Fourth of July Creek				2.8

Landmark	Columbia River (*RM)	Pend Oreille River (*RM)	Tributary (*RM)	Tributary (*RM)
M. Fk. LeClerc Creek				5.1
Middle Creek		57.6		
Mill Creek		58.3		
Cusick Creek		61.6		
Cee Cee Ah Creek		66.29		
Browns Creek			2.0	
Tacoma Creek		66.3		
Trimble Creek		66.3		
Calispell Creek		69.6		
Duck Club Dam			6.0	
Smalle Creek				2.5
Winchester Creek				8.0
S. Fk. Calispell Creek				12.1
Power Creek				12.1
Power Lake Dam				0.8
Town of Cusick		71.5		
Town of Usk		72.7		
Skookum Creek		73.2		
Kent Creek		78.5		
McCloud Creek		78.9		
Indian Creek		81.2		
Newport		87.8		
WA/Idaho Border		87.8		
Albeni Falls Dam		90.1		

Landmark (Priest River drainage)	Columbia River (*RM)	Pend Oreille River (*RM)	Tributary to Priest River (*RM)	Tributary (*RM)
Priest River		96.6		
Lower W. Br. Priest			5.0	
East River			23.0	
Upper W. Br. Priest			35.3	
Binarch Creek			42.0	
Priest Lake Outlet Dam			45.0	
Priest Lake Outlet Channel			45.0	
Lamb Creek				0.1
Priest Lake			45.5	
Kalispell Creek				4.5
Granite Creek				10.0
S. Fk. Granite Creek				10.7
N. Fk. Granite Creek				10.7
Thorofare			64.5	

Landmark	Columbia River (*RM)	Pend Oreille River (*RM)	Tributary (*RM)	Tributary (*RM)
Upper Priest Lake			67.2	
Upper Priest River			70.2	
Hughes Fork				0.5
Gold Creek				5.25
Jackson Creek				9.25
Bench Creek				10.5
Lake Pend Oreille		115.0		

*River miles (RM) are all approximate. River miles provided in the Washington Stream Catalogue (Williams et al. 1975) were used where available. When not available, river miles were derived from routed GIS coverages, global positioning system (GPS) coordinates, or pulled from published documents where available and are therefore also approximate.

WRIA 62 DESCRIPTION

Area Description

Water Resource Inventory Area (WRIA) 62 is approximately 742,400 acres in size (POCD 2001c, pg. 7) and is located entirely within the state of Washington in the northeastern corner of the state (Figure 2). Water Resource Inventory Areas are a Washington State designation. For the purposes of this report, the only divergence from the WRIA 62 boundaries is to include the mainstem Pend Oreille River beyond the Washington/Idaho border upstream to Albeni Falls Dam (2.3 mile reach) in Idaho and to exclude the portion of the Pend Oreille River mainstem from Boundary Dam downstream to the US/Canada border (1.0 mile reach). WRIA 62 is bordered by Canada to the north, Idaho to the east, and the Chewelah Mountains to the west. Its southern boundary lies slightly south of the town of Newport, which is about 40 miles north of the city of Spokane. Pend Oreille County makes up almost all of the WRIA except along the upper northwest edges of the WRIA where a very small portion of eastern Stevens County falls in WRIA 62. This is in the headwater areas of the Pewee (RM 18.0), Flume (RM 25.8), and Cedar (37.7) creek drainages upstream of any identified bull trout habitat.

Water Resource Inventory Area 62 encompasses the Pend Oreille River and its tributaries from the Canada border at RM 16.0 to the Washington/Idaho border at RM 87.8. The Pend Oreille River actually originates at Lake Pend Oreille in Idaho (RM 115), 27.2 miles east of the Washington/Idaho border. It is the only surface outflow from the lake. Flowing west, the Pend Oreille River crosses into Washington State at the city of Newport, Washington and continues west and northwest about 10 miles before turning north to flow toward its confluence with the Columbia River at Columbia River Mile 745.5. First, however, the Pend Oreille River crosses the Canada border at RM 16.0, traveling its last 16 miles to the Columbia River through southern British Columbia. Water Resource Inventory Area 62 also includes a small portion of the S. Fk. Salmo River from RM 8.8 – 13.0, where it dips down into Washington State. The S. Fk. Salmo River is a tributary to the Salmo River which flows into the Pend Oreille River in Canada at RM 13.3. Some headwater portions of tributaries that drain east into the Priest River system in Idaho are also captured in WRIA 62 (approximately 15 percent; Dames and Moore 1995, pg. 2) because they fall within Washington State. The headwaters of tributaries that drain into Idaho waters, contain bull trout, and are contained within WRIA 62 include; Gold Creek, Granite Creek, Kalispell Creek, Lamb Creek, Binarch Creek, Upper West Branch, and Lower West Branch.

WRIA 62 is part of the Pend Oreille Subbasin, which is part of the "Intermountain Province", both Northwest Power Planning Council (NPPC) designations (Table 3). The Pend Oreille River system is divided into three areas for planning purposes by the NPPC: the Lower Pend Oreille, the Priest River, and the Upper Pend Oreille. The Lower Pend Oreille planning area includes the Pend Oreille River and its tributaries from the Canada border (RM 16.0) upstream (south) to Albeni Falls dam in Idaho, 2.3 miles east of the WA/ID border. The Priest River planning area includes the entire Priest River system, a tributary to the Pend Oreille River. Lake Pend Oreille and the drainages upstream of the lake comprise the Upper Pend Oreille planning area of the Pend Oreille Subbasin. The two major tributaries that drain into the Lake Pend Oreille are the Clark Fork and Pack rivers.

With two exceptions, the Washington State WRIA 62 boundaries are almost entirely consistent with the Lower Pend Oreille planning area:

1. The Lower Pend Oreille planning area extends upstream (east) into Idaho to Albeni Falls dam (90.1). The eastern boundary of WRIA 62 is the WA/ID border (RM 87.8).

2. WRIA 62 also includes those portions of the Priest River planning area that extend west into Washington State. These are the headwater areas of tributaries to Hughes Fork, the headwaters of Granite, Kalispell, Lamb and Binarch creeks, and the headwaters of Upper West Branch and Lower West Branch.

Under USFWS bull trout recovery planning, WRIA 62 falls into two different USFWS bull trout "Recovery Units"; the Northeast Washington Recovery Unit, and the Clark Fork Recovery Unit (Table 3). The portion of WRIA 62 that drains into the Pend Oreille River in Washington State is included in the Northeast Washington Recovery Unit. The portion of WRIA 62 that drains into the Priest River drainage in Idaho State is included in the Clarke Fork Recovery Unit. Both Recovery Units encompass a geographic area much larger than just WRIA 62.

Table 3. Relationship of planning area designations: KNRD 2001

<table>
<tr><td>NPPC Province:</td><td>Intermountain Province</td><td></td><td colspan="3" rowspan="2"></td></tr>
<tr><td></td><td>NPPC Subbasin:</td><td>Pend Oreille Subbasin:</td></tr>
<tr><td colspan="2" rowspan="2"></td><td rowspan="2">NPPC Planning Areas:</td><td>Lower Pend Oreille: The Pend Oreille River from Albeni Falls down to the Canadian Border.</td><td rowspan="2">WRIA 62:</td><td rowspan="2">1. Includes all of the Lower Pend Oreille area except the mainstem Pend Oreille River from the WA/ID border to Albeni Falls (2.3 mile reach). 2. Only includes those portions of the Priest River area extending west into Washington State.</td></tr>
<tr><td>Priest River: From Upper Priest Lake down to the Pend Oreille River confluence.</td></tr>
</table>

	NPPC Planning Areas (cont):	Upper Pend Oreille: Lake Pend Oreille and its tributaries, except the Priest River, including the Clark Fork River up to Cabinet Gorge Dam, and the Pend Oreille River down to Albeni Falls Dam.		
	USFWS Recovery Units:	Northeast WA Recovery Unit: Columbia River and its tributaries above Chief Joseph Dam.	WRIA 62:	1. Only includes the portion of the NE Washington Recovery Unit that drains into the Pend Oreille River in Washington State. 2. Only includes the portion of the Clarke Fork Recovery Unit that drains into the Priest River drainage in ID.
		Clark Fork Recovery Unit: includes Lake Pend Oreille, Priest Lake, Flathead Lake and their respective tributaries.		

Many tributaries feed the Pend Oreille River within Washington State. The largest drainage is Sullivan Creek, which drains an area of approximately 142 square miles (Dames and Moore 1995, pg. 2). Other tributaries to the Pend Oreille River within Washington include: Slate Creek, Flume Creek, Sweet Creek, Sand Creek, Cedar Creek, Little Muddy and Big Muddy creeks, Lost Creek, Ruby Creek, LeClerc Creek, Middle Creek, Mill Creek, Cee Cee Ah Creek, Cusick Creek, Tacoma Creek, Calispell Creek, Skookum Creek, Kent Creek and McCloud Creek, Indian Creek, and Marshall Creek.

There are several dams on the Pend Oreille River, none of which have fish passage facilities. In Idaho, there is the Albeni Falls Dam (RM 90.1), completed in 1952 and operated by the U.S.

Army Corps of Engineers (COE). In Washington there are: Box Canyon Dam (RM 34.4), completed in 1955 and owned and operated by the Pend Oreille PUD; and Boundary Dam (RM 17.0), completed in 1967, owned by the City of Seattle, and operated by Seattle City Light (Entrix 2002, pg. 2-13). In Canada, there are: Seven Mile Dam (RM 9.0), owned and operated by B.C. Hydro; and Waneta Dam (RM 0.2), owned and operated by Teck Cominco (Entrix 2002, pg. 2-13; POCD 2001b, pg. 4). In addition to the mainstem Pend Oreille River hydroelectric dams, 24 other dams are listed in WRIA 62 with the WDOE Dam Safety Section (Table 4.). Where water projects involve dams and reservoirs with a storage volume of 10 acre-feet or more, WDOE is the responsible state agency for insuring these dams are engineered, constructed, operated, and maintained in a manner to reasonable secure proper operation, maintenance and safe performance (Chapter 173-175 WAC).

Table 4: DOE Inventory of Dams in WRIA 62

Dam Name	Other Dam Name	River Name	Off Channel	Hydraulic Height (Ft.)	Year Built	Jurisdictional Agency
Pend Oreille Mines Pond No. 1			Yes	0	1977	
Ione Mill Pond		Big Muddy Creek	No	21	1914	WDSO
Dahlin Dam		Bracket Creek	No	14	1987	WDSO
Cedar Creek Reservoir Dam		Cedar Creek	No	19	1950	WDSO
Sullivan Lake Dam		Harvey Creek	No	29	1931	FERC
Mountain Meadows Lake Dam	Kent Meadows - Blue Swamp Lake Dam	Kent Creek	No	10	1959	WDSO
Marshall Lake Dam		Marshall Creek	No	10	1912	WDSO
Power Lake Dam	Calispell Dam	North Fork Calispell Creek	No	56	1922	WDSO
Boundary Dam		Pend Oreille River	No	315	1967	FERC
Box Canyon Dam		Pend Oreille River	No	100	1955	FERC
Ponderay Newsprint Mill Settling Lagoon		Pend Oreille River-Offstream	Yes	24	1989	WDSO
Vaagen Mitigation Control Structure		Pend Oreille River-Offstream	Yes	4	1990	WDSO
Elliott Dam		South Fork Small Creek	No	7	1956	WDSO

Dam Name	Other Dam Name	River Name	Off Channel	Hydraulic Height (Ft.)	Year Built	Jurisdictional Agency
Mill Pond Dam		Sullivan Creek	No	55	1923	FERC
Flying Goose Ranch - Wetland Dam No. 1		Tr - Pend Oreille River	Yes	10	1995	WDSO
Marney Lake Dam		Tr-Deer Creek	No	15	1967	WDSO
Conger Lake Dam		Trimble Creek	No	20	1926	WDSO
Conger Pond Dam		Trimble Creek	Yes	9	1926	WDSO
Homestead Lake Dam		Tr-Moon Creek	Yes	18	1971	WDSO
Duncan Dam No. 1		Tr-Pend Oreille River	No	12	1966	WDSO
Duncan Dam No. 2		Tr-Pend Oreille River	No	15	1966	WDSO
Heater Pond Dam		Tr-Pend Oreille River	No	6	1952	WDSO
Locke Dam		Tr-Pend Oreille River	No	21	1973	WDSO
Pend Oreille County PUD Dam		Tr-Pend Oreille River	No	15	1973	WDSO
Willy O Lake Dam		Tr-Pend Oreille River	No	16	1959	WDSO
Yergens & Anselmo Dam No. 1		Tr-Pend Oreille River	No	15	1970	WDSO
Yergens & Anselmo Dam No. 2		Tr-Pend Oreille River	No	15	1970	WDSO
Tacoma Sportsman Pond		Tr-Tacoma Creek	No	8	1954	WDSO

Climate and Precipitation

(The following text on Climate is taken in its entirety from POCD 2001c). Pend Oreille County has a unique pacific maritime climate, similar to western Washington that mixes with the continental climate of the Rockies. The climate is influenced by both continental and maritime air masses. Due to the continental influence, summers are warmer and winters are colder than in coastal areas. Average annual precipitation at lower elevations near Newport, Washington is 63.5 centimeters (25.4 inches). At higher elevations, the average annual precipitation ranges from 89 to 140 centimeters (35.6 to 56 inches).

Most weather systems are controlled by prevailing westerly winds but during the winter, cold air from the Canadian Arctic can overwhelm the warm oceanic air decreasing the temperature dramatically. Daily winter temperature ranges from 15°F to 30°F. The maritime, prevailing, winds create warm-moisture laden air masses conflicting with the cold air masses in the jet stream above as they rise over the mountains. The mixing of cold and warm air masses releases greater amounts of precipitation particularly in the higher elevations. Lows in the mid-teens and twenties are common. Winters are among the cloudiest in the nation. Fog is common and rain and snowfall are expected throughout the winter. In the valleys, snow generally begins in November and remains on the ground through February. The majority of precipitation falls in the winter and spring, with the highest totals occurring from November through January. Total annual snowfall represents approximately 20% of the total annual precipitation. Average annual snowfall ranges between 64 and 90 + inches and generally increases with elevation and north latitude.

Summers are relatively cooler than other areas in eastern Washington with daytime temperatures ranging from 46°F to 76°F. Prevailing winds continue through June bringing moisture that gradually weakens to warmer eastern continental conditions. This causes an increase in temperature and a decrease in rainfall, cloud cover, and humidity. Summers are generally warm and sunny with light rainfall, although localized thunderstorms occasionally cause heavier amounts of precipitation. Peak rainfall occurs in late spring and early summer from May through June.

Geology

The geology of the lower Pend Oreille River downstream of Albeni Falls dam is complex and diverse due to multiple glacial periods, volcanic activity, flooding, and the natural processes associated with weathering and tectonic movement over millions of years. It's predominantly underlain by metamorphic or igneous bedrock. Except for the highest peaks, glaciation carved the landscape of the lower Pend Oreille. The Cordilleran ice sheet, which covered the area, has been estimated to have a thickness of 4,000 feet. The highest known evidence for elevation of the glacier is a "granite erratic" on Crowell Ridge at 6500 feet. It is believed the Cordilleran ice advanced in two stages. The earlier ice extended south to near Spangle, Washington south of Spokane. The second advanced only as far south as Newport, Washington. During these advances, southward-moving ice scoured the northward and southward sloping valleys. Level and undulating bench topography, remnants of lakes, small ponds, and glacial lakes were developed by ice scour in the area. The scour effect was caused by large ice blocks being caught in drift and grinding the Earth's surface as the ice sheet moved. Glacial deposits in lower areas created raised pockets of soil (EWU 1996).

Glacially modified foothills and mountains with deep, narrow valleys characterize the central and northern portions of WRIA 62. Extensive outwash and glaciolacustrine terraces characterize the southern portion. Mountains on both sides of the river form the Pend Oreille River valley. The sides of the Pend Oreille Valley are gently sloping to steep slopes composed of glacial drift, residuum and colluvium, and rock outcrops. To the east of the Pend Oreille River lies the Selkirk Mountain range, characterized by many deep, narrow valleys and steep slopes, and to the west lies the Chewelah Mountains, characterized by deep V-shaped valleys and numerous streams (Entrix 2002, pg. 2-4; POCD 2001b, pg. 7; POPUD 2000, pg. E1-1).

Elevations in the WRIA range from 1,700 feet (at Boundary Dam) to more than 7,309 feet (Gypsy Peak) above mean sea level. In the northeastern-most corner of Washington, from Metaline to the Canadian border, the heavily forested mountains become progressively higher and more rugged. At the time of maximum glacial advance, a few of the higher peaks projected above the ice: Gypsy Peak (7,309 feet), located in the Salmo Priest River between the Slate and Sullivan creek drainages, in the northern corner of WRIA 62; and to the south, South Baldy Mountain at 5,961 feet, located in the northeastern edge of the headwaters area of the Skookum Creek drainage. Intervening glaciated valleys range in elevation from 2,000 to 2,400 feet and the area is dotted with abundant lakes derived from the melting of glacial ice. Major natural lakes in the WRIA include Sullivan Lake, in WRIA 62's largest drainage (Sullivan Creek), and Bead Lake, which is located in the southeast portion of the WRIA and has no surface drainage outlet (Entrix 2002, pg. 2-4).

The Pend Oreille River forms a deeply incised channel from Metaline Falls north to its junction in Canada with the Columbia River. Two well-developed terraces are present along portions of the Pend Oreille River at approximately 2,100 and 2,575 feet in elevation. In the southern portions of the WRIA, expanses of flat agricultural land can be found along the Pend Oreille River and Calispell Creek valleys. In the Cusick area, the river flows adjacent to an extensive floodplain, some of which is now hydrologically disconnected by dikes and pumps (Entrix 2002, pg. 2-4).

Water Resources

Hydrology

The Pend Oreille River enters Washington and WRIA 62 at RM 87.8 just below Albeni Falls Dam at Newport and leaves the State and the WRIA at RM 16.0 just downstream of Boundary Dam. With an annual flow of approximately 25,680 cfs at Newport (1904-1941, 1953-1990) and 26,990 cfs at Boundary Dam (1913-1990), total runoff to the Pend Oreille River in WRIA 62 amounts to 1,300 cfs. Much of the annual runoff is produced primarily by melting snow, with peak flows typically occurring from April through June (FEMA 2001, pg. 3; USGS 1991, cited in Entrix 2001, pg. 2-9). Base (low flows) typically occur from August to October (USGS 1991, cited in Entrix 2001, pg. 2-9). The flow of the Pend Oreille River in WRIA 62 is controlled by the three dams listed previously (Albeni Falls, Box Canyon and Boundary dams), maintaining water elevations at reservoir levels (Northrop, Devine & Tarbell 1996a), and affecting river temperature, sediment, gravel recruitment, and habitat.

Of the 1,300 cfs gained by the Pend Oreille River in WRIA 62, about 18% is delivered by the Sullivan Creek drainage, the largest drainage in WRIA 62 (USGS 1991, cited in Entrix 2001, pg. 2-9). Additional significant contributors to flow are the Calispell, LeClerc and Tacoma drainages (about 5% each). The many small tributaries that drain directly into the mainstem contribute the remaining two-thirds of the WRIA's yield. WRIA 62 also includes a significant number of moderately sized drainages (totaling about 300 sq. miles) that drain eastward to the Priest River in Idaho. Some of these drainages are comparable in size to the major Pend Oreille drainages. Numerous Glacial lakes and wetlands are scattered throughout the WRIA. Some of the lakes have no surface outlet, the largest of which is Bead Lake (Entrix 2002, pg. 2-9).

Outlet Creek, in the Sullivan Creek drainage, is the only currently operating stream gauging station in the WRIA that is not on the Pend Oreille River. Outlet Creek (Sullivan Creek RM 5.3) drains a basin area of 51 square miles and is a tributary to Sullivan Creek in the northeast corner of the WRIA. The monthly hydrograph for this creek is considered typical for an uncontrolled, medium-to-large tributary to the Pend Oreille River in WRIA 62. This assumption is based on the similarity in climatic conditions found across the WRIA; however, variability in flow conditions may also be affected by underlying geology. The monthly hydrograph characteristics of Outlet Creek show a distinctly different pattern than those for the Pend Oreille River, with the highest flows occurring in October and November in response to rainfall, and an additional peak occurring in June resulting from snowmelt and rainfall. The lowest flows occur in late winter during periods of water storage in the snowpack, and during late summer during periods of low precipitation and high evapotranspiration (Dames and Moore 1995, pg. 7).

The monthly hydrograph of Outlet Creek shows that even though precipitation levels are comparable during spring and fall, streamflow during the spring (including melting of accumulated snow), is lower than rainfall and runoff-generated flows observed in the fall. This difference is apparently the result of high evapotranspiration in May and June. This pattern illustrates the seasonal nature of the water balance and also indicates that water is least available in the winter and summer in streams located wholly within WRIA 62 (other than the Pend Oreille River; Dames and Moore 1995, pg. 7).

<u>Groundwater</u>
Regionally extensive aquifers (aquifers extending into two or more watersheds) have not been identified or evaluated in northeastern Washington; however, the metamorphic and igneous basement rocks of the region may be interconnected through faults or fractures.

Based on the readily available literature, the majority of ground water is withdrawn from the unconsolidated glacial and alluvial deposits contained within the major rivers and stream valleys within WRIA 62. Based on topographic relief of the WRIA, the overall direction of movement of ground water within the glacial and alluvial deposits is probably toward the Pend Oreille River and tributaries; however localized flow direction may vary greatly based on geologic and hydrologic conditions. Seasonal fluctuation in ground water levels in the glacial and alluvial deposits is not documented, however water levels are expected to be higher in the winter and spring following periods of precipitation and snow melt, and lower in the summer, fall and winter. Recharge to the aquifer units occurs from direct precipitation where the aquifer outcrops, from stream seepage where the aquifer unit intersects the base of the stream, and from bank storage or flood water infiltration. The rate at which infiltration occurs is based on the type and extent of vegetative cover, physical properties of the surficial and underlying soils, amount of available storage, temperature, rainfall intensity and water quality (Dames and Moore 1995, pg. 10).

Ground water is also available within the Tiger formation in the southern portion of WRIA 62. Due to weak consolidation and cementation of the sandstone and pebble conglomerate deposits (resulting in relatively high permeability), the Tiger formation also provides an important source of ground water. This formation is located in the valley of the Pend Oreille River between Newport and Tiger. Tiger is located at the junction of State Hwy. 20 and Hwy. 31, four miles south of Ione. Limited outcrops of the Tiger formation are present along the terraces of the Pend Oreille River; however, glacial and alluvial lake deposits primarily overlie it. Recharge to the Tiger formation occurs from direct precipitation and snowmelt in the vicinity of the outcrops, from infiltration from the Pend Oreille River where the Tiger formation intersects the base of the river, and from the underlying basement rocks where the hydraulic gradient is upwards (Dames and Moore 1995, pg. 10, 11).

Groundwater\Surface Water Interaction

Recharge to an aquifer from stream seepage will occur when the water level in the stream is higher than underlying ground water levels. The rate of seepage is dependent on the magnitude of the water level difference and the permeability of the streambed materials. Alluvial aquifers in hydraulic continuity with a river or stream typically experience a high degree of water exchange with the associated surface water. The aquifers discharge to streams during low flow periods and receive recharge from the stream during high flow periods. This is due to the relatively high permeability of the alluvial materials and the close proximity of the aquifer with a stream or river. Aquifers that are separated from surface water bodies by depth or distance are confined and/or are composed of low permeability materials that require greater periods of time for water exchange to occur resulting in attenuation or dampening of the seasonal variability associated with surface waters (Dames and Moore 1995, pg. 12)

With few exceptions, limited data and information are available to describe ground water resources in WRIA 62 (Entrix 2002, pg. 2-10), however the ground water levels are expected to be highest in the spring following recharge and flood events in a system where the Pend Oreille River dominates ground water levels in the narrow alluvial aquifer located within the Pend Oreille River valley. This occurs in a river valley where the water level in the Pend Oreille River is relatively constant due to the large area of drainage and as a result of dams that control the river's elevation. The alluvial aquifer is also recharged with surface water that is diverted from irrigation of lowland areas during the late spring and summer. Where aquifer materials outcrop at the surface in the lower reaches of the streams and rivers, ground water generally discharges to streams (Dames and Moore 1995, pg. 11, 12).

One of the exceptions to the general lack of information in WRIA 62 on ground water resources is Browns Lake. Large annual water loss was also documented from Browns Lake (USFS 1969, Browns Lake Water Loss Geologic report, Kaniksu National Forest cited in Entrix 2002, pg. 2-50). Browns Lake lies in the Selkirk Mountains approximately three miles downstream from the watershed divide near the headwaters of Skookum Creek (flowing southwest), and Goose Creek (flowing east). It was postulated that water which leaks from Browns Lake through shear structures associated with the Browns Creek fault, forms a conduit through which Browns Lake water is delivered underground to surface waters.

Another exception to the general lack of information on WRIA 62 ground water is on the Kalispel Indian Reservation. A review of well data and water-bearing strata in the Kalispel Indian Reservation indicated the reservation is underlain by a single aquifer with the water table connected to the Pend Oreille River (Geiger et al. 1993 cited in Entrix 2002, pg. 2-50). Also, a USGS study of the principal aquifers on the Reservation using existing information stated that groundwater is the major source of domestic water use on the Reservation (Embrey et al. 1997, cited in Entrix 2002, pg. 2-51). Pat Buckley of the Pend Oreille PUD disputes this conclusion, saying that two-thirds of the Reservation uses water withdrawn from the Town of Cusick intake on the Pend Oreille River (November 2001, pers. comm., cited in Entrix 2002, pg. 2-51).

Vegetation

The majority of the WRIA that drains west into the Pend Oreille River is located in the Okanogan Highlands Physiographic Province (Franklin and Dryness 1973), which is characterized by conifer forest communities except on wet sites. The northern portion of the Pend Oreille River corridor is within the western hemlock vegetation zone (Franklin and Dryness 1973). Western red cedar is the major climax species in this zone, and grand fir is an important and persistent seral species. Sitka alder is characteristic at moist sites in this zone including riparian areas. Management activities within the landscape of the portion of WRIA 62 that drains west into the Pend Oreille River have reduced the function of the uplands by eliminating mature forests.

The southern portion of WRIA 62 near Albeni Falls Dam is within the Ponderosa pine vegetation zone, broadly defined to include areas where persistent, fire-maintained ponderosa pine forests predominate. Within this zone, groves of black cottonwood and quaking aspen typically occur on riparian or poorly drained sites. Other representative conifer species in this zone are Douglas fir, western larch, and grand fir. Lodgepole pine is a common seral species on burned sites. Representative shrub species in this zone include snowberry, shiny-leaf spiraea, and rose. On more mesic sites in the zone, ninebark, western serviceberry, and black hawthorn are typical (KNRD 2001, pg. 69).

Nearly all of the original forests between the major roads east and west of the Pend Oreille River within WRIA 62 are believed to have been logged or burned at least once, or permanently cleared for agriculture or residential development. A large part of this area is in pasture, hayfields, and fallow land. Seasonally flooded wetlands are extensive. Wetland types include seasonally flooded fields, scrub-shrub, and forests: persistently flooded, emergent wetlands; persistently flooded, shallow riverine sloughs; old sloughs that are presently connected to the river only during flood conditions; and ponds not connected hydrologically to the river (POPUD

2000, pg. E1-3). Riparian cottonwood galleries are in decline as managed hydrology and land use practices have limited regeneration and replacement. Noxious weeds dominate disturbed areas of the Pend Oreille River drainage in WRIA 62.

Vegetation within the Priest River draining portion of WRIA 62 varies in association with soil moisture conditions, slope aspect, elevation, precipitation, temperature, wildfire history, and land use patterns. The area is predominantly coniferous forest. In the higher elevations of the Selkirk range, subalpine fir and Engelmann spruce are the dominant species. A large area of the west side of the Priest River drainage is occupied by western red cedar and western hemlock in moist soils, and Douglas fir, grand fir, western larch, white pine, lodgepole pine, and ponderosa pine in semi-dry soils. There are some spectacular stands of western red cedar, for example, at the Roosevelt Grove of Ancient Cedars on Granite Creek. The make-up of coniferous species has changed through time because of timber harvesting and replanting, fire, and plant diseases (USFS 1999af, pg., III-363 thru 370).

Land Use and Ownership

WRIA 62 is mostly rural with large forested areas, mountains, valleys, and open pastures. Homes and ranches are widely dispersed. Current land ownership in Pend Oreille County includes public lands, private forest, agriculture, rural residential, and industrial areas. Approximately 67% of the land is managed by state (3.5%) and federal (63.4%) entities. Most of the remaining 33% is in private ownership, while 0.6% is tribal land. Agricultural land use is estimated at 4%, rangeland use at 2%, and urban use at 1%. Present habitat conditions are in many cases still affected by historic land use practices, wildfire events, hydroelectric development, and fisheries management decisions.

Land uses within the WRIA have not changed significantly within the past several decades. Economic activity within the region is predominantly timber harvesting and recreation, supplemented with grazing, mining, and heavy industry. WRIA 62 is predominantly forested (approximately 93%) with 59% of Pend Oreille County lying within the Colville and the Idaho Panhandle National Forests. Other forestlands in the Pend Oreille River drainage are largely owned by private corporations. Forest cover is more fragmented in southern Pend Oreille County. There are large blocks of agricultural land and many rural home sites. Subdivisions are scattered between the crop and forestlands, and development reaches urban densities where cabins line the shores of Davis, Diamond, Sacheen, and other lakes. The City of Newport is the largest urban area in WRIA 62, with approximately 2,000 residents. Other urban areas with less than 1,000 residents include Metaline, Metaline Falls, Ione, Cusick, and Usk. The total population of WRIA 62 is approximately 8,000 (Pend Oreille County Draft Comprehensive Plan, June 21, 2000 as cited POCDb 2001, pg.7 and Entrix 2002, pg. 2-33).

DISTRIBUTION AND CONDITION OF STOCK

(Todd Andersen, KNRD, contributing author)

Bull Trout Life History Description

The Upper Columbia Distinct Population Segment (DPS) of bull trout was listed as threatened under the federal Endangered Species Act (ESA) on June 10, 1998. The 1998 Bull Trout and Dolly Varden Appendix to the Washington State Salmonid Stock Inventory (SaSI; WDFW 1998a) identified the Pend Oreille bull trout/dolly varden stock as a distinct stock due to their geographic distribution, but listed the status of the Pend Oreille bull trout stock as "Unknown". Bull trout observations within WRIA 62 in the mainstem Pend Oreille River and its tributaries (excluding the S. Fk. Salmo River and tributaries to the Priest River drainage), are infrequent and little life history information is known. Viable bull trout populations still exist in the Priest River drainage and in the S. Fk. Salmo River drainage. Average densities of bull trout for the entire west side Priest Lake drainage in all habitat types sampled from 1982-1984 were 3.4 fish/100m^2 (Irving 1987, Figure 8). In 2002 in the S. Fk. Salmo River, 10 redds and 18 bull trout were observed (Baxter 2003, pg. 6). The WDFW SaSI Appendix (1998a) refers to the Pend Oreille bull trout stock as "bull trout/dolly varden", however Crane et al (1994) and others (reviewed by Utter 1994) demonstrated that genetic data can differentiate the two species (WDFW 2000). Also, a study of native salmonid fisheries in the Mid-Columbia River basin (Proebstel et al. 1998) provided conclusive evidence that bull trout (Salvelinus confluentus) in the Mid-Columbia River basin are clearly distinct from dolly varden (S. malma).

Four general forms of bull trout are recognized, each with a specific behavioral or life history pattern; anadromous, adfluvial, fluvial, and resident (Appendix A). The adfluvial form matures in lakes and ascends tributary streams to spawn, where the young reside for one to three years. Fluvial bull trout have a similar life history except they move from large rivers to smaller tributaries to spawn. Fluvial and adfluvial forms of bull trout complete some of the longest migrations among non-anadromous salmonids; migrations of up to 250 km (150 miles) have been reported (Fraley and Shepard 1989). Adfluvial and fluvial bull trout reach sexual maturity at age five to seven and can reach a size exceeding 22 pounds (Elle 1995, Fraley and Shepard 1989). Fish as large as 26 inches long and weighing 5 pounds or more were documented to be in the possession of individual Kalispel Tribal members (Gilbert and Evermann 1895). Non-migratory, resident bull trout spend their lives in headwater tributaries, apparently migrating very little, and seldom reach a size of over 12 inches at maturity (Brown 1992, pg. 14). With the exception of the South Fork Salmo River and the LeClerc Creek drainage, no reproducing populations of bull trout have been identified as existing in the Lower Pend Oreille subbasin (downstream of Albeni Falls Dam and upstream of Boundary Dam).

Bull trout are strongly influenced by water temperature during all life stages and for all life history forms. Generally, adult bull trout prefer temperatures below 18^{o}C (64^{o}F) and juveniles prefer water temperatures less than 13^{o}C (55^{o}F; Fraley and Shepard 1989, Goetz 1989). Optimum temperatures for growth are between 12^{o}C (54 ^{o}F) and 16^{o}C (60 ^{o}F; McMahon et al. 1998). Bull trout are known to exist in areas where water temperatures exceed 20^{o}C (68 ^{o}F; Adams and Bjornn 1997). However, McMahon et al. (1998) found that the upper incipient lethal temperature (the temperature constant where 50% of the population survives for 60 days) for bull trout was 20.8°C (69 °F). Most bull trout spawn from mid-September through October, with timing related to declining water temperatures. Adult redd site selection is determined by substrate size and quality, hiding cover, streamflow, and ground water sources (Spotts 1987; Baxter et al. 1999). Spawning sites are commonly found in areas of ground water interchange, both from the subsurface to the river, and from the river to the subsurface. Association with areas of ground water interchange can promote oxygen exchange and mitigate severe winter temperatures including the formation of anchor ice. Incubation time to hatching has been documented at approximately 113 days, with emergence about 223 days from the date of deposition, temperature dependant (Brown 1992). Fry have been documented to remain in the gravel for three weeks after emergence (McPhail and Murray 1979). In unstable stream channels, the long over-winter inter-gravel phase for incubation and development leaves bull trout vulnerable to bedload movement during high flow events and deposition of fine sediment as flows subside (Fraley and Shepard 1989; Goetz 1989).

Bull trout populations require high stream channel complexity which is created by abundant and variable sized wood and substrate. High complexity results in channel stability, refugia during high flow events, and cover utilized by all life stages of bull trout. Young-of-the-year (YOY) bull trout are highly associated with low velocity areas created by woody debris along stream margins and in side-channels. Juveniles are primarily bottom-dwellers closely associated with undercut banks, large substrate, or in-channel wood (Pratt 1985). Adult fish reside in pools with complex structure provided by wood or large substrate (Pratt 1985; Rieman and McIntyre 1993).

Summary of Historic Events and Historic Distribution

Prior to the construction of Grand Coulee Dam on the Columbia River (Columbia RM 896.6) in 1939, the lowermost portion of the Pend Oreille River was reported to have supported anadromous runs of chinook salmon, Oncorhynchus tshawytscha, and steelhead trout, O. mykiss. These fish were restricted primarily to the lower reaches of the Pend Oreille River due to natural fish barriers at Z-Canyon (RM 19; Bennett and Falter 1985), and Metaline Falls (RM 27; Bennett and Falter 1992; Smith, A.H. letter to J.R. Mullan, USFWS, June 14, 1993).

Presently, fire history, past timber harvest activities, the development of hydroelectric facilities, conversion of land to agriculture/rural/urban use, and mining have influenced the landscape in the Lower Pend Oreille and Priest River portions of the Pend Oreille subbasin. The Lower Pend Oreille area was first logged from 1915 to 1930 and much of the old-growth timber was removed. Logging railroads and log flumes were used on the mainstem Pend Oreille River and several of its tributaries. Log flumes were common, and their construction and use simplified the instream habitat by changing channel shape and function and decreasing the recruitment source for large woody debris. In more recent years, road construction and maintenance, timber harvest, and cattle grazing have degraded stream habitat conditions. Habitat fragmentation has occurred due to poor culvert placement that prevents upstream migration and precludes bull trout from some tributaries (KNRD 2001, pg. 83-86). Tributary dams and pump stations (i.e. Mill Pond Dam, Sullivan Lake Dam, Cedar Creek Municipal Dam, Calispell Pumps, Calispell Duck Club Dam, Priest Lake Outlet Dam) without fish passage facilities have also contributed to habitat fragmentation. Numerous forest fires occurred between 1910 and 1929 and impacted many drainages in WRIA 62. From 1917 to 1929, an estimated 60 to 70% of the LeClerc Creek watershed burned. The largest fire in the LeClerc Creek watershed occurred in 1929 (Andersen 2001, Kalispel Resident Fish Project 2000 Annual report, pg. 2).

Bull trout were once highly abundant in the Pend Oreille River and its tributaries (Gilbert and Evermann 1895), but this is no longer the case (Barber et al. 1990; Ashe et al. 1991; Bennett and Liter 1991; KNRD and WDFW 1997b, 1997c, 1998; KNRD 1999, 2000b; Maroney and Andersen 2000a, 2000b, 2000c; Andersen and Maroney 2001b, 2001c, 2002a, 2002b, 2002c). Appendix B provides a brief collection of anecdotal, historical accounts of bull trout observations in WRIA 62. Several factors are significant to the decline of bull trout populations in the Pend Oreille River in WRIA 62: habitat degradation on the mainstem and within the tributaries; human-made fish passage barriers into tributaries to the Pend Oreille River; exotic fish species introduction and management; and the construction and operation of three hydroelectric facilities on the mainstem Pend Oreille River (Boundary dam, Box Canyon dam and Albeni Falls dam).

The mainstem Pend Oreille River dams have isolated bull trout subpopulations, eliminated individuals from subpopulations, and reduced or eliminated genetic exchange (KNRD 2001, pg. 83). All of these characteristics are important in ensuring the long-term persistence of self-sustaining fish populations (Rieman and McIntyre 1993). None of these dams were built with fish passage facilities. Other dams and diversions such as Cedar Creek Dam, Sullivan Lake Dam, Mill Pond Dam, Calispell Pumps and the Priest Lake Outlet Dam constructed in Pend Oreille tributaries further fragment the connectivity of native salmonid populations (KNRD 2001, pg. 83).

Hydropower construction and operations continue to have an effect on existing bull trout and other native salmonid species habitat although the relative affect on bull trout production of the conversion of the Pend Oreille River to a reservoir system has not been adequately evaluated (McLellan 2001, pg. 119). Box Canyon dam is a run-of-river facility and velocities experienced are primarily determined by variations in seasonal flows from upstream (P. Buckley, POPUD, pers. comm., 2002). The low flows that occur in summer are natural runoff conditions and are not due to operations of Box Canyon dam (P. Buckley, POPUD, pers. comm., 2002). McLellan (2001) concluded that there is not a full understanding of all the limiting factors in the Boundary Reservoir system and how they relate to each other. McLellan’s 2001 report concluded that what is known is that the major limiting factors in the Boundary Reservoir reach of the Pend Oreille River were related to water temperature, retention times, and daily water level fluctuations.

Non-native species have had an impact on native salmonids in the Lower Pend Oreille River subbasin. Native and non-native populations of salmonids and other species have been supplemented or introduced by means of hatchery plantings in the Pend Oreille River and its tributaries since before the turn of the century. Some fish, such as brown trout (Salmo trutta), were introduced to the Pend Oreille River via plantings in the 1890's from an original Scottish strain (J. Hisata, as cited in Ashe and Scholz 1992). In the reach of the Pend Oreille River that now consists of the Box Canyon Reservoir, approximately 226,328 rainbow trout were planted from 1935 to 1953. An additional 48,445 cutthroat trout were planted during this period (Bennett and Liter 1991). A total of 32,500 cutthroat trout were planted in the Pend Oreille River in 1939. Hatchery plantings into the Pend Oreille River were discontinued in the late

1950's due to poor angler harvest. Net pen stocking and release has continued intermittently in the Pend Oreille River at Ione, Ruby, Metaline, and other locations. Intermittent tributary stocking of hatchery brook trout continued into the 1990's (Bennett and Garrett 1994). WDFW planted 500,000 walleye larvae in 1983 and 253,000 walleye larvae in 1984 (Bennett and Liter 1991). WDFW also planted 148 tagged adult walleye in 1987 (WDFW, Spokane, as cited in Ashe and Scholz 1992). Northern pike (Esox lucius) have also been found in the Box Canyon Reservoir of the mainstem Pend Oreille River in recent years. Between 2001 and 2002, seven northern pike weighing between 8 and 22 pounds were captured by anglers (D. Comins, POCD, pers. comm., 2002). Northern pike are piscivorous as adults.

The Box Canyon Reservoir of the mainstem Pend Oreille River is also managed by the Kalispel Tribe for largemouth bass production in an attempt to partially mitigate for the resident and anadromous fish losses caused by hydropower development and operation. The fishery is supplemented by a largemouth bass production program with hatchery, nursery, and rearing facilities on the Pend Oreille River approximately 9 miles north of the Usk bridge on State Hwy. 20 (KNRD and WDFW 1997b). Small largemouth bass feed principally on small crustaceans and insects. Fish longer than 4 inches feed primarily on various fish species from game fish to salmonids (Wydoski and Whitney 1979, pg. 125). In Boundary Reservoir, native northern pikeminnow (Ptychocheilus oregonensis) and largescale suckers dominated the fish community (McLellan 2001, pg. 104). Small pikeminnow feed primarily on insects but as they get larger they become more piscivorous, feeding on available fish species from gamefish to salmonids (Wydoski and Whitney 1979, pg. 86). Suckers feed exclusively on zooplankton as fry and then aquatic insect larvae, crustaceans, earthworms, and detritus as they grow. Relatively few game fish were collected in the Boundary Reservoir, with smallmouth bass and yellow perch (both non-natives) being the two most abundant game fish species (McLellan 2001, pg. 118). Smallmouth bass fry eat crustaceans then, when still small (1-2 inches), change to a diet of insects and begin to eat various fish species. Adult smallmouth bass have been reported to feed on insects, crayfish, and fishes. Yellow perch feed on zooplankton when young and then begin to feed on immature insects. Large perch feed on forage fish when available (Wydoski and Whitney 1979, pg. 128, 146).

Introduced species have impacted bull trout populations through competition, hybridization, and increased mortality. Brook trout can interbreed with bull trout and the progeny are normally sterile (Leary et al. 1993). Brown trout are highly pisciverous and can reduce a bull trout population through predation. When held in sympatry with bull trout at temperatures between 16^oC (60^oF) and 20^oC (68^oF), brook trout exhibited a higher growth rate than when held isolated at the same temperatures (McMahon et al 1999). Conversely, bull trout growth declined in the presence of brook trout (McMahon et al 1999). Brown trout are common and brook trout are abundant in the Pend Oreille River and the majority of its tributaries. It is postulated that introductions of largemouth bass and other non-native species have also contributed to predation pressures upon native salmonids in the Pend Oreille River and associated sloughs (KNRD 2001, pg. 86). However, while conducting an assessment of fishery improvement opportunities on the Pend Oreille River (Ashe et al. 1991, Ashe and Scholz 1992, and Barber et al. 1989 and 1990), salmonids were never found in the analysis of stomach contents. Yellow perch were by far the most important fish species found in largemouth bass diets (J. Maroney, KNRD, 1/29/03 final draft review comment, March 2003).

Brook trout were introduced into the Priest River subbasin by the U.S. Fish Commission during the early 1900's and are now widely distributed throughout most tributaries. Their presence in Upper Priest Lake and Priest Lake is very low, however (Fredericks et al. 1997). Research during the 1980's indicated that brook trout were having a negative effect on adfluvial cutthroat trout production in Priest Lake tributary streams (Irving 1987, Strach and Bjornn 1991). Surveys by the USFS in west side tributaries in the Priest River subbasin indicate that brook trout have increased in abundance and distribution. Comprehensive surveys are needed in all tributaries to Upper Priest Lake and Priest Lake to determine the distribution and abundance of brook trout to better define native fish restoration options (KNRD 2001, pg. 148).

Historically, WDFW operated a hatchery facility located on Skookum Creek from the early 1950's through the early 1960's. Fish propagated at this facility included cutthroat trout, rainbow trout, and eastern brook trout and were stocked in various area lakes, streams, and in the Pend Oreille River. Hatchery operations were discontinued at this site due to poor fish growth and performance resulting from extremely cold hatchery source water temperatures (WDFW Region One archive files).

Current Distribution and Status

Bull trout were once abundant in the Pend Oreille River (Gilbert and Evermann 1895). Fish as large as 66 cm (26 in) long and weighing 1.9 kg (5 pounds) or more were in the possession of individual Kalispel tribal members (Gilbert and Evermann 1895). However, due to factors such as degraded habitat, loss of connectivity, and non-native fish introductions, bull trout populations in the Lower Pend Oreille subbasin are low. Information on current bull trout distribution within the lower Pend Oreille River subbasin is limited, despite extensive sampling efforts since 1988. From 1988 to 1990, Barber et al. (1990), Ashe et al. (1991), and Bennett and Liter (1991) spent hundreds of hours sampling Box Canyon Reservoir and captured only eight bull trout. Only a few bull trout have been found in the mainstem Pend Oreille River (Barber et al. 1990, Ashe et al. 1991, Bennett and Liter 1991, R2 Resource Consultants 1998). From 1998 through 2001, KNRD and Duke Engineering and Services (DE&S) operated an adfluvial trapping program on priority tributaries to Box Canyon Reservoir. Only one bull trout was captured in any of the traps (Indian Creek trap; DE&S 2001b, pg. 9) and that fish may have come from Trestle Creek, a tributary to Lake Pend Oreille, since it was adipose fin clipped (J. Maroney, KNRD, pers. comm., 2002). KNRD has also done extensive electrofishing in Box Canyon Reservoir since 1997 and has not captured any bull trout (KNRD and WDFW 1998; KNRD 1999, 2000b; Andersen 2001, 2001b). Many tributaries to the Pend Oreille River have not been surveyed to determine bull trout presence or absence.

Although extensive sampling effort in Box Canyon Reservoir from 1988 to 1990 resulted in few bull trout, a 1989 creel census reports that 181 ($\pm$ 23) bull trout were harvested in Box Canyon Reservoir; a total greater than any other salmonid species (Barber et al. 1990, pg. v). The high number of bull trout captured by anglers as calculated from creel census data appears to be an anomaly since no bull trout were caught in 1998 despite higher angler effort (Ashe et al. 1989). In 1989, the catch per unit effort by anglers was 241% greater than in 1988. Barber et al. (1990) attributed increased catch rates in 1989 to the reservoir drawdown that occurred during the peak of the fishing season. The drawdown may have made bull trout more vulnerable to anglers (T. Andersen, 2002, KNRD, pers. comm.). Fish species numbers calculated from creel census data are based on random checks of anglers using angler estimates of numbers and species of fish caught while fishing. Reliability of creel census data is not high.

The SaSI report (1998) classifies the Pend Oreille bull trout stock status as “Unknown”, however the WDFW expressed concern over the extremely small numbers of bull trout observations in WRIA 62. In the portion of WRIA 62 within Washington State, with the exception of the South Fork Salmo River and that portion of WRIA 62 that drains eastward into the Priest River system in Idaho, individual bull trout observations have been rare and widely distributed with only 33 bull trout being captured or observed over the last 28 years When the portion of the South Fork Salmo River within Washington State is included in the count of bull trout observations in WRIA 62 over the last 28 years, the total rises to 53 individuals; 27 adult bull trout have been documented since 1974 in the S. Fk. Salmo River within Washington with 18 of those documented sightings being made in 2002 (Baxter 2003, pg. 6). Following Table 5 is a textual presentation section summarizing bull trout captured or observed over the last 28 years in the Pend Oreille River and its tributaries within Washington State - excluding those streams draining into the Priest River drainage. Viable bull trout populations do still exist in the Priest River system. Average densities of bull trout for the entire west side Priest Lake drainage in all habitat types sampled from 1982-1984 were 3.4 fish/100m^2 (Irving 1987, Figure 8).

Table 5. Summarized bull trout sightings since 1974.

Bull Trout Observations Agency/Investigator	Year	Location	Size	Comments
USFS (Tom Burke)	1974	S. Fk. Salmo River	10 -14 "	
USFS (Tom Burke)	1976	S. Fk. Salmo River	10 -14 "	
WDFW (Bob Peck)	early 1980's	Sweet Cr.	20"	gill net
WDFW (Bob Peck)	early 1980's	Sweet Cr.	34"	observed dead on bank
Barber et al. 1989	1988	Box Canyon Reservoir	unknown	Electrofishing
Bennett & Liter 1991	1989	Box Canyon Reservoir	unknown	Electrofishing
Bennett & Liter 1991	1990	Box Canyon Reservoir	unknown	Gill Net
Barber et al. 1990	1989	Char Springs (Box Cyn. Res.)	unknown	Electrofishing
Barber et al. 1990	1989	Char Springs (Box Cyn. Res.)	unknown	Electrofishing
Barber et al. 1990	1989	Char Springs (Box Cyn. Res.)	unknown	Electrofishing
Barber et al. 1990	1989	Box Cyn. Res. (near Cee Cee Ah Slough)	unknown	Electrofishing
Barber et al. 1990	1989	Box Cyn. Res. (Skookum Slough)	unknown	Electrofishing
Ashe et al. 1991	1990	Box Cyn. Res. (near Cee Cee Ah Slough)	unknown	Electrofishing
Plum Creek	1993	West Branch LeClerc	juvenile	
Plum Creek	1993	West Branch LeClerc	juvenile	
Plum Creek	1993	East Branch LeClerc	juvenile	
Plum Creek	1993	East Branch LeClerc	juvenile	
Cascade Environmental Services (CES)	1993	Sullivan Creek	adult female	found gutted on shoreline downstream of powerhouse
Cascade Environmental Services (CES)	1993	Sullivan Creek	adult	What was believed to be a bull trout, observed in 8' of water immediately down from RM 0.65 chute
WDFW (Vail)	1994	Boundary Reservoir (near mouth of Slate Crk)	16 - 18"	Hook and Line
USFS (Shuhda)	1994	Boundary Reservoir (near mouth of Slate Crk)	16 - 18"	Hook and Line
KNRD (Maroney)/ WDFW (Vail)	1995	East Branch LeClerc	1 adult	
KNRD/WDFW	1995	Cedar Creek	18-19"	Snorkel, just up from Cedar Creek Dam
KNRD/WDFW	1995	Mill Creek	14"	Snorkel, 200 yds. up from LeClerc Rd. crossing.
WDFW (Vail)	1995	Boundary Reservoir (near mouth of Slate Crk)	17 - 19"	Hook and Line

Agency/Investigator	Year	Location	Size	Comments
WDFW (Vail)	1995	Boundary Reservoir (near mouth of Slate Crk)	17 - 19"	Hook and Line
WDFW (Vail)	1995	Boundary Reservoir (near mouth of Slate Crk)	17 - 19"	Hook and Line
Angler	1995	S. Fk. Salmo River	20 -25"	hook and line
Angler	1995	S. Fk. Salmo River	20 -25"	hook and line
SCL (R2 consult)	1997	Boundary Reservoir	8"	Trap; caught twice
KNRD	1998	East Branch LeClerc	juvenile	Snorkel
KNRD	1998	Fourth of July	10"	Snorkel
KNRD	1999	Fourth of July	6"	Snorkel
KNRD/Duke Engineering	1999	Indian Cr.	25"	Trap
Baxter Environmental	1999	S. Fk. Salmo River	adult	Radio-telemetry
Baxter Environmental	1999	S. Fk. Salmo River	adult	Radio-telemetry
WDFW (McLellan)	2000	Sweet Cr.	12"	Snorkel
POCD 2001	2000	near mouth of Marshall Creek (Box Cny. Res.)	25"	Angler-hook and line
Baxter Environmental	2000	S. Fk. Salmo River	adult	Radio-telemetry
Baxter Environmental	2000	S. Fk. Salmo River	adult	Radio-telemetry
Baxter Environmental	2000	S. Fk. Salmo River	adult	Radio-telemetry
KNRD	2001	West Branch LeClerc	20"	Snorkel; female digging redd
Baxter Environmental	2002	S. Fk. Salmo River	18 adults	survey observation

- In 1974 and 1976, U.S. Forest Service personnel observed two bull trout, 25 – 35 cm (10-14 in) in length, in the South Fork Salmo River.

- In the early 1980's, WDFW fish biologist, Bob Peck, captured one bull trout in a gill net in Sweet Creek measuring 50 cm (20 in). Around the same time, Peck observed a dead bull trout (34 in.) on the bank of Sweet Creek.

- In 1988, one bull trout was captured by electrofishing in the Box Canyon Reservoir (Barber et al. 1989; Ashe et al. 1991, Table 4.1).

- In 1989, and again in 1990, Bennett and Liter (1991, Tables 3-2, 3-3) surveyed Box Canyon reservoir using various methods: gill netting, electrofishing and beach seining. In 1989, a bull trout of unknown size was captured while electrofishing in Box Canyon Reservoir. In 1990, one additional bull trout was captured by gillnet.

- Barber et al (1990) also did extensive electrofishing in Box Canyon Reservoir in 1988 and 1989. No bull trout were recorded captured in 1988 (Barber et al. 1990, Tables A-1 through A-4). In August 1989, during a selective electrofishing survey targeted at bull trout, 3 bull trout were captured in Char Springs (Barber et al. 1990, Table 3.9). Then, in September 1989, two bull trout were reported captured; one near Cee Cee Ah Slough, and one in Skookum Slough (Barber et al. 1990, Table 3.3 and A.19). Continuing with this project in 1990, Ashe et al. (1991) captured one bull trout while electrofishing near Cee Cee Ah Slough.

- In 1993, personnel from Plum Creek Timber Company observed four bull trout in the LeClerc Creek watershed. Two juveniles were observed in the West Branch and two juveniles were identified in the East Branch (Plum Creek sampling data 1993).

- Also in September 1993, biologists from Cascade Environmental Services observed a dead mature female bull trout along the Sullivan Creek shoreline below the powerhouse, approximately ¼ mile upstream from the mouth. What was believed to be a second adult bull trout was observed in eight feet of water immediately downstream of the natural chute at RM 0.65 by a CES biologist.

- In 1994, Curt Vail, WDFW Fishery Biologist, and Tom Shuhda, USFS, Fish Program Manager, captured two bull trout with hook and line, out of Boundary Reservoir near the mouth of Slate Creek. The bull trout measured 16 and 18 inches in length.

- In 1995, snorkelers from KNRD and WDFW observed one adult bull trout in East Branch LeClerc Creek, one 45 cm (18 in) bull trout in Cedar Creek (KNRD and WDFW 1997b), and one 35 cm (14 in) bull trout in Mill Creek. The observation in Mill Creek occurred about 200 yards upstream of the LeClerc Road crossing (J. Maroney, KNRD, pers. comm.., 2002).

- In 1995, Curt Vail, WDFW Fishery Biologist, and Lisette Vail captured three bull trout with hook and line, in Boundary Reservoir near the mouth of Slate Creek. Sizes ranged from 17 to 19 inches in length.

- Also in 1995, anglers reportedly caught two bull trout, 50 – 65 cm (20 – 25 in) in length, in the South Fork Salmo River.

- In 1997, R2 consultants trapped one 20 cm (8 in) bull trout twice (once in the summer and again in the fall) in Boundary Reservoir near the mouth of Slate Creek (R2 Resource Consultants 1998, pg. 3-5,6).

- In 1998, snorkelers from KNRD observed two bull trout in the LeClerc Creek drainage. One juvenile was observed in the East Branch and one 25 cm (10 in) bull trout was observed in lower Fourth of July Creek (KNRD 1999).

- In 1999, KNRD snorkelers observed one bull trout, 15 cm (6 in) in length, in Fourth of July Creek (KNRD 2000b). Also, KNRD and DE&S personnel captured a 64 cm (25 in) gravid female bull trout in a trap in Indian Creek.

- Also in 1999, using radio-telemetry gear Baxter Environmental consultants tracked two adult bull trout into the portion of the South Fork Salmo River that falls within the United States.

- In 2000, WDFW snorkelers observed an adult (30 cm/12 in) bull trout in Sweet Creek, approximately 400m upstream of State Hwy. 31 (McLellan 2001).

- Also in 2000, an angler reported to the POCD that he caught a 64 cm (25 in) bull trout near the mouth of Marshall Creek.

- In 2000, using radio-telemetry gear Baxter Environmental consultants tracked three bull trout into the portion of the South Fork Salmo River that falls within the United States.

- In 2001, personnel from KNRD observed a female bull trout, approximately 50 cm (20 in) in length, digging a redd in West Branch LeClerc Creek.

- In the fall of 2002, approximately 10 bull trout and 4 redds were observed in the vicinity of Watch Creek during the fall redd survey (J. Baxter, Baxter Environmental, consultant, email communication, September 2002). In the S. Fk. Salmo River as a whole, a total of 10 redds and 18 bull trout were observed (Baxter 2003, pg. 6).

- In Idaho, Lake Pend Oreille, Priest Lake, and Upper Priest Lake all support adfluvial populations of bull trout. Currently, bull trout populations in Priest and Upper Priest lakes in the Priest River drainage are considered severely depressed (Fredericks et al. 2000). The only known tributary utilized by adfluvial fish migrating out of Priest Lake (the lower-most lake in the Priest River drainage) is Granite Creek, which extends into the state of Washington. Bull trout were once common in Priest Lake and supported a sport harvest of up to 2,300 fish as recently as 1978 (Mauser et al. 1988, Table 12). Bull trout harvest in Priest Lake and all tributaries was closed in 1984. Granite Creek, the main tributary to Priest Lake, still supports a few bull trout in low densities (Irving 1987), but bull trout x brook trout hybrids have also been observed in that drainage. Above Priest Lake is Upper Priest Lake which is connected by a waterbody known as the Thorofare, 2.7 miles long. There are no known barriers between the two lakes however currently there is no documentation of bull trout moving from the lower Priest Lake to Upper Priest Lake (J. Cobb, USFS, pers. comm., March 2003). Bull Trout are still numerous in the upper portion of the Priest River drainage including the Hughes Fork drainage, although lake trout populations in Upper Priest Lake are believed to be significantly limiting bull trout populations in the upper Priest River drainage. The upper reaches of Gold, Jackson, and Bench creeks are located in Washington State. In the Upper Priest River and Hughes Fork drainage, the Idaho Department of Fish and Game is actively working to protect this fragile population from non-native lake trout.

Appendix C contains maps showing the "Historic", "Currently Occupied", "Suitable", and "Recoverable" bull trout habitat. "Individual Observations" of bull trout are also mapped in Appendix C. The map reflects knowledge of bull trout habitat and distribution current as of winter 2002. Appendix C also includes the Washington Conservation Commission 2496 Technical Advisory Group Guidelines for Mapped Bull Trout Presence/Habitat. All upper extents of distribution should be considered approximate. Table D1 in Appendix D provides detailed information on the sources of the fish distribution data that will be displayed in the distribution map.

The following sources were queried for bull trout distribution data: 1) WDFW StreamNet; 2) USFS Colville National Forest fish distribution survey data; 3) USFS Idaho Panhandle National Forest fish distribution data; 4) Pend Oreille PUD survey data; 5) Kalispel Tribe survey data; 6) Seattle City Light survey data and; 7) professional knowledge and observation from TAG participants including, but not limited to, Curt Vail, WDFW, Area Fish Biologist; Tom Shuhda, USFS, Forest Fish Program Manager; Andrew Scott and John Blum, Framatome ANP, consultants for Pend Oreille PUD; Al Solonsky, Seattle City Light; Todd Andersen and Joe Maroney, KNRD, Fisheries bioloigsts; and Jill Cobb, Forest Hydrologist, and Matt Davis, District Fisheries Biologist, USFS.

HABITAT LIMITING FACTORS BY WAU

Introduction

This report discusses salmonid habitat conditions in terms of habitat attributes that are limiting bull trout production as a result of human impacts within the 19 Washington State Department of Natural Resource (WDNR) Washington Administrative Units (WAUs) of the Pend Oreille WRIA 62 (Figure 1), and the mainstem Pend Oreille River. Listed from north to south, the WAUs are; South Salmo, Slate, Sullivan, Harvey, Box Canyon, Muddy, Ruby, LeClerc, Middle, Tacoma, Cee Cee Ah, Winchester, Tenmile, Deer Valley, Skookum, Kalispell, Granite, Gold creeks and Priest River (Figure 2). Because the Pend Oreille River is not assigned to any WAU, for the purpose of presenting it here in this report, it is divided into two reaches; Boundary Reservoir and Box Canyon Reservoir.

Habitat limiting factors are defined in the Salmon Recovery Act (RCW 77.85) as "conditions that limit the ability of the habitat to fully sustain populations of salmon." Relying on the combined technical expertise of the Technical Advisory Group (TAG), twelve habitat attributes and Species Competition were selected by the TAG as those factors most likely to be limiting bull trout productivity in WRIA 62 streams. Habitat attributes are those environmental conditions that traditionally appear in the literature to describe the relationship between biological performance and the environment (Mobrand Biometrics 1999). The 12 habitat attributes evaluated are: 1) artificial structures; 2) riparian condition; 3) streambank condition; 4) floodplain connectivity; 5) channel stability; 6) channel substrate; 7) large woody debris; 8) pool frequency and quality; 9) pool depth; 10) off-channel habitat; 11) water temperature; and 12) change in flow regime. The habitat attributes have been lumped into seven categories according to the attributes' relationship to its physical environment. The categories are: 1) Access to Spawning and Rearing Habitat; 2) Riparian Condition; 3) Channel Conditions/Dynamics; 4) Habitat Elements; 5) Water Quality; 6) Water Quantity; and 7) Species Competition. Although not a habitat attribute, the limiting affect of non-indigenous fish species competition on sustaining bull trout populations will also be assessed. Both the categories of habitat limiting factors and the habitat attributes were selected based on input from the TAG (Table 26).

A discussion of each habitat attribute is provided below in the section, "Categories of Habitat Limiting Factors". The discussion provides some background on each of the categories of habitat limiting factors and the specific attributes. Reading through "Categories of Habitat Limiting Factors" will provide the reader with a sense of the inter-connectedness of the habitat categories and how they relate to productivity of a species and particular life stages.

Within the section of this chapter titled, "Habitat Limiting Factors by Watershed", the stream reaches within each of the 19 WAUs of WRIA 62 and the mainstem Pend Oreille River that have been identified by the TAG as having either "Currently Occupied", "Suitable" or "Recoverable" bull trout habitat are presented under the headings: Watershed Description; Watershed Discussion of Hydrogeomorphology and Habitat Conditions; Watershed Current Known Habitat Conditions; Watershed Fish Use and Distribution; Watershed Summary; and Watershed Data Gaps. To facilitate the presentation of information on the mainstem Pend Oreille River, the Pend

Oreille River is delineated into two reaches; the Boundary Reservoir reach (RM 17.0–34.4) and the Box Canyon Reservoir reach (RM 34.4-90.1), and then discussed in detail. Stream reaches within a WAU that do not support bull trout or do not have “Currently Occupied”, “Historic”, “Suitable” or “Recoverable” bull trout habitat, but have been identified by the TAG as contributing to the degradation of downstream suitable bull trout habitat, will also be presented in this chapter. The definitions of “Currently Occupied”, “Historic”, “Suitable”, and “Recoverable” habitat are defined as follows:

> “Currently Occupied” - Defined reach(es) where bull trout are known to occur based on multiple observations of bull trout occurrence from 1980 to present;
>
> “Historic” - Reach(es) where, based on reliable data (compiled prior to 1980), bull trout have existed/occurred;
>
> “Suitable” - Defined reach(es) where, based on the best biological data, suitable bull trout habitat exists. Best biological data includes consideration of life history strategies, proximity and connectivity to adjacent areas of known occupied habitat, and logical extrapolation of range from similar systems. Suitable habitat is defined by the bull trout requirements for cold, clean, complex and connected habitat (USFWS Bull Trout Interim Conservation Guidance 1998). Habitat upstream of human-made barriers may be identified as suitable if the habitat meets the definition of suitable habitat;
>
> “Recoverable” - Defined reach(es) where, based on the best biological data, potential for suitable bull trout habitat exists, and recovery efforts would upgrade the habitat to suitable. Best biological data includes consideration of life history strategies, proximity and connectivity to areas of known historical or known occupied habitat, and logical extrapolation of range from similar systems. Suitable habitat is defined by the bull trout requirements for cold, clean, complex and connected habitat (USFWS Bull Trout Interim Conservation Guidance 1998).

Finally, a section titled “WRIA 62 Summary of Habitat Conditions” is provided at the end of this chapter. This section discusses the relative significance of all the WAUs to maintaining bull trout performance in WRIA 62.

The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate.

Description of Categories of Habitat Limiting Factors

ACCESS TO SPAWNING AND REARING HABITAT.

Incubation of bull trout eggs and fry occurs within the interstitial spaces of gravels in the beds of cool, clean streams and rivers. Once emergence from the gravel is complete, young bull trout are mobile, which increases their flexibility to cope with environmental variation by seeking suitable habitat conditions. Mobility particularly is limited for fry, so that suitable habitat and food resources must be available in proximity to spawning areas for successful first-year survival. Ideal rearing habitat affords low-velocity cover, a steady supply of small food particles, and refuge from larger predatory fishes, birds and mammals (Williams et al. 1996).

Bull trout are limited to spawning and rearing locations by natural features of the landscape. These features include channel gradient, groundwater recharge areas, and the presence of certain physical features of the landscape, e.g. logjams, falls. Flow can affect the ability of some landscape features to function as barriers. For example, some falls may be impassable at low flows, but then become passable at higher flows. In some cases flows themselves can present a barrier, such as extreme low flows in some channels; at higher flows fish are not blocked.

Throughout Washington, barriers have been constructed that have restricted or prevented juvenile and adult fish from gaining access to formerly accessible spawning and rearing habitat. These barriers include dams and diversions with no passage facilities, culverts that are poorly installed or designed, and dikes that isolate floodplain off-channel habitat. Other factors that may function as barriers to fish movement during certain times of the year are low stream flow or temperature conditions. However, in geographic areas where there persist populations of resident native fish species like bull trout, barriers (both natural and human-made) may actually serve to protect remaining native bull trout populations from interspecies competition from non-native species like brook trout.

This category, Access to Spawning and Rearing Habitat, includes known dams, dikes, culverts, and other artificial structures or conditions that restrict access to spawning habitat for adult salmonids or rearing habitat for juveniles. Appendix E has a table of known barriers in WRIA 62 (Table E1).

It should be noted that criteria for determining passability for bull trout at human-made structures (or even natural obstacles) can vary. For example, the Washington Department of Fish and Wildlife (WDFW 1998a) assesses fish passability at culverts based on the swimming ability of an adult trout (>6 inch). Powers and Orsborn (1985) assess passability at waterfalls and culverts based on the known swimming speeds, leaping capabilities, and swimming distances of adult salmon and steelhead trout (no size limit indicated). The barriers information contained in Table E1, in Appendix E, reflects the barriers information found in the text of this report. Fish passage barriers data is a compilation of: 1) McLellan (2001) GIS barriers data coverage; 2) USFS GIS culvert barriers coverage (2002); 3) WDFW SSHEAR GIS barriers data coverage (2002); 4) information obtained from the text of available reports; 5) professional knowledge. The GIS data from McLellan (2001), the USFS, and SSHEAR have been incorporated into a barriers coverage by the Washington Conservation Commission. The WCC barriers coverage does not reflect known barriers that were not available in a digital format at the time this report was being developed. Barriers on private lands have not been inventoried; this represente a data gap.

<u>Artificial Obstructions.</u>
Improperly placed or maintained culverts may:

- prevent access for bull trout fry and parr to off-channel overwinter refuges of ponds, wetlands and small creeks that are often dry during the summer;

- hinder or prevent passage of adult and juvenile fish due to high water velocity, insufficient water depth, elevated outlet, or debris accumulation;

- create flows of a greater velocity and/or a shallower depth than that in the natural stream, often resulting in conditions that restrict or prevent the upstream movement of fish;

- cause the erosion and downcutting of the stream due to the relatively high velocity of water exiting the downstream end of a culvert which can also result in the formation of a vertical drop that may prevent fish from accessing the lower end of the culvert;

- increase the risks of culvert failure and related degradation of fish habitat from the delivery of sediment into streams.

Improperly placed or maintained dikes, dams and other artificial structures may:

- block fish access to bull trout habitat;

- block access to a portion of the floodplain;

- prevent further development of side channels;

- prevent the recruitment of large woody debris;

- limit recruitment of spawning gravel;

- confine the channel, concentrating flows within the mainstem, increasing the erosive nature of the flows. Bed scour within the reach can negatively impact bull trout redds.

Low flows, dewatering, and high/low instream temperature may:

- prevent upstream or downstream movement of adults and juveniles;

- contribute to stranding of juveniles.

Natural Barriers

Steep gradients, falls, and naturally dewatering stream reaches:

- may preclude upstream and downstream movement of one or more life history stages of fish species.

RIPARIAN CONDITION.

The riparian ecosystem is a bridge between upland habitats and the aquatic environment, and includes the land adjacent to streams that interacts with the aquatic environment. Riparian forest characteristics in ecologically healthy watersheds are strongly influenced by climate, channel geomorphology, and location of the channel in the drainage network. For example, fires, severe windstorms, and debris flows can dramatically alter riparian characteristics. The width of the riparian zone and the extent of the riparian zone's influence on the stream are strongly related to stream size, geology, and drainage basin morphology. In a basin unimpacted by humans, the riparian zone would exist as a mosaic of tree stands of different acreage, ages (e.g. sizes), and species.

Riparian habitats include side channels which offer refuge from adverse winter conditions such as rain-on-snow events/flooding and icing, and often influence the water quality of adjacent aquatic systems. Riparian vegetation provides shade which shields the water from direct solar radiation thereby moderating extreme temperature fluctuations during summer and keeping streams from freezing during winter. Riparian vegetation helps stabilize banks by maintaining masses of living roots which reduce surface erosion, mass wasting of stream banks and consequently reducing sediment delivered to the stream channel (Platts 1991). Riparian vegetation also contributes to the recruitment of large woody debris (LWD). Large woody debris contributes to channel complexity, including pool development, and sediment storage. Riparian ecosystems act as reservoirs, storing run-off in soil spaces and wetland areas and diminishing erosive forces caused by high flow events. The presence of stream-side vegetation also reduces pollutants, such as phosphorous and nitrates through filtration and binding them to the soil. Riparian vegetation contributes nutrients to the stream channel from leaf litter and terrestrial insects that fall into the water.

Riparian zones are dynamic systems where natural disturbances such as fire, windstorms, debris torrents, mass slope failures, and LWD formation failures are part of the regime of habitat-forming processes (Swanston 1991). Within this system however, human land use practices can negatively impact natural functions. Riparian forests can be completely removed, broken longitudinally (by roads, for example), and their widths can be reduced. Further, species composition can be dramatically altered when native, old-growth, coniferous trees are harvested, allowing for the establishment of a younger seral stage of hardwood, deciduous tree species and young, smaller diameter conifers. Deciduous trees are typically of smaller diameter and shorter lived than coniferous species. They decompose faster than conifers so they do not persist as long in streams and are vulnerable to washing out from lower magnitude floods. Once impacted, the recovery of a riparian zone can take many decades as the forest cover reestablishes and matures and coniferous species colonize.

Salmonid habitat requirements are met in part by healthy, functioning riparian habitat. For example: adequate stream flows must be present in order for fish to access and use pools and hiding cover provided by root wads and LWD positioned at the periphery of the stream channel. Microclimate, soil hydration, and groundwater influence stream flow; these factors are in turn influenced by riparian and upland vegetation. Vegetation and the humus layer intercept rainfall and surface flows. This moisture is later released in the form of humidity and gradual, metered outflow through groundwater where the geology supports the groundwater/surface water interaction. Through this process, stream flows may be maintained through periods of drought (Knutson and Naef 1997).

This category, Riparian Condition, addresses factors that limit the ability of native riparian vegetation to provide shade, nutrients, bank stability, and a source for LWD. Human impacts to riparian function include timber harvest, clearing for agriculture or development, construction of roads, dikes, or other structures, and direct access of livestock to stream channels.

Some types of timber harvest, i.e. poorly managed riparian harvests and riparian clearcuts, or clearing for agriculture or development in riparian areas can:

- decrease bank stability;
- decrease recruitment of LWD;
- result in a loss of shading;
- result in a loss of cold water refugia;
- increase sediment delivery;
- decrease sources for nutrient input;
- decrease insect drop for fish consumption.

Improperly constructed roads, dikes or other structures can:

- interfere with delivery of LWD to stream channels;
- constrain lateral channel migration;
- increase sediment delivery to stream channels;
- increase surface water runoff to stream channels;
- contribute to increases in bank instability;
- contribute to channel incision (downcutting).

Poorly managed livestock grazing can:

- decrease bank stability;
- increase sediment recruitment;
- alter the composition of riparian vegetation;
- compact soil;
- increase nutrient and pollutant loading into streams.

CHANNEL CONDITIONS/DYNAMICS.

A stream channel represents the integration of physical processes occurring at the watershed level: hydrologic, i.e. precipitation, snow melt; erosional, i.e. debris flows, mass wasting; and tectonic processes, i.e. folded strata may dictate valley location, or rivers may exploit bedrock weakness along fault systems. The physical processes determine sediment, water, and LWD input to the channel. At the same time channel form or morphology is naturally constrained both laterally and vertically by valley form, riparian conditions and geology. The ability of the channel to transport and manage sediment, water and LWD is a function of the channel's morphology and roughness as well as a function of the input of sediment and LWD, i.e. source, transport, or response reaches; Montgomery and Buffington 1993. Channel form will change when any of these inputs are altered or when the channel is artificially confined or constrained.

Riprapping constructed to reduce a river's ability to migrate laterally (meander) and to reduce overbank flows within the channel migration zone, can retard habitat-forming processes (Beechie and Bolton 1999) and disrupt the bedload and LWD transport regimes of the river system. Additionally, improperly placed riprap can contribute to localized bed scour or channel incision, reducing the stream's ability to access its floodplain (USFS 1999c). Riprapping can also lead to accelerated bank erosion by diverting flow energies to more vulnerable stream banks in the reach; where riprapping contributes to stream incision, the toes of banks in the incised or bedscoured reaches are weakened and can fail.

Human land use activities within a watershed, such as road and residential development, vegetation removal, and water diversion, can alter the outcome of physical processes on channel formation and alter the ability of the channel to develop both laterally and vertically. For example, the quality and quantity of salmonid rearing and spawning habitat in a stream channel is controlled by the interaction of sediment and LWD with water and the transport of all three of these components through the channel network. Altering LWD levels or increasing sediment input can result in a decrease in the number and quality of pools, a decrease in the ability of the channel to retain sediment and organic matter, and an increasing width to depth ratio in low gradient reaches. Confining or constricting the stream channel can affect the rate and manner of sediment, LWD, and water transport through the system. It is important to note that habitat conditions in fish-bearing streams are intimately influenced by contributions of sediment and LWD from non-fish-bearing streams within a watershed. In the Pacific Northwest, LWD has been found to have a significant influence on the formation of pools and channel form (Nelson 1998).

Roads can affect streams directly by accelerating erosion and sediment loading, by altering channel morphology, and by changing the runoff characteristics of watersheds. These changes can later affect physical processes in streams, leading to changes in streamflow regimes, sediment transport and storage, channel bank and bed configurations, substrate composition and stability of slopes adjacent to streams (Furniss et al. 1991). Sediment entering a stream is delivered chiefly by mass soil movements and surface erosion processes (Swanston 1991). Failure of stream crossings, diversion of streams by roads, washout of road fills, and accelerated scour at culvert outlets are also important sources of sedimentation in streams within roaded watersheds (Furniss et al. 1991).

Improper agricultural practices and residential/urban development can also affect streams by accelerating erosion and sediment loading to streams and by changing the runoff characteristics of watersheds. Farmed fields left fallow, i.e. barren of vegetative cover, cause much surface erosion and sediment movement to streams as winter snow melts and runs off, carrying soil into stream channels. This surface erosion and transport of sediment to streams is particularly a problem where riparian vegetation has been removed and the land is farmed up to the bank's edge. The conversion of riparian habitat to landscaped lawns has the same effect, removing bank stabilizing root mass thereby contributing to accelerated streambank erosion. Riparian vegetation naturally functions as a filter, capturing sediments and buffering the flow of surface runoff into stream channels.

This category, ChannelConditions/Dynamics, addresses impacts to the channel's physical form and function resulting from land use management practices that degrade the riparian zone or confine or constrain the stream channel.

Streambank Condition.

Natural stream channel stability is achieved by allowing the river to develop a stable dimension, pattern, and profile such that over time, channel features are maintained and the stream system neither aggrades nor degrades (Leopold et al. 1992, Rosgen 1996). For a stream to be stable it must be able to consistently transport its sediment load, both size and type (Leopold et al. 1992, Rosgen 1996). When the stream laterally migrates, but maintains its bankfull width and width/depth ratio, stability is achieved even though the river is considered to be an "active" and "dynamic" system (Rosgen 1996). Changes in discharge and sediment supply result in a limited number of possible channel adjustments, which vary with channel form and position within the stream network (Montgomery and Buffington 1993). Potential adjustments include changes in width, depth, velocity, slope, roughness and sediment size (Leopold et al. 1992). Channel instability occurs when, over a period of years, the scouring process leads to degradation (downcutting), or excessive sediment deposition results in aggradation. This attribute, Streambank Condition, includes known areas of destabilized streambanks, actively eroding or stabilized by some channel stabilization technique.

Floodplain Connectivity.

Floodplains are relatively flat areas adjacent to larger streams and rivers that are periodically inundated during high flows. In a natural state, floodplains allow for the development of productive aquatic habitats through lateral movement of the main channel. Floodplains also provide storage for floodwaters, sediment, and LWD. Floodplains generally contain numerous sloughs, side channels, and other features that provide important spawning habitat, rearing habitat, and refugia during high flows. Large woody debris in an active channel or floodplain creates conditions necessary for plant colonization within an alluvial plain. Large woody debris is a primary determinant of channel morphology, forming pools, creating low velocity zones, regulating the transport of sediment, gravel, organic matter and nutrients and providing habitat and cover for fish (Bisson et al. 1987). The alluvial fan area of a stream's floodplain is an important feature of the floodplain, dissipating flow energy and maintaining and creating suitable rearing and spawning habitat over a wide range of flows. However, along larger mainstem streams, where a tributary's alluvial fan encroaches on the mainstem's floodplain (for example, at the edge of a valley wall), fans can constrict flood flows of the mainstem and locally increase energies.

There are two major types of human impacts to floodplain functions. First, channels are disconnected from their floodplain laterally as a result of the construction of dikes and levees, and longitudinally, as a result of the construction of road crossings. Riparian forests are typically reduced or eliminated as levees and dikes are constructed. Channels can also become disconnected from their floodplains as a result of downcutting and incision (degrading) of the channel from losses of LWD, decreased sediment supplies, and increased high flow events. Reduced overbank flooding resulting from increased entrenchment can reduce groundwater recharge and alter the flow regime (Naiman et al. 1992).

The second major type of human impact to floodplain function is loss of natural riparian and upland vegetation. Conversion of mature vegetated cover to impervious surfaces, early-mid seral deciduous riparian stands, pastures, and farmed fields has occurred as floodplains have been converted to urban/residential and agricultural uses. This land conversion has: 1) eliminated off-channel habitats such as sloughs and side channels, 2) increased flow velocity during flood events due to the constriction of the channel, 3) reduced subsurface flows, and 4) simplified channels since LWD is lost and channels are often straightened when levees are constructed.

Elimination of off-channel habitats such as sloughs and backwaters that function as overwintering habitat for spring chinook, steelhead and bull trout can result in the loss of these important rearing habitats for juvenile salmonids. The loss of LWD from channels reduces the amount of rearing habitat available for juveniles. Disconnection of the stream channels from their floodplain due to levee and dike construction increases water velocities, which in turn increases scour of the streambed. Salmon that spawn in these areas may have reduced egg to fry survival due to the scour. Removal of riparian zones can increase stream temperatures in channels, which can stress both adult and juvenile salmon. Sufficiently high temperatures can increase mortality (Hicks et al. 1991; Bjornn and Reiser 1991).

This attribute, Floodplain Connectivity, includes direct loss of aquatic habitat from human activities in floodplains (such as filling) and disconnection of main channels from floodplains with dikes, levees, and revetments. Disconnection can also result from channel degradation (downcutting) caused by changes in hydrology or sediment inputs.

Channel Stability

The shape of the cross section of a river channel at any location is a function of the flow, the quantity and character of the sediment in movement through the section, and the character of composition of the materials making up the bed and banks of the channel. In nature, the bed and banks will usually include vegetation, soil, and rock. When there is equilibrium between erosion and deposition, the cross section of a channel is said to be “stable”, meaning constant, but the position of the channel is not stable. In actuality, a natural channel carries sediment and may migrate laterally by erosion of one bank, maintaining on the average a constant channel cross section by deposition at the opposite bank. Stability is implied in the distinction between equilibrium and aggradation or degradation – the progressive building up or lowering of the channel bed. The unit of time here is significant; a channel may scour or fill but these are short-lived changes. An entire landscape is being reduced in elevation over geologic time, nevertheless, even while the channel is slowly eating away the land, its form and local gradient may remain constant and in quasi-equilibrium with available sediment and water (Leopold et al. 1992, pg. 198, 267).

Rivers and streams act as indicators of environmental stress when sediment supply and channel adjustments occur as a result of changes in vegetation composition, road building, conversion of the landscape to urban, residential, or agricultural use, and other watershed activities that create the cumulative impacts on river and stream systems. Channel instability can be the result of a stream adjusting to natural and human impacts to achieve a stable dimension, pattern, and profile that are in equilibrium with its gradient, sediment supply, and discharge (Cappellini 2001, pg. 23). For example, channel degradation or aggradation caused by channel scouring or excessive sediment deposition may be linked to a combination of road densities and location, channel bank hardening, and floodplain confinement in the watershed. It may also be linked to a natural flood event, natural landslide activity, or wildfire events. Naturally occurring channel changing events may also be exacerbated by human alterations in the watershed. The consistency of dimension, pattern, and profile that exists among rivers is more than chance occurrence. Mathematical relations exist illustrating a stratification of river systems by unique morphological forms that provide meaning to an otherwise random appearing, complex sets of interrelated variables (Rosgen 1996, pg. 1-3).

Width/depth ratio is the most sensitive and positive indicator of trends in channel instability due to channel aggradation of any morphological characteristic (Rosgen 1996). The width/depth ratio is defined as the ratio of the bankfull surface width to the mean depth of the bankfull channel (MacDonald et al. 1991; Rosgen 1996; Bain and Stevenson 1999) where: a low width-to-depth ratio (<10/a deep channel) is properly functioning; a moderate width-to-depth ratio (>10-12) is functioning at risk; and a high width-to-depth ratio (>12/ a shallow channel) is not properly functioning (Rosgen 1996). The bankfull stage is associated with the flow that just fills the channel to the top of its banks and at a point where the water begins to overflow into a floodplain (MacDonald et al. 1991; Rosgen 1996).

The magnitude and rate of change in channel width and width/depth ratio will depend on factors such as the slope of the stream the shape of the valley bottom, the bank and bed materials, and the recent flood history. Stream channel measurements must be combined with information on management activities, storm events, and sediment sources (i.e. roads, debris flows, landslides, or fires). Although this requirement may make it difficult to establish specific standards, it should not mask general trends.

Natural stream channel stability is achieved by allowing the river to develop a stable dimension, pattern, and profile such that, over time, channel features are maintained and the stream system neither aggrades nor degrades. For a stream to be stable it must be able to consistently transport its sediment load, both in size and type, associated with local deposition and scour (Rosgen 1996). Channel instability can occur when the amount of sediment entering the system exceeds the channel's transport capacity and deposition results in aggradation. As the width/depth ratio increases, i.e. the channel grows wider and more shallow, the hydraulic stress against the bank also increases and bank erosion is accelerated. Increases in the sediment supply to the channel develop from bank erosion, which by virtue of becoming an over widened channel, gradually loses its capability to transport sediment. Deposition occurs, further accelerating bank erosion, and the cycle continues (Rosgen 1996). A stream reach with eroding banks should be evaluated to determine to what extent the bank instability is within the natural range of variability or is a symptom of an increased trend toward channel degradation (incision) or aggradation (widening) resulting from human-induced changes to the watershed.

Entrenchment describes the relationship of the river to its valley and landform features in terms of the vertical containment of the river (Rosgen 1996). The entrenchment ratio is defined as the ratio of the flood-prone area width to the bankfull channel width where: a slightly entrenched channel (>2.2) is properly functioning; a moderately entrenched channel (1.4-2.2) is functioning at risk; and an entrenched channel (<1.4) is not properly functioning (Rosgen 1996). The flood-prone area width is measured at the elevation that corresponds to twice the maximum depth of the bankfull channel as taken from the established bankfull stage (Rosgen 1996). Entrenchment is qualitatively defined as the vertical containment of a river and the degree to which it is incised in the valley floor (Rosgen 1996).

Channel instability may occur when the scouring process leads to degradation, or lowering, of the channel bed (Rosgen 1996). Channel degradation may occur as a result of alterations within a watershed that increase stream discharge, increase stream gradient or decrease channel roughness features. Headcuts are evidence of a stream channel attempting to reestablish equilibrium in slope by lowering its bed (Leopold et al. 1992). A stream with eroding banks or headcut activity should be evaluated to determine to what extent the channel instability is within the range of natural variability or is a symptom of an increased trend toward channel degradation (incision) or aggradation (widening) resulting from human-induced changes in the watershed.

This attribute, Channel Instability, expresses a trend toward aggradation or degradation (incision) of a stream channel within the context of its natural geomorphology.

HABITAT ELEMENTS.

This category of Habitat Elements includes components of the stream channel that contribute to instream habitat complexity. These elements in turn translate to an increased potential for density dependent salmonid productivity.

Channel Substrate

Substrate refers to the mineral and organic material forming the bottom of a waterway or waterbody. The composition of the substrate determines the roughness of stream channels, and roughness has a large influence on channel hydraulics (water depth, width, and current velocity) of stream habitat. Substrate provides the micro-conditions needed by salmonids for both spawning and rearing (Bjornn and Reiser 1991). During incubation, sufficient water must circulate through the redd as deep as the egg pocket to supply the embryos with oxygen and carry away waste products (Bjornn and Reiser 1991). Streambed particles in the redd after eggs have been laid and covered, and particles that settle into the redd and surrounding substrate during incubation, affect the rate of water interchange between the stream and the redd, the amount of oxygen available to the embryos, the concentration of embryo wastes, and the movement of alevins (especially when they are ready to emerge from the redd). Conditions for embryos within redds may change little or greatly during incubation depending on weather, streamflows, spawning by other fish in the same area at a later time, and fine sediments and organic materials transported in the stream. Redds that remain intact during incubation may become less suitable for embryos if fine sediments are deposited in the interstitial spaces between the larger particles. The fine inorganic particles impede the movement of water and alevins in the redd and fine organic particles consume oxygen during decomposition; if the oxygen is consumed faster than the reduced intragravel water flow can replace it, the embryos or alevins will asphyxiate (Bjornn and Reiser 1991).

Once incubation is complete and the alevins are ready to emerge from the redd and begin life in the stream, they must move from the egg pocket up through interstitial spaces to the surface of the streambed. If fine sediments are being transported in a stream, some of the sediment is likely to be deposited in the redd. Emergence can be a problem if the interstitial spaces have been filled with sediment and do not permit passage of the alevins (Bjornn and Reiser 1991). The amount of fine sediment deposited and the depth to which it intrudes depend on the size of substrate in the redd, flow conditions in the stream, and the amount and size of sediment bring transported (Bjornn and Reiser 1991). Increased sediments also reduce pool depth from pool-filling, alter substrate composition, and result, through channel aggradation, in streambank instability.

This attribute, Channel Substrate, includes substrate condition as it relates to both rearing habitat and spawning and incubation habitat, including but not limited to, the degree of substrate embeddedness, substrate mobility, and percent fines.

Large Woody Debris (LWD).

Large woody debris (LWD) provides important physical and biological functions in the wide variety of habitats used by all salmonids; such as cover in which to hide from predators or retreat from high velocities. Smaller streams usually contain more wood than larger streams. Large woody debris creates lateral channel migration and complexity; Iit sorts gravels, stores sediment and gravel, contributes to channel stabilization and energy dissipation and maintains floodplain connectivity. The presence of LWD in the floodplain creates the diversity of habitat conditions that support multiple life stages of salmonids. Large accumulations of LWD in the lower floodplain can direct flow into meander loops and result in formation of riverine ponds and other off-channel habitat features, providing for the recruitment of new LWD from these side channel areas. The abundance of LWD is often associated with the abundance of salmonids and is thought to be the most important structural component of salmon habitat (Nelson 1998; Overton et al. 1995). Large woody debris east of the Cascades is generally described as wood material (>12 in diameter and >35 ft long; USFWS 1998) that mainly enters stream channels from stream bank undercutting, windthrow, and slope failures.

In smaller streams, LWD is a major component of channel form; it can influence channel meandering, bank stability, variability in channel width, and the forms and stability of gravel bars (Overton et al. 1995). In small streams, LWD traps sediment, causes local bed and bank scour, and creates pools. Small channels are highly dependent on in-channel woody debris structure for stability.

Size standards for LWD and number of pieces per area are highly variable between agencies, so are the threshold criteria established to differentiate between levels of habitat functionality as it relates to LWD. Some of this variation is the result of the variability among stream geomorphology, hydrology and the surrounding ecosystem. The anticipated location and size of

LWD accumulations within a stream channel and its floodplain are a function of the stream's hydrology, its physical characteristics (geomorphology) and the surrounding physical/vegetative environment. When considering channel conditions in fish-bearing streams, the potential contribution or recruitment of LWD from non-fish-bearing tributaries is an important factor.

This attribute, Large Woody Debris, addresses impacts resulting from: the removal or the lack of LWD; and the decrease or the loss in LWD recruitment and/or recruitment potential.

Absence of LWD:

- decreases channel complexity with fewer pools and less off-channel habitat;
- lowers salmonid productivity;
- decreases channel stabilization;
- decreases energy dissipation of flows;
- decreases salmonid cover.

Pool Frequency and Quality.

Pools are formed by the interaction of flow with solid and loose boundaries, such as large woody debris (LWD) boulders, bends, streambed and other flows (Nelson 1998). Pool formation primarily occurs during moderate to high flow events. The interaction of flow with these boundaries causes flow to converge and accelerate, increasing bed scour though increases in bed shear stress. Pools form around channel obstructions (i.e. boulders, bridge piers, culverts, LWD), at meander bends, and at tributary channel junctions (Nelson 1998). Sediment levels, LWD levels, and human-made channel obstructions can alter the pattern and frequency of pool development within the geologic and hydrologic confines of the channel. Pools function to provide adult holding habitat, juvenile overwinter rearing habitat and thermal refuge.

In a study of how sediment supply influences features like pools and habitat diversity in the presence of LWD, Nelson (1998) concluded that large woody debris had the most significant influence on pool frequency and amount of pool area present, with pool area is a function of LWD and channel slope. The location of LWD within the bankfull channel had a significant effect on the amount of pool area. Large woody debris in contact with the summer low flow stream channel was the most effective at forming pools. Large woody debris was also the primary pool-forming factor identified. No significant relationship was found between sediment supply and pool area although sediment supply did appear to have a weak positive relationship to pool frequency.

This attribute, Pool Frequency and Quality, addresses pools identified as the percent of wetted channel surface area comprising pool habitat, based on channel type.

Pool Depth.

In a study conducted in the Skagit and Stilliquamish watersheds (Nelson 1998), pool depth was determined to be predominantly a function of drainage area. Sediment supply by itself was not significantly related to pool depth, however, when sediment supply is combined with basin area these two variables explain significantly more of the variation in pool depth than either individually. Increases in sediment supply resulted in a slight decrease in pool depth and appear to take a subordinate role to basin area.

Pool depth is significant in that it affects the value of a pool for thermal refuge, adult holding, and juvenile overwintering habitat. Other variables, like shading provided by riparian vegetation and LWD structures associated with pools, can improve a pool's usefulness to fish. This attribute, Pool Depth, evaluates the presence or absence of pools greater than three feet deep (1 meter) in stream greater than nine feet (3 meters) in wetted width.

Off-Channel Habitat.

Off-channel habitat, or side channels, are formed as a by-product of channel migration and woody debris input and sediment accumulations (Beechie and Bolton 1999; Meehan 1991; Swanston 1991). Side channels are most predominant in stream types located in narrow to wide valleys and constructed from alluvial deposition (C type channel; Rosgen 1996). The "C" type channels also have a well developed floodplain (slightly entrenched), are relatively sinuous with a channel slope of 2% or less and a bedform morphology indicative of a riffle/pool configuration (Rosgen 1996). Off-channel habitat provides refuge for rearing juveniles from high flow events that can otherwise flush young fish downstream, potentially into less suitable habitat.

This attribute, Off-Channel Habitat, includes side channels, sloughs, and surface-connected wetlands that provide refuge from high velocity flows and predation for rearing juvenile bull trout.

WATER QUALITY.

Cool, clean, well-oxygenated water is required by salmonids. As stream temperatures rise, the stream's dissolved oxygen content is reduced. Instream temperatures for properly functioning condition for bull trout rearing is approximately 4 - 12°C, approximately 4 – 9°C for spawning, and approximately 2 - 5°C for incubation (USFWS 1998). Juvenile bull trout are rarely observed in streams with summer maximum temperatures exceeding 15°C (Fraley and Shepard 1989). Adult bull trout are more temperature tolerant but are seldom found in streams with summer temperatures exceeding 18°C (Shepard and Graham 1984). Water temperatures of approximately 23-25°C (73-77°F) are lethal to salmon and steelhead (Theurer et al. 1985) and genetic abnormalities or mortality of salmonid eggs occurs above 11°C (51.8°F).

Temperature increases and consequent reductions in available oxygen tend to have deleterious effects on fish and other organisms by: 1) inhibiting their growth and disrupting their metabolism; 2) amplifying the effects of toxic substance; 3) increasing susceptibility to diseases and pathogens; 4) encouraging an overgrowth of bacteria and algae which further consume available oxygen; and 5) creating thermal barrier to fish passage.

In addition to water temperatures, other water quality parameters such as turbidity, dissolved oxygen (DO) levels, the presence of fecal coliform, and pH levels can affect salmonid habitat quality. Major potential stream pollutants include nutrients such as nitrates and phosphates, heavy metals from mining waste, and compounds such as insecticides, herbicides, and industrial chemicals.

Water quality parameters addressed by this category include only stream temperature as it directly affects salmonid production. Currently, this water quality parameter is considered to be having a much greater negative influence on salmonid production in WRIA 62 than other water quality parameters (TAG 2002). Therefore, turbidity, dissolved oxygen levels, fecal coliform, pH levels, nutrients, heavy metals and agricultural/industrial chemicals are not addressed in this category although exceedences of state/federal water quality standards for some of these parameters have been documented in areas of WRIA 62. Access to habitat, riparian and channel conditions, habitat elements, change in flow regimes and competition by non-indigenous fish species are of much greater concern regarding salmonid production in these streams.

Temperature.
Water temperature strongly influences the composition of aquatic communities with salmonids thriving or surviving only within a limited temperature range. Physiological functions are commonly influenced by temperature, some behaviors are linked to temperature, and temperature is closely associated with many life cycle changes. Temperature indirectly influences oxygen solubility, nutrient availability, and the decomposition of organic matter, all of which affect the structure and function of biotic communities. As water warms, oxygen and nutrient availability decrease, whereas many physiological and material decomposition rates increase. These temperatures-moderated processes can influence the spatial and temporal distribution of fish species and aquatic organisms (Bain and Stevenson 1999).

Water temperature varies with time of day, season, and water depth. Although temperatures are particularly dependent on direct solar radiation, they are also influenced by water velocity, climate, elevation, location of stream in the watershed network, amount of streamside vegetation providing shade, water source, temperature and volume of groundwater input, the dimensions of the stream channel, and human impact. To effectively analyze the extent of impacts of high instream temperatures on salmonid behavior and survival, the duration of the high instream temperatures needs to be considered. For example, water temperatures may increase during the summer months during the daytime hours but may decrease in the evenings as the air temperature also drops. This diurnal effect on instream temperatures can act as a temporary barrier or stressor to salmonids. Conversely, instream temperatures that remain above preferred temperatures for salmonids for an extended period of time (days, weeks, or longer) may have more significant impacts to salmonid survivability and health than temperatures that remain elevated only on a diurnal basis. There are other factors that need to be considered when assessing the extent of short-term or more extended periods of high instream temperatures on salmonids, i.e. fish densities, habitat quality, habitat quantity, time of year. This attribute addresses high or low instream water temperatures that negatively affect salmonid migration or survival during any life history stage.

WATER QUANTITY.

Changes in flow conditions can have a variety of effects on salmonid habitat. Decreased flows can reduce the availability of summer rearing habitat and contribute to temperature and access problems, while increased peak flows can scour or fill spawning redds. Other alterations to seasonal hydrology can strand fish or limit the availability of habitat at various life stages. Extended periods of low flows can delay the movement of adults into streams, draining their limited energy reserves, affecting upstream distribution and spawning success. High winter flows can cause egg mortalities by scouring and/or sedimentation of the spawning beds. Low winter flows can contribute to anchor ice formation and result in the freezing of eggs or stranding of fry. The overwinter survival of juvenile fish can be negatively affected by the reduction in the quantity and quality of winter rearing habitat as a result of low flows.

Stream flow is moderated by riparian vegetation as well as vegetative cover in the uplands. The removal of upland and riparian vegetation through timber harvest, road development, and through the conversion of land for agriculture and residential/urban use alters surface water runoff patterns and ground water storage patterns. There is some debate concerning the extent to which upland vegetation affects stream flow regimes when analyzed at certain scales. Based on the relative area of upland to riparian habitat, there is discussion that in terms of precipitation interception, and evapotranspiration, uplands may play a bigger role than previously considered. Regarding riparian areas, riparian vegetation assists in regulating stream flow by intercepting rainfall, contributing to water infiltration, and using water via evapotranspiration. Plant roots increase soil permeability, and vegetation helps to trap water flowing on the surface, thereby aiding infiltration. Water stored in the subsurface sediments is later released to streams through subsurface flows. Through these processes, riparian and upland vegetation help to moderate storm-related flows and reduce the magnitude of peak flows and the frequency of flooding.

Stream flows may also be affected by the removal of instream flows for domestic, agricultural and municipal use, thereby reducing fish habitat quantity and quality. Loss of flow in a channel or a stream reach can also be the result of natural hydro-geologic conditions, or the result of human activities, or a combination of both factors. Often the cause or causes of dewatering, when there have been significant alterations in the drainage, is difficult to determine. The impacts of reduced flows vary depending on a combination of fish use in the affected reach and the extent and duration of reduced flows.

This category, Water Quantity, addresses changes in flow conditions brought about by changes in upland vegetative cover, road development, and water diversions.

Changes in upland vegetative cover may:

- influence snow accumulation and melt rates;
- influence evapotranspiration and soil water content;
- influence soil structure affecting infiltration and water transmission rates.

Road development may:

- increase magnitude and advance the timing of peak flow events by increasing impervious areas;
- extend channel networks by concentrating runoff.

Water diversions may:

- delay or prevent movement of spawning/migrating adults and rearing juveniles;
- reduce available rearing areas for juveniles;
- contribute to increased water temperatures and decreased dissolved oxygen;
- dewater or contribute to low flow conditions downstream of the point of diversion.

<u>Change in Flow Regime.</u>

The quantity of available water and the rate at which it reaches the stream channel and passes through the channel system are influenced by precipitation regimes, watershed size, vegetation cover, and certain topographic consideration (Swanston 1991). Altering the vegetative component of a watershed and diverting instream flows for out-of-stream uses can have a significant effect on the timing and magnitude of peak and low flows. Changes in flow conditions can have a variety of effects on salmonid habitat. Decreased low flows can reduce the availability of summer rearing habitat and contribute to temperature and access problems, while increased peak flows can scour or bury spawning nests. Changes in percent cover, species composition, and/or stand age class can change interception, evapotranspiration and soil water retention rates thereby changing flow regimes. Timber harvest activities, conversion of land to agricultural and urban/residential use, and fire are all actions that have the potential to disturb the vegetative community of a drainage to the extent that there is a noticeable affect on the stream flow regime. High road densities, soil compaction associated with agricultural activities, timber harvest, and grazing all contribute to increased surface water runoff and decrease soil permeability and water retention. The diversion of instream flows has the potential to alter the magnitude and duration of low flows, affecting stream channel conditions and decreasing total wetted area.

This attribute, Change in Flow Regime, addresses changes in peak or base flows and/or flow timing relative to what one would expect to see in an undisturbed watershed of similar size, geology and geography.

<u>SPECIES COMPETITION</u>

This category includes the presence of non-indigenous (exotic) fish that may have a negative affect on bull trout (i.e. eastern brook trout, German brown trout, and largemouth bass). Introduced fish species may out-compete, hybridize with, or prey upon native bull trout.

<u>Non-indigenous Fish Species</u>

Non-indigenous (exotic) species are those non-native species which colonize or invade habitats and may have deleterious effects on the native plants and wildlife. Managing and controlling exotic species is important for the maintenance of the integrity of ecosystems, including their function, composition and structure. The introduction of non-indigenous species can result in the alteration of plant and animal communities and their inter-relationships.

Brook trout, brown trout, and warm-water fish species like largemouth bass are non-native fish species introduced into the Lower Pend Oreille Subbasin and Washington State in general, to improve recreational fishing opportunities. The native salmonids of the Pend Oreille River system are bull trout, westslope cutthroat trout, and mountain whitefish. Although redband rainbow trout are native in some systems in Eastern Washington, we have not seen any documentation that they were native to the Pend Oreille (POPUD, 1/29/03 final draft report review comment, March 2003). Rainbow trout have been planted heavily in the Pend Oreille River and tributaries. Although their spawning time is different than bull trout, brook trout and brown trout, rainbow trout could prove to be formidable competitors to native salmonids in areas such as lower Sullivan Creek (POPUD, 1/29/03 final draft report review comment, March 2003). Bull trout and brook trout can hybridize extensively, leading to extirpation of bull trout populations (Mullan et al. 1992) since bull/brook trout hybrids are sterile (Leary et at. 1993). The physical act of hybridization also eliminates the potential for bull trout mating therefore wasting that year's reproductive effort (KNRD 1997, pg. 6). Bull trout and brook trout also compete for food and rearing and spawning habitat; brook trout are known to mature earlier than bull trout (2 - 4 years for brook trout and 6 -9 years for bull trout; H. Bartlett, WDFW, pers. comm., 2000) giving them a reproductive advantage. The threat posed by brown trout rests primarily in the specie's tendency to feed more heavily on fish species than most other trout (Wydoski and Whitney 1979, pg. 38). Largemouth bass also feed heavily on other fish species, including trout, and compete for food sources (Wydoski and Whitney 1979, pg. 125).

Under certain circumstances, human-made fish passage barriers isolate reaches of suitable salmonid habitat from colonization by non-native, introduced salmonid species persisting elsewhere in the watershed. Native salmonid populations like cutthroat or bull trout may persist upstream of an impassable fish barrier without experiencing the additional stresses imposed by hybridization, predation, and competition for available habitat and food resources from invasive, non-native fish species. However, there are negative impacts as well as benefits to salmonid populations artificially isolationed from accessing other portions of a watershed or subbasin. Salmonid fish populations can suffer from the lack of the exchange of genetic material with individuals from other populations and from the lack of opportunity to express an adfluvial or fluvial life history pattern. Populations without an opportunity to migrate to other portions of a drainage are more susceptible to negative impacts from cataclysmic event that may render their habitat unsuitable for some period of time.

This category, Non-indigenous Fish, addresses impacts to bull trout from the introduction of non-indigenous fish species.

Non-indigenous fish species may cause:

- extirpation of bull trout populations through hybridization, competition for food and habitat, and/or predation.

Habitat Limiting Factors by WAU

MAINSTEM PEND OREILLE RIVER

Mainstem Pend Oreille River Description

The portion of the Pend Oreille Subbasin upstream of Albeni Falls Dam extends through Idaho and well into Montana to the Cabinet Gorge Dam. Upstream of Lake Pend Oreille in Idaho (RM115.0), the river is named the Clark Fork River. The portion of the Pend Oreille River upstream of Albeni Falls is not included within the scope of this report. The portion of the mainstem Pend Oreille River included in this bull trout habitat limiting factors assessment extends from Boundary Dam (RM 17.0), located one mile upstream of the Canada/United States border, south to Albeni Falls Dam in Idaho (2.3 miles upstream of the Idaho/Washington border at RM 90.1). For the purposes of this report, the Pend Oreille River is divided into two distinct areas for presentation; 1) Boundary Reservoir and 2) Box Canyon Reservoir. This allows for the identification of habitat impacts that are comparable based on the effects of hydroelectric facility operations on habitat forming processes and fish passage.

- *Boundary Reservoir*: from Boundary Dam (RM 17.0) upstream to Box Canyon Dam (RM 34.4).
- *Box Canyon Reservoir*: from Box Canyon Dam to upstream to Albeni Falls Dam (RM 90.1).

The total length of the mainstem Pend Oreille River between Albeni Falls Dam and Boundary Dam is approximately 73 miles and flows entirely though Pend Oreille County within Washington State. Pend Oreille County is 64% public land, 35% private land, and 0.7% tribal land. Less than 1% is in Urban Growth Areas with most of the private land concentrated in the southern quarter of the county (K. Kuhn, Pend Oreille County Planning, 8/15/03 draft review comments, August 2002). The average annual precipitation ranges averages 25 inches, near Newportand up to 57 inches along the Pend Oreille County divide (WDOE 1995, pg. 3). The majority of precipitation falls in the winter and spring, with the highest totals occurring from November through January (WDOE 1995, pg. 3). Peak rainfall also occurs in May and June, particularly in the northern portions of the WRIA 62. Snowfall occurs typically from November to March (WDOE 1995, pg. 3). The largest recorded flood before the establishment of Albeni Falls Dam in 1955 occurred on June 13, 1948 (171,300 cfs at the Z Canyon gage near Metaline Falls; FEMA 2001, pg. 3).

The city of Newport, with approximately 2,000 residents and located at the Idaho/Washington border, is the largest urban area in the Pend Oreille River valley between Albeni Falls Dam and the Canada/ United States border (POCD 2001b, Part 1 sect. III). Other urban areas, with populations less than 1,000 are Usk, Cusick, Ione, Metaline and Metaline Falls. State Hwy. 20 parallels the Pend Oreille River from Newport north to Tiger. The highway continues north, paralleling the Pend Oreille River from Tiger to Metaline Falls (RM 26.5), as State Hwy. 31. A series of earthen dikes and railroad grades extend from Usk north to Jared to protect against overbank flows in the western floodplain of the Pend Oreille River.

Historical changes to the Pend Oreille River valley ecosystem range from intensive timber harvest impacts and catastrophic forest fires at the turn of the century, the boom-and-bust cycle of European settlement activities in the 1900's, to railroad and highway development impacts, flood control measures, exotic species introduction, and hydroelectric development (Table 6).

Table 6: Historic activities in the Pend Oreille River system within Washington State (source information mostly from, Bamonte and Bamonte 1996).

Date	Activity
1888	Sawmill in the Calispell Valley
1885	Duck Club Dam, Calispell Lake
1890's	Brown trout introduced to the Pend Oreille Watershed
1900-1913	Diking Districts formed
1900-1940	Logging boom ... 250 sawmills constructed in Pend Oreille County
1905-1935	County population soars to 30,000 people
1907-1939	30 major fires in the county during this timeframe
1910-1913	Railroad from Newport to Metaline Falls built for mining and logging
1910	The "Big Blow Up" occurs, a catastrophic fire of 3,000,000 acres over a three state area
1927	All old-growth gone due to logging or fires; decline in timber industry
1930's	Brook trout introduced
1935-1940	Great Depression. County population declines with slump in logging industry
1930-1960	Rainbow, brook and cutthroat fish stocking programs developed using a local hatchery
1950's	Construction of Albeni Falls Dam and Box Canyon Dam
1930-1980	Bounty on bull trout/dolly varden in Montana, Alaska, Idaho and B.C.
1960's	Construction of Boundary Dam
1980 's	County population has been reduced from 30,000 to approximately 8,500.
1997	Bass hatchery constructed on the Pend Oreille River (KNRD and WDFW 1997b)
2000 - 2001	Northern pike found in the Pend Oreille River (D. Comins, POCD, pers. comm., 2002)

Mainstem Pend Oreille River Hydrogeomorphology.

Currently, habitat conditions on the Pend Oreille River from Albeni Falls Dam downstream to its confluence with the Columbia River (Columbia RM 745.5) are dominated by the operation of hydroelectric facilities that have altered habitat-forming processes. Five hydroelectric facilities have been constructed on the Pend Oreille River from the mouth to Albeni Falls; Waneta Dam, Seven Mile Dam, Boundary Dam, Box Canyon Dam, and Albeni Falls Dam. None of these dams have fish passage facilities. Construction and operation of these hydroelectric facilities have eliminated connectivity thereby eliminating genetic interchange among fish populations in the Lower Pend Oreille Planning Area and decreasing the quantity of accessible bull trout spawning, rearing and overwintering habitat (KNRD 2001, pg. 84). The conversion of the Pend Oreille River to a reservoir system has also altered bull trout habitat quality in the mainstem Pend Oreille River by changing the flow, bedload, and LWD transport regimes in the mainstem Pend Oreille River, with its attendant effect on water temperature and habitat complexity. The introduction of non-native fish species aimed at increasing recreational fishing opportunities has further negatively impacted native bull trout populations in the Mainstem Pend Oreille River watershed.

In 1893 (prior to hydropower development), as part of an investigation of the Columbia River basin, the Pend Oreille River from Sandpoint downstream to the Big Eddy Canyon (also known as Z Canyon) was visited and its character documented by Gilbert and Evermann (1895).

Gilbert and Evermann (1895, pg. 181) described the Pend Oreille River valley in August of 1892 as follows:

> "The Pend d'Oreille (sic) River is one of the most beautiful and picturesque in America. It is a magnificent river, probably averaging over 1,000 feet in width and being very deep throughout most of its course. In most places, there is a strong current, becoming dangerous rapids in the narrower places. The water is clear and pure and cold – an ideal trout stream. The depth varies greatly, high water occurring in July from melting snows. Late in August or September the water is many feet lower than in July. High mountain slopes ascend abruptly from the river's banks throughout most of its course, and these are covered with heavy evergreen forest and a dense growth of underbrush. In other places, as at Usk, La Claires [sic], and Metaline, the river bottom widens out and there are many acres of excellent farming land. During high water large areas of this level land are covered by water, but when the waters subside these tracts become valuable meadow lands. Trout are abundant in this river; salmon trout are also quite abundant, and both bite readily. We know of no stream which offers finer opportunities for sport with the rod than the lower Pend d'Oreille [sic]. From the Big Cañon [sic] below Metaline we were compelled to walk back to Newport, a distance of about 75 miles. As there was no trail for the greater part of this distance, except a cattle trail, which was used by cattle only later in the summer and which was now under water, we found the trip a very difficult one, attended by many hardships. We reached Newport early in the morning of August 15, and we took the train for Colville, Washington (Gilbert and Evermann 1895, pg. 182)."

Gilbert and Evermann's historical account of the Pend Oreille River valley in August 1892 provides a description of the reach's hydrology and geomorphic character prior to hydropower development.

Abercrombie (1896) and Rathbun (1895) also visited the Pend Oreille Valley in the late 1800's. Both reports provide a description of the broad valley and the various falls. One should expect any characterizations of the Pend Oreille River to vary considerably depending on the time of year the observations were made. Lt. W.R. Abercrombie of the US Army surveyed the Pend

Oreille River for the War Department (Abercrombie 1896) in 1885. His tasks were to describe the condition, direction and navigability of the Pend Oreille River for military purposes. He describes the section of the Pend Oreille River downstream of Albeni Falls as follows:

> "From these falls to Sullivan creek, a distance of fifty-eight miles, the river is navigable for steamers drawing from four to five feet of water, at all seasons of the year. At high water in the spring and early in the summer steamers of a greater draught could proceed to Sullivan creek. The current does not exceed three miles per hour."
>
> "These facts I am not stating from any estimation, but from actual measurements, we sounded the river the whole distance and accurately measured the current. There are no rocks or other impediments that would obstruct cheap and easy navigation for steamers of the draught I have indicated."

Boundary Reservoir (RM 17.0 – 34.4).

Traveling downstream on August 9, 1892, Gilbert and Evermann (1895, pg. 181) described the portion of the Pend Oreille River which is now Boundary Reservoir:

> "[Metaline Falls is] just below the Metaline mining camp, or 7 miles below the foot of Box Cañon [sic]. The river between Box Canyon and Metaline Falls has a good strong current but no falls or rapids. The falls [Metaline Falls] are over a ledge of limestone, through which the river has cut, and are the largest and most important of any found in this river [the Pend Oreille River]. The total fall is perhaps as much as 30 feet, but it is in a series of rapids, there being no vertical drop at all. The stream is here inclosed [sic] between high rocky walls and is very turbulent for some distance. Salmon could probably ascend these falls without much difficulty. Just above Metaline Falls, Sullivan Creek flows into the Pend Oreille from the right bank [looking upstream]".
>
> "From Metaline, we walked down the river about 14 miles farther, on August 10, to the head of what is known as the Big Eddy Cañon [Z Canyon]. This cañon [sic] is about 3 miles long and is quite narrow, the limestone walls being so close together that in one place a fallen tree lies across from one wall to the other. The river rushes through this canyon with great fury, but there are no falls, and we do not believe that the ascent of salmon would be seriously interfered with. If it should be shown that salmon can not swim against such a strong current for so great a distance, we see no easy way by which it could be made less difficult. There are some relatively quiet nooks or eddies here and there, however, in which salmon would be able to rest and we therefore do not consider Big Eddy Cañon [Z Canyon] a serious obstacle to the ascent of fish. Lime Creek, a small but fine trout stream, flows into the river at the head of this canyon".
>
> "The river between Metaline Falls [RM 26.5] and Big Eddy Cañon [Z Canyon, RM 19.0] is quite swift, but contains no falls or rapids worth mentioning. The lower end of Big Eddy Cañon [Z Canyon] is but a short distance from the British Columbia line, just north of which the Pend d'Oreille [sic] turns abruptly westward and runs approximately parallel with the international boundary until it flows into the Columbia, a distance of

> about 27 miles from where it leaves the United States [this same distance is now known to be 17 miles]".

The 1892 survey expedition did not visit the lower 17 miles of the Pend Oreille River because another group had visited this portion of the river previously and a report was available, written by a Mr. Bean (Gilbert and Evermann 1895, pg. 181).

> "From Mr. Bean's report and from our conversations with prospectors and others living along the Pend Oreille, it appears that there is a series of rapids near the mouth of the river and another just above the mouth of [the] Salmon River [the Salmo River], which empties into the Pend Oreille just above the Washington line. These are all said to be rapids rather than falls and probably would not interfere with the ascent of salmon in the least. From the foregoing it therefore appears that there are no serious obstructions in the Clarke Fork [the Pend Oreille River] which would prevent salmon from reaching Lake Pend Oreille …" (Gilbert and Evermann 1895, pg. 181).

Rathbun (1895) also visited what is currently the Boundary Reservoir reach of the Pend Oreille River. Rathbun had this description of Metaline falls and fish passage at the falls:

> About seven or eight miles below the canyon [Box Canyon] and about 35 miles above the mouth of the Pend d'Oreille [sic] River are the Metaline Falls, the most serious of all the obstructions in the entire river. Their total descent is somewhere between 25 and 30 feet, more or less broken, and forming a rather serious set of rapids. On one side are perpendicular bluffs, 30 to 80 feet high, and on the other four large rock masses have fallen into the stream from the mountain which rises abruptly on that side. The possible effect of this obstruction upon the movements of salmon was not determined satisfactorily, although Dr. Gorham inclined to the opinion that it would be insurmountable in its present state".

With the construction of Boundary Dam in 1967, the character of the Pend Oreille River was further altered from its naturally-functioning condition. Boundary Dam operates primarily as a run-of-the-river project with a primary purpose of power production, supplying 50% of the city of Seattle's electricity (McLellan 2001, pg. 14). Boundary Dam does operate as a "peaking" reservoir at times. This means there is no significant change seasonally, to either peak or low flows by operation of the dam, however reservoir levels are higly altered on a 24-hour basis. Reservoir levels can change as much as 10 feet on a daily basis (A. Solonsky, Seattle City Light, pers. comm., 2002). The fast-flowing Pend Oreille River reach described in Gilbert and Evermann (1895), with its falls and rapids, sometimes flowing through narrow canyon walls, is now better characterized as a wider and slower moving river system (R2 Resource Consultants 1998, pg. 2-1). The draft R2 Resource Consultants report (1998) provides a more detailed description of the Boundary Reservoir based on geomorphic and bathymetric criteria.

The Boundary Reservoir reach of the Pend Oreille River is mostly steep sided with the exception of the upriver-most reach (RM 26.9/Sullivan Creek – 34.4/Box Canyon Dam). This reach is described as relatively wide and shallow, with silt, sand, and hard substrates (R2 Resource Consultants 1998, pg. 2-1). Of the five tributaries drainages in the Boundary Reservoir thought by local agency biologists to have habitat characteristics suitable for resident or adfluvial trout: 1) Flume Creek has a barrier falls directly at its mouth; 2) a barrier falls also exists about 0.6 miles up Sweet Creek; 3) a culvert is located about 0.5 miles up Sand Creek (RM 31.6); 4) a section of cascades and chutes at RM 0.6 and 0.65 on Sullivan Creek create a barrier to fish passage at some flows and Mill Pond Dam at RM 5.5 is a complete fish passage barrier; 5) multiple natural falls, cascades, and chutes on Slate Creek, located between RM 0.75 and the headwaters, were determined to be barriers in baseline assessment results presented in the 2000 Annual Report for the Resident Fish Stock Status project (McLellan 2001). In contrast, R2 Resource Consultants (1998) in a 1997 survey concluded that Slate Creek was barrier free, although several steep gradient portions of the creek could impede access by resident salmonids (R2 Resource Consultants 1998, pg. 2-12).

Box Canyon Reservoir (RM 34.4 – 90.1/Albeni Falls Dam).

In August 1892, a survey of the Pend Oreille River from the outlet of Lake Pend Oreille at Sandpoint, Idaho, downstream to the Idaho/Washington border (about 25 miles), disclosed only one fall or rapid, – Albeni Falls (Gilbert and Evermann 1895, pg. 180), which is now the site of Albeni Falls Dam. The falls was described as being about 1.5 miles upstream of the town of Newport and divided by a small, rocky island.

> "The falls were scarcely more than pretty steep rapids and would not interfere at all with the ascent of salmon. The part to the left of the islands (going downstream), at the time of our visit on August 9, 1892, had a total descent of probably 10 feet, but as a rapid, not in a vertical fall. During low water the descent would be somewhat greater. The fall on the right side [of the island] is of the same character and presents no greater difficulties. Just below Albeni Falls, the river is perhaps 1,000 feet wide and 20 to 30 feet deep in the channel. The stream was up, however, at this time, and would probably fall at least 10 feet before reaching low-water mark…" (Gilbert and Evermann 1895, pg. 181).

In July of 1885, Lt. Abercrombie (Abercrombie 1896) provided his description of Albeni Falls :

> "At Albeny [sic] Falls the river narrows and is no more than 400 yards in width. The river wall on the west side is high and nearly perpendicular. Upon the east side the bank is sloping and easily susceptible of placing in a lock or other necessary convenience. At high water the fall will average 15 feet. This fall is not a precipitous one, but rather continuous over a series of ledges of rock unitil the wall again strikes the quiet, smooth current below, a distance of about 50 feet."

During Rathbun's visit, he observed of Albani Falls that, "Trout pass freely up the falls, and they would therefore present no obstacle to salmon". Concerning Box Canyon, Rathbun stated,

> "At Box Canyon, the river is confined between two vertical walls from 30 to 150 feet high and not more than 70 feet apart in places. Being reduced to a narrow gorge, the stream becomes very deep and although comparatively smooth, is very swift and dangerous for boats, but offers no obstacles to the passage of fish."

Continuing downstream, Gilbert and Evermann (1895, pg. 182) had this description of Box Cañon [sic], which is now part of the Box Canyon Reservoir:

> "On August 9 we took [a] steamer and went down the river to Box Cañon [sic], a distance of about 60 miles, although the steamer people call it 80 miles. Throughout this distance the Pend d'Oreille [sic] is a beautiful, clear stream, with a good strong current, and varying in width from 500 to 1,000 feet. Box Cañon [sic] is a narrow gorge about 1.5 miles long. The walls are quite close together and the river rushes through the narrow passage with a very strong current. There is, however, no fall in the canyon and small boats have on several occasions been taken through without injury. There is nothing here to stop the ascent of salmon" (Gilbert and Evermann 1895, pg. 181).

Concerning Box Canyon, Rathbun (1895) stated,

> "At Box Canyon, the river is confined between two vertical walls from 30 to 150 feet high and not more than 70 feet apart in places. Being reduced to a narrow gorge, the stream becomes very deep and although comparatively smooth, is very swift and dangerous for boats, but offers no obstacles to the passage of fish."

With the construction of Albeni Falls Dam in 1952, some flood control began to be provided for downstream reaches of the Pend Oreille River, at least until Lake Pend Oreille reached its established high water level, (usually in early summer). During large flood events or when Lake Pend Oreille reaches its high water level, Albeni Falls Dam passes flows downstream (FEMA 2001, pg. 4). When Box Canyon Dam was subsequently constructed downstream in 1955, it provided little or no additional flood protection, being a run-of-the-river hydropower project. During normal operations, Box Canyon Dam operates to two feet of backwater at Albeni Falls Dam and a forebay elevation between 2028.8 and 2030.7 feet. However, at roughly 70,000 cfs, several slide gates are raised at Box Canyon Dam to prevent the water surface elevation from exceeding 2041 feet at Cusick. The opening of the slide gates causes a drawdown in the Box Canyon forebay and reduces the river to a natural water surface profile (FEMA 2001, pg. 4).

Mainstem Pend Oreille River Current Known Habitat Conditions.

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Pend Oreille River, Canada (62.0002). Waneta Dam, about 0.2 miles upstream of the confluence with the Columbia River, is a full barrier to fish passage. The dam lies north of the Canada/U.S. border in British Columbia, Canada and was constructed on the previous site of Waneta Falls. It is owned and operated by Teck Cominco. Waneta Falls was not originally a barrier to passage by salmon and steelhead trout as evidenced by the the strong salmon fisheries by Native American tribes in the Salmo River watershed located 13 miles upstream of the mouth of the Pend Oreille River (Baxter and Nellestijn 2000, pg. 1).

Pend Oreille River, Canada. Seven Mile Dam is about 9 miles upstream of the confluence with the Columbia River and is a full barrier to fish passage. The dam lies north of the Canada/U.S. border in British Columbia, Canada. It is owned and operated by B.C. Hydro.

Boundary Reservoir (62.0002). Boundary Dam at RM 17.0 is a full barrier to fish passage. The dam lies one mile south of the Canada/U.S. border in Washington State. Construction was completed in 1967. It is owned by the City of Seattle and operated by Seattle City Light. Construction of Boundary Dam inundated Metaline Falls and backwaters the Pend Oreille River upstream to Box Canyon Dam (RM 34.4).

Box Canyon Reservoir (62.0002). Box Canyon Dam at RM 34.4 is a full barrier to fish passage. The dam construction was completed in 1955 and is owned and operated by the Pend Oreille Public Utility District (PUD). It is located just north of the town of Ione and impounds water upstream to Albeni Falls Dam.

Albeni Falls Reservoir. Albeni Falls Dam at RM 90.1 is a full barrier to fish passage. The dam lies in Idaho 2.3 miles east of the Idaho/Washington State border. The dam was completed in 1952 and is owned and operated by the U.S. Army Corps of Engineers (USACOE). Albeni Falls Dam was the first hydroelectric development on the Pend Oreille River and controls outflow from Lake Pend Oreille.

Riparian Condition

Boundary Reservoir. The riparian habitat is in "Fair" condition as a result of fluctuating reservoir levels (±10 feet) as it affects riparian vegetation conditions (A. Solonsky, Seattle City Light, pers. comm., 2002). The riparian conditions have also been altered by development and historic timber harvest (J. Blum, A. Scott, Framatome ANP, pers. comm., 2002).

Box Canyon Reservoir. The riparian conditions have been altered by development and historic timber harvest (J. Blum, A. Scott, Framatome ANP, pers. comm., 2002).

Channel Conditions/Dynamics

Streambank Condition

Pend Oreille River WRIA-wide. Natural bank erosion along the mainstem has been modified and accelerated by a number of interacting factors, including the alteration of the natural flow and sediment transport of the Pend Oreille River by mainstem dams and diking (Entrix 2002, pg. 2-22).

Boundary Reservoir. Six percent of the shoreline along the Boundary Reservoir reach of the Pend Oreille River is actively eroding (Enserch 1994).

Box Canyon Reservoir. Based on analysis of the GIS erosion mapping database, almost 180 miles of the shoreline in the Box Canyon Reservoir reach was evaluated for erosion, including sloughs, islands, inlets, and the meandering shoreline. All shorelines were surveyed during August and September 1998. They were again reviewed in 1999. Eroding areas are defined as sections of shoreline experiencing rates of erosion substantially in excess of what would be expected to occur if the site in question were naturally vegetated and stable. Of the shoreline in the Box Canyon Reservoir reach, 64.7% was judged to be not eroding. Approximately 24.7 % was found to be eroding slowly, 9.3% was eroding at a moderately rapid rate, and 1.3% was eroding rapidly. The percentages include minor areas where erosion was occurring discontinuously, which are labeled *intermittent* (DE&S 2000, pg. 6, 7 & 20).

Floodplain Connectivity

Boundary Reservoir. The Boundary Reservoir reach (RM 17.0 – 34.4) has always been naturally a steep-sided segment of the Pend Oreille River. With the construction of Boundary Dam, the surface water elevation in the Boundary Reservoir reach is maintained at a higher level. The higher surface water elevation actually has increased linkages to wetlands and riparian areas adjacent to the Pend Oreille River (A. Solonsky, Seattle City Light, pers. comm., 2002).

Box Canyon Reservoir. Railroad embankments and a series of earthen dikes as described following, have reduced Pend Oreille River floodplain access. The lowland area from the town of Cusick (RM 69.9) downstream to Jared (RM 60.0) is approximately 15 miles long and 2-to-4 miles wide and is located along the west side of the Pend Oreille River (Northrop et al. 1996, pg. 1). Natural overbank flooding along the Pend Oreille River floodplains near Skookum Creek (RM 73.2), on the floodplains of the Kalispel Indian Reservation, and from Calispell Lake continuing downstream to the old town site of Jared (RM 60; including all of Calispell Flats) can be attributed to high river flows and backwater effects of the Pend Oreille River into its floodplain. Flooding along the Pend Oreille River is primarily due to late spring/early summer snowmelt events. Currently, the majority of the flow in the Pend Oreille River is the discharge from Albeni Falls Dam. Flows from tributaries to the Pend Oreille River within Washington State provide only a minor contribution due to the narrow drainage basin and moderate snowpack in the surrounding mountains between Albeni Falls and Box Canyon Dam (FEMA 2001, pg. 3). Following is a list of diking projects in the Pend Oreille floodplain between Jared and Cusick. Although the extent and location of dikes is available, a quantitative evaluation of the extent of lost floodplain has not been conducted to date. Much more detailed discussions of the genesis of the dikes and diking districts are provided in the draft report of the History of Diking Districts of Pend Oreille County (Northrup et al. 1996). As of March 2001, none of these flood control systems had been certified by FEMA and it was determined the 100-year flood would overtop the majority of the dikes and railroad embankments (FEMA 2001, pg. 4):

Box Canyon Reservoir. The privately-owned Woods dike is located near the mouth of Middle Creek (RM 57.6), along the east bank of the Pend Oreille River. In 1962, a pump was installed in the dike by the POPUD (Pend Oreille Public Utility District) to remove standing water on Woods property behind the dike which became a problem in 1961. The drainage area for the pump is 80 acres (Northrop et al. 1996, pg. 31).

Box Canyon Reservoir. The privately-owned Fountain (Norton) dike was built on the west side of the Pend Oreille River near the confluence of Gardiner Creek and the Pend Oreille River (RM 57.6) on the Fountain Ranch. It is located outside the Diking District No. 3 boundary. A pump in the dike is operated by the POPUD (Northrop et al. 1996, pg. 31).

Box Canyon Reservoir. In 1921 Diking District No. 3 was officially formed for the general purpose of flood control and drainage of farmland from the area just south of Cusick Creek (RM 61.6) and continuing south to a point just north of Tacoma Creek (RM 66.3). In the late 1920s or early 1930s a 22,105 foot-long dike was built along the Pend Oreille River to control floodwaters from the Pend Oreille River and also floodwaters entering the flooplain from what is called the Locke Creek watershed (2,250 acres). The Lock Creek watershed includes drainge from Brownie and Metcalf lakes entering the floodplain from the west. The combined water bodies have also been called Locke Lake (Northrop et al. 1996, pg. 23). Additionally, a dam on Locke Lake to create a flood storage facility and a pump station on Locke Creek near the confluence with Cusick Creek were constructed in 1972 (Northrop et al. 1996, pg. 23) have altered flows into the Pend Oreille River from the Cusick drainage, affecting floodplain function.

Box Canyon Reservoir. About 10 miles downstream (north) of Usk, (in the vicinity of Cusick Creek), the privately-owned Dillings dike was built along the east bank of the Pend Oreille River to prevent Pend Oreille River floodwaters from accessing its floodplain in this vicinity. It is believed to be one of the first built along the Pend Oreille River following construction of the railroad. Following construction of Box Canyon Dam, the POPUD installed a pump in the dike to maintain drainage for 292 acres behind the Dillings dike (Northrop et al. 1996, pg. 30).

Box Canyon Reservoir. Diking District No. 1 was formed in 1909 when the railroad was originally built, to protect the local farmlands from floodwaters of the Pend Oreille River and Trimble Creek (Northrup et al. 1996, pg. 5). The railroad embankment serves as a dike that holds back Pend Oreille River floodwaters from accessing its floodplain. A culvert in the railroad embankment was used to pass flow in Trimble Creek through the embankment to the Pend Oreille River. In 1962, the railroad replaced the deteriorating culvert and the POPUD constructed a pumping plant for Diking District No. 1at the mouth of Trimble Creek to reduce backwater flow to Trimble Creek. In 1988, Pend Oreille County assumed responsibility for the Trimble pump when Diking District No. 1 became inactive (Northrup et al. 1996, pg. 7).

Box Canyon Reservoir. In the vicinity of Calispell Creek (RM 69.6), the railroad embankment along the west side of the Pend Oreille River acts as a primary dike preventing Pend Oreille floodwaters from accessing its floodplain in the Calispell Flats area. Calispell Flats is a large floodplain extending from Calispell Lake to the south, and continuing north to Trimble Creek (RM 66.3; FEMA 2002, pg. 3). In 1909, Diking District No. 2 was officially formed. It is the largest of three diking districts on the Pend Oreille River (occupying approximately 15 square miles), providing flood control within the 148 square mile Calispell Creek drainage. The drainage includes the POPUD Power Lake facility, the Calispell Lake Duck Club facility, a series of interior dikes with the diking district, and pumping plants located at the mouth of Calispell Creek (POPUD 2000, Appendix E8-4, pg. 3; Northrop et al. 1996). The railroad embankment serves as the primary dike restricting Pend Oreille floodplain acess in the vicinity of Calispell Flats. Two interior dikes, the Murphy and the Pollin dikes, were constructed by the District around 1911, to protect agricultural lands from Calispell Creek floodwaters. Another interior dike, Kapps Cross dike on the north boundary of the district, was constructed sometime between 1911 and 1947. Doupe dike, another interior dike, was constructed by the District in 1950 (Northrop et al. 1996, pg. 12). As of 1961, there were 7.5 miles of interior dikes in the Calispell vicinity floodplain (Northrop et al. 1996, pg. 15). The Calispell Duck Club, which owns most of Calispell Lake and the Calispell Dam, has some control over Calispell Creek flows, maintaining lake levels for haying and hunting purposes. The pumping plant was constructed and put into operation in 1954 by the POPUD, to try to further reduce flooding problems in the valley and to allow operation of the Box Canyon hydroelectric project at elevations that would at times prevent natural discharge of Calispell Creek. In 1975, the POPUD constructed an additional pumping plant just upstream of the gated dike that separates the Pend Oreille River from the Calispell valley. It is located outside of the Diking District No. 2 boundary on Kalispel Tribe land. An easement was granted for the pumping plant that expires in 2005. The new plant provided additional pumping power to allow additional flood control (Northrop et al. 1996, pg. 17).

Channel Stability

Boundary Reservoir. Six percent of the shoreline along the Boundary Reservoir reach of the Pend Oreille River is actively eroding (Enserch 1994).

Box Canyon Reservoir. Based on analysis of the GIS erosion mapping database, almost 180 miles of the shoreline in the Box Canyon Reservoir reach was evaluated for erosion, including sloughs, islands, inlets, and the meandering shoreline. All shorelines were surveyed during August and September 1998. They were again reviewed in 1999. Eroding areas are defined as sections of shoreline experiencing rates of erosion substantially in excess of what would be expected to occur if the site in question were naturally vegetated and stable. Of the shoreline in the Box Canyon Reservoir reach, 64.7% was judged to be not eroding. Approximately 24.7 % was found to be eroding slowly, 9.3% was eroding at a moderately rapid rate, and 1.3% was eroding rapidly. The percentages include minor areas where erosion was occurring discontinuously, which are labeled *intermittent* (DE&S 2000, pg. 6, 7 & 20).

Habitat Elements

Channel Substrate

Boundary Reservoir. Channel substrate is assumed to be poor (> 17% fines) as a result of accumulations of mud and silt in the benthic substrates in the Boundary Reservoir reach. The lower half of the Boundary Reservoir reach has been significantly deepened following inundation, and channel velocities are relatively slow. It is assumed that fine material settles out and benthic substrate data would be similar with those data collected in Box Canyon Reservoir (A. Solonsky, Seattle City Light, pers. comm., 2002).

Boundary Reservoir. In large embayments and backwater channels like those found from Z Canyon to Slate Creek (RM 19.0 – 22.2), substrate generally has localized silt-bottom, shallow habitats with rooted, aquatic plant (macrophyte) beds. In the relatively wide and shallow reach from Metaline Falls upstream to Box Canyon Dam, substrate is generally silt, sand, and hard substrates (R2 Resource Consultants 1998, pg. 2-1).

Box Canyon Reservoir. The substrate in the reservoir is dominated by mud and silt and a few areas having sand, gravel or cobble (WDFW files cited in Ashe and Scholz 1992, pg. 5). Silt, clay and fine organic material composed 59% of the dominant substrate material evaluated at a flow of 25,000cfs (POPUD 2000, pg. E3-68, Table E3.1-26).

Large Woody Debris

Boundary Reservoir. From Slate Creek to Metaline Falls/Sullivan Creek (RM 22.2 – 26.9), rock outcroppings provide habitat complexity along with submerged woody debris (R2 Resource Consultants 1998).

Box Canyon Reservoir. Large woody debris (LWD) is present in limited amounts (POPUD 2000, pg. E3-20). From data collected during 1997 and 1998, at flows of 25,000 cfs, undercut bank, overhanging vegetation, boulders, logs and log jams, as well as root wads, were present at a rate of about 4% (POPUD 2000, pg. E3-64 and E3-68, Table E3.1-27).

Pool Frequency and Quality

Not applicable.

Pool Depth

Boundary Reservoir. Not applicable, however reservoir depths vary as follows: Boundary Dam to Z Canyon (RM 17.0- 19.0), water depths extend to 260 feet; Z Canyon to Slate Creek (RM 19.0 – 22.2), depths generally exceed 100 feet; Slate Creek to Metaline Falls/Sullivan Creek (RM 22.2 – 26.9), water depths typically are 80 – 100 feet; Metaline Falls/Sullivan Creek to Box Canyon Dam (26.9 – 34.4) typical water depths range from 10 – 25 feet (R2 Resource Consultants, pg. 2-3).

Box Canyon Reservoir. Not applicable, however the mean depth is 9 – 40 feet (Bennett and Liter 1991, pg. 5).

Off-Channel Habitat

Boundary Reservoir. Shallow-water habitat is rare along much of the reservoir with draw-downs dewatering large areas of the shoreline for several hours (McLellan 2001, pg. 99). However, Al Solonsky, Seattle City Light (pers. comm., 2002), has said that dam operations have generally increased off-channel habitat, particularly in the upstream half of the reservoir. Reservoir shoreline habitat currently varies as follows (McLellan 2001, pg. 99):

- from Boundary Dam to Z Canyon (RM 17.0- 19.0), the reservoir is steep-walled and deep, it is the widest part of the reservoir, and generally has low water velocities;

- from Z Canyon to Slate Creek (RM 19.0 – 22.2), the reservoir is predominantly canyon-like with steep rock walls, has several slow water habitats associated with bends in the river and island back-channels, and there are several large embayments and backwater channels to provide shallow water habitat;

- Slate Creek to Metaline Falls/Sullivan Creek (RM 22.2 – 26.9), reservoir is narrow with deep waters, the shoreline includes canyons with bedrock walls and some large trees, and rock outcroppings provide habitat complexity along with submerged woody debris;

- Metaline Falls/Sullivan Creek to Box Canyon Dam (26.9 – 34.4), the reservoir is relatively wide and shallow with silt, sand and hard substrates. Habitat diversity is provided primarily by islands, back channels and nearshore vegetation (R2 Resource Consultants, pg. 2-3).

Box Canyon Reservoir. Pre-dam construction, the USGS surveyed the area from 1912-1914 and provided a river bed profile (POPUD, 1/29/03 final draft review comment, March 2003). Further information on the USGS survey was not made available in time for releasing this final WRIA 62 Bull Trout Habitat Limiting Factors report. Post-construction of Box Canyon Dam, three distinctly different types of aquatic habitat exist in the reservoir: from Box Canyon Dam (RM 34.4) upstream to RM 55, the channel is a deeper reach with a steeply sloping bottom gradient; from RM 55 upstream to RM 80, the reach flows more slowly and is shallow and wide; the upstream-most reach of the reservoir (RM 80 to Albeni Falls Dam at RM 90.1) is more riverine in character (Bennett and Liter 1991, pg. 5). Seven sloughs were identified and sampled for water quality characteristics in 1989. The sloughs represent 228.5 acres of shallow water habitat (Falter et al. 1991, pg. 5). Ashe and Scholz (1992, pg. 118-136) identified seven sloughs for study between June 1990 and May 1991.

In an effort to quantify the loss of off-channel habitat as a result of Box Canyon Dam construction and operation, USFS, WDFW, and USFWS staff are conducting an analysis using pre-dam (1943) and post-dam (2000) aerial photographs. The 1943 and 2000 photographs were taken at similar flows of approximately 12,000 cfs. The analysis involves detailed mapping of side-channel, run/riffle, and tributary confluence habitat using the 1943 photos, and then comparing the mapped habitat to existing habitat using the 2000 photos. Mapping on approximately two-thirds of the affected reach has been completed to date (January 2003).

Based on the completed work, 162 acres of side- or off-channel habitat have been lost since construction of the Box Canyon Dam (T. Shuhda, USFS, pers. comm., 2003; USFS 2002g).

Water Quality

Temperature

Pend Oreille River WRIA-wide. The Pend Oreille River is listed on the 1998 303(d) list for multiple exceedences of state water temperature criteria.

Boundary Reservoir. Thermal stratification of the water column in the Pend Oreille River was not apparent based on water temperature monitored conducted from August 20 through October 27, 1996 at four sites in the Boundary Reservoir: 1) directly in front of Boundary Dam; 2) 4.5 miles above the dam near the mouth of Slate Creek (RM 22.2); 3) 8.5 miles above the dam near the mouth of Sullivan Creek; and 4) 12 miles above the dam near the mouth of Sweet Creek (R2 Resource Consultants 1998, pg. 2-6). Thermal stratification was also not apparent based on temperature measurements taken on September 15-16 and November 10-11, 1997 at the same sites as monitored in 1996 plus at an additional 11 reservoir locations on September 15-16 and an additional seven reservoir locations on November 10-11, 1997. These locations were chosen to characterize deeper sections of the reservoir (R2 Resource Consultants 1998, pg. 3-6). Water temperatures measured on August 22 and October 24, 2000 in the Boundary Reservoir were similar during the summer and fall at the forebay and at the Metaline Falls Bridge in both summer and fall regardless of depth as recorded by McLellan in 2000 (2001, pg. 33). McLellan (2001, pg. 98) concluded that Boundary Reservoir was isothermal in 2000 with a maximum temperature of 22ºC (71.6ºF), which appeared to be typical of the reservoir during the sampling period. This is the same conclusion reached by R2 Resource Consultants in 1998 (McLellan 2001, pg. 98). R2 Resource Consultants concluded that the high flushing rate of the reservoir and water turbulence created by several major channel constrictions likely inhibits or prevents vertical stratification of temperature and Dissolved Oxygen (DO) in the reservoir (R2 Resource Consultants 1998, pg. 2-6).

Boundary Reservoir. Water temperature sampling was conducted in Boundary Reservoir during August and September of 1996 and 1997 near the mouths of Sullivan, Flume, Slate, and Pewee creeks, which were those confluence areas thought to provide well-defined but relatively small zones of cool water refugia for salmonids in the reservoir. Water temperatures in these areas were systematically surveyed to determine the influence of cool water flowing into the reservoir. Cool water zones in the reservoir at the mouth of these creeks were well defined but relatively small (R2 Resource Consultants 1998, pg. 2-6).

Box Canyon Reservoir. Data for maximum water temperatures and seasonal water temperature regimes in the Box Canyon Reservoir are well documented (Bennett and Garrett 1994) and all the studies show the reservoir to be homothermous throughout with no horizontal or vertical stratification. River temperatures were above 50ºF (10ºC) for May through October (POPUD 2000, pg. E2-20). In 1990, main channel temperatures were at or near 70°F (21.1°C) for about 2 months in the summer, with a maximum mean weekly water temperature of 72.7°F (22.6°C; Bennett and Liter 1991). In August 1997, minimum daily water temperatures recorded were

68ºF (20ºC) with an average of 72ºF (22.1ºC). In 1998, the minimum daily temperature at the forebay was 71ºF (21.6ºC) and the average was 73ºF (23ºC). Bennett and Garrett (1994, pg. 36) stated that, "relatively warm temperatures in Box Canyon Reservoir result from surface flow from Lake Pend Oreille and have changed little by the construction of Box Canyon and Albeni Falls dams. There is very limited water temperature data available to determine annual maximum water temperatures (mid-July through mid-September) in the Pend Oreille River region for the period prior to the construction of Box Canyon dam. Pre-project water temperature data is limited to USGS stream gaging records for stream gage No. 12396500 which was located just downstream of the present Box Canyon dam. There are just three recordings, all in August 1952 on the 13th, 18th and 19th. The water temperatures were 21.7°C (71ºF), 20°C (68ºF) and 20°C (68ºF), respectively (POPUD 2000, pg. E2-20).

Box Canyon Reservoir. The sloughs of the Pend Oreille River show several different temperature patterns. Most of the sloughs are warmer than the main river in spring with the exception of Trimble Slough (7.8°C/46°F in April 1990). By June, all of the sloughs had a surface temperature about 6.0°C higher than the temperature in the river with the exception of Trimble Slough. By August, the case was reversed with the main river being slightly warmer than the sloughs. This condition continues into the early fall after which time the whole system becomes nearly homothermous as shown by the November 1989 sample (river and slough water temperatures all approximately 8.0°C/46°F; Falter et al. 1991, pg. 16). Falter et al. (1991, pg. 15) also observed the absence of thermal stratification during work conducted in 1989-90. Falter contributed this to the reservoir's short retention time and overall shallow depth that allows for mixing by wind and wave activity.

Box Canyon Reservoir. On August 16-17, 2001, surface water temperature data for the Box Canyon Reservoir reach of the Pend Oreille River was collected using a thermal infrared remote sensor and a visible band color video camera mounted on a helicopter (Watershed Sciences 2002). Thermal infrared remote sensors are only capable of measuring water temperatures at the surface. Stream temperatures on the Pend Oreille River from Box Canyon Dam upstream to Dover, Idaho at the outlet to Lake Pend Oreille varied between 22.1°C (71.8ºF)and 25.1°C (77.2ºF). Thermal stratification of the water column in the Pend Oreille River was intermittent, however the difference between the surface layer and the bulk underlying temperatures may be relatively small (0.5 - 2°C/ 32.9ºF – 35.6ºF) in magnitude. Data from in-stream temperature sensors located near the bottom of the water column reinforce this statement (Watershed Sciences 2002).

Of 19 tributaries detected between Box Canyon Dam and Albeni Falls Dam, only seven contributed water that was colder than the Pend Oreille River. In addition, a total of seven side-channel and off-channel features were sampled, all of which were warmer than the Pend Oreille River at the time of the survey (Watershed Sciences 2002, pg. 12 and 13).

There was a sharp drop in water temperature of 1.4°C at Albeni Falls Dam (RM 90.1) representing the difference between the thermally stratified condition upstream of the dam and a mixed condition downstream of the dam. Indian Creek at RM 81.2 enters considerably cooler (seven degrees cooler at 16.3°C/34.5ºF) than the Pend Oreille River, but flows from Indian Creek are very small in mid-August and therefore do not have a detectable influence on the bulk of water temperatures in the Pend Oreille River. Intermittent variability in surface water temperatures was noted from Indian Creek downstream to RM 72.7 (approximately the Town of Usk). Skookum Creek was the only tributary sampled for water temperature in this eight mile reach that was a source of thermal cooling. Skookum Creek, at 21.2°C (70.2ºF), came into the Pend Oreille River 2.5°C cooler than the mainstem (Watershed Sciences 2002, pg. 12).

Between river miles 67.5 (downstream of Calispell Creek but upstream of Trimble Creek) and RM 60.0 (downstream of Cusick Creek and upstream of Mill Creek) of the Pend Oreille River, there were four warm water tributaries and three side channels detected. In addition, a thermal stratification (at some level) was noted in several thermal sensory images in this reach (Watershed Sciences 2002, pg. 12).

A cooling trend was noted between RM 60.0 and RM 51.3 with four tributaries contributing to this trend (Mill Creek: 17.5°C/63.5°F, Middle Creek: 19.9°C/67.8°F, LeClerc Creek: 15.2°C/59.3°F, and Ruby Creek: 17.9°C/64.2°F). Maitlen Creek at RM 40.2 was the only other tributary sampled between Ruby Creek and Box Canyon Dam that registered cooler than the Pend Oreille River, but only by 0.40°C (Watershed Sciences 2002, pg. 12).

Box Canyon Reservoir. Using water and air temperature data collected during the the summer and fall of 1997 and 1998, hourly meterological data from the Spokane airport climate station, and hydrology data from USGS stream gage stations and POPUD operational hourly records at Box Canyon Dam, the CE-QUAL-W2 temperature and water quality model was used to create a Box Canyon Reservoir temperature model (POPUD 2002). Inflow accretion between Albeni Falls Dam and Box Canyon Dam is minimal during the summer/fall model period. Therefore, tributary and groundwater inflow is not of sufficient quantity to significantly affect the modeled water temperatures (POPUD 2000c). The closest available meteorological data was hourly data for the 1997-1998 period from the Spokane airport climate station. Precipitation data was reviewed but not used in the Box Canyon Reservoir temperature model. The calibrated model was applied to simulate the "without project" condition to evaluate the effect of the hydroelectric project on the temperature distributions in the reservoir (POPUD 2002).

"With project" and "without project" model result comparisons indicated that temperatures in the Box Canyon Reservoir are overall slightly cooler for the "with project" condition than the temperatures for the "without project" condition, even though daily variations of warming and cooling are observed. The only period of note when the "without project" water temperatures were significantly cooler than the "with project" temperatures was August 5-7, 1998. Modeled water temperatures at Ione were, on average, 1ºC warmer for the "with project" scenario.

During the period August 5-7, 1998, the total river flow at Box Canyon rapidly decreased from approximately 27,700 cfs to about 22,900 cfs. The modeled water surface elevation at Ione without the project dropped about 3.8 ft as opposed to 0.8 ft with the project. Air temperatures were seasonably warm but cooling through this period. It is hypothesized that the smaller water mass without the project was able to respond faster to the short-term cooling climate conditions. The trend in water temperatures however, reversed itself and the "without project" water temperatures were again slightly warmer than "with project" condition by August 8, 1998. At other times, when cooling air temperatures and dropping flow did not coincide, the "with project" temperatures were cooler; i.e. the trend reversal is dependent upon both contributing factors coinciding with the descending limb of the peak in the heating season (POPUD 2002).

Model results also show that temperature daily variations in the "without project" condition are generally larger than that in the "with project" condition because the water depth is shallower in the "without project" condition (POPUD 2002). Temperatures in the Box Canyon Reservoir reach of the river exceeded the water quality criteria of 20.0°C from mid-July through early September 1997 and 1998 based on collected temperature data in 1997 and 1998. For the "without project" scenario, temperatures in the Box Canyon Reservoir reach of the river were also shown to exceed the water quality criteria of 20.0°C from mid-July through early September. Model simulations showed that the primary factors controlling temperatures in Box Canyon Reservoir are the upstream boundary condition (inflow temperature from Albeni Falls) and meteorological forcing (POPUD 2002).

Water Quantity

Change in Flow Regime

Boundary Reservoir. The Pend Oreille River in the Boundary Reservoir reach is influenced by a run-of-the-river hydroelectric project, although it can operate as a "load following" reservoir at times to meet hydroelectric generation demands. The reservoir has little active storage (about 43,000 acre-feet) and is influenced by the flow released at Albeni Falls Dam in Idaho and other storage projects upstream (A. Solonsky, Seattle City Light, pers. comm., 2002). The mean annual discharge in water year 2000 was 22,273 cfs compared to the 25-year average of 25,192 (USGS data as cited in McLellan 2001, Resident Fish Stock Status 2000 Annual rept., pg. 33). The Boundary Reservoir elevation can fluctuate by as much as 10 feet on a daily basis, except during periods of high spring snowmelt (A. Solonsky, Seattle City Light, pers. comm., 2002). The mean average daily elevation change in water year 2000 was 2.4 meters (7.92 feet; USGS data as cited in McLellan 2001, pg. 33).

Box Canyon Reservoir. The Pend Oreille River in the Box Canyon Reservoir reach has been converted to a strictly run-of-the-river hydroelectric project reservoir. This means there is no significant change seasonally or daily, to either peak or low flows by operation of the dam (P. Buckley, POPUD, pers. comm., 2002). During normal operations, Box Canyon Dam operates with up to two feet of backwater at Albeni Falls Dam and a forebay elevation between 2028.8 and 2030.7 feet. However, at roughly 70,000 cfs, several slide gates are raised at Box Canyon Dam to prevent the water surface elevation from exceeding 2041 feet at Cusick. The opening of the slide gates causes a drawdown in the Box Canyon forebay and reduces the river to a natural water surface profile (FEMA 2001, pg. 4). Tom Shuhda of the USFS (pers. comm., 2003) agrees there is no change in the timing of peak or base flows created by the operation of Box Canyon Dam. However, regarding flow timing relative to an undisturbed watershed, there is an increase in the time it takes for a volume of water that flows into the Box Canyon Reservoir to move through the reservoir (T. Shuhda, USFS, pers. comm., 2003).

Box Canyon Reservoir. Construction of the railroad embankment and dikes within the floodplain of the Pend Oreille River between the old town site of Jared and Skookum Creek has altered the flow regime of the lower mainstem and its tributaries. Pumps installed in places in the dikes alter the flow of tributary floodwaters into the Pend Oreille River (Northrop et al. 1996).

Pend Oreille River WRIA-wide. In all of WRIA 62, there are 592 surface water permits and certificates allowing diversion or instream use of 82,042cfs. Almost all of this use is for power generation and from the Pend Oreille River (81,141.607 cfs; DOE Water Rights Application Tracking System/WRATS database information cited in Entrix 2002, pg. 2-121). There are outstanding surface water claims, groundwater certificates and permits, and exempt wells that have the potential to affect flows in the mainstem and in tributaries to the mainstem (Entrix 2002, pg. 2-127). The extent to which this out-of-stream and instream water use may limit sustaining bull trout populations in WRIA 62 is not known.

Species Competition

Non-indigenous Fish

Boundary Reservoir. Eastern brook trout, lake trout, brown trout, smallmouth bass and largemouth bass, lake trout, rainbow trout, black crappie, brown bullhead, pumpkinseed, tench, yellow perch are known to occur in the reservoir (McLellan 2001; R2 Resource Consultants 1998).

Box Canyon Reservoir. Eastern brook trout, brown trout, largemouth bass, black crappie, brown bullhead, pumpkinseed, tench, yellow perch, lake trout, rainbow trout, and kokanee are known to occur in the reservoir (Ashe and Sholz 1992; Bennett and Liter 1991; Barber et al 1990), as are northern pike (*Esox lucius*; D. Comins, POCD, pers. comm., 2002).

Mainstem Pend Oreille River Watershed Fish Distribution and Use.

Presently no known reproduction of bull trout is occurring within Boundary Reservoir or its tributaries (USFS 1999bc, pg. 3). A total of 6 adult bull trout have been documented in Boundary Reservoir since 1974 (Table 5). The size of the adults and location where captured indicate these fish are not resident but most likely adfluvial in life history (USFS 1999bc, pg. 3). Documented bull trout observations in Box Canyon Reservoir have also been rare. Only 16 adult bull trout have been documented in Box Canyon Reservoir since 1974 (Table 5).

Presently, Boundary and Box Canyon dams (RM 17.0 and 34.5, respectively), both without fish passage facilities, would serve to isolate bull trout populations, should they occur, within the Boundary Reservoir reach of the Pend Oreille River. Table 7 below describes current, known bull trout use in the Pend Oreille River in WRIA 62. Maps in Appendix C illustrate the extent of historic and currently occupied bull trout habitat in the WRIA 62 portion of the Pend Oreille River. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Bull trout have been documented as occurring historically and currently in the Pend Oreille River. Gilbert and Evermann (1895, pg. 181) provides documented accounts of bull trout in the Pend Oreille River from Z Canyon at RM 19.0 (called Big Eddy Canyon by Gilbert and Evermann) upstream to Lake Pend Oreille in Idaho (Pend Oreille RM 115.0) and continuing upstream into the tributaries to Lake Pend Oreille (Gilbert and Evermann 1895, pg. 181). Downstream of Lake Pend Oreille is the Priest River confluence (Pend Oreille RM 96.6). There are no fish passage barriers, natural or man-made, to prevent fish passage from the Pend Oreille River up into the lower 45 miles of the Priest River. Outlet Dam at the Priest Lake outlet currently does not allow for fish passage. There are several sizable tribuatary drainages that drain out of Washington State and feed into the lower 45 miles of the Priest River. The Pend Oreille River is critical for allowing movement of bull trout between one population and another as they seek access to lakes and colder streams in the Pend Oreille subbasin where they rear, mature, and spawn. All fish passage to and from Lake Pend Oreille, upstream of Albeni Falls Dam, is currently precluded by Albeni Falls Dam. Historically, Gilbert and Evermann (1895,) concluded that Albeni Falls did not likely create a passage barrier to upstream migrating salmon. Gilbert and Evermann (1895) made no reference as to the historic passability of Albeni Falls to bull trout specifically, although they described bull trout as being abundant in the Pend Oreille River downstream of Albeni Falls. Rathbun (1895) however, did remark that, "Trout pass freely up the falls [Albeni Falls] and they would therefore present no obstacle to salmon."

Table 7: Current, known bull trout use in the Pend Oreille River, RM 17.0 - 90.1

Mainstem Pend Oreille River	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Boundary Reservoir (RM 17.0 – 34.4)				X	X
Box Canyon Reservoir (RM 34.4 – 90.1)				X	X

Mainstem Pend Oreille River Summary.

The importance of the mainstem Pend Oreille River to sustaining bull trout populations in the Lower Pend Oreille Subbasin lies in providing fish passage at human-made barriers, reducing non-native fish species competition to some as yet unknown level, and recovering habitat conditions degraded by human activities to levels that will naturally support the maintenance of healthy bull trout populations.

Reestablishing the historic connection with Lake Pend Oreille is essential for recovery of the Pend Oreille core area population in Washington (USFWS 2002). Given what is known regarding bull trout life history forms, dams without fish passage facilities on the Pend Oreille River isolate bull trout subpopulations, eliminate individuals from subpopulations, and reduce or eliminate genetic exchange. All of these characteristics are important to ensuring the long-term persistence of self-sustaining fish populations (KNRD 2001, pg. 84). Dams on the Pend Oreille River downstream of Lake Pend Oreille have negatively impacted the connectivity for fluvial and adfluvial bull trout migratory life forms by isolating bull trout subpopulations, eliminating individuals from subpopulations, and reducing or eliminating genetic exchange (KNRD 2001, pg. 84; R2 Resource Consultants 1998, pg. 5-2).

Currently bull trout passage and habitat conditions on the mainstem of the Pend Oreille River are dominated by five hydroelectric facilities between the Columbia River confluence and Lake Pend Oreille (Waneta Dam/RM 0.2, Seven Mile Dam/RM 7.0, Boundary Dam/RM 17.0, Box Canyon Dam/RM 34.4 and Albeni Falls Dam/90.1). None of the dams provide for fish passage. In the portion of WRIA 62 within Washington State, with the exception of the South Fork Salmo River and that portion of WRIA 62 that drains eastward into the Priest River system, individual bull trout observations have been rare and widely distributed with only 33 bull trout being captured or observed over the last 28 years (Table 5). Preliminary adfluvial trapping data suggest that adfluvial populations of bull trout are non-existent in the Lower Pend Oreille River system, although the adfluvial trapping study did provide insight into how brown trout adfluvial fish populations behaved in the Lower Pend Oreille system (Andersen 2001, pg. 3; DE&S 2001a). Viable bull trout populations do exist in the portions of WRIA 62 which drain into the Priest River system in Idaho. Average densities of bull trout for the entire west side Priest Lake drainage in all habitat types sampled from 1982-1984 were 3.4 fish/100m^2 (Irving 1987, Figure 8).

Second to fragmentation of habitat caused by the lack of passage at hydroelectric dams on the mainstem Pend Oreille River, warm reservoir temperatures (or that lack of cool-water habitat) may limit the distribution, and possibly the abundance of bull trout in the Pend Oreille River system. In the Boundary Reservoir, the hypothesis that bull trout distribution and possibly abundance is limited is supported by the results of intensive fish sampling conducted over a two-year period (1996 and 1997) during which time only one bull trout was located (R2 Resource Consultants 1998, pg. 5-1). In the spring, summer and fall of 2000 another survey of the Boundary Reservoir using extensive electrofishing and gill net surveys did not detect any bull trout, again indicating low densities (McLellan 2001, pg. 22).

The extent to which the warm water temperatures in the reservoirs are a function of the conversion of the Pend Oreille River into a reservoir system, and the extent to which the temperatures are a function of natural conditions, is not clear. In an effort to better understand what the summer and fall natural instream temperatures regime on the Pend Oreille River between Albeni Falls Dam and Box Canyon Dam might have looked like prior to construction of the Box Canyon Dam, the POPUD had modeled temperatures in the Pend Oreille River (POPUD 2002). According to the POPUD temperature model, “with project” and “without project” model result comparisons indicated that temperatures in the Box Canyon Reservoir are overall slightly cooler for the “with project” condition than the temperatures for the “without project” condition, even though daily variations of warming and cooling are observed (POPUD 2002). A peer review of the results of the POPUD temperature modeling exercise (POPUD 2002) was not available at the time of the publication of this WRIA 62 Bull Trout Habitat Limiting Factors report.

According to pre-impoundment water temperature records for the Box Canyon Reservoir reach, prior to impoundment of the Pend Oreille River, water temperatures in the lower Pend Oreille River would have been seasonably (mid-summer) unsuitable for bull trout. Since historic records document an abundant bull trout population in the Lower Pend Oreille River (fish as large as 26 inches long and weighing 5 pounds or more were documented to be in the possession of individual Kalispel Tribal members; Gilbert and Evermann 1895), it is believed the historic bull trout populations included an adfluvial life history form (USFWS 2001, pg. 29). Prior to the construction of dams on the Pend Oreille River without fish passage facilities, adult bull trout could have returned to Lake Pend Oreille where they could have avoided unsuitable temperatures. Juvenile bull trout could move up into cooler tributary headwaters to rear, or if larger, could have emigrated to Lake Pend Oreille to mature and avoid warm water temperatures (USFWS 2001, pg. 29). The extent to which cold-water refugia rearing habitat currently exists in the Pend Oreille River system downstream of Albeni Falls dam, and is accessible to juvenile bull trout, is unknown. Based on thermograph temperature data compiled to date, and on preliminary thermal infrared remote sensing data analysis, cold water refugia for juvenile rearing may be limited in the Pend Oreille River and tributaries from Box Canyon Dam upstream to Albeni Falls to an unknown extent (Watershed Sciences 2002). The extent to which limited, available, cold-water rearing habitat in the Pend Oreille River system between Albeni Falls Dam and Boundary Dam is a result of natural conditions or exacerbated by human-induced alterations to the environment, is unknown.

Competition and hybridization with eastern brook trout, as well as competition with other non-native fish species like brown trout, rainbow trout, largemouth bass, and smallmouth bass, is another factor potentially limiting populations of bull trout in the Pend Oreille River system (R2 Resource Consultants 1998, pg. 5-2). The food base of the reservoir is another factor that may limit fish populations. Additionally, habitat alterations in the mainstem related to hydroelectric system operations (bedload transport, LWD transport, off-channel habitat), diking projects, tributary dams, and land use practices in the tributary drainages, contribute to the difficulty of sustaining bull trout populations in WRIA 62. These possibilities and other possible limiting factors warrant further investigation.

Boundary Reservoir

The low numbers of bull trout in Boundary Reservoir and its tributaries are likely attributed to a number of factors, fish passage being one of those factors. Fluvial and adfluvial bull trout frequently migrate long distances (i.e. 10 to 100 km) to spawning areas from mainstem rivers, lakes and reservoirs. The presence of two hydroelectric dams on the Pend Oreille River downstream of the Boundary Dam (Waneta and Seven Mile dams) and two hydroelectric dams upstream of Boundary Dam (Box Canyon and Albeni Falls dams) currently restricts the migration of fluvial and adfluvial bull trout populations in the Pend Oreille River to a number of unconnected stream reaches (Waneta Reservoir, Seven-Mile Reservoir, Boundary Reservoir, Box Canyon Reservoir, and Lake Pend Oreille). The restriction of bull trout to these cores areas likely increases their risk of extinction, since interchange between adjacent populations is important for maintaining the genetic viability of this species, as well as assuring their persistence within any given drainage over time (R2 Resource Consultants 1998, pg. 5-2; Rieman and McIntyre 1993).

Another significant factor negatively impacting bull trout in the Boundary Reservoir reach is water temperatures, which exceed 21°C (69.8°F) for prolonged periods during summer and fall. The absence of thermal stratification during periods of peak seasonal warming suggests that cold-water refuge areas for both adult and juvenile bull trout are scarce in the reservoir (McLellan 2001, pg. 98; R2 Resource Consultants 1998, pg. 5-1). R2 Resource Consultants (1998, pg. 5-1) concluded that point temperatures measurements conducted throughout the reservoir in 1996 and 1997 indicated cold-water refugia in the reservoir are probably restricted to the outlet regions of a few cooler tributaries (i.e. Slate, Flume, and Pewee creeks).

Distribution (and possibly abundance) of bull trout in Boundary Reservoir is likely limited by the lack of cool-water habitat. During an intensive two-year fish sampling survey conducted on Boundary Reservoir and its tributaries by R2 Resource Consultants in 1996 and 1997 for Seattle City Light, only one bull trout was captured (R2 Resource Consultants 1998, pg. 5-2). The bull trout was captured near the mouth of Slate Creek. The only other confirmed reports of bull trout capture in the Boundary Reservoir were from 1994 and 1995, during which time a total of five bull trout were captured near the mouth of Slate Creek by USFS and WDFW biologists using hook-and-line (R2 Resource Consultants 1998, pg. 5-2). The warm water temperatures in Boundary Reservoir are the result of the inflow of warm water from Box Canyon Dam, which ultimately results from surface water releases of Lake Pend Oreille water at Albeni Falls Dam (R2 Resource Consultants 1998, pg. 5-1).

Consequently, given the fragmentation of habitat by impassable dams on the Pend Oreille River, only tributaries could provide suitable rearing habitat for juvenile bull trout within Boundary Reservoir during the summer and early fall. Suitable habitat for adult bull trout during the warming season would be extremely limited. The extent to which the tributary waters are accessible to bull trout is limited by natural barriers and, in some cases, further limited by human-made barriers and degraded habitat conditions. Natural barrier falls exist at or near the mouths of Pewee Creek, Flume Creek, Sweet Creek, and to some extent Slate Creek and Sullivan Creek, while Mill Pond Dam at RM 5.5 on Sullivan Creek, restricts the extent of habitat available for migrating bull trout. Additionally, impoundments like Sullivan Lake affect the quality of habitat downstream through altered flow regimes and modified water temperatures (R2 Resource Consultants 1998, pg. 5-2). Only holding pools in tributary streams, pockets of cooler water in the vicinity of tributary mouths, and areas of groundwater influence along the shoreline of the mainstem Pend Oreille River could sustain migratory adult bull trout. Resident bull trout forms could persist in upper tributary drainages, although given habitat fragmentation, the opportunity for genetic interchange is limited.

Another factor potentially limiting populations of bull trout in the Boundary Reservoir is competition and hybridization with eastern brook trout and other non-native fish species. Brook trout were observed in many of the tributaries of Boundary Reservoir, including Slate Creek and Sullivan Creek, and were found to be the dominant fish species in Flume Creek (McLellan 2001; R2 Resource Consultants 1998). Brook trout seek many of the same habitat areas as bull trout in tributaries and may out-compete bull trout for habitat and food resources. Brook trout may interbreed with bull trout, producing sterile offspring. Genetic introgression with brook trout can greatly increase the risk of extinction for a bull trout population, especially when isolated by dams, waterfalls, and other barriers from bull trout populations in nearby drainages. Depending on the fish survey methodology used and collection type (electrofishing, gill net, hook and line, and creel census) species composition results varied. Combining the results of multiple survey techniques, based on survey work conducted in 2000, northern pikeminnow (a native species) were the most abundant species in Boundary Reservoir as measured by number (n = 609; McLellan 2001, pg. 53, Table 17). Species composition as represented by number caught and in descending order are: northern pikeminnow (n = 609), largescale suckers (n = 489), redside shiners (n = 197), smallmouth bass (n = 131), peamouth (n = 126), yellow perch (n = 103), mountain whitefish (n = 42), longnose sucker (n = 31), tench (n = 29), brown bullhead (n = 21), rainbow trout (n = 11), largemouth bass (n = 8), brown trout (n = 6), black crappie (n = 6), pumpkin seed (n = 5), burbot (n = 4), cutthroat trout (n = 2), and lake trout (n = 2).. By biomass, largescale suckers comprised the greatest portion of fish species. Smallmouth bass were the dominant game fish in the reservoir both by number and biomass (McLellan 2001, pg. 49). Overall, fish densities in Boundary Reservoir are relatively low. Low fish densities may be related to the steep topography of its banks and very narrow or non-existent littoral areas. Littoral areas (shallow shore areas) in the reservoir provide habitat for many fish species and juvenile fish, especially when these areas possess structural elements such as woody debris accumulations, large boulders or submerged macrophytes.

The food base of the reservoir is another factor that may limit fish populations. Because of the reservoir's short hydraulic retention time, the production of phytoplankton and zooplankton is likely reduced (McLellan 2001, pg. 118). Additionally, the steep topography of the reservoir places much of the volume of Boundary reservoir below the photic zone, which excludes primary production in much of the reservoir (McLellan 2001, pg. 118; R2 Resource Consultants 1998, pg. 5.3). The estimated photic zone depth in the Boundary Dam forebay was 11.6 m (38.28 feet) in the summer and 8.2 m (27.06 feet) in the fall. At the Metaline Falls Bridge, estimated photic zone depth was 9.5 m (31.35 feet) in the summer and 7.6 m (25.08 feet) in the fall (McLellan 2001, pg. 33). Also, the scarcity of littoral zones further limits primary production contributed by periphyton and macrophytes. Primary production (algae and macrophytes) and secondary production (invertebrates) in the reservoir may be concentrated along the littoral zones and tributary outlet areas (R2 Resources 1998, pg. 5-3). Phytoplankton chlorophyll *a* levels, zooplankton, and benthic macroinvertebrate densities were low when compared to other northwest United States reservoirs and lakes (McLellan 2001, pg. 102-104). McLellan (2001) concluded that they did not have a full understanding of all of the limiting factors in the Boundary Reservoir system and how they relate to one another. However, they did conclude that the major limiting factors for game fish production in general (not bull trout specifically) within Boundary Reservoir were related to water temperatures, reservoir retention times, and daily water level fluctuations as affected by powerhouse operations.

Box Canyon Reservoir

Factors limiting trout production in the Box Canyon reservoir were identified as warm water temperatures, lack of habitat diversity and food availability (Ashe and Scholz 1992, pg. 198). Continuous monitoring of water temperatures indicated maximum temperatures in the 70°F (21.1°F) range (Bennett and Liter 1991, pg. 85). Temperature conditions limit the distribution of native trout in the reservoir (Andersen 2001, pg. 3).

In the 1998-2001 Duke Engineering & Services tributary trapping study (Table 8; DE&S 1999a, pg. 20; DE&S 2001a, pg. 20), data revealed that a few adfluvial fish are present in Box Canyon reservoir, and still utilize some of the tributaries, primarily the Indian, Skookum and LeClerc creek systems. The primary adfluvial species was brown trout, an introduced salmonid trout species which is a fall spawner. Other species collected during the study that are native and exhibit adfluvial life history patterns were mountain whitefish and westslope cutthroat trout. Only one bull trout was collected and that was in the Indian Creek trap. The limited migration data collected on bull trout, mountain whitefish, and westslope cutthroat did not provide enough of a basis to determine if adfluvial populations of these species exist within the Box Canyon reservoir (DE&S 2001a, pg. 21).

Nearly all the tributaries within the Box Canyon reservoir studied by DE&S from 1998 through 2001 during an adfluvial fish trapping study (Ruby, Big Muddy, Cedar, W. Br. LeClerc, E. Br. LeClerc, Middle, Mill, Cee Cee Ah, Skookum, N. Fk. Skookum, and Indian creeks) tended to lack suitable depths to provide year-round residence for these large adult salmonids and may possibly lack adequate forage to sustain large resident tributary trout. The tributaries which did have adfluvial migrations (Indian, Skookum, and LeClerc creeks) tended to have similar characteristics such as stable flows, cooler seasonal water temperatures, and ample available spawning habitat. Fish migration behavior, within tributaries and between the tributaries and the reservoir, were related to seasonal flows and water temperatures (DE&S 2001a, pg.21). Trout within the Box Canyon reservoir did not appear to travel from one stream to another in search of more suitable physical or thermal habitat (DE&S 2001a, pg.21). In 2002, Pend Oreille River temperatures in the Box Canyon reach were mapped using thermal infrared remote (TIR) sensing data collected on August 16 and 17, 2002. Surface waters temperatures detected in the TIR effort substantiated earlier assessments that in the mostly thermally unstratified Pend Oreille River, water temperatures will exceed preferred temperatures for both adult and juvenile bull trout (Watershed Sciences 2002).

Generally, there is currently low habitat diversity within the Pend Oreille River in the Box Canyon Reservoir reach. Only about 8 miles (15%) of the Box Canyon reach qualify as riverine habitat which would be preferred by trout. The other 46 miles of the river consists mainly of shallow, slow-moving water, numerous sloughs and backwater areas and an abundance of macrophytes. In general, there are very few deep pools within the Box Canyon Reservoir and the substrate is mostly composed of silt and mud (Ashe and Scholz 1992, pg. 201). Operations of Box Canyon Dam result in a reduction in the quality and quantity of available rearing habitat for adult and juvenile salmonids in the Box Canyon Reservoir reach primarily due to inundation of historic rearing habitat. Specifically, 162 acres of run/riffle and side-channel habitat have been lost in the mainstem Pend Oreille River and its tributaries (USFS 2002g). Along with habitat, food is probably limiting trout production in the river since construction of the Box Canyon Dam eliminated nearly all the food-producing riffle areas.

Table 8: Location of DE&S adfluvial fish traps, 1998 - 2001

STREAM	LOCATION	DATES OPERATED
Big Muddy Creek	1 mile upstream from State Hwy. 20 crossing	1998
Cedar Creek	In the stream directly under the State Hwy. 20 overpass	1998 through 2000
Cee Cee Ah Creek	75 yds downstream of the LeClerc Creek Road crossing	1998 through 2000
E. Br. LeClerc Creek	50 yds upstream of the W. Br. LeClerc Creek confluence	1998 through 2001
Indian Creek	100 yds upstream of the Pend Oreille River confluence	1998 through 2001
Middle Creek	100 yds downstream of the LeClerc Creek Rd. crossing	1998
Mill Creek	100 yds upstream of the LeClerc Creek Rd. crossing.	1998
N. Fk. Skookum Creek	75 yds upstream of the Skookum Creek confluence	1998 through 2001
Ruby Creek	State Hwy. 20 crossing	1998 through 2000
Skookum Creek	100 yds upstream of the N. Fk. Skookum Creek confluence	1998 through 2000
W. Br. LeClerc Creek	Approximately 125 yds upstream from the E. Br. LeClerc Creek confluence	1998 through 2001

Mainstem Pend Oreille River Data Gaps.

- Knowledge of which life history stage is most limited by available habitat (including tributary habitat) and to what extent human-induced alterations are contributing to the limiting conditions (Ashe and Scholz 1992). The factors limiting the production of fish in Boundary Reservoir should be better identified and evaluated since field sampling conducted to date suggests that fish densities in the reservoir are low. The limiting factor studies should focus initially on determining the spatial availability and quantity of littoral habitats within the reservoir, and should identify limnological investigations which can be used to describe the food base of the reservoir (R2 Resource Consultants 1998, pg. 6-1).

- The number and condition of bull trout in Boundary Reservoir. Bull trout are likely present in very low numbers in the reservoir and its tributaries (R2 Resource Consultants 1998, pg. 6-1);

- The extent to which the location and operation of hydro facilities on the Pend Oreille River, from its confluence with the Columbia River upstream to Lake Pend Oreille, may be negatively affecting bull trout populations in WRIA 62 (POCD 8/15/03 draft review comments, September 2002);

- The extent to which non-native fish species in the Pend Oreille River and its tributaries from the confluence with the Columbia River upstream to Lake Pend Oreille, may be negatively affecting bull trout populations in WRIA 62;

- Bull trout swimming and jumping criteria to be used to better determine bull trout passability at falls, chutes, and man-made barriers (POPUD 1/29/03 final draft report review comment, March 2003).

SOUTH SALMO WAU

South Salmo WAU Description

The South Salmo WAU, approximately 15,956 acres, encompasses only the South Salmo River from RM 8.8 – 13.5. The South Salmo River flows west into Washington State from Idaho at RM 13.5, continuing downstream to RM 8.8 where it crosses the international border into British Columbia, Canada. The South Salmo River then joins the Salmo River 7.4 miles upstream from the Salmo River/Pend Oreille River confluence. The Salmo River is a tributary to the Seven Mile Reservoir reach of the Pend Oreille River entering the Pend Oreille River 13.3 miles upstream from the confluence with the Columbia River. Presently, the Columbia and Pend Oreille River dams, including Waneta and Seven Mile Dams on the lower Pend Oreille River in Canada, block passage of fish within and between the Columbia and Pend Oreille River systems.

The land classification is in wilderness status throughout those portions of the South Salmo River within Washington State (USFS 1999bb, pg. 1). Conifer/forb and conifer/alder plant communities dominate in riparian zones (USFS 1998a, pg. 5 of Current conditions section). Elevations range from 3,200 feet on the S. Fk. Salmo River where it flows north into Canada to 6828 feet at Lookout Point on Salmo Mountain. The average annual precipitation in the WAU ranges from 40 to 55 inches.

South Salmo WAU Hydrogeomorphology

Descriptions of geology and hydrology of the WAU is very limited. In general, channel types range from Rosgen A to B stream types. This means streams are generally steep, entrenched, cascading, step/pool streams to moderately entrenched, moderate gradient, riffle-dominated channels with infrequently spaced pools. The dominant substrate is cobble and small boulders (Entrix 2002, Table 3-1; USFS 1998a, pg. 5 of Current conditions section; Rosgen 1996, pg. 4-5). There is no streamflow data available (Entrix 2002, Table 3-1). The bedrock of the area is mostly bedded metasedimentary rocks (USFS 1998a, pg. 7).

South Salmo WAU Current Known Habitat Conditions

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the

Pend Oreille 2496 Technical Advisory Group (TAG). The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

South Salmo River (62.0002.02). There are no manmade barriers to fish passage in the South Fork of the Salmo River drainage. Regarding natural potential fish passage barriers, there is a canyon section upstream of Watch Creek with a number of 6-foot drops in the stream channel. This may explain why radio-tracked fish were located only to just above the Watch Creek confluence (J. Baxter, Baxter Environmental, email correspondence, September 2002). A radio-tagged adult male bull trout was tracked from the Salmo River up16.75 km (10 miles) into the South Salmo River indicating a lack of any fish passage barriers at least up to that point (Baxter and Nellestijn, 2000, pg. 18). Watch Creek is at approximately RM 9.9.

Riparian Condition

WAU-wide. The riparian areas along the South Fork of the Salmo River and its tributaries are remarkably intact. Although a catastrophic wildfire in the 1970s has removed some of the larger components of the riparian stands on a portion of the South Fork, the remaining vegetation is composed of species expected of the natural community. The riparian areas are also continuous in nature with no road crossings, a few trail crossings and dispersed camping areas. All of the road system and past timber harvest are located outside of riparian areas. The riparian area is presently providing adequate shade, detritus, and large instream wood for the stream system which supports native salmonids (USFS 1999bb, pg. 10).

Channel Conditions/Dynamics

Streambank Condition

WAU-wide. All reaches surveyed within the South Fork of the Salmo River watershed have streambanks that have 75 to 100 percent vegetative cover. In this watershed, this is due to the dynamic nature of the bankfull channel which is constantly changing streambanks. Streambanks above the bankfull flow have high vegetative cover (75% or greater) and well-established riparian communities. Greater than 80% of any stream reach has greater than 90% stability among those reaches surveyed in the watershed (USFS 1999bb, pg. 9).

Floodplain Connectivity

S. Fk. Salmo River. The South Fork of the Salmo River watershed consists of primarily Rosgen A and B channels types in V or U shaped narrow valley forms. The Rosgen A and B channel types with narrow V- or U-shaped valley form do not naturally have well developed off-channel habitat and extensive wetlands as would be found in C channels types within wide alluvial floodplains. Therefore, floodplains are relatively small as are riparian areas (USFS 1999bb, pg. 9).

Channel Stability

S. Fk. Salmo River. The average wetted width/maximum depth ratio is less than 10 for all reaches surveyed. The South Fork Salmo River is considered functioning appropriately regarding this indicator. Past natural and human-caused disturbances have not altered the channel equilibrium. The South Fork Salmo River appears to be in balance (USFS 1999bb, pg. 9, 11).

Habitat Elements

Channel Substrate

S. Fk. Salmo River. In 1997, percent surface fines in reaches surveyed by the USFS ranged from 5 to 12% in the streambed substrate. All reaches surveyed under this protocol had little to moderate particle packing. The packing is due to layering of the existing streambed materials rather than embeddedness from excessive fines (USFS 1999bb, pg. 8).

Large Woody Debris

WAU-wide. All reaches surveyed within the South Fork Salmo River drainage have numbers of instream LWD that exceed 20 pieces per mile that are greater than 12 inches in diameter and 35 feet in length (USFS 1999bb, pg. 8).

Pool Frequency and Quality

S. Fk. Salmo River. Pool frequency on surveyed reaches does meet the numbers of pools indicated for the specific average wetted width (16 to 29 feet) except for the lowest reach. Numbers range from 14 to 41 pools per mile. Although the pools per mile do not meet the criteria for one surveyed reach, is the USFS feels that present pool habitat numbers and size throughout the remainder of the stream are what should be expected within stream systems the size of the South Fork of the Salmo River. In absence of any factors that outwardly appear to limit the frequency of pools within the lowest reach, the drainage is considered to be functioning appropriately (USFS 1999bb, pg. 8).

Pool Depth

S. Fk. Salmo River. Pool depths in this drainage range from 2 to 6 feet, averaging 3 feet. These are considered adequate depths for these pools to act as suitable overwintering habitat. Snorkeling observations indicate that the amount of fines in pool substrate is negligible (USFS 1999bb, pg. 8).

Off-Channel Habitat

S. Fk. Salmo River. The South Fork of the Salmo River watershed consists of primarily Rosgen A and B channels types in V or U shaped narrow valley forms. This stream does not and did not historically have oxbows, backwater and ponds. The watershed does have shallow water habitat along the stream margins and some side channel habitat due to braiding initiated by large collections of wood debris jam (2 to 6 side channels per mile depending upon the reach). These areas provide rearing habitat for fry and juveniles as evidenced through observation while snorkeling (USFS 1999bb, pg. 9).

Water Quality

Temperature

S. Fk. Salmo River. Temperature data is limited to sporadic data from the USFS. Temperatures were measured during the summers of 1976-9, 1981-2, 1992, 1995 and 1997. Temperatures ranged from 49ºF (9.4ºC) to 59ºF (15ºC). The limited data indicates that water temperatures are within the tolerance of bull trout but not optimal during the summer months. Temperatures during the spawning period for bull trout are unknown but assumed to be lower than recorded summer water temperatures. Documentation is insufficient to determine the 7-day average maximum temperature in South Fork of the Salmo River and its tributaries. Spot temperatures during surveys, however, are within the acceptable range for bull trout rearing and assumed acceptable for spawning and incubation (USFS 1999bb, pg. 7). Based on the relatively undisturbed condition of the S. Fk. Salmo River drainage and what limited temperature data is available for the S. Fk. Salmo River, stream temperatures appear good (TAG 2002).

Water Quantity

Change in Flow Regime

WAU-wide. There is very little information concerning flow regimes for the South Fork of the Salmo River drainage (no hydrograph). Due to the low density of roads (the existing road density is 0.04) and very low level of acreage in harvested openings outside of the wilderness area but within the watershed (less than 1%), there should be a very limited effect to the natural flow regime. There is no reason to believe that there has been substantial change in peak flows, base flows, or flow timing (USFS 1999bb, pg. 10).

Species Competition

Non-indigenous Fish

WAU-wide. Eastern brook trout are found in the Salmo River and many of its tributaries. Brook trout have not been found within the portion of the South Fork of the Salmo within the state of Washington. The probability of hybridization between brook and bull trout in the main Salmo River is high although bull trout still exists in its pure form. Competition between bull trout and other species in the reservoir is not known but conditions are not optimal for the bull trout. Competition between species within the Salmo River is also unknown (USFS 1998a, pg. 7).

South Salmo WAU Fish Distribution and Use

Individual bull trout have been found in Lake Roosevelt, a 150-mile segment of the Columbia River stretching from Grand Coulee Dam (Columbia RM 595.6) to the Canadian border. Grand Coulee Dam does not have fish passage facilities, preventing fish passage upstream of Grand Coulee Dam in the Columbia River. The confluence of the Pend Oreille River with the Columbia River is in Canada, just north of the Canada/U.S. boundary at Columbia RM 745.5. Bull trout have been found in the Pend Oreille River in the Waneta (RM 0.2 – 9.0) and Seven Mile Reservoirs (RM 9.0 – 17.0) portions of the lower Pend Oreille River in Canada; neither of these dams have fish passage facilities. The Seven Mile Reservoir extends from the Seven Mile Dam upstream to Boundary Dam (RM 17.0) in Washington State (USFS 1999bb, pg. 3). The Salmo River flows into Seven Mile Reservoir in Canada at Pend Oreille RM 13.3. There are no known permanent barriers (natural or man-made) preventing fish movement from the Seven Mile Reservoir into the Salmo River (USFS 1999bb, pg. 8).

Because of impassable Pend Oreille River dams, presently bull trout populations utilizing the Salmo River drainage have access only to the Seven Mile Reservoir of the Pend Oreille River (USFS 1999bb, pg. 7). The population of bull trout in the Salmo River drainage currently appears to be a mainstem Salmo River overwintering, fluvial population only and does not utilize Seven Mile Reservoir. A study conducted by Baxter and Nellestijn (2000) observed that none of the ten radio-tagged bull trout entered Seven Mile Reservoir for any period during the study, which would be expected post-spawning if the fish were reservoir overwintering fish. The average size of spawners (~55 cm/ 22 inches) also suggests that the population is a mainstem resident population for most of its life-history, with a 70 cm (27.5 inch) fish being the upper limit of what was tagged in this study, and that has been observed by local anglers. The fact that large bull trout accounted for less than 0.1% of the fish captured in the reservoir in past studies, that no large bull trout have been sampled in recent studies, and that reservoir temperatures are for the most part warm further support this contention (Baxter and Nellestijn 2000, pg. 43).
In 1974 & 1976, Tom Burke, former USFS biologist, reported taking individual bull trout ranging from 10-14 inches in length, from the S. Fk. Salmo. In 1995, an angler reported catching 2 bull trout (20-25 inches in length) in S. Fk. Salmo. In 1999, 2 of 10 bull trout radio-tagged in the Salmo River by Jim Baxter, consultant for BC Hydropower, migrated into the US portion of the S. Fk. Salmo as far upstream as Watch Creek (RM 9.9). They returned to the Salmo River after the spawning season. In 2000, two of the 1999 radio-tagged bull trout returned to the S. Fk. Salmo River again migrating as far upstream as Watch Creek, then returning to the Salmo River

by the end of September of 2000. A third bull trout, radio-tagged in 2000 along with 5 other bull trout, also migrated into the S. Fk. Salmo River, migrating 0.9 miles (1.5 km) upstream of the Watch Creek confluence, before returning to the Salmo River by the end of August (Baxter 2001). Based on fall 2002 observations of bull trout and redds (approximately 10 bull trout and 4 redds), it is suspected that the S. Fk. Salmo River in the vicinity of the Watch Creek confluence, is the best bull trout spawning area in the S. Fk. Salmo River (J. Baxter, Baxter Environmental, email correspondence, September 2002). Prior to 2002, Tom Shuhda (USFS) and staff have snorkeled the S. Fk. Salmo River reach from Watch Creek upstream to RM 13.0 near the headwaters. They located trout species (but no bull trout), no fish passage blockages, and suitable habitat.

Table 9 below describes current, known bull trout use in the South Salmo WAU. Maps in Appendix C illustrate the extent of "Currently Occupied" and "Suitable" bull trout habitat in the WAU. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Table 9: Current, known bull trout use in the South Salmo WAU

South Salmo WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observation	Occurrence
S. Fk. Salmo River	X	X	X	X	

South Salmo WAU Summary

The factor most limiting bull trout populations in the Salmo River drainage and its tributaries had been legal harvest of bull trout up until 1999 (J. Baxter, Baxter Environmental, pers. comm., 2002). Prior to 1999, bull trout harvest of 2 fish per day greater than 30 inches was allowed. Currently, the only bull trout fishery allowed in the Salmo Creek drainage is catch-and-release. Poaching of bull trout in the mainstem Salmo River and possibly in the mouth of the S. Fk. Salmo River may also negatively impact the bull trout population in the drainage to an unknown extent (J. Baxter, Baxter Environmental, pers. comm., 2002). Extrapolation of bull trout numbers from spawner surveys since 1999 gives a preliminary indication that the numbers may be improving (J. Baxter, Baxter Environmental, pers. comm., 2002).

Presently, hydroelectric development on the Pend Oreille and Columbia rivers may be negatively affecting bull trout populations in the Salmo River watershed by eliminated spawning, rearing, and overwintering habitat while eliminating genetic exchange among bull trout populations using the Salmo River drainage. Migrating bull trout (fluvial and adfluvial life history forms) utilizing the Salmo River drainage are limited to the mainstem Salmo River and the Seven Mile Reservoir reach of the Pend Oreille River by Seven Mile Dam downstream on the Pend Oreille River and

Boundary Dam upstream. Neither Seven Mile nor Boundary Dam has fish passage facilities. The modification of the Pend Oreille River from riverine to reservoir habitat by the construction of mainstem hydroelectric dams, as well as the introduction of non-native fish species into the reservoirs and tributaries, may also play a role in negatively affecting the expression of the adfluvial bull trout life history form of the Salmo River populations (USFS 1998a, pg. 4, Synthesis and Interpretation section). If an adfluvial form of bull trout utilizing the Salmo River drainage persists in the Seven Mile Reservoir reach of the Pend Oreille River, it has not been identified recently (Baxter and Nellestijn 2000, pg. 40).

Data collected from radio-tagged bull trout in the Salmo River watershed from 1999 and 2000, indicated no bull trout migrated into the Seven Mile Reservoir. These results suggest that the Salmo River bull trout population is a fluvial population (Salmo River overwintering) and that the vast majority of bull trout in the Salmo River are not making migrations into the Seven Mile Reservoir (Baxter and Nellestijn 2000, pg. 14, 40). Prior to construction of hydroelectric dams on the Columbia River, the Salmo River watershed was a major producer of anadromous salmonids – chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*; Baxter and Nellestijn 2000, pg. 1). Anadromous salmonid species were extirpated from the upper Columbia region when their migration routes were cut off by the Columbia River dams. More recently, recreational fisheries for non-anadromous species such as rainbow trout and bull trout have dominated angler activity in the Salmo River watershed. Presently, these sport fisheries are also thought to have severely declined, and as mentioned earlier, the bull trout fishery has been reduced to catch-and-release only (Baxter and Nellestijn 2000, pg. 1).

Degraded habitat conditions have not been identified as a concern in the Salmo River watershed, however the bull trout population is estimated to be less than 200 individuals (Baxter and Nellestijn 2000, pg. 1). The habitat quality of the S. Fk. Salmo River within Washington State is such that reaches of the river can be used as reference reaches for comparative purposes to assess the condition of managed reaches of similar land and channel type. The land classification for the South Salmo WAU is wilderness status throughout those portions of the South Fork Salmo River within Washington State (USFS 1999bb, pg. 1). Reference reaches are stream reaches that are in an unmanaged condition (USFS 1998a, pg. 1, Synthesis and Interpretation section).

South Salmo WAU Data Gaps

- Population and trend data for bull trout in the South Salmo WAU. Suitable spawning habitat exists and much of the WAU has not been surveyed. It is impossible to predict growth and survival information with available data (USFS 1999bb, pg. 6). In particular, Lead and Watch creeks are lacking habitat and fish distribution/spawning surveys (from the POCD write-up of the South Salmo WAU section for the 8/15/02 draft of the Bull Trout Habitat Limiting Factors for WRIA 62 report, R. Dasher, author).

SLATE CREEK WAU

Slate Creek WAU Description

The Slate Creek WAU is located in the northeastern corner of Pend Oreille County, in Washington State. The Slate Creek WAU encompasses approximately 46,803 acres and captures the Pewee Creek, Lime Creek, Slate Creek, and Threemile Creek drainages which enters the Boundary Reservoir of the Pend Oreille River at RM 18.0, 19.0, 22.2, and 24.3, respectively. Both Pewee and Threemile creeks are naturally disconnected from the Pend Oreille River by falls at the mouths, and instream temperatures in Lime Creek naturally exceed the tolerance level for bull trout fry and juveniles. Only those drainages where bull trout have been observed or where “Suitable” or “Recoverable” bull trout habitat has been identified will be assessed in this report. Presently, only Slate Creek falls into this category. There is blockage to upstream fish passage from the lower 17 miles of the Pend Oreille River and from the Columbia Rivers by Boundary Dam (RM 17.0), approximately 4 miles downstream from the mouth of Slate Creek (USFS 1999, p.1). Slate Creek has four main tributaries: Slumber Creek, Uncas Gulch, Styx Creek, and an unnamed creek. Slumber Creek enters Slate Creek north of USFS Rd. 3155, near State Hwy. 31. Uncas Gulch flows into Slate Creek south of USFS Rd. 3155, west of the unnamed tributary. Styx Creek enters Slate Creek just west of Lead Hill Mountain, near the junction of USFS Rd. 3155 and USFS Rd. 3160. The unnamed tributary enters Slate Creek, south of USFS Rd. 3155 and west of the Lead Hill Mine.

Riparian vegetation is primarily composed of alder, alder/dogwood and conifer/alder communities on Slate Creek (USFS 1998a, pg. 3, Description of Conditions section). Elevations range from 800 feet at the valley floor to 7309 feet at Gypsy Peak. The average annual precipitation in the WAU ranges from 25 to 45 inches. The majority of the Slate Creek WAU falls within the Colville National Forest with a small section in the eastern portion of the WAU designated Wilderness. There is a small amount of non-resource private land in the WAU located adjacent to the Pend Oreille River north of Metaline Falls. Additionally a few privately-owned, 40-acre timber holdings exist in the Slate Creek drainage. There are no assessor designated Agriculture Open Space in the Slate Creek WAU (K. Kuhn, Pend Oreille County Planning, pers. comm., 2002).

Slate Creek WAU Hydrogeomorphology

Descriptions of geology and hydrology for the WAU are limited. The bedrock of the area is mostly bedded metasedimentary rock. Lead and Zinc have been mined in this area. In many areas, the bedrock is overlain by younger materials such as glacial drift, glacial till, glacial outwash, alluvium, and volcanic ash. Some of the alluvial and outwash material can be quite sandy. The primary erosional processes occurring in this area are streambank erosion and landslides (USFS 1998a, p.7, 8).

The majority of Slate Creek stream reaches are Rosgen B channel types with mean gradients ranging from 2-4 percent. Only the uppermost reach is classified as a Rosgen A channel type. The A channel type reach has a mean gradient of 5% and is located in a narrow v-shaped canyon with sideslopes exceeding 80 percent. Sinuosity (meandering) in Slate Creek is low due to valley floor constraints. Sinuosity of tributaries varies from low to moderate. The dominant substrates in the streambed of Slate Creek are gravels and cobble (USFSa 1998, pg. 3 of Current conditions section). The hydrologic regime is "snowpack-dominated". Spring runoff caused the peak runoff event of the year with much less response from summer rainstorms (USFSa 1998, pg. 16, Current Conditions section). Streamflow data for the WAU is limited to one observation made in 2001 on Slate Creek (Entrix 2002, Table 3-1).

Slate Creek WAU Current Known Habitat Conditions

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Pewee Creek (62.0007). A 50 m (165 ft.) vertical waterfall at the mouth is a full barrier to fish passage (McLellan 2001, pg. 64).

Lime Creek (62.0014). At RM 1.3, just downstream of the Lake Lucerne tributary and downstream of State Hwy. 31, Lime Creek goes subsurface for approximately 100 meters (330 feet; McLellan 2001, pg. 64).

Slate Creek (62.0019). There are no known man-made barriers to fish passage in the Slate Creek drainage (USFS 1999bc, pg. 8).
Slate Creek. Regarding natural fish passage barriers, the USFS identifies a 30-foot high series of cascades at RM 0.75 as a potential seasonal barrier to fish passage. The USFS identified no additional fish passage barriers on Slate Creek (USFS 1999bc, pg. 8). The USFS information is contradicted in McLellan (2001). McLellan identifies the series of cascades as four falls and a chute concluding that, combined, they prevent fish passage upstream in Slate Creek (McLellan 2001, pg. 75, Figure 12 & Appendix I). Moving in an upstream direction, these barriers are located near the break between Reaches 8 and 9 (RM 0.75). The first waterfall is the largest with a vertical height of 6.0 m (20 ft.). The second waterfall is approximately 4.0 m (13 feet) tall. The third waterfall is 5.0 m (16.5 feet) high and the stream narrowed to 1 m (3.3 feet) before plunging through a crack in the bedrock. The water plunged through the crack, away from the concave face of the cliff. The fourth waterfall was 2.8 m (9 feet) high. The final barrier in this 800 m (0.5 mile) stretch of Slate Creek was a chute. The chute was 30 m (99 feet) long, 2 m (6.6 feet) wide, and had a gradient of 38% with uninterrupted flow.

Slate Creek. Approximately 400 m (0.25 miles) upstream from the State Highway 31 bridge, another natural fish migration barrier is identified on Slate Creek by McLellan (RM 1.5; McLellan 2001, pg. 75, Figure 12; Appendix H). The barrier identified is a waterfall/chute which, facing upstream, has a 3.0 m (10 feet) waterfall on the right side and a chute 10 m (33 feet) long, 1 m (3 feet) wide, with a gradient of 24% on the left side (facing downstream).

N. Fk. Slate Creek. The most upstream natural barrier on Slate Creek identified by McLellan is a chute in the headwaters (27.5 m long, 1 m wide, 18% gradient) located 300 m downstream from the USFS Rd. 209 crossing (McLellan 2001, pg. 75, Figure 12 & Appendix I).

N. Fk. Slate Creek. Upstream of the upper-most natural barrier, McLellan (2001) indicates a man-made barrier point in the GIS potential barriers coverage. No further information is provided.

Slumber Creek (62.0022). The culvert (Culvert_id # 273) at RM 0.2 at the USFS Rd. 3100250 creek (road mile 1.8) crossing is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Slumber Creek. At RM 2.3, on August 17, 1991, the stream was observed to have naturally dewatered (T. Shuhda, USFS, pers. comm., 2002).

Styx Creek (62.0038). The USFS Rd. 3155 culvert crossing on Styx Creek (Culvert_id # 275) near the mouth is a full fish passage barrier (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Threemile Creek (62.0051). At the mouth, a 16.5 foot falls is a full barrier to fish passage (McLellan 2001, pg. 92).

Riparian Condition

Slate Creek drainage. The riparian areas along Slate Creek and its tributaries are remarkably intact. Although past harvest and catastrophic wildfires have removed some of the largest components of the riparian stands, the vegetation is primarily composed of species expected of the natural community. The riparian areas are also continuous in nature with few road crossings. A majority of the road system and past timber harvest is located outside of the riparian areas. The USFS Rd. 3155 has few riparian segments and most of the road is more than 200 feet from the creek (USFS 1998a, pg. 15 of Current Conditions section). The riparian area is presently providing adequate shade, detritus and large instream wood for a stream system which supports native salmonids (USFS 1999bc, pg. 10).

Channel Conditions/Dynamics

Streambank Condition

Slate Creek drainage. Reaches of Slate Creek and its tributaries on USFS land were surveyed. Greater than 80% of all stream reaches had greater than 90% stability (USFS 1999bc, pg. 9).

Floodplain Connectivity

Slate Creek drainage. The Slate Creek drainage consists of primarily Rosgen A and B channels types in V or U shaped narrow valley forms. However, a portion of USFS Rd. 3155 is located in a portion of the Slate Creek valley bottom. Slate Creek does not and did not historically have oxbows, backwater and ponds. The drainage does have shallow water habitat along the stream margins and some side channel habitat due to braiding initiated by large collections of wood debris. These areas provide rearing habitat for fry and juveniles as evidenced through observation while snorkeling. Since this type of habitat is evident throughout the watershed, Slate Creek is considered functioning appropriately for floodplain connectivity (USFS 1999bc, pg. 9).

Channel Stability

Slate Creek drainage. Habitat quality in the Slate Creek drainage is high. Past disturbances, natural and human-caused, have not altered the channel equilibrium. The system appears to be in balance (USFS 1999bc, pg. 11).

Habitat Elements

Channel Substrate

Slate Creek drainage. Pre-1997 USFS protocol (Hankin-Reeves) measured embeddedness on a reach-by-reach basis with the average embeddedness of the streambed substrate either greater or lesser than 35%. The 1997 protocol does not collect this data instead recording percent surface fines. All reaches surveyed under this protocol had embeddedness levels of less than 35%. It is not known how many reaches have less than 20%. Visual observations indicate that average embeddedness falls more often in the 20 to 25% range. The natural level of embeddedness is not known for this channel and geologic type due to lack of reference streams (USFS 1999bc, pg. 8).

Large Woody Debris

Slate Creek drainage. All reaches surveyed within the Slate Creek drainage have numbers of instream LWD that exceed 20 pieces per mile that are greater than 12 inches in diameter and 35 feet in length (USFS 1999bc, pg. 8).

Slate Creek. Slate Creek had a high number of LWD/100m. Acting LWD were considered any piece of organic debris with a diameter >10cm and a length >1m that intruded into the stream (McLellan 2001, pg. 111).

Pool Frequency and Quality

Slate Creek. Data on pool frequency was collected from 1991 to 1997. The criteria for what constitutes pool habitat were liberalized in the 1997 protocol, compared to earlier stream survey protocol. Therefore, the number of pools per mile recorded on Slate Creek prior to 1997 show pool frequency for Slate Creek to be less than expected for its wetted width based 1997 criteria for identifying pool habitat. Although the pools per mile do not meet the criteria for "good" (functioning appropriately), it is felt that present pool habitat numbers and size are what should be expected within stream systems the size of Slate Creek. In absence of any factors that outwardly appear to limit the frequency or quality of these pools, the drainage is considered to be functioning appropriately for pool frequency (USFS 1999bc, pg. 8).

Slate Creek. Slate Creek had a high number of large pools/km and high pool frequency (defined as portion of the stream with reduced velocity and usually deeper than a riffle; McLellan 2001, pg. 111).

Slumber Creek. Pool frequency data was collected using 1997 USFS Hankin-Reeves protocol for identifying pool habitat. Pool frequencies closely approximate what they should be for a stream with its wetted width (USFS 1999bc, pg. 8).

Styx Creek and Uncas Gulch (62.0029). Using pool frequency numbers collected using pre-1997 pool habitat criteria, and comparing them to current habitat rating criteria for pool frequency, pool numbers are less than expected. The criteria for what constitutes pool habitat were liberalized in the 1997 protocol, compared to earlier stream survey protocol. It is expected that pool numbers would increase if these creeks were resurveyed using the 1997 survey protocol and may meet the numbers given within the rating system for pool frequency. In absence of any factors that outwardly appear to limit the frequency or quality of these pools, the drainage is considered to be functioning appropriately for pool frequency (USFS 1999bc, pg. 8).

Pool Depth

Slate Creek. Pool depths range from 2.5 to 3.5 feet on average in Slate Creek. Any perceived or real deficit in pool habitat is not due to either lack of large woody debris or from the effects of aggradation. Depths of 2.5 to 3.5 feet on average are considered adequate depths for these pools to act as suitable overwintering habitat. Snorkeling observations indicate that the amount of fines in pool substrate is negligible (USFS 1999bc, pg. 8).

Slumber Creek and Uncas Gulch. Pool depths range from 2 to 3 feet on Slumber and Uncas Gulch. Any perceived or real deficit in pool habitat is not due to either lack of large woody debris or from the effects of aggradation. This is considered adequate depths for these pools to act as suitable overwintering habitat. Snorkeling observations indicate that the amount of fines in pool substrate is negligible (USFS 1999bc, pg. 8).

Styx Creek. Pool depths range from 1.8 to 2.3 feet in Styx Creek. Any perceived or real deficit in pool habitat is not due to either lack of large woody debris or from the effects of aggradation.

This is considered adequate depths for these pools to act as suitable overwintering habitat. Snorkeling observations indicate that the amount of fines in pool substrate is negligible (USFS 1999bc, pg. 8).

Off-Channel Habitat

Slate Creek drainage. The Slate Creek drainage consists of primarily Rosgen A and B channels types in V or U shaped narrow valley forms. Slate Creek does not and did not historically have oxbows, backwater and ponds. The drainage does have shallow water habitat along the stream margins and some side channel habitat due to braiding initiated by large collections of wood debris. These areas provide rearing habitat for fry and juveniles as evidenced through observation while snorkeling. Since this type of habitat is evident throughout the watershed, Slate Creek is considered functioning appropriately regarding this indicator (USFS 1999bc, pg. 9).

Water Quality

Temperature

Slate Creek. In the summer months, water temperatures were taken every day, twice a day in 1997 by the USFS during stream surveys. Other water temperature data was taken by the USFS hydrologist. The limited USFS data indicates that water temperatures are consistently between 44 and 48 ºF (7-9ºC) during the summer months and into the spawning period for bull trout. The USFS documentation is insufficient to determine the 7-day average maximum temperature in Slate Creek and its tributaries although the spot temperatures recorded during surveys were within the acceptable ranges for bull trout spawning and rearing and assumed acceptable for incubation (USFS 1999bc, pg. 7). This data is inconsistent with temperatures recorded by the R2 Resource, consultants for Seattle City Light.

Slate Creek. Thermographs were used to record water temperatures in the upper and lower reach of Slate Creek from August 15 through October 27, 1996 and again at the same locations in 1997 with hourly recordings from July 25 through November 11 (R2 Resource Consultants 1998, pg. 4-5). The two recording station were located, one at the mouth of Slate Creek and one at Slate Creek's confluence with Uncas Gulch. The maximum temperature recorded on Slate Creek was 15.4°C on August 5 and August 6, 1997, at the lower thermograph site. Table F1 in Appendix F provides the calculated 7-day maximum and minimum temperatures for each station with dates, and the minimum and the maximum temperature recorded for each station with dates (R2 Resource Consultants 1998, Appendix B).

Slate Creek. Between June 28th and October 17th, 2000, the temperature of lower Slate Creek was measured 1,339 times with the thermograph. Maximum temperature (± standard deviation) was 13.34°C/56.0°F on August 8th and 9th, with a minimum of 2.80°C/37.0°F on October 6th (McLellan 2001, pg. 75).

Slate Creek. Between July 7th and October 17th, 2000, the temperature of upper Slate Creek was measured 1,231 times with the thermograph. Maximum temperature (± standard deviation) was

9.46°C/49.0°F on July 31st with a minimum of 1.54°C/34.8°F on October 6th (McLellan 2001, pg. 75).

Slate Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting temperature data (along with pH, dissolved oxygen, stream flow, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) at the mouth of Slate Creek (D. Comins, POCD, email comm., Feb. 2003).
Lime Creek. Natural summertime water temperatures exceed the tolerance level for bull trout fry and juveniles (T. Shuhda, USFS, email comm., 2003).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Slate Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting stream flow data (along with pH, dissolved oxygen, temperature, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) near the mouth of Slate Creek (D. Comins, POCD, email comm., Feb. 2003).

Slate Creek drainage. There is very little information concerning flow regimes for the Slate Creek drainage (no hydrograph). In addition, there are no undisturbed watersheds of similar size, geology and geography in the Pend Oreille River system. Due to the low density of roads (1.7 miles/sq. mi.) and low level of acreage in harvested openings (less than 15%) within the watershed, there should be a very limited effect to the natural flow regime. There is no reason to believe that there has been substantial change in peak flows, base flows or flow timing (USFS 1999bc, pg. 10).

Species Competition

Non-indigenous Fish

Slate Creek WAU. All life stages of brook trout have been observed throughout the Slate Creek drainage during snorkeling surveys indicating successful reproduction. The most recent stocking of brook trout in Slate and Slumber creeks was in 1981, however it is likely that brook trout were stocked earlier (USFS 1998a, pg. 2, Characterization section and pg. 1, Description of Current Conditions section). Brown trout have not been confirmed in the Slate Creek drainage although they do exist in Boundary Reservoir although in very low densities (R2 Resource Consultants 1998, pg. 3-2 throught 3-6).

Slate Creek WAU Fish Distribution and Use

Slate Creek flows into the Boundary Reservoir reach of the Pend Oreille River at RM 22.2. The extent to which a series of natural falls and chutes beginning at RM 0.75 on Slate Creek and occurring at other upstream locations are barriers to fish passage is disputed (USFS 1999bc; McLellan 2001). Slate Creek has been surveyed using day snorkeling and electroshocking as recently as 1997 without finding bull trout presence within the stream (USFS 1999bc, pg. 3), however, several unusual brook trout phenotypes were observed in upper Slate Creek (R2 Resource Consultants 1998, pg. 4-1; Markle 1992). These individuals were paler in overall color than most brook trout and had relatively clear dorsal fins; the lower third of the dorsal fin was spotted. These markings are similar to those which have been observed in brook trout *x* bull trout hybrids (R2 Resource Consultants 1998, pg. 4-1; Markle 1992). Bull trout have been found in the Pend Oreille River in and around the mouth of Slate Creek but not within Slate Creek itself. The reach of the Pend Oreille River into which Slate Creek flows, while not free-flowing in nature due to the impounding effect of Boundary dam, has a source of cold water from Slate Creek that is attractive to bull trout (R2 Resource Consultants 1998). Because bull trout have not been located in Slate Creek or its tributaries, Table 10 below is blank for bull trout occurrence in the Slate Creek WAU. Maps in Appendix C illustrate the extent of "Suitable" bull trout habitat in the WAU. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

The historic relative abundance and distribution of bull trout within the Slate Creek WAU is not known. Given the knowledge of salmonid biology and behavior, and the historic presence of bull trout in the mainstem Pend Oreille River from the Columbia River confluence upstream (Baxter and Nellestijn 2000; Gilbert and Evermann 1895), it is likely bull trout would have entered Slate Creek to the extent possible (USFS 1998a, pg. 1 of Description of Reference Conditions section). Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. The extent to which bull trout could have successfully utilized Slate Creek habitat historically is not clear based on existing information. For all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years.

Table 10: Current, known bull trout use in the Slate Creek. (Table is blank for bull trout since there are no current, known observations of bull trout in the Slate Creek WAU).

Slate Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Slate Creek					X
Slumber Creek					
Uncas Gulch					

Styx Creek					
S. Fk. Slate Creek					
N. Fk. Slate Creek					X

Slate Creek WAU Summary

Human-caused factors that are limiting the sustainability of bull trout populations in the Slate Creek WAU can be tied to occurrences outside the Slate Creek drainage. Habitat in the Slate Creek WAU is largely unimpacted by human activities. Both Pewee and Threemile creeks are naturally disconnected from the Pend Oreille River by falls at the mouths and instream temperatures in Lime Creek naturally exceed the tolerance level for bull trout fry and juveniles. On Slate Creek, the extent to which natural cascades/falls/chutes beginning at RM 0.75 impede fish passage further into the drainage is uncertain. Instream conditions of managed stream reaches in Slate Creek are near the upper range of natural variability when it comes to pool frequency and LWD. Historic instream habitat conditions are represented by the lower reaches of Slate Creek which tend to contain large debris jams, high amounts of large diameter instream wood, and deep pool habitat (USFS 1998a, pg. 2, 3, Description of Ref. Conditions section). Out-of-drainage human alterations to the Pend Oreille River system that are limiting bull trout populations in the Slate Creek WAU include the modification of the Pend Oreille River from riverine to reservoir habitat. The construction of Boundary, Seven Mile, and Waneta dams has isolated populations of fish and eliminated the fluvial and adfluvial life history form of bull trout in the lower Pend Oreille River system. The introduction of non-native fish into the reservoir and tributaries has also negatively affected the viability of bull trout in the Boundary Reservoir reach of the Pend Oreille River system by introducing increased competition with and possibly predation upon bull trout.

Slate Creek WAU Data Gaps

- No data gaps identified by TAG.

<u>SULLIVAN CREEK WATERSHED</u>

The Sullivan Creek WAU (58,685 acres) and the Harvey Creek WAU (32,760 acres) encompass all tributaries draining into Sullivan Creek. Sullivan Creek ultimately drains into the Pend Oreille River at RM 26.9. Together the Sullivan Creek WAU and Harvey Creek WAU make up the Sullivan Creek watershed. The following section will be referred to as the Sullivan Creek Watershed in this report for ease of reference to most maps and studies for this geographic area.

Sullivan Creek Watershed Description

The Sullivan Creek watershed (91,445 acres) originates as rainfall and snowmelt in the Priest-Salmo Mountains. Two major tributaries, Harvey Creek and Sullivan Creek, originate at the peaks of Monumental and Salmon Mountains at an elevation of 5,711 and 6,400 feet, respectively (CES 1996, pg.2). Normal pool elevation of Boundary Reservoir is 1,990 feet and normal pool elevation of Sullivan Lake is 2,588 feet (J. Maroney, KNRD, 1/29/03 final draft written review comments, Feb. 2003). Sullivan Creek drains the area east and northeast of Sullivan Lake and has a total drainage basin of 52 square miles. Sullivan Creek flows 21.4 miles westerly into the Pend Oreille River at RM 26.9 near the town of Metaline Falls. Harvey Creek flows approximately 15 miles north-northwesterly from its headwaters before flowing into Sullivan Lake, a natural lake. The water holding capacity of Sullivan Lake was increased by the construction of Sullivan Lake Dam about 0.5 miles upstream of the confluence with Sullivan Creek. The 0.5-mile reach of stream from the outlet of Sullivan Lake at Sullivan Lake Dam to its confluence with Sullivan Creek is called Outlet Creek. The average annual precipitation over the basin area is about 40 inches, varying from 30 inches in the valleys to about 50 inches on the ridges (CES 1996, pg. 2; Williams et al. 1975). The USFS manages 97.4% of the Sullivan Creek drainage (56,771 acres). A portion of the Salmo-Priest Wilderness lies within the drainage (14,758 acres), comprising 25.3% of the Sullivan Creek drainage (USFS 1996a, pg. I-42).

Although the Sullivan Creek drainage has probably been at least marginally utilized by people since the retreat of the ice sheets, archaeological excavation on the north end of Sullivan Lake has confirmed occupation of the area for at least 3,000 years. Traditionally, the Sullivan Creek drainage was used by the Kalispel people as a hunting and resource gathering area. Gold placer activities along Sullivan Creek were among the earliest in the Northwest dating back to 1857 and continuing to the present time. The town of Metaline is the earliest community in Pend Oreille County; it began as a mining camp dating back to this period. Sullivan Lake Dam, originally a wood crib dam, was constructed about 1910 (USFS 1996a, pg. III-3; Bamonte 1996, pg. 177), raising the level of Sullivan Lake, a natural lake, 25 feet; Mill Pond Dam, also originally a wood crib dam, was constructed in 1913 creating Mill Pond (USFS 1996a, pg. I-32, Bamonte 1996, pg. 177). Both wood crib dams were replaced with concrete dams in1922 and 1923, respectively (Bamonte 1996, pg. 177).

Presently, residential development in the drainage is very limited. In the vicinity of the Sullivan Creek/Harvey Creek confluence, there are about nine residences and a small store located on private land. The only other residential development occurs in the vicinity of Lime Lake (about a dozen residences), located in the very lower portion of the watershed. The watershed is accessed by Sullivan Lake Road, which follows along the west shore of Sullivan Lake. A network of USFS roads (233.7 total miles) and approximately 4.4 miles of private roads provide access to other areas of the Sullivan Creek drainage (USFS 1996a, pg. I-36). Camping is the predominant recreational activity in the watershed. Recreational mining also occurs; legal use allows for gold panning and limited suction dredging under permits from the Washington Department of Fish and Wildlife (USFS 1996a, pg. I-42).

Sullivan Creek Watershed Hydrogeomorphology.

The Sullivan Creek watershed was glaciated with the exception of granite peaks that stuck above the ice. At the base of the granite peaks, there is a transition zone where the granite gives way to glacial till; glacial till is a very dense, poorly sorted mixture of clay, silt, sand and gravel deposited directly beneath glacial ice. Where the glacial till starts, there are long linear alpine springs formed when water running down the granite hits the flat slope of the glacial till and ponds there. These springs are the source of the tributaries (USFS 1996a, pg. III-11).

The headwaters of most tributaries to Sullivan Creek typically have steep gradients (Rosgen A3; 5-20%) which generally occur in steep sideslopes, although there are some wider glacial scour features (USFS 1996a, pg. I-10). Sullivan Creek above Gypsy Creek (RM 13.8), including the lower portions of most larger tributaries, is generally less steep than the headwaters reaches (5-8 %) and has a boulder/cobble dominated bed (Rosgen A2). Upstream of Gypsy Creek, Sullivan Creek flows through a fairly narrow valley (150 to 500 feet wide), however this reach does include significant areas of lower gradient sections (USFS 1996a, pg. I-10). Sullivan Creek from Gypsy Creek downstream to N. Fk. Sullivan Creek (RM 2.35) is generally low gradient (1.5-4%), also with a boulder/cobble dominated bed (Rosgen B3). The stream in this reach flows through a glacial valley, and the valley bottom generally ranges from 300 to 1200 feet wide. Some sections appear to have been straightened (USFS 1996a, pg. I-10). Sullivan Creek from N. Fk. Sullivan Creek downstream to the mouth is generally a steep (4-10%), bedrock-dominated channel (Rosgen A1 channel; USFS 1996a). It is deeply entrenched and deeply confined as it cuts through a rock canyon. Landslides are the primary erosion processes evident in the Sullivan Creek watershed (USFS 1996a, pg. I-5).

The runoff regime in the Sullivan Creek watershed is snow-pack dominated, and spring run-off is the major channel forming hydrologic event (USFS 1996a, Sullivan Crk. Watershed Assessment, pg. I-9). Rain-on-snow events are rare in the northern portion of Pend Oreille County where the Sullivan Creek watershed is located. During the period of record, Sullivan Creek has not experienced high flows from rain-on-snow events (USFS 1996a, pg. III-2). Measurements taken at a USGS streamflow gage (No.12396900) show maximum flows occur in May through June with the minimum flows (baseflow) occurring in the winter months, a result of frozen conditions. The gage is located on Sullivan Creek where Mill Meadow Bridge crosses Sullivan Creek Road, just above the confluence of Sullivan Creek with Outlet Creek (RM 5.3). Maximum flow recorded at the confluence of Outlet Creek was 1,200 cfs on May 25, 1961. Minimum flow recorded at the gage was 12 cfs on December 1965. Years of gage operation are 1959-1972 and 1978-to present (R. Dasher, POCD, pers. comm., 2002). McLellan (2001) offers just one day of discharge data on Sullivan Creek, measured just upstream of the confluence with Outlet Creek (RM 5.3); 1.17 m^3/second (41.3 cfs) on August 16th, 2000. The discharge of lower Sullivan Creek measured near the mouth on August 16th was 2.20 m^3/second (78 cfs; McLellan 2001, pg. 82).

Sullivan Creek Watershed Current Known Habitat Conditions.

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Sullivan Creek (62.0074). Using the Powers and Orsborn methodology (1984), at RM 0.6, about 500 feet upstream of the powerhouse, there is a "turbulent cascade" that is a fish passage barrier (CES 1996, pg. 21). Although Cascade Environmental Services (CES) submits that the barrier is a formidable obstruction to upstream migration of bull trout, the barrier cannot be classified, with the information available, as an absolute blockage under all conditions and flows. This barrier was assessed at multiple flows on various dates: Sept. 22, 1994/ 50cfs; July 6, 1995/ 198cfs; August 7, 1995/ 72cfs; November 2, 1995/ 192cfs; November 4, 1995/ 323cfs (CES 1996, pg. 22, 24).

Sullivan Creek. Using the Powers and Orsborn methodology (1984), at RM 0.65, approximately 720 feet upstream of the powerhouse, there is barrier comprised of a complex chute with a cascades component (CES 1996, pg. 22, 23). Although CES submits that the barrier is a formidable obstruction to upstream migration of bull trout, the barrier cannot be classified, with the information available, as an absolute blockage under all conditions and flows. This barrier was assessed at multiple flows on various dates: Sept. 22, 1994/ 50cfs; July 6, 1995/ 198cfs; August 7, 1995/ 72cfs; November 2, 1995/ 192cfs; November 4, 1995/ 323cfs (CES 1996, pg. 22, 24).

Sullivan Creek. Mill Pond Dam is currently a barrier to upstream fish passage (McLellan 2001, pg. 82; USFS 1999ce, pg. 9). There is downstream fish passage at Mill Pond Dam via the spillway (POPUD 1/29/03 final draft report review comments, March 2003). The dam is a 55-foot high concrete structure constructed in 1913-1914 for power production. It is owned by the Pend Oreille Public Utility District (POPUD) and is located at RM 3.25. The original log-crib dam was constructed in 1913 with a wooden fish ladder (USFS 1996, pg. I-13). However, in the early 1920s, the log crib dam was replaced by a concrete structure and the fish ladder was not replaced (T. Shuhda, pers. comm. cited in POCD 2001b, Part 2, pg. 6).

Outlet Creek (62.0093). Sullivan Lake Dam (RM 0.5) is currently a barrier to upstream fish passage (McLellan 2001, pg. 82; USFS 1999ce, pg. 9). There is downstream fish passage through the open dam gates when water is not being stored (POPUD 1/29/03 final draft report review comments, March 2003). The dam is a 29-foot high structure constructed around 1921-23 (USFS 1996, pg. I-13) and raised the level of Sullivan Lake by 25 feet (Bamonte 1996, pg. 177). It is owned and operated by the Pend Oreille PUD and is located at the outlet of Sullivan Lake. The original log-crib dam was constructed in 1913 with a wooden fish ladder (USFS 1996, pg. I-13). However, in 1922, the log crib dam was replaced by a concrete structure (raising the lake level by 40 feet; Bamonte 1996, pg. 177) and the fish ladder was not replaced (T. Shuhda cited as pers. comm. in POCD 2001b, Part 2, pg. 6).

Noisy Creek (62.0101). At the mouth, the creek naturally dewaters annually for nine months from about late June/early July until spring runoff (T. Shuhda/USFS and C. Vail/WDFW, pers. comm., 2002).

N. Fk. Sullivan Creek (62.0075). The culvert crossing at Sullivan Lake Road (County Rd. 9345) near the mouth is a barrier to fish passage (C. Vail, WDFW, 1/29/02 final draft review comments, Feb. 2003).

N. Fk. Sullivan Creek. Not far downstream from the N. Fk. Sullivan Creek Dam (RM 0.25) there is a 6 foot vertical falls that appears to be a full barrier to upstream fish passage (T. Shuhda, USFS, email comm., Feb. 2003; C. Vail, WDFW, 1/29/02 final draft review comments, February 2003). Shuhda (USFS) bases his determination that the natural falls is a barrier on his observations made at low flows. Shuhda notes he has not observed the falls at high flows. Vail (WDFW) bases his determination that the natural falls is a barrier due to height and lack of a plunge pool at the base, on his observations made on Feb. 3, 2003.

N. Fk. Sullivan Creek. The concrete N. Fk. Sullivan Creek Dam was constructed in the late 1950s and is located at RM 0.25. It is owned and operated by the POPUD to supply drinking water for the town of Metaline Falls. The facility is small with a reservoir that stores less than 10 acre-feet of water. The dam is currently a barrier to upstream fish passage (USFS 1996, pg. I-39; POCD 2001b, Part 2, pg. 6) however a natural 6 foot vertical falls just downstream of the dam has been identified as a full barrier to upstream fish passage (by T. Shuhda, USFS, email comm., Feb. 2003; C. Vail, WDFW, 1/29/02 final draft review comments, February 2003).

Kinyon Creek (62.0183). The culvert (Culvert_id # 98) at RM 0.3 at the County Rd. C2220 creek crossing (road mile 1.2) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Riparian Condition

Drainage-wide. Upstream of Mill Pond Dam (RM 3.25), the riparian areas along Sullivan Creek and Harvey Creek and its tributaries have been heavily logged historically. Past harvest and wildfires have removed most of the largest components of the riparian stands, although species composition of the vegetation community is primarily composed of species expected of the natural community. The riparian areas are also continuous in nature with limited road crossings. Portions of the riparian areas have been replaced by USFS and county road systems limiting the total riparian area from historic levels (USFS 1999ce, pg. 12). County Rd. 9345 and USFS Rd. 2220 are located within a major portion of the Sullivan Creek valley bottom. County Rd. 9345 and USFS 1935 are located within a major portion of the Harvey Creek valley bottom (USFS 1999ce, pg. 11). While the riparian vegetation is not at climax conditions, over 50% of the existing vegetation is what would be expected of these conditions. The riparian area is presently providing adequate shade, detritus, and LWD for the stream system. In some areas, particularly valley bottoms, the width of the existing riparian buffer may not be adequate to filter all the sediment that leaves the road surfaces during the year (USFS 1999ce, pg. 12).

Drainage -wide. Seventy-six user-created (dispersed) campsites have been identified by the USFS, the majority of which are located in the immediate vicinity of streams (about 37 sites are located within 300 feet of streams; USFS 1996, pg. I-41). Several sites are compacted, however it is not believed the compaction has a significant negative impact habitat conditions in Sullivan Creek (USFS 1996, pg. III-3).

Sullivan Creek. Before human influence, conifers grew to the edge of the creek bank, which is the first terrace, and hardwoods grew in the creek on depositional areas. Climax riparian vegetation for Sullivan Creek from the mouth upstream to Deemer Creek (RM 17.6) is hemlock/wild ginger with thinleaf alder on point bars and other depositional areas. The existing riparian vegetation contains spruce with some small cedar and hemlock. Historically the area has been hi-graded since the 1800s as seen from some very old, large stumps. On Sullivan Creek upstream of the confluence with Deemer Creek, the riparian vegetation is in climax condition. Large hemlock trees line the channel and supply the stream with LWD. Sitka alders grow in the creek in depositional areas (USFS 1996, pg. III-10, IV-9).

Mill Pond. The mature, large tree component of the well-developed riparian vegetation along Mill Pond is sparse (USFS 1996, pg. III-9). Records indicate a large cedar grove was logged and cleared to build the Mill Pond Dam around 1909 (Bamonte 1996, pg. 177, 178). The Inland Portland Cement Company needed to generate electricity before they could begin producing cement and Mill Pond Dam was one part of the hydroelectric project the cement company developed starting in 1909. It began with the construction of Sullivan Lake Dam. After building Mill Pond dam, the concrete company constructed a sawmill at the west end of the mill pond to provide lumber for the construction of the cement plant and a 6'x 9' wooden flume. The 2.5 mile flume channeled the water from the mill pond dam down to a reservoir and from there the water dropped 450 feet through a three-foot pipe to a generating plant on Sullivan Creek that was located just upstream from the confluence with the Pend Oreille River (Bamonte 1996, pg. 177).

Outlet Creek. Alterations within the riparian zone of Outlet Creek (i.e. home development, stream gaging station placement) have a small negative impact on riparian habitat (TAG 2002).

Sullivan Lake. The mature, large-tree component of the well-developed riparian vegetation along Sullivan Lake is sparse (USFS 1996, pg. I-14). Huge stumps along the lakeshore, still visible through the clear waters of Sullivan Lake, reveal the size of the trees that once grew along the lake prior to construction of Sullivan Lake Dam (Bamonte 1996, pg. 177).

Sullivan Lake. Riparian vegetation is negatively impacted by artificially managed lake levels on Sullivan Lake as a result of the operation of Sullivan Lake dam. In an agreement with the USFS, during the summer period, the lake levels are maintained at a higher elevation to accommodate recreation interests. There is as much as a 20-foot drawdown on Sullivan Lake from the end of November to the beginning of March when spring runoff begins refilling the Lake (J. Blum, Framatome ANP, pers. comm., 2002).

Deemer Creek (62.0203a). In 1994, the USFS collected data on various habitat attributes for Deemer Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of riparian conditions as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

Deemer Creek. Climax riparian vegetation below 5,200 feet and at the confluence with Sullivan Creek is hemlock/oakfern association. Currently it is not in climax condition and is mainly spruce/hemlock/cedar (USFS 1996, pg. III-10).

M. Fk. Harvey Creek (62.0119) and N. Fk. Harvey Creek (62.0119a). In 1992, the USFS collected data on various habitat attributes for M. Fk. Harvey Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of riparian conditions as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

Channel Conditions/Dynamics

Streambank Condition

Watershed-wide. Seventy-six user-created (dispersed) campsites have been identified by the USFS, the majority of which are located in the immediate vicinity of streams (about 37 sites are located within 300 feet of streams; USFS 1996, pg. I-41). Several sites are compacted, however it is not believed the compaction has a significant negative impact on habitat quality in Sullivan Creek (USFS 1996, pg. III-3).

Drainage-wide. Streambanks above the bankfull flow have high vegetative cover (75% or greater) and well-established riparian communities. Eleven out of 14 reaches in upper Sullivan Creek have streambanks with 25 to 50% vegetative cover (USFS 1999ce, pg. 10).

Sullivan Creek. The slopes along the south side of lower Sullivan Creek were the historical site of a 2.5-mile, cedar, closed-box flume that transported water to produce power from the present Mill Pond Reservoir to a powerhouse near the mouth of Sullivan Creek. The flume was constructed from a stand of mature cedar from the south end of Sullivan Lake. This flume historically caused landslides into the creek. Presently the slopes are still unstable as evidenced by landslides as recent as 1997 (USFS 1999ce, pg. 11).

Sullivan Creek. Historically, Sullivan Creek appears to be prone to landslide activity, especially where the stream channel intercepted slide areas (USFS 1996, pg. IV-1). From 1955 to the mid-1970s, timber harvest activity and associated road construction was considerable. As far back as the 1950s to mid-1960s, some reaches of Sullivan Creek were straightened. Then around 1970, high flows damaged the Sullivan Creek Road (USFS Rd. 2200 and 2220), so riprap was placed and LWD removed to prevent lateral migration of the channel to protect the road (USFS 1996, pg. IV-4, IV-5). The armoring and straightening were apparently done to stop small rotational slides along the valley sides and to protect U.S. Forest Roads 2200 and 2220 (Sullivan Creek Road) where construction of roads cutting the toe of slopes, may have reactivated old slide areas (USFS 1996, pg. IV-4). The number of landslides has decreased since the mid-seventies. The jammer roads that are prone to failure have apparently failed and the practice has been discontinued. The trend for human-caused debris torrents is decreasing because fewer roads are being constructed and larger culverts are being installed in streams (USFS 1996, pg. V-1). Currently, the banks along Sullivan Creek are generally in pretty stable condition (USFS 1996, pg. III-2).

Sullivan Creek. Portions of Sullivan Creek from N. Fk. Sullivan Creek (RM 2.35) upstream to Gypsy Creek (RM 13.8) have been straightened (USFS 1996, pg. III-3). Evidence was found that a section of channel was straightened in 1962 under a Federal work program. Aerial photo interpretation by the USFS, comparing 1949 and 1972 photos confirmed that the channel is straighter today than in 1949, and that the straightening was done in the late 1950s to mid 1960s (USFS 1996, pg. IV-1).

Sullivan Creek. A slide near Clark Creek is being undercut by Sullivan Creek (USFS 1996, pg. III-1).

Outlet Creek. There are unstable banks along Outlet Creek (J. Blum, Framatome ANP, pers. comm., 2002).

Harvey Creek. Streambank condition is fair (USFS 2002f, 1991 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

M. Fk. Harvey Creek. Streambank condition is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

N. Fk. Harvey Creek. Streambank condition is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Floodplain Connectivity

Sullivan Creek drainage. The Sullivan Creek drainage consists of primarily Rosgen A and B channels types in V- or U-shaped narrow valley forms. Rosgen A and B channel types with narrow V-or U-shaped valley form do not naturally have well developed off-channel habitat and extensive wetlands as found in C channels types within wide alluvial floodplains. Floodplains are relatively small as are riparian areas. Streams such as Sullivan and Harvey creeks and their tributaries do not and did not historically have many oxbows, backwater and ponds. The watershed does have shallow water habitat along the stream margins and some side channel habitat due to bar formation and braiding initiated by occasional large collections of wood debris (USFS 1999ce, pg. 9).

Deemer Creek. In 1994, the USFS collected data on various habitat attributes for Deemer Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of floodplain connectivity as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

Harvey Creek. In 1991, the USFS collected data on various habitat attributes for Harvey Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of floodplain connectivity as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

M. Fk. Harvey Creek. In 1992, the USFS collected data on various habitat attributes for M. Fk. Harvey Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of floodplain connectivity as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

N. Fk. Harvey Creek. In 1992, the USFS collected data on various habitat attributes for N. Fk. Harvey Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of floodplain connectivity as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

Channel Stability

Sullivan Creek. From the mouth upstream to Gypsy Creek (RM 13.8), the channel has deepened somewhat and stabilized. Mid-channel bars have generally disappeared. Bankcutting and lateral migration have generally ceased (some bankcutting continues due to dredging; USFS 1996, pg. III-3).

Sullivan Creek. Efforts to protect Sullivan Creek Road (USFS Rd. 22/2220), located near the creek, means that the creek cannot be allowed to meander "naturally" (USFS 1996, pg. V-2).

Sullivan Creek. Construction of Mill Pond and Sullivan Lake dams has changed the flow and bedload transport regimes of Sullivan Creek downstream of the dams. It is difficult to determine how the reduced sediment load and the reduced peak spring (channel maintenance) flows below Mill Pond combine to affect Sullivan Creek (USFS 1996, pg. V-2). Under the current operations agreement, Sullivan Lake has to be at "full pool" by June 1 of the year. To reach "full pool" level by June 1, depending on the spring run-off timing and volume, in the spring certain volumes of flow begin to be held back at the dam reducing flows in Sullivan Creek below Sullivan Lake Dam. In high run-off years, water flows down Sullivan Creek below the dam have exceeded 1000 cfs in the spring, sufficient to have blown out some instream restoration activities in Sullivan Creek (POPUD, 1/29/03 final draft report review comments, March 2003).

Sullivan Creek. Channel stability on Sullivan Creek ranges from good to excellent (Wasson 1992, unpublished USFS rept, cited in USFS 1996, pg. III-3).

Leola Creek (62.0203). Channel stability is fair (USFS 2002f, 1994 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Deemer Creek. Channel stability is fair (USFS 2002f, 1994 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Habitat Elements

Channel Substrate

Drainage-wide. Chronic surface erosion from roads is the primary source of fine sediment in-stream. There are approximately 46 miles of road within 200 feet of streams, many of which are closed but Sullivan Creek Road (USFS Rd. 2200 and 2220) is open and is adjacent to Sullivan Creek for most of its length (USFS 1996, pg. III-1).

Sullivan Creek. All reaches surveyed (RM 0 – 21) had embeddedness levels of <35%. The natural level of embeddedness is not known for these channels and geologic types due to lack of reference streams (USFS 1999ce, pg. 9).

Sullivan Creek. Flooding and scouring are likely occurrences in lower Sullivan Creek. Streamflows in the Sullivan Creek reach downstream of the powerhouse (RM 0.6) are not regulated by the Project. High flows during snowmelt are typical and can exceed 1,000cfs during times of the year when bull trout eggs and alevins are still in the gravel (CES 1996, pg. 25).

Sullivan Creek. Downstream of Mill Pond (RM 3.25), channel bedload material is deficient. All bedload sediment, and most suspended sediment that enters Mill Pond, is deposited behind the dam (USFS 1996, pg. I-9, I-13). A delta has developed in Mill Pond, estimated to contain 72,719 cubic yards of material (cited to Jones 1977, an unpublished USFS rept. on Sullivan Creek watershed, in USFS 1996, pg. IV-1).

Sullivan Creek. Upstream of Mill Pond (RM 3.25), spawning habitat is poor due to lack of habitat to trap spawning gravels (USFS 1996, pg. I-13).

Sullivan Creek. Considerable timber harvest has occurred in the Sullivan Creek watershed (USFS 1996, pg. IV-4). From 1955 through the mid-1970s, extensive logging occurring in the watershed using the Idaho Jammer system. Jammer “roads” were built every 100-500 feet and trees were yarded to these roads. Generally the “roads” had no culverts or other drainage structures, and were closed after harvest (USFS 1996, pg. IV-2). Some channel straightening from RM 0.5 – 2.1 and riprapping and gabion placement was undertaken along Sullivan Creek as far back as the 1950s to mid-1960s; evidence was found of one section of Sullivan Creek being straightened in 1962 under a federal work program. Aerial photo interpretation confirms that Sullivan Creek is straighter today than it was in 1949 (USFS 1996, pg. IV-1).

Historically, Sullivan Creek appears to be prone to landslide activity, especially where the stream channel intercepted slide areas (USFS 1996, pg. IV-1). The armoring and straightening were apparently done to stop small rotational slides along the valley sides and to protect U.S. Forest Roads 2200 and 2220 (Sullivan Creek Road) where construction of roads cutting the toe of slopes, may have reactivated old slide areas (USFS 1996, pg. IV-4). Also, in the 1970s riprap was placed and LWD was removed to prevent lateral migration of the stream after high flows damaged the road (USFS 1996, pg. IV-5). Currently, the channel has deepened somewhat and stabilized. Mid-channel bars have generally disappeared. Bank cutting and lateral migration have generally ceased (some bank cutting continues due to dredging; USFS 1996, pg. IV-5). The extent to which this has been exacerbated by human-induced activities in the watershed, like timber harvest, roading, channel straightening, and bank armoring, is uncertain.

Sullivan Creek. Debris torrents, triggered by road systems associated with extensive jammer logging from 1955 through the mid-1970s, put a lot of bedload and organic debris into Sullivan Creek (combined with probably surface erosion from the jammer logging). Aerial photo examinations by the USFS showed evidence of several hundred-year-old landslides in road cuts made along U.S. Forest Rd. 2212 near Totem (RM 10.75) and Rainy creeks (RM 11.7; USFS 1996, pg. IV-1).

Outlet Creek. Operation of Sullivan Lake Dam may contribute to sediment deposition in Outlet Creek (J. Blum, Framatome ANP, pers. comm., 2002). However, Outlet Creek is known to provide good kokanee spawning habitat because it has stable flows and a lower gradient than Sullivan Creek (C. Vail, WDFW, email comm., 2002).

Sullivan Lake. Being a lake, fines probably do accumulate in Sullivan Lake (J. Blum, Framatome ANP, pers. comm., 2002). The extent to which sediment levels are artificially elevated in the lake is unknown.

Tributaries to Sullivan Creek. All reaches surveyed, with the exception of one reach on Harvey Creek, had embeddedness levels of <35%. The natural level of embeddedness is not known for these channels and geologic types due to lack of reference streams (USFS 1999ce, pg. 9).

Large Woody Debris

Sullivan Creek. Woody debris is generally below Mill Pond Dam. High winter flows through the steep-walled canyon appear to flush woody debris out of the lower system (CES 1996, pg. 25).

Sullivan Creek. Nine out of 19 reaches of Sullivan Creek had <20 pieces/mile of LWD. The riparian areas along Sullivan Creek have been historically harvested and have roads located within some of the riparian areas. Dams on Sullivan Lake and on Sullivan Creek have prevented and continue to prevent the downstream movement of large wood into lower Sullivan Creek where five of the nine large wood deficient reaches exist. Upstream of the Sullivan Lake and Mill Pond dams, the ability of the existing riparian areas to provide future recruitment source for LWD in the long term is good (USFS 1996ce, pg. 9).

Sullivan Creek. Large woody debris occurred in low densities in Sullivan Creek (McLellan 2001, pg. 119)

Sullivan Creek. Woody debris removal in Sullivan Creek and channel straightening in portions of Sullivan Creek from N. Fk. Sullivan Creek (RM 2.35) upstream to Gypsy Creek (RM 13.8), may have contributed to a more simplified channel (USFS 1996, pg. III-3). Woody debris jams were removed in the 1970s to reduce lateral migration and bank cutting around the jams (USFS 1996, pg. IV-5). Low LWD levels are causing major channel instability. Historically, Sullivan

Creek had large debris jams that stored sediment, provided bank armoring, deepened the channel, and provided resistance to flow. Historic riparian harvest, road building, and dispersed recreation have greatly diminished the supply of LWD that make up debris jams (USFS 1996, pg. III-8).

Harvey Creek. Three out of 8 reaches had <20 pieces/mile of LWD. The riparian areas along Harvey Creek have been historically harvested and have roads located within some of the riparian areas, however the ability of the existing riparian areas to provide future recruitment source for LWD in the long term is good (USFS 1996ce, pg. 9).

Tributaries to Harvey Creek. All reaches surveyed had numbers of LWD >20 pieces/mile (USFS 1996ce, pg. 9).

Pool Frequency and Quality

Sullivan Creek drainage. Sullivan Creek pool numbers are less than expected for most of its reaches. The criteria for what constitutes pool habitat were liberalized in the 1997 protocol when compared to earlier stream survey protocol. The 1993 protocol was used on stream surveys on Sullivan Creek. It is expected that pool numbers would increase if the creek were resurveyed using the 1997 survey protocol and may meet the numbers given within the rating system for this indicator. Although the pools per mile do not meet the criteria for functioning appropriately, it is felt that present pool habitat numbers and size are what should be expected within stream systems the size of Sullivan Creek (USFS 1999ce, pg. 9).

Sullivan Creek. The stream downstream of the canyon and powerhouse (RM 0.6) consists primarily of riffles, boulder runs, and low-gradient cascades. Large woody debris is generally lacking within and below the diversion reach (RM 0.5 - 3.25). High winter flows through the steep-walled canyon appear to flush woody debris out of the lower system, so that pools, overhead cover, and hydraulic complexity are created by bedrock and boulder (CES 1996, pg. 25).

Sullivan Creek. Pools are lacking in Sullivan Creek. Woody debris removal and channel straightening in portions of Sullivan Creek from N. Fk. Sullivan Creek (RM 2.35) upstream to Gypsy Creek (RM 13.8), may have contributed to a more simplified channel (USFS 1996, pg. III-3).

Drainage tributaries. Pool frequency, on surveyed reaches within the Sullivan Creek drainage, does not meet the numbers indicated for the specific average wetted width. The criteria for what constitutes pool habitat have been liberalized in the 1997 protocol when compared to earlier stream survey protocol. The 1993 protocol was used on stream surveys in the Sullivan Creek drainage. It is expected that pool numbers would increase using the 1997 survey protocol and may meet the numbers given within the rating system for this indicator. Although the pools per mile do not meet the criteria for functioning appropriately, it is felt that present pool habitat numbers and size are what should be expected within stream systems the size of Sullivan Creek and its tributaries (USFS 1999ce, pg. 9).

Leola Creek. Pool frequency and quality is fair (USFS 2002f, 1994 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Deemer Creek. Pool frequency and quality is poor (USFS 2002f, 1994 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Harvey Creek. Pool frequency and quality is poor (USFS 2002f, 1991 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

M. Fk. Harvey Creek. Pool frequency and quality is poor (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

N. Fk. Harvey Creek. Pool frequency and quality is poor (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Pool Depth

Sullivan Creek. Pools ranged from 2.5 to 10 feet on the average in Sullivan Creek in reaches surveyed by the USFS. Snorkeling observations indicate that the amount of fines in pool substrate are negligible (USFS 1999ce, pg. 9). McLellan (2001, pg. 85), however, by randomly sampling each surveyed reach for pool habitat, found pools greater than three feet deep to be few in number.

Deemer Creek. Pool depth is poor (USFS 2002f, 1994 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Harvey Creek. Pool depth is poor (USFS 2002f, 1991 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

M. Fk. Harvey Creek. Pool depth is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

N. Fk. Harvey Creek. Pool depth is poor (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Off-Channel Habitat

Sullivan Creek drainage. The Sullivan Creek drainage consists of primarily Rosgen A and B channels types in V- or U-shaped narrow valley forms. Streams such as Sullivan and Harvey creeks and their tributaries do not and did not historically have many oxbows, backwater and ponds. The watershed does have shallow water habitat along the stream margins and some side channel habitat due to bar formation and braiding initiated by occasional large collections of wood debris (USFS 1999ce, pg. 9).

Water Quality

Temperature

Sullivan Creek. Using thermographs, stream temperatures were recorded weekly just above the powerhouse (approximately RM 0.6) from May 19, 1993 until October 17, 1995. Maximum temperature during the period of record was 67.4°F recorded July 23, 24, 26, 1994 and August 4, 1994. The 7-day average maximum temperature for the period of record was 76.4°F (July 22 through 29, 1994). Minimum temperature during the period of record was 23.3°F recorded February 7 and 8, 1994. The 7-day average minimum temperature for the period of record was 28.8°F (Jan. 4 through 10, 1995). Weekly stream temperatures were also collected using thermographs at the Mill Pond Dam from March 1 through June 26, 1993 and from August 13, 1993 through October 17, 1995. Maximum temperature during the period of record was 66.0°F recorded July 25, 1994. The 7-day average maximum temperature for the period of record was 64.9°F (July 24 through 30, 1994). Minimum temperature during the period of record was 30.6°F recorded January 5, 1995. The 7-day average minimum temperature for the period of record was 31.1°F (Jan. 2 through 8, 1995; CES 1996, Appendix J). The USFS calculated the 7-day average maximum temperatures during bull trout incubation, rearing and spawning periods in lower Sullivan Creek are as follows (USFS 1999ce, pg. 7, 8):

Period	7-day Average Temperature (ºF)
Incubation	49.2
Rearing	64.9
Spawning	58.9

Sullivan Creek. From July 24 to October 28, 2002, the USFS deployed a thermograph at the USFS boundary on lower Sullivan Creek. The 7-day average maximum temperature during the period of record was 17.1°C; the maximum temperature for the period of record was 17.9°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

Sullivan Creek. Thermographs were used to record water temperatures in the upper and lower reach of Sullivan Creek from August 15 through October 27, 1996 and again at the same locations in 1997 with hourly recordings from July 25 through November 11 (R2 Resource Consultants 1998, pg. 4-5). The two recording station were located, one at the mouth of Sullivan Creek and one midway between Lime Lake Road turnoff and the North Fork confluence with Sullivan Creek. The maximum temperature recorded on Sullivan Creek was 19.4°C on August 5, 1997 at the lower thermograph site. The 7-day average maximum temperature recorded during the period of record on Sullivan Creek was 16.9ºC at the lower thermograph site between August 24 and 30, 1996. The 7-day average maximum temperature recorded at the upper Sullivan Creek thermograph site during the period of record was 14.0 ºC between August 1 and 7, 1997 (Appendix F – Table F1). Water temperatures throughout the 1997 monitoring period were warmer in lower Sullivan Creek and showed the influence of waters discharged from Sullivan Lake, as well as the warming effect of Mill Pond Dam. The differences in maximum daily temperatures between the lower and upper station, nearly 6.5°C, were greater than the differences observed in upper and lower temperature monitoring stations in Slate, Flume, Sweet and Sand creeks during the same period (R2 Resource Consultants 1998, pg. 4-12, 13, and Appendix B).

Sullivan Creek. In 1993, the USFS recorded water temperatures twice daily during the summer months while conducting stream surveys. In 1995 and 1997, the USFS recorded water temperatures twice daily as part of the bull trout surveys being conducted in those years. Other miscellaneous stream temperatures were taken by the USFS hydrologist. The limited data in upper Sullivan Creek (above Mill Pond Dam, RM 3.5) indicates that water temperatures are consistently between 50 and 59°F (10-15°C) during the summer months and 41 to 53°F (5-12°C) into the spawning period for bull trout. Documentation is insufficient to determine the 7-day average maximum temperature in upper Sullivan Creek.

Sullivan Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting temperature data (along with pH, dissolved oxygen, stream flow, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) at the mouth of Sullivan Creek (D. Comins, POCD, email comm., Feb. 2003).

Sullivan Creek. The temperature of Sullivan Creek near the mouth was measured 1,363 times with and electronic recording thermograph, between June 28th and October 19th, 2000. A maximum temperature of 18.86°C/66°F was recorded on August 9th and a minimum of 4.93°C/40.87°F on September 23rd (McLellan 2001, pg. 29, 82).

Sullivan Creek. The temperature of Sullivan Creek approximately one mile upstream of the Outlet Creek confluence (RM 6.3) was measured 1,363 times with an electronic recording thermograph, between June 28th and October 19th, 2000. A maximum temperature of 14.60°C/58.28°F was recorded on August 9th and a minimum was 2.45°C/36.41°F on October 6th.

Sullivan Creek. The temperature of Sullivan Creek just upstream of the Deemer Creek confluence (RM 17.6) was measured 763 times with the thermograph, between August 17th and October 19th, 2000. A maximum temperature of 10.56°C/51°F was recorded on August 25th and a minimum of 1.02°C/33.84°F on October 6th (McLellan 2001, pg. 29, 82).

N. Fk. Sullivan Creek. From July 18 to September 18, 2002, the USFS deployed a thermograph at the USFS boundary on N. Fk. Sullivan Creek just upstream from the Sullivan Creek confluence. The 7-day average maximum temperature during the period of record was 11.8°C; the maximum temperature for the period of record was 12.2°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

Gypsy Creek. Limited water temperature data indicates that water temperatures range between 48º and 60ºF. (9-16ºC) and 40-48ºF (4-9ºC) during the bull trout spawning period. Documentation is insufficient to determine the 7-day average maximum temperature (USFS 1999ce, pg. 7).

Leola Creek. Limited water temperature data indicates that water temperatures range from 46-50ºF. (8-10ºC) during the summer months and 38-43ºF. (3-6ºC) during the spawning period for bull trout. Documentation is insufficient to determine the 7-day average maximum temperature (USFS 1999ce, pg. 7).

Deemer Creek. Limited water temperature data indicates that water temperatures range from 48-50ºF (9-10ºC) during the summer months and 38-46ºF (3-8ºC) during the spawning period for bull trout. Documentation is insufficient to determine the 7-day average maximum temperature (USFS 1999ce, pg. 7).

Harvey Creek. Limited water temperature data prior to 2002 indicated that water temperatures ranged from 50-59ºF (10-15ºC) during the summer months and 38-50ºF (3-10ºC) during the spawning period for bull trout. Documentation was insufficient to determine the 7-day average maximum temperature (USFS 1999ce, pg. 7). From July 24 to October 24, 2002, a thermograph was deployed by the USFS to record water temperatures near the mouth of Harvey Creek. The 7-day average maximum temperature during the period of record was 13.7°C; the maximum temperature for the period of record was 14.9°C (K. Honeycutt, USFS, pers. comm., 2003).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Sullivan Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting stream flow data (along with pH, dissolved oxygen, temperature, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) near the mouth of Sullivan Creek (D. Comins, POCD, email comm., Feb. 2003).

Sullivan Creek. From the mouth upstream to Sullivan Lake dam, flows have been moderated from natural levels by the artificial raising and lowering water levels in Sullivan Lake behind Sullivan Lake Dam (USFS 1999ce, pg. 11). There is as much as a 20 foot drawdown on Sullivan Lake from the end of November to the beginning of March when spring runoff begins refilling the Lake (J. Blum, Framatome ANP, pers. comm., 2002). Current maximum spring run-off flows below Outlet Creek is perhaps half to three quarters of their historic levels (USFS 1996, pg. V-2). Although there are no undisturbed watersheds of similar size, geology and geography for comparison, the artificial manipulation at the dam causes a substantial change in peak flows, base flows and flow timing (USFS 1999ce, pg. 11).

N. Fk. Sullivan Creek. N. Fk. Sullivan Lake dam, located at RM 0.25, is operated as a run-of-the-river dam. There is an eight-inch pipe at the base of the dam. Even during the lowest flows during the summer months, there is typically water spilling over the dam (J. Blum, Framatome ANP, email comm., 2003).

Harvey Creek drainage. There is very little flow data concerning flows in the Harvey Creek drainage. Conditions are similar to those in Sullivan Creek itself. The road density is moderate with some of the road system located in the valley. There is a low level of acreage in harvested openings. A majority of the most recent openings are on private lands on the lowest reaches. There are no undisturbed watersheds of similar nature for comparison purposes. It is presently unclear whether there is any evidence of an altered flow regime (USFS 1999ce, ph. 11).

Species Competition

Non-indigenous Fish

Watershed-wide. Eastern brook trout are found throughout Sullivan Creek, Copper Creek, the first mile of Deemer Creek, Fireline, Kinyon, Mankato and Stony creeks. Brook trout are thought to use the tributaries for spawning and rearing habitat with very little spawning occurring in Sullivan Creek (USFS 1996, Sullivan Creek Watershed Assessment, pg. I-13). Streams have not been stocked in eastern Washington since the mid-1980s (USFS 1996, pg. I-13).

Sullivan Creek. During snorkeling fish surveys conducted between August 7 and August 16, 2000, brook trout were only observed upstream of the Mill Pond Dam and not downstream, although both areas were surveyed. Brook trout were observed from the lowest reach above the Mill Pond upstream to the headwaters. Brown trout were also observed (McLellan 2001, pg. 82, 83). During 1995 fish surveys, CES detected brook trout from the mouth upstream to the headwaters (CES 1996, Appendix B).

Sullivan Creek. Brown trout are known to occur in Sullivan Lake and throughout Sullivan Creek both downstream and upstream of Mill Pond dam, though not in its tributaries, except for Outlet Creek (T. Shuhda, USFS, pers. comm., 2002; CES 1996, Appendix B). Two adfluvial populations of brown trout are found in Sullivan Creek from the mouth upstream to the confluence of Rainy Creek (RM 11.7). The first population comes up from the Boundary Reservoir reach of the Pend Oreille River to spawn in Sullivan Creek downstream of Mill Pond (RM 3.25; USFS 1996, pg. I-13). However, Framatome ANP biologists (consultants for the POPUD) believe the lower chutes and cascades at RMs 0.6 and 0.65 on Sullivan Creek are barriers to upstream fish passage limiting the upper extent of fish use for salmonids entering Sullivan Creek from Boundary Reservoir (POPUD 1/29/03 final draft report review comments, March 2003). The second population comes up from Mill Pond to spawn in upper Sullivan Creek and its tributaries, up to the confluence of Rainy Creek (USFS 1996, pg. I-13). Brown trout have also been found in Outle Creek which the USFS considers the main spawning grounds for brown trout saying spawning habitat above Mill Pond in main Sullivan Creek is limited (USFS 1996, pg. I-14). Framatome ANP biologists suspect that fish in Outlet Creek either come down from Sullivan Lake when the Sullivan Lake Dam gates are open or migrate upstream from Mill Pond (POPUD 1/29/03 final draft report review comments, March 2003). Also, Framatome ANP biologists have seen extremely large brown trout spawning at the confluence of Sullivan Lake and Harvey Creek (POPUD 1/29/03 final draft report review comments, March 2003). Streams have not been stocked with non-native salmonid fish species in eastern Washington streams since the mid-1980's (USFS 1996, pg. I-13).

Sullivan Creek. There are kokanee in Mill Pond that use Sullivan Creek for spawning and rearing habitat. It is unclear whether the kokanee are a remnant population of sockeye from before the damming of the Pend Oreille River or if they had been stocked (USFS 1996, pg. I-11). Streams have not been stocked with kokanee in eastern Washington streams since the mid-1980's (USFS 1996, pg. I-11). For the Sullivan Creek kokanee to be a remnant population of Columbia River sockeye, there would need to have been salmonid fish passage at Z Canyon (RM 19.0) and Metaline Falls (RM 26.5) on the Pend Oreille River. Sullivan Creek flows into the Pend Oreille River at RM 26.9, ust upstream of Metaline Falls. It is most commonly accepted that upstream anadromous fish passage on the Pend Oreille River was limited by Metaline Falls.

Sullivan Creek. Although redband rainbow trout are native in some systems in Eastern Washington, the POPUD states they have seen no documentation of native redband rainbow trout in the Pend Oreille River system between Albeni Falls and Boundary dams. Rainbow trout have been planted heavily in the Pend Oreille River and tributaries. Although their spawning time is different than bull trout, brook trout and brown trout, rainbow trout could prove to be formidable competitors in areas such as lower Sullivan Creek (POPUD, 1/29/03 final draft report review comment, March 2003).

N. Fk. Sullivan Creek. No non-native fish species are known to occur upstream of the N. Fk. Sullivan Creek Dam, only west slope cutthroat (C. Vail, WDFW, 1/29/02 final draft review comments, Feb. 2003; CES 1996; USFS 1992 electrofishing survey data, internal files).

Outlet Creek. Between May and August 1995, brook trout were detected during fish surveys (CES 1996, Appendix B).

Gypsy Creek. Brook trout were detected from the mouth upstream to the headwaters (CES 1996, Appendix B).

Sullivan Lake. Brook trout and brown trout are known to occur in Sullivan Lake (C. Vail, WDFW, pers. comm., 2002; Wydoski and Whitney 1979, pg. 37). A state record brown trout came from Sullivan Lake, weighing in at 22 pounds (Wydoski and Whitney 1979)

Harvey Creek. Brook trout are known to occur in Harvey Creek (J. McLellan, C. Vail, WDFW, pers. comm., 2002).

Sullivan Creek Watershed Fish Distribution and Use

Sullivan Creek flows into the Boundary Reservoir reach of the Pend Oreille River at RM 26.9. There is disagreement over the extent to which the natural cascades and chute at RM 0.6 and 0.65 historically blocked and currently block fish passage into upstream reaches of Sullivan Creek. Bull trout have not been found upstream of the uppermost natural cascades/chute at RM 0.65. Although the streams in the Sullivan Creek watershed have been surveyed for bull trout by electroshocking and snorkeling, only two bull trout have been observed. In 1993, a gutted, adult female bull trout was found about 150 feet upstream from the mouth of Sullivan Creek, on the shore. Also in 1993, John Blum, a biologist for CES, observed what he believed to be an adult bull trout in about 8 feet of water immediately downstream of a natural chute at RM 0.65 on Sullivan Creek. After repeated diving at the site, CES was not able to positively identify the species of the observed fish due to high water velocities, water depth, and turbulence at the location (J. Blum, Framtome ANP, pers. comm., 2002). Bull trout have not been found in any of the tributaries to Sullivan Creek, including N. Fk. Sullivan Creek. Using the Hillman and Platts methodology for detecting bull trout (1993) at seven sites on N. Fk. Sullivan Creek, at least one of which was located upstream of the N. Fk. Sullivan Creek Dam (RM 0.25), bull trout were not been detected in N. Fk. Sullivan Creek (J. Blum, Framatome ANP, pers. comm., 2003). Table 11 below describes current, known bull trout use in Sullivan Creek watershed. Maps in Appendix C illustrate the extent of "Individual Observations" and"Currently Occupied", "Recoverable", and "Suitable" bull trout habitat in the watershed. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Given the knowledge of salmonid biology and behavior, and the historic use by bull trout of the mainstem Pend Oreille River from the Columbia River confluence upstream (Baxter and Nellestijn 2000; Gilbert and Evermann 1895), it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. For all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years.

Given natural fish passage at the lower cascades and chute on Sullivan Creek (RM 0.6 and 0.65), currently the Mill Pond Dam (there is downstream fish passage at Mill Pond Dam via the spillway), and the Sullivan Lake Dam (also downstream fish passage through open gates in the dam when water is not being stored) block upstream fish passage between the majority of habitat in the Sullivan Creek watershed and the mainstem Pend Oreille River system. At RM 3.25 on Sullivan Creek, the Mill Pond Dam blocks access into the Sullivan Creek drainage. The Sullivan Lake Dam on Outlet Creek (flows into Sullivan Creek at RM 5.3), one-half mile upstream of its confluence with Sullivan Creek, blocks fish passage up into the Harvey Creek WAU. Based on a 1992 and 1994 USFS stream surveys, Sullivan, N. Fk. Sullivan Creek, Outlet, Harvey, M. Fk. Harvey, N. Fk. Harvey, Pass, Gypsy, Deemer, and Leola been identified by the Technical Advisory Group (TAG) as containing "Suitable" or "Recoverable" habitat.

N. Fk. Sullivan Creek flows into Sullivan Creek at RM 2.35, downstream of Mill Pond Dam, but a 6-foot vertical falls on N. Fk. Sullivan Creek not far upstream from the mouth appears to be a full barrier to upstream fish passage (T. Shuhda, USFS, email comm., Feb. 2003; C. Vail, WDFW, 1/29/03 final draft review comments, February 2003). Just upstream from the natural falls, the N. Fk. Sullivan Creek Dam at RM 0.25 is a barrier to upstream fish passage. The extent to which bull trout are not detected upstream of the falls may lend support to the argument that bull trout never inhabitated N. Fk. Sullivan Creek upstream of the N. Fk. Sullivan Creek Dam because of a natural conditions not because of a human-caused barrier. One WDFW fish biologist has observed that Sullivan Creek upstream of the falls is naturally too small to have supported fluvial or adfluvial life history forms of bull trout (C. Vail, WDFW, 1/29/03 final draft review comments, Feb. 2003). Also, if resident life history forms of bull trout ever inhabited N.

Fk. Sullivan Creek, they would likely still be present since the drainage upstream of the N. Fk. Sullivan Creek Dam is undisturbed by human activities with no non-native fish species present (C. Vail and J. McLellan, WDFW, 1/29/03 final draft review comments, Feb. 2003).

Table 11: Current, known bull trout use in the Sullivan Creek Watershed.

Sullivan Creek Watershed	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Sullivan Creek				X	X
N. Fk. Sullivan Creek					
Outlet Creek					X
Sullivan Lake					X
Harvey Creek					X
M. Fk. Harvey Creek					
N. Fk. Harvey Creek					
Pass Creek					
Gypsy Creek					X
Leola Creek					
Deemer Creek					X

Sullivan Creek Watershed Summary.

Historic disruption of habitat, lack of connectivity to more suitable habitat, and no plans to improve habitat conditions in lower Sullivan Creek in the next two generations prevent the Sullivan Creek watershed from functioning appropriately to sustain bull trout populations (USFS 1999ce, pg. 12). Non-native salmonid species also occur in the watershed. The extent to which brown trout, brook trout, and rainbow trout may limit the recovery of bull trout populations in the Sullivan Creek watershed is unknown.

Given there is some degree of fish passage at the lower natural cascades and chute (RM 0.6 to 0.65), habitat capable of supporting strong and significant populations of native salmonids still exists throughout the Sullivan Creek watershed . The extent to which there is fish passage at these natural cascades and chute however, is disputed among technical staff. To date, despite electroshocking and snorkeling efforts in the Sullivan Creek watershed, only two bull trout have been documented; both were below the uppermost of these two barriers (RM 0.65).

Multiple, significant, man-made fish passage barriers exist in the Sullivan Creek watershed blocking fish passage between the majority of habitat in the watershed and the mainstem Pend Oreille River system. These barriers are on Sullivan Creek at Mill Pond Dam at RM 3.25, and at the outlet to Sullivan Lake at the Sullivan Lake Dam which blocks passage into the Harvey Creek tributary drainage. Based on survey and assessment work by Cascade Environmental Services (CES), CES biologists regard the section of natural cascades and chutes near the mouth of Sullivan Creek (RM 0.6 to 0.65) as formidable obstructions to upstream migration of bull trout. CES submits that with the information available the barriers cannot be classified as absolute blockages under all conditions and flows, but that these natural barriers may be a primary factor in the apparent absence or extremely low densities of both fluvial and adfluvial populations of bull trout upstream of RM 0.65. Temperature, habitat conditions, and flood scour may also be factors in the apparent absence or extremely low densities of bull trout in lower Sullivan Creek, in what is sometimes referred to as the diversion reach. The diversion reach extends from to the powerhouse downstream Mill Pond Dam (RM 0.5 – 3.25; CES 1996, pg. 26).

Current existing operations of Sullivan Lake and Mill Pond dams also have altered the channel equilibrium of lower Sullivan Creek. This lower portion of Sullivan Creek appears to be functioning under different conditions than above Mill Pond Dam. And, although bedload and LWD is still provided to Sullivan Creek above Mill Pond Dam via upper Sullivan Creek which is not obstructed by any dams, bedload and LWD delivery to Sullivan Creek from the Harvey Creek WAU is obstructed by Sullivan Lake Dam on Outlet Creek. Mill Pond Dam is at RM 3.25 on Sullivan Creek; the Outlet Creek confluence with Sullivan Creek is at RM 5.3. The operation of Sullivan Lake Dam has a noticeable effect on the flow regime and the transport of bedload and LWD. These characteristics are not consistent with a pristine watershed of similar geology and geography (USFS 1999ce, pg. 12). The habitat below Mill Pond Dam lacks in LWD and gravels due to interception of upstream sources by the dam. Water temperatures also tend to be above the tolerance level for bull trout fry and juveniles during some summer months in this habitat below Mill Pond Dam (USFS 1999ce, pg. 10). Sediment is not considered to be a serious problem in the watershed (USFS 1999ce, pg. 8, 9), and although a few reaches on Harvey Creek and Sullivan Creek upstream of the dams are below expected levels for LWD, recruitment potential is good and LWD in tributaries is at expected levels. There are slide areas below Mill Pond Dam which provide sediment input; also placer gold mining occurs in the watershed in areas that could be potentially accessible to bull trout; these operations have the ability to disturb the stream bed and fish that may be in the area (POPUD 1/29/03 final draft report review comments, March 2003).

Sullivan Creek Watershed Data Gaps.

- It is uncertain the extent to which human-induced activities like past timber harvest, roading, channel straightening and bank armoring, and alteration to bedload and LWD transport by the dams are contributing to habitat degradation in Sullivan Creek. A channel migration zone study may be needed;

- Placer gold mining should be evaluated to determine if restrictions or elimination of this activity could impoveimprove habitat conditions for bull trout (POPUD 1/29/03 final draft report review comments, March 2003).

<u>BOX CANYON WAU</u>

Box Canyon WAU Description

The Box Canyon WAU encompasses approximately 56,172 acres and captures several tributaries that flow into the Pend Oreille River, including Beaver Creek, Flume Creek, Pocahontas Creek, Sweet Creek, Sand Creek, and Cedar Creek. Beaver, Flume, Pocahontas, Sweet, and Sand creeks enter the Boundary Reservoir reach of the Pend Oreille River at RMs 24.3, 25.8, 29.4, 30.9, and 31.6, respectively. Cedar Creek enters the Box Canyon Reservoir reach at RM 37.7. Beaver and Pocahontas creeks are not addressed in this report because no “Individual Observations” or “Currently Occupied” or “Suitable” bull trout habitat has been identified in either of these drainages. Elevations in the Box Canyon WAU range from 6,215 feet at Linton Mountain to approximately 1,800 feet at the Pend Oreille River.

<u>Flume Creek</u> has 13.0 m (43 foot) vertical waterfall located at RM 0.2 that is a fish passage barrier (McLellan 2001, pg. 63; R2 Resource Consultants 1998).

<u>Sweet Creek</u> drains an area of approximately 11 square miles. At least 50% of the drainage is in private ownership. The portion of the drainage within the USFS boundary is roadless with a management emphasis on semi-primitive non-motorized recreation (USFS 1999ca). A natural falls at RM 0.6 on Sweet Creek blocks upstream fish passage further into the Sweet Creek drainage (McLellan 2001, pg. 91).

<u>Sand Creek</u> drains an area of approximately 8.4 square miles (USFS 1999bf). An impassable culvert at RM 0.25 on Sand Creek is a full barrier blocking fish passage from the Boundary Reservoir into Sand Creek (McLellan 2001, pg. 65).

<u>Cedar Creek</u> is approximately 11.5 miles long and drains an area of approximately 19 square miles (USFS 1999ae, pg. 1; KNRD and WDFW 1997b, pg. 8). The 19-foot high Cedar Creek municipal dam at RM 1.5 is a full barrier blocking upstream fish passage on Cedar Creek. The dam had formerly served as the water supply reservoir for the Town of Ione, but in the 1988, its use as the principal water supply was discontinued when the town switched to a well supply (MWH 2002, pg. 2).

Box Canyon WAU Hydrogeomorphology.

Descriptive information in the literature on the hydrogeomorphology of drainages in the Box Canyon WAU is limited. In Flume Creek, the dominant substrate is cobble and the dominant habitat type is riffle (86%). The discharge of Flume Creek on September 6, 2000 was 0.25 m^3/second (McLellan 2001, pg. 63). In Sweet Creek the dominant substrate is boulder and the dominant habitat type is riffle (81%). The discharge of Sweet Creek on September 11, 2000 was 0.15 m^3/second (McLellan 2001, pg. 91). In Sand Creek, the dominant substrate is sand and the dominant habitat type is riffle (69%). The discharge of Sand Creek on September 7, 2000 was 0.01 m^3/second (McLellan 2001, pg. 65). The lower reach of Sand Creek is braided, and water runs through a delta area that contains a porous stream bed with subsurface flows. Estimated flow during August 1996 was less than 1 cfs, and no channel areas exceeding one foot deep were observed with the lower 0.25 miles of Sand Creek (R2 Resource Consultants 1998, pg. 2-15). Cedar Creek is fed by the water from surrounding ridges and two secondary tributaries; Jim Creek and Lost Lake Creek. Discharge at approximately RM 0.75 ranged from 3.03 cfs on September 23, 2002 to 104.33 cfs on June 3, 2003 (POCD preliminary data from 2002 DOE Water Resources Grant study).

Box Canyon WAU Current Known Habitat Conditions.

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

<u>Access to Spawning and Rearing</u>

<u>Obstructions</u>

(natural barriers are also provided here)

<u>Beaver Creek (62.0053).</u> At the mouth there is an 83 foot falls that is a full fish passage barrier (McLellan 2001, pg. 92).

<u>Flume Creek (62.0054).</u> There is a 13.0 m (43 foot) vertical waterfall located at approximately RM 0.2 that is a fish passage barrier (McLellan 2001, pg. 63; R2 Resource Consultants 1998).

<u>Flume Creek.</u> At RM 1.0, the culvert under the County Road, Boundary Road, is a potential fish passage barrier. The culvert outlet was approximately 2.5 m (8 feet) vertically above the surface of the plunge pool (McLellan 2001, pg. 63).

Flume Creek. The culvert at the USFS Rd. 350 (RM 4.75) crossing is a potential fish passage barrier. The culvert outlet is 1.5 m (5 feet) high and there is no plunge pool below it (McLellan 2001, pg. 63).

Sweet Creek (62.0224). At RM 0.5, the State Hwy. 31 stream crossing is shown as a barrier in the WDFW Salmonid Screening, Habitat Enhancement, and Restoration Division (SSHEAR) GIS barriers coverage current as of November 2002. However, an adult bull trout was observed upstream of the culvert in 2000 (McLellan 2001, pg. 91). Juvenile whitefish have also been observed upstream of the State Hwy. 31 crossing indicating there is at least some degree of passage at the crossing (C. Vail, WDFW, pers. comm., 2002).

Sweet Creek. Beginning at RM 0.6 (R2 Resource Consultants 1998, pg. 2-12), there is a series of four natural waterfalls, each a fish passage barrier. The first waterfall is a 6.0 m (20 foot) falls located 200 m (700 feet) upstream from the State Hwy. 31 crossing (McLellan 2001, pg. 91). The second waterfall is a also a 6 m (20 foot) falls located 20 m (70 feet) upstream of the first waterfall. The third waterfall is also a 6.0 m (20 foot) falls and located 500 m (1,650 feet) upstream of the second waterfall. The fourth waterfall has an 8.2 m (27 foot) vertical height and is located 150 m (500 feet) upstream of the third waterfall (McLellan 2001, pg. 91).

Sand Creek (62.0242). In the lower stream reach, on September 17, 1979, a portion of the streambed was dry (RM 0.0 – 0.25) with water going subsurface. The stream was observed earlier in September 28, 1977 and also found to be dry. It is unclear whether the stream continues to go subsurface for part of its length each year. Flow recorded at the mouth on June 3, 1992 was 0.83 cfs. This is very low for that time of year (USFS 1999bf, pg. 9). Estimated flow during the placement of the a thermograph on August 15, 1996 was <1 cfs and no channel areas exceeding 1 ft in depth was observed in the lower 0.25 miles (R2 Resource Consultants 1998, pg. 2-14). The literature does not indicate whether dewatering is a natural condition or related to human impacts in the drainage.

Sand Creek. At RM 0.25, where the railroad track crosses the creek near USFS Rd. 3669, the 75 m (247 foot) long culvert has a 2 m (6 foot) vertical drop from the bottom edge of the culvert to the surface of the pool. This is a full barrier to upstream fish passage (McLellan 2001, pg. 65; USFS 1999bf, pg. 7).

Sand Creek. At RM 1.2, there is a natural, 5.0 m (16.5 foot) waterfall that is a barrier to upstream fish passage (McLellan 2001, pg. 65).

Sand Creek. The culvert (Culvert_id # 301) at RM 1.8 at the USFS Rd. 3310160 creek crossing (road mile 2.9) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Cedar Creek (62.0262). At RM 1.0 a culvert crossing under a private drive is a partial barrier to fish passage. The culvert likely allows fish passage at some flows (B. Heiner, WDFW Engineer and S. Lembcke, WDFW, 1/29/03 final draft review comments, Feb. 2003).

Cedar Creek. At RM 1.5, the Cedar Creek Dam is a full barrier to fish passage. The dam was originally constructed in the early 1900s and replaced in 1950 (MWH 2002, pg. 2). The current dam in an un-reinforced concrete arch dam approximately 19 feet high. It was constructed to impound 10-15 acre-feet of water. The dam had formerly served as the water supply reservoir for the Town of Ione, but in 1988, its use as the principal water supply was discontinued when the town switched to a well supply. Since then, the dam and the municipal water filtration/chlorination system have fallen into disrepair and the reservoir has become filled with sediments to within 1 - 2 feet of the dam crest. The Cedar Creek Dam has been identified by the Washington State Department of Ecology's (DOE) Dam Safety Section as at risk of structural failure during any significant flooding event. Consequently, the Town of Ione is currently engaged in a search for funds to address the safety concern and concurrently fish passage at the site. In the fall of 2002, the Town of Ione applied for funds from the Washington State Salmon Recovery Funding Board (SRFB) to remove the dam. As of the writing of this report, the awards for the 2002 Fourth Round SRFB grants have not determined. The Town of Ione retains its claim to surface water in Cedar Creek.

Jim Creek (62.0262a). At RM 1.25, there is a natural, 50 foot falls/cascade that is a barrier to fish passage (USFS 1999ae, pg. 8).

Jim Creek. At RM 1.75 there is a natural 66 foot falls that is a barrier to fish passage (USFS 1999ae, pg. 8).

Riparian Condition

Sand Creek. On USFS land (upstream of RM 2.0), the road system is primarily located outside the valley bottom, although approximately 0.75 miles of the road system are located inside of the riparian areas. Much of this road system (0.5 mile) is not maintained but has been closed to vehicular traffic due to lack of maintenance. The remaining 0.25 mile is maintained only when there is damage to the road. This section of road is being overgrown but is kept open through use by the public (USFS 1999bf, pg. 9).

Sand Creek. Wildfires and past harvest have removed most of the largest components of the riparian stands along Sand Creek, however the vegetation species composition is primarily composed of species expected of the natural riparian community. The riparian areas are also continuous in nature with the exception of several road crossings and 0.75 miles of old road located within the RHCA (Riparian Habitat Conservation Area). The riparian area appears to be providing adequate shade, detritus, and large instream wood for the stream system (USFS 1999bf, pg. 9).

Cedar Creek. The riparian alder plant community in the lower 1.5 miles of Cedar Creek has been fragmented by development within the town of Ione (A. Scott, Framatome ANP, pers. comm., 2002).

Cedar Creek drainage. Approximately 1.0 mile of county road within private and USFS lands and 0.3 mile of USFS road on USFS lands are located inside of the riparian areas (USFS 1999ae, pg. 10).

Cedar Creek and Jim Creek. Wildfires and past harvest have removed some of the largest components of the riparian stands along Cedar and Jim creeks, however the vegetation species composition is primarily composed of species expected of the natural riparian community. The riparian areas are continuous in nature with the exception of a few road crossings and portions of USFS and county roads within the RHCA. The riparian area does not appear to be providing adequate shade, LWD, and streambank stability for the lower portions of the stream system. However, the riparian areas in the headwater areas of this drainage appear to be functioning well (USFS 1999ae, pg. 10, 12).

Cedar Creek. Livestock grazing occurs within the riparian areas of Cedar Creek. Formal observations of riparian and streambank conditions indicate that this vegetation is not being overgrazed and that this activity is not degrading riparian and instream habitat (USFS 1999ae, pg. 11).

Jim Creek. In 1992, the USFS collected data on various habitat attributes for Jim Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of riparian condition as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003). In 1995, the Kalispel Tribe collected data for instream habitat attributes and also conducted snorkel stations for Jim Creek. This data has also not been analyzed (J. Maroney, KNRD, pers. comm., 2003).

Channel Conditions/Dynamics

Streambank Condition

Sand Creek. Streambank condition is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Cedar Creek. The lower 1.5 miles flows through the town of Ione where disturbances related to development have had a negative impact on bank condition (A. Scott, Framatome ANP, pers. comm., 2002).

Cedar Creek drainage. In isolated areas, there is a small amount of bank trampling and bare areas due to overgrazing by cattle. The amount of sediment introduction to the streams due to livestock grazing is small compared to the sediment that enters the stream from the county road that lies within the riparian areas of Cedar Creek, the road crossings on private lands that periodically are overtopped and destroyed by high flows, and the off-road vehicle use on and off the powerline right-of-way which passes through private and USFS lands adjacent to Lost Lake Creek (USFS 1999ae, pg. 12).

Floodplain Connectivity

Sand Creek. Floodplains along the creek are narrow, located in V-shaped valley forms of low to moderate sideslopes. The existing riparian areas are functioning and hydrologically linked to the main channel of Sand Creek (USFS 1999bf, pg. 9).

Cedar Creek. Human alterations to lower Cedar Creek may have reduced floodplain function (A. Scott, Framatome ANP, pers. comm., 2002).

Cedar Creek. Within USFS lands (upstream of RM 2.0), floodplains along the creek are narrow and located in U-shaped valley forms of low to moderate sideslopes with moderate to steep sideslopes along the upper reaches. The existing riparian areas are functioning and hydrologically linked to the main channels with the exception of where the County road, Cedar Creek Road (also called Eight Avenue), encroaches upon Cedar Creek. This portion of the drainage also has a series of old beaver ponds along the county road in the Cameron Meadows area that are hydrologically connected (USFS 1999ae, pg. 10).

Jim Creek. Within USFS lands (upstream of RM 3.0), floodplains along the creek are narrow and located in U-shaped valley forms of low to moderate sideslopes with moderate to steep sideslopes along the upper reaches. The existing riparian areas are functioning and hydrologically linked to the main channels. This portion of the drainage has a series of old beaver ponds along the county road in the Cameron Meadows area that are hydrologically connected (USFS 1999ae, pg. 10).

Channel Stability

Sand Creek. Channel stability is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Cedar Creek. The Kalispel tribe has conducted stream habitat surveys on Cedar Creek (KNRD and WDFW 1997b; T. Andersen, KNRD, pers. comm., 2003). However, the habitat data analysis and interpretation needed to make a determination of channel stability as per the USFWS habitat rating criteria has not been done.

Habitat Elements

Channel Substrate

Note: Although the documents themselves nor full citations for the documents were not made available in time for inclusion in the habitat limiting factors assessment prior to publication, the following documents deserve mention here to the extent they may prove beneficial for future habitat evaluation and planning efforts in the Box Canyon WAU: Box Canyon WAU Road Maintenance and Abandonment Plan (RMAP). The document is a matter of public record and can be found at the WDNR Northeast Regional Office in Colville, WA (Stimson 1/29/03 final draft report review comments, February 2003).

Sand Creek. Of the reaches surveyed, 5 out of 6 reaches have embeddedness levels of >35%. Reaches with embeddedness levels of >35%, include the four reaches located within USFS lands. Sand is the dominant streambed substrate material in one out of four of the USFS reaches, with gravel as the subdominant material. The remaining reaches have a dominant streambed substrate of gravel. The dominant substrate of the streambanks is sand throughout these reaches and a certain amount of natural erosion is expected. Although the natural level of embeddedness is not known due to lack of a reference watershed for comparison purposes, it appears that the level of embeddedness, hence higher than natural rates of bank erosion, are directly related to this lack of streambank cover (USFS 1999bf, pg. 7).

Cedar Creek drainage. Based on stream survey work in 1995, the percent fines ranged from 0 to 33%. A majority of the habitat has less than 4% of sand and silt as percent of the streambed substrate, however there was an accumulation of fines greater than 12% in a few of the surveyed reaches (USFS 1999ae, pg. 8).

Cedar Creek. Reaches of Cedar Creek within USFS lands (upstream of RM 2.0) were surveyed for physical habitat condition in 1992. Cedar Creek was surveyed for physical habitat from about RM 0.5 upstream to its headwaters by the Kalispel Tribe in 1995. Cedar Creek reaches had embeddedness levels of <35% upstream of Cameron Meadows and the confluence of Lost Lake Creek (USFS 1999ae, pg. 8). Reaches of Cedar Creek below the Lost Lake Creek confluence had embeddedness levels ranging from 27 to 40% (USFS 1999ae, pg. 8). Embeddedness levels were high on the reaches surveyed both immediately downstream and immediately upstream of the Cedar Creek Dam (68.1% and 63.7%, respectively; KNRD and WDFW 1997b, pg. 15). Embeddedness levels generally decreased in reaches continuing upstream of the Cedar Creek dam, ranging from 49.5% – 26.1%, with the very last reach surveyed showing an embeddedness level of 57.1%. The last reach was a very short reach located in the very headwaters of Cedar Creek (KNRD and WDFW 1997b, pg. 15). Sediment from grazing of the riparian areas, in conjunction with the road maintenance and off-road use in riparian areas, contribute to the present level of embeddedness of the pool substrate along several reaches (USFS 1999ae, pg. 13). The extent to which this sediment level is above background levels is unknown (TAG 2002).

Large Woody Debris

Sand Creek. Numbers of instream LWD exceed 20 pieces per mile on all reaches (USFS 1999bf, pg. 8).

Cedar Creek. Large woody debris levels downstream of Cedar Creek Dam is lacking. Potential LWD recruitment is also limited downstream of the dam (A. Scott, Framatome ANP, pers. comm., 2002).

Cedar Creek and Jim Creek. Numbers of LWD exceed 20 pieces per mile on all reaches upstream of Cedar Creek Dam (USFS 1999ae, pg. 8).

Pool Frequency and Quality

Sand Creek. Numbers of pools per mile on all reaches are lower than what is expected for a stream with an average wetted width of 12 feet, which is 60 pools/mile. The dominant pool substrate is sand which appears to be moderately reducing pool volume (USFS 1999bf, pg. 8).

Cedar Creek. Numbers of pools per mile on all reaches of Cedar Creek are lower than the 48 pools/mile expected for a stream with an average wetted width of 11-15 feet with the exception of one reach. Sand and finer material does not appear to be severely reducing pool volume although embeddedness of pool substrate does occur. Although LWD levels exceed standards for functioning appropriately, the relatively low number of instream large wood is most likely a factor that is limiting pool formation. Another factor contributing to low pool frequency is that the upper reaches of Cedar Creek are higher gradient step pool systems that tend to have low numbers of pools per survey definition (USFS 1999ae, pg. 8).

Jim Creek. The numbers of pools per mile on all reaches are lower than the 60 pools/mile expected for a stream with an average wetted width of 7-9 feet. Sand and finer material does not appear to be severely reducing pool volume although embeddedness of pool substrate does occur. Although LWD levels exceed standards for functioning appropriately, the relatively low number of instream large wood is most likely a factor that is limiting pool formation. Another factor is that the upper reaches of both Jim Creek are higher gradient step pool systems that tend to have low numbers of pools per survey definition (USFS 1999ae, pg. 8).

Pool Depth

Sand Creek. Pool depth is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Cedar Creek. Sand and finer material does not appear to be severely reducing pool volume in reaches surveyed by the USFS upstream of the Cedar Creek Dam (USFS 1999ae, pg. 9). Grazing of the riparian areas, in conjunction with the road maintenance and offroad use in riparian areas, does not appear to cause additional filling of existing pool habitat immediately downstream of the disturbances. The channels appear to be handling much of this excess sediment through flushing. However, sediment from these activities is contributing to the present level of embeddedness of the pool substrate along several reaches. Also, only 2 – 8% of 4.3 miles surveyed by the USFS had pools greater than 3 feet deep (USFS 1992 Cedar Creek stream survey data).

Jim Creek. Pool depth is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Off-Channel Habitat

Sand Creek. Approximately 1% of all existing habitat is side channel habitat on all reaches. These areas tend to be the result of braiding around debris jams and are low energy areas. Also, beaver dams and ponds, both active and inactive are frequent in this drainage (USFS 1999bf, pg. 8).

Cedar Creek and Jim Creek. Approximately 3.1- 5.5% of all existing habitat is side channel habitat on surveyed reaches of Cedar Creek within USFS lands (upstream of RM 2.0). These areas tend to be the result of braiding around debris jams and are low energy areas. Jim Creek and the remaining reaches of Cedar Creek have not been surveyed for off-channel habitat but high levels of pocket water (series of small pools outside of the main current) are high for both streams. This small amount of off-channel is most likely a result of the configuration of the stream in a narrow u-shaped valley form and not because of human caused influences (USFS 1999ae, pg. 9). In lower Cedar Creek, downstream of the USFS surveyed reaches, the average gradient is >2% except right at the confluence with the Pend Oreille River. Therefore, side channel habitat is not expected (TAG 2002).

Water Quality

Temperature

Flume Creek. Thermographs were used to record water temperatures in the upper and lower reach of Flume Creek from August 15 through October 27, 1996 and again at the same locations in 1997 with hourly recordings from July 25 through November 11 (R2 Resource Consultants 1998, pg. 4-5). The two recording station were located, one at the mouth and one midway between the South and Middle forks of Flume Creek. The maximum temperature recorded on Flume Creek was 14.8°C on August 5 and 6, 1997 at the lower thermograph site. The 7-day average maximum temperature recorded during the period of record on Flume Creek was 14.2ºC at the lower thermograph site between August 1 and 7, 1997. The 7-day average maximum temperature recorded at the upper Flume Creek thermograph site during the period of record was 12.6 ºC between August 24 and 30, 1996 (Appendix F – Table F1).

Flume Creek. The temperature of both upper and lower Flume Creek was measured 1,338 times with an electronic recording thermograph, between June 28 and October 17, 2000. Maximum temperature recorded on upper Flume Creek was 12.68°C/54.82°F on August 9, 2000 and a minimum of 2.88°C/37.18°F on October 6, 2000. Maximum temperature recorded on lower Flume Creek was 14.71°C/58.46°F on July 21st and 29, 2000 and a minimum of 3.19°C/37.7°F 4 on October 6, 2000. The 7-day average maximum temperature could not be calculated from the information provided in the report (McLellan 2001, pg. 63).

Flume Creek. From July 24 to September 30, 2002, the USFS deployed a thermograph at the USFS boundary on Flume Creek. The 7-day average maximum temperature during the period of record was 11.5°C; the maximum temperature for the period of record was 12.6°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

Flume Creek, Sweet, Sand and Cedar Creeks. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting temperature data (along with pH, dissolved oxygen, stream flow, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) near the mouths of Flume, Sweet, Sand, and Cedar creeks (D. Comins, POCD, email comm., Feb. 2003).

Sweet Creek. . Thermographs were used to record water temperatures in the upper and lower reach of Sweet Creek from August 15 through October 27, 1996 and again at the same locations in 1997 with hourly recordings from July 25 through November 11 (R2 Resource Consultants 1998, pg. 4-5). The two recording station were located, one just downstream of the State Hwy. 31 road crossing of Sweet Creek, and one immediately upstream of the State Hwy. 31 road crossing (RM 0.5). The upper and lower thermograph sites were in close proximity and there was little difference in temperature between the two sites. The maximum temperature recorded on Sweet Creek was 16.1°C on August 5 and 6, 1997 at the lower thermograph site. The 7-day average maximum temperature recorded during the period of record on Sweet Creek was 15.3ºC at the lower thermograph site between August 1 and 7, 1997 (Appendix F- Table F1).

Sweet Creek. The temperature of Sweet Creek was measured 1,338 times with an electronic recording thermograph, between June 28th and October 17th. Maximum temperature recorded on Sweet Creek was 15.63 °C/60.13°F on August 6th, 7th, and 9th, and a minimum of 2.26°C/36.07°F on October 6th (McLellan 2001, pg. 91).

Sand Creek. There is sporadic water temperature data on Sand Creek from the USFS. Water temperature was taken in 1979 by the Forest Hydrologist. Water temperatures were also taken by the crews surveying Sand Creek for physical habitat inventory and electroshocking (1992) and snorkeling (1997). The water temperatures ranged from 11ºC (52ºF) to 14ºC (58ºF) during a 2 week period in July of 1992. Water temperature taken on August 15, 1997 recorded 12.5ºC (55ºF) in the upper reach of the creek. The upper reaches had the lowest temperatures 52 - 54ºF. There is not enough continuous data available to determine a 7-day average maximum temperature. Highest water temperatures recorded were 14ºC (58ºF) during the month of July on a lower reach of Sand Creek. Lowest temperature recorded were 5ºC (41ºF) in May of 1979. It is not known whether water temperatures are suitable for bull trout spawning and incubation due to lack of information. Water temperatures appear to be marginal for bull trout rearing in lower Sand Creek with more tolerable temperatures in the upper headwaters (USFS 1999bf, pg. 7).

Sand Creek. . Thermographs were placed to record water temperatures in the lower reach of Sand Creek from August 15 through October 27, 1996 and again at the same location in 1997 with hourly recordings from July 25 through November 11 (R2 Resource Consultants 1998, pg. 4-5). The thermograph placed in 1996 near the mouth of Sand Creek was dewatered soon after placement in August. The lower reach of Sand Creek is braided, and water runs through a delta area that contains a porous streambed with subsurface flows. Estimated flow during placement of the thermograph was less that 1 cfs, and no channel areas exceeding 1-ft deep were observed within the lower 0.25 miles of the mouth (R2 Resource Consultants 1998, pg. 2-15). In 1997, the thermograph placed at the mouth of Sand Creek successfully recorded for the entire monitoring period. The maximum temperature recorded on lower Sand Creek was 16.6°C on August 5 and 6, 1997. The 7-day average maximum temperature recorded during the period of record on Sand Creek was 15.9 ºC at the lower thermograph site between August 1 and 7, 1997 (Appendix F – Table F1).

Sand Creek. The temperature was measured 1,363 times with an electronic recording thermograph, between June 28th and October 19th, 2000. Maximum temperature recorded was 16.26 °C (62°F) on August 23rd and a minimum of 2.53 °C (36.5°F) on October 6th (McLellan 20001, pg. 65).

Cedar Creek. Cedar Creek is listed on the 1998 DOE 303(d) list for temperature exceedences (WDOE 1998).

Cedar Creek. The USFS conducted limited water quality monitoring on Cedar Creek as early as 1964 (Entrix 2002, pg. 2-57). From 1990 to 1996 water temperatures were collected monthly during spring and fall by the USFS near the confluence of Cedar and Jim Creeks. Stream temperatures exceeded 18ºC/64.4ºF only once during 41 sampling times (Entrix 2002, pg. 2-57). Kalispel Tribal biologists recorded stream temperatures during their habitat survey work on Jim and Cedar Creeks in 1995. In 1998 water temperatures were collected daily from June through September by the USFS (USFS 1999ae, pg. 7). The POPUD collected limited temperature data on Cedar Creek in 1998, 1999 and 2000 (POPUD 2000c). Most recently, the USFS collected stream temperatures in lower Cedar Creek using a thermograph from July 2 to October 24, 2002 (K. Honeycutt, USFS, pers. comm., 2003).

Cedar Creek. Instream temperatures were collected by the POPUD in 1998, 1999, and 2000 at the mouth of Cedar Creek in concert with the operation of an adfluvial fish trap. The period of record for 1998 was July 15 – October 13. The 7-day average maximum temperature for the 1998 period of record was 20.1ºC from July 24 through July 30. The period of record for 1999 was April 1 – August 31. The 7-day average maximum temperature for the 1999 period of record was 18.9ºC from July 30 through August 5. The period of record for 2000 was January 1 – November 30. The 7-day average maximum temperature for the 2000 period of record was 19.97ºC from August 4 through August 10 (POPUD 2000c).

Lower Cedar Creek. On Cedar Creek below the municipal dam, water temperatures recorded by the USFS ranged from 20ºC (68º F) on July 21, 1994 to 4ºC (40ºF) on November 18, 1992. The 7-day average maximum temperature was 17.4ºC (63ºF) . Water temperatures in lower Cedar Creek, below the municipal dam, appear to be unsuitable for bull trout rearing. Specifically, daily water temperatures exceeded 16ºC from July 22 through August 15 in 1998. Monthly temperature readings exceeded 16ºC during the months of July and August (USFS 1999ae, pg. 7).

Upper Cedar Creek. The USFS water temperature data recorded on Cedar Creek prior to 2002 and upstream of the dam is limited to readings taken during snorkeling and physical inventory surveys. Water temperatures ranged from 10 to 11ºC on September 8, 9, 14 and 15, 1992, 8 to 13ºC on July 17, 1995, and 10 to 13ºC on August 28, 1995 on Cedar Creek above the dam. The difference between water temperatures taken the same time of day above and below the pond formed by the municipal dam was 2ºC. Waters above the pond were two degrees cooler than below the dam. This indicates that the dam and pond are a heat sink that is raising water temperatures below the dam beyond the tolerance levels for bull trout fry and juveniles during the summer months (USFS 1999ae, pg. 7). From July 2 to October 24, 2002, a thermograph was deployed by the USFS at the confluence of Cedar and Jim creeks to record water temperatures. The 7-day average maximum temperature during the period of record was 19.5°C; the maximum temperature for the period of record was 20.3°C (K. Honeycutt, USFS, pers. comm., 2003).

Cedar Creek. Water temperature was sampled one day a month for the months of August, September, October, March, April, May, June, and July from 1997 through 1998 on Cedar Creek at the mouth. A 7-day average maximum temperature can not be derived from this data. The maximum temperature recorded was 17.4ºC/63.3ºF on July 20, 1998. The minimum temperature recorded was 4.5ºC/40ºF on March 24, 1998 (POCD 1999, Appendix B).

Cedar Creek. Water temperature was sampled one day a month for the months of August, September, October, March, April, May, June, and July from 1997 through 1998 on Cedar Creek just upstream of the town of Ione. A 7-day average maximum temperature can not be derived from this data. The maximum temperature recorded was 16.4ºC/61.5ºF on July 20, 1998. The minimum temperature recorded was 4.3ºC/39.7ºF on March 24, 1998 (POCD 1999, Appendix B).

Cedar Creek. Water temperature was sampled one day a month for the months of August, September, October, March, April, May, June, and July from 1997 through 1998 on Cedar Creek just upstream of the confluence of Lost Lake Creek. A 7-day average maximum temperature can not be derived from this data. The maximum temperature recorded was 13.9ºC/57ºF on August 26, 1997. The minimum temperature recorded was 4.3ºC/39.7ºF on October 20, 1997 (POCD 1999, Appendix B).

Jim Creek. Prior to 2002, water temperature data was limited to readings taken during snorkeling and physical inventory surveys. Temperatures on Jim Creek ranged from 9.5 to 12ºC on August 28-29, 1995; a 7-day average maximum temperature can not be derived from this data (USFS 1999ae, pg. 7). From July 19 to September 30, 2002, a thermograph was deployed by the USFS to record water temperatures near the mouth of Jim Creek. The 7-day average maximum temperature during the period of record was 16.1°C; the maximum temperature for the period of record was 16.8°C (K. Honeycutt, USFS, pers. comm., 2003).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Flume, Sweet, Sand, and Cedar Creeks. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting stream flow data (along with pH, dissolved oxygen, temperature, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) near the mouth of Flume, Sweet, Sand and Cedar creeks (D. Comins, POCD, email comm., Feb. 2003).

Sand Creek. There are no undisturbed watersheds of similar nature for comparison purposes. The high density of roads (2.9 miles/sq. mile), located primarily outside of the Riparian Habitat Conservation Areas (RHCA) and low level of acreage in harvested openings within the watershed (9.4%) may not have a noticeable effect to the natural flow regime. Not enough information is available for this determination (USFS 1999bf, pg. 9). The proposed Wolf Creek Timber Sale would increase the harvested openings to 14.6%. This is still under the 15% threshold for appropriately functioning Equivalent Clearcut Area (ECA; USFS 1999bf, pg. 14).

Cedar Creek. Cedar Creek Dam is a run-of-the-river dam meaning water is not stored behind the dam above the level of the pool originally created by the dam. This means for any increase in water volume coming into the pool behind the dam, the same volume of water is passed downstream of the dam. Therefore, flows downstream of the Cedar Creek Dam are not affected by the dam (A. Scott, Framatome ANP, pers. comm., 2002).

Cedar Creek. There is little flow data on Cedar Creek. There are no undisturbed watersheds of similar nature for comparison purposes. The low density of roads (1.85 miles/sq. mile) and low level of acreage in harvested openings within the watershed >15%) may not have a noticeable effect to the natural flow regime. However, not enough information is available for this determination (USFS 1999ae, pg. 10).

Species Competition

Non-indigenous Fish

Flume Creek. Brook trout are known to occur throughout Flume Creek. During snorkeling surveys in 1997, Flume Creek was comprised almost exclusively of brook trout (R2 Resource Consultants 1998, pg. 4-3, 5). During snorkeling surveys in 2000, brook trout were the only fish species observed (McLellan 2001, pg. 63).

M. Fk. Flume Creek. Several unusual brook trout phenotypes were observed in the M. Fk. Flume Creek. These individuals had markings similar to those which have been observed in Brook trout *x* bull trout hybrids (R2 Resource Consultants 1998, pg. 4-1).

Sweet Creek. Brook trout are known to occur in Sweet Creek (McLellan 2001, pg. 91; R2 Resource Consultants 1998, pg. 4-3).

Sand Creek. A few eastern brook trout were observed in the stream below the impassable culvert. It is unknown whether reproduction is occurring (USFS 1999bf, pg. 13). Using snorkel surveys in 1997, brook trout were identified throughout Sand Creek (R2 Resource Consultants 1998, pg. 4-3).

Cedar Creek. Brook trout have been identified both upstream and downstream of the Cedar Creek dam. They were most closely associated with the lower portion of the stream and especially in close proximity with the Cedar Creek Dam (KNRD and WDFW 1997b, pg. 43). Brook trout heavily outnumbered the native salmonid populations (30.6 brook trout/100m^2, 5.9 cutthroat/100m^2, 0.1 bull trout/100m^2; KNRD and WDFW 1997b, pg. 29 and Fig. 15, pg. 36). Brown trout and rainbow trout have been identified below the Cedar Creek dam (J. Maroney, KNRD, pers. comm., 2003).

Box Canyon WAU Fish Distribution and Use.

Four bull trout have been documented in the Box Canyon WAU; one in Cedar Creek and three in Sweet Creek. Neither snorkeling nor electrofishing surveys have detected bull trout in Flume or Sand creeks (McLellan 2001, pg. 63; USFS 1999bf, pg. 10; R2 Resource Consultants 1998, pg.

4-1 through 4-5). The streams in the Box Canyon WAU flow into the Boundary Reservoir and Box Canyon reservoirs. Table 12 below describes current, known bull trout use in Box Canyon WAU. Maps in Appendix C illustrate the extent of "Individual Observations" and "Currently Occupied", "Suitable" and "Recoverable" bull trout habitat in the WAU. Table D1 in Appendix D provide sources for the information on the fish distribution maps. Based on a Kalispel Natural Resource Department (KNRD) 1995 habitat survey (KNRD and WDFW 1997b, pg. 43) and a 1992 USFS stream survey, Cedar and Jim creeks have been identified by the TAG as containing "Recoverable" habitat. Flume and Sand creeks have been identified by the TAG as containing "Suitable" habitat.

The Cedar Creek drainage had been electroshocked and snorkeled as late as 1995 finding only the one bull trout. In 1995, one 18-19 inch adult bull trout was observed in Cedar Creek in a pool just upstream of the Cedar Creek Municipal Dam by KNRD and WDFW biologists (KNRD and WDFW 1997b, pg. 43). Additional snorkeling fish surveys in the fall of 1997 by R2 Resource Consultants on Cedar Creek did not detect bull trout (R2 Resource Consultants 1998). Adfluvial trapping near the mouth of Cedar Creek from April through October of 1998 did not result in the capture of any bull trout in Cedar Creek (USFS 1999ae, pg. 15).

In Sweet Creek, in the fall during the early 1980s, an adult 20-inch bull trout was captured by a Bob Peck (WDFW biologist) using a gill net in the mouth of Sweet Creek. Peck also observed a dead bull trout along the stream bank upstream from the mouth. In 1988, Sweet and Lunch creeks were snorkel surveyed for the presence of bull trout throughout their lengths by R2 Resource Consultants and no bull trout were observed (USFS 1999ca, pg. 3). Additional snorkeling fish surveys in the fall of 1997 by R2 Resource Consultants on Sweet Creek did not detect bull trout (R2 Resource Consultants 1998). Then, in the fall of 2000, a 12-inch adult bull trout was observed during a snorkeling survey by another WDFW biologist. The bull trout in 2000 was observed in the plunge pool downstream of the barrier waterfall in Sweet Creek at RM 0.6, approximately 400 meters upstream of the State Hwy. 31 stream crossing (McLellan 2001, pg. 91).

Given the knowledge of salmonid biology and behavior, and the historic use by bull trout of the mainstem Pend Oreille River (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. For all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years. There are no known natural blockages into the lower 0.2 miles of Flume Creek, the lower 0.6 miles of the Sweet Creek, the lower 1.2 miles of Sand Creek, or into the Cedar Creek drainage within the Box Canyon WAU.

Table 12: Current, known bull trout use in the Box Canyon WAU

Box Canyon WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Flume Creek					X
M. Fk. Flume Creek					X
Sweet Creek				X	X
Sand Creek					X
Cedar Creek				X	X
Jim Creek					

Box Canyon WAU Summary

Drainages within the Box Canyon WAU have been surveyed for habitat conditions to varying degrees using varying methodologies (McLellan 2001, pg. 27; USFS 1999cc; R2 Resource Consultants 1998, pg. 4-17; KNRD and WDFW 1997, pg. 10). This makes it difficult to evaluate the resulting data using any one set of habitat rating criteria. The bull trout habitat limiting factors assessment uses the U.S. Fish and Wildlife Service (USFWS) habitat rating criteria developed for bull trout for making ESA Determinations of Effect (USFWS 1998).

Flume, Sweet, and Sand creeks all drain into the Boundary Reservoir reach of the Pend Oreille River, located between Boundary Dam (RM 17.0) and Box Canyon Dam (RM 34.4); Cedar Creek drains into the Box Canyon Reservoir, located between Box Canyon Dam (RM 34.4) and Albeni Falls Dam (RM 90.1). Flume, Sweet, and Sand Creeks offer limited access to habitat for migratory life history forms of bull trout due to natural barriers in close proximity to the mouths of the drainages (river miles 0.2, 0.6, and 1.25, respectively). In Flume, Sweet, and Sand creeks, bull trout have only been detected in Sweet Creek downstream of the natural barrier at RM 0.6.

Cedar Creek does not have natural passage barriers precluding fish access into the drainage. However, the Cedar Creek municipal dam at RM 1.5 is a full barrier to fish passage. Based on habitat and fish survey efforts on Mill, Cee Cee Ah, LeClerc, Indian, and Cedar creeks (all emptying into the Box Canyon Reservoir), KNRD and WDFW (1997b, pg. 45) concluded that Cedar Creek may represent the best habitat conditions of all the tributary streams surveyed in the Box Canyon reach of the Pend Oreille River. KNRD and WDFW (1997b, pg. 45) observed that Cedar Creek exhibited the least degraded habitat of the streams assessed, especially in the drainages upper reaches, and that the amount of consecutive stream reaches exhibiting quality habitat was unequaled.

Flume Creek

A 13.0 meter (43 foot) natural falls at RM 0.2 on Flume Creek is a barrier to upstream fish passage. Upstream of the falls, there are road culverts that are potential fish passage barriers. Brook trout are the dominant fish species in Flume Creek to the extent that during a snorkeling survey in 2000 (McLellan 2001, pg. 63), brook trout were the only species observed in the stream. Maximum recorded stream temperatures are in the range of fair for bull trout rearing (USFWS 1998; McLellan 2001, pg. 63; R2 Resources 1998, pg. 4-12) and minimum recorded stream temperatures are in the range of fair for bull trout spawning (USFWS 1998; McLellan 2001, pg. 63; R2 Resources 1998, pg. 4-12). Instream temperatures are not available for winter months when bull trout eggs are incubating (December - June 28). Data on other habitat attributes was collected and evaluated by R2 Resource Consultants for Seattle City Light using Hillman and Platts (1993) criteria (R2 Resource Consultants 1998, pg. 4-17) and by the Kalispel Tribal Natural Resources Department (KNRD) using stream survey methodology developed by Espinoza (1988), further revised by Huntington and Murphy (1995, an internal KNRD document, #1-95). To determine the cause and extent to which other habitat conditions could impact potential bull trout habitat, further evaluation and analysis of habitat attribute data (other than barriers, instream temperature, and brook trout competition) is needed.

Sweet Creek

A natural falls creates an upstream fish passage barrier at RM 0.6 (USFS 1999ca, pg. 1). Recorded temperatures are generally in the range of fair to poor for bull trout life history stages (McLellan 2001, R2 Resource Consultants 1998).

Sand Creek

There is a fish blocking culvert at RM 0.3 on Sand Creek and a natural falls blocking fish passage at RM 1.2. The existing habitat has been modified by human activities within the watershed. Physical inventory data indicates that there is a problem primarily with streambank stability and embeddedness of the streambed substrate throughout the system (USFS 1999bf, pg. 13). The existing summer water temperatures and present condition of the streambed substrate is most likely marginal for bull trout rearing (USFS 1999bf, pg. 8). Catastrophic natural events such as wildfire appear to be infrequent, however the Sand Creek drainage appears to have fairly stable natural processes. The riparian habitat has recovered from the last major fires in the early 1930s. Riparian vegetation is also recovering from past harvest activity. The instream habitat appears to be of fair to good quality and complex enough to provide refuge for all life stages of the rainbow and cutthroat trout found there (USFS 1999bf). Bull trout have not been found in the Sand Creek drainage.

Cedar Creek

The existing habitat has been modified somewhat by human activities within the watershed. A majority of the habitat in the Cedar Creek drainage is disconnected from the Pend Oreille River by the municipal dam on Cedar Creek at RM 1.5. As of 2002, an effort has been underway by the Town of Ione to address fish passage at the dam. Habitat quality in the Cedar Creek drainage appears to be good in the upper reaches and poor to fair in the lower reaches of Cedar Creek, according the USFS habitat survey methodology and habitat rating criteria. Habitat upstream of the dam contains “Recoverable” habitat (USFS 1999ae, pg. 9, 13).

Habitat survey methodology and habitat rating criteria used in the Kalispel Resident Fish Project (KNRD and WDFW 1997b, pg. 10 and Table 1) indicated that Cedar Creek had the lowest rates of embedded substrates (average 41.8% ± 21.9) of five tributaries to the Box Canyon Reservoir reach of the Pend Oreille surveyed (Mill, Cee Cee Ah, LeClerc, Indian, and Cedar creeks; KNRD and WDFW 1997b, pg. ii, 7, 15). Embeddedness levels were high on each reach surveyed both immediately downstream and immediately upstream of the Cedar Creek Dam (68.1% and 63.7%, respectively; KNRD and WDFW 1997b, pg. 15). Embeddedness levels then generally decreased in reaches continuing upstream of the Cedar Creek dam, ranging from 49.5% – 26.1%, with the very last reach surveyed showing an embeddedness level of 57.1%. The last reach was a very short reach located in the very headwaters of Cedar Creek (KNRD and WDFW 1997b, pg. 15). Based on survey data, KNRD and WDFW (1997b) concluded that spawning gravels of higher quality existed in Cedar Creek in the amount of 18.8m^2/km. KNRD and WDFW also observed that Cedar Creek had a relatively low volume of summer habitat (one of 14 reaches with 100% summer habitat), but the largest number of primary pools/km at 7.9 (KNRD and WDFW 1997b, pg. 15).

However, Cedar Creek also exhibited non-native brook trout populations throughout Cedar Creek that heavily outnumbered the native cutthroat trout populations (KNRD and WDFW 1997b, pg. 29). Overall, KNRD and WDFW (1997b, pg. 42) determined Cedar Creek has the least degraded habitat among Mill, Cee Cee Ah, LeClerc, Indian, and Cedar creeks (including Whiteman, Mineral and Fourth of July Creek, tributaries to LeClerc Creek) with all facets of the habitat described as relatively intact especially in the upper reaches of Cedar Creek. Degree of embeddedness was determined to be the best indicator of habitat quality for Cedar Creek. Embedded reaches were related to old clearcut areas or are associated with sediment deposits behind the Cedar Creek Municipal dam. Bank stability, bank cover and instream cover were determined to be excellent for the entire stream (KNRD and WDFW 1997b, pg. 42).

USFS data indicated that existing summer water temperatures are above the tolerance level for bull trout fry and juveniles downstream of the Cedar Creek dam. The primary factor raising water temperatures above desired is the effect of solar radiation on the pool behind the municipal dam acting as a heat sink (USFS 1999ae, pg. 12).

In contrast to conclusions in the KNRD Resident Fish Project 1995 Annual Report (KNRD and WDFW 1997b), the USFS data indicated that present condition of the streambed substrate on certain reaches is suitable but not optimal for bull trout spawning and rearing due to high embeddedness levels, low numbers of instream wood and pool habitat (USFS 1999ae, pg. 9). KNRD and WDFW (1997b, pg. 42) indicated that embedded reaches were associated with deposition area behind the Cedar Creek Dam and with old clearcut areas. The USFS observed that isolated areas of bank trampling where livestock access the stream add sediment to the embeddedness levels of embedded reaches. The USFS concluded that grazing, along with other sources of sediment such as surface and fill erosion from the county road, maintains the level of embeddedness in the downstream habitat (USFS 1999ae, pg. 13).

Rather than grazing impacts, the USFS considers the primary factors limiting vegetative coverage of streambanks to be past debris flows, stream crossings failures, and off-road vehicle use (USFS 1999ae, pg. 14). County road maintenance continues to limit the amount of LWD recruitment along those areas where the road system is within the riparian areas. The loss of any potential trees along the riparian areas due to this annual maintenance has a greater effect on LWD levels than the present level of grazing. Grazing of the riparian areas, in conjunction with the road maintenance and off-road use in riparian areas, does not appear to cause additional filling of existing pool habitat immediately downstream of the disturbances. The channels appear to be handling much of this excess sediment through flushing, however sediment from these activities is contributing to the present level of embeddedness of the pool substrate along several reaches (USFS 1999ae, pg. 9).

While interspecific competition between brook trout and bull trout is likely responsible for the current situation for the bull trout in the Cedar Creek drainage, degraded habitat conditions within portions of the drainage also appear to be favoring the brook trout (USFS 1999ae, pg. 9). The USFS reports that finding the one bull trout upstream of the impassable Cedar Creek Dam does indicate that successful reproduction did occur somewhere in watershed upstream of the impassable barrier dam. It is not clear to what extent habitat conditions and the presence of brook trout are limiting the continued viability of bull trout in the Cedar Creek drainage upstream of the dam (USFS 1999ae, pg. 10).

Box Canyon WAU Data Gaps.

- Sediment budgets

MUDDY CREEK WAU

Muddy Creek WAU Description

The Muddy Creek WAU encompasses approximately 39,151 acres and captures the Little Muddy, Big Muddy, Maitlen and Renshaw creek drainages which enter the Box Canyon Reservoir of the Pend Oreille River at RM 38.0, 38.0, 40.0 and 42.0, respectively. Only those drainages where bull trout have been observed or where “Suitable” or “Recoverable” bull trout habitat has been identified will be assessed in this report. Presently, only Little Muddy and Big Muddy creeks fall into this category.

The Muddy Creek watershed is a composite of USFS, DNR, and private land with the USFS being the largest landowner. The DNR has one large block of land in the southwest portion of the watershed, with two small parcels overlapping the northern portion of the Muddy Creek drainage and the southern portion of the Box Canyon WAU. Privately owned parcels of land are distributed throughout the watershed. The private land located near the Pend Oreille River is used mainly for agricultural purposes. The town of Ione is located just to the northeast edge of the Muddy Creek drainage. Elevations in the drainage range from 1,250 feet towards Big Meadow Lake to 750 feet at the mouth of Muddy Creek as it enters the Pend Oreille.

Muddy Creek WAU Hydrogeomorphology.

The LeClerc Creek Watershed Analysis (WDNR 1997, pg. 4C-9, Hydrology section) makes reference to the "Little Muddy Creek at Ione" gauging station. Based on data from this station cited in the WDNR LeClerc Creek Watershed Analysis (WDNR 1997), "rain during spring snowmelt" (RSS) events were the most significant runoff generating mechanism in the area, while "rain-on-snow" (ROS) events were uncommon and did not appear to be significant runoff-generating mechanisms in Little and Big Muddy creeks. The second most significant runoff generating mechanism was "spring snowmelt under clear skies" (CSS). The WDNR LeClerc Creek Watershed Analysis (WDNR 1997) reported that the two largest events of record for Little Muddy Creek were generated by CSS and occurred on 4/23/69 (300cfs) and 4/22/59 (257 cfs). Additionally, the USFS recorded four flow observations each on Little Muddy Creek and Big Muddy Creek between August 1988 and November 1988 (Entrix 2002, pg. 2-46). The maximum recorded flow on Little Muddy Creek was 1.3 cfs; maximum recorded flow on Big Muddy Creek was 1.4 cfs. The minimum recorded flow on Little Muddy Creek was 0.21 on September 14, 1988; the minimum recorded flow on Big Muddy Creek was 0.51 on October 27, 1988.

Most of the soils have a volcanic ash surface layer over granitic glacial outwash, sand, and till. The surface volcanic ash soil horizons are generally less than a foot thick and are moderately resistant to erosion. This surface layer has a high nutrient holding capacity. Removal of this layer may result in higher rates of soil erosion and loss of soil productivity. The sub-soil is formed from granitic materials, generally sands and till. This material is usually very sandy and easily eroded. A relatively high percentage of soils in the Aits soils series occur in the Muddy Creek drainage (up to 81% in the N. Fk. Big Muddy Creek and 67% in S. Fk. Big Muddy Creek). The Aits soils have lenses of clay and silt in the subsoil that cause water to flow among these lenses, creating wet spots in unexpected areas which are not associated with stream channels. This condition can cause unexpected water concentrations in road cuts. Water in road cuts can cause erosion and sediment in streams (USFS 2001b, pg. 4 - 9 of Soils section).

Gradients in Little Muddy Creek range from 1 – 6% with generally narrow valley forms. Dominant streambed particle size is a mixture of sand, gravels and cobbles with the entire length embedded. Gradients in Big Muddy Creek range from 1 – 17%. The channel is moderately entrenched. The dominant streambed particle size is sand with embedded gravels and cobbles the entire length (USFS 2001b, pg. 2 of Channel Conditions module in Soils section).

Muddy Creek WAU Current Known Habitat Conditions.

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information.

All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Big Muddy (62.0279) and Little Muddy creeks (62.0278). The State Hwy. 31 concrete box culvert at the mouth currently provides fish passage between the Pend Oreille River and Ione Mill pond, into which Big and Little Muddy creeks enter from the west (USFS 2001a, Chpt. 1, pg. 5). Bruce Heiner, WDFW engineer, surveyed the box culvert at Hwy. 31 on July 14, 2000 and determined the culvert was at least a partial fish passage barrier. Heiner described the culvert as 7.5 feet wide by 8 feet high and 82 feet long with a slope of 0.222 ft/ft. The flow on July 14, 2000 was 9.6 cfs with average velocities of 6.5 to 7.25 feet per second. Water stains were noted 1.1 to 1.2 feet high on the culvert sides. Assuming no backwater effects from the river, Heiner indicated this would equate to flows of 125 to 140 cfs with corresponding velocities of 15 to 16 feet per second createing a velocity barrier in the culvert at high flows also. Heiner also stated that there might be situations where the river is high and the stream flow is low creating a backwater effect that might allow for fish passage through the culvert but that possibility could not be determinded from the site visit (S. Lemcke, 2002, WDFW, March 28, 2002 email correspondence with Bruce Heiner, WDFW).

Big Muddy Creek. At the railroad trestle crossing (RM 0.1), a large debris jam was observed by Andrew Scott, Framatome ANP (pers. comm., 2002) in 1998. It was still in place in 2000. Scott reported there was a four-to-five foot drop below the log jam. It is unknown to what extent the LWD jam acts as a fish passage barrier.

Big Muddy Creek. At RM 1.2, the County Rd. 2705 (Greenhouse Rd.) crossing is a fish passage barrier (T. Shuhda, 2002, USFS, pers. comm.).

Riparian Condition

WAU-wide. Approximately 1.3 miles of county and private roads within private, state and USFS lands and 0.3 mile of USFS road on USFS lands are located inside of the riparian areas (USFS 1999bd, pg. 10).

WAU-wide. On stream reaches surveyed by the USFS, livestock grazing does occur primarily in the riparian areas (USFS 1999bd, pg. 14). Grazing has, in limited areas, changed the characteristics of the riparian vegetation and decreased the amount of brush and trees that shade the stream and moderate summer temperatures (USFS 1999bd, pg. 11). The loss of any potential trees along the riparian areas due to this annual road maintenance, however, has a greater effect riparian habitat conditions than the present level of grazing (USFS 1999bd, pg. 12).

Little Muddy Creek and Big Muddy Creek. Wildfires and past harvest have removed some of the largest components of the riparian stands along Little Muddy and Big Muddy creeks, however the species composition of the riparian community is primarily composed of species expected of the natural riparian community. The riparian areas are also continuous in nature with the exception of a few road crossings and portions of USFS, private, and county roads within the RHCA (1.3 mile of county and private roads and 0.3 mile of USFS road). The riparian area does not appear to be providing adequate shade, large instream wood and streambank stability for several portions of the stream system as evidenced by the high summer water temperatures, low amounts of instream wood and, in the case of Big Muddy Creek, streambanks with less than 50% cover (USFS 1999bd, pg. 10).

Channel Conditions/Dynamics

Streambank Condition

Big Muddy Creek. Livestock grazing does occur primarily in the riparian areas (USFS 1999bd, pg. 14) and does disturb present streambank stability in a few isolated locations. The grazed areas are considered minor when compared to the overall streambank condition throughout the watershed. Grazing, however, is not the primary limiting factor for the level of vegetative coverage of streambanks. Other factors such as past debris flows, stream crossings failures, and use by off road vehicles have also disturbed streambank conditions and are more often the cause for low streambank vegetative coverage (USFS 2002f; USFS 1999bd, pg. 13).

Little Muddy Creek. The condition of the percentage of ground cover for the streambanks was 50-75% and 75-100% along all of the reaches surveyed within USFS lands on Little Muddy Creek (USFS 1999bd, p. 9).

Floodplain Connectivity

Big Muddy Creek and Little Muddy Creek. Within USFS lands, floodplains along the creek are narrow and located in U-shaped valley forms of low to moderate sideslopes along the lower reaches. The uppermost reaches are located in wide U-shaped valley forms with broad floodplains. The existing riparian areas are functioning and hydrologically linked to the main channels with the exception of where County Rd. 2714 encroaches upon Little Muddy Creek (USFS 1999bd, pg. 9).

Channel Stability

Little Muddy Creek. There is no information available for channel stability conditions from RM 0.0 – 1.25.

Habitat Elements

Channel Substrate

Little Muddy Creek. All reaches of Little Muddy Creek within USFS lands were surveyed in 1994 for physical habitat conditions. All of the reaches of Little Muddy Creek surveyed had embeddedness levels of greater than 35% (USFS 1999bd, pg. 8). Little Muddy Creek flows through decomposed granitics and glacial fluvial deposits. Sand is the dominant streambed substrate in seven of 11 reaches. It is also the dominant bank material in all but twp of those seven reaches. It is unknown what the natural, background level of sediments is for this system but sediment is being delivered to the stream by the road system at certain points (USFS 2001b, pg. 8 of Fisheries rept. Section).

Big Muddy Creek. All reaches of Big Muddy Creek within USFS lands were surveyed in 1992 for physical habitat conditions. All of the reaches of Big Muddy Creek surveyed had embeddedness levels of greater than 35% (USFS 1999bd, pg. 8). Sand is the dominant streambed substrate. There is an alder/sedge meadow in the upper two miles of the stream where gradient is 1%. Cattle-use has led to erosion in this reach and is contributing sediment to downstream reaches (USFS 2001b, pg. 9 of Fisheries rept. Section).

Large Woody Debris

Muddy Creek drainage. County road maintenance continues to limit the amount of large wood recruitment along those areas where the road system is within the riparian areas. The loss of any potential trees along the riparian areas due to this annual maintenance has a greater effect on this indicator than the present level of grazing (USFS 1999bd, pg. 12). Large woody debris levels are poor (USFS 2002f; 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Little Muddy Creek. Numbers of instream large woody debris exceed 20 pieces per mile on all but one reach surveyed on USFS lands (USFS 1999bd, pg. 8). This is a 0.25 mile long reach that runs through an old homestead that is now used for dispersed camping. There are very few large trees for recruitment in this area due to past use levels (USFS 2001b, pg. 8 of Fisheries rept section). Another reach on Little Muddy Creek was marginal for LWD levels. This was a 0.72-mile reach (reach 9) that had only 20 pieces of LWD/mile (USFS 2001b, pg. 7, Table 1 of Fisheries rept section). All reaches other than Reach 4 have had past historic harvest or fire that has reduced LWD recruitment potential. In addition, this stream has historically had splashdams built to move timber downstream. The use of splashdams would have cleaned the stream of naturally occurring debris during the heyday of logging in the early 1900s (USFS 2001b, pg. 8, Fisheries rept section).

Big Muddy Creek. Numbers of instream large woody debris exceed 20 pieces per mile on the uppermost two miles. These LWD deficient reaches tend to be located in perched water tables where large numbers of old beaver ponds are evident. The dominant riparian vegetation type has changed from conifers to sedge and brush species (USFS 1999bd, pg. 8).

Pool Frequency and Quality

Little Muddy Creek. Sand and finer material appear to be severely reducing pool volume and embeddedness of pool substrate does occur (USFS 1999bd, pg. 8). Data presented for the Muddy Creek drainage in the Lost Ruby Watershed Analysis Appendix (2001b, Table 1, pg. 7, Fisheries rept. section) indicated number of pools/mile is low in reaches 10 and 11 of Little Muddy Creek (16.03 and 10.23, respectively), but also below expected levels for reaches 1-4 (20.81, 18.93, 41.34, and 36.87, respectively).

Big Muddy Creek. Numbers of pools per mile on all reaches of Big Muddy Creek range from 32 to 58 pools are what is expected for a stream with an average wetted width of 15 feet (39 pools per mile), however sand and finer material appear to be severely reducing pool volume and embeddedness of pool substrate does occur (USFS 1999bd, pg. 8). Data presented for the Muddy Creek drainage in the Lost Ruby Watershed Analysis Appendix (2001b, Table 1, pg. 7, Fisheries rept. section) indicated number of pools/mile is low in the uppermost two miles of Big Muddy Creek. This is the same area where the channel is an alder/sedge meadow. Number of pools/mile for the lower 6.7 miles, where the average stream width is 11 feet, is well above the 48 pools/mile expected for a stream width between 10 and 15 feet (74.82, 93.69 and 133.69, reaches 1 through 3; 2001b, Table 1, pg. 7, Fisheries rept. section).

Pool Depth

Little Muddy and Big Muddy creeks. Sand and finer material appear to be severely reducing pool volume, and embeddedness of pool substrate does occur in stream reaches surveyed on USFS lands (USFS 1999bd, pg. 8). Sediment from road maintenance and grazing are factors causing the present level of embeddedness of the pool substrate along several reaches (USFS 1999bd, pg. 12).

Off-Channel Habitat

Little Muddy and Big Muddy creeks. Approximately 0.6 to 12.9% of all existing habitat is side channel habitat on surveyed reaches within USFS lands. Approximately 1.2 to 2.4% of all existing habitat is side channel habitat on surveyed reaches of Big Muddy Creek within USFS lands. These areas tend to be the result of braiding around debris jams and are low energy areas. The uppermost reaches of Big Muddy Creek also have large amounts of off-channel habitat in the form of continuous beaver ponds connected by braided stream channels (USFS 1999bd, pg. 8).

Water Quality

Temperature

Little Muddy Creek. Water temperature was taken monthly during spring through fall from 1990-1992 and 1996-97 on Little Muddy Creek. It was also recorded by USFS survey crews during their survey work on Little Muddy Creek in 1992 and 1994. Although the 7-day average maximum temperature can not be determined from the data collected by the USFS prior to 2002, summer water temperatures ranged from 5ºC/59ºF on July 26, 1991 to 33ºF on November 7, 1991 (USFS 1999bd, pg. 7). From July 23 through September 30, 2002, the USFS deployed a thermograph upstream of the powerline stream crossing, which is about midway between the County Rd. 2705 and 2714 stream crossings. The 7-day average maximum temperature during the period of record was 16.0°C; the maximum temperature for the period of record was 17.5°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

Little Muddy Creek. From July 11 to December 10, 2002, the KNRD deployed a thermograph to record water temperature in Little Muddy Creek at the County Rd. 2705 stream crossing. The 7-day average maximum temperature for the period of record was 18.1°C, from July 12 through July 18, 2002 (KNRD stream temperature data, M. Wingert, KNRD, email comm., Jan. 6, 2003).

Little Muddy Creek. From July 11 to November 4, 2002, the KNRD deployed a thermograph to record water temperature in Little Muddy Creek at the County Rd. 2714 stream crossing. The 7-day average maximum temperature for the period of record was 20.3°C, from July 12 through July 18, 2002 (KNRD stream temperature data, M. Wingert, KNRD, email comm., Jan. 6, 2003).

Big Muddy Creek. Water temperature was taken monthly during 1994 and 1996 on Big Muddy Creek. Limited water temperature data was also recorded by USFS survey crews during their survey work on Big Muddy Creek in 1992 and 1994. Although a 7-day average maximum temperature could not be determined from the limited data collected by the USFS prior to 2002, the range of water temperatures recorded extended from 17ºC (62ºF) on July 20, 1992 to 9ºC (49ºF) on September 19, 1996 (USFS 1999bd, pg. 7). From July 23 through September 30, 2002, the USFS deployed a thermograph at the USFS boundary upstream of County Rd. 2705. The 7-day average maximum temperature during the period of record was 15.5°C; the maximum temperature for the period of record was 16.7°C (K. Honeycutt, USFS, pers. comm., 2003).

Big Muddy Creek. Water temperature data was collected at the adfluvial fish trap location by DE&S from May 21 to December 7, 1998, during the adfluvial fish trapping study conducted for the POPUD. The adfluvial fish trap was located just upstream of the railroad crossing about 0.1 miles upstream from the mouth of Big Muddy Creek. Recorded water temperatures were at 9ºC in mid-May and gradually increased to 18ºC in late-July. Temperatures then gradually decreased for the rest of the study period, bottoming-out near 1ºC in early December (DE&S 2001a, pg. 17).

Big Muddy Creek. From July 11 to December 10, 2002, the KNRD deployed a thermograph to record water temperature in Big Muddy Creek at the County Rd. 2705 stream crossing. The 7-day average maximum temperature for the period of record was 16.4°C, from July 12 through July 18, 2002 (KNRD stream temperature data, M. Wingert, KNRD, email comm., Jan. 6, 2003).

Big Muddy Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting temperature data (along with pH, dissolved oxygen, stream flow, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) at the mouth of Big Muddy Creek (D. Comins, POCD, email comm., Feb. 2003).

Muddy Creek drainage. There are excessive summer water temperatures downstream of the Ione Mill Pond municipal dam (USFS 1999bd, pg. 13).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Big Muddy Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting stream flow data (along with pH, dissolved oxygen, temperature, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) near the mouth of Big Muddy Creek (D. Comins, POCD, email comm., Feb. 2003).

WAU-wide. There is little flow data on the Muddy Creek watershed. There are no undisturbed watersheds of similar nature for comparison purposes. The high density of roads (3.0 mi/sq. mi) and moderate level of acreage in harvested openings (<15%) within the watershed may have a noticeable effect to the natural flow regime. Also, approximately 1.3 mile of county and private roads within private, state and USFS lands and 0.3 mile of USFS road on USFS lands are located inside of the riparian areas. However, not enough information is available for this determination (USFS 1999bd, pg. 10).

Species Competition

Non-indigenous Fish

Little Muddy Creek. Little Muddy Creek supports a population of eastern brook trout ranging from 1.75 to 7.5 inches. This appears to be a viable population (USFS 2001a, pg. 3 of Fisheries rept.).

Big Muddy Creek. Big Muddy Creek contains a population of eastern brook trout ranging from 1.5 to 7 inches This appears to be a viable population (USFS 2001a, pg. 3 of Fisheries rept.).

Muddy Creek WAU Fish Distribution and Use.

The streams in the Muddy Creek WAU flow into the Box Canyon Reservoir reach of the Pend Oreille River. Bull trout have not been found in the Muddy Creek WAU. Therefore, Table 13 below, which describes current, known bull trout use in the WAU, is blank for bull trout. Maps in Appendix C illustrate the extent of "Recoverable" bull trout habitat in the WAU. Table D1 in Appendix D provide sources for the information on the fish distribution maps. Streams in the Muddy Creek drainage were electroshocked in 1992, 1994, and 1996 and an adfluvial trap was placed near the mouth of Big Muddy Creek in 1998 from June through October. Renshaw Creek was electroshocked in 1994 but no bull trout were located. Maitlen Creek has not been surveyed specifically for bull trout.

Given the knowledge of salmonid biology and behavior, the historic use by bull trout of the mainstem Pend Oreille River (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), and a lack of natural barriers at the tributary mouths, it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. For all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years.

Table 13: Current, known bull trout use in the Muddy Creek WAU. (Table is blank for bull trout since there are no current, known observations of bull trout in the Muddy Creek WAU).

Muddy Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Little Muddy Creek					X
Big Muddy Creek					X
Maitlen Creek					
Renshaw Creek					

Muddy Creek WAU Summary.

It is unclear from the literature which human-caused actions are contributing in what degree to limiting potentially sustainable bull trout populations in the Muddy Creek WAU. The County Rd. 2705 fish passage barrier culvert at RM 1.2 on Big Muddy Creek (T. Shuhda, 20002, USFS, pers. comm.) and riparian habitat degradation as a result of road maintenance and grazing practices are identified in the literature as two human actions contributing to channel habitat degradation. Elevated instream temperatures are attributed, to some degree in the literature to natural causes (beaver dams), in combination with riparian habitat degradation. There are also well distributed populations of brook trout within the Muddy Creek WAU (USFS 1999bd, pg. 9, 10). There are no identified natural barriers in either the Little Muddy Creek or Big Muddy Creek drainages. Bull trout have not been documented as occurring in the Muddy Creek WAU.

The existing summer water temperatures in certain portions of the Little and Big Muddy creeks are above the tolerance level for bull trout rearing (USFS 1999bd, pg. 11). In the upper reaches of both Little and Big Muddy Creeks, the USFS has identified solar radiation on pools behind old beaver dams as the primary factor raising water temperatures above desired levels Road maintenance and grazing decrease the amount of brush and trees that might contribute to moderating instream temperatures. Grazing has, in limited areas, changed the characteristics of the riparian vegetation and decreased the amount of brush and trees that shade the stream and moderate summer temperatures (USFS 1999bd, pg. 12, 13).

The present condition of the streambed substrate is not optimal for bull trout spawning and rearing due to high embeddedness levels, low numbers of instream wood and quality of pool habitat (USFS 1999bd, pg. 13). Physical inventory data indicates that there is a problem primarily with streambank stability on two surveyed reaches and also with the numbers of pools throughout the system (USFS 1999bd, pg. 13). County road maintenance continues to limit the amount of large wood recruitment along those areas where the road system is located within the riparian areas. The loss of any potential trees along the riparian areas due to annual road maintenance has a greater effect on LWD levels and recruitment than the present level of grazing (USFS 1999bd, pg. 12, 13).

Muddy Creek WAU Data Gaps.

- Sediment budget

RUBY CREEK WAU

Ruby Creek WAU Description

The Ruby Creek WAU encompasses approximately 45,213 acres and includes the Lost Creek and Ruby Creek drainages. Lost Creek flows southeasterly 13 miles from its headwaters before entering the Pend Oreille River at RM 47.8; Ruby Creek flows about 10 miles generally east before it enters the Pend Oreille River at RM 52.0. The Lost and Ruby creek drainages feed into the Box Canyon Reservoir portion of the Pend Oreille River. Elevations range from 2,025 feet at the mouth to 5,474 feet at Timber Mountain.

There are no climatic or stream flow stations within the Ruby Creek WAU (USFS 2001b, Climate Section, pg. 1) so only a small amount of flow data exists. For Ruby Creek, flows range from 2.8 cfs recorded on September 28, 1994 to 182 cfs on May 14, 1997 (USFS 1999b, pg. 9). For Lost Creek, flows range from 0.26 cfs recorded on July 19, 1994 to 85.6 cfs on April 24, 1994 (USFS 1999a, pg. 9, 15). The Ruby Creek WAU contains three perennial creeks; Lost, S. Fk. Lost, and Ruby creeks (USFS 2001a, Chpt. 1, pg. 5). There are also two lakes in the Lost Creek drainage. These are Brown’s Lake (Carl’s Lake) and Nile Lake (USFS 2001a, Chpt. 1, pg. 5).

Ruby Creek WAU Hydrogeomorphology.

Glacial outwash filled valley bottoms and created broad riparian zones in the upper reaches of the watershed. Riparian areas become narrower and steeper as they drop down toward the Pend Oreille River. Much of the watershed is characterized by rolling slopes and in many areas a flat alluvial or glacial outwash formation is located near the stream courses. Within USFS lands, floodplains vary between narrow and wider more open valley forms. Along Ruby Creek, U-shaped valley forms of moderate to steep sideslopes gradually open up to a wide valley form in uppermost 1.5 miles of the watershed. Reaches of Little Ruby and the North Fork flow through a wide open U-shaped valley form (USFS 1999b, pg. 9). Lost Creek on USFS land flows through U-shaped valley forms with low to moderately steep sideslopes (USFS 1999a, pg. 9). The channel gradient downstream of Nile Lake is less than 6% with two very flat sections containing beaver ponds (USFS 2001b, Channel Condition Section, pg. 2).

Lakes, wet meadows, and wet areas (not connected by surface flows to streams) occur frequently in the watershed. Wet meadows are likely naturally prone to drying out during prolonged drought events as evidenced by conifer snags present from early century droughts in the meadows. The wet areas appear to be the result of lenses of finer textured material in the sub-surface, primarily fine sands, silts and sometimes clays. These wet areas are often small (10 sq. ft.) and seasonal, drying up by mid-to-late summer. Riparian vegetation is rarely associated with the wet areas, apparently a natural condition related to the hydrology of these areas (USFS 2001a, Chpt. IV, pg. 1).

The valley width of both Ruby and Lost creeks varies from 100 to 600 feet with the lower portion braiding during spring runoff as flows interact with debris jams. Sand is the dominant streambed substrate in the lower reach with what appears to be adequate LWD, although pools were not as abundant as expected and pool filling appeared to be occurring. (USFS 2001b, Channel Conditions Section, pg. 1). The steep gradient of the lower reach of Ruby Creek causes the reach affected by fine sediment deposition at the confluence with the Pend Oreille River to be quite short – not more than 200 feet. The more coarse material settle out just upstream of State Hwy. 20, located 120 feet upstream of the mouth (the Hwy. 20 bridge supports marks the upper limit of the water's edge at high pool). Fine sediment accumulates at the mouth of Ruby Creek, and well into the Pend Oreille River channel (DE&S 1999, pg.3 and Table 4). North Fork Ruby Creek is a very low gradient tributary to Ruby Creek with lots of beaver dams and sediment retention. (USFS 2001b, Channel Conditions Section, pg. 1). Instream wood is crucial for much of the pool formation in the Ruby Creek drainage watershed (USFS 1999b, pg. 12).

Historically, erosion would have been episodic with high erosion rates following natural disturbances (primarily wildfires) sending a lot of sediment into the watershed streams over a short time period (USFS 2001a, Chpt. IV, pg. 1). Most of the soils in the WAU have a volcanic ash surface layer over granitic glacial outwash, sands and till. The surface volcanic ash horizons are generally less that a foot thick and are moderately resistant to erosion. This surface layer has a high nutrient holding capacity and is sensitive to compaction. Removal of this layer may result in higher rates of soil erosion and loss of soil productivity. The subsoil is formed from granitic glacial material, generally sands and till. This material is usually very sandy and easily eroded (USFS 2001a, Chpt. 1 page 3 and Chpt. III pg. 1).

Ruby Creek WAU Current Known Habitat Conditions.

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

S. Fk. Lost Creek (62.0323). At RM 3.8 a natural falls is a blockage to fish passage. The falls is approximately 8 feet in vertical height (USFS 1999c).

Ruby Creek (62.0322). There were no known natural blockages historically, nor are there presently, to prevent fish passage from the Pend Oreille River into Ruby Creek (USFS 2001a, Chpt. 1, pg. 5).

Ruby Creek. The culvert (Culvert_id # 152) at RM 9.4 at the USFS Rd. 2700910 creek crossing (road mile 0.1) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

N. Fk. Ruby Creek (62.0368a). The culvert (Culvert_id # 150) at RM 0.2 at the County Road 2489 creek crossing (road mile 3.9) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

N. Fk. Ruby Creek. The culvert (Culvert_id # 149) at RM 1.7 at the USFS Rd. 2700423 creek crossing (road mile 1.5) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Little Ruby Creek (62.0368b). The culvert (Culvert_id # 151) at RM 0.8 at the County Road 2489 creek crossing (road mile 6.5) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Riparian Condition

WAU-wide. The plant communities of some riparian areas are not representative of their vegetative potential. Hardwoods such as black cottonwoods were probably more common with their abundance closely tied to natural disturbance and beaver movement through the watershed. However, current hardwood abundance is very low and essentially of the same structural stage.

(USFS 2001a, Chpt. IV, pg. 1). In general, the softwood climax tree species in riparian areas would be red cedar and Western hemlock with a scattered overstory of Western larch, white pine and douglas fir (USFS 2001b, Hydrology Section, pg. 2).

S. Fk. Lost Creek. In 1994, the USFS collected data on various habitat attributes for S. Fk. Lost Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of riparian conditions as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

Ruby Creek drainage. Although wildfires and past harvest have removed some of the largest components of the riparian stands along Ruby Creek, the vegetation is primarily composed of species expected of the natural riparian community. However, the riparian areas are crossed by many USFS and county roads within the drainage on USFS lands and the riparian area does not appear to be providing adequate shade based upon limited water temperature data for the hottest months. Large instream wood is being recruited in adequate levels for all of the stream system on USFS lands with the exception of the meadow habitat (USFS 1999b, pg. 10).

Ruby Creek drainage. Overgrazing has also noticeably changed the characteristics of the riparian vegetation and decreased the amount of brush and trees that shade the stream and moderate summer temperatures in areas where easy access to the riparian exists from the road system and powerline and in the corral located within the RHCA (USFS 1999b, pg. 11).

Ruby Creek drainage. Approximately 3.75 miles of the USFS road system is located inside the riparian areas of Ruby Creek and its tributaries within USFS lands. There are additional miles of county road located in the valley bottom of Ruby Creek (USFS 1999b, pg. 10).

N. Fk. Ruby Creek. Streambank trampling by livestock appears to be damaging riparian vegetation. It is unknown what impacts this is having on accelerating sedimentation (USFS 2001b, Channel Conditions Section, pg. 1).

Little Ruby Creek). In 1992, the USFS collected data on various habitat attributes for Little Ruby Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of riparian conditions as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

Channel Conditions/Dynamics

Streambank Condition

N. Fk.. Ruby Creek. There is excessive bank instability due to cattle grazing (USFS 2001b, Fisheries Section, pg. 7).

Little Ruby Creek. Streambank condition is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Floodplain Connectivity

S. Fk. Lost Creek. In 1994, the USFS collected data on various habitat attributes for S. Fk. Lost Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of floodplain connectivity as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

Ruby, Little Ruby and N. Fk. Ruby creeks. On USFS lands, these streams lie primarily in U-shaped valley forms of moderate to steep sideslopes gradually opening up to a wide valley form at the uppermost 1.5 miles of the watershed. In the low gradient reaches, the streams have well functioning meadows with what appear to be a perched water table. The existing riparian areas are functioning and hydrologically linked to the main channel of Ruby Creek and its tributaries (USFS 1999b, pg. 9).

Channel Stability

Ruby Creek. The close proximity of County Road 2489 in Sections 8, 10, 11, 12, 15 in conjunction with the sandy streambank material in these sections, causes a problem with high sand bedload movement (USFS 2001b, Channel Conditions Section, pg. 1).

Little Ruby Creek. Channel stability is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Habitat Elements

Channel Substrate

Ruby Creek. All reaches of Ruby Creek surveyed have embeddedness levels of greater than 35% (USFS 1999b, pg. 8). Sediment introduction from poorly located roads and streambank erosion from livestock overgrazing maintain the level of embeddedness in the stream habitat over natural conditions (USFS 1999b, pg. 12).

N. Fk. Ruby Creek. All reaches of the North Fork surveyed have embeddedness levels of greater than 35% (USFS 1999b, Ruby pg. 8).

N. Fk.. Ruby Creek. Streambank trampling by livestock appears to be damaging riparian vegetation. It is unknown what impacts this is having on accelerating sedimentation (USFS 2001b, Channel Conditions Section, pg. 1).

Little Ruby Creek. One out of three reaches surveyed on Little Ruby Creek has an embeddedness level greater than 35% (USFS 1999b, pg. 8).

Large Woody Debris (LWD)

Ruby Creek. Overgrazing of the riparian areas, in certain locations, limits the amount of brush and trees along riparian areas in this watershed. These small areas are lacking in future recruitment sources for large instream wood. However, the overall existing condition of the riparian vegetation along Ruby Creek is adequate to provide recruitment sources for future instream wood in this watershed within USFS lands (USFS 1999b, pg. 12). Numbers of instream LWD exceed 20 pieces per mile on all reaches surveyed on Ruby Creek. Recruitment sources for instream wood in the future along the surveyed reaches appear to be adequate (USFS 1999b, pg. 8).

N. Fk. Ruby Creek, Little Ruby Creek. LWD on one reach on each of these two streams did not exceed 20 pieces per mile. These two reaches are primarily in wide valley forms with extensive braiding and beaver ponds. The primary woody riparian vegetation in these reaches is alder, dogwood and willow and few conifers. The lack of large instream wood, where it occurs, is due to the nature of the stream channel and water table (USFS 1999b, pg. 8).

Pool Frequency and Quality

S. Fk. Lost Creek. Pool frequency and quality is poor (USFS 2002f, 1994 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Ruby Creek. Data collected during a 1992 USFS stream survey indicate pool frequency is poor (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Little Ruby Creek. Pool frequency and quality is poor (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Pool Depth

S. Fk. Lost Creek. Pool depth is fair (USFS 2002f, 1994 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Ruby Creek. Pools tend to be less than 2 feet in depth. Sand and finer material appears to be reducing pool volume and embeddedness of pool substrate does occur (USFS 1999b, pg. 8).

Little Ruby Creek. Pool depth is fair (USFS 2002f, 1992 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Off-Channel Habitat

Ruby Creek drainage. Approximately 0 to 8.4% of all existing habitat is side channel habitat on surveyed reaches of Ruby Creek and its tributaries within USFS lands. These areas tend to be the result of braiding around debris jams or old beaver dams and are low energy areas. These areas serve as backwater areas for fry and juveniles. The watershed is considered to be functioning appropriately for this reason (USFS 1999b, pg. 8).

Water Quality

Temperature

S. Fk. Lost Creek. From July 23 to October 28, 2002, the USFS deployed a thermograph near the mouth of S. Fk. Lost Creek. The 7-day average maximum temperature during the period of record was 16.2°C; the maximum temperature for the period of record was 17.2°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

S. Fk. Lost Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting temperature data (along with pH, dissolved oxygen, stream flow, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) at the mouth of S. Fk. Lost Creek (D. Comins, POCD, email comm., Feb. 2003).

Ruby Creek. Water temperature was taken by the USFS on Ruby Creek sporadically by the hydrologist from 1969 to 1993 with weekly temperatures taken during the summer months from 1994 to 1998. Consecutive daily water temperatures were not recorded. The temperatures ranged from 1°C (33°F) on October 28, 1991 to 20°C (68°F) on July 24, 1998 (USFS 1999b, pg. 7). From July 23 to October 28, 2002, the USFS deployed a thermograph near the mouth of Ruby Creek at the USFS boundary. The 7-day average maximum temperature during the period of record was 18.4°C; the maximum temperature for the period of record was 20.4°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

Ruby Creek. Water temperature data was collected at the adfluvial fish trap location by DE&S in 1998, 1999 and 2000 during the adfluvial fish trapping study conducted for the POPUD. The adfluvial fish trap was located near the mouth of Ruby Creek. Water temperatures peaked in late July to early August in all years. The high temperature was 21°C in late July 1998. Daily average water temperatures were coolest in 2000 (DE&S 2001a, pg. 17).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Ruby Creek drainage. The moderate density of roads and moderate level of acreage in open condition within the watershed may have a noticeable effect to the natural flow regime, however not enough information is available for this determination. Road density in the Ruby Creek drainage is 2.3 mi./sq.mile. Approximately 3.75 miles of the USFS road system is located inside the riparian areas of Ruby Creek and its tributaries within USFS lands. There are additional miles of county road located in the valley bottom of Ruby Creek. Greater than 15% of the Ruby Creek drainage is presently in an equivalent clearcut acreage configuration. There is only a small amount of flow data on the Ruby Creek watershed and there are no undisturbed watersheds of similar nature for comparison purposes (USFS 1999b, pg. 9, 10).

S. Fk. Lost Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting stream flow data (along with pH, dissolved oxygen, temperature, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) at the mouth of S. Fk. Lost Creek (D. Comins, POCD, email comm., Feb. 2003).

Species Competition

Non-indigenous Fish

Ruby Creek. Brook trout successfully spawn and rear in Ruby Creek (USFS 1999b, pg. 10).

Ruby Creek WAU Fish Distribution and Use.

The streams in the Ruby Creek WAU flow into the Box Canyon Reservoir reach of the Pend Oreille River. Bull trout are not known currently to occur in the Ruby Creek WAU. Therefore, Table 14 below, which describes current, known bull trout use in the Ruby Creek WAU, is blank for bull trout. Maps in Appendix C illustrate "Recoverable" bull trout habitat. In the Ruby Creek WAU, based on USFS stream surveys (1992, 1993, and 1994) only the Ruby Creek drainage has been identified by the TAG as containing "Recoverable" habitat. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Although by name ("char", the term historically applied to bull trout), there is no early historic documentation of the occurrence of bull trout in the Ruby Creek WAU, the Kalispel Tribe believes historic bull trout occurrence has been documented in the Ruby Creek drainage based on information contained in field notes taken by A.H. Smith from 1936-1938. Lyons (2002) states that Smith described the capture of "trout" in traditional tribal Kalispel fishing weirs placed at the mouth of Ruby Creek in late summer. The Kalispel Tribe contends that documentation of the capture of "trout" historically in Ruby Creek at the mouth in late summer infers the presence of a bull trout population in the drainage (Lyons 2002). Notes by Smith reprinted in a 1983 court document (Smith 1983, pg. 203) only detailed the presence of a traditional single-family weir used in early spring and remaining at the site for about a month. According to notes reprinted in Smith 1983, at this early spring weir trout were caught "for the most part, or perhaps entirely, trapping them on their way upstream to spawn". The reprints of Smith's notes found in Smith 1983 may not represent the complete information contained in Smith 1936-1938 as indicated by Lyon (2002).

It is worth noting that given the knowledge of salmonid biology and behavior, the historic use by bull trout of the mainstem Pend Oreille (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), and a lack of natural barriers at tributary mouths, it is likely bull trout would have entered accessible tributaries to the Pend Oreille River Oreille whenever possible historically. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. Presently, for all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years.

Table 14: Current, known bull trout use in the Ruby Creek WAU (Table is blank for bull trout since there are no current, known observations of bull trout in the Ruby Creek WAU).

Ruby Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
S. Fk. Lost Creek					
Ruby Creek					X
N. Fk. Ruby Creek					
Little Ruby Creek					

Ruby Creek WAU Summary.

The existing habitat in the Ruby Creek WAU has been modified somewhat by human activities and bull trout are not known to occur currently in the WAU. It is unclear from the literature which human-caused actions are contributing in what degree to limiting potentially sustainable bull trout populations in the WAU. In the Ruby Creek drainage, the high level of substrate embeddedness, high water temperatures, low numbers of deep pool habitat for winter rearing, and a well distributed population of brook trout are limiting factors for the bull trout (USFS 1999b, pg. 10). Although no longer stocked, brook trout are presently found throughout Ruby Creek, the result of stocking efforts dating back to 1942 (USFS 2001b, Fisheries Section, pg. 4).

The existing summer water temperatures are above the tolerance level for bull trout fry and juveniles in Ruby Creek (USFS 1999a, pg. 8, 10, 11; USFS 1999b, pg. 8). The USFS has identified solar radiation on the beaver pond system within the meadows of the Ruby Creek drainage and the decrease in overhead canopy where roads have affected the shading function of the riparian vegetation as the primary factors raising temperatures in Ruby Creek (USFS 1999b, pg. 11). Overgrazing has also noticeably changed the characteristics of the riparian vegetation and decreased the amount of brush and trees that shade the stream and moderate summer temperatures. Habitat degradation occurs in areas where easy access to the riparian areas exists from the road system and powerline right-of-way as well as in the corral area located within the RHCAs of Ruby Creek (USFS 1999b, pg. 11).

The present condition of the streambed substrate is not optimal for bull trout spawning and rearing due to high embeddedness levels and the low numbers of larger deep pools (USFS 1999a, pg. 8, 10, 11; USFS 1999b, pg. 8). Sediment introduction from poorly located roads, road maintenance, and streambank erosion from livestock overgrazing maintains the level of embeddedness in the stream habitat over natural conditions (USFS 1999b, pg. 12, 13). The constant activity of beaver dam creation, sediment accumulation, and beaver dam decay may be a source of excessive sediment periodically (USFS 1999b, pg. 13).

Ruby Creek WAU Data Gaps.

- Continuous water temperature monitoring data (Entrix 2002, Table 3-1).
- Continuous flow data (Entrix 2002, Table 3-1).
- Assessment of sediment delivery and bedload transport (Entrix 2002, Table 3-1).

LECLERC CREEK WAU

LeClerc Creek WAU Description

Portions of the LeClerc Creek WAU are located within the boundaries of the Colville National Forest, in the Selkirk Mountains, approximately 70 miles north of Spokane. The 64,285 acre WAU encompasses the entire LeClerc Creek watershed, which drains into the Pend Oreille River at RM 56.2. The LeClerc Creek WAU also includes minor drainages that flow into the Pend Oreille River from the east, from the mouth of LeClerc Creek upstream to RM 45.6. LeClerc Creek itself drains 58,000 acres (88%) of the WAU, with the miscellaneous small tributary drainages located adjacent to the river contributing the remaining 12 percent. Also included within the WAU is the 13,000-acre Dry canyon drainage, which has no surface water outflow, although it is likely connected to the West Branch LeClerc Creek via subsurface flow (WDNR 1997, pg. 4C-2). The Pend Oreille River forms the western boundary of the WAU (WDNR 1997, pg. 3-1, 3-3, 4E-4). Only those drainages where bull trout have been observed or where "Suitable" or "Recoverable" bull trout habitat has been identified will be assessed in this report. Presently, in the LeClerc Creek WAU, only the LeClerc Creek drainage falls into this category.

Elevations within the WAU varies from a low of 2,040 feet along the Pend Oreille River to a height of 6,665 feet at Molybdenite Mountain located on the north rim of the LeClerc Creek watershed, with nearly 90% of the watershed lying between 2,500 and 5,000 feet. Precipitation and temperature in the WAU are seasonal, with more than 75% of the annual total precipitation falling in the six months of October through March. Annual precipitation generally increases with elevation, ranging from approximately 25 inches at the lower elevations to approximately 80 inches along the northern watershed divide. Winters are typically cold with continuous snowpack normally covering all but the lowest elevations from November though May. The area is subject to midwinter and spring rain-on-snow events. Peak streamflow events occur as a result of both rain-on-snow and rain (WDNR 1997, pg. 3-2).

There is little development within the WAU at present. The principal land use is timber management with more than 95% of the WAU forested. The LeClerc Creek watershed is owned predominantly by Stimson Lumber Company or managed by the USFS. The USFS is the single largest landowner within the WAU. The USFS lands are most concentrated at the higher elevations and in the northern portion of the WAU. The WDNR also manages scattered parcels within the WAU as State Trust lands. Limited acreage is also owned by Idaho Forest Industries and by Crown Pacific. Minor areas located on alluvial terraces adjacent to LeClerc Creek and the Pend Oreille River have been converted to pasture lands and rural home sites. Acreage of privately owned, non-agency and non-industrial parcels is limited and mostly supports private, rural homes located along the mainstem LeClerc Creek, East Branch LeClerc Creek, Dry Canyon area, and the portion of the Pend Oreille River bordering the WAU on the west (WDNR 1997, pg. 4E-4). The Kalispel Reservation and Tribal headquarters are also located along the Pend Oreille River within the WAU (WDNR 1997, pg. 3-1).

In the past, timber harvest began in earnest in the LeClerc Creek drainage between 1915 and 1930. Diamond City, built by the Diamond Match Company on the west side of W. Br. LeClerc Creek next to the sawmill, was a hub of activity between 1922 and 1925. Diamond City and the sawmill were across from Lost Creek, about three and a half miles northeast of where the W. Br. LeClerc Creek emerges at Dry Canyon (Bamonte and Bamonte 1996, pg. 111). The upper valley of W.Br. LeClerc Creek was heavy with old growth white pine and logging such an area required flumes to transport the logs. So, these early harvests were facilitated by the construction of log-transport flumes adjacent to lower LeClerc Creek, by aerial tramways, and by construction of railroad lines up the East, Middle, and W. Branches of LeClerc Creek (WDNR 1997, pg. 4C-7). Log flumes extended up the lower East Branch by 1917, up Fourth of July drainage by 1920, and descended several miles from the upper reaches of the W. Br. LeClerc Creek by 1921 (Bamonte and Bamonte 1996, pg. 111). A rail line started in 1925 and located parallel to the lower East Branch LeClerc Creek, portions of Fourth of July Creek, and much of the Middle Branch LeClerc Creek eliminated sections of riparian cover (WDNR 1997, 4-D). At its peak, Diamond City consisted of about 20 houses, a one-room school, a company store, a number of bunkhouses, a commissary, recreation hall, dining room, kitchen, barn, offices, work shops, and horse and feed sheds. However, it was not long before the white pine timber was exhausted and in 1927 Diamond Match ceased operations at this site. Within the next year, Diamond City had completely disappeared (Bamonte and Bamonte 1996, pg. 114).

Also during that same period, two-thirds of the WAU was burned by forest fires (WDNR 1997, pg. 4C-7). Wide-spread, stand-replacing fires occurred in 1919 and between 1925 and 1933 reduced stand age and likely altered stand composition along most stream channels. Two large fires burnt through much of the WAU in 1925 and 1929 respectively (Colville National Forest GIS data as provided in comments by Rhonda Dasher, POCD). The 1925 fire burned the upper portion of Dry Canyon drainage and most of the Fourth of July drainage. The 1929 fire burned the upper and lower West Branch, portions of the Middle Branch, and most of the East Branch drainages. These intense fires completely burnt both riparian and hillslope timber as evidenced in early photo records (1932). Dominance of lodgepole pine (*Pinus contorta)*, particularly in the upper West Branch, is an attribute of past stand replacing fires (WDNR 1997, 4-D). Western white pine *(Pinus monticola)* once dominated upland forests in much of the LeClerc Creek WAU. It was a major seral tree under the natural fire regime of periodic stand replacing fires

(Williams et al. 1995). Following the introduction of white pine blister rust and targeted harvesting, this species is no longer a dominant species in upland or drier riparian stands (WDNR 1997, 4D-2).

Very little timber harvest occurred in the WAU between World War II and the early 1970s. Since the 1970s, additional timber harvest has occurred, primarily on large industrial private and small private lands. At present, the majority of the land area in the WAU is occupied by mature forest (WDNR 1997, pg. 4C-7). Past timber harvest and catastrophic fires in the late 1920s reduced the average riparian tree size and often resulted in brushy vegetation growing along stream banks and on the floodplain. Riparian areas with a central brushy corridor are typical in the WAU. Cattle grazing impacts to riparian vegetation are noticeable in isolated locations. Road systems needed to accommodate timber management within the WAU are nearly complete; only limited mileage of additional road is likely to be constructed, primarily on state and industrial lands. Few new roads and only limited timber harvest is expected on USFS lands (WDNR 1997, pg. 3-2).

LeClerc Creek WAU Hydrogeomorphology

The LeClerc Creek drainage system consists of three primary tributaries. The West Branch LeClerc Creek flows south from steep headwaters on 6,784 foot Molybdenite Mountain. The Middle Branch also flows generally south, but originates from gentler granitic hills at an elevation of about 4,700 feet. The East Branch flows southwest from 5,700 foot Monumental Mountain.

Approximately 15,000 years ago, during the Pleistocene era, all but the highest elevations of the WAU were affected by continental glaciation. Extensive deposits of glacio-fluvial materials continue to overlay the underlying and much older base rocks in many areas. The geology of the WAU is dominated by granitic rock. The majority of the WAU consists of foothills of granitic rock that have been smoothed by continental glaciation; ridges are broadly rounded with moderate, short slopes. Low-order streams are steep and confined in V-shaped canyons; higher-order streams are moderate-to-low gradient and contained in wider valleys mantled with glacial deposits. The headwaters of the West Branch LeClerc Creek and the east flank of the WAU, including the headwaters of Fourth of July Creek, consist of high, steep mountains of granitic rock with a moderately to deeply entrenched drainage pattern. Ridges are typically rounded and mountain slopes are steep. Low-order streams are confined by residual slopes.
The larger valley bottoms have been shaped primarily by past glaciation, rather than fluvial processes. The lower valleys are filled with secondary glacial deposits consisting of glaciolacustrine deposits and glacial drift. Although alluvial deposits do overly the glacial deposits, active, alluvial floodplains are not extensive along any of the channels. The short mainstem LeClerc Creek (RM 0.0-1.5) flows across a low glacial terrace that is bordered by a higher terrace. The channel is sinuous, but not highly meandered. The lower two miles of the East and West Branch cut down through the level of the high terrace. At the level of the high terrace, the West Branch is quite sinuous, winding through a series of wet meadows. The East and Middle Branches tend to be less sinuous, and more confined by the foothill sideslopes. All three of the main tributaries gradually become steeper and more confined toward the headwaters. Several of the steep headwater streams, especially in the West Branch, are punctuated with

small, wet meadows and ponds where they cross flatter benches of the foothills deep (WDNR 1997, pg. 4E-5).

Because of the granitic parent material, which quickly breaks down into sand, extensive deposits of coarse and fine sediment were found in channels up to 15 % gradient. Typically streams with a gradient of 4 – 20% are considered "transport" reaches. Transport reaches are capable of transporting as much sediment as is supplied under natural conditions, given time. However, these higher gradient streams were not transporting all of the fine sediment supplied, despite the steep gradient and lack of large, active source areas. This is discussed in detail, by stream segments, in the WDNR LeClerc Creek Watershed Analysis, Stream Channel Assessment Module (1997, pg. 4E-9).

No continuous streamflow gauging data exists for LeClerc Creek. Spot flow measurements taken by both the USFS and the KNRD do exist. Gauging stations located near LeClerc Creek were used to determine flow conditions within the LeClerc Creek drainage (WDNR 1997, pg. 4C-7). Peak flows in the LeClerc Creek drainage are triggered most commonly by rain-on-snow events and to a slightly lesser extent by spring snowmelt under clear skies. It is possible that mid-winter events can occur, though very infrequently. However, when they do occur, they may trigger some of the largest peak flow events (WDNR 1997, pg. 4C-9). The topographic position of lower W. Br. LeClerc Creek (stream segments H1 and H2) relative to the internally draining Dry Canyon drainage suggests there may be groundwater hydraulic continuity with discharge to the W. Branch. Numerous springs were observed in the lower three miles (stream segment H1 and H2) and the observed stream flow appeared noticeably greater than that of the upstream channel segment (WDNR 1997, pg. 4D-33, 36). Based on bedrock stratigraphy, groundwater accretion may be occurring in E. Br. LeClerc Creek in the vicinity where thermograph monitoring station was placed during the Watershed Analysis (WDNR 1997). Monitoring was conducted from July 18, 1996 through August 13, 1996 using hobo™ thermographs. The only bull trout observations in the LeClerc Creek WAU have occurred in the cool water reaches in the West and in the East Branches of LeClerc Creek (WDNR 1997, pg. 4D-33, 36).

LeClerc Creek WAU Current Known Habitat Conditions.

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

In 1997, Stimson Lumber Company initiated the state watershed analysis process for the LeClerc Creek WAU. The results of this effort are contained in the WDNR LeClerc Creek Watershed Analysis (1997). Where it is relevant, tables and written text from WDNR 1997 have been included in Appendix G for the benefit of the users of this habitat limiting factors report. Appendix G contains:

1. a description of the ten geomorphic units (GMU) identified in the Watershed Analysis process and their relationship to habitat-forming processes (WDNR 1997, Section 4E.7, pp. 13-45);

2. written summaries of the general attributes of fish habitat and species use by GMU (WDNR 1997, Section 4F.6.1-10, pp. 4F-3 thru 4F-8);

3. a table that rates habitat conditions for life stages by channel segment according to the Washington Forest Practices Board habitat rating criteria (Washington Forest Practices Board 1997) and habitat attribute type (WDNR 1997, Table 4F-2, pp. 4F-17 thru 4F-19);

4. written text evaluating channel segments relative benefit by life history stage (WDNR 1997, Section 4F.7.1-3, pg. 4F-8 thru 4F-10);

5. the criteria used to rate habitat conditions in the WDNR Watershed Analysis taken from the Washington Forest Practice Board Manual: Standard Methodology for Conducting Watershed Analysis (WDNR 1997, Table F-2, pg. F-24,25).

In the following list of habitat information for the LeClerc Creek WAU, the alpha-numeric stream segments references used in WDNR 1997 are repeated. The corresponding stream rivermiles are not supplied in the WDNR LeClerc Creek Watershed Analysis (1997) and where not readily available, were not inclused in this report.

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

W. Br. LeClerc Creek (62.0419). Old beaver dams in the upper portion of Segment H3 may function as impediments to migration but do not constitute barriers (WDNR 1997, pg. 4F-5).

W. Br. LeClerc Creek. In the vicinity of the W. Branch LeClerc Creek Road crossing (approximately RM 1.5 – 3.0), a stream reach less than approximately one-half mile long was observed to dewater (Segment H3; WDNR 1997, pg. 4F-5) with flows going subsurface in 2001 and 2002 but not in 1999. This is thought to be a natural occurrence (J. Gross, KNRD, pers. comm., 2002).

W. Br. LeClerc Creek. At RM 8.0 (upstream of the Whiteman confluence, near juncture of J1 & J2), a log-crib diversion structure precludes upstream fish passage. The integrity of this structure is questionable and it is likely to decay and fail within the next decade (WDNR 1997, pg. 4F-2). Maroney and Andersen (2000d, pg. 22) identify this as a splash dam that is holding back a large amount of sediment. Maroney and Andersen (2000d) agree it has the potential to fail within the next decade and is a fish passage barrier.

W. Br. LeClerc Creek. The culvert (Culvert_id # 409) at RM 11.8 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest). The culvert has a gradient of 13.5% and is a potential velocity barrier to fish (3m/second; Maroney and Andersen 2000d, pg. 19).

W. Br. LeClerc Creek. The culvert (Culvert_id # 408) at RM 13.6 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Whiteman Creek. The culvert (Culvert_id # 405) at RM 2.7 at the USFS Rd. 1936000 creek crossing (road mile 2.7) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Mineral Creek. The culvert (Culvert_id # 406) at RM 1.4 at the USFS Rd. 1936000 creek crossing (road mile 19.0) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Saucon Creek (62.0439). The culvert (Culvert_id # 407) at RM 1.0 at the USFS Rd. 1935000 creek crossing (road mile 15.5) is a full barrier to fish passage (USFS 2002 culvert barrier database). The culvert is a fish passage barrier due to gradient, water velocity, and lack of a holding pool at the culvert mouth. Brook trout and cutthroat currently occupy reaches upstream of this culvert (WDNR 1997). There are no barriers downstream of the USFS Rd. 1935 culvert (T. Andersen, KNRD, pers. comm., 2002, based on KNRD habitat surveys in lower one mile).

E. Br. LeClerc Creek (62.0420). Just downstream of the Middle Branch LeClerc Creek confluence (at the upper end of Segment D4), there is a bedrock falls identified in the DNR Watershed Analysis as a full barrier to upstream fish passage (WDNR 1997, pg. 4F-6). However, bull trout have been observed upstream of the bedrock falls by Washington Department of Fish and Wildlife (WDFW) and Kalispel Natural Resource Department (KNRD) staff (T. Andersen, KNRD, pers. comm., 2002).

Fourth of July Creek (62.0449). In 1996, KNRD conducted a habitat inventory on Fourth of July Creek. The four consecutive stream reaches surveyed upstream of RM 0.25 had gradients of 5%, 14%, 10% and 10%, respectively. Brook trout were observed in Fourth of July Creek downstream of these steep reaches but not upstream. The steep reaches beginning at RM 0.25 are a potential barrier to bull trout passage (T. Shuhda, USFS, pers. comm., 2002; KNRD and WDFW 1997c).

M. Br. LeClerc Creek (62.0462). At RM 0.5, the County Road 308 crossing may be a fish passage barrier. The culvert is perched relatively high and the water plunges onto boulders where there is no step pool present (Maroney and Andersen 2000a, pg. 25).

M. Br. LeClerc Creek. The culvert (Culvert_id # 131) at RM 1.0 at the USFS Rd. 1935115 creek crossing (road mile 0.0) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

M. Br. LeClerc Creek. The culvert (Culvert_id # 256) at RM 1.3 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

M. Br. LeClerc Creek. The culvert (Culvert_id # 255) at RM 2.2 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

M. Br. LeClerc Creek. The culvert (Culvert_id # 302) at RM 3.74 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

M. Br. LeClerc Creek. The culvert (Culvert_id # 254) at RM 3.76 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

M. Br. LeClerc Creek. The culvert (Culvert_id # 253) at RM 5.2 at the USFS Rd. 1935011 creek crossing (road mile 1.4) is a full barrier to fish passage M. Br. LeClerc Creek (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

M. Br. LeClerc Creek. The culvert (Culvert_id # 252) at RM 5.8 at the USFS Rd. 1935011 creek crossing (road mile 2.3) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Unnamed tributary to the Pend Oreille River. Near the mouth, the LeClerc Creek Road culvert (stream segment L1) is a barrier to upstream fish passage. The downstream end of the culvert is perched high enough above the surface of the tributary so as to prevent fish access. This unnamed tributary is the first stream entering (river right) the Pend Oreille River downstream of LeClerc Creek (WDNR 1997, pg. 4F-3).

Unnamed tributary to the Pend Oreille River. This unnamed tributary originates at Yokum Lake. Upstream fish passage is impeded in the lower 0.25 miles (stream segment L12). Then, the LeClerc Creek Road culvert at RM 0.25 (stream segment L12) is a barrier to upstream fish passage. The downstream end of the culvert is perched high enough above the surface of the tributary so as to prevent fish access (WDNR 1997, pg. 4F-3). Upstream fish passage is prevented in the portion of the creek upstream of RM 0.25 by the presence of many cascades and small waterfalls (stream segment L13) (WDNR 1997, pg. 4F-8).

Riparian Condition

WAU-wide. Past timber harvest and catastrophic fires in the late 1920s reduced the average riparian tree size and often resulted in brushy vegetation growing along streambanks and on the floodplain. Riparian areas with a central brushy corridor are typical in the WAU (WDNR 1997, pg. 4D-1, 4D-25).

LeClerc Creek. Portions of the lower one mile have been converted to residential lawn (T. Andersen, KNRD and A. Scott, Framatome ANP, pers. comm., 2002).

W. Br. LeClerc Creek. Cattle grazing in segment J10 is contributing to maintaining streamsides in a brushy state. Lack of an overstory coniferous tree canopy is attributable to wet soil conditions rather than solely due to cattle grazing damage to tree saplings (WDNR 1997, pg. 4D-1, 5-34).

Whiteman Creek (62.0424). There is low bank cover in the lower reaches of Whiteman Creek (KNRD and WDFW 1997b, pg. 41).

Whiteman Creek. Cattle grazing in the vicinity of RM 1.0 was contributing to maintaining streamsides in a brushy state. Lack of an overstory coniferous tree canopy is attributable to wet soils, not cattle grazing (WDNR 1997, pg. 5-34). The riparian area on Whiteman Creek in the vicinity of RM 1.0 was fenced in 1996 (T. Andersen, KNRD and K. Honeycutt, USFS, pers. comm., 2002).

Mineral Creek (62.0430). The riparian area in the lower two miles has been negatively impacted by cattle grazing (T. Andersen, KNRD, pers. comm., 2002).

Saucon Creek. In the lower one mile, dense alders dominate the riparian area (Maroney and Andersen 2000a, pg. 17).

E. Br. LeClerc Creek. On portions of the stream bank, the riparian vegetation has been replaced by riprap and roadbeds, creating gaps in connectivity and total loss of riparian function (ie. large wood and detritus recruitment, shading, cover, bank stabilization). In other areas, vegetation is not at its potential due to past riparian harvest or fires limiting the numbers of large diameter individual trees and stands (USFS 2000, pg. 11).

E. Br. LeClerc Creek. Cattle grazing in segment D1 (the stream reach from Seco Creek confluence upstream about one mile; RM 8.7 – 9.7) is contributing to maintaining streamsides in a brushy state. Lack of an overstory coniferous tree canopy is attributable to wet soils, not cattle grazing (WDNR 1997, pg. 5-34).

Fourth of July Creek. Cattle grazing, reduced riparian vegetation, and some land use practices in some upper reaches are contributing to poor bank stability, increased sediment levels instream, and channel instability (KNRD and WDFW 1997b, pg. 41).

Fourth of July Creek. Cattle grazing in segment E2 is contributing to maintaining streamsides in a brushy state. Lack of an overstory coniferous tree canopy is attributable to wet soils, not cattle grazing (WDNR 1997, pg. 5-34).

M. Br. LeClerc Creek. On portions of the stream bank, the riparian vegetation has been replaced by riprap and roadbeds, creating gaps in connectivity and total loss of riparian function (ie. large wood and detritus recruitment, shading, cover, bank stabilization). In other areas, vegetation is not at its potential due to past riparian harvest or fires limiting the numbers of large diameter individual trees and stands (USFS 2000, pg. 11).

M. Br. LeClerc Creek. Cattle grazing impacts are negatively impacting aquatic habitat in the lower 6 miles. In areas where grazing is evident, trampled banks are unstable and riparian vegetation is degraded, contributing to elevated instream sediment levels (Maroney and Andersen 2000c, pg. 23, 24).

M. Br. LeClerc Creek. Cattle grazing in segment F1 – F7 and F15 is contributing to maintaining streamsides in a brushy state. Lack of an overstory coniferous tree canopy is attributable to wet soils, not cattle grazing (WDNR 1997, pg. 5-34).

Channel Conditions/Dynamics

Streambank Condition

LeClerc Creek. There is active bank erosion in the lower one mile (T. Andersen, KNRD and A. Scott, Framatome ANP, pers. comm., 2002).

W. Br. LeClerc Creek. Streambank stability was very good (average 96%) throughout the surveyed reaches from the mouth upstream to RM 12 (Maroney and Andersen 2000d, pg. 19-22).

W. Br. LeClerc Creek. Cattle grazing in segment J10 has resulted in trampling of the streambanks and streambed. Where cattle cross the channel, banks are eroding and the pool-riffle structure of the bed has been damaged. Sediment is depositing in pools and spawning gravel in depositional reaches downstream (WDNR 1997, pg. 5-34). This is a localized condition only (T. Andersen, KNRD, pers. comm., 2002).

W. Br. LeClerc Creek. A long, high bank at the Diamond City site is unstable and contributing sediment to the stream (Maroney and Andersen 2000d, pg. 21). This is a localized condition only (T. Andersen, KNRD, pers. comm., 2002).

W. Br. LeClerc Creek. A slope failure (about 20 meters long by 10 meters high) was observed near the downstream end of reach 7. The failure is unstable and contributes sediment to the stream (Maroney and Andersen 2000d, pg. 20). This is a localized condition only (T. Andersen, KNRD, pers. comm., 2002).

Whiteman Creek. Cattle grazing in segment K8 has resulted in trampling of the streambanks and streambed. Where cattle cross the channel, banks are eroding and the pool-riffle structure of the bed has been damaged. Sediment is depositing in pools and spawning gravel in depositional reaches downstream (WDNR 1997, pg. 5-34).

Mineral Creek. Mineral Creek has poor bank stability. Cattle grazing and reduced riparian vegetation have increased lateral channel incision further adding to bank instability and sediment problems. Land use practices have resulted in increased sediment levels in the stream channel altering the channel morphology (KNRD and WDFW 1997b, pg. 41).

Saucon Creek. Bank cover and instream cover were good. Streambank stability measured as visual estimate of the percent stable bank per transect, was 99.6% (Maroney and Andersen 2000a, pg. 17).

E. Br. LeClerc Creek. Cattle grazing in segment D1 (the stream reach from Seco Creek confluence upstream about one mile; RM 8.7 – 9.7) has resulted in trampling of the streambanks and streambed. Where cattle cross the channel, banks are eroding and the pool-riffle structure of the bed has been damaged. Sediment is depositing in pools and spawning gravel in depositional reaches downstream (WDNR 1997, pg. 5-34).

M. Br. LeClerc Creek. Cattle grazing impacts are negatively impacting aquatic habitat in the lower 6 miles. In areas where grazing is evident, trampled banks are unstable and riparian vegetation is degraded, contributing to elevated instream sediment levels (Maroney and Andersen 2000a, pg. 23, 24).

M. Br. LeClerc Creek. Cattle grazing in segment F1 – F7 and F15 has resulted in trampling of the streambanks and streambed. Where cattle cross the channel, banks are eroding and the pool-riffle structure of the bed has been damaged. Sediment is depositing in pools and spawning gravel in depositional reaches downstream (WDNR 1997, pg. 5-34).

M. Br. LeClerc Creek. The USFS Rd. 1935 is constraining the channel in portions of the lower 2.5 miles resulting in some bank erosion and erosion of the road bed into the channel (Maroney and Andersen 2000a, pg. 24).

Floodplain Connectivity

WAU-wide. Over the 62-years of historical aerial photo record, stream channels in the WAU displayed little migration across their respective floodplain or alluvial fan (WDNR 1997, pg. 4D-4).

M. Br. LeClerc Creek. Portions of USFS Rd. 1935 are located within the floodplain (T. Andersen, KNRD, pers. comm., 2002). The USFS Rd. 1935 is constraining the channel in portions of the lower 2.5 miles resulting in some bank erosion and erosion of the road bed into the channel (Maroney and Andersen 2000a, pg. 24).

Channel Stability

WAU-wide. Over the 62-years of historical aerial photo record, stream channels in the WAU displayed little migration across their respective floodplain or alluvial fan (WDNR 1997, pg. 4D-4). The aerial photo interpretation did not reveal any significant changes to channel pattern, width, and location along any of the channel segments in the LeClerc Creek WAU. Sediment appears to be stored within the channel or transported downstream, and does not result in channel widening or aggradation of a magnitude that is detectable on the aerial photos. Furthermore, field surveys reveal that the sediment transported to the "response" reaches is primarily sand, rather than gravel. The response of stream channels to inputs of sand tends to be bed fining and pool filling, which would not be detectable on aerial photos (WDNR 1997, pg. 4E-10; USFS 1997, pg. I-10).

Mineral Creek. Cattle grazing and reduced riparian vegetation have increased lateral channel incision further adding to bank instability and sediment problems. Land use practices have resulted in increased sediment levels in the stream channel altering the channel morphology (KNRD and WDFW 1997b, pg. 41).

E. Br. LeClerc Creek. Coarse and fine sediment is delivered to the very upper reaches of an unnamed tributary (stream segments D9 and D12) to E. Br. LeClerc Creek. The tributary enters the E. Br. LeClerc Creek about 0.5 miles upstream of Seco Creek (RM 8.7) where E. Fk. LeClerc Creek Road crosses E. Br. LeClerc Creek. The sediment is transported downstream to stream segment D3 of the E. Br. LeClerc Creek causing fining of the channel bed and filling of pools, and possibly causing channel widening and aggradation, thereby resulting in reduction of summer and winter rearing habitat and embryo survival (WDNR 1997, pg. 5-5).

Habitat Elements

Channel Substrate

Note: Although the documents themselves nor full citations for the documents were not made available in time for inclusion in the habitat limiting factors assessment prior to publication, the following documents deserve mention here to the extent they may prove beneficial for future habitat evaluation and planning efforts in the LeClerc Creek WAU: LeClerc Creek Sediment Reduction Plan and the LeClerc Creek WAU Road Maintenance and Abandonment Plan (RMAP). The document is a matter of public record and can be found at the WDNR Northeast Regional Office in Colville, WA (Stimson 1/29/03 final draft report review comments, February 2003).

LeClerc Creek. All reaches of LeClerc Creek have embeddedness levels greater than 35%. Natural background levels of instream sediment are unknown, however current instream sediment levels are considered to be elevated as a result of human alterations to the drainage (USFS 2000, pg. 9). There is on-going sediment monitoring in E. Br. LeClerc Creek by Framatome ANP for Stimson Lumber Company. Stimson has indicated that data analysis based on the current sediment monitoring in E. Br. LeClerc strongly suggests a high natural background level of sediment within this system (Stimson, 1/29/03 final draft report review comments, February 2003).

LeClerc Creek. Some coarse and fine sediment is delivered to the mainstem LeClerc Creek (RM 0.0 – 1.05; stream segment A1; WDNR 1997, pg. 5-8).

W. Br. LeClerc Creek. The stream habitat in W. Branch appears to be impacted from high volumes of sediment (Maroney and Andersen 2000d, pg. 22). The two C5 channel types were extremely embedded with a 92.8% and a 85.6% embeddedness estimate. The B3, A2 and A4 channel types were moderately embedded (average 60% embeddedness; Maroney and Andersen 2000d, pg. 19-22).

W. Br. LeClerc Creek. Ninety-three percent of sediment delivered to streams in the W. Branch LeClerc Creek drainage comes from the numerous unsurfaced, rutted roads in upper West Branch, Redman, and Whiteman drainages. High flow events route fine sediment down to the depositional reaches of segments H4 and H5 of W. Br. LeClerc Creek. Erodible soils are commonly found throughout the watershed, and unsurfaced roads built in these materials are easily rutted and eroded (particularly road segments 158-160, 198-201, 210-211, and 212-221, WDNR 1997, pg. 5-17, 18).

W. Br. LeClerc Creek. Coarse and fine sediment is delivered to W. Br. LeClerc Creek from the upper reaches of the drainage (stream segments J1-4, J28 and J32) through the lower reaches of W. Br. LeClerc Creek (stream segments H5 and H6). Most of this material will be transported over time to segment H5 where it will result in pool filling, fining of the stream bed, and reduced channel depth. These impacts reduce the quality and quantity of both summer and winter rearing habitat, as well as reduce embryo survival of salmonids. Some amount of fine sediment may be transported to stream segment H4 where it would further fine the channel bed and fill pools, thereby reducing winter rearing habitat and embryo survival (WDNR 1997, pg. 5-8).

W. Br. LeClerc Creek. A slope failure (about 20 meters long by 10 meters high) was observed near the downstream end of reach 7. The failure is unstable and contributes sediment to the stream (Maroney and Andersen 2000d, pg. 20).

Whiteman, Mineral and Fourth of July creeks. Embeddedness levels greater than 35% were recorded on most of the reaches surveyed, with sand being the predominate size of the streambed material throughout the lower reaches. Natural background levels of instream sediment are unknown, however current instream sediment levels are considered to be elevated as a result of human alterations to the drainage (USFS 2000, pg. 9).

Whiteman Creek. Cattle grazing is contributing to bank instability and sediment deposition in Reach 4 primarily. A large beaver pond in Reach 4 acts as a sediment trap possibly eliminating large amounts of sediment deposition in lower reaches of Whiteman Creek (KNRD 1997, pg. 41). In some stream reaches with an A channel type, embeddedness exceeds 30% (T. Andersen, KNRD, pers. comm., 2002).

Mineral Creek. There is a high level of embeddedness in Mineral Creek. Cattle grazing and land use practices contribute to destabilized banks and increased sediment levels in the stream that exacerbates bank instability (KNRD and WDFW 1997b, pg. 41). Embeddedness levels range from 57-81% (T. Andersen, KNRD, pers. comm., 2002).

Saucon Creek. The first mile of Saucon Creek is an A4 channel type with an 8.7% gradient and an average stream width of two meters. As measured during the field season of 1999 (July 12 to November 7), embeddedness was 61.3% in Reach 1 (RM 0.0 – 1.0, USFS Rd. 1935 crossing) where frequent accumulations of LWD were retaining sediment in this reach (Maroney and Andersen 2000a, pg. 16). An A4 channel type is a steep, deeply entrenched and confined channel that is incised in coarse depositional materials (Rosgen 1996, pg. 5-48). The A4 channel bed features may be described as a step/pool or cascading channel that is often influenced by the occurrence of organic woody debris that form debris dams, behind which are stored significant amounts of sediment in the pools. The A4 stream types typically have a high sediment supply which is combined with high energy streamflow to produce very high bedload sediment transport rates (Rosgen 1996, pg. 5-48).

E. Br. LeClerc Creek. There are slope failures in the lower five miles associated with mechanical disturbance of slopes and loss of root strength due to harvest activities. Delivery of sediment to stream channels was observed at all failure sites (WDNR 1997, pg. 5-9).

E. Br. LeClerc Creek. In 2000, the East Fork LeClerc Creek Road (a county road) was relocated. Prior to relocation, a 1.5-mile section of this county road (road segments 6-8) contributed an estimated 237 tons/year of fine sediment to the E. Br. LeClerc Creek, or 28% of all human-caused surface erosion within the entire E. Br. LeClerc Creek drainage. This road is responsible for 91.5% of the total delivered sediment volume from all roads within the lower 5.1 miles of E. Br. LeClerc Creek, including tributaries (WDNR 1997, pg. 5-36).

E. Br. LeClerc Creek. Fine sediment has been contributed to streams by surface erosion originating from lightly graveled, high traffic roads at locations where roads are immediately adjacent to streams (within approximately 50 feet) and where road ditches drain directly into streams. Coarse and fine sediment is delivered to stream segments B1 – B5 (RM 0.0 – 5.1), causing fining of the channel bed, filling pools, and reduced channel depth. These impacts will reduce winter rearing habitat and potentially reduce embryo survival for salmonids (WDNR 1997, pg. 5-8, 5-36).

E. Br. LeClerc Creek. Fine sediment has been contributed to streams by surface erosion originating from numerous lightly graveled roads and stream crossings distributed throughout the E. Br. LeClerc Creek drainage between RM 5.1 to 8.7. Fine sediment is delivered to E. Br. LeClerc Creek from RM 5.1 – 8.7 (channel segments C1 and C2), causing fining of the channel bed and filling of pools, thereby reducing winter rearing habitat and potentially reducing embryo survival for salmonids (WDNR 1997, pg. 5-38).

E. Br. LeClerc Creek. Fine sediment is delivered to the very upper reach of E. Br. LeClerc Creek (stream segment D6) and transported downstream to stream segment D3, causing fining of the channel bed and filling of pools, and possibly causing channel widening and aggradation, thereby resulting in reduction of summer and winter rearing habitat and embryo survival (WDNR 1997, pg. 5-5).

E. Br. LeClerc Creek. Coarse and fine sediment is delivered to the very upper reaches of an unnamed tributary (stream segments D9 and D12) to E. Br. LeClerc Creek. The tributary enters the E. Br. LeClerc Creek about 0.5 miles upstream of Seco Creek (RM 8.7) where E. Fk. LeClerc Creek Road crosses E. Br. LeClerc Creek. The sediment is transported downstream to stream segment D3 of the E. Br. LeClerc Creek causing fining of the channel bed and filling of pools, and possibly causing channel widening and aggradation, thereby resulting in reduction of summer and winter rearing habitat and embryo survival (WDNR 1997, pg. 5-5).

Fourth of July Creek. Embeddedness is 70-plus percent in the lowest reach (KNRD and WDFW 1997b). The extent to which embeddedness is a function of the natural geomorphology (this is a depositional reach), related to the past existence of a dam at the mouth of Fourth of July Creek, or disturbances in the upper drainage, is unknown (TAG 2002). There was a dam on the East Branch of LeClerc Creek about two miles upstream of the confluence of the East Branch and main LeClerc, where 4th of July Ck. enters. The dam formed a pond about 2 to 3 acres (Tom Shuhda, USFS, pers. comm., 2002 - personal interview by Tom Shuhda, USFS, with LeClerc Creek private landowner and longtime resident Bill Piper on May 21, 1997).

Fourth of July Creek. Fine sediment is delivered to the lower-most stream segments (E 1 and E2) of Fourth of July Creek. The lower one mile is steep with gradients from 18-20%. Segment E2 is a depositional reach with a 4-8% gradient. The sediment originally comes into the stream system from the very upper reach of Fourth of July Creek (segment E3) and also to unnamed tributaries to upper Fourth of July which drain into the creek from the south (stream segments E6, E8, E11, E13, E14, E16 and E17). The sediment causes short term pool filling and increased embeddedness in pool tails, thereby resulting in reduced embryo survival in redds constructed in pocket accumulations of spawning gravel (WDNR 1997, pg. 5-6). Impacts could also reduce the quality and quantity of both summer and winter rearing habitat (WDNR 1997, pg. 5-8).

Fourth of July Creek. Mean embeddedness levels collected in the field season of 1995, ranged from 68.7% to 82.6% (pg. 10, 11, 14 and Table 6, pg. 22). The 1997 pre-project embeddedness was 82% in the lower-most reach at the mouth (Reach 8). Following construction of instream structures in Reach 8, embeddedness decreased (60% in 1998, 71% in 1999, and 20% in 2000). Although combined spawning gravels increased in the reach from 18 m^2 in 1997 to 20 m^2 in 1998, no spawning gravel was identified during the 1999 survey and only 0.5 m^2 was observed in 2000. Nov habitat was classified as pool in 1997 or 1998, however pools comprised 12.4% of the habitat in 1999 and 32% in 2000. Average depth increased from 12.5 cm in 1997 to 14.2 cm in 1999, but decreased to 11.8 cm in 2000. Average width also decreased; the 1997 pre-assessed width was 2.4 m and the 2000 average width was 1.9 meters. No primary pools were identified in the 1997 project pre-assessment of the 1998 project post assessment. One primary pool was counted in 1999 and six in the 2000 project post assessment (Andersen 2001, pg. 47).

M. Br. LeClerc Creek. Cattle grazing impacts are negatively impacting aquatic habitat in the lower 6 miles. In areas where grazing is evident, trampled banks are unstable and riparian vegetation is degraded, contributing to elevated instream sediment levels (Maroney and Andersen 2000a, pg. 23, 24).

M. Br. LeClerc Creek. Thirty-nine percent of the sediment delivered to streams from roads in the M. Br. LeClerc Creek drainage originates from 2.1 miles of road (road segments 138 -140). The surface erosion originates from lightly graveled, high traffic roads on the highly erodible soils at locations where roads are immediately adjacent to streams. The fine sediment is delivered to stream segments F1-F3 and F15 of M. Br. LeClerc Creek (where USFS Rd. 1935 heads north toward W. Br. LeClerc Creek; WDNR 1997, pg. 5-13).

Seco Creek (62.0475). Fine sediment is delivered to the very upper stream reaches in the Seco Creek drainage (stream segments G2 – G6), where it is routed to the depositional reach in the lower 1.5 miles of Seco Creek (stream segment G1; WDNR 1997, pg. 5-6).

Seco Creek. The lower one mile was categorized as a B5 channel type. Substrate in the lower one mile reach was 83.0%. Sediment deposition was associated with accumulations of LWD (Maroney and Andersen 2000a, pg. 19). A B5 channel type has a gradient between 2-4%, is moderately entrenched, and channel materials are composed of predominantly sand and small gravel with occasional silt/clay. The B5 channel is relatively stable where the presence of dense riparian vegetation is noted. Large, woody, organic debris is an important component of fish habitat where it is available in this type of environment (Rosgen 1996, pg. 5-76).

Seco Creek. Substrate embeddedness was very high (average 87%) even for A type channels which describes the two reaches extending from RM 1.0-2.5 (Maroney and Andersen 2000a, pg. 19). The A5 channel types are steep, entrenched and confined channels, incised in predominantly sandy materials that are frequently intermixed with gravels. The channel bed and banks are unstable and very sensitive to induced changes in streamflow regime or sediment supply (Rosgen 1996, pg. 5-52).

Large Woody Debris

WAU-wide. Large woody debris (LWD) is lacking or in an advanced stage of decay for a majority of fish-bearing streams throughout the WAU. Past timber harvest and catastrophic fires in the late 1920s reduced the average riparian tree size and often resulted in brushy vegetation growing along streambanks and on the floodplain (WDNR 1997, pg. 4D-25). Riparian areas with a central brushy corridor are typical in the WAU. Much of the larger diameter pieces of LWD in the channels were recruited during or before fires and the intensive timber harvesting that occurred in the 1920s. The LWD has been in the channels for over 65 years or more and is in an advanced stage of decay (WDNR 1997, pg. 4D-1). The major recruitment mechanisms for LWD recruitment are windthrow, tree mortality due to disease and infestation, and fire. Neither bank undercutting nor lateral channel shifting is a significant recruitment mechanism (WDNR 1997, pg. 4D-22).

W. Br. LeClerc Creek. Large woody debris levels are poor in W. Br. LeClerc Creek downstream of RM 8.0. The KNRD reported an average of 16.6 pieces of LWD/mile in the lower 8.0 miles of W. Br. LeClerc Creek which has an average width of 23.6 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

W. Br. LeClerc Creek. Large woody debris levels are good in W. Br. LeClerc Creek from RM 8.0 – 12.0. The KNRD reported an average of 22 pieces of LWD/mile from RM 8.0 – 12.0 of W. Br. LeClerc Creek which has an average width of 16.7 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

W. Br. LeClerc Creek. Channel segments H3-1 and H3-2 are considered to be at high risk of habitat degradation. Existing LWD is in an advanced state of decay, and the channel is highly sensitive to LWD functions (WDNR 1997, pg. 5-28).

Saucon Creek. Large woody debris levels are poor in the lower one mile of Saucon Creek. The KNRD reported an average of 0.018 pieces of LWD/mile in the lower one mile of Saucon Creek which has an average width of 8.5 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

E. Br. LeClerc Creek. The lower portions of E. Br. LeClerc Creek are deficient in LWD (USFS 2000, pg. 9).

E. Br. LeClerc Creek. Road segments 6, 7, and 8 negatively affect LWD recruitment to E. Br. LeClerc Creek stream segments B3, B4, and B5 (RM 2.8 – 5.1; WDNR 1997, pg. 5-28).

M. Br. LeClerc Creek. Middle Branch LeClerc Creek are deficient in LWD (USFS 2000, pg. 9).

Seco Creek. Acting Woody Debris accumulations averaged 27.8 pieces/100m in the lower 2.4 miles. Acting Woody debris is the number of woody debris with a diameter >10cm and a length >1m. Sediment deposition in lower one mile was high and generally associated with LWD accumulations anchored by the alders which dominated the riparian areas where the stream gradient was 2-3%. Accumulations of LWD were trapping sediment and the primary pool forming feature from RM 1.0-2.5 (Maroney and Andersen 2000a).

Pool Frequency and Quality

W. Br. LeClerc Creek. Pool frequency is low to moderate from the mouth upstream to the old diversion dam (RM 8; Maroney and Andersen 2000d, pg. 20-22). The KNRD reported an average 5.1 pools/mile in the lower 8.0 miles of W. Br. LeClerc Creek, which has an average width of 23.6 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003). Downstream of the old diversion dam there is a 1.2 mile A2 channel type followed by B3 channel type reaches sandwiching about a 4-mile section situated about midway between the mouth and the dam which is classified as a C5 channel (Maroney and Andersen 2000d, pg. 20-22). An A2 channel type is a steep, deeply entrenched and confined stream channel. Gradients range from 4-10% producing a channel with step/pool features. Stream types are incised in predominantly boulder-sized channel material with lesser amounts of cobble and gravel materials present (Rosgen 1996, pg. 5-40). A B3 channel type is moderately entrenched with channel gradients between 2-4%. The bed is dominated by cobble materials and characterized by a series of rapids with irregular spaced scour pools the average pool-to-pool spacing is 3-4 bankfull channel widths. Pool spacing adjusts inversely to stream gradient in the B3 channel types. Large woody debris, when available, is an important component for fisheries habitat (Rosgen 1996, pg. 5-68). A C5 channel type is a slightly entrenched, meandering, sand-dominated, riffle/pool channel with a well developed floodplain. Generally gradients are <2% with a high width/depth ratio due to the depositional characteristics of the stream bed and the active lateral migration tendencies. The streambanks are generally composed of sandy material. The C5 channel is very susceptible to shifts in both lateral and vertical stability caused by direct channel disturbance and changes in the flow and sediment regimes of the contributing watershed (Rosgen 1996, pg. 5-100).

W. Br. LeClerc Creek. Pool frequency in the four-miles surveyed upstream of the old diversion dam at RM 8.0 were low except for a one-mile reach about 2 miles upstream of the dam and one other reach 0.5 miles long at the top of the surveyed extent of W. Br. LeClerc Creek (RM 12), which were rated as moderate (Maroney and Andersen 2000d, pg. 20-22). The KNRD reported an average 5.7 pools/mile from RM 8.0 – 12/0 of the W. Br. LeClerc Creek, which has an average width of 16.7 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003). With the exception of the first 0.6 mile reach upstream of the old diversion dam (which is a B3 channel type), the stream is classified as an A2 channel type with an A4 channel in the upper 0.5 mile reach. Both A2 and A4 channel types are steep, deeply entrenched and confined stream channels with gradients ranging from 4-10%. However, an A4 channel type is incised in coarse depositional materials. The A4 channel materials are typically unconsolidated, heterogenous, noncohesive materials, dominated by gravel, but also containing small amounts of boulders, cobble and sand. The A4 channel bed features may be described as a step/pool or cascading channel that is often influenced by organic woody debris that form debris dams behind which are stored significant amounts of sediment in the pools. The streams are generally unstable with banks that contribute large quantities of sediment (Rosgen 1996, pg. 5-48).

Whiteman Creek. There is a lack of overwintering habitat, instream cover, and low pool frequency (USFS 2000, pg. 9; KNRD and WDFW 1997b, pg. 41). The KNRD reported an average 3.2 pools/mile for the lower 2 miles of Whiteman Creek which has an average width of 10.5 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Mineral Creek. There is a lack of pool habitat and overwintering habitat in the lowest reach (USFS 2000, pg. 9; KNRD and WDFW 1997b, pg. 41).

Saucon Creek. Pool frequency is poor for Saucon Creek. The KNRD reported an average 11.1 pools/mile for the lower one mile of Saucon Creek which has an average width of 8.5 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

E. Br. LeClerc Creek. Pool frequency is poor for E. Br. LeClerc Creek. The KNRD reported an average 4.2 pools/mile for E. Br. LeClerc Creek from the mouth upstream to the headwater falls. The average width of E. Br. LeClerc Creek was not provided (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Fourth of July Creek. Based on habitat inventories in 1996, there was a lack of pool habitat and overwintering habitat in the lowest reach (3%; KNRD and WDFW 1997b, pg. 41). Consequently, KNRD installed instream structures in Fourth of July Creek in 1997 to create more pool habitat (Andersen 2001, pg. 47). In 2001, pool habitat had increased to 50% (Andersen 2001b, pg. 46).

M. Br. LeClerc Creek. Pool frequency was high in the lower 0.5-mile reach, however many pools lacked good depth and were not classified as “primary pools” (Maroney and Andersen 2000a, pg. 25). Pool frequency was poor overall for M. Br. LeClerc Creek in the lower five miles. The KNRD reported an average 14.2 pools/mile for the lower 5.0 miles of M. Br. LeClerc Creek. The average width of M. Br. LeClerc Creek was not provided (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Seco Creek. Habitat in Seco Creek was impaired due to high amounts of sediment which resulted in poor substrate condition and low pool-to-riffle ratios (Maroney and Andersen 2000a, pg. 25). Pool frequency and quality is poor with KNRD reporting an average 9.6 pools/mile for the lower 2.5 miles of Seco Creek which has an average width of 7.5 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Pool Depth

W. Br. LeClerc Creek. Pool depth is fair in the lower 8 miles of W. Br. LeClerc Creek. The KNRD reported few pools greater than one meter deep (29 pools) in the lower 8.0 miles of W. Br. LeClerc Creek, which has an average width of 23.6 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

W. Br. LeClerc Creek. Pool depth is fair from RM 8.0 – 12.0 of W. Br. LeClerc Creek. The KNRD reported few pools greater than one meter deep (19 pools) in the four mile reach from RM 8.0 – 12.0 of W. Br. LeClerc Creek which has an average width of 16.7 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

W. Br. LeClerc Creek. Ninety-three percent of sediment delivered to streams in the W. Branch LeClerc Creek drainage comes from the numerous unsurfaced, rutted roads in the Upper West Branch, Red Man, and White Man drainages. High flow events route fine sediment down to the depositional reaches of Segments H4 and H5 of W. Br. LeClerc Creek. Erodible soils are commonly found throughout the watershed, and unsurfaced roads built in these materials are easily rutted and eroded (particularly road segments 158-160, 198-201, 210-211, and 212-221, WDNR 1997, pg. 5-17, 18).

W. Br. LeClerc Creek. Coarse and fine sediment is delivered to W. Br. LeClerc Creek from the upper reaches of the drainage (stream segments J1-4, J28 and J32) through the lower reaches of W. Br. LeClerc Creek stream segments H5 and H6). Most of this material will be transported over time to segment H5 where it will result in pool filling, fining of the streambed, and reduced channel depth. These impacts reduce the quality and quantity of both summer and winter rearing habitat, as well as reduce embryo survival of salmonids. Some amount of fine sediment may be transported to stream segment H4 where it would further fine the channel bed and fill pools, thereby reducing winter rearing habitat and embryo survival (WDNR 1997, pg. 5-8).

Whiteman Creek. There is a lack of overwintering habitat, instream cover, and low pool frequency (USFS 2000, pg. 9; KNRD and WDFW 1997b, pg. 41). The KNRD reported zero pools greater than one meter deep in the lower 2.0 miles of Whiteman Creek which has an average width of 10.5 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Mineral Creek. Riffle habitat is dominant throughout the stream, indicating a lack of winter habitat and primary pools (USFS 2000, pg. 9; KNRD and WDFW 1997b, pg. 41).

E. Br. LeClerc Creek. Fine sediment has been contributed to streams by surface erosion originating from lightly graveled, high traffic roads at locations where roads are immediately adjacent to streams (within approximately 50 feet) and where road ditches drain directly into streams. Coarse and fine sediment is delivered to stream segments B1 – B5 (RM 0.0 – 5.1), causing fining of the channel bed, filling pools, and reduced channel depth. These impacts will reduce winter rearing habitat and potentially reduce embryo survival for salmonids (WDNR 1997, pg. 5-8, 5-36).

E. Br. LeClerc Creek. Fine sediment has been contributed to streams by surface erosion originating from numerous lightly graveled roads and stream crossings distributed throughout the E. Br. LeClerc Creek drainage between RM 5.1 to 8.7. Fine sediment is delivered to E. Br. LeClerc Creek from RM 5.1 – 8.7 (channel segments C1 and C2), causing fining of the channel bed and filling of pools, thereby reducing winter rearing habitat and potentially reducing embryo survival for salmonids (WDNR 1997, pg. 5-38).

E. Br. LeClerc Creek. Fine sediment is delivered to the very upper reach of E. Br. LeClerc Creek (stream segment D6) and transported downstream to stream segment D3, causing fining of the channel bed and filling of pools, and possibly causing channel widening and aggradation, thereby resulting in reduction of summer and winter rearing habitat and embryo survival (WDNR 1997, pg. 5-5).

E. Br. LeClerc Creek. Coarse and fine sediment is delivered to the very upper reaches of an unnamed tributary (stream segments D9 and D12) to E. Br. LeClerc Creek. The tributary enters the E. Br. LeClerc Creek about 0.5 miles upstream of Seco Creek (RM 8.7) where E. Fk. LeClerc Creek Road crosses E. Br. LeClerc Creek. The sediment is transported downstream to stream segment D3 of the E. Br. LeClerc Creek causing fining of the channel bed and filling of pools, and possibly causing channel widening and aggradation, thereby resulting in reduction of summer and winter rearing habitat and embryo survival (WDNR 1997, pg. 5-5).

Fourth of July Creek. There is a lack of pool habitat and wintering habitat in the lowest reach (USFS 2000, pg. 9; KNRD and WDFW 1997b, pg. 41), however the stream width in the lower 0.25 miles is only 2.7 meters wide. The habitat rating criteria for assessing pool depth (USFWS 1998) applies only to stream greater than three meters in width.

Fourth of July Creek. Fine sediment is delivered to the lower reaches of Fourth of July Creek (stream segments E 1 and E2). The lower one mile is steep with gradients from 18-20%. Segment E2 is a depositional reach with a 4-8% gradient. The sediment originally comes into the stream system from the very upper reach of Fourth of July Creek (segment E3) and also to unnamed tributaries to upper Fourth of July which drain into the creek from the south (stream segments E6, E8, E11, E13, E14, E16 and E17). The sediment causes short term pool filling and increased embeddedness in pool tails, thereby resulting in reduced embryo survival in redds constructed in pocket accumulations of spawning gravel (WDNR 1997, pg. 5-6). Impacts could also reduce the quality and quantity of both summer and winter rearing habitat (WDNR 1997, pg. 5-8).

M. Br. LeClerc Creek (62.0462). Thirty-nine percent of the sediment delivered to streams from roads in the M. Br. LeClerc Creek drainage originates from 2.1 miles of road (road segments 138 -140). The surface erosion originates from lightly graveled, high traffic roads on the highly erodible soils at locations where roads are immediately adjacent to streams. The fine sediment is delivered to Segments F1-F3 and F15 (WDNR 1997, pg. 5-13).

M. Br. LeClerc Creek. Pool frequency was high in the lower 0.5-mile reach, however many pools lacked good depth and were not classified as "primary pools" (Maroney and Andersen 2000a, pg. 25).

Off-Channel Habitat

W. Br. LeClerc Creek. There are few side channels in the Le Clerc Creek drainage and no off-channel ponds according to the 1991 and 1995 habitat inventory data. The small amounts of off-channel habitat in the drainage are found primarily in the West and East Branches of LeClerc Creek. Side channels ranged from 1.1 to 6.3% of the habitat surveyed on the West Branch (USFS 2000, pg. 9).

W. Br. LeClerc Creek. In reach 8, a large woody debris jam was causing channel braiding throughout the floodplain (Maroney and Andersen 2000a, pg. 21).

W. Br. LeClerc Creek. In reach 5, large aggregations of LWD (some jams have >30 pieces) have created depositions of substrate on the upstream side of the jams. In these areas, channel splitting and the creation of new channels was observed (Maroney and Andersen 2000a, pg. 20).

E. Br. LeClerc Creek. There are few side channels in the Le Clerc Creek drainage and no off-channel ponds according to the 1991 and 1995 habitat inventory data. The small amounts of off-channel habitat in the drainage are found primarily in the West and East Branches of LeClerc Creek. Side channels ranged from 0 to 0.81% for the East Branch habitat surveyed (USFS 2000, pg. 9).

Whiteman, Mineral, and Fourth of July creeks. These streams tend to be Rosgen B3 or B4 channel types in narrow valley forms which may explain their lack of off channel habitat (USFS 2000, pg. 10).

Water Quality

Temperature

WAU-wide. Maximum water temperature exceedences occurred (61.3ºF/16.3ºC) at four of the seven sites monitored by WDNR from July 18 to August 13, 1996 despite relatively high canopy closure. When data analysis was run separately for groundwater influenced sites and for all other sites, elevation showed a good predictive relationship to maximum temperature. Based on analysis of the limited number of sites monitored, it appears that Class AA water temperatures criteria may not be met below 5,300 feet except where cool groundwater inflow governs the diurnal temperature range. This condition is aggravated by reductions in canopy closure. The three sites that did not exceed 61.3 ºF (includes the two on lower West Branch LeClerc Creek and the one site on the middle East Branch LeClerc Creek) had cold water temperatures with small diurnal fluctuations characteristic of groundwater dominated streamflow.(WDNR 1997, pg. 4D-33, 34). Monitoring locations were located on lower and upper West Branch LeClerc Creek, lower and middle East Branch LeClerc Creek, and lower Middle Branch LeClerc Creek. Exact locations could not be determined from the WDNR Watershed Analysis report (WDNR 1997). Seven-day average maximum temperatures could not be calculated from the information provided in the WDNR Watershed Analysis report.

LeClerc Creek. Water temperature was sampled one day a month for the months of August, September, October, March, April, May, June, and July from 1997 through 1998 on the mainstem LeClerc Creek where LeClerc Creek Road crosses the stream. Seven-day average maximum temperatures can not be calculated with this limited data, however the maximum temperature recorded was 12ºC/54ºF on August 24, 1998. The minimum temperature recorded was 3.1ºC/37.6ºF on March 24, 1998 (POCD 1999, Appendix B).

LeClerc Creek. On August 17, 2001, surface water temperature data for LeClerc Creek was collected using a thermal infrared remote sensor and a visible band color video camera mounted on a helicopter (Watershed Sciences 2002). Thermal infrared remote sensors are only capable of measuring water temperatures at the surface. LeClerc Creek warmed slightly over the 1.1 miles from the confluence of the West and East Branches of LeClerc Creek to the confluence with the Pend Oreille River. LeClerc Creek was a cooling source to the Pend Oreille River (Watershed Sciences 2002, pg. 15). Water temperatures in the Pend Oreille River at RM 56.2 were 20.4ºC on August 17, 2001; water temperatures were 15.4ºC in LeClerc Creek at the confluence with the Pend Oreille River. At the confluence of the West and East Branches of LeClerc Creek, on August 17, 2001, water temperatures were 14.3ºC in LeClerc Creek. Water temperature on the same date in the E. Fk. LeClerc Creek at the mouth was 18.3ºC; water temperature at the mouth W. Fk. LeClerc Creek was 12.7ºC (Watershed Sciences 2002, pg. 15).

LeClerc Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting temperature data (along with pH, dissolved oxygen, stream flow, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) at the mouth of LeClerc Creek (D. Comins, POCD, email comm., Feb. 2003).

W. Br. LeClerc Creek. Water temperature data was collected by the USFS using thermographs deployed at the USFS boundary from June through October 1996. The USFS calculated a 7-day average maximum temperature of 43.1 ºF for the period September 16 – September 20, 1996 (USFS 2000, pg. 7).

W. Br. LeClerc Creek. Water temperature was sampled one day a month for the months of August, September, October, March, April, May, June, and July from 1997 through 1998 W. Br. LeClerc Creek near the USFS boundary. Seven-day average maximum temperatures can not be calculated with this limited data, however the maximum temperature recorded was 15.2ºC/59.4ºF on August 24, 1998. The minimum temperature recorded was 2.2ºC/36ºF on October 20, 1998, then 2.3ºC/36ºF on March 24, 1998 and 3.5ºC/38ºF on April 20, 1998 (POCD 1999, Appendix B).

W. Br. LeClerc Creek. A thermograph was placed about 300 meters upstream from the confluence with E. Br. LeClerc Creek by the KNRD. Temperatures were recorded from July 12 to November 7, 1999. Stream temperatures never exceeded 12.9 to 13°C (Maroney and Andersen 2000d, pg. 16). The 7-day average maximum instream temperature was 12.9°C for the period of record and occurred from July 28 through August 3, 1999 (T. Andersen, KNRD, email comm., Jan. 6, 2003). The thermograph was located downstream of the dewatering reach located between RM 1.5 and 3.0.

W. Br. LeClerc Creek. Water temperature data was collected at the adfluvial fish trap location by DE&S in 1998, 1999 and 2000 during the adfluvial fish trapping study conducted for the POPUD. The adfluvial fish trap was located just upstream from the mouth of W. Br. LeClerc Creek. Limited overlapping temperature data exist for this tributary. West Branch LeClerc Creek maintains the coolest water tempearures in the summer and the warmest in the winter. It receives substantial groundwater flows, which regulate the streams temperature and flow. Over the three-year period during which water temperatures were recorded, winter water temperatures of 5-6°C remained stable until spring runoff dropped instream water temperatures for 4-8 weeks until the snow melt was done. Temperatures gradually climbed back to their peak near 12°C in early August before dropping back to 6°C by late fall. Mid-summer water temperatures were regularly 5-7°C colder than most all other tributaries observed during the adfluvial fish trapping study. In all years, a minor migration peak made up of juvenile salmonids was observed when water temperatures reached approximately 11°C (DE&S 2001a, pg. 15).

W. Br. LeClerc Creek. From July 23 to October 30, 2002, the USFS deployed a thermograph approximately one mile upstream from the mouth of W. Br. LeClerc Creek. The 7-day average maximum temperature during the period of record was 12.0°C; the maximum temperature for the period of record was 13.0°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

W. Br. LeClerc Creek. On August 17, 2001, surface water temperature data for LeClerc Creek was collected using a thermal infrared remote sensor and a visible band color video camera mounted on a helicopter (Watershed Sciences 2002). Thermal infrared remote sensors are only capable of measuring water temperatures at the surface and in some cases, surface water temperatures were sometimes obscured by riparian vegetation and could not be adequately sampled. Near the headwaters of W. Br. LeClerc Creek (RM 13.5) water temperatures are cool (about 11.0°C) and show a general warming trend downstream to where Mineral Creek flows into the West Branch (RM 10.6). Mineral Creek is a source of thermal cooling that continued downstream about one-half mile. Then, instream temperatures for approximately the next 2.5 miles, ranged from 16.4°C to 17.9°C but began to rise at about RM 7.5 to reach a local maximum temperature of 19.7°C at RM 7.1. At RM 7.1 another cooling trend occurred and stream temperatures returned to near 17.0°C. The survey did not detect any surface water or point source inflows that would contribute to this cooling. However, the location of the cooling trend corresponds closely to the convergence of Dry Canyon and W. Fk. LeClerc Creek suggesting a possible sub-surface inflow from Dry Canyon (Watershed Sciences 2002, pg. 16).

Between river miles 6.5 and 2.3, stream temperatures show a net increase of 5.6°C (17°C – 22 6°C). Local thermal veriablity is noted throughout this reach. One notable location is a weland area with multiple channels that occurs at RM 4.5 where the minimum temperature recorded was 18°C at the downstream end of the wetland area (Watershed Sciences 2002, pg. 16).

At RM 2.0, cool water emerges from within the stream channel and stream temperatures in W. Br. LeClerc Creek return to about 10.3°C. Upstream of this location, there is little surface water visible in the stream channel. The cool water discharge at this location may originate upstream and flow through channel substrate. A second area of sub-surface discharge was detected at RM 1.9. This inflow seems to occur in the right channel of a split channel area. The groundwater inputs collectively define stream temperatures in the lower two miles of W. Fk. LeClerc Creek (Watershed Sciences 2002, pg. 16)

W. Br. LeClerc Creek. Two cool water sites in the lower three miles (stream segment H1 and H2) were identified and are believed to be strongly influenced by groundwater inflow, possibly from the Dry Canyon drainage (WDNR 1997, pg. 4F-3). One cooler site is located just above the first mile of stream. Temperatures recorded here were 1.5ºC cooler here (Maroney and Andersen 2000d, pg. 22). The topographic position of lower W. Br. LeClerc Creek (stream segments H1 and H2) relative to the internally draining Dry Canyon drainage suggests there may be groundwater hydraulic continuity with discharge to the W. Branch. Numerous springs were observed in the lower three miles (stream segment H1 and H2) and the observed stream flow appeared noticeably greater than that of the upstream channel segment. Monitoring was conducted from July 18, 1996 through August 13, 1996 using hobo™ thermographs. The only bull trout observations in the LeClerc Creek WAU have occurred in the cool water reaches in the West and in the East Branches of LeClerc Creek (WDNR 1997, pg. 4D-33, 36). It is possible that bull trout were found only in these two stream channel segments because of selection for cooler water temperatures resulting from plumes of upwelling groundwater immediately upstream (WDNR 1997, pg. 4F-3).

W. Br. LeClerc Creek. Andrew Scott, Framatome ANP (pers. comm., 2002) reported that at about RM 2.0, there is a zone of groundwater influenced inflow about 100 feet in length.

Saucon Creek. A thermograph recorded stream temperatures from July 12 to November 7, 1999. The maximum temperature recorded was just over 13ºC/55.4ºF (late August, exact date not provided in report). The thermograph was located on Saucon Creek near the mouth (Maroney and Andersen 2000a, pg. 16). The 7-day average maximum instream temperature was 12.12°C for the period of record and occurred from August 1 through August 7, 1999 (T. Andersen, KNRD, email comm., Jan. 6, 2003).

E. Br. LeClerc Creek. Water temperature data was collected by the USFS using thermographs from June through October 1996 deployed near the mouth of E. Br. LeClerc Creek. The USFS calculated a 7-day average maximum temperature of 47.6 ºF for the period September 16 – September 20, 1996 (spawning). A 7-day average maximum temperature of 63.8 ºF was calculated for the period July 24 – July 28, 1996 (rearing; USFS 2000, pg. 7). Forty-eight degrees Fahrenheit is within the preferred range for bull trout spawning and rearing. Water temperatures exceeding 59 ºF are considered poor for bull trout rearing (USFWS 1998).

E. Br. LeClerc Creek. Water temperature was sampled one day a month for the months of August, September, October, March, April, May, June, and July from 1997 through 1998 on E. Br. LeClerc Creek near the USFS boundary. Seven-day average maximum temperatures can not be calculated with this limited data, however the maximum temperature recorded was 61.6ºF on

July 20, 1998. The minimum temperature recorded was 37.6ºF on March 24, 1998 (POCD 1999, Appendix B).

E. Br. LeClerc Creek. One cool water site was identified between RM 1.25 and RM 8.7 (stream segment C2). Based on bedrock stratigraphy, groundwater accretion may be occurring in the vicinity of where the thermograph monitoring station was placed. Monitoring was conducted from July 18, 1996 through August 13, 1996 using hobo™ thermographs. The only bull trout observations in the LeClerc Creek WAU have occurred in the cool water reaches in the West and in the East Branches of LeClerc Creek (WDNR 1997, pg. 4D-33, 36). It is possible that bull trout were found only in these two stream channel segments because of selection for cooler water temperatures resulting from plumes of upwelling groundwater immediately upstream (WDNR 1997, pg. 4F-3).

E. Br. LeClerc Creek. Water temperature data was collected at the adfluvial fish trap location by DE&S in 1998, 1999 and 2000 during the adfluvial fish trapping study conducted for the POPUD. The adfluvial fish trap was located just upstream from the mouth of E. Br. LeClerc Creek. Daily average water temperatures were difficult to compare year-to-year due to the relatively small period of overlap during the three years. This was primarily due to high waters affecting trap operations and a lost temperature monitor in 1999. The limited overlap data indicate that for the three-year period, peak water temperatures of 16-20°C occurred in early August and only lasted for a week to ten days. After that, a gradual decrease in temperature occurred throughout the fall period. The mid-summer migration activities appeared to occur between 12-16°C. The coolest daily temperatures occurred in 2000, while in 1999 they appeared to be the warmest. Data also indicated that summer peak temperatures dropped rapidly in 1999 and 2000, while a more gradual decrease occurred in 1998. The maximum temperature of 20°C for the three year period was observed in early August 1999 (DE&S 2001a, pg. 14).

E. Br. LeClerc Creek. On August 17, 2001, surface water temperature data for LeClerc Creek was collected using a thermal infrared remote sensor and a visible band color video camera mounted on a helicopter (Watershed Sciences 2002). Thermal infrared remote sensors are only capable of measuring water temperatures at the surface and in some cases, surface water temperatures were sometimes obscured by riparian vegetation and could not be adequately sampled. Upstream of RM 11.1 (the uppermost reaches of E. Br. LeClerc Creek), temperature sampling was difficult due to the stream's small size and vegetation masking. Consequently, stream temperatures were only sampled intermittently. Steam temperatures were in the vicinity of 12°C (Watershed Sciences 2002, pg. 18, 19). Between RM 11.1 and 2.7, stream temperatures warmed approximately 6.5°C. Two surface water inputs (Seco Creek and M. Fk. LeClerc Creek) sampled in this 8.5 mile reach were sampled and both contributed water that was warmer than mainstem temperatures (Seco Creek/14.0°C and M. Fk. LeClerc Creek/19.1°C; Watershed Sciences 2002, pg. 18).

There is a sharp increase in temperatures observed at RM 2.7 (reason was not apparent) and then a stream temperature decrease of about 2.1°C between RM 2.2 and 1.7. Fourth of July Creek flows (15.6°C) into E. Br. LeClerc Creek (17.3°C) at this point and is a source of thermal cooling. No other surface water inflows were detected in the 2.2 to 1.7 mile reach. Stream temperatures increased slightly downstream to RM 0.9 at which point a surface water inflow at

15.5°C further lowered stream temperatures in E. Br. LeClerc Creek by 1.4°C (18.3°C to 16.9°C). The inflow was not identified on the USGS 7.5 topographic maps, but seemed to originate in a small pond or spring along the right bank (Watershed Sciences 2002, pg. 18).

E. Br. LeClerc Creek. From July 10 to November 26, 2002, the KNRD deployed a thermograph at the first bridge crossing of County Rd. 3503 to record water temperature in E. Br. LeClerc Creek. The 7-day average maximum temperature for the period of record was 19.9°C from July 11 to July 17, 2002 (KNRD stream temperature data, M. Wingert, KNRD, email comm., Jan. 6, 2003).

E. Br. LeClerc Creek. From July 23 to October 30, 2002, the USFS deployed a thermograph at the USFS boundary near the Fourth of July Creek confluence. The 7-day average maximum temperature during the period of record was 18.2°C; the maximum temperature for the period of record was 20.0°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

E. Br. LeClerc Creek. From July 11 to October 28, 2002, the KNRD deployed a thermograph on E. Br. LeClerc Creek at the first bridge crossing south of the 1935/3521 road crossings. The 7-day average maximum temperature for the period of record was 19.1°C from July 14 to July 20, 2002 (KNRD stream temperature data, M. Wingert, KNRD, email comm., Jan. 6, 2003).

E. Br. LeClerc Creek. From July 10 to October 28, 2002, the KNRD deployed a thermograph on E. Br. LeClerc Creek 4.5 miles upstream from the 1935/3521 intersection bridge crossing. The 7-day average maximum temperature for the period of record was 13.5°C from July 12 to July 18, 2002 (KNRD stream temperature data, M. Wingert, KNRD, email comm., Jan. 6, 2003).

E. Br. LeClerc Creek. Air and water temperature monitoring was conducted by Framatome ANP for Stimson Lumber Company on upper E. Br. LeClerc Creek. A summary report for 2000 through 2003 has been prepared (Stimson, 1/29/03 final draft report review, February 2003) but was not available in time to be reviewed and incorporated into this bull trout habitat limiting factors assessment.

M. Br. LeClerc Creek. Water temperature data was collected by the USFS using thermographs from June through October 1996. The exact location of the thermograph site is not indicated in the USFS report. The USFS calculated a 7-day average maximum temperature of 47.3 ºF for the period September 16 – September 20, 1996 (spawning). A 7-day average maximum temperature of 62.6 ºF was calculated for the period July 24 – July 28, 1996 (rearing; USFS 2000, pg. 7).

M. Br. LeClerc Creek. The 7-day average maximum water temperature was 18.8ºC between August 3 and August 9, 2000 (USFS unpublished temperature data, K. Honeycutt, USFS, pers. comm., 2002).

M. Br. LeClerc Creek. Two thermographs, one at the upper end of reach 5 and one at the lower end of reach 7, recorded stream temperatures from July 12 to November 8, 1999. Stream temperatures at the lower site (Reach 7) exceeded 18ºC/64.4ºF in August on four different days during the recording period (Maroney and Andersen 2000a, pg. 20). A 7-day average temperature could not be calculated from the information provided in the report, however KNRD reported a 7-day average maximum instream temperature in the lower 5 miles of M. Br. LeClerc Creek of 15.23°C for the period of record and occurred from August 1 through August 7, 1999 (T. Andersen, KNRD, email comm., Jan. 6, 2003).

M. Br. LeClerc Creek. On August 17, 2001, surface water temperature data for M. Br. LeClerc Creek was collected from the mouth upstream to RM 4.0 using a thermal infrared remote sensor and a visible band color video camera mounted on a helicopter (Watershed Sciences 2002). Thermal infrared remote sensors are only capable of measuring water temperatures at the surface and riparian vegetation can obscure surface water inputs. Because of M. Fk. LeClerc Creek relatively narrow stream width, in some cases the imagery data was not visible. Smaller channel widths can also result in higher inaccuracies in the measured radiant temperatures. There was very little surface water visible in the M. Fk. LeClerc Creek that could be accurately sampled. Given these limitations, the average water temperature was determined to be 19.1°C (Watershed Sciences 2002, pg. 18, 19, 21).

Seco Creek. A thermograph recorded stream temperatures at the mouth of Seco Creek from July 13 to November 10, 1999. The maximum temperature recorded was just over 14ºC/57ºF in early August (exact date not provided in report; Maroney and Andersen 2000a, pg. 17). The 7-day average maximum instream temperature was 13.22°C for the period of record and occurred from August 2 through August 8, 1999 (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Seco Creek. On August 17, 2001, surface water temperature data for Seco Creek was collected using a thermal infrared remote sensor and a visible band color video camera mounted on a helicopter (Watershed Sciences 2002). Thermal infrared remote sensors are only capable of measuring water temperatures at the surface and riparian vegetation can obscure surface water inputs. The average water temperature was determined to be 14.0°C (Watershed Sciences 2002, pg. 19).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

LeClerc Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting stream flow data (along with pH, dissolved oxygen, temperature, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) near the mouth of LeClerc Creek (D. Comins, POCD, email comm., Feb. 2003).

LeClerc Creek drainage. There is insufficient information concerning flow regimes for the Le Clerc Creek drainage (no hydrograph). In addition, there are no undisturbed watersheds of similar size, geology and geography for comparison. Due to the high road density (2.73

miles/sq. mi.) and high level of acreage in harvested openings within the drainage (>15%), there should be an effect to the natural flow regime. Although not calculated, the drainage density has been increased more than minimally by the existing road system. There is presently an increase over the natural drainage pattern of the watershed due to the presence of the road system, past timber harvest, past wildfire, and conversion of forested lands to non-forested uses. However, the degree of alteration of the watershed from its previous natural hydrology is not known (USFS 2000, pg. 11).

Unnamed tributary to the Pend Oreille River. This unnamed tributary originates at Yokum Lake. This stream dries up in the summer. Large deposits of coarse sediment from mass wasting events which may be associated with poorly constructed roads on steep slopes, may increase the extent and duration of sub-surface flow (WDNR 1997, pg. 5-11).

Species Competition

Non-indigenous Fish

WAU–wide. Brook trout occur throughout the LeClerc Creek WAU. Although brook trout far outnumber cutthroat throughout the fish-bearing network in the drainage, moderate populations of cutthroat do occur, but only in the upper reaches of Fourth of July Creek and the high-gradient stream segments (>4%) of tributaries to the W. Br. LeClerc Creek upstream of the confluence with Red Man/White Man creeks. This is perhaps an indication of areas within the drainage where physical habitat attributes may provide a competitive advantage to native cutthroat which allows them to successfully co-exist in the presence of brook trout invasion (WDNR 1997, pg. 4F-3).

LeClerc Creek. Brook trout are known to occur in LeClerc Creek (WDNR 1997, Figure 4F-1).

W. Br. LeClerc Creek. Brook trout were detected throughout the stream during snorkeling surveys (Maroney and Andersen 2000d, pg. 18, Figure 4).

Whiteman Creek. Whiteman Creek had one of the greatest densities of brook trout observed among four streams surveyed; Mineral Creek, Fourth of July Creek, Cee Cee Ah Creek, and Indian Creek (KNRD and WDFW 1997b, pg. 42).

Mineral Creek. Brook trout are known to occur in Mineral Creek (KNRD and WDFW 1997b, pg. 42).

E. Br. LeClerc Creek. Brook trout are known to occur in LeClerc Creek (WDNR 1997, Figure 4F-1).

Fourth of July Creek. Prior to construction of instream structures in 1997 in the lowest reach of Fourth of July Creek to address on-site embeddedness, cutthroat and brook trout were observed (8 fish/100 m^2 and 3 fish/100 m^2, respectively). Following project implementation, numbers of each species fluctuated both up and down, to where in 1999, cutthroat increased 700% (35 fish/100 $m^{2)}$ and brook trout were not even observed. But in 2000, cutthroat declined to 9.3

fish/100 m^2 and brook trout increased to 22.2 fish/100 m^2. One bull trout and one brown trout were observed in both 1998 and 1999 (Andersen 2001, pg. 47). The extent to which the instream structures affected fish populations is not clear.

<u>M Br. LeClerc Creek.</u> Brook trout were observed in the lower 7 miles (Maroney and Andersen 2000a, pg. 22-25).

<u>Seco Creek.</u> Brook trout were the only fish species observed in the uppermost and lower-most reaches (Reach 3 and 1) and density was relatively low in all reaches surveyed (RM 0.0 – 2.4; Maroney and Andersen 2000a, pg. 17).

LeClerc Creek WAU Fish Distribution and Use.

LeClerc Creek flows into the Box Canyon Reservoir reach of the Pend Oreille River. Bull trout are known to occur in the LeClerc Creek watershed. Table 15 below describes current, known bull trout use in the LeClerc Creek WAU. Maps in Appendix C illustrate the extent of "Historic", "Currently Occupied", "Suitable", and "Recoverable" bull trout habitat in the WAU. Table D1 in Appendix D provide sources for the information on the fish distribution maps. More recently, a total of eight bull trout, both adult and juvenile, have been documented in West Branch LeClerc Creek, East Branch LeClerc Creek, and Fourth of July Creek since 1993 (POCD 2001b; TAG 2002). The presence of juveniles indicates that, although most likely very limited, successful reproduction of bull trout is occurring in LeClerc Creek (USFS 2000, pg. 6).

Bull trout have been documented as occurring historically in the LeClerc Creek WAU (Smith 1983, pg. 203). Smith's notes reprinted in court documents (Smith 1983) indicated the use of a single-family weir used at the mouth of LeClerc Creek "built in early spring to capture trout and char exclusively". The term "char" was used historically to refer to bull trout. Lyons (2002, pg. 3, 4) states that in Smith's complete notes from 1936-1938, Smith described the capture of "trout" in traditional Kalispel fishing weirs placed at the mouth of LeClerc Creek in late summer. The Kalispel Tribe contends that documentation of the capture of "trout" historically in LeClerc Creek at the mouth in late summer infers the presence of a bull trout population in the drainage (Lyons 2002). The reprints of Smith's notes found in Smith 1983 may not represent the complete information contained in Smith 1936-1938 as indicated by Lyon (2002).

Given the knowledge of salmonid biology and behavior, the historic use by bull trout of the mainstem Pend Oreille (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), and a lack of natural barriers at tributary mouths, it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. Currently, for all practical purposes viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years.

Table 15: Current, known bull trout use in the LeClerc Creek WAU

LeClerc Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
LeClerc Creek					X
W. Br. LeClerc Creek	X	X		X	X
Whiteman Creek					X
Mineral Creek					X
Saucon Creek					
E. Br. LeClerc Creek		X		X	X
Fourth of July Creek		X		X	X
M. Br. LeClerc Creek					X
Seco Creek					X

LeClerc Creek WAU Summary.

Past historic events and activities such as wildfires, flume construction, riparian harvest, cattle grazing, and the construction of roads and railroads in riparian habitat, have modified or eliminated riparian vegetation throughout the watershed. Some areas such as the headwaters of the West, East, and Middle Branches of LeClerc Creek, and tributaries such as Fourth of July, Whiteman and Mineral creeks, have intact functioning riparian communities with few road crossings and species composition expected of the natural community. However past historic and present use has caused a moderate loss of connectivity and ecosystem function between these better functioning riparian areas and degraded lower reaches (USFS 2000, pg. 11). The habitat has recovered from the last major fires in the early 1930s. It is continuation of some actions such as road use and cattle grazing that continue to accentuate localized disturbances (USFS 2000, pg. 12).

The LeClerc WAU has been impacted by historic, large-scale logging operations, early twentieth-century wildfires that have changed tree species composition, and the introduction of exotic fish species (from the POCD write-up of the LeClerc Creek WAU section for the 8/15/02 draft of the Bull Trout Habitat Limiting Factors for WRIA 62 report, R. Dasher, author). Past timber harvest and catastrophic fires in the late 1920s reduced the average riparian tree size, thereby reducing potential LWD recruitment, and often resulted in brushy vegetation growing along streambanks and on the floodplain (WDNR 1997, pg. 4D-25). Instream LWD numbers are low primarily due to past riparian harvest and fires (WDNR 1997, pg. 4B-6). Where LWD is present, it is often associated with sediment deposits where sedimentation is high (Maroney and Andersen 2000a). The extent to which high instream sediment levels and instream temperature exceedences are still being influenced by the impacts from historic logging and wildfire is unclear in the literature. There is on-going sediment monitoring in E. Br. LeClerc Creek by Framatome ANP for Stimson Lumber Company. Stimson has indicated that data analysis based on the current sediment monitoring in E. Br. LeClerc strongly suggests a high natural background level of sediment within the E. Br. LeClerc system (Stimson, 1/29/03 final draft report review comments, February 2003). Framatome ANP has also been monitoring air and water temperatures in upper E. Br. LeClerc Creek since 2000 for Stimson Lumber. As with the sediment monitoring results, the summary report for the 2000-2002 temperature monitoring was not available in time to be reviewed and incorporated into this bull trout habitat limiting factors assessment. Logging practices within the past five years have not contributed substantial amounts of delivered sediment to stream in the watershed (WDNR 1997, pg. 4B-6).

Human-caused impacts continue to occur in the WAU (i.e. road impacts, grazing, timber harvest) and negatively affect channel stability. High sediment loading from high road density and poorly constructed roads are contributing to degradation of instream habitat conditions, specifically by pool filling and fining of spawning gravels (WDNR 1997, pg. 4D-25). Embeddedness rates are very high in some stream reaches of M. Br. LeClerc Creek and Seco Creek (maximum of 93.3% in W. Br. LeClerc Creek; Maroney and Andersen 2000a). Riparian vegetation has been replaced by gravel roads in certain locations (USFS 2000, pg. 8). Riparian areas with a central brushy corridor are typical in the WAU and instream LWD levels are lacking for a majority of fish-bearing streams (WDNR 1997, pg. 4D-1). Many riparian areas, particularly in the Middle Branch, have been overgrazed with non-native grasses replacing shrubs and forbs (USFS 2000, pg. 8). Historic and current increase in bedload material over natural levels has resulted in channel widening in some stream reaches. The impacts of channel widening may result in elevated water temperatures, especially significant during the summer months (USFS 2000, pg. 8).

High instream temperatures appear to be directly related to the cumulative effects of the elimination and reduction of riparian habitat functions, particularly in Middle Branch LeClerc Creek and in lower East Branch LeClerc Creek. Impaired riparian functions in the drainage include thermal regulation and filtration of sediment delivered by surface erosion to the stream system. An exception to this pattern of elevated stream temperatures resulting from degraded riparian habitat can be found where groundwater inflow actually lowers stream temperatures. Another exception to elevated stream temperatures being tied to human impacts are beaver pond impoundments. Beaver ponds can act as temperature sinks so that water temperatures in the beaver impoundment and downstream of the pond may be elevated regardless of presence of adjacent riparian habitat (USFS 2000, pg. 8). Water temperature exceedences occurred at some sites monitored by WDNR despite relatively high canopy closure. Based on analysis of the limited number of sites monitored (seven), it appears that there may be a relationship between water temperatures and elevation to where Class AA water temperatures criteria may not be meet below 5,300 feet except where cool groundwater inflow governs the diurnal temperature range. This condition is aggravated by reductions in canopy closure (WDNR 1997, pg. 4D-34).

Generally, fish distribution in the LeClerc Creek drainage is naturally limited by increased gradients and diminished discharge in headwater reaches (WDNR 1997, pg. 4F-2). In addition, flow in a portion of Segment H3 on W. Br. LeClerc Creek has been reported to go subsurface periodically during dry years (WDNR 1997, pg. 4D-25). Fish movement in the Dry Canyon drainage is precluded, at least in the summer months, by an extensive network of dry channel segments upstream of Caldwell Lake and the lack of surface water connection to known fish-bearing water (WDNR 1997, pg. 4F-2). Known human-made fish passage barriers in the WAU preclude access to a very small portion of “Suitable” and “Recoverable” habitat. Brook trout occur throughout the WAU presenting a high degree of potential predation and competition with bull trout for habitat needs. However, evidence of groundwater influence in both the West and East Branch LeClerc creeks, the low incidence of natural fish passage barriers within the LeClerc Creek drainage, “Suitable” and “Recoverable” bull trout habitat, and confirmed observations of both adult and juveniles life stages, strongly suggest beneficial conditions exist in the LeClerc Creek drainage for bull trout, especially if sediment input can be decreased.

LeClerc Creek WAU Data Gaps.

- long-term, continuous instream temperature monitoring to allow for a more drainage-wide evaluation of temperatures;
- the extent of the relationship between elevation and stream temperature in the WAU.

<u>MIDDLE CREEK WAU</u>

Middle Creek WAU Description

The Middle Creek WAU encompasses approximately 29,270 acres and includes both Middle Creek and Mill Creek drainages. Middle Creek has a drainage basin area of 6,577 acres (Maroney and Andersen 2000b) and flows generally southeasterly about 7 miles before it empties into the Pend Oreille at RM 57.6; Mill Creek has a drainage basin area of 80.2 square kilometers (48.4 square miles), and flows generally easterly approximately 6 miles before it empties into the Pend Oreille River at RM 58.3; (Williams et al. 1975). The Middle and Mill creek drainages feed into the Box Canyon Reservoir portion of the Pend Oreille River.
There are no climatic or stream flow stations within the Middle Creek WAU so only a small amount of sporadically collected flow data exists, collected by the USFS in 1999 and the Pend Oreille Conservation District (POCD) in 1988 (USFS 1999aa; ENTRIX 2002, Table 3-1 & pg. 2-47). Three streamflow measurements each were made on both Middle and Mill creeks between August and October of 1988 by Pend Oreille Conservation District (POCD 1995). The USFS did not take flow measurements on Middle Creek, however they did take flow measurements on Mill Creek at the USFS boundary in 1999. For Middle Creek, the maximum flow recorded was 1.5 cfs (no date provided in USFS report); the lowest flow recorded was 1.2 cfs on September 15,

1998 (USFS 1999aa). For Mill Creek, the maximum flow recorded was 28.7cfs by the USFS in April 1999 (USFS 1999aa); the lowest flow recorded was 1.7 cfs on September 15, 1998 (POCD 1995).

Middle Creek WAU Hydrogeomorphology

The Mill Creek drainage is fed by water sources from North Baldy Mountain and the surrounding lower ridges. Mill Creek in the upper reaches has a gently gradient with beaver habitat and a slow meandering channel. The underlying geology tends to be dominated by decomposed granitic material and glacial tills that are highly erosive. The lower portion of the stream has an erosion resistant geology and changes to a high gradient system with cascading riffles and plunge pools until it reaches the confluence with the Pend Oreille River (KNRD and WDFW 1997b, pg. 7). A natural falls located approximately 1.3 miles upstream from the mouth of Mill Creek is a natural, year-round blockage to fish passage into the Mill Creek watershed (J. Maroney, KNRD, pers. comm., 2002). Catastrophic events, such as wildfire and debris torrents, appear to be infrequent (USFS 1999aa, pg. 10).

Middle Creek WAU Current Known Habitat Conditions.

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Middle Creek (62.0493). A culvert at the LeClerc Road crossing (RM 0.25) is a fish passage barrier (A. Scott, Framatome ANP, pers. comm., 2002).

Middle Creek (62.0493). Upstream of the LeClerc Road crossing (RM 0.25) for approximately 0.8 miles, Middle Creek is a Rosgen Aa2 type channel. The average gradient in this reach was high (13.4%; Maroney and Andersen 2000b, pg. 21). This is a known barrier to brook trout and a potential barrier to bull trout (T. Andersen, KNRD, pers. comm., 2002).

Mill Creek (62.0503). The culvert (Culvert_id # 106) at RM 0.3 at the County Rd. 9329 creek crossing (road mile 18.76) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Mill Creek. A natural falls located approximately 1.3 miles upstream from the mouth of Mill Creek is a natural, year-round blockage to fish passage into the Mill Creek watershed (J. Maroney, KNRD, pers. comm., 2002).

Riparian Condition

Middle Creek. From RM 2.0 – 3.5, there was an old road adjacent to the stream (Maroney and Andersen 2000b, pg. 20). The road has since been rehabilitated (T. Andersen, KNRD, pers. comm., 2002).

Middle Creek. From RM 2.0 – 3.0 and RM 3.5 – 4.5, there is evidence of past clearcuts are present on both sides of the stream (Maroney and Andersen 2000b, pg. 20). The timber stand from RM 3.5 – 4.5, is now approaching 20 years of age (Stimson Lumber, 1/29/03 final draft review comments, February 2003).

Mill Creek drainage. Approximately 3.5 miles of USFS cost-share road are located inside of the riparian areas of the watershed (USFS 1999aa, pg. 10).

Mill Creek drainage. The riparian area does not appear to be providing adequate shade or vegetative buffer for several portions of the stream system as evidenced by the high summer water temperatures and substrate embeddedness. The riparian areas are made discontinuous due to numerous road crossings of USFS and private roads within the Riparian Habitat Conservation Area (RHCA) and past clearcut acreage that included riparian vegetation. In addition, the long-term recruitment source for instream large woody debris will be lacking until the tree component matures and decays. Vegetation is primarily composed of species expected of the natural riparian community, however most of the tree component is in an immature size class. Road fill/riprap has let to the replacement of the native vegetation with introduced species. (USFS 1999aa, pg. 10).

Mill Creek. Maintenance and use of a 1.5 mile segment of USFS Rd. 1200000 continues to limit the amount of adjacent riparian vegetation in the riparian area of Mill Creek. However there is enough remaining overhead canopy along this segment to provide adequate shading (USFS 1999aa, pg. 12).

Mill Creek. Removal of riparian vegetation may be responsible for a poor width-to-depth ratio. There is also a greater than naturally expected deposition of large and small woody debris in portions of the stream. This is a function of large woody debris deposition from land use activities around the stream. The overabundance of woody debris encourages increased sediment deposition in areas where pools and spawning gravel are present (KNRD and WDFW 1997b, pg. 41).

Channel Conditions/Dynamics

Streambank Condition

Middle Creek. In the 0.8 mile stream reach ustream of the LeClerc Road crossing, some slope failures were observed that terminated in the stream channel. These sites were contributing sediment to the stream although overall bank stability was >80% (Maroney and Andersen 2000b, pg. 21). The cause of the slope failures is not indicated in the KNRD habitat survey report.

Mill Creek. The continued maintenance and use of road segments has disturbed present streambanks stability where road fill failure on USFS Rd. 1200000, has disturbed the existing vegetation on Mill Creek (USFS 1999aa, pg. 14).

Mill Creek. Throughout most of the stream there is poor bank stability (KNRD and WDFW 1997b, pg. 42).

Floodplain Connectivity

Mill Creek drainage. Streams are well connected to their floodplains. The existing riparian areas are functioning and hydrologically linked to the main channels of Mill Creek and its tributaries (USFS 1999aa, pg. 9).

Channel Stability

Mill Creek. A general characteristic of Mill Creek is a poor width-depth ratio. This could be due to the removal of riparian vegetation (KNRD and WDFW 1997b, pg. 41).

Habitat Elements

Channel Substrate

Note: Although the documents themselves nor full citations for the documents were not made available in time for inclusion in the habitat limiting factors assessment prior to publication, the following documents deserve mention here to the extent they may prove beneficial for future habitat evaluation and planning efforts in the Middle Creek WAU: Middle Creek WAU Road Maintenance and Abandonment Plan (RMAP). The document is a matter of public record and can be found at the WDNR Northeast Regional Office in Colville, WA (Stimson 1/29/03 final draft report review comments, February 2003).

Middle Creek. Substrate embeddedness from the upper reaches of Middle Creek down to its confluence with the Pend Oreille River, are high (range 94.7% to 59.8%). Where LWD is present, sediment accumulates (Maroney and Andersen 2000b, pg. 19 - 21).

Mill Creek. Surveyed in 1995-96, eleven of thirteen of the reaches of Mill Creek surveyed have embeddedness levels of greater than 35% (USFS 1999aa, pg. 8). Average embeddedness in all ten reaches surveyed in 1995 by the Kalispel Tribe exceeded 35% (range of average embeddedness per reach: 68.5% to 96.1%; KNRD and WDFW 1997b, pg. 21).

Mill Creek. Based on habitat assessment work accomplished prior to 1999, sediment was identified as coming off the road surface of 1.5 miles of USFS Rd 1200000 where the road lies within the riparian area of Mill Creek. The road is cost shared between Stimson Lumber Company and the USFS (USFS 1999aa, pg. 11). Using the WDNR definition of "Stream Adjacent Parallel Road" (i.e. a road or road segment within the Riparian Management Zone of a stream), Stimson GIS analysis indicates only 570 feet of Rd. 1200000 actually lies within the Riparian Management Zone (RMZ) of Mill Creek (Stimson Lumber, 1/29/03 final draft review comments, February 2003). Poor road location and design resulted in the road acting as a point sources of sediment into the stream (USFS 1999aa, pg. 11). In October 2000, the road segment within the RMZ, and associated cross drains and stream crossings, received extensive road maintenance activities to control sediment delivery (Stimson Lumber, 1/29/03 final draft review comments, February 2003). Although the level of sediment input from the road segment is unknown, this sediment continues to maintain the high level of substrate embeddedness of a majority of the stream habitat (USFS 1999aa, pg. 11).

Nola Creek. The result of a cutbank failure that was impairing road surface drainage into the ditchline, sediment was identified as coming off the road surface of USFS Rd 1200300 and into Nola Creek near a stream crossing. The road is cost shared between Stimson Lumber Company and the USFS. Poor road location and design had resulted in the road acting as a point sources of sediment into the stream. Although the level of sediment input from the above mentioned road segment was unknown prior to 1999, the sediment was continuing to maintain the high level of substrate embeddedness of a majority of the downstream habitat (USFS 1999aa, pg. 11). Although the referenced stream crossing was not indicated in the USFS 1999 report (USFS 1999aa, pg. 11), this may be in reference to where USFS 1200250 crosses Sylvis Creek (section 19, T35N, R45E; per Stimson's Middle WAU Road Maintenance and Abandonment Plan [no date provided], Stimson Lumber, 1/29/03 final draft review comments, February 2003). In October 2000, the Sylvis Creek crossing was removed in association with the formal abandonment of approximately 2,400 feet of USFS Rd. 1200250. Concurrent with this activity, abandonment and stabilization of a failed crossing on Nola Creek in Section 29 (Stimson Lumber Company Rd. 1200203) was also completed (Stimson Lumber, 1/29/03 final draft review comments, February 2003).

Large Woody Debris

Middle Creek. Large Woody Debris is low (5.6 pieces/mile) in the lowest 0.35 mile reach of Middle Creek but generally fair to good in the next 7 miles upstream (Maroney and Andersen 2000b, pg. 16).

Mill Creek. The numbers of pieces greater than 12 inch diameter and longer than 35 feet in length are unknown. Although the present numbers of large instream wood are unknown, the potential recruitment sources for future large instream wood are lacking due to riparian harvest to the stream edge in many areas and also replacement of some riparian areas with the existing road system. The existence of roads within the riparian areas have replaced or reduced the capabilities of large wood recruitment sources. For example, through road maintenance and use, the amount of brush and trees in a portion of the riparian area continue to be limited adjacent to a 1.5-mile road segment of Rd 1200000 (USFS 1999aa, pg. 8, 13).

Pool Frequency and Quality

Middle Creek. Pool frequency is poor for Middle Creek. The KNRD reported an average 3.05 pools/mile in the lower six miles. The average width of Middle Creek is 10.5 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Mill Creek drainage. Numbers of pools per mile on all surveyed reaches of Mill Creek watershed range from 4.5 to 28 pools. The numbers for reaches in the Mill Creek watershed are below what is expected for a stream with an average wetted width of 10-15 feet (48 pools per mile). Sand and finer material appears to be severely reducing pool volume and embeddedness of pool substrate does occur on most reaches throughout the watershed. Water temperatures in the pools are marginal for bull trout (USFS 1999aa, pg. 8).

Mill Creek. Recruitment sources for future instream wood that is crucial for much of the pool formation is negatively affected by the continued maintenance and use of USFS Rd. 1200000 within the riparian areas of Mill Creek. The continued maintenance and use of this road segment restricts brush and tree growth and is expected to continue to have a noticeable local effect on wood supply and, indirectly, pool formation (USFS 1999aa, pg. 12).

Pool Depth

Middle Creek. Pool depth is poor for the lower 6.0 miles of Middle Creek. The KNRD reported one pool greater than one meter deep in the lower 6 miles of Middle Creek which has an average width of 10.5 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Mill Creek drainage. Sand and finer material appears to be severely reducing pool volume and embeddedness of pool substrate does occur on most reaches throughout the watershed (USFS 1999aa, pg. 8).

Mill Creek and Nola Creek. The road maintenance and use of segments of USFS Rds. 1200000 and 1200300 continues to cause sediment movement off the roads and into the streams. This additional sediment input does appear to cause filling of existing pool habitat immediately downstream of the segments although it is impossible, in many areas, to separate this contribution from that of the maintenance and use of the remaining road system (USFS 1999aa, pg. 12).

Off-Channel Habitat

Mill Creek drainage. Off-channel habitat tends to be the result of braiding around old beaver dams and debris jams (USFS 1999aa, pg. 8).

Water Quality

Temperature

Middle Creek. A thermograph was placed about 800 meters upstream from the confluence with the Pend Oreille River. Stream temperature was recorded every minute from July 12 to November 7, 1999. The maximum temperature recorded during the summer was 15°C (59°F) in August 1999. The minimum temperature recorded was 1°C (34°F) on November 7, 1999 (Maroney and Andersen 2000b, pg. 16). The 7-day average maximum instream temperature was 14.64°C for the period of record and occurred from August 2 through August 8, 1999 (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Mill Creek. Monthly water temperature data has been collected sporadically at one site on Mill Creek at the Forest boundary by the USFS from 1969-72, 1974-75 and 1990-93. The 7-day average maximum temperature can not be determined by the existing data which was collected weekly, monthly or sporadically. The water temperatures ranged in Mill Creek from 1.0°C (33°F) on March 26, 1990 to 15°C (59°F) on July 24, 1990. Although summer water temperatures were collected only from 1990-94, these temperatures appear to be fair for bull trout rearing during the summer months (USFS 1999aa, pg. 7).

Mill Creek. The KNRD reported a 7-day average maximum instream temperature of 14.89°C in the lower 1.3 miles of Mill Creek occurring from August 11 through August 17, 2001 (T. Andersen, KNRD, email comm., Jan. 6, 2003). The exact location of the thermograph and the period of record was not provided.

Mill Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting temperature data (along with pH, dissolved oxygen, stream flow, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) at the mouth of Mill Creek (D. Comins, POCD, email comm., Feb. 2003).

Mill Creek drainage. The primary factor raising water temperatures above desired conditions appears to be the effect of solar radiation on the stream and its tributaries where the riparian vegetation has been harvested to the stream edge or replaced by other roads in the riparian areas (USFS 1999aa, pg. 12).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Mill Creek. Using Pressure Data Loggers, starting in May 2002, the POCD has been collecting stream flow data (along with pH, dissolved oxygen, temperature, nitrate, nitrite, total suspended solids, phosphorus, fecal coliform, turbidity, and total dissolved solids) near the mouth of Mill Creek (D. Comins, POCD, email comm., Feb. 2003).

Mill Creek drainage. There is limited flow data on the Mill Creek watershed. There are no undisturbed watersheds of similar nature for comparison purposes. There is a moderate amount of increase in the natural drainage network as a result of the existing road system within the watershed. The high density of roads (3.3 mi./sq. mi.) and high level of acreage in open condition (>15%) on private lands within the watershed may have a noticeable effect to the natural flow regime. A substantial portion of the USFS cost-share and private road system is located in the valley bottom. The Mill Creek watershed presently has an equivalent clearcut acreage configuration of 36%. Approximately 3.5 miles of USFS cost share road are located inside of the riparian areas of the watershed. However, not enough information is available for this determination (USFS 1999aa, pg. 9, 10).

Species Competition

Non-indigenous Fish

Middle Creek drainage. Brook trout were observed in Middle Creek in 1989 and 1990 during limited electrofishing survey sampling (Bennett and Liter 1991, Table 3-6 and 3-7, pg. 65 and 67). The location of the survey reaches were not indicated in the report.

Middle Creek drainage. Brook trout have not been observed upstream of RM 0.25 during fish surveys by KNRD (T. Andersen, KNRD, pers. comm., 2002). Beginning at RM 0.25, the KNRD had documented a 0.8 mile reach with an average gradient of 13.4%. This steep gradient reach appears to be a barrier to brook trout (T. Andersen, KNRD, pers. comm., 2002). McLellan (WDFW, 1/29/03 final draft review report comments, February 2003) stated that in fall 2002 no brook trout were collected during electrofishing surveys at nine sites distributed between RM 1.0 and the headwaters of Middle Creek. Cutthroat trout were the only trout fish species collected.

Mill Creek drainage. There are well-distributed, successfully reproducing populations of brook trout in Mill Creek (USFS 1999aa, pg. 11; KNRD and WDFW 1997b, pg. 29, Bennett and Liter 1991, Table 3-6, pg. 65).

Middle Creek WAU Fish Distribution and Use.

The streams in the Middle Creek WAU flow into the Box Canyon Reservoir reach of the Pend Oreille River. One bull trout has been documented in the Middle Creek WAU; in Mill Creek, one 14-inch bull trout was found by Kalispel Tribe and WDFW biologists while snorkeling, about 200 yards upstream of the LeClerc Road crossing during the summer of 1995 (J. Maroney, KNRD, pers. comm., 2002). Table 16 below describes current, known bull trout use in Middle Creek WAU. Based on Forest Service (USFS) and Kalispel Natural Resource Department (KNRD) stream habitat surveys (KNRD 1995; USFS 1999aa; Maroney and Andersen 2000b), maps in Appendix C illustrate the extent of "Individual Observations" and "Suitable" and

"Recoverable" bull trout habitat. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Given the knowledge of salmonid biology and behavior and the historic use by bull trout of the mainstem Pend Oreille River (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is unknown. For all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years. On Mill Creek, there is a natural barrier to upstream fish passage at RM 1.3 (J. Maroney, KNRD, pers. comm., 2002). On Middle Creek, upstream of RM 0.25, there is a 0.8 mile reach of high gradient stream (average 13.4%) that is a potential barrier to bull trout (Maroney and Andersen 2000b, pg. 21).

Table 16: Current, known bull trout use in the Middle Creek WAU

Middle Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Middle Creek					X
Mill Creek				X	X

Middle Creek WAU Summary.

Middle Creek

The stream habitat in Middle Creek appears to be impacted from high volumes of sediment. The habitat attributes that reflect these degraded conditions include high substrate embeddedness, decreased spawning gravel quantity and quality, low pool to riffle ratios, and low primary pool frequency. Substrate embeddedness ranged from 57.6% to 94.7%. It appears that accumulations of small and large woody debris are acting as sediment traps throughout the stream. Spawning gravel was scarce (0 – 3 sq. meters) except in Reach 5 where it was present in moderate amounts (5.5 sq. meters), in Reach 8 where it was present in large amounts (22 sq. meters), and Reach 9 where it was moderately abundant (12 sq. meters). Pool-to-riffle ratios were relatively low for all reaches (ranging from 0.0:1 to 0.3 to 1). Generally, the impacts have resulted in limited winter and spawning habitat for fish populations in Middle Creek (Maroney and Andersen 2000b, pg.

19-21). Upstream of RM 0.25, there is a 0.8 mile reach of high gradient stream (average 13.4%). This gradient is a barrier to the upstream movement of brook trout and potentially a barrier to upstream bull trout passage as well (Maroney and Andersen 2000b, pg. 21).

Mill Creek

The existing habitat has been modified by human activities within the watershed. The high level of embeddedness of the substrate, low numbers of deep pool habitat for winter rearing, summer water temperatures near the expected tolerance levels and well distributed populations of brook trout are limiting factors for the species (USFS 1999aa, pg. 11). Portions of the instream habitat appear to be of poor to fair quality throughout most of the watershed and there is a natural barrier to upstream fish passage at RM 1.3 (J. Maroney, KNRD, pers. comm., 2002).

The riparian areas are made discontinuous due to numerous road crossings of USFS and private roads within the RHCA and past clearcut acreage that included riparian vegetation. The existing summer water temperatures, due to the number of openings in the canopy, are marginal for bull trout in the watershed. Wildfires, road building and past timber harvest have removed some of the largest components of the riparian stands along Mill Creek. The remaining vegetation is primarily composed of immature size classes of species expected of the natural riparian community except where road fill/riprap have led to the replacement of the native vegetation with introduced species. There presently are inadequate recruitment sources for future instream wood for the watershed. Long-term recruitment source for instream large woody debris will be lacking until the tree component matures and decays. The existence of roads within the riparian areas have replaced or reduced the capabilities of large wood recruitment sources. (USFS 1999aa, pg. 10, 13).

The present condition of the streambed substrate is not optimal for bull trout spawning and rearing due to high embeddedness levels (USFS 1999aa, pg. 9, 10; KNRD and WDFW 1997b, pg. 42) and very low amount of pool habitat (winter rearing habitat) on many reaches. In general, habitat in the lower reaches of the watershed tends to be of higher quality and more complex. Embeddedness is less in the lower reaches of this watershed (USFS 1999aa, pg. 9, 10). Catastrophic events such as wildfire and debris torrents appear to be infrequent (USFS 1999aa, pg. 10).

Middle Creek WAU Data Gaps.

- A sediment budget analysis including an inventory of the existing condition of roads in the Mill Creek drainage and their contribution to sediment delivery to the surface water network;
- baseline streamflow data. (Entrix 2002, Table 3-1).

CEE CEE AH CREEK WAU

Cee Cee Ah Creek WAU Description

The Cee Cee Ah Creek WAU drains approximately 27,050 acres. The WAU includes the Cee Cee Ah drainage as well as unnamed tributaries to the Pend Oreille River entering from the east and located north and south of the Cee Cee Ah Creek confluence. Cee Cee Ah Creek has two main tributaries, Browns and Half Moon creeks. There are also two natural lakes in the watershed, Browns and Half Moon Lakes. Neither of these lakes have outlets that connect with Cee Cee Ah Creek or its tributaries (USFS 1999ab, pg.1). The average annual precipitation in the WAU ranges from 30 to 45 inches.

The WAU has a variety of habitat types ranging from open alpine meadows to lowland dense forests to cleared agricultural lands. Fire has been the major disturbance factor that affected the historical array and landscape pattern of plan communities and seral stages in the WAU. Most of the stand is about 70-80 years old, with isolated microsites that are older or younger. Some riparian areas are as old as 110-130 years. Much of the area has been selectively logged (primarily high-grade logging) prior to the 1950s. This has resulted in the majority of the landscape patches being dominated by Douglas fir and grand fir multistoried stands (USFS 1996, pg. 4).

Browns Lake is one of the most heavily used recreation sites on the Newport Ranger District and includes a USFS campground and shoreline trails. Significant dispersed camping areas also occur along Browns Creek. Paved roads and good gravel roads provide easy access into the WAU (USFS 1996, pg. 7).

Cee Cee Ah Creek WAU Hydrogeomorphology

The underlying geology is dominated by hard metasediments. In the Cee Cee Ah WAU, these hard rocks have created numerous short, steep peaks such as Cee Cee Ah Peak and Half Moon Hill. The geology is faulted and generally the faults tend SE-NW and the cross-faults tend SW-NE. Most of the faults occur in the zone west of Cooks Mountain and Browns Lake, breaking this portion of the landscape up into small steep hills and valleys. Glacial, lacustrine and alluvial materials fill in the low lying areas. Numerous different terraces are evident, and the edges of the terraces are often steep. The main streams follow ancient fault lines with the gradient of each channel segment largely determined by the gradient of the terrace. Stream gradients are very flat for long distances as they flow along one terrace, and then drop quickly to the next lower terrace creating a stream system that vacillates between steep and flat channel types (USFS 1996, pg. 1). Cee Cee Ah Creek has an intermediate gradient on top, a flat gradient in the middle, a steep gradient in the lower section with a 25 m (8 foot) waterfall at RM 2.5, and a low gradient for the last 2.0 km (1.2 miles). This creek has an extensive slough system for the last 1 km (0.6 miles) before its confluence with the Pend Oreille River (KNRD and WDFW 1997b, pg. 7).

The dominant erosion process appears to be surface erosion and ravel (including dry rockslides). Surface erosion is highest on the soils derived from granitic rock. Debris torrents and rotational landslides are rare. The lowest reaches of the streams flow through very erosive lacustrine and flood deposits (USFS 1996, pg. 4).

The hydrology of the area is snow-pack dominated, and peak flows occur in the spring generally from May to early July. Rain-on-snow events are rare. Browns Lake formed behind a glacial outwash terrace and has no surface outflow. Water levels in Browns Lake fluctuate significantly, virtually draining the entire lake at times. In the winter of 1993, the lake nearly went dry (USFS 1996, pg. 1).

Cee Cee Ah Creek WAU Current Known Habitat Conditions

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Cee Cee Ah Creek (62.0608). A poorly placed culvert at RM 2.0, where USFS Rd. 1921000 crosses Cee Cee Ah Creek (road mile 0.25) immediately above the confluence with Browns Creek, is a year-round barrier to fish passage (Cul-id #112, USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest ; USFS 1999ab, pg. 8, 11).

Cee Cee Ah Creek. At RM 5.5 on USFS Rd. 1920380 (road mile 0.14) there is a culvert that is a full barrier to fish passage (Cul-id #111, USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Cee Cee Ah Creek. An 8-foot natural falls at RM 3.5 (KNRD and WDFW 1997b, pg. 7) is a full barrier to fish passage (USFS 1999ab, pg. 8).

Browns Creek (62.0608a). At RM 1.1 on USFS Rd. 500032 there is a partially blocking culvert (Cul-id #350, USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Browns Creek. At RM 3.0 on USFS Rd. 5030039 there is a partially blocking culvert (Cul-id #115, USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Browns Creek. The outlet from Browns Lake goes subsurface due to the underlying geology at about RM 3.0 (USFS 1999ab, pg. 8).

Riparian Condition

Watershed-wide. Approximately 6.5 miles of USFS standard and cost-share road are located inside of the riparian areas of the watershed (USFS 1999ab, pg. 10).

Watershed-wide. Approximately 0.5 mile of cost-share roads between Stimson and the USFS (USFS Rd.1920000, 1920051) and USFS road (USFS Rd.1921000) are located within the riparian areas of Cee Cee Ah Creek or its tributaries (USFS 1999ab, pg. 11). Due to their location and design, these roads are point sources of sediment into the stream system in general and specifically where USFS Rd. 1921000 crosses Cee Cee Ah Creek (USFS 1999ab, pg. 11).

Watershed-wide. Wildfires, road building and past timber harvest have removed some of the largest components of the riparian stands along Cee Cee Ah Creek and its tributaries. The riparian areas are made discontinuous due to numerous road crossings of USFS and private roads within the RHCA and past clearcut acreage that included riparian vegetation. Vegetation is primarily composed of species expected of the natural riparian community, however most of the tree component is in an immature size class. The riparian area does not appear to be providing adequate shade or vegetative buffer for several portions of the stream system as evidenced by the high summer water temperatures and substrate embeddedness (USFS 1999ab, pg. 11).

Cee Cee Ah Creek. In the lower 2.5 miles, the riparian area is dominated by shrubs and stream shading appears to be lacking in portions of this reach. Large woody debris recruitment from riparian sources was low. In the mile of river reach immediately preceding the natural falls, the riparian area is dominated by conifers with riparian shrubs being relatively sparse (Maroney and Andersen 2000c, pg. 22).

Browns Creek. The area of riparian habitat impacted by riparian roads in the Browns drainage is calculated to be >25% (USFS 1999af, pg. III-750). USFS Stream survey data from 1995 indicate past riparian harvest and evidence of past instream woody debris removal probably related to firewood gathering (USFS 1995 unpublished data, K. Honeycutt, USFS, pers. comm., 2002).

Channel Conditions/Dynamics

Streambank Condition

Cee Cee Ah Creek. From the LeClerc Road crossing downstream to the mouth, bank stability is relatively low with areas of eroding bank common (Maroney and Andersen 2000c, pg. 22).

Cee Cee Ah Creek. Slightly upstream of the LeClerc Road crossing, a bull dozed-in diversion channel has raw banks and is contributing sediment to the stream channel in the reach (Maroney and Andersen 2000c, pg. 21).

Cee Cee Ah Creek and Browns Creek. Seventy to ninety percent of the streambanks are stable along the reaches surveyed by the USFS. This open condition is caused by many factors including the existing road configuration and past harvest within the riparian areas (USFS 1999ab, pg. 9).

Cee Cee Ah Creek. The continued maintenance of the road segments where road crossings of USFS Rds. 1920000 and 1920051 occur, have disturbed the existing vegetation has disturbed present streambank stability (USFS 1999ab, pg. 14).

Floodplain Connectivity

Cee Cee Ah Creek and Browns Creek. Floodplains alternate between narrow and wider areas. Stream reaches surveyed lie either in narrow U-shaped valley forms of steep to moderate sideslopes, particularly at the headwaters and lowest 2 miles, or in the broader U shaped valley form with low to moderate sideslopes which represents a majority of the watershed. These areas tend to have B channel types which are well connected to their floodplains. The existing riparian areas are functioning and hydrologically linked to the main channels of Cee Cee Ah Creek and its tributaries (USFS 1999ab, pg. 9).

Channel Stability

Cee Cee Ah Creek. Using a bulldozer, a private landowner has created a diversion channel in the lower one mile of Cee Cee Ah Creek between LeClerc Creek Road and the old bridge site located upstream a short distance. The diversion channel has raw banks and is contributing sediment to the stream channel (Maroney and Andersen 2000c, pg. 21).

Cee Cee Ah Creek . The channel is functioning and becoming more stable. During the 1998 USFS stream survey, it was noted that the extensive beaver dams in Cee Cee Ah Creek may be stabilizing the channel by limiting channel downcutting and lateral migration while storing large amounts of fine sediments (USFS 1999af, pg. III-715).

Browns Creek. Overall, Browns Creek is fairly stable though stream surveyors noted isolated areas of both aggradation and degradation. Sediment from Browns Creek Road (USFS Rd. 1921) is likely the source for much of the fine sediment (USFS 1999af, pg. III-715).

Habitat Elements

Channel Substrate

Note: Although the documents themselves nor full citations for the documents were not made available in time for inclusion in the habitat limiting factors assessment prior to publication, the following documents deserve mention here to the extent they may prove beneficial for future habitat evaluation and planning efforts in the Cee Cee Ah Creek WAU: Cee Cee Ah Creek WAU Road Maintenance and Abandonment Plan (RMAP). The document is a matter of public record and can be found at the WDNR Northeast Regional Office in Colville, WA (Stimson 1/29/03 final draft report review comments, February 2003).

Cee Cee Ah Creek. From the natural falls at RM 3.5 downstream to the confluence with the Pend Oreille River, embeddedness levels exceed 35%, ranging from 51% to 62.9% (Maroney and Andersen 2000c, pg. 18).

Cee Cee Ah Creek. Using a bulldozer, a private landowner has created a diversion channel in the lower one mile of Cee Cee Ah Creek between LeClerc Creek Road and the old bridge site located upstream a short distance. The diversion channel has raw banks and is contributing sediment to the stream channel (Maroney and Andersen 2000c, pg. 21).

Cee Cee Ah Creek. Nine of ten of the reaches surveyed upstream of the falls in 1995 had embeddedness levels greater than 35 percent (USFS 1999ab, pg. 8).

Browns Creek. In the Brown's Creek drainage, the USFS has indicated that Browns Creek Road (USFS Rd. 1921) is a major source of sediment in the drainage (USFS 1999af, pg. III-715, 728). The TAG (2002) however, does not believe that Browns Creek Road is contributing a major source of sediment to Browns Creek. Nor does the TAG feel that sediment levels in Browns Creek are significantly elevated overall. Beaver are present in the system and sediment being stored behind beaver dams is likely natural levels of bedload being transported through the system (TAG 2002).

Cee Cee Ah drainage. Due to their location and design, approximately 0.5 mile of cost share roads between Stimson and the USFS (Rd.1920000, 1920051) and USFS road (Rd.1921000) are point sources of sediment into the stream system specifically, from an eroding stream crossing where USFS Rd. 1921000 crosses Cee Cee Ah Creek and surface erosion from the roadbeds (USFS 1999ab, pg. 11). This erosion maintains the present level of embeddedness in the downstream habitat (USFS 1999ab, pg. 13).

Cee Cee Ah drainage. Extensive timber harvest in the headwaters of the Cee Cee Ah basin (about 70%) and extensive road construction have resulted in degraded streams that transport large volumes of sediment to the mainstem Cee Cee Ah Creek, which has a high level of embeddedness. During high flow events, it appears that the stream is transporting pulses of sediment which are deposited behind obstructions or in pools as the stream flows recede (USFS 1999af, pg. III-715).

Large Woody Debris

Cee Cee Ah. The LWD levels from the LeClerc Road crossing downstream to the confluence with the Pend Oreille River are low (3.6 pieces/mile). Recruitment from this reach is also low (Maroney and Andersen 2000c, pg. 22).

Cee Cee Ah. The LWD levels from the from the falls at RM 3.5 downstream to an old bridge located about 230 feet upstream of the LeClerc Road crossing, were less than 20 pieces/mile in two of four reaches surveyed by KNRD in 1999 (range 14.5 – 29.4 pieces/mile; (Maroney and Andersen 2000c, pg. 18, 21, 22).

Cee Cee Ah. The numbers of pieces of LWD on USFS land greater than 12 inch diameter and longer than 35 feet in length are unknown (USFS 1999ab, pg. 8).

Browns Creek. Hankin-Reeves stream survey protocol was used on inventories on Brown's Creek. All surveyed reaches on these streams have greater then 20 pieces of large instream wood per mile. The numbers range from 127-166 pieces per mile (USFS 1999ab, pg. 8).

Pool Frequency and Quality

Cee Cee Ah Creek. Pool habitat was low from the mouth upstream to the falls at RM 3.5 (Maroney and Andersen 2000c, pg. 18, 21, 22).

Cee Cee Ah Creek. Numbers of pools per mile on all reaches of the Cee Cee Ah Creek watershed surveyed by USFS range from 0 to 11 pools. The numbers for reaches in the Cee Cee Ah Creek watershed are below what is expected for a stream with an average wetted width of 7-10 feet (60 pools per mile). Sand and finer material appears to be reducing pool volume and embeddedness of pool substrate does occur on most reaches throughout the WAU. Water temperatures in the pools are marginal for bull trout (USFS 1999ab, pg. 8).

Browns Creek. Numbers of pools per mile on all surveyed reaches of Browns Creek range from 0 to 23 pools. The numbers for reaches in the Brown's Creek are below what is expected for a stream with an average wetted width of 5-10 feet (60 pools per mile; USFS 1999ab), although appropriate for the stream type in the TAG's professional opinion (TAG 2002). However, sand and finer material appears to be reducing pool volume and embeddedness of pool substrate does occur on most reaches throughout the WAU. Water temperatures in the pools are marginal for bull trout (USFS 1999ab, pg. 8).

Pool Depth

Cee Cee Ah Creek. Winter habitat was absent in the half-mile reach located immediately downstream of the Browns Creek confluence (Maroney and Andersen 2000c, pg. 21).

Cee Cee Ah Creek and Browns Creek. Sand and finer material appears to be reducing pool volume and embeddedness of pool substrate does occur on most reaches throughout the watershed. Water temperatures in the pools are marginal for bull trout (USFS 1999ab, pg. 8).

Off-Channel Habitat

Cee Cee Ah Creek. Split channels were common in the half-mile reach immediately below the natural falls (Maroney and Andersen 2000c, pg. 21).

Water Quality

Temperature

Cee Cee Ah Creek. Monthly water temperature data has been collected sporadically at one site on Cee Cee Ah Creek at the Forest boundary by the USFS from 1974-75 and 1990-92. Daily water temperatures were recorded in 1993 from April 14 through August 13. The 7-day average maximum temperature based on this one season of data was 12.6°C (54°F) for the rearing period (USFS 1999ab, pg. 7). From July 23 to October 28, 2002, the USFS deployed a thermograph on Cee Cee Ah Creek just upstream from the Browns Creek confluence. The 7-day average maximum temperature during the period of record was 15.4°C; the maximum temperature for the period of record was 16.4°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

Cee Cee Ah Creek. Two thermographs were placed in Lower Cee Cee Ah in 1999 by the KNRD. The first site was at the 1921 road crossing and the second thermograph was located about 150 feet downstream of the LeClerc Road crossing. Site one recorded temperature from July 14 to November 10 and site two recorded temperature from July 13 to November 30. Seven-day average maximum temperatures could not be calculated from the information provided in the report; recorded temperatures for both sites are displayed graphically in the report. Maximum temperature recorded at site one (the lower site) exceeded 15°C for many days between late-July and September 1, 1999. Recorded temperatures appear to have exceeded 15°C at site one from about the end of July to August 11, 1999. Recorded temperatures also appear to have exceeded 15°C at site two many times between the end of July and about September 1, 1999. Recorded temperatures at site two did exceed 18 °C on two occasions in the first week in August 1999 (Maroney and Andersen 2000c, pg. 15).

Cee Cee Ah Creek. Water temperature data was collected at the adfluvial fish trap location by DE&S in 1998, 1999 and 2000 during the adfluvial fish trapping study conducted for the POPUD. The adfluvial fish trap was located just upstream from the mouth of Cee Cee Ah Creek. Temperature data for Cee Cee Ah Creek indicated that 2000 recorded the warmest average daily water temperatures and 1999 the coolest average daily water temperatures. The maximum temperature recorded for the two year period was 17°C (DE&S 2001a, pg. 13).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Watershed-wide. There is limited flow data on the Cee Cee Ah Creek watershed. Flows measured at the Forest boundary range from 2.7 cfs to 23.5 cfs, October and May respectively (no date provided in report; USFS ab, pg. 9). There are no undisturbed watersheds of similar nature for comparison purposes. The high density of roads throughout (4.6 miles/sq. mile) and high level of acreage in open condition (>15%) on private and state lands within the watershed may have a noticeable effect to the natural flow regime. A substantial portion of the USFS and private road system is located in the valley bottom. Approximately 6.5 miles of USFS standard and cost share road are located inside of the riparian areas of the watershed. However, not enough information is available for this determination (USFS 1999ab, pg. 10). According to survey data collected in 1998 by the USFS, about 70% of the headwaters of the Cee Cee Ah drainage have been harvested (USFS 1999af, pg. III-715).

Species Competition

Non-indigenous Fish

Cee Cee Ah Creek and Browns Creek. Brook trout are found throughout Cee Cee Ah (Bennett and Liter 1991, Table 3-6) and Browns creeks. German brown trout are found downstream of the impassable falls on Cee Cee Ah Creek and throughout Browns Creek (USFS 1996, pg. 4).

Cee Cee Ah Creek. During snorkeling surveys in 1999 by KNRD, both brook trout and brown trout were observed, brook trout in low densities and brown trout in moderate densities (Maroney and Andersen 2000c, pg. 22).

Cee Cee Ah Creek WAU Fish Distribution and Use

Cee Cee Ah Creek flows into the Box Canyon Reservoir reach of the Pend Oreille River. Bull trout are not known currently to occur in the Cee Cee Ah Creek WAU although electrofishing, snorkeling and adfluvial trapping have been utilized in the search for this species. Therefore, Table 17 below, which describes current, known bull trout use in the Cee Cee Ah Creek WAU, is blank for bull trout. Based on USFS and KNRD stream habitat surveys (KNRD 1995; USFS 1999ab; Maroney and Andersen 2000c), maps in Appendix C illustrate the extent of "Suitable" bull trout habitat in the Cee Cee Ah Creek WAU. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Although by name ("char", the term historically applied to bull trout) there is no historic documentation of the occurrence of bull trout in the Cee Cee Ah Creek WAU, the Kalispel Tribe believes historic bull trout occurrence has been documented in the Cee Cee Ah Creek drainage based on information contained in field notes taken by A.H. Smith from 1936-1938 (Lyons 2002). Lyons states that Smith described the capture of "trout" in traditional Kalispel fishing weirs placed at the mouth of Cee Cee Ah Creek in late summer. The Kalispel Tribe contends that documentation of the capture of "trout" historically in Cee Cee Ah Creek at the mouth in late summer infers the presence of a bull trout population in the drainage (Lyons 2002). In court documents containing reprints of Smith's 1936-1938 notes, Smith described the construction of a tribal weir at the mouth of Cee Cee Ah Creek about mid-July where large quantities of all kinds of fish were caught though "trout made up the greatest part of the catch". Smith's notes described divers diving down into the cold water of Cee Cee Ah Creek to swim beneath the surface to where warm water backed up from the Pend Oreille River. Smith noted that if the divers proceeded in the reverse direction, the cold water could cause them to loose consciousness as though they were hit on the head (Smith 1983, pg. 205).

Given the knowledge of salmonid biology and behavior, the historic use by bull trout of the mainstem Pend Oreille (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), and a lack of natural barriers at the tributary mouth, it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. Presently, for all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years.

Table 17: Current, known bull trout use in the Cee Cee Ah Creek WAU. (Table is blank for bull trout since there are no current, known observations of bull trout in the Cee Cee Ah Creek WAU).

Cee Cee Ah Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Cee Cee Ah Creek					X
Browns Creek					X

Cee Cee Ah Creek WAU Summary

Stream reaches in lower Cee Cee Ah Creek appear to be impacted from past land management activities with most reaches downstream of the falls (RM 3.5) exhibiting degraded stream habitat conditions. Elevated instream sediment levels have resulted in high substrate embeddedness and reduced pool habitat. The degraded conditions limit overwintering, spawning, and rearing habitat (Maroney and Andersen 2000c, pg. 24). The high substrate embeddedness levels, low numbers of deep pool habitat, summer water temperatures near the expected tolerance levels of bull trout, and well distributed populations of brook trout, are limiting factors for bull trout (USFS 1999ab, pg. 11).

A majority of the sediment introduction is due to private road maintenance (USFS 1999ab, pg. 14). Road construction in the riparian areas has changed the characteristics of the riparian vegetation, decreasing the amount of brush and trees adjacent to the stream. Although most of the sediment comes from roads, logging, mining, burning, grazing and recreation activities have also contributed to surface erosion (USFS 1996, pg. 13).

The riparian habitat has recovered from the last major fires in the early 1930s although the fully mature tree class component is lacking. Road construction in the riparian areas has changed the characteristics of the riparian vegetation and decreased the amount of brush and trees that shade the stream and moderate summer temperatures. The present water temperature regime indicates that summer water temperatures are only marginally within the tolerance range for bull trout in Cee Cee Ah Creek. The USFS has determined that the primary factor raising water temperatures above desired levels appears to be the effect of solar radiation on the stream proper, including the old and new beaver dams in the upper portion of the watershed (USFS 1999ab, pg. 12). Recruitment sources for future instream wood in stream reaches adjacent to stream segments where roads are negatively impacting the riparian area are expected to be negatively affected by the continued maintenance of road segments within the riparian areas. A majority of the riparian areas elsewhere in the watershed, however, continue to provide for instream wood. Since present large instream wood numbers on USFS lands are unknown in Cee Cee Ah Creek, it is unclear as to how adequate the recruitment is (USFS 1999ab, pg. 13).

The present condition of the streambed substrate is not optimal for bull trout spawning and rearing due to high embeddedness levels and very low amount of pool habitat on many reaches. Embeddedness is less in the lower reaches of the watershed (USFS 1999ab, pg. 9). Surface erosion from road segments within riparian areas and the creek crossing of USFS Rd. 1921000 will continue to provide point sources of sediment directly into the creek, maintaining embeddedness levels in the downstream habitat. This additional sediment input does appear to cause filling of existing pool habitat immediately downstream of the segments although it is impossible in many areas to separate this contribution from that of road maintenance on the remaining private road system in the WAU (USFS 1999ab, pg. 13).

Cee Cee Ah Creek WAU Data Gaps.

- LWD levels (>12" in diameter and >35' in length) in Cee Cee Ah Creek (USFS 1999ab);
- continuous stream flow data for Cee Cee Ah Creek (Entrix 2002, Table 3-1);
- continuous water temperature data for Cee Cee Ah Creek (Entrix 2002, Table 3-1);
- conduct an evaluation and characterization of hydraulic continuity of the alluvial aquifer in the Cee Cee Ah Creek valley sediments and determine the relationship to the mainstem Pend Oreille and the lower Cee Cee Ah Creek streamflow (Entrix 2002, Table 3-1);

TACOMA CREEK WAU

Tacoma Creek WAU Description

The Tacoma Creek WAU encompasses approximately 62,887 acres and includes both the Cusick and Tacoma creek drainages. Cusick Creek, with a drainage basin area of 9.6 square miles (6,144 acres), flows west/southwesterly about 7 miles before it empties into the Pend Oreille at RM 61.6; Tacoma Creek, with a drainage basin area of 61.6 square miles (39,424 acres), flows southwesterly approximately 21.4 miles before it empties into the Pend Oreille River at RM 66.3 (Williams, et al., 1975). The Cusick and Tacoma creek drainages feed into the Box Canyon Reservoir portion of the Pend Oreille River entering from the west. The highest elevation in the WAU is Calispell Peak at 6,855 feet. The climate is a combination of both maritime and continental patterns. Average annual precipitation in the WAU ranges from 15 inches in the valley to about 40 inches in the mountains. About 60% of the precipitation is snow (USFS 1998, pg. 3). Average air temperatures in the summer range from 40 to 80 degrees Fahrenheit. In winter, average air temperatures range from 10 to 32 degrees Fahrenheit (USFS 1998, pg. 11).

Most of the timber stands are 70-80 years old with microsites of both older and younger stands. Most of the WAU was logged and burned several times starting about 1900 through the 1930s. Many log mills and log camps were established in the area about 1910 through 1950. In many areas, logs were transported with flumes, chutes and splash dams. There was a major flume system along Tacoma Creek. More recently, a considerable amount of timber harvest has occurred since the 1950s with the majority of that harvest occurring in the last 15 years. In the Pend Oreille valley bottom, timber land was cleared for agriculture starting about 1900. Grazing and haying are extensive on the agricultural lands in this area years (USFS 1998, pg. 3). Homesteading of this area had a significant impact on the landscape we see today. Between 1900-1940, communities were established at Tacoma Creek and Boulder Mountain – communities with schools and community centers. Lands were cleared, and many of these cleared homestead meadows persist today. Much of the land was logged and burned during this homestead era. Many trails and roads were developed linking communities, homes and logging camps (USFS 1998, pg. 3, 5).

Tacoma Creek WAU Hydrogeomorphology.

The Tacoma Creek WAU appears to have unstable natural processes, specifically soil erosion. The underlying geology tends to be dominated by decomposed granitic material that is highly erosive. Catastrophic events, such as wildfire and debris torrents, appear to be infrequent watershed (USFS 1999c, pg. 10). The underlying geology is mostly granite and metamorphic rock covered by glacial materials and volcanic ash. Most of the analysis area was covered under the continental glaciers of the last ice ages, but a small are near Calispell Peak extended above the glaciers. As the glaciers retreated, they left a series of remnant terraces. Landslides are rare, but have occurred on the margins of the ancient terraces at the interface of till and bedrock. At the lowest elevations, the area has been covered by lakes at various times (USFS 1998, pg. 11). The middle and lower segments of Cusick and Tacoma creeks are characterized by low gradients (Rosgen channel type B). Under natural conditions, beaver played an important role in channel development and maintenance (USFS 1998, pg. 3).

The hydrology of the area is snow-pack dominated, and peak flows occur in the spring generally from May to early July. An analysis of streamflow and snow pack data conducted to gain an understanding of peak flow triggering mechanisms in the Tacoma Creek area concluded that rain during spring snowmelt was the most frequent cause of peak flows in this area (USFS 1998, pg. 14). Mid-winter rain-on-snow events are rare, but can cause runoff damage from peak flows (USFS 1998, pg. 11).

Tacoma Creek WAU Current Known Habitat Conditions

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Cusick Creek (62.0524). The State Hwy. 20 culvert (RM 0.5) is a fish passage barrier (SSHEAR database).

Cusick Creek. There is a partially blocking culvert (Culvert_id # 261) at RM 5.2 at the USFS Rd. 3128070 crossing (road mile 0.02; USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Cusick Creek. The culvert (Culvert_id # 159) at RM 5.7 at the USFS Rd. 2441000 creek crossing (road mile 3.9) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Cusick Creek. The culvert (Culvert_id # 156) at RM 7.0 at the County Road 2441 creek crossing (road mile 5.3) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Cusick Creek. The culvert (Culvert_id # 155) at RM 7.6 at the USFS Rd. 3128090 creek crossing (road mile 0.0) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

S. Fk. Tacoma Creek (62.0571). The culvert (Culvert_id # 303) at RM 3.6 at the USFS Rd. 3116501 creek crossing (road mile 0.2) is a partial barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

N. Fk. of S. Fk. Tacoma Creek. The culvert (Culvert_id # 166) at RM 4.3 at the USFS Rd. 13116125 creek crossing (road mile 3.3) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Riparian Condition

Cusick Creek. The riparian area does not appear to be providing adequate shade and LWD for several portions of the stream system as evidenced by the high summer water temperatures and low amounts of instream wood (USFS 1999ac, pg. 10).

Cusick Creek. Riparian vegetation is composed of species expected of the natural riparian community, however wildfires and past harvest have removed some of the largest components of the riparian stands (USFS 1999ac, pg. 10).

Cusick Creek. Approximately 6 miles of county road and 1.1 mile of USFS road within USFS lands are located inside of the riparian areas of the watershed negatively impacting riparian vegetation (USFS 1999ac, pg. 10).

Cusick Creek. Grazing, particularly in the F4 channel in the meadows upstream of Parker Lake, has changed the characteristics of the riparian vegetation and decreased the amount of brush and trees that shade the stream and moderate summer temperatures. The meadow area above Parker Lake has been fenced since 1997 and the riparian vegetation is recovering slowly (USFS 1999ac, pg. 11). In 2000, additional riparian fencing was put in place to fully exclude cattle from riparian areas above Parker Lake except for one cattle crossing access (R. Fletcher, POCD, pers. comm., 2002).

Tacoma Creek drainage. The existing road density is 3.0 miles per sq. mi. Approximately 6 miles of county road and 3.5 mile of USFS road within USFS lands are located inside of the riparian areas of the watershed (USFS 1999c, pg. 9, 10).

Tacoma Creek (62.0547). Riparian vegetation is primarily composed of species expected of the natural riparian community, however wildfires, roadbuilding and past harvest have removed some of the largest components of the riparian stands (USFS 1999c, pg. 10).

Tacoma Creek. The riparian areas are made discontinuous due to numerous road USFS and county road crossings within the RHCA and past clearcut acreage that included riparian vegetation (USFS 1999c, pg. 10). Dispersed camping in riparian areas also impacts riparian habitat (K. Honeycutt, USFS, pers. comm., 2002).

S. Fk. Tacoma Creek. There are cattle grazing impacts on lower S. Fk. Tacoma Creek (Olsen et al. 2002, in prep.).

Channel Conditions/Dynamics

Streambank Condition

Cusick Creek. Streambank erosion from excessive use of isolated streambanks by cattle does occur. The actual amount of increased sediment introduction into the stream system from this is unknown. (USFS 1999ac, pg. 12).

Floodplain Connectivity

Cusick Creek. Within USFS lands, floodplains along the creek alternate between narrow and wider areas. Stream reaches surveyed lie in narrow U-shaped valley forms of low to moderate sideslopes, particularly at the headwaters. However, approximately 2.5 miles of streamchannel and Parker Lake are located in a very broad valley form with low sideslopes. These areas tend to have C Rosgen channel types which are well connected to their wide floodplains, however the channel has degraded to an F4 channel type. The existing riparian areas are functioning and hydrologically linked to the main channel of Cusick Creek (USFS 1999ac, pg. 9).

Tacoma Creek. Within USFS lands, floodplains along the creek naturally alternate between narrow and wider areas. Stream reaches surveyed lie either in narrow U-shaped valley forms of moderate sideslopes, particularly at the headwaters or in the broader U shaped valley form with low to moderate sideslopes. These areas tend to have B Rosgen channel types which are well connected to their floodplains (USFS 1999c, pg. 9). The connectivity of the stream with its floodplain is intact through most of its length (USFS 1999c, pg. 14). The existing riparian areas are functioning and hydrologically linked to the main channel of Tacoma Creek (USFS 1999c, pg. 9).

Channel Stability

Cusick Creek. At the Cusick Creek/Hwy. 20 intersectin, grazing impacts have degraded the stream channel (TAG 2002).

Cusick Creek. From RM 4.5 – 8.9, there is only one section where the channel has degraded as a result of grazing. The degradation is from past cattle grazing in the one-mile meadow reach immediately upstream of Parker Lake (USSF 1997 stream survey data, K. Honeycutt, USFS, pers. comm., 2002). The riparian area of this location is now fenced to exclude cattle grazing (R. Fletcher, POCD, pers. comm., 2002).

Habitat Elements

Channel Substrate

Cusick Creek. All reaches within USFS lands surveyed have embeddedness levels of greater than 35% (USFS 1999ac, pg. 8).

Cusick Creek. Streambank erosion from bank trampling by livestock, along with other sources of sediment such as surface and fill erosion from the county and USFS road system, maintains the level of embeddedness in the downstream habitat (USFS 1999ac, pg. 12).
Tacoma Creek. All reaches of Tacoma Creek within USFS lands have been surveyed for physical habitat condition in 1991. All of the reaches of Tacoma Creek and its tributaries surveyed have embeddedness levels greater than 35% (USFS 1999c, pg. 8).

Tacoma Creek. Streambank erosion from bank compaction and sloughing by the recreating public, along with other sources of sediment such as surface and fill erosion from the county road system, maintains the level of embeddedness in the downstream habitat (USFS 1999c, pg. 12).

N. Fk. of S. Fk. Tacoma Creek. Road densities and headwater harvest are contributing to chronic sediment delivery (USFS 2002b).

Large Woody Debris

Cusick Creek. Five of nine reaches surveyed for LWD had levels less than 20 pieces per mile. The LWD deficient reaches are located from the USFS boundary upstream for 2.5 miles. One of the reaches that are deficient is located along Parker Lake. This is a natural meadow area and vegetation would not be expected to contain recruitment sources for large instream wood. A majority of the riparian areas above Parker Lake continue to provide for instream wood (USFS 1999ac, pg. 12). The remaining deficient reaches have been modified by past actions including homesteading (USFS 1999ac, pg. 8). The small areas where grazing may restrict brush and tree growth are expected to have a noticeable effect on wood supply and indirectly pool formation. Due to the overall existing condition of the riparian vegetation along Cusick Creek, there presently are inadequate recruitment sources for future instream wood for the lower half of the drainage (USFS 1999ac, pg. 12).

Tacoma Creek. Habitat inventory surveys by KNRD from RM 2.0 – 11.0 found LWD levels to be poor (T. Andersen, KNRD, pers. comm., 2002). A 1991 USFS stream survey on a 5.2 mile reach of Tacoma Creek (RM 5.8 – 11.0), found 2.2 miles were poor for LWD (USFS 1991 stream survey data, K. Honeycutt, USFS, pers. comm., 2002).

Tacoma Creek drainage. The existence of roads within the riparian areas have replaced or reduced the capabilities of large wood recruitment sources. Road maintenance and the existence of roads within the riparian areas have replaced or reduced the capabilities of large wood recruitment sources and continue to limit the amount of brush and trees in portions of the riparian areas adjacent to road segments located within the RHCA. However, due to the overall existing condition of the riparian vegetation along Tacoma Creek and its tributaries, there presently are adequate recruitment sources for future instream wood for the watershed (USFS 1999c, pg. 12).

Pool Frequency and Quality

Cusick Creek. Numbers of pools per mile on all reaches of Cusick Creek (range: 107 - 426 pools per mile) are above what is expected for a stream with an average wetted width of 7-19 feet (39- 60 pools per mile). However, sand and finer material appear to be severely reducing pool volume and embeddedness of pool substrate does occur. Water temperatures in the pools are marginal or above the tolerance level for bull trout (USFS 1999ac, pg. 8). The small areas where grazing may restrict brush and tree growth are expected to have a noticeable effect on wood supply and indirectly pool formation (USFS 1999ac, pg. 12).

Tacoma Creek. Numbers of pools per mile on all reaches of Tacoma Creek range from 1 to 2 pools. Numbers for Tacoma Creek are below what is expected for a stream with an average wetted width of 15-20 feet (39 pools per mile; USFS 1999c, pg. 8). Sand and finer material appear to be severely reducing pool volume and embeddedness of pool substrate although this does occur throughout the watershed. Water temperatures in the pools are marginal for bull trout (USFS 1999c, pg. 8). Number of pools were found to be low in KNRD 2002 habitat inventory surveys of Tacoma Creek (T. Andersen, KNRD, pers. comm., 2002).

S. Fk. Tacoma Creek. Only 0.16 of 6.5 miles surveyed had an appropriate number of pools. The reach with good pool frequency was located in a stand of old growth (USFS 1996 stream survey data, K. Honeycutt, USFS, pers. comm., 2002).

S. Fk. Tacoma Creek. Pool frequency is poor for S. Fk. Tacoma Creek. The KNRD reported an average 3.4 pools/mile for S. Fk. Tacoma Creek in the lower nine miles (T. Andersen, KNRD, email comm., Jan. 6, 2003). The average width of S. Fk. Tacoma Creek was not provided.

N. Fk. of S. Fk. Tacoma Creek. Pool frequency averages between 30 and 50 pools/mile with pool filling occurring (USFS 1997 stream survey data, K. Honeycutt, USFS, pers. comm., 2002).

Pool Depth

Cusick Creek. Sand and finer material appear to be severely reducing pool volume and embeddedness of pool substrate does occur (USFS 1999ac, pg. 8).

Tacoma Creek. Sand and finer material appear to be severely reducing pool volume and embeddedness of pool substrate although this does occur throughout the watershed (USFS 1999c, pg. 8).

Tacoma Creek. Pool depth is fair for the lower 11.0 miles of Tacoma Creek. The KNRD reported few pools greater than one meter deep (30 pools) in the lower 11 miles of Tacoma Creek which has an average width of 23.6 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

S. Fk. Tacoma Creek. There are few pools in S. Fk. Tacoma Creek. Only 1 –4% of pools were greater than three feet deep (USFS 1996 stream survey data, K. Honeycutt, USFS, pers. comm., 2002).

N. Fk. of S. Fk. Tacoma Creek. Only 3 – 6% of pools were greater than three feet deep (USFS 1997 stream survey data, K. Honeycutt, USFS, pers. comm., 2002).

Off-Channel Habitat

Cusick Creek and Tacoma Creek drainages. Off-channel habitat for stream reaches on USFS land tends to be the result of braiding around old beaver dams and are low energy areas. The watershed has a preponderance of old beaver dams that also are acting as slow water habitat for juveniles and fry (USFS 1999ac, pg. 8; USFS 1999c, pg. 8).

Water Quality

Temperature

Cusick Creek. Water temperature was taken monthly from 1990 to 1992 on Cusick Creek near the USFS boundary (RM 4.2) by the forest hydrologist. Water temperatures were also taken weekly by the hydrologist from June through September of 1997 at the USFS boundary and another location above Parker Lake. Parker Lake is a 22-acre lake with a maximum depth of 18 feet. This body of water is a heat sink during the summer months. Differences in water temperatures taken above and below the lake ranged from 3 - 4.5°F with the waters below being warmer than above (USFS 1999ac, pg. 7). Water temperatures were also collected by the USFS from July 23 to October 28, 2002 using a thermograph placed at the USFS boundary at RM 4.2. The 7-day average maximum temperature during the period of record was 19.4°C; the maximum temperature for the period of record was 21.5°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

The water temperatures ranged from 4°C (40°F) on November 13, 1991 to 20°C (68°F) on July 23, 1997 in Cusick Creek. This limited data indicate that summer water temperatures in the Cusick Creek watershed appear to be marginal for bull trout rearing above Parker Lake. The portion of Cusick Creek below Parker Lake has summer water temperatures above the tolerance level for bull trout rearing (USFS 1999ac, pg. 7). Although the 7-day average maximum temperature could not be determined from the temperature data collected prior to 2000, the 7-day average maximum temperature during the period of record in 2000 was 19.4°C. The 7-day period during which the average maximum temperature occurred was not provided.

Cusick Creek. Water temperature was sampled one day a month for the months of August, September, October, March, April, May, June, and July from 1997 through 1998 on Cusick Creek near the Pend Oreille floodplain. The maximum temperature recorded was 18.9ºC/66ºF on July 20, 1998. The minimum temperature recorded was 4.6ºC/40ºF on March 24, 1998 (POCD 1999, Appendix B).

Cusick Creek. Water temperature was sampled one day a month for the months of August, September, October, March, April, May, June, and July from 1997 through 1998 on Cusick Creek just below the State Hwy. 20 crossing. The maximum temperature recorded was 18.8ºC/66ºF on July 20, 1998. The minimum temperature recorded was 4.6ºC/40ºF on March 24, 1998 (POCD 1999, Appendix B).

Cusick Creek. Water temperature was sampled one day a month for the months of August, September, October, March, April, May, June, and July from 1997 through 1998 on Cusick Creek near the outlet of Parker Lake. The maximum temperature recorded was 22.0ºC/71.6ºF on July 20, 1998. The minimum temperature recorded was 3.4ºC/38.1ºF on March 24, 1998 (POCD 1999, Appendix B).

Tacoma Creek. The lower reaches of Tacoma Creek may act as a thermal barrier to fish passage during summer months (Bennett and Garrett 1994, pg. 37).

Tacoma Creek. Water temperature data has been collected at four sites on Tacoma Creek by the USFS. The location of the sites where temperatures were recorded was not provided in the USFS report. Of these four sites, one site has monthly data during the field season from 1992 - 1994 and 1997. The 7-day average maximum temperature can not be determined by the existing data, however the USFS report concluded that existing summer water temperatures are poor to fair for bull trout in the lower half of the watershed. The water temperatures ranged from 4°C (40°F) on October 27, 1997 to 17°C (62°F) on June 10, 1992 in Tacoma Creek (USFS 1999c, pg. 7, 11).

Tacoma Creek. From July 23 to October 28, 2002, the USFS deployed a thermograph just upstream of the Sportsmans Pond confluence. The 7-day average maximum temperature during the period of record was 15.3°C; the maximum temperature for the period of record was 16.6°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

Tacoma Creek. The KNRD reported a 7-day average maximum instream temperature of 13.9°C in the lower 11.0 miles of Tacoma Creek occurring from July 23 through July 29, 2002 (T. Andersen, KNRD, email comm., Jan. 6, 2003). The exact location of the thermograph and the period of record were not provided.

S. Fk. Tacoma Creek. The KNRD reported a 7-day average maximum instream temperature of 12.7°C in the lower 9.0 miles of S. Fk. Tacoma Creek occuring from July 12 through July 18, 2002 (T. Andersen, KNRD, email comm., Jan. 6, 2003). The exact location of the thermograph and the period of record were not provided.

N. Fk. of S. Fk. Tacoma Creek. The KNRD reported a 7-day average maximum instream temperature of 14.17°C in the lower 6.25 miles of N. Fk. of S. Fk. Tacoma Creek occuring from July 12 through July 18, 2002 (T. Andersen, KNRD, email comm., Jan. 6, 2003). The exact location of the thermograph and the period of record were not provided.

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Cusick Creek drainage. There is very limited flow data on the Cusick Creek drainage. Flows range from 0.96 cfs to 17.1 cfs in October and April (year not provided in report; USFS 1999ac) respectively. There are no undisturbed watersheds of similar nature for comparison purposes. The high density of roads (4.4 miles/sq. mile) and moderate level of acreage in open condition (13.2%) on private lands within the watershed may have a noticeable effect to the natural flow regime. However, not enough information is available for this determination (USFS 1999ac, pg. 9).

Tacoma Creek drainage. There is very limited flow data on the Tacoma Creek watershed. Flows range from 4.3 cfs to 149.1 cfs, July and June (year not provided in report; USFS 1999c) respectively. There are no undisturbed watersheds of similar nature for comparison purposes. The high density of roads (3.0 miles/sq. mile) and high level of acreage in open condition (24.9%) on private lands within the watershed may have a noticeable effect to the natural flow regime. However, not enough information is available for this determination (USFS 1999c, pg. 9, 10).

Tacoma Creek. A small dam exists at the outflow of Sportsman Pond, which drains into Tacoma Creek. The pond is naturally formed in a shallow basin which was probably a seasonal pond. When the small dam was placed at the outflow in 1954 to develop the pond for rearing trout, the pond became more perennial, though it still occasionally dries up, especially in the summers (USFS 1998, pg. 12).

S. Fk. Tacoma Creek. Conger Ponds (3.2 and 5.3 acres, respectively) were built in 1926 for fish propagation and irrigation. They are fed by a diversion from S. Fk. Tacoma Creek and drain via Trimble Creek to the Pend Oreille River (USFS 1998, pg. 12).

Species Competition

Non-indigenous Fish

Cusick Creek. The habitat supports brook trout populations for all life stages (USFS 1999ac, pg. 8).

Tacoma Creek. The habitat supports brook trout populations for all life stages (USFS 1999c, pg. 8; Bennett and Liter 1991, pg. 65).

S. Fk. Tacoma Creek. Brook trout are present (KNRD 2002 unpublish survey data, T. Andersen, KNRD, pers. comm., 2002).

N. Fk. of S. Fk. Tacoma Creek. Brook trout are present (KNRD 2002 unpublish survey data, T. Andersen, KNRD, pers. comm., 2002).

Tacoma Creek WAU Fish Distribution and Use.

The streams in the Tacoma Creek WAU flow into the Box Canyon Reservoir reach of the Pend Oreille River. Bull trout are not known currently to occur in the Tacoma Creek WAU, therefore Table 18 below, which describes current, known bull trout use in the WAU, is blank for bull trout. Based on USFS and KNRD stream habitat surveys (KNRD 1995 habitat survey; USFS 1991 and 1996 stream surveys), maps in Appendix C illustrate the extent of “Recoverable” bull trout habitat in the Tacoma Creek WAU. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Although by name ("char", the term historically applied to bull trout) there is no historic documentation of the occurrence of bull trout in the Tacoma Creek WAU, the Kalispel Tribe believes historic bull trout occurrence has been documented in the Tacoma Creek drainage based on information contained in field notes taken by A.H. Smith from 1936-1938 (Lyons 2002). Lyons states that in his notes, Smith described the capture of "trout" in traditional Kalispel fishing weirs placed at the mouth of Tacoma Creek in late summer. The Kalispel Tribe contends that documentation of the capture of "trout" historically in Tacoma Creek at the mouth in late summer infers the presence of a bull trout population in the drainage (Lyons 2002). Notes reprinted from pages in Smith 1936-1938 in a 1983 court document (Smith 1983, pg. 204) describe the construction of a large, traditional, tribal weir historically used at the mouth of Tacoma Creek. Smith recorded that people went to the site about mid-July to build the weirs where "large quantities of trout and all kinds of small fish" were captured (Smith 1983, pg. 204). Smith also noted the traditional construction of a weir at the mouth of Cusick Creek about the middle of July by one man and his brother where "all kinds of small fish, though mostly trout, were caught as they were ascending the creek" (Smith 1983, pg. 204). The reprints of Smith's notes found in Smith 1983 may not represent the complete information contained in Smith 1936-1938 as indicated by Lyon (2002).

Given the knowledge of salmonid biology and behavior, the historic use by bull trout of the mainstem Pend Oreille (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), and a lack of natural barriers at tributary mouths, it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. Presently, for all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years. .

Table 18: Current, known bull trout use in the Tacoma Creek WAU. (Table is blank for bull trout since there are no current, known observations of bull trout in the Tacoma Creek WAU).

Tacoma Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Cusick Creek					X
Tacoma Creek					X

S. Fk. Tacoma Creek					X
N. Fk. Tacoma Creek					X

Tacoma Creek WAU Summary.

Cusick Creek

The existing habitat has been modified somewhat by human activities within the watershed. Low numbers of LWD, low numbers of deep pool habitat for winter rearing, summer water temperatures above the expected tolerance levels for the species and well distributed populations of brook trout are limiting factors for the species (USFS 1999ac, pg. 11).

The present water temperature regime indicates that water temperatures are not within the tolerance range for bull trout in Cusick Creek below Parker Lake during the summer months. Parker Lake is a 22-acre lake with a maximum depth of 18 feet. The USFS attributes elevated instream temperatures downstream of Parker Lake to the natural effect of solar radiation with the lake acting as a heat sink during the summer months. Summer water temperatures in the upper portion of the watershed are marginal. Grazing, particularly in meadows upstream of Parker Lake, has changed the characteristics of the riparian vegetation and decreased the amount of brush and trees that shade the stream and moderate summer temperatures. The meadow area above Parker Lake has been fenced since 1997 and the riparian vegetation is recovering slowly. The USFS has determined that the primary factor raising water temperatures above desired levels appears to be the effect of solar radiation on pools behind old and new beaver dams and Parker Lake within the reaches of Cusick Creek (USFS 1999ac, pg. 11).

Although the existing riparian vegetation is primarily composed of species expected of the natural riparian community, wildfires and past harvest have removed some of the largest components of the riparian stands along Cusick Creek. The riparian areas are continuous in nature with the exception of a few road crossings and portions of USFS and county roads within the RHCA. However, the riparian area does not appear to be providing adequate shade and LWD for several portions of the stream system as evidenced by the high summer water temperatures and low amounts of instream wood (USFS 1999ac, pg. 10). A majority of the riparian areas above Parker Lake continue to provide for instream wood (USFS 1999ac, pg. 12). The LWD deficient stream reaches have been modified by past actions including homesteading (USFS 1999ac, pg. 8). The small areas where grazing may restrict brush and tree growth are expected to have a noticeable effect on wood supply and indirectly pool formation. Due to the overall existing condition of the riparian vegetation along Cusick Creek, there presently are inadequate recruitment sources for future instream wood for the lower half of the watershed. This is due to both overgrazing of the riparian areas and the existence of roads within the riparian areas that have replaced or reduced the capabilities of large wood recruitment sources (USFS 1999ac, pg. 12).

The present condition of the streambed substrate is not optimal for bull trout spawning and rearing due to high embeddedness levels, low numbers of instream wood and deep pool habitat

(USFS 1999ac, pg. 8). The dominant erosion process is surface erosion from riparian roads (USFS 1998, pg. 3). Although the majority of the sediment introduction is due to maintenance of county roads, road maintenance on the USFS road system continues to cause sediment movement off the road into the stream. The additional sediment input does appear to cause filling of existing pool habitat immediately downstream of USFS maintained road segments, although it is impossible to separate this contribution from that of maintenance of the county road system. Sediment from road maintenance activities are also factors contributing to the present level of embeddedness of the pool substrate along the surveyed stream reaches. Streambank erosion from bank trampling by livestock, along with surface and fill erosion from the county and USFS road system, maintains the level of embeddedness in the downstream habitat (USFS 1999ac, pg. 12). Grazing continues to maintain a minor point source of sediment into the watershed from access points that are being overutilized by livestock. Livestock overutilization of riparian areas has decreased the amount and health of the native vegetation allowing grass and forbs to replace brush and trees and reducing future large instream wood recruitment. Overall, grazing will continue to cause a small amount of sediment introduction into the stream habitat. Openings in the riparian area's overhead canopy as created by overgrazing impacts will continue to influence water temperatures during the summer (USFS 1999ac, pg. 12).

Tacoma Creek

The existing habitat has been modified by human activities within the watershed. Summer water temperatures near the expected tolerance levels for the bull trout, low numbers of deep pool habitat for winter rearing, high level of embeddedness of the substrateand well distributed populations of brook trout are limiting factors for the species (USFS 1999c, pg. 10). Large woody debris is also below expected levels in Tacoma Creek (USFS 1991 stream survey and KNRD 2002 habitat inventory).

The limited data available for instream temperatures in Tacoma Creek indicate that summer water temperatures in this watershed appear to be fair to poor for bull trout. Road construction originally changed the characteristics of the riparian vegetation and decreased the amount of brush and trees that shade the stream and moderate summer temperatures. Maintenance of road segments located within the RHCA continues to limit the ability of the adjacent riparian vegetation to provide shade. The USFS has determined that the primary factor raising water temperatures above desired appears to be the effect of solar radiation on the stream proper and on pools behind old and new beaver dams within the reaches of Tacoma Creek.

Large woody debris levels are below what is expected for Tacoma Creek and as a result pool numbers are low. Large woody debris is crucial for much of the pool formation in a stream like Tacoma Creek with an average wetted width of 15-20 feet (USFS 1999c, pg. 8). The riparian habitat has recovered from the last major fires in the early 1930s, however large wood recruitment in reaches where road construction and maintenance has negatively impacted the riparian habitat is presently less than desired (USFS 1999c, pg. 10). Overall though, the existing condition of the riparian vegetation along Tacoma Creek and its tributaries is capable of providing adequate recruitment sources for future instream wood for the watershed (USFS 1999c, pg. 12). The riparian areas are made discontinuous due to numerous road crossings of USFS and county roads within the RHCA and past clearcut acreage that included riparian vegetation. The riparian area does not, however, appear to be providing adequate shade or vegetative buffer for several portions of the stream system as evidenced by the high summer water temperatures and substrate embeddedness (USFS 1999c, pg. 10).

The present condition of the streambed substrate is not optimal for bull trout spawning and rearing due to high embeddedness levels and very low amount of pool habitat (USFS 1999c, pg. 8). The dominant erosion process is surface erosion from riparian roads (USFS 1998, pg. 3). Road maintenance continues to maintain a point source of sediment into the watershed from road segments that are poorly designed and located. Continued maintenance of road segments allows grass and forbs to replace brush and trees and reduce future large instream wood recruitment in adjacent stream habitat. A majority of the sediment introduction is due to road maintenance activities (USFS 1999c, pg. 12). The additional sediment input from road maintenance does appear to cause filling of existing pool habitat immediately downstream of maintained road segments although it is impossible to separate this contribution from that of maintenance of the county road system. Sediment from road maintenance activities is also a factor causing the present level of embeddedness of the pool substrate along the surveyed reaches (USFS 1999c, pg. 12). Streambank erosion associated with bank compaction and streambank sloughing resulting from public recreation impacts, along with surface and fill erosion from the road system, maintains the level of embeddedness in the downstream habitat (USFS 1999c, pg. 12).

Upstream of RM 5.0 on N. Fk of S. Fk. Tacoma Creek, sediment deposition is occurring, forming instream depositional bars and causing channel widening. The elevated instream sediment is associated with timber harvest activities in the upper watershed. Downstream of RM 5.0, there are generally transport reaches until RM 3.1 where the gradient flattens. Beaver are active in these low gradient reaches which are wet meadows. Deposition also occurs in the wet meadows (K. Honeycutt, USFS, pers. comm., 2002).

Tacoma Creek WAU Data Gaps.

- No data gaps identified by the TAG.

CALISPELL CREEK WATERSHED

(Andrew Scott, Framatome ANP, contributing author)
The Winchester Creek WAU (49,074 acres) and the Tenmile Creek WAU (43,450 acres) encompass all tributaries draining into Calispell Creek. Calispell Creek ultimately drains into the Pend Oreille River at RM 69.6. Together the Winchester Creek WAU and Tenmile Creek WAU make up the Calispell Creek watershed. The following section will be referred to as the Calispell Creek Watershed in this report for ease of reference to most maps and studies for this geographic area.

Calispell Creek Watershed Description

The Calispell Creek watershed encompasses approximately 92,523 acres. It is located in eastern Washington approximately 10 miles west of Cusick, Washington. The Calispell Creek watershed is made up of approximately 40% government-owned land (Colville NF and State of WA) and 60% privately-owned land. Elevations range from 5773 feet on the Chewelah

Mountain summit (USFS topographic map) to 2050 feet at the town of Cusick (T. Driver, Landowner, pers. comm., 2003). The elevation of the Pend Oreille River (on the downstream side of the railroad dike pump station) at 90,000 cfs is 2041.0 feet (POCD 2001a, pg. 17 of 35; Northrop et al. 1996a, pg. 2). At 43,000 cfs, the elevation of the Pend Oreille River (again on the downstream side of the railroad dike pump station) is at 2032.25 feet (POCD 2001a, pg. 31 of 35). The elevation of Calispell Creek at the upstream side of the railroad dike pump station is maintained at an approximate elevation between 2027.0 and 2027.5 feet (POCD 2001a, pg. 31 of 35). The top of the dike is 2053 feet (T. Driver, landowner, pers. comm., 2003). The average annual precipitation in the watershed ranges from 8 to 14 inches. Total annual snowfall averages 64 to 90+ inches (POCD 2001a pg 19).

The large Calispell Creek watershed encompasses diverse topography which in turn provides a broad variety of land uses. The stream headwaters are in higher elevations with moderate to steep terrain and are heavily forested. These areas are actively logged, both on private and public lands. Elevation and water availability also provide for hydroelectric generation from Power Lake, which drains the Middle and North forks of Calispell Creek (D&ES 2000). The headwater tributaries meet to form the larger 2nd through 4th order streams. In the headwaters, these tributaries are characterized by relatively narrow high gradient flows with large substrate. As they meet the valley floor, the velocities slow and flows tend to spread out laterally. The substrate becomes smaller and more mobile (D&ES 2001b). This broad low-gradient plain, known as the Cusick valley or Cusick Flats by the local community, is actively used for agriculture including grass hay production, livestock pasturing and dairy operations. Development is primarily rural with scattered ranch operations and private homesteads throughout the Cusick valley and in the surrounding lower elevations.

This watershed includes many smaller drainages that merge to form Calispell Lake. Starting generally west of Calispell Lake, Tenmile and Gletty creeks along with numerous unnamed tributaries, merge with the North Fork and the Middle Fork of Calispell Creek to drain approximately 78,100 acres (Andersen and Maroney 2002b, pg 1). These creeks first empty into Power Lake, where a hydroelectric generating facility is located. The outlet from Power Lake flows south to meet the South Fork Calispell Creek. South Fork Calispell Creek flows almost directly north, draining an area south of the lake of approximately 7,300 acres (Andersen and Maroney 2002c, pg 1).

Winchester Creek and its tributary, Graham Creek, flow into Calispell Lake from the northwest. The outlet of Calispell Lake is Calispell Creek. At the outlet, a small man-made dam is used to maintain lake levels for waterfowl production (DE&S 2001b). Calispell Creek flows approximately 6.5 miles before emptying into the Pend Oreille River at RM 69 (Williams, et al. 1975; DE&S 2001b, pg 2). Smalle Creek and its main tributary, East Fork Smalle Creek drain directly into Calispell Creek (RM 2.75) below Calispell Lake. Winchester and Smalle creeks drain approximately 17,280 acres.

The Calispell watershed typically has one spring runoff that can begin as early as March and may last into June. Flows can come off rapidly when rain-on-snow events occur, and regular flooding in the Cusick valley is common. Average annual flows in Calispell Creek from 1955 through 1998 ranged from 300-1000 cfs (USGS 2002). A high flow of 3300 cfs was recorded in 1974

(USGS 2002). Creek flows typically back up into the valley by simultaneous high flows in the Pend Oreille River (POCD 2001a, pgs 15-18). In an effort to minimize flooding, the Pend Oreille Public Utility District (POPUD) in cooperation with Diking District #2 operates and maintains a series of pumps near the mouth of Calispell Creek (POCD 2001a, pg 31). Numerous dikes and culverts have been placed in various areas adjacent to the lower Calispell Creek flood plain in effort to direct seasonal runoff (POCDa 2001, pg 13).

Presently, there are no climatic or stream flow monitoring stations within the Calispell Creek watershed, so current conditions specific to this watershed is not available. The USGS collected continuous streamflow data on Calispell Creek from 1950 through 1973 (USGS streamflow data from www.usgs.gov, Sept. 2001) and the USFS has taken limited flow measurements at the Forest boundary recording ranges from 2.7 cfs to 102.5 cfs, during fall and spring (USFS 1999, pg 10). The following is a more generalized description of the area. The Calispell Creek watershed including the Calispell valley has a mixed climate. It lies on the border of the pacific maritime and the continental air masses (POCD 2001a pg 18). Wet cool springs usually give way to hot dry summers. Fall tends to be warm early and get progressively cooler and wetter as winter descends. Winters tend to be cold, with the majority of snowfall coming in December and January. Snowfall tends to increase with elevation and north latitudes (POCD 2001a, pg 19). Most weather is dominated by the prevailing westerly winds but winter cold air is much affected by the Canadian arctic. Daily summer temperatures range from 46° F to 85° F while winter temperatures 0° F to 30° F.

Calispell Creek Watershed Hydrogeomorphology

Glacially modified lowlands and mountains with deep narrow valleys characterize the Calispell Creek watershed. The valley Calispell Creek flows through is made up of gentle to steep sloping sides composed of glacial drift, residuum and colluvium, and rock outcrops (POCD 2001a, pg 15). The valley is roughly 15 miles long and 2 to 4 miles wide.

The soils of the Calispell watershed are two different types, based on the formation processes that occurred after glaciers receded (POCD 2001a, pg 20). They are the Cusick flat area (the valley) and the forested upper watershed. The main difference between the two areas where the soil types are found is slope. The Cusick flat area was once underneath the glacier. As the glacier receded, the area under the glacier became a lake where sediments that entered the lake settled out (POCD 2001a, pg 21). Cusick Silty Clay Loam dominates these sediments. As the ancient lake receded, it became a floodplain for Calispell Creek and its tributaries, other area tributaries and the Pend Oreille River. The upper, forested portion of the Calispell Watershed was on the edge or the side of the glacier. The soil-forming materials here are primarily granitic and metamorphic rock. The sediment found in the upper forested areas are more coarse and less mobile due to rock type, narrower stream corridors and higher gradient conditions. The slopes are steep with sandy soils (POCD 2001a, pg 21). Soils in both areas are considered geologically young and thus, not well developed.

The hydrology of the Calispell watershed is also divided into two distinct areas. The upper, forested areas are typically steep stable channels where runoff occurs at medium to fast rates depending upon weather and conditions. The upper reaches of the North Fork, Middle Fork and

South Fork Calispell watersheds are characterized by varying channel types. Rosgen A type channels are the most common with gradients ranging from 1-13% and substrates dominated by cobble and sand (Andersen and Maroney 2002 a,b,c). Smalle Creek has similar channel characteristics in its upper drainages (DE&S 2001b, Andersen and Maroney 2001c). In the upper Calispell Creek and Smalle Creek watersheds, floodplains along the creek alternate between narrow and wide areas. Stream reaches are either in narrow U-shaped valleys with moderate side slopes, particularly in the headwaters or in the broader U-shaped valleys with low to moderate side slopes that represent the majority of the watersheds. These tend to have Rosgen B channel types, which are well connected to their floodplains (USFS 1999, pg 10). These upper reaches are also potential downstream sediment sources from road construction primarily to support timber operations. Increased erosion was estimated at 14% over natural background erosion, which is considered a small increase for a managed watershed (POCD 2001a, pg 22).

As the upper elevations give way to the Cusick valley, the forested areas thin to open grassland and the watershed dramatically changes appearance. With the exception of Smalle Creek and a few intermittent streams, the entire Calispell watershed drains into Calispell Lake. Numerous dikes and culverts have been installed in the floodplain in an attempt to move water off of and away from agricultural fields. The lake now spills out at the Calispell Duck Club Dam and forms the main stem of Calispell Creek. A Rosgen C type channel, broad, shallow and slow, dominates the stream corridor and water temperatures increase and water quality and clarity decrease. This Cusick valley area is prone to flooding with an average gradient of 2% or less. The substrate is dominated by silt and sand (DE&S 2001b, pg 2). In a description of Kalispel weir fishing (Smith 1983), Smith provides some information that give an impression of the character of the stream near the mouth prior to human-alteration of the watercourse. The construction of the Calispell Creek weir, about 45 yards upstream from the Pend Oreille River confluence where the creek was 35 yards wide, was a large affair. As many as 60 to 84 men were engaged in the construction. An encampment was on the north shore where the weir mat was constructed and sod blocks were cut to be used as weights to secure the bottom of the mat to the channel bed. The weir frame was constructed of poles about the diameter of fence posts which were pushed – not driven with a rock – into the soft mud bottom of Calispell Creek, in pairs 6 or 8 feet apart.

Flood control has become an increasingly important issue within the Calispell Creek watershed, primarily in the area of the Cusick valley which naturally flooded historically. After the construction of Box Canyon Dam in 1955, flood control became more of an issue as the dam could back water onto adjacent lands and slow runoff to the Pend Oreille River (POCD 2001a, pg 11). Local concerns over flood damage and negative impacts to parts of the watershed have resulted in a flood hazard management plan being developed for the Calispell Creek watershed in 2001 (POCD 2001a). As part of this management plan, restorative efforts have been recommended to address various watershed problems.

Calispell Creek Watershed Current Known Habitat Conditions

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 Technical Advisory Group (TAG). The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Calispell Creek (62.0628). At RM 0.5 pumps and floodgates in the railroad dike act as a barrier to fish passage into the Calispell Creek watershed. In 1909 the Idaho and Washington Northern Railroad constructed a rail line on the west side of the Pend Oreille River. Part of the railroad embankment still serves as a dike in this reach of the river during flood conditions. Presently, the POPUD maintains the pump operations (POCD 2001a, pg. 11; USFS 1999ad, pg 1).

Calispell Creek. Mean annual summer temperatures in the lower 6.0 miles of Calispell Creek exceed the upper lethal limits of many salmonids (DE&S 2001b, pg 2, Table 1). Mean and maximum water temperatures recorded at Calispell pumps and at the Calispell Lake outlet also exceed properly functioning conditions established for bull trout use (USFWS 1998). The extent to which elevated water temperatures could form a seasonal thermal barrier to upstream and downstream migration is unknown (DE&S 2001b, pg 6, Table 1).

Calispell Creek. At RM 6.0 the Calispell Duck Club maintains a low-head dam at the outlet of Calispell Lake. During summer low flows, passage over this dam is difficult due to limited water quantities and high water temperatures (DE&S 2001b, pg 2). Boards to regulate lake levels are installed in the dam at the start of September to bring water levels up in Calispell Lake, and removed when the lake begins to freeze, in an effort to keep open water (POCD 2001a, pg. 18). When boards are in place, fish passage can be obstructed if flows are low. Therefore, passage at the Duck Club Dam is limited seasonally by high water temperatures, low flows, and the physical barrier of boards in the dam (POPUD 1/29/03 final draft report review comments, March 2003).

Smalle Creek. Downstream of the West Calispell Road (RM 2.5) there are beaver dams that may reduce fish passage (A. Scott, Framatome ANP, pers. comm., 2002).

Smalle Creek (62.0631). There is a natural waterfall barrier at RM 6.6 (DE&S 2001b, Andersen and Maroney 2001c).

East Fork Smalle Creek (62.0631a). At RM 3.7, there is a natural barrier made up of a large boulder/cascade (Andersen and Maroney 2001c).

Winchester Creek (62.0666). At RM 0.9, double culverts on the Westside Calispell Road present a migration barrier for upstream fish passage. The square, larger of the two culverts has a width of 11 feet, a depth of 0.2 feet and a vertical drop of 2.1 feet. The plunge pool underneath the culvert had a depth of 1.2 feet in April 2001, with a plume which extended downstream 3.4 feet. Fish would not be able to successfully leap into this culvert and negotiate to the upstream side of the road. The smaller culvert was circular, and 5.4 feet in diameter. The drop form the culvert was 0.9 feet onto a flat apron. Water in the culvert was only 0.4 feet deep, with velocities exceeding 3.0 ft/second (DE&S 2001b).

<u>Winchester Creek.</u> At RM 1.5, in April of 2001, there was a small human-made partial boulder barrier (at low flows; DE&S 2001b, pg 2, Winchester section).

<u>Winchester Creek.</u> At RM 1.6, in April of 2001, there was a natural log barrier with a jump height of 2.3 feet and a downstream pool depth of 2 feet with no suitable areas for launching or landing (DE&S 2001b, pg 2, Winchester section).

<u>Winchester Creek.</u> The culvert (Culvert_id # 170) at RM 6.7 at the County Rd. 12110 creek crossing (road mile 3.8) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

<u>Winchester Creek.</u> At RM 10.1, there are two low falls (about 3 feet high) followed by a long, 35-foot chute that drops approximately 20 feet (DE&S 2001b, pg. 2, Winchester Creek section). The USFS (1999ad) identified this natural chute/cascade as a barrier.

<u>Dorchester Creek (62.0685).</u> About 0.3 miles downstream of Westside Calispell Road, Dorchester Creek goes into a cattail marsh, continuing downstream through the marsh for approximately one mile before entering Calispell Lake (DE&S 2001b, pg. 2, Dorchester Creek section).

<u>Dorchester Creek.</u> Between Westside Calispell Road (RM 1.3) and where Dorchester Creek flows into the cattail marsh (RM 1.0), Dorchester Creek flows through three-to-four constructed, instream, farm ponds. The ponds are linked by a series of culverts that create barriers to upstream migration. The most extreme of these culverts has a drop-height of at least four feet. The other culverts have similar drops and all are impassable to fish migrating upstream from Calispell Lake (DE&S 2001b, pg. 2, Dorchester Creek section; POPUD 2000b, pg. 8).

<u>Dorchester Creek.</u> At RM 1.6, there is a stump in the stream that creates a barrier at low flows. This is upstream of Westside Calispell Road. The stump creates a 2.2-foot high falls with inadequate jumping and landing areas. At higher flows the barrier may become passable. At least three other similar partial barriers (at low flow conditions) were found upstream of the stump at RM 1.6. In general, Dorchester Creek is very small upstream of the Westside Calispell Road (DE&S 2001b, pg. 2, Dorchester Creek section).

<u>Power Creek (62.0690).</u> At RM 0.2, a natural falls/cascade barrier exists on Power Creek. The assessment was made using Powers and Orsborne (1984) criteria for assessing fish passage at waterfalls. The natural falls/cascade is 7.5 feet wide, with an above water vertical rise of 5.1 feet. The pool at the base of the falls has a depth of 1.4 feet (DE&S 2001b, pg. 5, Calispell Crk. Section). Water from the North Fork and Middle Fork Calispell creeks flows into Power Lake.

Some flow from Power Lake is diverted to the Power Creek Hydroelectric Plant and empties into South Fork Calispell Creek about 0.85 miles above the West Fork Calispell Road. The natural channel from Power Lake descends down an impassable series of boulder cascades and falls to the South Fork Calispell Creek a few hundred yards upstream of the Power Creek Hydroeletric Plant (POPUD 1/29/03 final draft report review comments, March 2003.

Power Creek. Larger natural barriers exist immediately upstream of the natural falls/cascade barrier at RM 0.2, but were not surveyed (DE&S 2001b, pg 6, Calispell Crk. Section).

Power Creek. Power Lake Dam, owned and operated by the POPUD, is located at RM 0.5 and does not provide fish passage (P. Buckley, POPUD, pers. comm., 2003).

S. Fk. Calispell Creek (62.0689). At 1.3 miles above the confluence with Power Creek, a naturally occurring boulder-cascade barrier exists. This boulder-formed cascades limits upstream passage. The assessment was made using Powers and Orsborne (1984) criteria for assessing fish passage at waterfalls. The landing pool above the barrier is short and shallow (0.3 feet) further hindering upstream progress. At higher flows this barrier may be passable, although increased water velocities at higher flows may further impede passage (DE&S 2001b, pg 4, Calispell Crk. Section).

S. Fk. Calispell Creek. At 1.56 miles above Power Creek, the channel appears to naturally flow underground for approximately 1,500 feet. Local farmers claim it is dry most of the year (DE&S 2001b, pg 4, Calispell Crk. Section).

S. Fk. Calispell Creek. An impassible road culvert exists 3.2 miles above Power Creek (DE&S 2001b, pg 4, Calispell Crk. Section).

S. Fk. Calispell Creek. Natural barriers occur at RM 4.0 and RM 4.1 (Andersen and Maroney 2002c, pg 19).

N. Fk. Calispell Creek (62.0690). A natural fish barrier was identified at RM 2.95 (Andersen and Maroney 2002b, pg. 24).

M. Fk. Calispell Creek (62.0702). The Middle Fork has three identified natural barriers at RM 0.1 (Andersen and Maroney 2002a, pg 17).

Gletty Creek (62.0733). No known barriers exist on Gletty Creek (Andersen and Maroney 2002b).

Tenmile Creek (62.0733). There are two poorly placed culverts located in the upper watershed (USFS 1999ad, pg 8).

Riparian Condition

Calispell Creek. There is virtually no overhead canopy from Calispell Lake downstream to the town of Cusick at the Pend Oreille River confluence (DE&S 2001b). The extent to which the

Cusick flats area once naturally supported a woody vegetation component (shrub and tree species) in the riparian zone is disputed.

In a book describing the history of Pend Oreille County (Bamonte and Bamonte 1996, pg. 251), the wet meadows that existed on both sides of the Pend Oreille River around the towns of Cusick, Usk, and the Calispell Valley were said to be among the most productive camas grounds in the Northwest (Thoms 1989; Chalfant 1974). The Calispell Valley was described as appearing “like a sea of blue” in the spring when the camas was in bloom (Bamonte and Bamonte 1996, pg. 252). Chittenden and Richardson (1905, pg. 460, 461) provides Father Pierre-Jean DeSmet’s description of the area near the Town of Cusick during DeSmet’s visit to the Pend Oreille valley in the winter of 1844-45. DeSmet found a “vast beautiful prairie, three miles in extent, surrounded by cedar and pine…”. According to Thom’s work (Thom 1989), the lower elevations on the valley floor (2,035 – 2040 feet above sea level) were annually flooded prior to the construction of dams and levees and encompassed 6,000 – 7,000 hectares of camas-rich meadow habitat. In addition to camas, common plants in the valley floor included sedges, spikerush, common rush, cutgrass, reed canary grass, and mannagrass. The higher, occasionally flooded surfaces on the valley floor (elevations 2,050 feet to 2080 feet), supported coniferous vegetation, but meadow habitat occured there as well. Ponderosa pine, cottonwood, aspen, hawthorne, sedges grasses and shrubs were especially common on the occasionally flooded elevations as they are on high valley floor terraces 2,080 feet and above, which are above the 100-year floods (Thoms 1989, pg. 363). Farmers and landowners who have resided in the valley dating back to the late 1800’s state that Calispell Creek has never had a canopy of woody shrubs or trees (T. Driver, 2003; POCD, written correspondence, Feb. 26, 2003). By 1900, there were close to 400 milk cows in the Caslipell valley alone (Bamonte and Bamonte 1996, pg. 79).

The description of large camas meadows, it has been argued by some TAG participants, does not preclude the existence of a woody riparian component of perhaps alders, willows, and associated plant species adjacent to the Calispell Creek stream channel. As support for this argument, review of aerial photographs and streambanks along lower Cee Cee Ah Creek and lower Trimble and Tacoma creeks (where they have not been altered by land use practices) support what appear to be willow species and hawthorne. It is thought that the floodplain in the Calispell Creek confluence area, being similar in geomorphology to the floodplain areas of Cee Cee Ah, Trimble and Tacoma creeks can be used as an indicator of potential riparian plant community composition for the Calispell Creek floodplains (S. Lembcke, WDFW, pers. comm., 2002). Soils maps in and around the Calispell/Tacoma/Trimble creek area are available from the Natural Resource Conservation Service (NRCS) and may be useful in determining the extent to which certain plant species could have thrived in the Cusick flats area, but this assessment has not been undertaken to date. Presently, flood control diking, hydropower development, farming, grazing, transportation system development, and urban/residential development have greatly altered the natural hydrology and natural vegetative component in the Calispell valley.

<u>Calispell Lake, lower Calispell Creek and lower Smalle Creek.</u> Nearly all of the riparian areas along Calispell Lake, lower Calispell Creek and lower Smalle Creek were actively used for livestock grazing and grass hay production. Cattle grazing and trampled banks have negatively affected most of the riparian areas where grazing has occurred (DE&S 2000; DE&S 2001b). Since 2000, the area around the confluence of Calispell Creek and Smalle Creek has been fenced

to exclude livestock (J. Carney, landowner, pers. comm., 2002; R. Fletcher, POCD, pers. comm., 2002), however some cattle grazing still continues on lower Calispell Creek (A. Scott, Framatome ANP, pers. comm., 2002) and degradation to the lower Smalle Creek channel from past cattle grazing is still evident (TAG 2002). Occasional areas of shrubs and trees provide limited overhead canopy, however grasses and forbs make up the bulk of riparian vegetation on nearly all the valley creeks (DE&S 2001b). Based on personal observation by farmers and landowners who have resided in the valley dating back to the late 1800's, Calispell Creek has never had a canopy of woody shrubs or trees (T. Driver, landowner; POCD, written correspondence, Feb. 26, 2003). Currently, much of lower Calispell Creek flows through large treeless fields used for grass hay production. Smalle Creek flows through a swampy area with undefined channels and wetland vegetation (alder and dogwood species) before emerging to flow through grass hay fields immediately upstream of its confluence with Calispell Creek (DE&S 2001b).

Upper reaches of Winchester, Dorchester and Smalle Creek. These tributary drainages have conditions similar to other Calispell Creek tributaries. Logging operations with associated road building as well as cattle grazing have created a patchwork of disturbed and altered riparian areas (DE&S 2001b, KNRD 2001c).

Smalle Creek. From its confluence with Calispell Creek continuing upstream about 3 miles, Smalle Creek is a low gradient (<2%) stream that has experienced cattle grazing and excess sediment delivery from the upper watershed. Cattle grazing has degraded the riparian habitat in the lower few miles of Smalle Creek (Andersen and Maroney 2001c, pg. 21). Although lower Smalle Creek has been fenced to exclude cattle grazing, degradation to the channel from past cattle grazing is still evident (TAG 2002).

E. Fk. Smalle Creek. Downstream of the natural barrier, unstable banks are common (84% stability) due to impacts from cattle grazing and the stream is entrenched. Riparian fencing is recommended to allow for the re-establishment of the riparian canopy (Andersen and Maroney 2001c, pg. 28).

Winchester Creek. In the uplands, remnants of abandoned road systems within riparian areas were extensive. Lowland riparian areas were impacted by historic logging and grazing practices (Andersen and Maroney 2001b, pg. 26).

S. Fk. Calispell Creek drainage. The drainage appears to have the highest quality riparian conditions of the N. Fk, M. Fk., and S. Fk. Calispell Creeks drainages. Road construction and timber harvest appears to be limited to the extreme upper portions of the watershed (Andersen and Maroney 2002c, pg 22). Most riparian areas along the middle portions of this drainage were undisturbed and functioning well (A. Scott, Framatome ANP, pers. comm., 2002).

N. Fk. Calispell Creek drainage. The drainage has had numerous clear-cut logging operations that have removed or destroyed all riparian vegetation. That, combined with summer cattle grazing and recreational use has heavily impacted various section of the stream (Andersen and Maroney 2002b, pg 29).

M. Fk. Calispell drainage. The drainage has suffered riparian abuses similar to the North Fork Calispell. Cattle grazing, off-road vehicle use and past timber harvests have left areas along the upper portions of the stream with eroding banks, little overhead canopy and reduced or destroyed stream side vegetation (KNRD 2001b, pg 36-40).

Channel Conditions/Dynamics

Streambank Condition

Lower Calispell Creek. Downstream of Calispell Lake (RM 6.0) there are substantial reaches with altered banks. Channelization, diking, dredging and damming have all occurred along various portions of the channel. With the exception of the Calispell Creek/Smalle Creek confluence, cattle are actively grazed and grass hay is produced on hundreds of acres in the land adjacent to lower Calispell Creek (DE&S 2001b). Since 2000, the area around the confluence of Calispell Creek and Smalle Creek has been fenced to exclude livestock (J. Carney, landowner, pers. comm., 2002; R. Fletcher, POCD, pers. comm., 2002). Unstable and unvegetated banks below the Duck Club Dam are active sources of fine sediment causing reduced water quality in the stream. LWD is virtually nonexistent, as there are little or no sources in this area (DE&S 2001b). Summer low flows often meander through braided channels filled with clay and sand fine sediments.

Calispell Creek. From RM 7.5 upstream to the Power Creek confluence, streambanks are 50 – 80% stable (A. Scott, Framatome ANP, pers. comm., 2002).

Lower Smalle Creek. Cattle grazing impacts to the lower reaches of Smalle Creek are similar to those along Calispell Creek. Although more of its banks are vegetated with trees and shrubs, it still has substantial side- and down-cutting of the stream channel. This, combined with seasonally intense livestock grazing up until the year 2000 when cattle were excluded from the Smalle Creek/Calispell Creek confluence with fencing, is a constant source of sediment within the channel. Substrate embeddedness is well over 50% (DE&S 2001b). The confluence of Smalle Creek and Calispell Creek has a large shifting deposit of sediment which likely acts as a barrier to fish migration during low flows (DE&S 2001b).

Smalle Creek. From its confluence with Calispell Creek continuing upstream about 3 miles, Smalle Creek is a low gradient (<2%) stream that has experienced cattle grazing and excess sediment delivery from the upper watershed. However, in contrast to Duke Engineering & Services (DE&S) data which mentions "substantial" bank side-cutting, streambanks stablility was recorded at 96-99 percent stable by Kaslispel NaturalResourceDepartment (KNRD) methodology and criteria in the lower few miles of Smalle Creek (Andersen and Maroney 2001c, pg. 21). The lower 2,730 m (1.7 miles) of Smalle Creek is classified as an F3b type channel with impacts from cattle grazing and excess sediment delivery from the upper drainage contributing to its classification (Andersen and Maroney 2001c, pg. 21). An F3 channel type is a cobble dominated, entrenched, meandering channel, deeply incised in gentle terrain with a gradient of 2-4% (Rosgen 1996, pg. 5-151). An "F" stream type is often described as working towards re-establishment of a functional floodplain inside the confines of a channel that is consistently increasing its width. "F" channel types are deeply incised in valleys of relatively low elevational relief, containing highly weathered rock and/or erodible materials (Rosgen 1996, pg. 4-10).

E. Fk. Smalle Creek. The lower 1,920 m (1.2 miles) of E. Fk. Smalle Creek is classified as an F4 channel type. It is described in the KNRD habitat survey report as entrenched, with a relatively low gradient (1.4%), and only 84% streambank stability due to cattle grazing impacts (Andersen and Maroney 2001c, pg. 28). An F4 channel type is a gravel dominated, entrenched, meandering channel, deeply incised in gentle terrain with a gradient <2% (Rosgen 1996, pg. 5-154).

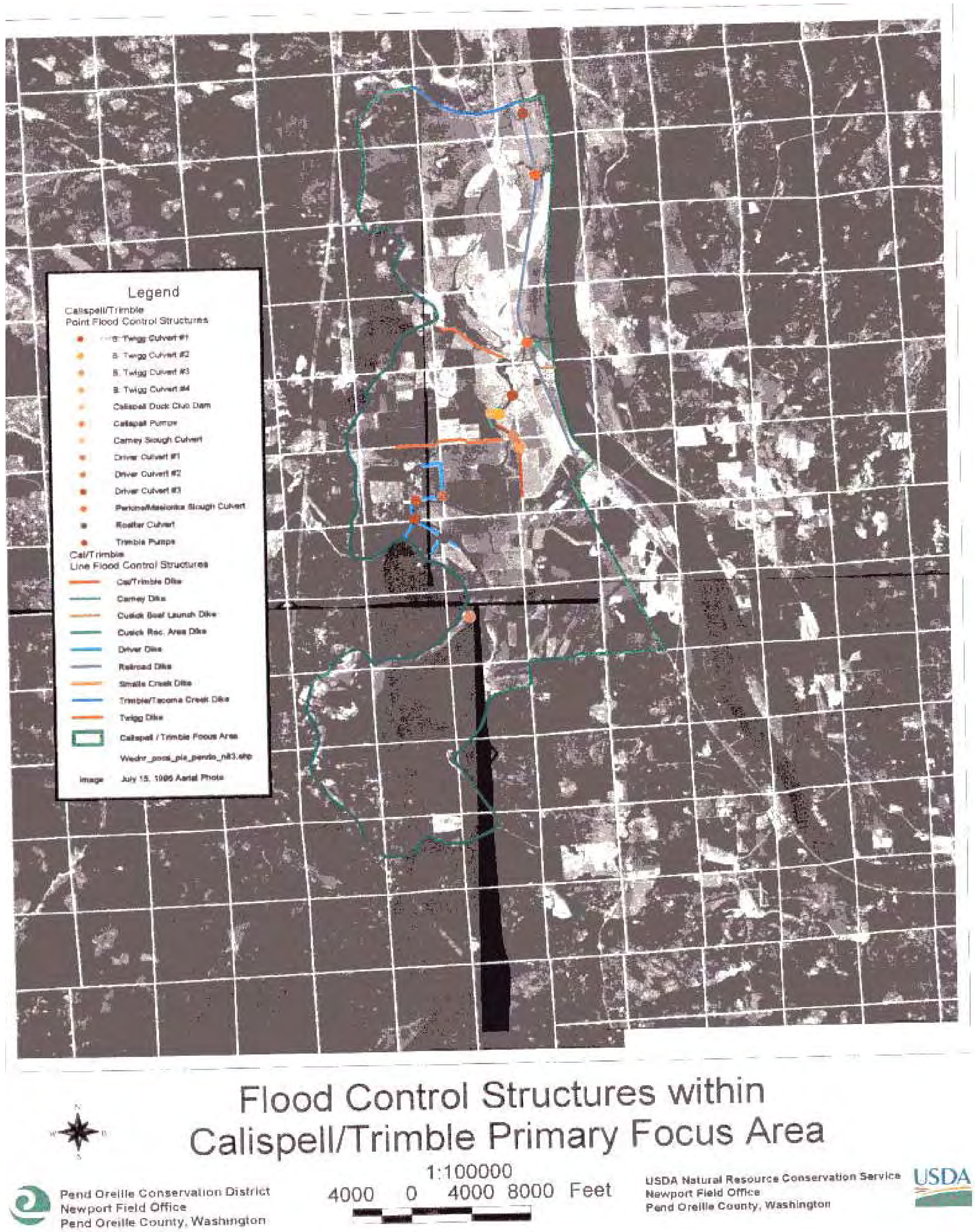
Winchester Creek, Dorchester Creek, and upper Smalle Creek drainages. These drainages have similar bank stability issues throughout the upper areas. Remnant abandoned road systems within the riparian areas are extensive throughout Winchester Creek watershed. However, bank stability was very high with an average 99% stability recorded from RM 1.25 upstream to the natural chute/cascade barrier at about RM 10.5 (Andersen and Maroney 2001b, pg 26). Smalle Creek tends to flow through more wetland areas in the middle reach and its banks tend to be less well defined (DE&S 2001b).

N. Fk. Calispell, M. Fk. Calispell, and S. Fk. Calispell creeks. Streams in these drainages all have relatively stable banks in the upper forested areas. Areas of active erosion from timber operations, cattle grazing and recreation can be found throughout but are generally located in isolated areas (Andersen and Maroney 2002a, b, c).

Floodplain Connectivity

Calispell Creek. In 1909 the Idaho and Washington Northern Railroad constructed a rail line on the west side of the Pend Oreille River. Part of the railroad embankment still serves as a dike in this reach of the river during flood conditions. Because the railroad embankment did not follow the Pend Oreille River the entire length of the floodplain in this reach, additional dikes were constructed over the years along the river. An interior diking system was also constructed (Figure 3). Maximum river elevation in this reach is set by Box Canyon Dam operations. When the Pend Oreille River elevation is higher than the Calispell River and Trimble Creek elevations, floodgates drop to prevent Pend Oreille floodwaters from entering the floodplain in the vicinity of Calispell and Trimble creeks. However, the floodgates also prevent free flow from Calispell and Trimble Creeks from entering the Pend Oreille River. Flow from Calispell and Trimble creeks then has to be pumped over the dikes into the river. Depending on runoff volume, the pumps may not be able to keep up with the water volume. Consequently, local runoff water levels may rise in Calispell and Trimble creeks, eventually topping their banks (POCD 2001a, pg. 6, 11).

Figure 3: Flood Control Structures, Calispell/Trimble Primary Focus Area



Lower Calispell and lower Smalle Creek. The W. Calispell Creek Road alters the flow of flood waters entering the Calispell flats area (TAG 2002).

Calispell Creek. From RM 7.5 upstream to the Power Creek confluence, some rural development and site work for the powerhouse have negatively impacted floodplain function in the floodplain (TAG 2002).

Smalle Creek. The lower 2,730 m (1.7 miles) of Smalle Creek is classified as a Rosgen F3b type channel with impacts from cattle grazing and excess sediment delivery from the upper drainage contributing to its classification (Andersen and Maroney 2001c, pg. 21). A Rosgen F3 channel type is a cobble dominated, entrenched, meandering channel, deeply incised in gentle terrain with a gradient of 2-4% (Rosgen 1996, pg. 5-151). An "F" stream type is often described as working towards re-establishment of a functional floodplain inside the confines of a channel that is consistently increasing its width. "F" channel types are deeply incised in valleys of relatively low elevational relief, containing highly weathered rock and/or erodible materials (Rosgen 1996, pg. 4-10).

E. Fk. Smalle Creek. The lower 1,920 m (1.2 miles) of E. Fk. Smalle Creek is classified as an F4 channel type. It is described in the KNRD habitat survey report as entrenched, with a relatively low gradient (1.4%), and only 84% streambank stability due to cattle grazing impacts (Andersen and Maroney 2001c, pg. 28). An F4 channel type is a gravel dominated, entrenched, meandering channel, deeply incised in gentle terrain with a gradient <2% (Rosgen 1996, pg. 5-154).

Channel Stability

Lower Calispell Creek. The soil types, topography and adjacent land use all contribute to the altered channel conditions, however active channel migration was only observed in the lower end of Smalle Creek where major bank sloughing was observed (A. Scott, Framatome ANP, pers. observation, 2001).

Calispell WAU upstream of Calispell Lake. No identified concerns of channel instability were included in the literature or by professional knowledge for any of the creeks in the upper Calispell watershed (above Calispell Lake). In their extensive habitat inventories done on the North, Middle and South Forks of Calispell Creek, the Kalispel Tribe's Natural Resource Department (KNRD) regularly reported bank stability, which appears to be an important part of channel stability. The bank stability percentages estimated by KNRD on over 30 sampling sites throughout the upper Calispell Creek watershed were all found to be at acceptable according to current standards (Andersen and Maroney 2002a, b, c).

Smalle Creek. The lower 2,730 m (1.7 miles) of Smalle Creek is classified as an F3b type channel with impacts from cattle grazing and excess sediment delivery from the upper drainage contributing to its classification (Andersen and Maroney 2001c, pg. 21).

An F3 channel type is a cobble dominated, entrenched, meandering channel, deeply incised in gentle terrain with a gradient of 2-4% (Rosgen 1996, pg. 5-151). An "F" stream type is often described as working towards re-establishment of a functional floodplain inside the confines of a channel that is consistently increasing its width. "F" channel types are deeply incised in valleys of relatively low elevational relief, containing highly weathered rock and/or erodible materials (Rosgen 1996, pg. 4-10). Active channel migration was only observed in the lower end of Smalle Creek where major bank sloughing was occurring (A. Scott, Framatome ANP, pers. observation, 2001).

E. Fk. Smalle Creek. The lower 1,920 m (1.2 miles) of E. Fk. Smalle Creek is described in the KNRD habitat survey report as entrenched, with a relatively low gradient (1.4%) and only 84% streambank stability due to cattle grazing (Andersen and Maroney 2001c, pg. 28). The reach is classified as an F4 channel type (Andersen and Maroney 2001c, pg. 28) which is a gravel dominated, entrenched, meandering channel, deeply incised in gentle terrain with a gradient <2% (Rosgen 1996, pg. 5-154). An "F" stream type is often described as working towards re-establishment of a functional floodplain inside the confines of a channel that is consistently increasing its width. "F" channel types are deeply incised in valleys of relatively low elevational relief, containing highly weathered rock and/or erodible materials (Rosgen 1996, pg. 4-10).

Habitat Elements

Channel Substrate

Note: Although the documents themselves nor full citations for the documents were not made available in time for inclusion in the habitat limiting factors assessment prior to publication, the following Washington Department of Natural Resources (WDNR) documents deserve mention here to the extent they may prove beneficial for future habitat evaluation and planning efforts in the Calispell Creek watershed: Winchester Creek WAU Road Maintenance and Abandonment Plan (RMAP). The document is a matter of public record and can be found at the WDNR Northeast Regional Office in Colville, WA (Stimson 1/29/03 final draft report review comments, February 2003).

Watershed-wide. KNRD noted in its habitat inventories of North, Middle and South Forks of Calispell Creek that most of their habitat improvement recommendations were to combat fine sediment deposition and substrate embeddedness (Andersen and Maroney 2002a, b, c).

Calispell Creek. Downstream of Calispell Lake (RM 0.0 – 6.1), the flow and gradient are not sufficient during most of the year to move existing sediment loads (DE&S 2000). Because of this, the channel is wide and shallow with expansive areas of silt and sand deposits (DE&S 2001b).

Calispell Lake. Nearly all sediment transport from South Fork Calispell Creek along with Winchester and Dorchester creeks is captured in Calispell Lake. Power Lake has undoubtably trapped some proportion (perhaps most) of the sediment transported down the North and Middle Forks of Calispell Creek since 1921, although it is possible that the trapping efficiency of the 62 surface acre Power Lake has decreased through time as available sediment storage has been filled. Sediment delivery to streams from mass wasting events, harvest activities, agricultural sources, stream channel instability, and roads is insignificant compared to the natural background rate of erosion, with roads being the largest source of accelerated sediment delivery to streams in the Calispell Creek watershed (14% delivery rate of natural). This rate of delivery from roads is relatively low compared to other watersheds in the region and no "problem" roads that contribute a disproportionately large amount of sediment due to poor location or condition were observed. Substantial sources of accelerated sedimentation of Calispell Lake have not been identified so it is uncertain whether or not the lake has been filling during recent years (POPUD 2000a, pg. 9-11). In conversation with the Calispell Duck Club mgr, Andrew Scott was told aerial photos taken in the 1960s, when compared to photos from the 1980s, show former channels within the lake no longer exist due to increased sediment loads and reduced flushing flows (A. Scott, Framatome ANP, pers. comm. w/ Calispell Duck Club manager, 2001).

Smalle Creek. In the lower 2,730 m (1.7 miles), a reach grazed by cattle, embeddedness was recorded at 47 % with very stable streambanks (96% stability; Andersen and Maroney 2001c, pg. 21). Embeddedness rates for the remaining stream length upstream to the natural barrier were also high with a couple of reaches recorded to have 92% embeddedness.

E. Fk. Smalle Creek. In the lower 1.2 miles, with a gradient of 1.4%, embeddedness was recorded to be 65%. The reach immediately upstream, with a gradient of 2-4% had a recorded embeddedness rate of 69% (Andersen and Maroney 2001c, pg. 28).

Winchester Creek. There were high levels of fine sediment in all reaches surveyed by KNRD biologists from RM 1.24 – 10.5 (Andersen and Maroney 2001b, pg 21).

Graham Creek. Substrate embeddedness in the lower 0.8 mile, A3 channel type, was fair with 46% embeddedness recorded. The lower part of the reach had an old roadbed adjacent to the channel that was observed to be eroding and contributing sediment to the channel. Near the mouth, a man-made pond with an earth dam recently existed. Unstable banks were observed in the old pond bottom and dam. Three stand pipes had been washed out of the dam (Andersen and Maroney 2001b, pg. 26). From RM RM 0.8-1.5, in an A4 channel type, 51% embeddedness was recorded (Andersen and Maroney 2001b, pg. 25). Both A3 and A4 channel types have gradients from 4-10%, however an A3 channel type has a cobble channel bed and an A4 channel type has a gravel channel bed (Rosgen 1996, pg. 5-6). Typically "A" type channels exhibit a high sediment transport potential and a relatively low in-channel sediment storage capacity. "A" channel types are typically described as step/pool channels (Rosgen 1996, pg. 4-6).

N. Fk. Calispell Creek and S. Fk. Calispell Creek. Habitat inventory studies conducted in 2001 by KNRD found that the N. Fk. and the S. Fk. of Calispell Creek, upstream of RM 1.5, were actively transporting limited amounts of sediment from several sources (i.e., timber operations, cattle grazing, recreation) but overall embeddedness was at acceptable levels (Andersen and Maroney 2002a,b,c). Approximately 35% of the reaches surveyed on N. Fk. Calispell were at or exceeding substrate embeddedness threshold levels for salmonid reproduction (Andersen and Maroney 2002a,b).

M. Fk. Calispell Creek. The Middle Fork Calispell appeared to be a more active contributor of sediment from its headwater areas. The USFS found that 18 of 29 survey reaches in the upper Calispell drainage had embeddedness levels greater than 35% (USFS 1999, pg 9). Over 60% of the reaches surveyed by KNRD were at or exceeding substrate embeddedness threshold levels for salmonid reproduction (Andersen and Maroney 2002 a,b).

Large Woody Debris

Upper reaches of drainages, WAU-wide. Large woody debris (LWD) has not been surveyed for all tributaries in the Calispell Creek watershed. However, a number of studies done in various tributaries within the drainages indicates that LWD is available throughout the entire upper drainages but in varying quantities. The USFS noted that LWD exceed 20 pieces per mile in 26 of 29 reaches surveyed on Calispell Creek and felt that this level indicated that for LWD, this attribute was functioning properly (USFS 1999ad, pg. 9). The trend in most all of the tributaries was for LWD to be greatest in the least disturbed areas and higher up in the watersheds.

Calispell Creek. Large woody debris is absent in the lower 6 miles of Calispell Creek (TAG 2002).

Calispell Creek. Large woody debris is low from RM 7.5 upstream to the Power Creek confluence (A. Scott, Framatome ANP, pers. comm., 2002).

Smalle Creek. LWD was found to be moderate to low as the creek emerged from the upper forested watershed DE&S 2001b). Upon entering the floodplain of Calispell Creek, LWD levels in Smalle Creek rapidly declined as did tree presence. Within a mile of its confluence with Calispell Creek, LWD was absent in Smalle Creek (DE&S 2001b). Large woody debris as measured by KNRD methodology was low in the lowest 1.7-mile, low gradient reach of Smalle Creek (Andersen and Maroney 2001c, pg. 21).

Smalle Creek. KNRD found LWD levels to be moderate to high in upper portions of Smalle Creek (Andersen and Maroney 2001c, pg. 22). The USFS found LWD levels to be good in Smalle Creek (USFS 1992 stream survey, K. Honeycutt, USFS, pers. comm., 2002).

Winchester Creek. Both KNRD and DE&S biologists evaluated LWD in Winchester and Dorchester creeks. KNRD looked at approximately 9.5 miles from RM 1.25 – 10.5 and DE&S looked at the lower 1.7 miles of Winchester Creek from Calispell Lake upstream. Both surveys found LWD to be high in the majority of sites sampled (Andersen and Maroney 2001b, pg. 19-22; DE&S 2001b). Stream reaches surveyed included both A and B channel types and one 1.7-mile long C4 channel type reach located about two miles upstream from the mouth (Andersen and Maroney 2001b, pg. 19-22.). The stream channel from the mouth upstream to about RM 0.5 (surveyed by DE&S) is in a very low gradient area. LWD tended to decrease in quantity as the stream approached the lake.

Calispell Lake. Calispell Creek becomes devoid of LWD as it enters Calispell Lake. Recruitment of LWD is nonexistent in the lake and below the lake to its confluence with the Pend Oreille River (DE&S 2001b).

Power Creek. There is no potential for recruitment of LWD to stream reaches downstream of Power Lake Dam (A. Scott, Framatome ANP, pers. comm., 2002).

S. Fk. Calispell Creek. DE&S surveyed approximately 4.3 miles of the South Fork Calispell Creek, upstream from its confluence with Power Creek (RM 1.5). From the Power Creek confluence upstream to Rocky Gorge Road, LWD was found in low to moderate quantities (DE&S 2001b). Isolated sections did contain high LWD densities but they were sparsely scattered throughout the stream corridor.

Upper S. Fk. Calispell Creek and two tributaries. LWD levels were evaluated at five sites by KNRD in the upper-most reaches of these streams. LWD was found at only moderate levels in four of the five sites.

N. Fk. Calispell Creek. Six of 18 reaches surveyed along the main branch had less than 20 pieces/mile of LWD (Andersen and Maroney 2002b).

M. Fk. Calispell Creek and five tributaries. Thirteen of 28 reaches evaluated for LWD had low levels of LWD (Andersen and Maroney 2002a). Low amounts of LWD were typically encountered in the lower portions of these forested watersheds. The USFS noted that reaches along the M. Fk. Calispell Creek were deficient of LWD where dispersed recreational use was heavy (USFS 1999ad, pg 9).

Pool Frequency and Quality

WAU-wide. Pool Frequency (PF) has not been surveyed for all tributaries in the Calispell Creek watershed. A number of surveys conducted on various tributaries within this drainage indicate that PF is moderate to high in the majority of reaches surveyed (Andersen and Maroney 2002a,b,c). In contrast, the USFS noted that PF in most tributaries surveyed in the Calispell watershed were well below the expected range of 39-60 pools/mile for properly functioning tributaries of these sizes (USFS 1999ad, pg. 9).

Calispell Creek. Pool frequency is poor on Calispell Creek from RM 7.5 to the Power Creek confluence (A. Scott, Framatome ANP, pers. comm., 2002).

Smalle Creek. From the mouth upstream to W. Calispell Creek Road there are no pools (A. Scott, Framatome ANP, pers. comm., 2002).

Smalle Creek. From RM 5.3 upstream to RM 7.3 (Smalle Creek falls) pool frequency is poor (USFS 1999 stream survey, K. Honeycutt, USFS, pers. comm., 2002).

Smalle Creek. The KNRD reported an average 12.3 pools/mile for Smalle Creek from the W. Calispell Creek Road upstream to Smalle Falls at RM 7.3 for which the average width is 12.8 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

E. Fk. Smalle Creek. The KNRD reported an average 8.5 pools/mile for E. Fk. Smalle Creek in the lower 3.7 miles where the average width is 12.5 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003). From RM 2.0 upstream to the natural barrier at RM 3.7, pool frequency was low (A. Scott, Framatome ANP, pers. comm., 2002).

Winchester Creek. KNRD looked at 11 reaches within 9.5 miles (starting at RM 1.25). KNRD found primary pools to be about equally divided between low, moderate and high frequency among stream reaches that included A and B channel types and one 1.7-mile long C4 channel type reach located about two miles upstream from the mouth. The stream reach with one of the highest primary pool frequencies in the surveyed portions of Winchester Creek (stream reach 9 with 22.9 pools/km) was a 0.65-mile long B3 channel type that also had the lowest recorded acting LWD (Andersen and Maroney 2001b, pg. 19-22). DE&S looked at approximately 1.7 miles of Winchester Creek from Calispell Lake upstream and observed no trend in primary pools in the reaches except that the amount of LWD directly affected the primary pool frequency in the lower 1.7 miles surveyed (DE&S 2001b). Pool frequency from RM 5.4 – 9.8, as surveyed by the USFS was found to be low (USFS 1990 stream survey, K. Honeycutt, USFS, pers. comm., 2002).

Graham Creek. Pool frequency was low in the lower 1.3 miles surveyed (Andersen and Maroney 2001b, pg. 24).

S. Fk. Calispell Creek. DE&S surveyed approximately 4.3 miles of S. Fk. Calispell Creek from its confluence with Power Creek (RM 1.5) upstream to Rocky Gorge Road . Although pool frequency was evaluated, pool quality was not. PF was low in the lower section below its confluence with Power Creek (DE&S 2001b). Above the Power Creek confluence with S. Sk. Calispell Creek (RM 1.5), PF becomes moderate until reaching the dewatered section (RM 3.0). Upstream of this area, PF again becomes low as the stream exits the forest area and flows through a large open treeless marsh (DE&S 2001b).

M. Fk. Calispell Creek. All ten reaches ranked high for PF (Andersen and Maroney 2002a).

Pool Depth

WAU-wide. The USFS noted that road maintenance on USFS roads was an active source of sediment in many forested streams. They noted that this additional sediment input combined with other human-induced sources appears to cause degraded pool habitat in much of the Calispell Creek watershed (USFS 1999ad, pg. 14).

Lower Calispell Creek and lower Smalle Creek. Pools were very limited in number. Pools that were observed were filled with fine silts and sand from active bank erosion and upstream sources (DE&S 2001b).

Smalle Creek. Overall, pool depth is fair in Smalle Creek on reaches surveyed by the USFS (USFS 1992 stream survey, K. Honeycutt, USFS, pers. comm., 2003). The KNRD reported only seven pools greater than one meter deep between W. Calispell Road and RM 7.3 at Smalle Falls on Smalle Creek which has an average width of 12.8 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

E. Fk. Smalle Creek. From RM 2.0 upstream to the natural barrier at RM 3.7, there were no pools over three feet deep (USFS 1993 stream survey, K. Honeycutt, USFS, pers. comm., 2002). The KNRD reported seven pools greater than one meter deep in the lower 3.7 miles of E. Fk. Smalle Creek which has an average width of 12.5 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Winchester Creek. Although Dorchester and Winchester creeks appeared to have somewhat more stable riparian habitat, sediment recruitment and deposition were still observed in many areas along the surveyed reaches (DE&S 2001b). The KNRD reported few pools greater than one meter deep (4 pools) in the lower 10.1 miles of Winchester Creek which has an average width of 12.8 feet (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Off-Channel Habitat

Lower Calispell Creek. Lower Calispell Creek, from Calispell Lake downstream to the Pend Oreille River, provides limited off-channel habitat. Various efforts such as diking, channelization and damning to reduce flooding have left poor habitat in this area of the stream (POCD 2001a pg. 11-13; DE&S 2001b).

Lower Smalle Creek. Some side channels and backwater areas were observed immediately below County Road 9205 where Smalle Creek flows into a small wetland (DE&S 2001b). Below the wetland, the stream is heavily impacted by adjacent land use and past efforts to control flooding which minimized off-channel habitat (A. Scott, Framatome ANP, pers. comm., 2002).

Calispell Lake. Calispell Lake does provide abundant off-channel habitat during periods of high flow (DE&S 2001b). However, when water levels drop rapidly, off-channel areas may strand juvenile bull trout given the dense vegetation and sedimentation (POCD 2001a, pgs 11-13; DE&S 2001b).

Calispell Creek. From RM 7.5 upstream to the Power Creek confluence, there is some off-channel habitat, although it is not frequent (A. Scott, Framatome ANP, pers. comm., 2002).

Water Quality

Temperature

WAU-wide. Water temperature data is sporadic for Calispell Creek and its tributaries. The USFS and the KNRD have monitored temperatures at various locations throughout past years.

Calispell Creek and Calispell Lake. Low velocities and a complete lack of instream or riparian cover likely contribute to high temperatures and low oxygen levels in the summer, and offer no protection from avian or piscivorous predators. The reach of Calispell Creek from the Duck Club Dam downstream to the first road crossing is heavily impacted by cattle pasturing and grazing, with creek bank damage evident. High instream temperatures and low oxygen levelscombined may act as seasonal barriers for migration to and from the Pend Oreille River even if the Calispell pumps were retrofitted to provide passage (DE&S 2001b, pg. 2).

Calispell Lake. From September 1 through September 30, 1999 and from October 1 through October 4, 1999, DE&S biologists installed thermographs at the inlet and outlet of Calispell Lake. A third thermograph installed near the Calispell pumps was stolen. The average temperature in September at the lake inlet was 11.2°C with a maximum recorded temperature of 14.5°C and a minimum recorded temperature of 7.6°C. The average temperature in September at the lake outlet was 16.2°C with a maximum recorded temperature of 20.9°C and a minimum recorded temperature of 10.0°C. Water temperatures flowing into Calispell Lake from the S. Fk. Calispell Creek in 1999 were quite cool indicative of habitat suitable for maintaining populations of resident cold-water trout species (POPUD 2000b, pg. 7, Table 3).

Smalle Creek. The USFS found water temperatures taken at the USFS boundary ranged from 0 °C (32 °F) on October 28, 1991 to 14 °C (57.2 °F) July 19, 1992 (USFS 1999ad, pg 7). KNRD also monitored temperatures on Smalle Creek. From mid-July to mid-September 2000, thermographs were placed at a lower, middle and upper station on Smalle Creek. Stream temperatures remained relatively cool at the upper two sites. Maximum summer stream temperatures in the upper and middle sites were approximately 13°C (55.4°F) and 15°C (59°F), respectively (Andersen and Maroney 2001c, pg 16). Summertime stream temperatures were warm in lower Smalle Creek. In late July and early August, daily maximum temperature exceeded 19°C (66.2 °F) ten times (KNRD 2001c, pg.16), however a 7-day maximum average could not be calculated from the information provided in the report. From July 23 to October 28, 2002, the USFS deployed a thermograph at the USFS boundary. The 7-day average maximum temperature during the period of record was 14.2°C; the maximum temperature for the period of record was 15.0°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

Smalle Creek. The KNRD reported a 7-day average maximum instream temperature of 19.16°C in Smalle Creek between W. Calispell Road and RM 7.3 at Smalle Falls occuring from August 3 through August 9, 2000 (T. Andersen, KNRD, email comm., Jan.

6, 2003). The exact location of the thermograph and the period of record were not provided.

E. Fk. Smalle Creek. Water temperatures recorded approximately one mile downstream from the USFS boundary on E. Fk. Smalle Creek ranged from 1°C (33.8 °F) on October 28, 1991 to 17°C (62.6 °F) on June 10, 1992 (USFS 1999ad, pg 7).

E. Fk. Smalle Creek. From July 18 to mid-September 2000, instream temperatures were recorded at an upper and a lower thermograph site on E. Fk. Smalle Creek. Stream temperatures at the upper site never exceeded 14°C, but at the lower site, daily maximum temperatures were near or exceeded 18°C for a two-week period in late July and early August (Andersen and Maroney 2001c, pg. 23). The 7-day average maximum instream temperature was 20.4°C recorded at the lower site and occurred from September 25 through October 1, 2000 (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Winchester Creek. The USFS reported water temperatures approximately 0.5 miles upstream of the Forest boundary on Winchester Creek ranged from 0 °C (32°F) on January 22, 1991 to 14 °C (57.2 °F) on July 24, 1990 (USFS 1999ad, pg. 7). Plum Creek Timber Company biologists surveyed portions of Winchester Creek during July 1994. Temperatures ranged from 11°C (51.8°F) to 18°C (64.4°F; DE&S 2000). KNRD monitored temperatures on Winchester Creek from July 18 – September 21, 2000 using thermographs at a lower, middle and upper station. Stream temperatures remained relatively cool at the upper two sites. Maximum summer stream temperatures in the upper and middle sites were approximately 14°C and 16°C, respectively. Summertime stream temperatures were a bit warmer in lower Winchester Creek. In late July and early August, daily maximum temperature exceeded 16°C to over 17°C (Andersen and Maroney 2001b, pg.16). A 7-day maximum average could not be calculated from the information provided in the report. From July 23 to October 28, 2002, the USFS deployed a thermograph at the USFS boundary in lower Winchester Creek. The 7-day average maximum temperature during the period of record was 15.3°C; the maximum temperature for the period of record was 16.4°C (K. Honeycutt, USFS, email comm., Jan. 6, 2003).

Winchester Creek. The KNRD reported a 7-day average maximum instream temperature of 16.9°C in the lower 10 miles of Winchester Creek occuring from July 31 through August 6, 2000 (T. Andersen, KNRD, email comm., Jan. 6, 2003). The exact location of the thermograph and the period of record were not provided.

Power Creek. Relatively wide fluctuations of stream temperature were observed below Power Lake (KNRD 2001a, pg 30).

S. Fk. Calispell Creek and Dorchester Creek. No water temperature data available.

N. Fk. Calispell Creek. Except for the headwater areas, stream temperatures were relatively warm in N. Fk. Calispell Creek (KNRD 2001a, pg 30). Temperatures recorded above Power Lake showed summer maximum stream temperature of 20.3°C (68.5 °F), with 20°C (68 °F) exceeded only one day during the summer. Stream temperatures in N. Fk. Calispell Creek just upstream of the confluence of the M. Fk. Calispell were cooler than the upstream and downstream sites, with maximum summer stream temperature 18.7°C (65.6 °F). In 2001, the highest stream temperatures recorded in N. Fk. Calispell Creek were at a site located upstream of the confluence of Gletty Creek. The summer maximum temperature was 21.0°C (69.8 °F) and temperatures exceeding 20°C (68 °F) were recorded on five different days. Temperatures near the headwaters remained relatively cool throughout the summer, with the highest stream temperature recorded at the headwaters site 11.2°C (52.2 °F; Andersen and Maroney 2002b, pg 36). The USFS found that water temperatures at the mouth of the N. Fk. Calispell Creek ranged from 2 °C (36 °F) on November 25, 1974 to 14 °C (57 °F) on June 7, 1970 in Calispell Creek (USFS 1999ad, pg 7).

M. Fk. Calispell Creek. The USFS found water temperatures at the mouth ranged from 2°C (36°F) on November 4, 1992 to 15°C (59°F.) on July 19, 1992. Water temperatures taken approximately 1 mile upstream from the mouth reached 16 °C (60.8°F) on July 9, 1979 and July 24, 1980 (USFS 1999ad, pg 7). KNRD biologists found stream temperatures in M. Fk. Calispell Creek and tributaries were not as warm as in the neighboring N. Fk. Calispell Creek watershed (Andersen and Maroney 2002a, pg 36). The thermograph located in lower M. Fk. Calispell Creek recorded the highest stream temperatures in the drainage. Maximum daily stream temperatures exceeded 18°C (64.4 °F) on five occasions in 2001. Although daily mean temperatures never exceeded 17°C (62.6 °F) at this site, daily means exceeded 15°C (59 °F) on 22 different days throughout the summer. The thermograph located in the headwaters of M. Fk. Calispell Creek never recorded a stream temperature higher than 14 °C (57.2 °F). The various tributaries KNRD looked at in the M. Fk. drainage were similar with daily maximums ranging from 14 °C to 17 °C (57.2 to 62.6 °F; Andersen and Maroney 2002a, pg 36).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Watershed-wide. There is limited flow data on the Calispell Creek watershed. The high density of roads and high level of acreage in open condition on private lands within the watershed may have a noticeable effect on the natural flow regime. However, not enough information is available for to make a conclusive determination (USFS 1999, pg 10).

Calispell Creek. Dike construction in lower Calispell Creek has altered the natural flow regime. Currently, when the Pend Oreille River elevation is higher than Calispell Creek, flood dike gates drop, preventing back flow from the Pend Oreille River into the Calispell

Creek system but also preventing the free flow from Calispell Creek into the Pend Oreille River. Flow from Calispell Creek is then pumped over the dikes into the Pend Oreille River. Depending on runoff volume, the pumps may or may not be able to keep up with the inflow of water (POCD 2001a, pg. 6).

Calispell Lake. At RM 6.0 the Calispell Duck Club maintains a low-head dam at the outlet of Calispell Lake (DE&S 2001b, pg 2). Boards to regulate lake levels are installed in the dam at the start of September to bring water levels up in Calispell Lake, and removed when the lake begins to freeze, in an effort to keep open water (POCD 2001a, pg. 18).

Power Lake. Power Lake, on N. Fk. Calispell Creek, is a natural lake whose outlet was originally dammed in 1922 by the Delkenna Power Company for the purpose of hydropower generation. Power Lake, today at about 62 surface acres (Bennett and Liter 1991, pg. 6) is a small volume storage facility with a normal storage volume of 1000 acre feet (DOE Dam Safety Program). Elevation was increased approximately bout 20 feet with the installation of the dam at the Power Lake outlet (P. Buckley, POPUD, pers. comm., 2002). The N. Fk. Calispell Creek drainage upstream of Power Lake is is a large watershed 78,134 acres in size (Andersen and Maroney, 2002b, pg. 1). In the late 1950s, the POPUD purchased the Power Lake hydro-facililty from an owner that had purchased the facility from Delkenna Power some time in the past. In the early 1990s, the POPUD reinforced the dam and reconstructed the spillway to meet current safety standards (P. Buckley, POPUD, pers. comm., 2002).

S. Fk. Calispell Creek. In upper S. Fk. Calispell Creek there is a man-made pond with a dam and control structure. This alters the hydrology of S. Fk. Calispell Creek (A. Scott, Framatome ANP, pers. comm., 2002).

S. Fk. Calispell Creek. A spring flowing out of the hillside upstream of the natural boulder cascade barrier at RM 1.34, but some distance below RM 1.56 where S. Fk. Calispell Creek leaves the forest, supplies approximately half of the streamflow into S. Fk. Calispell (DE&S 2001b, pg. 4).

Species Competition

Non-indigenous Fish

Watershed-wide. The most wide-spread non-native species in the Calispell watershed is brook trout (Andersen and Maroney 2002a,b,c). Brook trout were planted and have naturally migrated into and established populations in many of the tributaries of the Calispell Creek drainage.

Calispell Creek. Brook trout have been observed and caught at various times throughout Calispell Creek at all times of the year, from upper Calispell Creek all the way downstream to the confluence of Calispell Creek and the Pend Oreille River (A. Scott, J. Blum, Framatome ANP, pers. comm., 2002). Brook trout were reported in creel surveys by the Washington Department of Game (now the Washington Department of Fish and Wildlife) prior to the constuction of Box Canyon Dam (POPUD 2000, pg. E3-3)

Calispell Creek and Calispell Lake. Exotic warmwater species present include largemouth bass, pumpkinseed sunfish, yellow perch, black crappie, brown bullhead, yellow bullhead, tench and brown trout (DE&S 2000, pg E3.6). These species are primarily found in Calispell Lake and downstream to the confluence with the Pend Oreille River. Warm water fish were reported in creel surveys by the Washington Department of Game (now the Washington Department of Fish and Wildlife) prior to the constuction of Box Canyon Dam (POPUD 2000, pg. E3-3).

Smalle Creek. During the 2000 field survey season, brook trout were the only fish species observed at snorkel stations (Andersen and Maroney 2001c, pg. 16).

E. Fk. Smalle Creek. During a fish survey of the lower 8.5 miles of E. Fk. Smalle Creek in 2000, brook trout were observed only downstream of the natural barrier at RM 3.7 (Andersen and Maroney 2001c, pg. 23).

Winchester Creek. Brook trout were observed throughout snorkeled reaches of Winchester Creek (Andersen and Maroney 2001b, pg. 16).

Graham Creek. During the KNRD habitat survey of the lower 1.3 miles of Graham Creek during the 2000 field season, no snorkeling surveys were conducted because the stream was too small to accommodate a snorkeler. Using observations from streambanks, only cutthroat trout were observed in Graham Creek. A dam, used to create a pond near the mouth of Graham Creek, appeared to have recently either failed or been removed. No other barriers were observed in the lower 1.3 miles of Graham Creek and this dam may have served as a barrier at one time, keeping brook trout from colonizing Graham Creek given that brook trout are known to occur in Calispell Creek (Andersen and Maroney 2001b, pg. 25). In 2001, however, an electrofishing survey found brook trout in Graham Creek (T. Andersen, KNRD, pers. comm., 2002).

Power Creek. Brook trout are known to occur in Power Creek (A. Scott, Framatome ANP, pers. comm., 2002).

N. Fk. of Calispell Creek, M. Fk. of Calispell Creek, and S. Fk. of Calispell Creek. Brook trout are known to occur (Andersen and Maroney 2002a,b,c).

Calispell Creek Watershed Fish Distribution and Use.

Calispell Creek flows into the Box Canyon Reservoir reach of the Pend Oreille River. Bull trout are not known currently to occur in the Calispell Creek Watershed, therefore Table 19 below, which describes current, known bull trout use in the Calispell Creek Watershed is blank for bull trout. Maps in Appendix C illustrate “Recoverable” bull trout habitat. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Although by name ("char", the term historically applied to bull trout), there is no historic documentation of the occurrence of bull trout in the Calispell Creek Watershed, the Kalispel Tribe believes historic bull trout occurrence has been documented in the Calispell Creek Watershed based on information contained in field notes taken by A.H. Smith from 1936-1938 (Lyons 2002). Lyons states that in his notes, Smith described the capture of "trout" in traditional Kalispel fishing weirs placed at the mouth of Calispell Creek in late summer. The Kalispel Tribe contends that documentation of the capture of "trout" historically in Calispell Creek at the mouth in late summer infers the presence of a bull trout population in the drainage (Lyons 2002). In reprints of Smith's 1936-1938 notes contained in court documents (Smith 1983), Smith described the construction of a large, traditional, tribal weir at the mouth of Calispell Creek each year, one in summer, at which time the fishing lasted until the first of August, and another one in autumn. Smith noted that all kinds of small fish, including trout, were trapped there in greater numbers than at any other weir site.

Given the knowledge of salmonid biology and behavior, the historic use by bull trout of the mainstem Pend Oreille (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), and a lack of natural barriers at the tributary mouth, it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. Presently, for all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years.

Table 19: Current, known bull trout use in the Calispell Creek Watershed**.** (Table is blank for bull trout since there are no current, known observations of bull trout in the Calispell Watershed).

Tacoma Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Calispell Creek					X
Smalle Creek					X
E. Fk. Smalle Creek					X

Calispell Lake					X
Winchester Creek					X
Graham Creek					X
Power Creek					X
S. Fk. Calispell Creek					X

Calispell Creek Watershed Summary.

The barrier at the pumping station at RM 0.5 on Calispell Creek is the most limiting factor to sustaining bull trout populations in the Calispell Creek watershed. The watershed currently can not support an adfluvial bull trout life history forms due to lack of fish passage at the pumping station located near the confluence with the Pend Oreille River. Bull trout have not been documented as occurring currently in the Calispell Creek watershed. The extent to which bull trout could have successfully utilized Calispell Creek watershed habitat historically is not clear based on existing information. There were no known full, natural blockages historically to prevent fish passage between the Pend Oreille River and the Calispell Creek watershed. There is historical documentation that the Calispell drainage was one of the main tribal fisheries sites in the lower Pend Oreille River where great numbers of trout (although not char by name) and small fish were documented as being captured there annually, both in summer and fall (Lyons 2002; Allan Smith 1983, Petitioner's Exhibit 65 of Kalispel Tribe v. United States, pg. 286).

Given passage at the pumps, degraded habitat conditions on Calispell Creek from the mouth upstream to Calispell Lake may act in combination to immediately create seasonal barriers for migration to and from the Pend Oreille River. The low flows and a complete lack of instream or riparian cover likely contribute to high temperatures and low oxygen levels in the summer, and offer no protection from avian or piscivorous predators. The reach of Calispell Creek from the mouth to the lake is heavily impacted by cattle pasturing and grazing, with creek bank damage evident (DE&S 2001b, pg. 2). The extent to which the Cusick flats area once naturally supported a woody vegetation component (shrub and tree species) in the riparian zone is disputed. Based on personal observation by farmers and landowners who have resided in the valley dating back to the late 1800's, Calispell Creek has never had a canopy of woody shrubs or trees (POCD, written correspondence, Feb. 26, 2003).

Some tributaries to Calispell Creek could support resident and adfluvial life history forms of bull trout given access to the Pend Oreille River, however several major barriers restrict access into tributaries within the watershed. On Smalle Creek, there is a natural barrier falls at RM 7.3, however the lower 5 to 7 miles of Smalle Creek appear to be accessible from Calispell Lake. Winchester and Dorchester creeks have human-made barriers near their mouths that preclude adfluvial fish migration (POPUD 2000b, pg. 10). The S. Fk. Calispell Creek appears to provide up to 1.5 miles of potential trout habitat free of migrational barriers before naturally dewatering for about 1,500 feet as flows decrease in the summer. Portions of the S. Fk. Calispell Creek channel stays dry most of the year until subsurface water levels increase (DE&S 2001b). The extensive tributary system of North and Middle Fork Calispell creeks, Tenmile Creek, and Power Lake cannot be accessed by adfluvial populations due to natural barriers on Power Creek (RM 0.2) between Power Lake and the S. Fk. Calispell Creek confluence (POPUD 2000b, pg. 10).

Nearly all sediment transport from South Fork Calispell Creek along with Winchester and Dorchester creeks is captured in Calispell Lake. Power Lake has undoubtably traped some proportion (perhaps most) of the sediment transported down the North and Middle Forks of Calispell Creek since 1921, although it is possible that the trapping efficiency of Power Lake has decreased through time as available sediment storage has been filled. However, sediment delivery to streams from mass wasting events, harvest activities, agricultural sources, stream channel instability, and roads is insignificant compared to the natural background rate of erosion, with roads being the largest source of accelerated sediment delivery to streams in the Calispell Creek watershed (14% delivery rate of natural). This rate of delivery from roads is relatively low compared to other watersheds in the region and no “problem” roads that contribute a disproportionately large amount of sediment due to poor location or condition were observed. Substantial sources of accelerated sedimentation of Calispell Lake have not been identified so it is uncertain whether or not the lake has been filling during recent years (POPUD 2000a, pg. 9-11). However, in conversation with the Calispell Duck Club manager, Andrew Scott was told aerial photographs taken in the 1960s, when compared to photos from 1980s, show former channels within the lake no longer exist. It is possible that increased sediment loads and reduced flushing flows have resulted in channel filling (A. Scott, Framatome ANP, pers. comm. w/ Calispell Duck Club manager, 2001).

Below Calispell Lake, the flow and natural gradient are not sufficient during most of the year to move existing sediment loads (DE&S 2000). The extent to which the dikes and flood control management in the Calispell Creek floodplain affect sediment transport, if at all, is not known. Presently, in the lower reach of Calispell Creek (downstream of Calispell Lake) the channel is wide and shallow with expansive areas of silt and sand deposits (DE&S 2001b). The lower Calispell Creek drainage below Calispell Lake flows through fine silty clay loam soils, which are easily suspended in the water column (POCD 2001a, pg 21). These areas are typically flat and intensively managed for grass hay production and livestock grazing (POCD 2001a, pg 28). Encroachment on the floodplain, primarily from agriculture, road building, and flood control practices (i.e.: pumping, diking, berming, channelization) have reduced floodplain function (POCD 2001a, pg 11-15). Soil types, land use, and flood water control measures have reduced the potential for LWD along the lower portions of Calispell Creek. Finally, DE&S biologists found very limited numbers of pools in lower Calispell and Smalle creeks. Those pools that were observed were filled with fine silts and sand from active bank erosion and upstream sources (DE&S 2001b).

The characteristic trend of the upper Calispell Creek tributaries is small and narrow with relatively steep gradients. Because of this, pool formation tends to be limited and those pools that are there tend to be small and shallow. However, the North and Middle forks of Calispell Creek showed the highest degrees of limited pool depths, primarily from sedimentation. The largest contributor of sediment in the Calispell basin was determined to be from forest roads in the upper watershed (POPUD 1999 cited in POCD 2001a, pg. 22). Studies conducted by Kalispel Tribe biologists found pool depths were greatly influenced by the amount of human activity (i.e., road building, cattle grazing, recreation) in the watershed (Andersen and Maroney 2002b, pg 35). Accordingly, the upper portions of the South Fork, where disturbances were minimal, also had the highest pool frequency and good depths for the size of the pools (Andersen and Maroney 2002c, pg. 24). Duke Engineering & Services (DE&S) also looked at several watersheds in the upper forested areas. Their surveys of the South Fork, Winchester and Dorchester creeks found similar problems with limited pool depths (DE&S 2001b). Their surveys indicated that man-made alterations that had greatly decreased pool depths due to sediment deposition had impacted the South Fork below Rocky Gorge Road. Although Dorchester and Winchester creeks appeared to have somewhat more stable riparian habitat, sediment recruitment and deposition were still observed in many areas along the surveyed reaches (DE&S 2001b).

Competition from non-indigenous populations of brook trout also presents a significant limiting factor to bull trout recovery in the Calispell Creek watershed. This is most problematic in the upper watershed, however the brook trout distribution is very widely distributed. Efforts to eliminate brook trout would be costly and need to be very thorough.

Calispell Creek Watershed Data Gaps.

- Accurate stream withdrawal data;

- stream channel habitat conditions, especially regarding water temperature, floodplain connectivity, channel substrate, and LWD transport and flow regimes on Calispell Creek from the mouth upstream to the S. Fk. Calispell Creek/Power Creek confluence;

- accurate extent of exotic species distribution within the watershed (POPUD 1/29/03 final draft report review comments, March 2003);

- lack of historical and current knowledge about bull trout presence/absence in Calispell watershed (POPUD 1/29/03 final draft report review comments, March 2003);

- present effects of Duck Club dam and Calipell Lake management on water quality, salmonid migration issues, salmonid habitat and sediment transport (POPUD 1/29/03 draft final report review comments, March 2003).

SKOOKUM CREEK WAU

Skookum Creek WAU Description

The Skookum Creek WAU encompasses approximately 59,339 acres and includes the Skookum (RM 73.2), Indian (RM 81.2), Marshall (RM 83.7) and Exposure (RM 86.0) creek drainages. Only the Skookum and Indian creek drainages, Indian Creek with an individual bull trout observation and both Indian and Skookum creek drainages with identified "Recoverable" bull trout habitat, will be presented in this report. Skookum Creek, the third largest tributary drainage to the Box Canyon reservoir (USFS 1999af, pg. III-716), drains in a southwesterly direction about 10 miles before it empties into the Pend Oreille at RM 73.2. Indian Creek, with a drainage basin area of 12 square miles, flows south approximately 2.3 miles (KNRD and WDFW 1997b, pg. 7) before it empties into the Pend Oreille River at RM 81.2 (Williams, et al. 1975). The Skookum and Indian creek drainages feed into the Box Canyon Reservoir portion of the Pend Oreille River entering from the east.Skookum Creek flows off USFS lands and meanders through nearly 5,000 acres of agricultural lands and residential areas before reaching its confluence with the Pend Oreille River at RM 73.2 (POCD 2002a, Introduction section). There is no livestock grazing on USFS lands within the Skookum Creek drainage (USFS 1999af, pg. III-730). The downstream reaches of Indian Creek are also in private ownership, and like the Skookum Creek drainage, land uses include grazing, agriculture, and residential development (USFS 1999af, pg. III-719).

Skookum Creek WAU Hydrogeomorphology

The underlying geology is dominated by hard metasediments. Just north of the Skookum Creek WAU, these hard rocks have created numerous short step peaks such as Half Moon Hill, Kings Mountain, Cee Cee Ah Peak, Cooks Hill, and Ojibway Knoll. The geology is faulted and generally the faults tend SE-NW and the cross-faults tend SW-NE. Most of the faults occur in the zone west of Cooks Mountain (Skookum Creek drainage) and Browns Lake (Cee Cee Ah Creek drainage), breaking this portion of the landscape up into small steep hills and valleys. About 11% (3,400 acres) of the Skookum Creek drainage is in a "blind" drainage (drainages do not flow overland into another drainage), all located in S. Fk. Skookum Creek (USFS 1996, pg. 15). Glacial, lacustrine and alluvial materials fill in the low lying areas. Numerous different terraces are evident, and the edges of the terraces are often steep. The main streams follow ancient fault lines with the gradient of each channel segment largely determined by the gradient of the terrace. Stream gradients are very flat for long distances as they flow along one terrace. The stream can then drop quickly to the next lower terrace creating a stream system that vacillates between steep and flat channel types (USFS 1996, pg. 1). The three primary stream channels in the Skookum Creek drainage (North Fork and South Fork Skookum Creek and Skookum Creek) have a well-defined floodprone area easily identified by highly errodable stream bank terraces (POCD 2002a, Introduction section). Indian Creek, which has no secondary tributaries and is spring fed, flows through relatively low gradients and is generally wide and shallow. A series of beaver dams are constructed at the mouth of this stream creating potential migration barriers (KNRD and WDFW 1997b, pg. 8).

The dominant erosion process appears to be surface erosion and ravel (including dry rockslides). Surface erosion is highest on the soils derived from granitic rock. Debris torrents and rotational landslides are rare. The lowest reaches of the streams flow through very erosive lacustrine and flood deposits (USFS 1996, pg. 4). The hydrology of the area is snow-pack dominated, and peak flows occur in the spring generally from May to early July. Rain-on-snow events are rare (USFS 1996, pg. 1) although during spring-time, in the higher elevations, some of the rainfall may fall on snow. Rapid spring run-off is sometimes accelerated by these rainfall events in the spring (USFS 1996, pg. 14).

Skookum Creek WAU Current Known Habitat Conditions

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Skookum Creek (62.0786). The culvert (Culvert_id # 118) at RM 9.4 at the USFS Rd. 5000541 creek crossing (road mile 6.8) is a full barrier to fish passage (USFS culvert barriers database, 2002, Newport Ranger District, Colville National Forest).

Indian Creek (62. 0836). A series of beaver dams are constructed at the mouth of this stream creating potential migration barriers (KNRD and WDFW 1997b, pg. 8).

Indian Creek. Just upstream from the mouth, the culvert at the LeClerc Creek Rd. crossing is a possible barrier to fish passage at high flows due to velocity and should be assessed for passability (S. Lembcke, WDFW, pers. comm., 2003).

Indian Creek. Upstream about 300 yards from the LeClerc Creek Road crossing, a private landowner landscaping project has modified the stream reach in such a way that may pose a potential barrier to fish passage (R. Fletcher, POCD, pers. comm., 2002; S. Lembcke, WDFW, pers. comm., 2003).

Indian Creek. At RM 0.75 there is a culvert on private land that may be a barrier to fish passage (T. Andersen, KNRD, R. Fletcher, POCD, pers. comm., 2002; S. Lembcke, WDFW, pers. comm., 2003).

Marshall Creek (62.0842). There is one known blockage to fish passage in the Marshall Creek watershed. It is man-made stabilizing dam with a fish screen at the outlet of Marshall Lake. This is a yearlong blockage to fish passage (USFS 1999ag, pg. 8).

Riparian Condition

Skookum. Greater than 25% of the riparian areas on USFS land are in roads; 7 miles/sq.mile of riparian roads for Skookum Creek. From 10-25% of the riparian areas on USFS lands have been harvested in this drainage, however the drainage has not experienced wildfire on USFS lands (USFS 1999af, pg. III-716, 750).

Skookum Creek and Indian Creek drainages. Many of the timber stands near the streams are dominated by pole-sized trees. High-grade timber harvest, firewood cutting, and removal of hazard trees are the presumed causes of the lack of larger trees. The suppression of low intensity fires and overstocking continue to inhibit the development of large trees to replace the trees removed. Many stream reaches lack cottonwood, aspen, and willow. Currently, alder is the primary non-coniferous species in riparian areas (USFS 1996, pg. 39).

Indian Creek. The riparian habitat in the lower 0.25 miles has been converted to residential use (R. Fletcher, POCD, and T. Andersen, KNRD, pers. comm., 2002).

Indian Creek. From 10 - 25% of the riparian areas on USFS land are in roads and from 10-25% of the riparian areas on USFS lands have been harvested. The Indian Creek drainage has experienced wildfire followed by salvage logging on USFS lands (USFS 1999af, pg. III-750).

Marshall Creek. Approximately 0.2 miles of continuous private road are located inside of the riparian areas of the watershed. There are also several stream crossings by USFS, county and private roads. Disturbances are not concentrated in unstable or potentially unstable areas (USFS 1999ac, pg. 10).

Marshall Creek. Past timber harvest and fires have removed some of the largest components of the riparian stands along Marshall Creek within the watershed. The riparian areas of Marshall Creek appear to be continuous with few road crossings of county and private roads within the RHCA. These areas have been harvested in the past and the actual condition on private lands is still unknown. It is therefore unclear whether the riparian area of Marshall Creek is providing sufficient large instream wood recruitment, adequate shade and is acting as an effective sediment filter due to lack of instream wood, water temperature and embeddedness level data (USFS 1999ac, pg. 10).

Channel Conditions/Dynamics

Streambank Condition

Skookum Creek drainage. On USFS land, streambanks are generally stable. There are some limited areas of bank instability where channels drop to lower terraces, but the instability is minor and probably natural (USFS 1996, pg. 16).

Floodplain Connectivity

Skookum Creek. In 1993, the USFS collected data on various habitat attributes for Skookum Creek (USFS 2002f). However, the habitat data analysis and interpretation needed to make a determination of floodplain connectivity as per the USFWS habitat rating criteria has not been done (K. Honeycutt, USFS, pers. comm., 2003).

Channel Stability

Skookum Creek drainage. There is little evidence of aggradation due to increased bedload or sediment (USFS 1996, pg. 16). Overall, the Skookum Creek channel upstream of the N. FK. Skookum Creek confluence, the N. Fk. Skookum Creek, the S. Fk. Skookum Creek and Sandwich Creek are stable and expected to remain stable (USFS 1999af, pg. III-731).

Skookum Creek. Channel stability is poor (USFS 2002f, 1993 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

N. Fk. Skookum Creek (62.0793). County Rd. 3407 follows the lower reaches of the stream for 2.5 miles. The road is partially surfaced with gravel and receives a high level of use due to homes on the road. The road is suspected to be a significant source of sediment in the N. Fk. Skookum Creek drainage. In addition, a culvert failure precipitated a landslide on the Bear Paw Rd (USFS Rd. 5015020) in the spring of 1997 which deposited sediment into N. Fk. Skookum Creek. Sediment delivery and movement through the system is currently elevated. Overall, portions of this stream were identified as not properly functioning due to cobble embeddedness and sediment (USFS 1999af, pg. 731).

S. Fk. Skookum Creek. About 0.4 miles of USFS Rd. 1900016 are encroaching on the stream channel (USFS 1999af, pg. III-733).

Habitat Elements

Channel Substrate

Note: Although the documents themselves nor full citations for the documents were not made available in time for inclusion in the habitat limiting factors assessment prior to publication, the following documents deserve mention here to the extent they may prove beneficial for future habitat evaluation and planning efforts in the Skookum Creek WAU: Skookum Creek WAU Road Maintenance and Abandonment Plan (RMAP). The document is a matter of public record and can be found at the WDNR Northeast Regional Office in Colville, WA (Stimson 1/29/03 final draft report review comments, February 2003).

Skookum Creek drainage. All Terrain Vehicle (ATV) activities in riparian areas of Skookum Creek contribute sediment. In general, the ATV use is not extensive and is probably a minor downstream sediment source. Likewise, contribution of instream sediment from dispersed campsites near streams is slight (USFS 1996, pg. 13).

Skookum Creek drainage. Sediment production from roads and other activities accounted for increases of 57% over background (excluding blind drainages; USFS 1996, pg. 14). According to the WA Department of Natural Resource (WDNR) habitat rating criteria, sediment increases of 50-100% over background will have small but chronically detectable effects on the channel (cited in Entrix 2002, pg. 2-26).

Skookum Creek. Kings Lake Road (County Rd. 3389) and USFS Rd. 5030 follow Skookum Creek for most of its length. While both of these roads are surfaced with gravel, both roads have a relatively high level of use and are suspected to be a significant source of sediment in the Skookum Creek tributary drainage, with large pulses of sediment being delivered from roads to the stream during storm events. Sediment delivery and movement through the system is currently elevated. Cobble embeddedness was a concern onreaches of Skookum Creek on USFS land (USFS 1999af, pg. III-716, 730). USFS surveyed stream reaches in 1995 exceeded 35% embeddedness (USFS 1996, pg. 17).

N. Fk. Skookum Creek. County Rd. 3407 follows the lower reaches of the stream for 2.5 miles. The road is partially surfaced with gravel and receives a high level of use due to homes on the road. The road is suspected to be a significant source of sediment in the N. Fk. Skookum Creek drainage. In addition, a culvert failure precipitated a landslide on the Bear Paw Rd (USFS Rd. 5015020) in the spring of 1997 which deposited sediment into N. Fk. Skookum Creek. Sediment delivery and movement through the system is currently elevated with large pulses of sediment reaching the stream, with storm events, from the road systems on USFS land. Overall, portions of N. Fk. Skookum Creek were identified as not properly functioning due to cobble embeddedness and sediment (USFS 1999af, pg. III-717, 731).

Indian Creek. Average embeddedness ranged from 37.9% to 84% from the mouth up to RM 2.3, exhibiting moderately high rates of embedded substrate (KNRD and WDFW 1997b, Table 10). On USFS reaches surveyed, Indian Creek was identified as not properly functioning due to cobble embeddedness (USFS 1999af, pg. 735).

Large Woody Debris

Skookum Creek and Indian Creek drainages. Many of the timber stands near the streams are dominated by pole-sized trees. High-grade timber harvest, firewood cutting, and removal of hazard trees are the presumed causes of the lack of larger trees. The suppression of low intensity fires and overstocking continue to inhibit the development of large trees to replace the trees removed (USFS 1996, pg. 39).

Indian Creek. On USFS reaches surveyed, Indian Creek was identified as not properly functioning due to lack of LWD (USFS 1999af, pg. 735). A KNRD 1995 habitat inventory also indicated low levels of LWD (KNRD and WDFW 1997b).

Marshall Creek. Past timber harvest and fires have removed some of the largest components of the riparian stands along Marshall Creek within the watershed. The riparian areas of Marshall Creek appear to be continuous with few road crossings of county and private roads within the RHCA. These areas have been harvested in the past and the actual condition on private lands is still unknown. It is therefore unclear whether the riparian area of Marshall Creek is providing sufficient large instream wood recruitment, adequate shade and is acting as an effective sediment filter due to lack of instream wood, water temperature and embeddedness level data (USFS 1999ac, pg. 10).

Pool Frequency and Quality

Indian Creek. Three of four reaches surveyed had low pool habitat (KNRD and WDFW 1997b, Table 10 and pg. 26).

Pool Depth

Skookum Creek. Pool depth is fair on USFS surveyed reaches (USFS 2002f, 1993 stream survey; K. Honeycutt, USFS, pers. comm., 2003).

Indian Creek. There are no pools greater than three feet in depth in the lower 2.25 miles of Indian Creek (T. Andersen, KNRD, email comm., Jan. 6, 2003).

Off-Channel Habitat

Skookum Creek WAU. No information available.

Water Quality

Temperature

Skookum Creek. Water temperatures may create a thermal barrier, preventing fish movement between Skookum Creek and the Pend Oreille River (Bennett and Garrett 1994, pg. 37; USFS 1996, pg. 16). Water in the lowest kilometer (0.6 mile) of Skookum Creek moves sluggishly during summer and there is little riparian shading. Rapid warming of stream temperature in this lower reach of Skookum Creek was observed with water temperatures eventually exceeding 26°C (79°F; Bennett and Garrett 1994, pg. 37).

Skookum Creek. In 1996, the Pend Oreille Conservation District collected spot, water temperature data at three locations on Skookum Creek in conjunction with a riparian enhancement implementation project funded in 1996 (POCD 2002a).

Skookum Creek. A spring is located approximately 3.2 km upstream from the confluence of Skookum Creek and N. Fk. Skookum Creek and is the site of an inactive state fish hatchery. This spring continually discharges 0.14m^3/sec into Skookum Creek and is responsible of most of the flow during periods of dry weather resulting in relatively stable flows in Skookum Creek downstream from the confluence of the North Fork. The spring generally provides cooler water in the summer and slightly warmer water in the winter into Skookum Creek (Bennettt and Garrett 1994, pg. 9). It was reported by the USFS, that water from Half Moon Lake may flow underground into the mainstem of Skookum Creek (USFS 1999af, pg.III-716).

Skookum Creek. Water temperature data was collected at the adfluvial fish trap locations by DE&S in 1998, 1999 and 2000 during the adfluvial fish trapping study conducted for the POPUD. The adfluvial fish trap was located just upstream of the N. Fk. Skookum Creek confluence. After spring runoff, there was a gradual warming process, to a peak temperature of 18°C from mid-july through mid-August. Temperatures in 1998 remained warmer longer into the fall than for either 1999 or 2000. A possible faulty thermograph in this tributary in 1999 greatly reduced the amount of summer and early fall water temperature data. The year 2000 appeared to have the coolest average daily water temperatures (DE&S 2001a, pg. 12).

Skookum Creek. The Pend Oreille Conservation District recorded water temperatures at three monitoring locations on Skookum Creek using a handheld D.O. or conductivity monitor with a digital thermometer. Temperatures were recorded once monthly in 2001 for the months of August, September, October and November. A 7-day average maximum temperature can not be determined with this limited data, however water temperatures in August exceeded the preferred temperature range for rearing and spawning at all three stations (Station 4/13.7°C; Station 5/16.8°C; Station 5.1/18.7°C). The water temperature recorded at Station 5.1 only, continued in the range of poor for rearing at 11.0°C. Station 4 was located at the Best Chance Road stream crossing. Stations 5 and 5.1 were located within 50 feet of the mouth of Skookum Creek and within 100 feet of one another. The stream course in this lower reach of Skookum Creek passes through open canopy pasture land and the channel is wide with shallow, slower moving water. Within this lower channel reach, Site 5.1 is located under a canopy of alders and hawthorns (POCD 2002a, Appendix C).

N. Fk. Skookum Creek. Water temperature data was collected at the adfluvial fish trap location by DE&S in 1998, 1999 and 2000 during the adfluvial fish trapping study conducted for the POPUD. The adfluvial fish trap was located just upstream of the confluence with Skookum Creek. Water temperature changes were gradual from week to week and were dependent upon the season. Slowly rising temperatures in the spring and early summer reached their peak in August of all years recorded. Summer average water temperatures were warmer by as much as 6°C in 1998 and 1999 than in 2000 for the period of late July through late August. Daily temperature fluctuations also appeared to be dampened in 2000. The highest recorded daily average temperature for 1998 and 1999 was 15°C. In 2000, the highest recorded daily average temperature was 12°C (DE&S 2001a, pg. 11).

N. Fk. Skookum Creek. From July 11 to November 18, 2002, the KNRD deployed a thermograph to record water temperature in N. Fk. Skookum Creek 1.5 miles up Best Chance Road from Kings Lake Rd. intersection. The 7-day average maximum temperature for the period of record was 17.1°C occurring three times from July 18 to July 27, 2002 (KNRD stream temperature data, M. Wingert, KNRD, email comm., Jan. 6, 2003).

Indian Creek. Water temperature data was collected at the adfluvial fish trap location by DE&S in 1998, 1999 and 2000 during the adfluvial fish trapping study conducted for the POPUD. The adfluvial fish trap was located just upstream from the mouth of Indian Creek. The daily average temperature of Indian Creek indicated its season water temperatures were least affected by ambient air temperatures during the three-year study. The greatest daily temperature fluctuations did occur during the summer months. Weekly average temperatures for 1999 and 2000 were 1-3°C colder than 1998 temperatures for the same period of record. Data from 1999 and 2000 were similar for most of the same months and indicated that less diurnal fluctuations occurred in these years than in 1998 (DE&S 2001a, pg. 10).

Indian Creek. The Pend Oreille Conservation District recorded water temperatures at one location on Indian Creek using a handheld D.O. or conductivity monitor with a digital thermometer. The monitoring location was at the LeClerc Creek Road crossing. Temperatures were recorded between August 2001 and April 2002, excluding the months of December, January and February. A 7-day average maximum temperature cannot be determined with this limited data. Of the nine temperature readings taken, the highest recorded temperature was 10.6°C on Augst 27, 2001 (POCD 2002a, Appendix C).

Indian Creek. The KNRD reported a 7-day average maximum instream temperature of 14.5°C in the lower 2.25 miles of Indian Creek for the period from July 4 through July 10, 2001 (T. Andersen, KNRD, email comm., Jan. 6, 2003). The exact location of the thermograph and the period of record were not provided.

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Skookum Creek drainage. Runoff patterns within Skookum Creek, N. Fk. Skookum Creek, S. Fk. Skookum Creek and Sandwich Creek have been altered somewhat due to past disturbances (USFS 1999af, pg. III-731). The Equivalent Clearcut Area (ECA) in the mainstem Skookum Creek drainage from the confluence of N. Fk. Skookum Creek upstream to the headwaters is estimated at 8%. The ECA in the N. Fk. Skookum Creek drainage is estimated at 21%. Road density in the mainstem Skookum Creek drainage from the confluence of N. Fk. Skookum Creek upstream to the headwaters is 4.6 miles/sq.mile. Road density in the N. Fk. Skookum Creek drainage is 5.4 miles/sq.mile (USFS 1999af, pg. III-716). The trend in water yield as measured by peak flow modification is decreasing slowly within the drainage as vegetation becomes reestablished following past timber harvests in the drainage (USFS 1999af, pg. III-731).

N. Fk. Skookum Creek. This creek is closed to further water appropriations (except livestock and domestic; USFS 1996, pg.1).

Indian Creek. At approximately RM 1.0, there is a water diversion on Indian Creek which uses an 8 – 10 inch pipe to divert water from the stream. The diversion has the potential to alter base flow conditions by some undetermined amount (R. Fletcher, POCD, pers. comm., 2002).

Marshall Creek. There is a man-made stabilizing dam at the outlet of Marshall Lake. The outlet from Marshall Lake, which forms Marshall Creek, goes subsurface in the summer and the fall (USFS 1999ac, pg. 9). There is speculation that Marshall Lake hydrology influences Char Springs, which is along the mainstem Pend Oreille River, and is a known source of ground water influence for the Pend Oreille River.

Marshall Creek drainage. There is a moderate amount of increase in the natural drainage network as a result of the existing road system within the watershed (2.8 miles per sq. mi.; USFS 1999ac, pg. 10).

Species Competition

Non-indigenous Fish

Skookum Creek. Brook trout are known to occur (Bennett and Liter 1991, Table 3-6, pg. 65).

Skookum Creek. The most common salmonids captured in 175 days from May through December 1998 were brown trout (DE&S 1999a, pg.9)

Indian Creek. In a 1995 snorkel survey, brook trout were abundant with representatives for nearly all age classes (KNRD and WDFW 1997b, pg. 29). Bennett and Liter (1991, pg. 65) also captured brook trout in Indian Creek.

Skookum Creek WAU Fish Distribution and Use.

The streams in the Skookum Creek WAU flow into the Box Canyon Reservoir reach of the Pend Oreille River. Only one bull trout has been documented in the Skookum Creek WAU; a large, gravid, adult female bull trout was captured moving downstream in mid-September 1999 at the mouth of Indian Creek in an adfluvial trap by Duke Engineering and Services (DE&S 2001a,). An adipose fin clip showed this fish to be from Trestle Creek (tributary to Lake Pend Oreille) in Idaho. The female was tagged by KNRD and released. The same female was recaptured and released in June 2000 near the mouth of Marshall Creek by an angler (POCD 2001b). Table 20 below describes current, known bull trout use in Middle Creek WAU. Based on USFS and KNRD stream habitat surveys, and on theDE&S Adfluvial Trapping study (KNRD 1995 habitat survey; USFS 1993 stream survey; DE&S 2001a), maps in Appendix C illustrate the extent of "Individual Observations" and "Recoverable" habitat in the Skookum Creek WAU. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Given the knowledge of salmonid biology and behavior, the historic use by bull trout of the mainstem Pend Oreille River (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), and a lack of natural barriers at the tributary mouths, it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. For all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years. .

Eastern brook trout were introduced into the WAU in the early 1900s (USFS 1996, pg.40). They are very abundant in Indian Creek with representatives for nearly all age classes (KNRD and WDFW 1997b, pg. 29).

Table 20: Current, known bull trout use in the Skookum Creek WAU.

Skookum Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Skookum Creek					X

N. Fk. Skookum Creek					
Indian Creek				X	X

Skookum Creek WAU Summary.

Skookum Creek

Animal keeping practices on land adjacent to Skookum Creek are resulting in the most adverse impacts on the stream currently, specifically in the form of fecal coliform levels, riparian impacts, and bank destabilization (Ashe and Scholz 1992, pg. 263). Past and more recent timber harvest activities also contribute to present degraded habitat conditions. Because the USFS lands in this area were part of the originally established National Forest, extensive timber harvest did not occur on these lands as it did in other portions of the Colville National Forest Newport Ranger District which remained in private ownership and were logged. The rate of harvest on lands in the Skookum drainage had been pretty stable until the mid-1980s when harvest from private lands accelerated (USFS 1996, pg. 16). The area of riparian habitat impacted by riparian roads in the Skookum Creek drainage is calculated to be >25% (USFS 1999af, pg. III-750).

One habitat condition very much worth noting in the Skookum Creek drainage for its potential to benefit bull trout populations in the lower Pend Oreille River system is the presence of spring activity in Skookum Creek. These springs generally provide cooler water in the summer and slightly warmer water in the winter. When reservoir temperatures increased from 18°C to 20°C during the summer of 1992, radio-tagged brown trout were observed to move into Skookum Creek upstream to a reach that did not exceed 16°C during that summer (Bennett and Garrett 1994, pg. 21).

Indian Creek

The lower reaches of Indian Creek have been are degraded by land use practices such as road development, agriculture, home development and livestock grazing. As a result, the stream lacks structure and channel complexity (POCD 2002a, pg. 11, 12). Habitat impacts contribute to stream confinement and exacerbate streambank and streambed instability. Indian Creek is naturally confined in a narrow valley already restricting the stream's course to a confined meander belt. The headwaters of Indian Creek begin at approximately 2,800 feet in elevation and join the Pend Oreille River at 2,032 feet in elevation with approximately an overall average gradient of 2.2% (POCD 2002a, Introduction section). The main habitat limiting factor in Indian Creek is the lack of pools. The lower two miles are composed of essentially all riffle habitat providing virtually no wintering or holding waters. The lower 2 miles also have low levels of riparian cover (KNRD and WDFW 1997b, pg. 42).

Indian Creek was the only tributary to the Pend Oreille River within the Box Canyon reservoir reach where a bull trout was captured in three years of adfluvial fish trapping efforts – 1998, 1999 and 2000. From 1998 to 2000, daily average water temperature of Indian Creek indicated ambient air temperatures had the least effect on its seasonal water temperatures although the greatest daily temperature fluctuations did occur during the summer months. Flows in Indian Creek remained the most stable of all 11 Box Canyon Reservoir tributaries studied by DE&S from 1998 through 2000. Except for flood events from late May through mid-July of each year, the tributary discharged consistently around 15 cfs in 1998 and 10 cfs in 1999 and 2000. For all years, the data showed a single high flow peak in late June which coincided with the Pend Oreille River rising and backing flows up in the creek. During all three years, fish migration activity did not appear to be triggered by flow fluctuations in Indian Creek. In 1998, the largest peak migration was observed in mid-October and was composed of adult salmonids moving upstream. In 1999, peak migration was observed in late-may and early-June and consisted mostly of juvenile brown and brook trout moving both up- and downstream. In 2000, no peak migration was observed. In 1999, flows dropped lower than in 1998 but still remained fairly stable. In 2000, flows dropped even lower than in 1999 (DE&S 2001a, pg. 10).

Skookum Creek WAU Data Gaps.

- Streamflow data and hydrograph (Entrix 2002, Table 3-1);
- extent of the hydraulic continuity between Skookum Creek and the Pend Oreille River (Entrix 2002, Table 3-1);
- migration zone study to determine channel and riparian zone conditions for Skookum Creek and its major tributaries (Entrix 2002, Table 3-1).

DEER VALLEY WAU

Deer Valley WAU Description

The Deer Valley WAU encompasses approximately 33.763 acres and includes the Davis (RM 72.6), Bracket (RM 77.1), Kent (RM 78.5), and McCloud (RM 78.9) creek drainages. Only the Kent and McCloud creek drainages, with identified recoverable bull trout habitat, will be presented in this report. Kent Creek, with a drainage basin area of 3,950 (POCD 2001c, pg. 3), acres, drains north about 2.25 miles before it empties into the Pend Oreille at RM 78.5. McCloud Creek, with a drainage basin area of 5,500 acres (POCD 2001c, pg. 3), flows north approximately 2 miles before it empties into the Pend Oreille River at RM 78.9 (Williams, et al 1975). The Kent and McCloud creek drainages feed into the Box Canyon Reservoir portion of the Pend Oreille River entering from the southwest about 10 miles north of Newport (RM 88.5). Both drainages have headwater elevations of about 3000 feet and flow into the Pend Oreille River at around 2100 feet. Davis Creek, which drains approximately 15,350 acres, has headwaters similar to those of Kent and McCloud creeks (POCD 2001c, pg. 3). The mean annual precipitation for the WAU is approximately 30 inches (POCD 2001c, pg. 5).

The area's indigenous peoples, the Kalispel, and their ancestors, have a documented history of over 4,000 years of living in this WAU. The Deer Valley WAU of today is still predominantly forested lands, but with small areas of agricultural land distributed throughout. Kent and McCloud creeks have not been developed extensively in the past because of steep terrain and limited road access (POCD 2001c, pg. 7). However, based on 2001 census figures, the portion of Pend Oreille County where the Deer Valley WAU lies is experiencing a growth in population numbers. Davis Creek has more consistent development along its banks due mostly to access provided by State Hwy. 211 and a wider, more easily developed valley (POCD 2001c, pg. 7).

Deer Valley WAU Hydrogeomorphology.

The geologic bedrock found within the southern portion of Pend Oreille County, where the Deer Valley WAU is located, is comprised of metamorphosed sedimentary rocks and quartzite. Flood deposits from Lake Missoula glaciation underlie areas in the southeastern section of Pend Oreille County. A lobe of Cordilleran ice sheet dammed this huge lake (4,800,000 miles) in the Clarke Fork Valley. Catastrophic floods occurred periodically when this ice dam failed. The northern-most catastrophic flood spillway is in a narrow channel now occupied by Davis Lake (POCD 2001c, pg. 5, 6).

Deer Valley WAU Current Known Habitat Conditions.

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 Technical Advisory Group (TAG). The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate. The numbers following stream names correspond to a numbering system developed by the Washington Department of Fisheries for streams in the Columbia River system (Williams et al. 1975).

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Kent Creek (62.0819). There is an earthen dam at the outlet of Mountain Meadows Lake (RM 2.75). Drainage from the area upstream of Mountain Meadows Lake only reaches Kent Creek when water levels in the dammed lake are high enough to reach the lake's overflow pipe, primarily during March and April (POCD 2001c, pg. 23).

Riparian Condition

Kent Creek. There are numerous homes along or near the riparian areas on Kent Creek (POCD 2001c, pg. 23).

Kent Creek. A section of bank sloughed into Kent Creek in 1997 or 1998, upstream of the K2 POCD water quality monitoring site (RM 2.0), discoloring the water as far downstream as the first Deeter Road stream crossing. Between September 1999 and October 2000, the creek was still cutting its channel though the bank material deposited into the channel during the bank failure (POCD 2001c, pg. 23).

McCloud Creek (62.0828). From the Pend Oreille River confluence upstream to within 40 feet of the railroad crossing, McCloud Creek has been straightened and flows through wetland pastures that were not being grazed between September 1999 and September 2000. The extent to which riparian vegetation has been altered from its natural potential is not indicated in the literature (POCD 2001c, pg. 22).

McCloud Creek. Upstream of the railroad crossing (RM 1.75) to near its headwaters, the stream is bordered by McCloud Creek Road however the stream contains ample amounts of riparian vegetation. Within the sampled area (from the railroad crossing upstream to the Virginia Road intersection), the creek does not travel through any large expanses of open canopy where additional heating of the water could take place (POCD 2001c, pg. 22).

Channel Conditions/Dynamics

Streambank Condition

Kent Creek. A section of bank sloughed into Kent Creek in 1997 or 1998, upstream of the K2 POCD water quality monitoring site (RM 2.0), discoloring the water as far downstream as the first Deeter Road stream crossing. Between September 1999 and October 2000, the creek was still cutting its channel though the bank material deposited into the channel during the bank failure (POCD 2001c, pg. 23).

Floodplain Connectivity

Kent Creek. Portions of the stream channel are located along Deeter Road. Just before joining the Pend Oreille River, Kent Creek passes under the railroad grade and State Hwy. 20 (POCD 2001c, pg. 23).

McCloud Creek. Downstream of where the Pend Oreille Valley Railroad crosses McCloud Creek (RM 1.75) a portion of the stream has been straightened and then flows into wetland pastures as it heads towards State Hwy. 20. It then takes a 90 degree turn to the west, follows along Hwy. 20, crosses under McCloud Creek Road (RM 1.0) and into a backwater channel prior to going under State Hwy. 20 (RM 0.5) and out into the Pend Oreille River (POCD 2001c, pg. 22).

McCloud Creek. From about 40 feet downstream of the railroad crossing down to the mouth, Kent Creek may be inundated by the Pend Oreille River during spring run-off (POCD 2001c, pg. 10).

Channel Stability

Kent Creek. Portions of the stream channel are located along Deeter Road. Just before joining the Pend Oreille River, Kent Creek passes under the railroad grade and State Hwy. 20 (POCD 2001c, pg. 23).

Kent Creek. A section of bank sloughed into Kent Creek in 1997 or 1998, upstream of the K2 POCD water quality monitoring site (RM 2.0), discoloring the water as far downstream as the first Deeter Road stream crossing. Between September 1999 and October 2000, the creek was still cutting its channel though the bank material deposited into the channel during the bank failure (POCD 2001c, pg. 23).

McCloud Creek. Downstream of where the Pend Oreille Valley Railroad crosses McCloud Creek (RM 1.75), a portion of the stream has been straightened. The stream channel flows into wetland pastures as it heads towards State Hwy. 20 before taking a 90 degree turn to the west. It then follows along Hwy. 20, crosses under McCloud Creek Road (RM 1.0), and into a backwater channel prior to going under State Hwy. 20 (RM 0.5) and out into the Pend Oreille River (POCD 2001c, pg. 22).

Habitat Elements

Channel Substrate

Note: Although the documents themselves nor full citations for the documents were not made available in time for inclusion in the habitat limiting factors assessment prior to publication, the following documents deserve mention here to the extent they may prove beneficial for future habitat evaluation and planning efforts in the Deer Valley WAU: Deer Valley WAU Road Maintenance and Abandonment Plan (RMAP). The document is a matter of public record and can be found at the WDNR Northeast Regional Office in Colville, WA (Stimson 1/29/03 final draft report review comments, February 2003).

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Large Woody Debris

Deer Valley WAU. No information available.

Pool Frequency and Quality

Deer Valley WAU. No information available.

Pool Depth

Deer Valley WAU. No information available.

Off-Channel Habitat

Deer Valley WAU. No information available.

Water Quality

Temperature

Kent Creek. Temperature data is very limited. Temperature measurements were taken once monthly (with the exception of November, December, January, and February) between September 1999 and September 2000 at three sites on Kent Creek: K1 just below the first culvert on Deeter Road; K2 at about RM 2.0, just downstream of two tributaries that come into Kent Creek; and K3 at the outlet of Mountain Meadows Lake . Seven-day average maximum temperatures can not be determined with the limited data, however, recorded temperatures do indicate temperatures exceeded the preferred range for rearing (4° - 12°C) during July and for initiating spawning (4° - 9°C), in September. Monthly recorded temperatures during the period of record did not exceed 15°C at either the K1 or K2 site. The recording device at K3 was dewatered during all months of the recording period with the exception of April and May of 2000 (POCD 2001c, Appendix C). K3 is located upstream of the uppermost extent of mapped "Recoverable" bull trout habitat on Kent Creek.

McCloud Creek. Temperature data is very limited. Temperature measurements were taken once monthly (with the exception of November, December, January, and February) between September 1999 and September 2000 at two sites on McCloud Creek: M1 was 40 feet downstream of the McCloud Creek railroad crossing; and M2 was at the intersection of Virginia Road and McCloud Road, in the upper drainage, but still downstream of the mapped upper extent of "Recoverable" bull trout habitat. Seven-day average maximum temperatures can not be determined with the limited data, however monthly recorded temperatures during the period of record did not exceed 15°C at either site. Recorded temperatures also did not exceeded the preferred range for rearing (4° - 12°C) at either site. During the period of record, recorded temperatures only exceeded the preferred range for spawning (4° - 9°C) once, by 0.3°C at the lower-most site (M1), in September 2000 (POCD 2001c, Appendix C).

Water Quantity

Change in Flow Regime

The Water Rights Application and Tracking System (WRATS) database of water rights permits, certificates, applications and claims is kept by the Washington Department of Ecology (DOE). The Entrix report (Entrix 2002, pg. 2-121 through 2-125) presents this data in various formats (by use, ownership type, water source/surface or ground). Further evaluation of the data is needed to fully evaluate any potential impacts to flow regime.

Kent Creek. Flows in Kent Creek are limited to input from small tributaries and springs along the side of Deeter Road. Drainage from the area upstream of Mountain Meadows Lake only reaches Kent Creek when water levels in the dammed lake are high enough to reach the lake's overflow pipe, primarily during March and April. Rain events accounted for higher flows in March of 2000, but the highest flows for 2000 were in June (POCD 2001c, Appendix C and pg. 24).

Kent Creek. There is an earthen dam at the outlet of Mountain Meadows Lake (RM 2.75). Drainage from the area upstream of Mountain Meadows Lake only reaches Kent Creek when water levels in the dammed lake are high enough to reach the lake's overflow pipe, primarily during March and April (POCD 2001c, pg. 23).

McCloud Creek. Flow measurements were taken once monthly (with the exception of November, December, January, and February) between September 1999 and September 2000 at two sites on McCloud Creek (RMs 1.75 and 2.25) and three sites on Kent Creek (RMs 0.5, 2.0, 2.75). Four of seven flow measurements showed higher flows at RM 1.75 than RM 2.25 on a given day. There is no observable place where irrigation or groundwater recharge may be taking place to cause this difference (up to 0.72 cfs; POCD 2001c, Appendix C and pg. 23).

Species Competition

Non-indigenous Fish

Kent Creek. Brook trout are known to occur (J. O'Connor, KNRD, pers. comm., 2002).

McCloud Creek. Brook trout are known to occur (J. O'Connor, KNRD, pers. comm., 2002).

Deer Valley WAU Fish Distribution and Use.

The streams in the Deer Valley WAU flow into the Box Canyon Reservoir reach of the Pend Oreille River. Bull trout are not known to occur in the Deer Valley WAU, therefore Table 21 below, which describes current, known bull trout use in the WAU, is blank for bull trout. Based on WDFW/KNRD stream habitat surveys (WDFW/KNRD 2001 habitat survey), maps in Appendix C illustrate the extent of "Recoverable" habitat in the Deer Valley WAU. Table D1 in Appendix D provide sources for the information on the fish distribution maps.

Given the knowledge of salmonid biology and behavior, the historic use by bull trout of the mainstem Pend Oreille River (Ashe et al. 1991; Bennett and Liter 1991; Barber et al. 1989 and 1990; Gilbert and Evermann 1895), and a lack of natural barriers at the tributary mouths, it is likely bull trout would have historically entered accessible tributaries to the Pend Oreille River Oreille whenever possible. Once in a river system, it is generally the strategy of fish species to enter accessible waterways whenever possible. This strategy is seen with brook trout for example. Which tributaries to the Pend Oreille

River would have proved attractive historically to bull trout and the extent to which bull trout could have successfully utilized that tributary habitat historically is not clear based on existing information. For all practical purposes, viable bull trout populations have been extirpated from the Pend Oreille River and its tributaries between Albeni Falls and Boundary dams with only 33 bull trout observations in the past 28 years.

Table 21: Current, known bull trout use in the Deer Valley WAU. (Table is blank for bull trout since there are no current, known observations of bull trout in the Deer Valley WAU).

Deer Valley WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Kent Creek					X
McCloud Creek					X

Deer Valley WAU Summary.

There is a possibility of impacts from increasing development in the drainages of the Deer Valley WAU (POCD 2001c, pg. 3), however relatively little information is available in the literature on existing aquatic habitat conditions or human-caused alterations to stream function. The POCD collected baseline data monthly from September 1999 through September 2000 for some water quality parameters (POCD 2001c). The limited data showed problems with turbidity in Kent Creek and problems with temperatures above the criteria levels for “good” for some life history stages of bull trout (POCD 2001c, Appendix C).

Deer Valley WAU Data Gaps.

- Extent of the hydraulic continuity between the low-lying areas of the Deer Valley WAU adjacent to the Pend Oreille River (Entrix 2002, Table 3-1);
- fish distribution and use in Deer Valley WAU streams (Entrix 2002, Table 3-1);
- riparian habitat conditions (Entrix 2002, Table 3-1).

PRIEST RIVER DRAINAGE

Portions of the upper reaches of tributaries that drain eastward into the Priest River system in Idaho are located within Washington State. These stream reaches have been incorporated into Washington Adminstrative Units (WAUs) by the Washington State Department of Natural Resources. The names of these WAUs are; Priest River, Kalispell Creek, Granite Creek, and Gold Creek (Figure 2 – WAU boundaries in WRIA 62). The breakdown of tributaries in the WAUs and their connection to the Priest River drainage is illustrated in Table 26. Specific habitat conditions will only be presented for those portions of stream reaches that occur in Washington State. The portions of the drainages that occur in Idaho State will be discussed only in general terms in this report. Literature references are provided for more detailed descriptions and discussions of habitat conditions in Idaho stream reaches. Prior to providing descriptions and habitat condition information for each WAU individually, following is a brief description of the Priest River Subbasin area.

The WAUs draining into the Priest River system are part of the Priest River drainage (979 square miles). The Priest River drainage is one of three Northwest Power Planning Council (NPPC) planning areas that make up the entire Pend Oreille Subbasin. These are: 1) the Upper Pend Oreille River area which includes all of Lake Pend Oreille and its tributaries from Cabinet Gorge Dam, located on the Clark Fork River, downstream to Albeni Falls Dam located on the Pend Oreille River; 2) the Lower Pend Oreille River area which includes the Pend Oreille River and its tributaries between Albeni Falls Dam and the U.S./Canadian border; and 3) the Priest River area which includes the Upper Priest Lake, Priest Lake, and all tributaries up to the U.S./Canadian Border (KNRD 2001, pg. 2).

The Priest River drainage is primarily within the northwest corner of the Idaho Panhandle with approximately 24 square miles of the drainage in British Columbia, Canada where the headwaters of the Upper Priest River originate in the Nelson mountain range. Headwaters of the major tributaries on the western side of the area are located in Washington. The drainage is flanked on the east and west sides by the Selkirk mountain range. Elevation ranges from 2,051 feet at Albeni Falls dam to more than 7,000 feet in the east side of the Selkirk Mountains. The headwaters of mainstem tributaries on the west side of the Priest Lake drainage are at lower elevations, mostly between 4,000 and 5,000 feet.

The geology, vegetative patterns and land use history is quite variable over the entire drainage. In the extreme north, the streams tend to have older, larger trees in the riparian zones and streams tend to be in balance between water sediment yields. Further south, there is a transition of stream characteristics. In the middle zone, the streams were recently glaciated, but the drainages have had more logging and roading than what occurred in the extreme northern section of the Priest Lake drainage. The streams in the middle drainages (i.e. Granite and Kalispell) tend to have elevated levels of bedload because of past land use practices and their inherently unstable soils. The geologies of the lower Priest River drainage are more weathered than what is found to the north because this portion of the Priest River basin did not experience the ice flows of the last glaciation. The underlying geologies are a mix of weathered granitics and belts as well as lacustrine deposits. With the exception of those creeks flowing through belt rocks, most of the stream substrates are relatively fine. The land uses within the lower Priest River basin include home construction, timber harvesting, and agriculture. The mainstem Priest River from the confluence of Upper West Branch downstream to the Pend Oreille River is on the Idaho 303(d) list for exceedences of sediment standards (USFS 1999af, pg. III-444).

The vegetation in northern Idaho is a result of the prevailing climatic pattern in which westerly winds carry maritime air masses from the northern Pacific across the northern Rocky Mountains. Strong maritime air flow carries high levels of moisture to this area. Moist maritime air that moves across the northwest carries significant moisture descending from the Cascade Mountains and across the Columbia Plateau. When this warm/moist air is driven into the Selkirk Mountains, heavy/wet snows can occur and are common in the Priest River area. These storms often result in significant windthrow and breakage (USFS 1999af, pg. III-362, 368). Due to the strong influence of inland marine airflows, precipitation in the Priest River subbasin is generally higher than the rest of the Rocky Mountains (USFS 2002, pg. 19 of 116). July and August are the only distinct summer months and temperatures are relatively mild because of the Pacific maritime influence (average daily summer maximums are around 82°F). Winter temperatures also are relatively mild compared to areas east of the Rocky Mountains. Annual precipitation (rain and melted snow) averages 32 inches. Average precipitation within the peaks of the Selkirk Mountains can reach 60 inches. At elevations above 4,800 feet, snowfall accounts for more than 50% of total precipitation (Finklin 1983). The wettest months are normally November, December, and January.

Starting from the northern end, the lake complex in the Priest River subbasin is made up of Upper Priest Lake (about three miles long), a connecting channel called the Priest River Thorofare (2.7 miles long), and Priest Lake (19 miles long). Priest Lake is the second largest natural lake, in terms of volume, within Idaho. Water levels in the lakes and the Thorofare are controlled by a lowstage dam located at the outlet of Priest Lake (the lower, southern-most lake) and operated by Washington Water Power. The outlet dam at Priest Lake is does not provide for fish passage. Lower Priest River originates at the outlet of Priest Lake, in the southwest corner of the lake, and flows 45 river miles to its confluence with the Pend Oreille River at the Town of Priest River.

The Priest River drainage has numerous tributaries. The Upper Priest portion of the subbasin drains into the upper lake (Upper Priest Lake) and into the Thorofare, with a total drainage area of 204 square miles. The main tributary to Upper Priest Lake is the Upper Priest River. The Upper Priest River is joined by Hughes Fork about one-half mile before entering the northwest corner of the lake. From the Canadian border flowing downstream, Upper Priest River flows through a steep canyon at a moderate gradient (about 100 feet/mile) and then flattens into a fairly large floodplain for the last 2 miles. About 0.5 miles south of the Canada border, a waterfall is the upper limit of fish migration. Hughes Fork has a moderate gradient and includes a large wetland area, Hughes Meadow, about 7 miles up from the mouth. Other major tributaries to the Upper

Priest portion of the drainage flow in from the east side of the subbasin into Upper Priest Lake and the Thorofare (i.e. Trapper and Caribou creeks) and are not discussed in this report.

The west side of the Priest Lake drainage extends from Beaver Creek, which flows into the northwestern corner of Priest Lake just south of the Thorofare, to the southern end of Priest Lake. This portion of the subbasin has one large, tributary drainage, Granite Creek, and two moderately-sized tributary streams, Lamb Creek and Kalispell Creek, all of which originate in Washington State. Granite Creek, draining about 64,000 acres, is the largest drainage watershed in the Priest Lake portion of the Priest River subbasin. Headwaters of the south and north forks of Granite Creek range in elevation from 4,000 to 5,000 feet. Overall, the average gradient of Granite Creek is low, with many flat sections with associated wetlands. Approximately 26% of the Priest Lake shoreline is privately owned and is where the most concentrated residential and business development has occurred. Within the federal and state owned lands, there has been considerable waterfront development through lease lot programs. The drainages of Kalispell Creek and Lamb Creek have large areas of flat gradient in the middle and lower elevations. These are naturally areas of meadows and wetlands. In the lower end Lamb Creek there has been considerable modifications of the historic wetland complex through wetland draining, grazing, and road and home development. In the lower end of both drainages, home development is having an increasing impact on the stream systems. The ground water systems are extensive in these drainages, and many branch streams go subterranean prior to discharging into the primary tributary channels.

The lower Priest River flows 45 miles from the outlet dam on the southwest corner of Priest Lake to its confluence with the Pend Oreille River near the town of Priest River. Major tributaries include the Upper West Branch and Lower West Branch on the west side of the subbasin and the East River flowing in from the east. Vegetation of the area varies in association with soil moisture conditions, slope aspect, elevation, precipitation, temperature, wildfire history, and land use patterns. The area is predominately coniferous forest of mixed species. The make-up of coniferous species has changed through time because of timber harvesting and replanting, fire, and plant diseases. The majority of the west side of the subbasin lands is USFS National Forest land with private property comprising approximately 10% of the west side lands. More than 90% of the east side of the subbasin is managed by the State of Idaho

PRIEST RIVER WAU

Priest River WAU Description

The Priest River WAU encompasses the upper reaches of the Lower West Branch drainage. From its headwaters in Washington State, the Lower West Branch flows 25.3 miles southeastward into Idaho toward its confluence with the Priest River, draining 56,835 acres. Most of the mainstem flows through flat terrain, and tributaries to the west, north and east originate in hillslopes and mountains, however Torelle Falls at RM 8.2 on the mainstem Lower West Branch is a complete barrier to fish passage. Elevations within the drainage range from 5,988 feet on South Baldy Mountain in Washington to 2,100 feet at the confluence of the Lower West Branch and the mainstem of the Priest River in Idaho. Average annual precipitation increases from 32 inches at the mouth to approximately 40 inches at high elevations. Precipitation is 25 – 50% snow with a snowmelt dominated runoff pattern. Peak flow occurs from mid-March through late April. A large area of gradual topography surrounding the mainstem, ranging from 2,100 – 3,100 feet elevation does experience mid-to-late-winter rain on snow events (USFS 1999af, pg. III-462; IDEQ 2001, pg. 111).

The Lower West Branch drainage (56,835 acres) is a mixture of federal lands and private ownership with a small acreage of Idaho State ownership. Industrial timber holdings in the entire drainage total 1,468 acres (3%). In the Washington Priest River WAU portion of the drainage, there are 1,919 acres in private non-industrial land where there is hay cropping, grazing, and non-industrial private land timber operations. Within Idaho, there are 9,978 private acres which are not industry owned. Most of these private holdings have been given a general designation of agricultural zone with hay cropping and grazing; small scale timber operations occur on this private land. Land in the Lower West Branch drainage under USFS management totals 42,743 acres, 32% in Washington. Most of this land is managed for timber production and there is a substantial 7,895 acres in grazing allotments (IDEQ 2001, pg. 114).

The drainage is underlain by granite, belt rocks, and ancient lake deposits. Higher elevation lands of the northern mountain range are residual granitic batholith; the western and southeastern mountain ridges are residual belt rock; and the valley hillslopes and stream bottom lands of the mainstem are lacustrine deposits that have developed into vast meadow areas (USFS 1999af, pg. III-462; IDEQ 2001, pg. 110). Around 85% of the mainstem length is gradually sloped with a majority of the gradient less than 0.5%. The predominant channel type is a gravel or sand dominated, entrenched, meandering channel, deeply incised in gently terrain (Rosgen F4/F5 stream type), but there are long stretches of C and D Rosgen stream channel types with broad floodplains.

Riparian vegetation is a mix of alder/willow and sparse to dense conifer overstory. Along the stream course are many wetland areas. Significant areas of flatlands surrounding the Lower West Branch and lower sections of tributaries have been converted to hay cropping and grazing. Approximately 62 miles of the watersheds 192 perennial stream miles (32%) flow through private land and another 25 stream miles flow through federal land with allotments for grazing.

The Lower West Branch drainage falls into a portion of the Priest River subbasin that represents some of the more highly altered landscapes in the subbasin. Modifications include timber harvest, road building, and grazing with much of the valley bottoms having been converted to agricultural use (USFS 2002, pg. 89 of 116). The Lower West Branch drainage itself has a long history of logging. From 1912 until the summer of 1930, a timber sale of several thousand acres was carried out in the Lower West Branch and Upper West Branch drainages. The sale was concentrated in the second growth timber where in 1895, Lieberg (1897) described the area as being severely burned over.

Since that early sale, a succession of sales has occurred on USFS lands. Within the entire Lower West Branch, logging has occurred on over 25% of the drainage and the road density throughout the basin is about 5.7 miles/square mile (USFS 1999af, pg. III-462).

Originally, Northern Pacific Railroad owned the odd-numbered sections in the Priest River subbasin area. Most of those sections were either homesteaded beginning in the 1890s, or sold to large timber companies until the USFS acquired some of these lands through land exchanges in the 1930s. The homesteading focused on the lower portion of the drainage where settlers cleared the flatter lands for agricultural purposes or filed on homesteads for the timber rights. Presently, the headwaters of the basin are managed primarily by the USFS though there are some inholdings of private land. A relatively large portion of the lowlands are privately owned and managed, with scattered parcels of industrial timber land. Virtually the entire acreage of these private lands has been logged historically, as evidenced by cleared lands or by old stumps. Based on estimates from recent aerial photos, roughly 50-60% of the private lands in the Lower West Branch drainage are currently forested (USFS 1999af, pg. III-382, 462).

Priest River WAU Current Known Habitat Conditions.

Only the headwaters of the Lower West Branch drainage (Priest River WAU) are located in Washington State; the remainder of the drainage is located in Idaho. Bull trout have never been documented historically or currently in the Lower West Branch drainage (despite survey effort) and Torrelle Falls at RM 8.2 of the 25.3 mile long Lower West Branch is a natural fish passage barrier. Given the scope of the Washington Conservation Commission's limiting factors assessment, the description of habitat conditions in the drainage have been limited to a general summary of habitat conditions.

Priest River WAU Fish Distribution and Use.

It is unknown if bull trout inhabited the lower 8.2 miles of Lower West Branch historically and there is no documentation that they are currently present in the drainage. Bull trout radio telemetry work initiated by the Idaho Department of Fish and Game (IDFG) in late August 2002 in the East River system has reliably established current bull trout use of the mainstem Priest River downstream of the East River confluence (RM 23.0), and in the East River system. The Lower West Branch flows into the mainstem Priest River at RM 5.0. A complete fish migration barrier exists on the mainstem Lower West Branch at Torrelle falls (RM 8.2; IDEQ 2001, pg. 114). The first identified potential human-caused fish passage barrier (RM 11.5) on Lower West Branch Creek is about three miles upstream of Torelle Falls at the Johnson Road culvert crossing (J. Cobb, USFS, pers. comm., 2002). About seven miles further upstream on Lower West Branch Creek there is a double culvert crossing (RM 18.5) on USFS Rd. 305, locally called "the tubes", that is a known barrier to fish passage (J. Cobb, USFS, pers. comm., 2002). Brook trout occur in the drainage, but densities were low when the mainstem was surveyed (IDEQ 2001, pg. 114).

In 1987, Idaho Department of Fish and Game (IDFG) conducted an electro-fishing survey within the mainstem Lower West Branch from the mouth upstream to the

Idaho/Washington border, and within Moores Creek. The USFS conducted snorkeling and electro-fishing surveys in several tributaries in 1992 and 1998. The IDEQ electro-fished two lower mainstem sites in 2000. Bull trout were not detected in any of these surveys, therefore Table 22 below, which describes current, known bull trout use in the Priest River WAU is blank for bull trout. Maps in Appendix C illustrate "Recoverable" bull trout habitat in the WAU; Table D1 in Appendix D provide supporting information for the fish distribution maps.

Table 22: Current, known bull trout use in the Priest River WAU. (Table is blank for bull trout since there are no current, known observations of bull trout in the Priest River WAU).

Priest River WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Lower West Branch					X

Priest River WAU Summary.

The Priest River WAU encompasses the upper reaches of the Lower West Branch drainage located in Washington. Lower West Branch then flows 25.3 miles southeastward into Idaho toward its confluence with the Priest River about 3.5 miles upstream of the Pend Oreille River confluence. The Lower West Branch is a large and complex watershed system with a long history of extensive development and land uses. Elevated instream temperatures in the Lower West Branch from its confluence with the Priest River upstream to Torrelle Falls, and continuing upstream of the falls, are believed to be the primary factor limiting bull trout use in the Lower West Branch (J. Cobb, M. Davis, USFS, pers. comm., 2002). Lack of canopy coverage to provide thermal regulation, along with the negatively impacted stream channel morphology, appear to be the mechanisms contributing to elevated instream temperatures (J. Cobb, M. Davis, USFS, pers. comm., 2002). The destabilized channel morphology is being driven by elevated sediment loads and a low level of functional LWD in the system. Large woody debris recruitment is also limited. The present riparian plant community is in a shrub seral stage; large diameter coniferous stumps scattered within the riparian zone are evidence of the removal of this component from the riparian zone during timber harvest from the 1920s through the 1950s (J. Cobb, USFS, USFS, pers. comm., 2002). Riparian vegetation management targeted at increasing riparian canopy coverage (particularly the conifer component) for the Lower West Branch is critical to mitigating the elevated instream temperatures. In addition to providing shade to the stream, a coordinated effort is needed to control the delivery of sediment to the stream. Reducing sediment delivery would improve the width to depth ratio in the channel and would contribute to reducing stream temperatures.

Torrelle Falls, at RM 8.2, is a natural falls that is a complete barrier to fish passage. The first identified potential human-caused fish passage barrier (RM 11.5) on Lower West Branch Creek is about three miles upstream of Torelle Falls at the Johnson Road culvert crossing (J. Cobb, USFS, pers. comm., 2002). About seven miles further upstream on Lower West Branch Creek there is a double culvert crossing (RM 18.5) on USFS Rd. 305, locally called "the tubes", that is a known barrier to fish passage (J. Cobb, USFS, pers. comm., 2002).

With the exception of some tributaries, the watershed and its streams appear to range from poorly functioning to functioning at risk (IDEQ 2001, pg. 114). The mainstem of the Lower West Branch has been adversely impacted by frequent introductions of large volumes of bedload, historic ditching of tributary channels, past filling of wetlands, and altering of natural drainage patterns with road construction. The channel will not likely move towards stability until large-scale rehabilitation projects are implemented (USFS 1999af, pg. III-462). Knowledge of habitat conditions on stream reaches downstream of Torelle Falls (RM 8.2) is limited, however between October 14 and October 22, 1998, a USFS stream survey was conducted on the mainstem Lower West Branch. The 1998 survey did capture one reach of Lower West Branch downstream of the falls, starting at the USFS lands boundary (RM 7.2). It was classified as an F4 stream type with predominantly gravel and sand with some pockets of cobble. This reach had very little LWD. Where the stream butts up against State Hwy. 57, there was a 20 m *x* 20 m bank slough. Most pools were in the meander bend and banks appeared to be relatively stable with minimal acting erosional forces. There were some old beaver dams in the reach and riparian zone was alder, hawthorn, grasses, and dogwood (USFS 1998b, pg. 1).

Although, restoration of aquatic species is a low priority recommendation in the USFS Ecosystem Assessment of the Priest River Subbasin (USFS 2002, pg. 93 of 116), analyses and field surveys indicate that excessive sediment loading is and has been a chronic water quality concern in the drainage for a long period of time (IDEQ 2001, pg. 110; USFS 1999af, pg. III-462). The Lower West Branch Priest River is on the 1998 IDEQ 303(d) list for sediment (IDEQ 2001, pg. 110). Sediment load calculations suggest that the current sediment load represents at least a moderate increase over background. Currently there is an array of land use practices which are contributing to sediment: increasing development on private lands into small (5 to 10 acre) ranchettes; substandard private roads and driveways; high density USFS roads and stream crossings; maintenance procedures on county roads that contribute to instream sedimentation; timber harvest practices on non-industrial private lands that are not consistent with BMPs; and direct cattle access to streams on private property and USFS grazing allotments (IDEQ 2001, pg. 110). There is evidence that peak flows have been elevated somewhat over natural levels in parts of the watershed (USFS 1999af, pg. III-462).

The Lower West Branch headwaters have had a long history of intense forest development and cattle grazing. The headwaters area has responded with elevated sediment delivery and peak flows. These characteristics are exhibiting a slow recovery trend as roads stabilize and vegetation becomes re-established. Road density calculated for the USFS Lower West Branch Headwaters HUC is 6.8 miles/square mile with a riparian road density of 4.2 miles/square mile. The number of stream crossings is calculated to be 0.9 per mile of stream (USFS 1999af, pg. III-464, 465).

Priest River WAU Data Gaps.

- Temperature studies;
- riparian planting feasibility;
- sediment point sources (J. Cobb, USFS, 1/29/02 final draft review comments, February 2003);
- a road survey identifying high risk channel crossings, high risk roads and manmade fish barriers (J. Cobb, USFS, 1/29/02 final draft review comments, February 2003).

KALISPELL CREEK WAU

Kalispell Creek WAU Description

The Kalispell Creek WAU encompasses the upper drainages of the Upper West Branch, Binarch, Lamb, and Kalispell creeks within Washington State. The remainder of these drainages flow eastward, crossing into Idaho and draining into Priest Lake and Priest River.

Upper West Branch

Upper West Branch flows southeast 22.3 miles to discharge into the lower Priest River (RM 35.3). It drains approximately 44,623 acres and there are approximately 112 miles of perennial streams within the drainage. The lower one-half of the Upper West Branch is mainly a gradual gradient channel through areas of floodplains, but there are some steep reaches near the mouth (IDEQ 2001, pg. 159), namely a site called Mission Falls at RM 0.5, which is not considered a barrier to fish passage. Elevations range from 6,173 feet at the top of North Baldy in Washington to about 2,320 feet where the Upper West Branch flows into Priest River.

The drainage is primarily in USFS lands with 1,627 acres of private land, mostly zoned for agricultural use. About 8,000 acres of USFS land are designated as grazing allotment (IDEQ 2001, pg. 159). Twenty-three percent of the drainage has been logged (IDEQ 2001, pg. 159), with a total road density of 5.9 miles/square mile, a stream crossing frequency of 1.0 crossings/mile of stream and a riparian road density of 5.5 miles/square mile (IDEQ 2001, pg. 159; USFS 2001, pg. III-457, Table III-159). The upper one-half of the drainage burned over in wildfires between 1880 and 1890, and there were large fires between 1925 and 1939 in the headwater lands of Upper West Branch (IDEQ 2001, pg. 159).

Binarch Creek

Binarch Creek flows southeast 8.5 miles to discharge on the west side of the lower Priest River (RM 42.0). It drains approximately 7,232 acres. Elevations range from 2,420 feet at the confluence to 4,170 feet at Binarch Peak in Idaho. The stream is mostly low to moderate gradient meandering through an uncontained floodplain in a wide valley bottom. Annual average precipitation increases from 32 inches at the mouth to approximately 35 inches at high elevations. Precipitation is 25-50% snow with a snowmelt dominated runoff pattern. Peak flow is estimated to be during mid-March through late April (IDEQ 2001, pg. 136).

The underlying geology of the drainage is granitic in the headwaters and metamorphic belt rocks in the remainder of the drainage. The watershed was not scoured by glaciation, but its valley is filled with a reworked glacial outwash pushed in from melting glaciers immediately to the north (USFS 1999af, pg. III-455). Around 1890, almost the entire drainage of Binarch Creek was burned in a large wildfire. No other significant fires have occurred in the drainage since that time. The entire drainage is within the Idaho Panhandle National Forest (IPNF) and a major area of the middle stream reach (RM 3.5 – 6.25) has been designated by the USFS as a Research Natural Area, which comes with numerous land use restrictions (IDEQ 2001, pg. 135). A major length of Binarch Creek has a low to moderate gradient and has extensive senescent and active beaver complexes which have created large pools, glides, and marshes. Binarch Creek flows subsurface in portions of these lower to mid-elevations reaches except during the periods of heavy annual spring runoff. There are no domestic water sources within this drainage. Historically, Binarch Creek was a series of beaver dams and ponds, however the beaver were largely trapped out. Subsequently, the stream system's ability to manage bedload transport was highly altered and streamflows were reduced. In the past 10 to 15 years, it appears that the beaver populations are recovering. Increased beaver activity has the potential to contribute to stream system improvements (USFS 1999af, pg. III-455).

Lamb Creek

Lamb Creek flows southeast 12.8 miles to discharge into the west side of the Priest Lake outlet channel, just upstream of the outlet dam (RM 45.0). It drains approximately 15,615 acres and there are approximately 31 miles of perennial streams. Elevations range from 2,438 feet at the outlet channel to 5,476 feet at Gleason Mountain in Washington. Average annual precipitation increases from 32 inches at the mouth to approximately 40 inches at high elevations. Precipitation is 25-50% snow with a snowmelt dominated runoff pattern. Peak flow is during mid-March although late April. The Lamb Creek drainage has a legacy of large fire events between 1890 and 1939, intermixed with salvage logging.

The lower half of the Lamb Creek flows through a broad, flat terrain with a majority of the section having less than a 0.5% slope. It is primarily Rosgen C4 and C5 channel type

(IDEQ 2001, pg. 82), which is a slightly entrenched, meandering gravel or sand dominated, riffle/pool channel with a well developed floodplain (Rosgen 1996, pg. 5-96). Some of the lower wetlands and wet meadows have been converted to agricultural use and residential/commercial use restricting access to the floodplain. Historically, a major area of the lower reach was likely a large contiguous wetland where beaver dams and pools would have been common. Currently, beaver dams and pools are common in Lamb Creek only upstream of stream reaches which flow through privately managed lands. Valley hillslopes and stream bottom lands are glacial outwash and till and alluvial deposits (IDEQ 2001, pg. 82). The higher elevation lands of the north and west are granitic batholith. The southern mountain ridge is belt rock. Granite bedrock and boulders are part of the upper elevation channels and there is often good canopy cover (IDEQ 2001, pg. 82).

The Lamb Creek drainage has been extensively developed both on and off national forest system lands. In the lower end of the drainage, there have been considerable modifications of a historic wetland complex such as wetland draining, grazing, and home development. Years ago, Lamb Creek was ditched through existing agricultural lands; home and road development is now encroaching on the lower reaches of Lamb Creek and flooding has been reported as a problem in recent years. The road network has a relatively high density (IDEQ 2001, pg. 81; USFS 1999af, pg. III-453).

Kalispell Creek

Kalispell Creek drains 25,210 acres and is a tributary entering the west side of Priest Lake. It flows 14.6 miles east from the headwaters and then southeast to Priest Lake. There are approximately 64 miles of perennial streams in the drainage. Elevations in the Kalispell Creek drainage range from approximately 2,438 feet at Priest Lake to 5,552 feet at Hungry Mountain in Washington. Average annual precipitation increases from 32 inches at the mouth to approximately 40 inches at high elevations. Precipitation is about 25 – 50% snow with a snowmelt dominated runoff pattern. Peak flow is during the period of mid-March through early May. Rain-on-snow events in mid-to-late winter produce only minor hydrograph spikes. Higher elevation lands surrounding the watershed are granitic batholith, and valley hillslopes and stream bottom lands are glacial outwash, till and alluvial deposits. The northern half of the drainage was glaciated, the southern half was unglaciated. The lower-most reaches of Kalispell Creek east of State Hwy. 57 are primarily Rosgen C channel types. Rosgen C channel types are low gradient (<2%), meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplains (Rosgen 1996, pg. 4-4). Alder/shrub bottoms are a very common riparian type, along with associated beaver influenced areas. There are some sections of conifer forest immediately adjacent to the stream. The headwaters of Kalispell Creek and tributaries to the mainstem offer better rearing and spawning habitat than the lower-most reaches of Kalispell Creek, in part because of a higher percentage of Rosgen B channel types, with fewer sand depositional zones, a greater percentage of pools formed by LWD, and more abundant gravels and cobbles (IDEQ 2001, pg. 124). Rosgen B channel types are moderately entrenched, moderate gradient (2-4%), and riffle dominated, with infrequently spaced pools and very stable stream bed and banks (Rosgen 1996, pg. 4-4).

Kalispell Creek WAU Current Known Habitat Conditions.

Only the upper reaches of the Upper West Branch, Binarch, Lamb, and Kalispell drainages (Kalispell Creek WAU) are located in Washington State. The remainder of the drainages are located in Idaho. Given the scope of the Washington Conservation Commission's limiting factors assessment, the description of habitat conditions in the drainage have been limited to the reaches in Washington State where bull trout are known to occur, or where there is "Suitable" or "Recoverable" habitat. Habitat conditions for stream reaches of drainages in Idaho and for Lamb and Binarch creeks are limited to a general summary of habitat conditions presented in the Kalispell Creek WAU Summary.

The following list of information was compiled from a combination of existing data from published and unpublished sources, as well as the professional knowledge of members of the Pend Oreille 2496 TAG. The information presented in the report shows where field biologists have been and what they have seen or studied. The information represents the known and documented locations of impacts. The absence of information for a stream does not necessarily imply that the stream is in good health but may instead indicate a lack of available information. All references to River Miles (RM) are approximate.

Access to Spawning and Rearing

Obstructions

(natural barriers are also provided here)

Upper West Branch. At RM 0.5, there is a natural falls named Mission Falls however this falls is not thought to be a barrier to upstream fish migration. A walk-through survey of the site was conducted by USFS personnel K. Weidich and T. Carrothers on September 4, 2002 to evaluate the falls potential to be a bull trout migration barrier. Mission Falls consists of an upper and lower falls, the lower one being approximately 40 feet downstream of the upper falls. Both falls spanned the entire width of the stream channel. The lower falls are approximately 30 feet wide with a maximum drop of 3 feet. Maximum pool depth below the lower fall is 5 feet. The upper falls is approximately 45 feet wide and consists of two separate falls, each dropping 3 feet. Smaller pools below each falls lead into one larger pool stretching three-quarters of the width of the stream. Maximum depths of the smaller pools are approximately 3 feet and the large pool is 5 feet deep. Above the falls is a run approximately 100 feet long with a 1% slope. Maximum thalweg depth of the run is 1.5 feet. Digital photos were taken of all falls and upstream of the falls (J. Cobb., USFS, pers. comm., 2002).

Binarch Creek. In the lower to mid-elevations, the stream flow of Binarch Creek goes subsurface in short reaches except during the periods of heavy annual spring runoff (USFS 1999af, pg. III-455). The subsurface flows are predominantly evident at old beaver dam sites, all of which were large, abandoned, filling-in, and forming highly vegetated land forms (Wingert 2001, USFS Binarch Creek August 2001 stream survey).

Lamb Creek. The culvert on Outlet Bay Road (RM 0.25) is a potential velocity barrier to fish passage at high flows (J. Cobb, USFS, pers. comm., 2002).

Lamb Creek. There is a 15 foot waterfall on Lamb Creek about 2 miles downstream of the Washington/Idaho border (J. Cobb, USFS, pers. comm., 2002).

Kalispell Creek. Beaver dams are quite large and numerous in the upper portion of the stream reach which extends from just upstream of Virgin Creek (RM 8.5) to just below the confluence with Chute Creek (RM 13.0). During a fall 2001 stream survey (USFS 2002a Stream Survey, pg. 5), the USFS Rd. 308 culvert crossing of Kalispell Creek, located just upstream of the confluence of Mush and Kalispell creeks (RM 12.5), was observed to be dammed by beaver. The resulting reservoir upstream of the culvert was very large. A flood event caused by backwatering at the culvert has the potential to cause stream channel damage downstream (USFS 2002a, pg. 5). The beaver-dammed culvert also has the potential to be a fish passage barrier to fish migrating into Kalispell Creek at low flows (M. Davis, USFS, pers. comm., 2002).

Kalispell Creek. Just upstream of the confluence with Deerhorn Creek (RM 13.25) on Kalispell Creek, there is a waterfall that is most likely a barrier to fish passage (USFS Kalispell Stream Survey 2002a, pg. 6). Irving (1987, pg. 126) mentions a 20-foot rock falls on Kalispell Creek near the confluence of Chute Creek (RM 13.0). This is likely the same falls mentioned by Irving (1987).

Chute Creek. There is a 70-foot falls on Chute Creek about one-third of a mile upstream from its confluence with Kalispell Creek (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Riparian Condition

Upper West Branch drainage. Riparian road density is 5.5 mi./mi^2 (IDEQ 2001, pg. 159).

Upper West Branch drainage. Riparian vegetation has been impacted by cattle grazing (USFS 2002e, pg. 57). A portion of the Upper West Branch upstream of the Washington State line is included in the USFS Upper Squaw Valley cattle grazing allotment (Rademacher 1998).

Binarch Creek. High concentrations of very old cut stumps and cut logs (over 25 years old), deposited parallel to the creek, were prevalent along the entire stream length with frequency increasing progressing towards the headwaters. From the USFS Rd. 219 stream crossing located in Idaho, just downstream (east) of the Washington/Idaho border upstream to the headwaters in Washington State, there are high concentrations of these 25-year-old-plus cut stumps in the riparian zone with high concentrations of LWD bridging the channel in this reach. Large woody debris jams within the channel were filled with sediment and the cause of some channel migrations in the reach (Wingert and Hamilton 1998). From more recent field reviews, it appears that Binarch Creek is stabilizing itself from past disturbances (J. Cobb, USFS, pers. comm., 2002).

Lamb Creek. Associated with residential development, some private landowners have removed riparian vegetation along Lamb Creek where home development is encroaching on the lower reaches of Lamb Creek. Roads and structures are being located within the historic floodplain of the stream and wetlands (USFS 1999af, pg. III-453).

Kalispell Creek. Large stumps in the riparian area show evidence of the loss of the large tree component in the riparian zone, the result of past logging operations (1920s and 1930s) and more recent home development (J. Cobb, USFS, pers. comm., 2002).

Kalispell Creek. Near the crossing of Kalispell Creek and Hwy. 57, there is an on-going gravel operation within the riparian zone (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Kalispell Creek. About 4.0 miles upstream of the Hwy. 57 stream crossing, USFS Rd. 308 encroaches on Kalispell Creek for about one mile and on the floodplain for about 3 miles (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Kalispell Creek drainage. Road density is moderate at 3.0 mi./mi^2. The length of total road network within a 200 ft. zone of streams is 13.8 miles or 0.3 mi/mi. of stream (IDEQ 2001, pg. 128, 129).

Channel Conditions/Dynamics

Streambank Condition

Upper West Branch. Bank erosion is common along the lower reaches due to vegetation changes as a result of cattle grazing. Banks have also eroded as a result of cattle trampling while accessing water (USFS 2002e, pg. 57). A portion of the Upper West Branch upstream of the Washington State line is included in the USFS Upper Squaw Valley cattle grazing allotment (Rademacher 1998).

Binarch Creek. There are 10 human-made check dam structures in the lowest reach of Binarch Creek, four of which have failed. In some instances, the failed check dams have caused channel migration and side cutting (Wingert and Hamilton 1998).

Binarch Creek. In the very upper reach, USFS Rd. 219 crosses Binarch Creek near the Washington/Idaho border. The section of the stream below the road crossing is negatively influenced by the road which follows on either side of the stream for 1/3 mile; bank failures, channel migrations, side channels, and stream divergence are common place. LWD accumulations in the channel, filled-in with sediment, are the cause of some of the channel migrations (Wingert and Hamilton 1998).

Lamb Creek. Elevated amounts of in-channel sediment are associated with aggradation of bedload within the stream channel in low gradient reaches. This is coupled with cattle grazing, and some removal of riparian vegetation and encroachment within the floodplain associated with residential development. These factors are all contributing to channel instability in Lamb Creek (USFS 1999af, pg. III-453).

Kalispell Creek. Development along streambanks in the lowest reach has eliminated riparian vegetation in some places and added riprap in places, leading to accelerated erosion in this reach (USFS 2002a).

Kalispell Creek. About 4.0 miles upstream of the Hwy. 57 stream crossing, USFS Rd. 308 encroaches on Kalispell Creek for about one mile. The USFS Rd. 308 then continues to encroach on the floodplain for about another three miles, although not on the channel itself. There is also a gravel operation within the riparian zone and encroaching on the floodplain immediately upstream of the Hwy 57 bridge (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Floodplain Connectivity

Upper West Branch. About 10 miles upstream from the mouth, a portion of the Upper West Branch and Goose Creek has been ditched through private property (J. Cobb, USFS, pers. comm., 2002).

Upper West Branch. Until the summer of 2001, the USFS Rd. 312 was encroaching on the mainstem of the Upper West Branch. The USFS relocated USFS Rd. 312 and restored connectivity of the Upper West Branch to its floodplains and wetlands for about 0.6 miles (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Lamb Creek. Historically, portions of the stream have been ditched where it passes through agricultural lands reducing the stream's access to its floodplain. Home development is encroaching on the lower reaches of Lamb Creek. The location of roads and structures within the historic floodplain of the stream and wetlands contribute to flood occurrence and damage (USFS 1999af, pg. III-453).

Kalispell Creek. Beaver activity in the lower reaches of Kalispell Creek are backing up water, inundating a significant portion of the floodplain and having an aggrading effect on the channel (USFS 2002a). The stream in these reaches is successfully accessing its floodplain.

Kalispell Creek. Conversion of the lower section of Bismark Meadows (RM 4.5 – 6.0) to hay cropping through cross drainages eliminated some historic meandering and floodplain effectiveness. Sediment delivery has been observed when drainages channels are mechanically re-deepened, and the spoils are piled on top of the ditch bank (IDEQ 2001, pg. 130).

Kalispell Creek. About 4.0 miles upstream of the Hwy. 57 stream crossing, USFS Rd. 308 encroaches on Kalispell Creek for about one mile. The USFS Rd. 308 then continues to encroach on the floodplain for about another three miles, although not on the channel itself (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Kalispell Creek. A four-mile section of USFS Rd. 308 closely parallels Kalispell Creek within its floodplain. The USFS Rd. 308 constricts the stream and reduces the effective floodplain and riparian area where it travels up the valley floor of the middle segment of Kalispell Creek (RM 6.5 – 7.5; IDEQ 2001, pg. 123).

Channel Stability

Upper West Branch drainage. Stream channel condition and stability have been altered due to changes in the timing, magnitude, and quantity of flows from historical disturbance. Ditching of portions of the lower Upper West Branch and Goose Creek, have artificially created an incised channel reach. Where the channel ditching was discontinued, however, the channel is aggrading. Changes in flows have generally exacerbated existing channel disturbances such as weakened stream banks or encroaching roads within channels or their active floodplain (USFS 1999af, pg. III-458).

Binarch Creek. Beaver dams are increasing channel stability. The channel behind the dams is aggrading where bedload is being trapped in the ponds. Flows have been observed to go subsurface in these aggraded reaches during low flow periods. Beaver dams once played a vital role in controlling/maintaining streamflows and sediment transport. Historically, the mainstem of Binarch Creek was a series of beaver dams and ponds. However, the beaver population was largely trapped out. Some of the older dams have failed and few dams have replaced them. Subsequently, large volumes of sediment began moving through the lower reaches of Binarch Creek. The sand is derived primarily from the channel and not the slopes. With the recovery of beaver populations in the drainage, it is expected that overall conditions of the stream should improve over time, continuing to trend towards channel stability (Wingert and Hamilton 1998).

Binarch Creek. In the very upper reach, USFS Rd. 219 crosses Binarch Creek near the Washington/Idaho border. The section of the stream below the road crossing is negatively influenced by the road which follows on either side of the stream for 1/3 mile; Bank failures, channel migrations, side channels, and stream divergence are common place. LWD accumulations in the channel, filled-in with sediment, are the cause of some of the channel migrations (Wingert and Hamilton 1998).

Lamb Creek. The streams in the headwaters are transporting elevated amounts of sediment and show indications of channel scouring from past high water yields. Downstream, where the gradient flattens-out, the stream is depositing a considerable amount of sand within the channel confines. Historically, portions of the stream have been ditched where it passes through agricultural lands. Stream confinement has also occurred on the lower reaches of Lamb Creek as a result of home development and associated road development (USFS 1999af, pg. III-453).

Kalispell Creek. The width-to-depth ratio of the lower reach (upstream from the confluence with Priest Lake) is considerably greater than expected (32.3) given its C4 channel type. One reason for the high W/D ratio is development along streambanks in

the reach which has eliminated riparian vegetation in some places and added riprap in places, leading to accelerated lateral bank erosion in this reach (USFS 2002a).
Kalispell Creek. The entrenchment ratio is relatively high (1.68) for the stream reach from the confluence of Chute Creek (RM13.0) to just below the confluence with Deerhorn Creek (RM13.25). The reach is an A-type channel and passes through a deeply incised V-shaped canyon with easily eroded granitic parent material. Some slopes exceed 100% in certain places and slides are naturally active (USFS 2002a, pg. 6). An A stream type channel is steep, entrenched, and confined and acts naturally to transport bedload material (Rosgen 1996).

Kalispell Creek. Only a relatively small portion of Kalispell Creek is directly affected by Bismark Meadows. However, historically, Bismark Meadows was very integral to the hydrology of Kalispell Creek. The conversion of the lower section of Bismark Meadows (RM 4.5 – 6.0) to hay cropping through cross drainages eliminated some historic meandering and floodplain effectiveness. Sediment delivery has been observed when drainages channels are mechanically re-deepened, and the spoils are piled on top of the ditch bank (IDEQ 2001, pg. 130).

Habitat Elements

Channel Substrate

Upper West Branch. Fish habitat is negatively affected by the increase in sand bedload (USFS 2002e, pg. 57).

Binarch Creek. Binarch Creek was listed on the 1994 and 1996 Idaho 303(d) list for sediment exceedences from the headwaters to its confluence with the Priest River. It was retained on the 1998 Idaho 303(d) list (IDEQ 2001, pg. 135). Elevated sand deposition in Binarch Creek is attributed to past road construction (6.4 miles/square mile), and failed beaver dams. The sand is derived primarily from the channel and not the slopes. Beaver dams once played a vital role in controlling/maintaining streamflows and sediment transport. Historically, the mainstem of Binarch Creek was a series of beaver dams and ponds. However, the beaver population was largely trapped out. Some of the older dams have failed and few dams have replaced them. Subsequently, large volumes of sediment began moving through the lower reaches of Binarch Creek and the streamflows were reduced. With the recovery of beaver populations in the drainage, it is expected that overall conditions of the stream should improve over time, continuing to trend towards channel stability (Wingert and Hamiliton 1998).

Binarch Creek. With the exception of the very lowest stream reach, pool frequency is low and pool habitat is extremely poor due to aggradation of sediment, although pool cover is excellent (Wingert and Hamilton 1998). Except for the lowest stream reach, Binarch Creek is a low gradient, low velocity, meandering, E channel type where sediment will naturally settle out. Road density and past harvest in the Binarch Creek drainage, with the exception of the lower portion of the drainage, is low. The extent to which sediment levels in Binarch Creek are elevated above natural levels by human-induced changes in the drainage is unknown (M. Wingert, KNRD, pers. comm., 2003).

Lamb Creek. Lamb Creek is listed on the 1994 and 1996 303(d) lists for exceeding instream sediment standards. The listing is the result of the EPA analysis of 1992 (IDEQ 2001, pg. 201).

Kalispell Creek. Kalispell Creek is listed on the 1996 and 1998 303(d) list for exceeding instream sediment standards. The 1996 listing is the result of the IPNF watershed analysis (IDEQ 2001, pg. 201). The 1998 listing is for Kalispell Creek from the Washington State line downstream to its confluence with the Priest River (USFS 2002, pg. 81 of 116). Although both the Idaho Department of Environmental Quality (IDEQ) and the USFS agreed that the current level of sediment load to Kalispell Creek has not likely impaired cold water biota beneficial use below Full Support, nor will it prohibit recovery to Full Support, the Priest Lake Watershed Group recommended a sediment TMDL be prepared, as did the EPA (IDEQ 2001, pg. 123). Percent fines data for Kalispell Creek indicates spawning habitat is not of high quality, with highly covered or embedded gravel and cobble (IDEQ 2001, pg. 133).

Kalispell Creek. The sand bedload exceeds the stream's capacity to transport it, with a result of filling in of pools and covering of spawning gravels, having a negative impact on the salmonid fishery of Kalispell Creek (IDEQ 2001, pg. 123).

Kalispell Creek. A portion of USFS Rd. 308, downstream of the Virgin Creek confluence (RM 7.5 – 8.5) delivers sediment to Kalispell Creek and is considered a "Significant Management Problem" (IDEQ 2001, pg. 129). Using sediment yield and delivery-to-streams calculations, the IDEQ (2002, pg. 129, 130) has calculated potential sediment yields to Kalispell Creek as a result of USFS Rd. 308. The calculation takes into account that: 1) during high discharge periods the stream may erode at the road bed or fill slope; 2) the road is insufficiently armored; and 3) the confined stream energy may erode the stream banks and the stream bed. The USFS disagrees with the calculated sediment yields, contending that it is unlikely that the whole road segment would erode and that the USFS has taken actions to mitigate the road's potential to contribute to sediment yields in Kalispell Creek. The USFS is continuing to investigate road removal options for the portion of USFS Rd. 308 where it encroaches on the floodplain (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Kalispell Creek. A 2.0-mile section of USFS Rd. 308 (RM 8.5 – 10.5) encroaches into the floodplain and within 150 feet of the stream. Sediment calculations by IDEQ seem to show that the current sediment load from the road network in the Kalispell Creek drainage is relatively low, with the exception of about a two-mile section of USFS Rd. 308 which closely parallels Kalispell Creek within the floodplain (IDEQ 2002, pg. 123).

Large Woody Debris

Upper West Branch. The stream flows from harvested and roaded headwaters through private ranches and finally into a broad valley before reaching the Priest River (USFS 2002e, pg. 57). Surveys of the stream and reviews of aerial photos document that much of the riparian habitat in the middle reaches has been removed through logging or mechanical clearing to the extent that long-term recruitment of LWD has been negatively impacted. Other reaches have had some riparian harvest but not enough to significantly modify long-term recruitment of LWD (J. Cobb, USFS, pers. comm., 2002).

Lamb Creek. On Lamb Creek, there are some stream segments with very little existing in-channel LWD or recruitable LWD. There are also some stream reaches of Lamb Creek with ample existing LWD but where recruitment of LWD is limited because of past riparian harvesting (USFS 1997a; J. Cobb, USFS, field notes, 1995).

Kalispell Creek. There is insufficient recruitment of LWD in some reaches of Kalispell Creek because of home development, historic fires, and past streamside harvest. Sparse instream cover and insufficient recruitment of LWD, which forms pools, contributes to an impaired salmonid fishery in the Kalispell Creek drainage (IDEQ 2001, pg. 123). Low LWD levels in the lowest reach of Kalispell Creek are mainly due to the young age of the surrounding forest and private development near the floodplain and possibly in the channel (USFS 2002a). In an upper reach of Kalispell Creek which begins just upstream of the Virgin Creek confluence (USFS Reach 6), the forest is generally immature so there is little recruitment of LWD and LWD is lacking instream (USFS 2002a, pg. 5). Historic fires in this area in the 1920s and 1930s burned large portions of the riparian zones in this area of Kalispell Basin and the timber stands have not yet recovered.

Pool Frequency and Quality

Upper West Branch. In general, the Upper West Branch has ample pools with good depth, however the lack of sufficient LWD in the channel reduces the overall stability of the pools. In the sand dominated reaches, the pools are prone to shifting as flows increase and small debris jams fail. The portions of the Upper West Branch and Goose Creek that have been ditched lack sufficient pools (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Binarch Creek. With the exception of the very lowest stream reach, pool frequency is low and pool habitat is extremely poor due to aggradation of sediment, although pool cover is excellent (Wingert and Hamilton 1998). With the exception of the lowest reach, Binarch Creek is a low gradient, low velocity, meandering, E channel type where sediment will naturally settle out. Pool cover is good in Binarch Creek, however pool frequency is lower than expected for this channel type, with even meander bend pools infrequent (M. Wingert, KNRD, pers. comm., 2003).

Lamb Creek. Pool frequency is appropriate for the stream's channel type, however, the natural substrate (sand) is very mobile and pools are subject to change (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Kalispell Creek. Pool frequency in the lower reaches (upstream to State Hwy. 57) are appropriate for the channel type, however pools are mostly created by beaver dams and have a likelihood of filling with sediment. The instream sediment plug which is moving through the Kalispell Creek system is from fires and timber harvest activities in the 1920s and 1930s, and from railroad and road development (J. Cobb, USFS, pers. comm., 2002). The USFS has stated that with few exceptions, identified sediment sources from USFS road networks and timbered units on USFS managed land have been addressed. The IDEQ sediment calculations support this statement showing that the current sediment load from road network is relatively low, with the exception of about a four-mile section of USFS Rd. 308 that closely parallels Kalispell Creek within its floodplain. Large stand-replacing fires in the early-to-mid-1900s, coupled with poor vegetative recovery, timber harvesting and the construction of a transportation network, collectively led to elevated levels of sediment and increased water yields (IDEQ 2001, pg.123).

Pool Depth

Upper West Branch. Pool depth is appropriate for most of the Upper West Branch and its tributaries. However, because of the predominance of sand and lack of LWD for long-term structure, the pools are subject to filling (J. Cobb, USFS, pers. comm., 2002).

Binarch Creek. With the exception of the very lowest stream reach, pool frequency is low and pool habitat is extremely poor due to aggradation of sediment, although pool cover is excellent (Wingert and Hamilton 1998). With the exception of the lowest reach, Binarch Creek is a low gradient, low velocity, meandering, E channel type where sediment will naturally settle out (M. Wingert, KNRD, pers. comm., 2003).

Lamb Creek. Pool depth is appropriate for the stream's channel type, however, the natural substrate (sand) is very mobile and pools are subject to change (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Kalispell Creek. Beaver created the largest pools in the Kalispell drainage of all the Priest River west-side tributary drainages. These large pools offer good over-wintering and rearing habitat for fish (USFS 1998 Priest River R.D. field notes in preparation for the Kalispell draft Environmental Impact Statement cited in IDEQ 2001, pg. 133) however they have a likelihood of filling with sediment. The instream sediment plug which is moving through the Kalispell Creek system is from fires and timber harvest activities in the 1920s and 1930s, and from railroad and road development(J. Cobb, USFS, pers. comm., 2002).

Off-Channel Habitat

Upper West Branch. About 10 miles upstream from the mouth, a portion of the Upper West Branch and Goose Creek has been ditched (J. Cobb, USFS, pers. comm., 2002).

Lamb Creek. Historically, portions of the stream have been ditched where it passes through agricultural lands, reducing access to its floodplain (USFS 1999af, pg. III-453).

Kalispell Creek. From State Hwy. 57 to the Hungry Creek confluence, USFS Rd. 308 encroaches in the channel migration zone and is negatively impacting off-channel habitat (J. Cobb, USFS, pers. comm., 2002).

Kalispell Creek. Conversion of the lower section of Bismark Meadows (RM 3.5 – 4.5) to hay cropping through cross drainages eliminated some historic meandering and floodplain effectiveness.

Water Quality

Temperature

Kalispell Creek. Kalispell Creek is listed on the 1998 IDEQ 303(d) list for temperature exceedences from the Washington State line downstream its confluence with the Priest River (USFS 2002, pg. 81 of 116). The IDEQ placed a temperature sensor near the mouth of Kalispell Creek from August 8 – October 25, 1997. Although the IDEQ did not report the 7-day average maximum temperature, the average daily temperature over this period was 10.3°C (IDEQ 2001, pg. 131).

Water Quantity

Change in Flow Regime

Upper West Branch drainage. Twenty-three percent of the drainage has been logged (IDEQ 2001, pg. 159) over the past 50 years. Runoff patterns and sediment yields within the headwaters of the Upper West Branch drainage have been altered due to past disturbances. The frequency and magnitudes of frequently occurring peak flows have likely been increased in the past due mainly to changes in evapotranspiration rates, canopy cover and road development (USFS 1999af, pg. III-458). Timber harvesting in this basin has been minimal in the past 10 years and it appears from field observations that streamflows are normalizing in the basin as the forest regenerates. Still those areas that are ditched are accelerating the movement of water through the system because the floodplains are not accessible. Presently, the actual amount of water coming off the basin is within the range of natural variability. Human impacts, however, have altered the resiliency of the channel to manage water, bedload and debris channeled into the stream course during and following natural events (J. Cobb, USFS, pers. comm., 2002).

Lamb Creek. Tree removal from past harvest has increased water yield due to reduction of evapotranspiration. The timing and magnitude of peak flows have been altered due to changed in canopy cover, however overall, water yield from timber harvests is decreasing as older harvest units revegetate. In the lower end of the drainage, there have been considerable modifications of historic wetland complex that include drainage, grazing, and home development. Years ago, Lamb Creek was ditched through the existing agricultural lands to improve the land for farming. In the lowest elevations of Lamb Creek, residential development includes some encroachment into the floodplain and riparian vegetation removal (USFS 1999af, pg. III-453).

Kalispell Creek drainage. Large fires in the early-to-mid-1900s, intermixed with poor vegetative recovery timber harvest and the construction of a transportation network, collectively led to increased water yields within the drainage (IDEQ 2001, pg.123). Currently, there still appears to be an altered hydrologic regime in the Kalispell Creek drainage because at least one-quarter of the drainage has not recovered from historic fire impacts (J. Cobb, USFS, pers. comm., 2002).

Species Competition

Non-indigenous Fish

Upper West Branch. Brook trout are known to occur and are abundant (Horner et al. 1988, pg. 124 and Table 7; Horner et al. 1987, pg. 110 and Table 7).

Binarch Creek. Brook trout are known to occur and are abundant in the lower 1.35 miles based on survey efforts in 1986 by the IDFG (Horner et al. 1987, pg. 110 and Table 7). During 1998 fish surveys, the USFS also detected brook trout in lower Binarch Creek up to RM 1.5. The USFS surveys above RM 1.5 did not detect any brook trout (USFS 2001c). Binarch Creek naturally goes subsurface in various areas upstream of RM 1.5. A pure strain of cutthroat trout are known to occur upstream of the naturally dewatering areas (M. Wingert, KNRD, pers. comm., 2003).

Lamb Creek. Brook trout are known to occur based on a 2000 IDEQ electro-fishing survey at an upper and lower site on Lamb Creek (IDEQ 2001, pg. 81).

Kalispell Creek. Brook trout are the dominant salmonid species, but IDEQ reported that even their population numbers appear low in relation to other comparable streams (IDEQ 2001, pg. 123 and Table 3-8).

Hungry Creek. Brook trout are known to occur (IDEQ 2001, pg. 123 and Table 3-8; Irving 1987). Based on fish survey information collected from 1982 through 1984, Irving (1987, pg. 96) found brook trout in drainages of both Priest Lake and Upper Priest Lake but found them to be most abundant in Hungry Creek and No Name Creek, a tributary to Kalispell Creek.

Kalispell Creek WAU Fish Distribution and Use.

Table 23 below describes current, known bull trout use in the Kalispell Creek WAU. Maps in Appendix C illustrate "Recoverable" bull trout habitat in the WAU; Table D1 in Appendix D provide supporting information for the fish distribution maps. Upper West Branch and Binarch Creek flow into the lower Priest River. Lamb Creek flows into the Priest Lake outlet channel and Kalispell Creek flows into Priest Lake. There were no known natural blockages historically, nor are there presently, to prevent fish passage from the Priest River system into the streams within the Kalispell Creek WAU. Using his best professional judgement, Irving (1987, pg. 26, 27, Table 4) identified upper extents of fish passage for the Kalispell drainage. Irving's area of study did not include the Upper West Branch, Binarch, or Lamb creeks. Irving only identified barriers near the mouths of both Mush and Pable creeks; a 1 meter (3 foot) log falls on Mush Creek and a 6.2 meter (20.5 foot) falls on Pable Creek (Irving 1987, pg. 108, Table A1). With current barrier assessment methodology and criteria, the extent to which the falls and log jams identified by Irving based on professional knowledge, are fish passage barriers, is questionable.

Bull trout once inhabited Kalispell Creek but the last reported observation of bull trout was in 1984 (IDEQ 2001, pg. 127; Irving 1987, pg. 39, Table 5). Snorkeling surveys conducted in 1982, 1983 and 1984 in Kalispell Creek and some of its tributaries found bull trout at very low densities (Irving 1987, Table 5). In the 1982 and 1983 surveys, bull trout were found in only one 3.35-mile section of Kalispell Creek where a mean bull trout density of 0.08 fish/100 m^2 was recorded (Irving 1987). In the draft Priest River Basin Bull Trout Problem Assessment, Kalispell Creek is considered of high importance to bull trout (Panhandle Basin Bull Trout Technical Advisory Team 1998, Table 3). Several electro-fishing efforts by the USFS have been conducted in Kalispell Creek since 1990, along with IDEQ electro-fishing in 2000, but bull trout have not been detected. Local ranchers state that bull trout were historically present in the Upper West Branch and Goose Creek, a tributary, but they are suspected to not be present now (IDEQ 2001, pg. 159). Bull trout are not known to occur presently in Upper West Branch, Binarch Creek, or Lamb Creek (Horner et al. 1986, pg. 112).

Brook trout have been documented throughout the Kalispell Creek WAU (Irving 1987, Table 5).

Table 23: Current, known bull trout use in the Kalispell Creek WAU.

Kalispell Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Upper West Branch					X

Binarch Creek					X
Lamb Creek					X
Kalispell Creek		X			X
Hungry Creek					X

Kalispell Creek WAU Summary.

From the Lamb Creek drainage south (including the Lower West Branch drainage), tributaries to the Priest River subbasin represent some of the more highly altered landscapes in the Priest River Subbasin. The landscapes are extensively modified by past activities including wildfire, timber harvest, road building and grazing. The area contains a large amount of nonfederal ownership lands and much of the valley bottoms have been converted for agricultural use. The area streams contain isolated populations of native fish with exotic species interspersed. The mainstem Priest River as well as the Lower West Branch, Lamb, Binarch, and Kalispell creeks have 303(d) listings for sediment. All will be retained on the 303 (d) list for temperature (J. Cobb, USFS, pers. comm., 2002). The headwater areas of any given drainage in the Kalispell Creek WAU are less impacted than the rest of the drainage and the habitat in the headwater areas is still functioning within the natural range of variability. The remaining areas of drainages have multiple habitat degradation concerns (USFS 2002, pg. 89 of 116). The Kalispell drainage is also heavily impacted by past activities and is at risk for many of its ecological functions (USFS 2002, pg. 89 of 116); the habitat quality of the lower-most reach of Kalispell Creek is considered low-marginal because of the lack of adequate cover and habitat complexity (IDEQ 2002, pg. 124).

Upper West Branch

Elevated instream temperature in the ditched reaches of the Upper West Branch is the habitat condition most limiting bull trout use in the Upper West Branch drainage. The factor most closely tied to elevated instream temperatures is the simplification of the stream channel structure in the lower five miles of Goose Creek (the Big Meadows area), and in the mainstem Upper West Branch from the Goose Creek confluence downstream for approximately four miles. Historic ditching of the stream channels resulted in altered flow regimes through the ditched stream reaches, decreased in-channel structure, and decreased stream channel cover. Goose Creek was originally ditched to accommodate an historic railroad. Subsequent land use practices, like grazing, have exacerbated instream temperature problems and further negatively impacted the riparian zone (J. Cobb, M. Davis, USFS, pers. comm., 2002).

Runoff patterns and sediment yields within the headwaters of the Upper West Branch drainage have been altered due to past disturbances as evidenced by changes in evapotranspiration rates, canopy cover and road development. Peak stream flows are normalizing within the basin as the older areas of disturbance regenerate and the past road obliteration work stabilizes. Historically, changes in streamflows had generally exacerbated existing channel disturbances such as weakened stream banks or encroaching roads within channels or their active floodplain (USFS 1999af, pg. III-458). The mainstem of the Upper West Branch is where so much of the historical sediment from past activities has settled. In addition to sediment delivered from upstream sources, sediment has also been contributed to this section from localized activities (USFS 1999af, pg. III-461). No fish passage barriers have been identified on Upper West Branch (USFS 1999af, pg. III-458, 461). This includes Mission Falls which is located at RM 0.5 but has been determined by the USFS to be passable to migrating bull trout (J. Cobb, USFS, pers. comm., 2002).

Binarch Creek

A very small portion of the upper drainage of Binarch Creek lies within Washington State. Therefore, the opportunity to contribute to sustaining bull trout populations in the Binarch Creek drainage by implementing habitat restoration or protection projects within the Washington State portions of the drainage is limited. Stream channel dewatering in Binarch Creek is known to occur naturally in the low- to mid-elevations and is documented as occurring as far downstream as RM 3. Binarch Creek flows subsurface in the lower to mid-elevations except during periods of heavy annual spring runoff. Rabe (1995) noted that at about RM 5.75, two miles upstream of the RNA boundary (RM 3.75 – 6.75), steep talus slopes constrict the valley floor and the stream in places goes underground (USFS 1999af, pg. III-455; Wingert 2001). Subsurface flows in Binarch Creek are believed to be a function of natural conditions (J. Cobb, USFS, pers. comm., 2002). The subsurface flows are predominantly evident at old beaver dam sites, all of which were large, abandoned, filling-in, and forming highly vegetated land forms. Except for the seasonally dewatered conditions, there are no other known fish passage barriers (USFS 1999af, pg. III-455, 456). Brook trout have only been detected in the lower 1.5 miles of Binarch Creek during 1986 surveys by IDFG and also in 1998 surveys by the USFS.

In the Idaho portion of the Binarch Creek drainage, there are some negative habitat impacts associated with roads and past harvest. In the very upper reach of Binarch Creek, USFS Rd. 219 crosses the stream near the Washington/Idaho border. The section of the stream below the road crossing is negatively influenced by the road which follows on either side of the stream for 1/3 mile; bank failures, channel migrations, side channels, and stream divergence are common place. The cause of some of the channel migrations is LWD accumulations in the channel that have filled-in with sediment, (Wingert and Hamilton 1998). From the headwaters to just downstream the USFS Rd. 219 crossing, there are high concentrations of cut stumps in the riparian zone. High concentrations of LWD bridge the channel in this same reach (Wingert and Hamilton 1998).

The elevated level of sand deposition in Binarch Creek is attributed to past road construction (6.4 miles/square mile; riparian road density 5.7 miles/sq. mile), historict timber harvesting, and failed beaver dams. Though the road densities appear to be relatively high, the values do need to be put in context. Binarch Creek is a fairly small drainage with an elongated drainage pattern. The majority of the roads in the system follow the riparian zone in the lower end of the drainage. Also, there are several miles of roads on sideslopes that have naturally revegetated with brush. Opportunities exist to reduce the risk of additional sediment delivery to the streams by improving drainage off of existing roads and by obliterating the non-essential roads that contribute to the high road density values. The sediment within the live channel will continue to be reworked through the system each spring during the peak stream runoff (J. Cobb, USFS, 1/29/03 final draft review comments, February 2003). The USFS attributes elevated instream sand loads as being derived primarily from the channel and not the slopes. Historically, beaver dams played a vital role in controlling/maintaining streamflows and sediment transport. However, the beaver population was largely trapped out in the 1970s. During the 1970s and 1980s, some of the older dams failed and few dams have replaced them. With the recovery of beaver populations in the drainage, it is expected that overall conditions of the stream should improve over time, continuing to trend towards channel stability (Wingert and Hamilton 1998).

Lamb Creek

In addition to a partial fish passage barrier culvert at RM 0.25, stream channel alterations associated with agricultural use and residential development in lower Lamb Creek are the primary limiting condition to sustaining bull trout populations in the Lamb Creek drainage. In the lower reaches of Lamb Creek, a large wetland-wet meadow floodplain was drained and ditched for agricultural development. The historic wetland-wet meadow complex has also been modified for rural residential/commercial development. These modifications have negatively impacted floodplain and channel function.

On the broadest scale, the Lamb Creek drainage is hydrologically destabilized. Past timber harvest and road construction impacts, in addition to agricultural use and residential development in lower Lamb Creek, collectively are contributing to degraded habitat conditions in the drainage. Along with stream encroachment and altered flows, instream bedload levels are exceeding the stream’s transport capacity (IDEQ 2001, Pg. 81; USFS 1999af, pg. III-453). A few streams in the headwaters are transporting elevated levels of sediment and show indications of channel scouring during high water yields. Sediment load calculations for the Lamb Creek drainage suggests that the current sediment load represents a moderate increase over background, and possibly could inhibit any future fisheries management effort to benefit cutthroat trout within the stream system (IDEQ 2001, PG. 81). A 15-foot waterfall on Lamb about two miles downstream of the Washington/Idaho State border, is a full barrier to upstream fish passage.

Kalispell Creek

Overall, the conditions most limiting bull trout populations in the Kalispell Creek drainage are unclear. Survey of habitat conditions and analysis of the data is on-going, mostly by the USFS and IDEQ. Perhaps related to the decline of bull trout populations in the Kalispell Creek drainage, is the loss of adfluvial bull trout populations in Priest Lake (G. Rothrock, IDEQ, pers. comm., 2003). In addition to the declining success of an adfluvial life history form, habitat degradation has occurred in the Kalispell drainage, perhaps further contributing to the loss of bull trout populations in the drainage.

However, the extent to which factors outside the Kalispell Creek drainage, in combination with habitat degradation or alone, may have contributed to the loss of bull trout populations within the drainage is unknown.

Sediment levels related to a large sediment pulse from the 1930s is still negatively affecting channel conditions. Kalispell Creek is on the 1998 IDEQ 303(d) list for sediment exceedences. The USFS has stated that with few exceptions, identified sediment sources from USFS road networks and timbered units on USFS managed land have been addressed. The IDEQ sediment calculations support this statement showing that the current sediment load from road network is relatively low, with the exception of about a three-mile section of USFS Rd. 308 that closely parallels Kalispell Creek within its floodplain. Large fires in the early-to-mid-1900s intermixed with poor vegetation recovery, timber harvesting, and construction of a transportation network, led historically to high sediment delivery and water yield in the drainage. However, the conclusion of the USFS watershed assessment is that the current habitat conditions seem largely a reflection of historic fire and legacy land use rather than recent sediment loading, and to some degree a reflection of the predominant granitic geology.

Kalispell Creek is listed on the 1998 IDEQ 303(d) list for temperature exceedences from the Washington State line downstream its confluence with the Priest River (USFS 2002, pg. 81 of 116) and the overall habitat quality of the lower half-mile reach of Kalispell Creek is considered low-to-marginal. A lack of adequate instream cover, habitat complexity, and depth to support large numbers of fish define habitat degradation in lower Kalispell Creek. Major sections of the stream channel have thick, sandy bottoms. Recruitment of LWD is low, in part because of timber removal, railroad construction, road construction, and historic fire. Percent fines and cobble embeddedness is high.

In the headwaters of Kalispell Creek and its tributaries, the channel type lends itself more to spawning and rearing habitat for salmonids but much of this spawning habitat is highly embedded (IDEQ 2002, pg. 124; USFS 2002 stream survey, pp. 2-5). Beaver dams and pools are common throughout Kalispell Creek. On Kalispell Creek, just upstream of the confluence with Deerhorn Creek (RM 13.25), there is a waterfall that is most likely a barrier to fish passage (USFS Kalispell Stream Survey 2002a, pg. 6). Historically, in the lower gradient stream reaches of the drainage, beaver were probably very important to maintaining fisheries and to providing channel structure. Accordingly to preliminary reviews (aerial photo interpretation and field surveys) by the USFS, there are fewer large diameter trees lining the streams than there were 100 years ago. A reduction in larger diameter trees would reduce the role of LWD in the stream today. Woody debris is lacking in the system today, further contributing to degraded habitat conditions resulting from elevated instream sediment levels. It appears from surveys conducted in 2002, that beaver activity in the basin has accelerated significantly in the past two years and that the beaver dams are providing the streams with channel structure. It is possible that historically that streams relied alternatively on LWD and beavers depending upon where the streams riparian zone was successionally. Currently, sparse instream cover and insufficient recruitment of LWD, which forms pools, is contributing to an impaired salmonid fishery in the Kalispell Creek drainage, as does competition with brook trout in the drainage (IDEQ 2001, pg. 123).

Kalispell Creek WAU Data Gaps.

- An investigation of macroinvertebrate and chemical conditions in Kalispell Creek to determine the health of the aquatic system. Bull trout were last observed in Kalispell Creek in 1984 and fish populations in general are low (M. Davis, USFS, pers. comm., 2002);

- the extent to which the loss of the adfluvial bull trout population in Priest Lake may limit the sustainability of a bull trout population in Kalispell Creek;

- the effect of the lack of bull trout passage at the Priest Lake Outlet Dam on bull trout populations in the the Kalispell WAU;

- stream temperature data on most streams in the Kalispell WAU;

- a road condition and maintenance survey identifying high-risk channel crossings, high-risk roads, and manmade fish barriers;

- Evaluation of riparian planting needs.

<u>GRANITE CREEK WAU</u>

Granite Creek WAU Description

Granite Creek is a major tributary to Priest Lake (USFS 1999af, pg. III-446) of which the Granite Creek WAU encompasses only the North and South forks in the upper Granite Creek drainage, almost in their entirety. The headwaters of the two forks originate in high mountainous areas of Washington State from 5,700 to 6,500 feet in elevation with steep B and A channel types. Downstream of the North Fork (11.7 miles in length) and the South Fork (14 miles in length), the mainstem Granite Creek flows eastward 10.7 miles southeastward to its confluence with the Priest Lake. The mainstem Granite Creek is mostly low gradient and free of significant fish passage barriers, however Granite Creek from the mouth to the headwaters is proposed for listing on the 303(d) list for temperature exceedences (USFS 2002, pg. 65, 72). The drainage size is 64,024 acres; Granite Creek is the single largest tributary drainage to the Priest Lake. There are approximately 129 miles of perennial streams with the Granite Creek drainage (IDEQ 2001, pg. 157, 158). Granite Creek has been strongly influenced by continental glaciation and develops a snowpack in mid-winter that tends to be responsive to "rain-on-snow" hydrologic events (USFS 1999af, pg. III-446). Precipitation in the drainage ranges from 38 to 43 inches annually (USFS 2002, pg. 65 and 72 of 116). There were extensive natural wildfires and multiple reburns over much of the Granite Creek drainage between 1890 and 1940.

The WAU boundary, which is also the Washington/Idaho state line, bisects the Granite Creek drainage about ¼ mile upstream of the point where Granite Creek splits into the North and South forks. Stream survey data collected for the South Fork Granite Creek portion of the upper drainage indicate that embeddedness was moderate (38%) and stream banks were generally stable (82%). Spawning gravels were common for fall spawning bull trout with substrate dominated by cobble (43.9%). The average gradient of South Fork Granite Creek is 4.3% (KNRD 1997a, pg. 4). There are also reaches of gradual gradient in the upper watershed with wide floodplains and wet meadows, such as the large Sema Meadows (RM 3.0) of the South Fork drainage. Sema Creek is essentially an open, grassy meadow where, with any increase in gradient, small timbered areas have developed, although none more than about ¼ mile in length (USFS 2002e, pg. 11-13). The geology of North Fork Granite Creek is primarily glaciated belts with fairly stable soils. In some locations of the drainage, dense subsoil restricts water movement and root penetration. This somewhat impervious layer contributes to increased windthrow and cutbank sloughing (USFS 2002e, pg. 3). The Granite Creek drainage is primarily USFS land. There are blocks of industrial timber land within the South Fork drainage and there are private residential and timber lands adjacent to the lower main stem channel and surrounding the mouth of Granite Creek. Land use is mostly timber harvesting and the USFS reports low to moderate land use disturbance with 9% of the drainage logged, a total road density of 3.7 miles/ sq. mile, a stream crossing density of 0.6 crossings/mile, and a riparian road density of 3.1 miles/sq. mile (USFS 1999af, pg. III-447).

Road development and timber harvest in the Granite Creek drainage has led to subtle changes in the flow regime drainage-wide, with the exception of the mainstem of S. Fk. Granite Creek (J. Cobb, USFS, pers. comm., 2002). A disproportionate number of landslides appear to be associated with the presence of roads in the drainage (USFS 1999af, pg. III-446) and USFS Rd. 302 parallels a five-to-seven-mile portion of Granite Creek/N. Fk. Granite Creek encroaching on the riparian zone (USFS 2002c Granite Creek Stream Survey). Road encroachment by USFS Rd. 302 is negatively impacting LWD levels and substrate conditions on North Fork Granite Creek (J. Cobb, M. Davis, USFS, pers. comm., 2002). The limited late successional riparian habitat, especially in the Tillicum Creek drainage (tributary to N. Fk. Granite Creek) is related to the impacts from the historic natural fires (J. Cobb, M. Davis, USFS, pers. comm., 2002). There are domestic water rights associated with the private land holdings in the lower reaches of the mainstem Granite Creek. Residential developments are also evolving in the lower reaches of the drainage (USFS 1999af, pg. III-446).

Granite Creek WAU Current Known Habitat Conditions.

Only North Fork Granite Creek and South Fork Granite Creek are located within Washington State (Granite Creek WAU). The remainder of the drainage is located in Idaho. Given the scope of the Washington Conservation Commission's limiting factors assessment and the limited extent of degraded habitat conditions indicated in the literature for the stream reaches within Washington State, the description of habitat conditions in the drainage have been limited to a general summary. Habitat conditions for stream reaches for the portion of the drainage in Idaho are also limited to a general summary of habitat conditions (Granite Creek WAU Summary).

Granite Creek WAU Fish Distribution and Use.

Table 24 below describes current, known bull trout use in the Granite Creek WAU. Maps in Appendix C illustrate currently occupied and "Suitable" bull trout habitat in the WAU; Table D1 in Appendix D provide supporting information for the fish distribution maps. Granite Creek flows into Priest Lake and there were no known natural blockages historically, nor are there presently, to prevent fish passage from the Priest River system into the streams within the Granite Creek WAU. Using his best professional judgement, Irving (1987, pg. 26, 27, Table 4) identified upper extents of fish passage on select streams in the drainage. Irving did not identify any natural barriers on Granite Creek, however he did describe Granite Falls (RM 6.8) on North Fork Granite Creek within Washington State as a 9.1 m (30 foot) falls that marked the upper extent of bull trout distribution on N. Fk. Granite Creek. Irving also identified as a barrier a one-meter falls on South Fork Granite Creek at RM 7.4 and a 30-foot rock falls on Tillicum Creek at RM 0.2 as a fish passage barrier. With current barrier assessment methodology and criteria, the extent to which some natural falls, cascades, or log jams identified by Irving (based on professional knowledge) as fish passage barriers, is questionable. In the very upper reaches of South Fork Granite Creek, steep gradients (32.5% at the first steep gradient recorded) and intermittent flow was identified by Kalispel Natural Resource Department (KNRD) as likely to begin limiting fish passage (KNRD 1997a, pg. 19, 26, 45, Appendices C, D, and G).

The precise historic distribution of bull trout in Granite Creek is unknown, however bull trout are still present in Granite Creek although at low densities (USFS 2002e, pg. 5). The drainage was considered of high importance in bull trout recovery planning efforts by the Panhandle Basin Bull Trout Technical Advisory Team (TAT; Panhandle Basin Bull Trout TAT 1998 Table 3). Although historic abundance numbers for bull trout in Granite Creek is not available, the cutthroat trout is an example of another adfluvial salmonid population that once flourished in the Granite Creek drainage. The adfluvial cutthroat trout population of Granite Creek was at one time large enough to support the taking of adults for an artificial spawning operation being conducted during the 1930s and 1940s. During the spring of 1947, one thousand six hundred and sixty cutthroat spawners were caught in the Granite Creek trap located approximately six miles up from the lake confluence, indicating a fair sized number of adfluvial life history salmonids (cutthroat in this case) were spawning in Granite Creek as late as 1947. In 1956, although numerous attempts were made to collect cutthroat spawners in Granite Creek with a hook and line, the net result was a dozen fish captured (Bjornn 1957, pg. 51, 52).

More recently, in the 1970s, Tom Holman, a local landowner (pers. comm., 2002), reported catching a large 3-foot bull trout in Granite Creek in the Myers Ranch reach, which is upstream of Kerr Lake. Between 1983 and 1994, IDFG conducted fish sampling surveys on the mainstem Granite Creek and on the South Fork in various years. Bull trout were present in the mainstem and in the South Fork, both at low densities (0.2 and 0.5 fish/100m^2, respectively; IDEQ 2001, pg. 41). In 1997, IDFG surveyed the upper mainstem Granite Creek by electrofishing and detected no bull trout (IDEQ 2001, pg. 158). The IDFG also surveyed the South Fork in 1997 but captured only one bull trout. The KNRD also surveyed the South Fork in 1997 by snorkeling but no bull trout were captured (KNRD 1997a, pg. 4). Irving (1987, pg. 34-39, Table 5) surveyed for bull trout in the Granite Creek drainage in 1982, 1983, and 1984. Irving detected bull trout in 1982 in Granite, Tillicum, and S. Fk. Granite creeks. In 1983, bull trout were detected in Granite, N. Fk. Granite, Blacktail, Jost, Zero, Packer, Fedar, Tillicum, and S. Fk. Granite creeks. In 1984, bull trout were detected in N. Fk. Granite, Blacktail, Packer, Tillicum, and S. Fk. Granite creeks. All bull trout detections made by Irving were only found in low densities. Brook trout are known to occur throughout the Granite Creek drainage (USFS, 2002d; USFS 2002e; Irving 1987, pg. 34-39, Table 5).

Table 24: Current, known bull trout use in the Granite Creek WAU.

Granite Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Granite Creek	X	X	X		X
S. Fk. Granite Creek	X	X	X		X
N. Fk. Granite Creek	X	X	X		X
Tillicum Creek	X	X	X		X

Granite Creek WAU Summary.

Of the streams flowing into Priest Lake from the west, Granite Creek is likely the most important stream in regards to maintaining bull trout persistence in this portion of the Priest River Subbasin (USFS 1999af, pg. III-522). The Granite Creek drainage develops a snowpack in mid-winter that tends to be responsive to “rain-on-snow” hydrologic events (USFS 1999af, pg. III-446), however overall, the ecological functions for the portion of upper Granite Creek drainage lying upstream of the Zero Creek confluence (RM 13.5), are consistently high. Remnant adfluvial native fish are present and riparian area impacts are mostly related to historic natural fires that burned much of the Granite Creek drainage between 1890 and 1940. Water quality is excellent, stream flows tend to be well regulated, are generally stable and operating within expected dynamic equilibrium for post-fire conditions. The watersheds essentially are properly functioning with landscapes functioning in an historic manner. Although much of the area burned in

1926, the unburned areas have a high portion of old growth and ancient cedar stands and the area has a high concentration of peatlands and wetlands (USFS 2002, pg. 64 of 116).

The lower portion of the Granite Creek drainage (downstream of the Zero Creek confluence about ½ mile east of the Washington/Idaho border) transitions from the high integrity landscapes of the upper drainage to landscapes at higher risk and with multiple ecological restoration needs. Sediment levels in lower Granite Creek are the most limiting factor to bull trout populations in the drainage. Sediment delivery is from mass failures associated with roads. Recent failures have occurred in N. Fk. Granite Creek and on the mainstem Granite Creek; on average there is one mass failure per year (J. Cobb, USFS, pers. comm., 2002). In the very upper reaches of N. Fk. Granite Creek (upstream of N. Fk. Granite Creek falls at RM 6.8), in 1998 the USFS noted that some portions of USFS Rd. 1124 were failing due to a lack of road maintenance and the recurrence of an ancient mass failure. Since the initital observations of USFS Rd. 1124 failures, more recent surveys have documented that USFS Rd. 1124 failures are increasing, causing sediment delivery to Willow Creek and N. Fk. Grantite Creek and impacting fish habitat downstream. In a joint effort (KNRD, WDFW, USFS), in February 2003, the USFS began conducting the environmental analysis for a proposed a road treatment project (Willow Creek Stream Restoration Proposal Project) for 8.4 miles of USFS Rds. 1122 and 1124. The proposed project is aimed at removing the risk of road failure and subsequent damage to the aquatic resources and improving fish habitat (USFS Feb. 18, 2003 notice of environmental analysis and request for comments).

Second to road failures contributing to elevated sediment levels in Granite Creek, stream channel confinement and riparian habitat degradation limit bull trout populations. Confinement of the stream channel is the result of road location within the channel migration zone. Negative impacts to riparian zone conditions are the result of fragmentation by roads, residential development, and past harvest activities (J. Cobb, USFS, pers. comm., 2002). Remnant native fish populations are present, but valley bottom roads constrict stream migration routes and introduced fish species are pervasive. Stream flows tend to be well regulated and water quality is good (USFS 2002, pg. 71 of 116), however Granite Creek from the mouth to the headwaters is proposed to be listed on the 303(d) list for temperature exceedences (USFS 2002, pg. 65, 72). From August 8 – September 30, 1997, the Idaho Department of Environmental Quality (IDEQ) placed a temperature sensor in lower Granite Creek. Although the IDEQ report does not supply the raw data nor the 7-day average maximum temperature for the period of record, the report provides the highest mean daily temperature (12.1ºC/53.8ºF) and maximum hourly temperature (13.8ºC/56.8ºF). On 70% of the days for which stream temperatures were recorded, the Environmental Protection Agency (EPA) bull trout temperature criterion was exceeded (IDEQ 2001, pg. 159).

Much of the habitat degradation in the lower drainage is due to fragmentation by roads, residential development, and past harvest activities. Portions of this area contain significant old growth but many stands are fragmented by recent harvest activity. Important peatland and wetlands occur in the lower drainage, including Packer Meadows around Granite Creek (USFS 2002, pg. 71 of 116). The mainstem Granite Creek remains a fairly stable stream that does have some problems with elevated sediment deposition and lack of incorporated LWD The lack of incorporated LWD in the system further inhibits the system's ability to manage the elevated bedload level and increased water yield within Granite Creek. The lack of functioning LWD may be a symptom of high streamflows and/or channel configurations (USFS 1999af, pg. III-446). An interesting observation in the mainstem of Granite Creek is the lack of large woody debris spanning the channel. It appears that during spring runoff periods, the LWD is moved up against the channel banks. There are some sections of the channel where braiding occurs, though these limited reaches are located immediately downstream of steeper confined channel reaches. The stream appears to have elevated levels of sediment moving through the system. This elevated level of sediment could be attributed in the natural migration of the channel, failure of existing roads and historic road construction, timber harvesting and wildfires (J. Cobb, USFS, pers. comm., 2002).

The watershed has experienced several high-energy floods in the last decade. The floods were regional in nature and are the expected response in this kind of landscape. The watershed was subject to an unusual degree of mass wasting and debris avalanches that resulted in local sedimentation and damage to some tributary streams. A disproportionate number of landslides appeared to be associated with the presence of roads in the watershed (USFS 1999af, pg. III-446).

Granite Creek WAU Data Gaps.

- Identification of fish passage barriers.

GOLD CREEK WAU

Gold Creek WAU Description

The Gold Creek WAU encompasses the upper reaches and headwaters of Gold Creek. Gold Creek (RM 5.25) is a primary tributary to Hughes Fork which is a tributary to the Upper Priest River in Idaho. A portion of Jackson (RM 9.25) and Bench (RM 10.5) creeks, two eastward draining tributaries that originate in Washington and discharge into the middle reach of Hughes Fork, are also included in the Gold Creek WAU. The remainder of the Hughes Fork drainage is located in Idaho. The entire drainage, including the Washington portion, is 38,647 acres in size. Hughes Fork flows into Upper Priest River in Idaho at RM 0.5, just upstream of the northern tip of Upper Priest Lake. Hughes Fork has a mainstem length of 14 miles and approximately 67 miles of perennial streams. The mainstem of Hughes Fork is mostly gradual gradient for the first 0.5 mile of its length. About seven miles upstream from the mouth of Hughes Fork, the stream flows though Hughes Meadows, a large wetland/wet meadows complex (IDEQ 2001, pg. 151). The mainstem upstream of Hughes Meadows is dominated by sands, but is considered hydrologically stable. A reach of Hughes Fork running through Hughes Meadow was channelized during the 1940s for construction of an airstrip. The channelized stream reach is now considered extremely poor habitat and has been a source of increased sediment to downstream reaches. This instability is apparent further downstream in the excessive depositional features and the lack of sufficient large organic debris (Panhandle Basin Bull Trout TAT 1998, pg. 20). The watershed is considered of high importance in bull trout recovery plans (Panhandle Basin Bull Trout TAT 1998, Table 3).

The entire Hughes Fork drainage is on USFS land, and the western range of the drainage (the majority of which falls into the Gold Creek WAU) is part of the Salmo-Priest Wilderness Area (IDEQ 2001, pg. 151). Past land use has been primarily timber harvest however no timber harvest or new road construction has taken place since about 1997 (J. Cobb, USFS, pers. comm., 2002). The USFS reports moderate historic land use disturbance with 18% of the watershed logged, a total road density of 3.1 miles/sq. mile, a stream crossing frequency of 0.6 crossings/mile of stream, and a riparian road density of 2.5 miles/sq. mile (IDEQ 2001, pg. 151). With a total of 19% of the drainage in hydrologic openings, there are increased peak flows during high runoff events (Panhandle Basin Bull Trout TAT 1998, Table 3). Based on a USFS gauging station on Upper Priest River, the estimated Water Year 1995 mean daily spring high flow for lower Hughes Fork ranged from 400-650 cfs, and summer base flow in 40 – 90 cfs (IDEQ 2001, pg. 151).

Gold Creek (RM 5.25), Jackson Creek (RM 9.25), and Bench Creek (RM 10.5) are major tributaries to Hughes Fork that originate in Washington State; the lower portions of the drainages are located in Idaho. The Gold Creek drainage is one of the more heavily harvested drainages in the Hughes Fork watershed. Impacts to the lower reaches of Gold Creek are mostly restricted to natural historic fire occurrences. Impacts to upper Gold Creek reaches include riparian harvest activities (J. Cobb, USFS, pers. comm., 2000). The Gold Creek drainage has a road density of 4.9 miles/sq. mile and a riparian road density of 4.3 miles/sq. mile. Gold Creek also has 1.2 road crossings/mile of stream. Muskegon Creek, a large tributary to Gold Creek whose upper reaches lie in Washington, has a culvert fish passage barrier near the mouth at the USFS Rd. 1013 crossing (Panhandle Basin Bull Trout TAT 1998, pg. 20, 21). The IDEQ placed a temperature sensor in Gold Creek from August 8 to September 30, 1997. Although the IDEQ did not report the 7-day average maximum temperature or the thermograph location, the maximum mean daily temperature recorded was 12.2ºC (54ºF) and the maximum hourly temperature was 14.1ºC (57.4ºF). On most days the EPA temperature criterion for bull trout was exceeded (IDEQ 2001, pg. 151).

The Bench Creek and Jackson Creek drainages are relatively un-influenced by management activities with the exception of the Ledge Creek drainage, a tributary to Jackson Creek, and the first ¼ mile of Jackson Creek. The remainder of the Jackson Creek drainage has not seen a fire since 1910 and has only been harvested using helicopters so there was no associated road building (USFS 1998c). In 2002, surveyors noted a 300 meter portion of the lowest reach of Jackson Creek was dewatered prior to reaching the Hughes Fork confluence. Surface flows were observed to resume within the riparian zone of the confluence with Hughes Fork. The dewatering may be attributed to the drought-like conditions in the Fall of 2002 (J. Cobb, USFS, pers. comm., 2002). In the lower ¼ mile of Jackson Creek, there are some destabilized stream channel banks in

the first 300 meters up from the mouth of Jackson Creek (J. Cobb, USFS, pers. comm., 2002). There is also an old beaver dam at the mouth of the creek causing backwatering of the creek, riparian flooding, lateral overland flows, and channel migration. Another smaller, non-functional beaver dam is contributing to channel side-cutting in this lower reach (USFS 1998c). These two beaver dams were the only sign of beaver activity in Jackson Creek. The high concentrations of fine silt in this lower reach constitute 100% of the substrate in this reach. There is also a clearcut bordering the south side of the drainage in the lower reach contributing to channel instability in the reach.
In Ledge Creek, a tributary to Jackson Creek, historic natural fire and later harvest and associated road development during the early 1990s, are contributing to elevated sediment levels and increased peak flows in Jackson Creek. Massive concentrations of fine sediment and gravels have recently aggraded the confluence of Ledge and Jackson creeks, causing overland flow and channel migration (USFS 1998c). These impacts have resulted in sedimentation of channel substrate and pool filling in Jackson Creek downstream of the Ledge Creek confluence (J. Cobb, USFS, pers. comm., 2002).

Gold Creek WAU Current Known Habitat Conditions.

Only the upper portions and headwaters of eastward-draining tributaries to Hughes Fork are located within Washington State (Gold Creek WAU). The remainder of the drainage and the entire length of the mainstem Hughes Fork are located in Idaho. Given the scope of the Washington Conservation Commission's limiting factors assessment and the limited extent of degraded habitat conditions indicated in the literature for the stream reaches within Washington State, the description of habitat conditions in the drainage have been limited to a general summary Habitat conditions for stream reaches for the portion of the drainage in Idaho are also limited to a general summary of habitat conditions (Gold Creek WAU Summary).

Gold Creek WAU Fish Distribution and Use.

Table 25 below describes current, known bull trout use in the Gold Creek WAU. Maps in Appendix C illustrate currently occupied and "Suitable" bull trout habitat in the WAU; Table D1 in Appendix D provide supporting information for the fish distribution maps. Hughes Creek flows into Upper Priest River. There were no known natural blockages historically, nor are there presently, to prevent fish passage from the Priest River system into Hughes Creek. Using his best professional judgement, Irving (1987, pg. 26, 27, Table 4) identified upper extents of fish passage for selected streams in the Hughes Fork drainage. Irving identified the following as fish passage barriers: Gold Creek at RM 2.7 a 20-foot falls; Jackson Creek at RM 1.1 a 4-foot rock and log jams falls; and Bench Creek at RM 0.5 a 3-foot rock and log jams falls. With current barrier assessment methodology and criteria, the extent to which falls and log jams identified by Irving (based on his best professional judgement) are fish passage barriers, is questionable. Regarding a falls on Gold Creek, Joe Maroney (KNRD) has identified a 5-to-6 meter (15-20 foot) natural falls in the headwaters of Gold Creek, about 500 feet upstream of the Washington/Idaho border (RM 3.5). In regards to Irving's observation of a falls at RM 2.7, driving the Muskegon Road up Gold Creek Maroney did not observe any falls downstream of the falls he reported in the headwaters of Gold Creek. There is also not any indication on the topographic map of the Gold Creek drainage of a gradient break that could indicate a falls downstream of the Washington/Idaho border (J. Maroney, KNRD, pers. comm., 2003). It is possible Irving's rivermile estimate was incorrect.

Bull trout were historically present (USFS 1999af, pg. III-520, Table-194) and are still present in the Hughes Fork drainage (Irving 1987, pg. 34-39, Table 5). The drainage was considered of high importance in bull trout recovery planning efforts by the Panhandle Basin Bull Trout TAT (Panhandle Basin Bull Trout TAT 1998 Table 3). Irving (1987, pg. 84) found bull trout throughout the Priest Lake subbasin but reported that they were most abundant in tributaries of Upper Priest Lake with the highest densities being found in Bench (32 fish/100 m^2) and Jackson (14 fish/100 m^2) creeks. In the 1970s, Tom Holman, a local landowner (pers. comm., 2002), observed large bull trout in Hughes Creek at Hughes Meadows, so dense he described the fish as "stacked-up two-to-three deep in the pools". Bull trout redd surveys conducted by the IDFG Panhandle Region Fisheries Management Program on Hughes Fork, Jackson Creek and Bench Creek (among other Priest Lake subbasin streams) since 1992 have recorded redds on all three streams.

Brook trout occurrence was documented in Hughes Fork and Gold Creek but not in Jackson and Bench creeks during survey efforts by Irving from 1982 through 1984 (Irving 1987, pg. 34, Table 5). Brook trout were later documented by the USFS in Bench Creek by electroshocking in 1996 (USFS 2002d). Brook trout were observed in the Jackson Creek by the USFS during the 1998 stream survey (USFS 1998c).

Table 25: Current, known bull trout use in the Gold Creek WAU.

Gold Creek WAU	Bull Trout				Eastern Brook Trout
	Spawning	Rearing	Migration	Individual Observatio	Occurrence
Hughes Fork	X	X	X		X
Gold Creek	X	X	X		X
Muskegon Creek	X	X	X		
Jackson Creek	X	X	X		X
Bench Creek	X	X	X		X

Gold Creek WAU Summary.

The Hughes Fork drainage, of which Gold Creek is a primary tributary with its headwaters located in Washington State, is considered critical to the viability of native fish species, including bull trout (USFS 2002, pg. 57 of 116). Gold Creek is one of the more heavily harvested and roaded drainages in the Hughes Fork watershed. Gold Creek, from its headwaters to the mouth, has been proposed for listing on the 303(d) list for temperature exceedences (USFS 2002, pg. 58 of 116). Gold Creek has been adversely impacted by land use disturbances, primarily roads (USFS 2002, pg. 58 of 116). The reach of Hughes Fork that passes through Hughes Meadows (RM 7.0, upstream of the Gold Creek confluence) was channelized back in the 1940s and remains an extremely unstable stream reach. The introduction of non-native fish species into the drainage also imposes risks on the recovery of bull trout in the entire Hughes Fork drainage.

The Bench Creek and Jackson Creek drainages are relatively un-influenced by management activities with the exception of the Ledge Creek drainage, a tributary to Jackson Creek, and the first quarter-mile of Jackson Creek. The remainder of the Jackson Creek drainage has not seen a fire since 1910 and has only been harvested using helicopters so there was no associated road building (USFS 1998c; J. Cobb, USFS, 1/29/03 final draft review comments, February 2003). Irving (1987, pg. 84) found bull trout throughout the upper Priest River drainage but reported that they were most abundant in tributaries of Upper Priest Lake with the highest densities being found in Bench (32 fish/100 m^2) and Jackson (14 fish/100 m^2) creeks. Brook trout have been documented in both Bench and Jackson creeks as well as Hughes Fork and Gold Creek. The confluence of Jackson Creek and Hughes Fork consists of 100% silt. Silt sedimentation in the Hughes Fork is over 1.0 meter deep at this location. This is primarily a function of natural hydrogeomorphic conditions associated with low stream channel gradient and beaver dams in the reach. Past timber harvest and roads have elevated sediment levels coming from the Ledge Creek drainage and are contributing to channel and bank destabilization in the lower reaches of Jackson Creek downstream of the Ledge Creek confluence. Much of the silt at the mouth of Jackson Creek is the result of overland flow of the stream in response to a beaver dam barricading the mouth. Also, in the Ledge Creek drainage, a tributary to Jackson Creek, historic natural fire and later harvest and associated road development during the early 1990s, contribute to elevated sediment levels and increased peak flows downstream. These impacts have resulted in sedimentation of channel substrate and pool filling in Jackson Creek (J. Cobb, USFS, pers. comm., 2002).

Gold Creek WAU Data Gaps.

- A road survey identifying high risk channel crossings, high risk roads and manmade fish barriers;
- stream temperature data is lacking on most streams.

WRIA 62 Summary of Habitat Conditions

It is apparent that the habitat of the Pend Oreille River is no longer suitable for the production of trout [in general] for which it once was known (Ashe and Scholz 1992, pg. 198). It is unknown which bull trout life history stage is currently most limiting to bull trout production in the lower Pend Oreille River system downstream of Albeni Falls and within Washington State. It is also unknown which habitat attribute or combination of habitat attributes, as negatively impacted by human impacts, are most limiting each bull trout life history stage in the Lower Pend Oreille system downstream of Albeni Falls within Washington State. However, several factors are known to be significant to the decline of bull trout populations in the Pend Oreille River in WRIA 62: habitat degradation on the mainstem and within the tributaries; human-made fish passage barriers into tributaries to the Pend Oreille River; exotic fish species introduction and management; and the construction and operation of hydroelectric facilities on the mainstem Pend Oreille River and the Columbia River. The Northeast Washington Recovery Unit Team feels that complete recovery of bull trout populations in the Pend Oreille River in Washington is contingent upon reconnection with the Lower Clark Fork Recovery Subunit in Idaho (habitat upstream of Albeni Falls dam; USFWS 2002, pg. 1 of 26).

Even given that fish passage is provided at Albeni Falls dam, it is not clear from the existing literature the extent to which, if at all, bull trout populations could be recovered in the Pend Oreille River system downstream of Albeni Falls Dam. The USFWS Bull Trout Draft Recovery Plan (USFWS 2002, pg. 38) for Northeast Washington has stated that to reach a recovered condition within the Pend Oreille Core Area within 25 years could require the use of artificial supplementation. Studies to determine the effectiveness and feasibility of using artificial propagation to recover bull trout populations in the Northeast Washington Recovery Unit area are being recommended in the draft Bull Trout Recovery Plan, Chapter 23 (USFWS 2002, pg. 38). The extent to which exotic fish species, mainstem Pend Oreille River habitat as negatively impacted by dam operations, human-made fish passage barriers on tributary streams, or habitat degradation in tributaries would immediately preclude bull trout recovery even given fish passage at mainstem hydroelectric dams (beginning with Albeni Falls dam) is unknown.

On the Pend Oreille River, Waneta and Seven Mile dams in Canada, Boundary and Box Canyon dams in Washington and Albeni Falls Dam in Idaho have disconnected Lake Pend Oreille from the Pend Oreille River system downstream of Albeni Falls dam, fragmenting this river system. Fragmentation of the Pend Oreille River by impassable hydroelectric dams have eliminated the possibility of having an adfluvial bull trout life history form in the lower Pend Oreille River and its tributaries downstream of Albeni Falls Dam, especially given the natural tendency toward high summertime water temperatures in the mainstem Pend Oreille River. There are adfluvial bull trout in some portions of the Priest River drainage in Idaho. The headwaters of some tributaries to the Priest River are located within the boundaries of Washington State. The dams have also eliminated access to historic spawning, rearing, and overwintering habitat within the Pend Oreille River system in Washington State. Other dams and water diversion facilities without fish passage facilities (i.e. Sullivan Creek Dam, Mill Pond Dam, Cedar Creek Dam, the Calispell pumps, Calispell Duck Club Dam, and Priest Lake Outlet Dam) were constructed in tributaries to the Pend Oreille River and have further fragmented native populations and reduced connectivity.

It is important to note that the Priest River subbasin bull trout populations are declining as well, although connectivity to large lakes (where bull trout migrate to mature for four to six years before returning to natal streams to spawn) is generally intact and there appears to be available habitat within the subbasin for all life stages. This decline has been attributed to predation and competition from non-native salmonids, particularly lake trout in the lake environments where juvenile bull trout migrate to mature. In the summer of 2002, the Idaho Department of Fish and Game (IDFG) tested the use of strobe lights to deter the movement of lake trout from Priest Lake up into Upper Priest Lake. The IDFG is currently working to secure permits to continue the use of strobe lights as deterrence to lake trout movement (J. Cobb, USFS, email correspondence, March 2003). Predation and competition from non-native salmonids, and introduced warm-water fish species like largemouth bass, smallmouth bass, northern pike, walleye, and yellow perch is also a significant limiting factor for bull trout in the mainstem Pend Oreille River and its tributaries within WRIA 62 downstream of Albeni Falls. However, if bull trout do not have access to the Pend Oreille River system downstream of Albeni Falls dam, no amount of habitat recovery efforts or elimination of competition from non-native fish species can restore naturally sustainable bull trout populations in the lower Pend Oreille River system. Planning efforts underway by the USFWS (bull trout recovery planning; USFWS 2002, pg. 29), the Northwest Power Planning Council (subbasin planning; KNRD 2001, pg. 95), the Bonneville Power Administration/Corp of Engineers/Bureau of Reclamation (USFWS 2000, pg. 43, 90), and the Pend Oreille Public Utilities District (Box Canyon Dam Federal Energy Regulatory Commission relicensing; FERC 2002; FERC 2002, pg. 102) have all indicated in their respective draft planning documents the significance of reestablishing bull trout passage at Albeni Falls Dam. The extent to which exotic fish species competition in the lower Pend Oreille River system may limit bull trout recovery given fish passage at human-made barriers on the Pend Oreille River, is unknown.

Also, the relative affect on bull trout production of the conversion of the Pend Oreille River to a reservoir system has not been adequately evaluated. McLellan (2001, pg. 119) concluded that there is not a full understanding of all the limiting factors in the Boundary Reservoir system and how they relate to each other. The report concluded that what is known is that the major limiting factors in the Boundary Reservoir reach of the Pend Oreille River were related to water temperature, retention times, and daily water level fluctuations. Water temperatures in excess of 21°C (69.8°F) have been recorded over prolonged periods in Boundary Reservoir during summer and fall. The absence of thermal stratification during periods of peak seasonal warming suggests that cold-water refuge areas for bull trout are scarce in the reservoir (McLellan 2001, pg. 98; R2Consultants 1998, pg. 5-1). R2 Research Consultants (1998, pg. 5-1) concluded that point temperatures conducted throughout the reservoir in 1996 and 1997 indicated cold-water refugia in the reservoir are probably restricted to the outlet regions of a few cooler tributaries (i.e. Slate, Flume, and Pewee creeks).

Habitat degradation associated with forest management practices, grazing, and road construction has also impacted bull trout (WDFW 1998, pg. 415). Nearly all of the original forests between the major roads east and west of the Pend Oreille River are believed to have been logged or burned at least once since the mid-1800s (POPUD 2000, pg. E1-3). As land use management has increased in WRIA 62, so have the sediment inputs into streams while the stream's natural ability to transport sediment has been compromised by channel and hydrology alterations (KNRD and WDFW 1997b, pg. 2). Human-caused habitat degradation presents problems in several tributaries while natural and human-made blockages exist in other tributaries limiting available access to suitable habitat (Ashe and Scholz 1992, pg. 198-209).

The survey efforts and assessment of habitat productivity within the Lower Pend Oreille and Priest River NPPC Planning Areas of the Pend Oreille Subbasin is fragmented and not coordinated (Table 1). After determining which bull trout life history stage habitat need (i.e. adult holding, juvenile rearing, incubation, juvenile overwintering) is most limited by which human-caused alterations in the lower Pend Oreille planning area, bull trout productivity needs to be evaluated at a broader geographic scale than at just the reservoir reach or watershed level. An assessment of bull trout limiting factors at a broader geographic scale in the lower Pend Oreille River system is needed to facilitate more effective information gathering and exchange so as to ultimately result in the development of a scientifically defensible restoration strategy. At a minimum scale, the assessment must take into account the relative importance of Lake Pend Oreille and the Priest River portions of the Pend Oreille Subbasin to bull trout recovery in the lower Pend Oreille River system.

TRIBUTARY HABITAT

Tributary habitat plays an important role in sustaining salmonid populations in WRIA 62. Man-made habitat alteration and habitat degradation associated with forest management practices, hydroelectric development, flood control, livestock grazing, and road construction have impacted bull trout in WRIA 62 (WDFW 1998, pg. 415); nearly all of the original forests between the major roads east and west of the Pend Oreille River are believed to have been logged or burned at least once since the mid-1800s (POPUD 2000, pg. E1-3). Except for in the South Fork Salmo River and portions of Priest River tributary streams (Hughes Fork, Granite Creek, and Kalispell Creek) located within Washington State, individual bull trout observations have been rare in WRIA 62. Only 33 bull trout observations have been documented over the past 28 years in WRIA 62, excluding sightings in the S. Fk. Salmo River WAU and Priest River draining tributaries. Viable bull trout populations still exist in the S. Fk. Salmo River WAU and portions of WRIA 62 which drain into the Priest River system in Idaho. Average densities of bull trout for the entire west side Priest Lake drainage in all habitat types sampled from 1982-1984 were 3.4 fish/100m^2 (Irving 1987, Figure 8).

The extent to which the tributary waters are accessible and suitable to bull trout is limited by natural barriers and conditions, and in some cases, further limited by human-made barriers and degraded habitat conditions. For example, natural barrier falls at or near the mouths of Pewee, Flume, Slate, and Sweet creeks, and human-made barriers near the mouth or in the lower reaches of Sullivan, Cedar, and Calispell, restricts the extent of habitat available for migrating bull trout in the Pend Oreille River. Additionally, impoundments like Sullivan Lake affect the quality of habitat downstream through altered flow regimes and modified water temperatures (R2 Resource Consultants 1998, pg. 5-2). Temperatures in tributaries that negatively impact bull trout survival have the potential to limit bull trout production in the Lower Pend Oreille River system. However, even if the Pend Oreille River could support a healthy adult trout population, it appears that the tributaries to the Box Canyon Reservoir at least, have only limited potential to produce large numbers of trout that could be recruited into the fishery in the reservoir (Ashe and Schultz 1992, pg. 206).

The three greatest threats to tributary bull trout habitat include: 1) habitat degradation from past land use activities; 2) habitat fragmentation and loss of connectivity due to man-made structures; and 3) hybridization and competition from introduced fish species (Andersen 2001, pg. 3). Fish habitat in selected tributaries to the Pend Oreille River in the Box Canyon Reservoir (Cee Cee Ah, Indian, Browns, Fourth of July, Mineral, and Whiteman creeks) is generally poor due to a lack of large woody debris (LWD), lack of pool-type habitat, and high volumes of fine sediment. As a result of these conditions, rearing, spawning, and winter habitat were identified as limiting factors to fish populations in most of these stream reaches (Andersen 2001, pg. 4).

Additionally, the streams draining into the Box Canyon Reservoir are high gradient and low order (small) streams that are typically naturally unproductive. As a result, food availability may be limiting trout production in the tributaries. Benthic macroinvertebrate densities in samples collected from the tributaries were lower than almost all other tributaries in the region (Utah, Idaho, and Washington samples; Ashe and Scholz 1992, pg. ii). Grazing and logging impacts present problems in several tributaries while immense beaver dams constitute migrational barriers in others. Conditions that would have naturally, negatively affected fish access into the Calispell Creek drainage (the largest tributary in the Box Canyon Reservoir reach) most if not all years, have been exacerbated by habitat alterations in the lower reaches (Ashe and Scholz 1992, pg. 208), including a human-made blockages at RM 0.5 and 6.0, dike construction, and conversion of land to agricultural use.

Seasonal fluctuations of water temperatures within a given tributary appear to be one of the main initiators of salmonid movement for Cee Cee Ah, East Branch LeClerc, and Muddy creeks in the Box Canyon reservoir reach. Tributary flows were another important factor affecting salmonid migration. Tributaries within the Box Canyon Reservoir that appeared to have flow-induced migrations included the north fork and main branch of Skookum Creek, Ruby Creek and Cedar Creek. It is unclear whether these fish movements within and into the various tributaries was in sole response to increased flows or whether a combination of changing water temperatures and fluctuating flows initiated movement. It is very likely they were responding to both parameters (DE&S 2001b, pg. 19).

Trends such as fish movement are difficult to determine based on changing water temperature and instream flow data. It is likely that in normal to above-normal precipitation years, flow fluctuations are the main driving force behind migration. In years where precipitation is below normal, spring runoff is minimal, or there are long periods of time between events, water temperatures become the driving migration force. This may be due in part to the tributaries' reduced abilities to moderate temperatures because of reduced water volumes. All of the tributaries in Box Canyon Reservoir except two (Indian and West Branch LeClerc creeks) have limited groundwater inputs and thus show wide seasonal temperature variations based on surrounding ambient air temperatures (DE&S 2001a, pg. 8). Indian and West Branch LeClerc creeks both receive substantial groundwater inputs, which may act as both temperature flow buffers and regulators. Duke Engineering & Services (DE&S) theorized that elevated summer reservoir temperatures might push salmonids into tributaries for seasonal refuge. If that were the case, the expectation would be to see a summer upstream migration of salmonids, particularly in these two tributaries. The results of summer trap operations over the three-year period did not support this theory. No substantial upstream migrations were observed in these or other tributaries (DE&S 2001a, pg. 20).

The Kalispel Tribe prioritized five Pend Oreille tributary drainages for study in the Box Canyon Reservoir reach of the Pend Oreille River; Mill Creek, Cee Cee Ah Creek, LeClerc Creek, Indian Creek, and Cedar Creek. Of the tributaries prioritized for study, four tributary drainages were identified as priority tributaries for enhancement for native bull trout and cutthroat habitat based on their higher potential for restoration. These are the Cee Cee Ah Creek, Mill Creek, Indian Creek and LeClerc Creek drainages (KNRD and WDFW 1997b, pg. 4). Ashe and Scholz (1992, pg. 261) recommended LeClerc, Cee Cee Ah and Skookum Creeks, tributaries to Box Canyon Reservoir, for habitat improvements for the purpose of benefiting self-sustaining trout populations. The selection of the tributaries took into account available fish populations, existing habitat conditions, and existing limiting factors.

Although production potential of the tributaries to Box Canyon Reservoir is limited, the spawning habitat in most tributaries is of good quality (Ashe and Scholz 1992, pg. ii, 189-209). The USFWS has proposed designating as "Critical Habitat", the following streams or stream reaches in WRIA 62 between Boundary Dam and Albeni Falls Dam: 1) *Pend Oreille River* from Boundary Dam to Albeni Falls Dam; 2) *Slate Creek* from its confluence with the Pend Oreille River upstream 10.1 miles; 3) *Sullivan Creek* from its confluence with the Pend Oreille River upstream 22.0 miles to its headwaters; 4) *Cedar Creek* from its confluence with the Pend Oreille River upstream 10.0 miles to its headwaters; 5) *Ruby Creek* from its confluence with the Pend Oreille River upstream 13.1 miles to its headwaters; 6) *LeClerc Creek* from its confluence with the Pend Oreille River upstream 1.2 miles to the confluence of the W. Br. of LeClerc Creek and the E. Br. of LeClerc Creek; 7) *W. Br. LeClerc Creek* from its confluence with LeClerc Creek upstream 15.4 miles to its headwaters; 8) *E. Br. LeClerc Creek* from its confluence with

LeClerc Creek upstream 12.9 miles to its headwaters; 9) *Fourth of July Creek* from its confluence with E. Br. LeClerc Creek upstream 3.8 miles to its headwaters; 10) *Mill Creek* from its confluence with the Pend Oreille River upstream 1.3 miles to a barrier falls; 11) *Tacoma Creek* from its confluence with the Pend Oreille River, the *N. Fk. of the S. Fk. of Tacoma Creek* from its confluence with the S. Fk. Tacoma Creek, and the *S. Fk. Tacoma Creek* from its confluence with Tacoma Creek upstream a total of 38.3 miles to their respective headwaters; 12) *Calispell Creek* from its confluence with the Pend Oreille River upstream 2.6 miles to the confluence of Smalle Creek; 13) *Smalle Creek* from its confluence with Calispell Creek upstream 6.6 miles to a barrier falls; 14) *E. Fk. Smalle Creek* from its confluence with Smalle Creek upstream 4.2 miles to a barrier falls; and 15) *Indian Creek* from its confluence with the Pend Oreille River upstream 5.3 miles to its headwaters (USFWS 2002b, pp. 298-302).

Currently, with the exception of the LeClerc Creek drainage and the S. Fk. Salmo River, no evidence has been documented of reproducing bull trout populations in the Pend Oreille River system in Washington downstream of Albeni Falls dam. However, the 1998-2000 tributary adfluvial trapping study results in the Box Canyon Reservoir reach of the Pend Oreille River by DE&S (2001b) revealed that adfluvial brown trout populations are present in the Box Canyon Reservoir and do utilize some of the tributaries, primarily the Indian, Skookum and LeClerc creek systems. Limited migration data collected on mountain whitefish, westslope cutthroat trout and bull trout did not provide enough of a basis to determine if adfluvial populations of these species exist within the Box Canyon project boundaries. The tributaries with these adfluvial migrations tended to have similar characteristics such as stable flows, cooler seasonal water temperatures and ample available spawning habitat. Nearly all of the studied tributaries tended to lack suitable depths to provide year round residence for these large adult salmonids and may possibly lack adequate forage to sustain large resident tributary trout. Fish migration behavior within tributaries, and between the tributaries and the reservoir, were related to seasonal flows and water temperatures. Only one bull trout was captured and tagged in one tributary (Indian Creek) and recaptured at the mouth of another tributary (Marshall Creek). Salmonids within the Box Canyon project area did not appear to travel from one stream to another in search of more suitable physical or thermal habitat (DE&S 2001b, pg. 21).

THE PRIEST RIVER DRAINAGE

Documented reproducing bull trout populations do still persist in the Priest River drainage of Idaho. Specimens of up to 25 pounds were recorded taken from Priest lakes in years just prior to 1956. The harvest in Priest Lake in 1956 was approximately 1,800 (Bjornn 1957, pg. 71) while presently, bull trout are only occasionally found in Priest Lake and its tributaries (Panhandle Basin Bull Trout TAT 1998, pg. 9).

The strongest remaining bull trout populations in the Priest River drainage are now found in Upper Priest Lake, although in declining numbers. The Upper Priest Lake adfluvial fish spawn in Upper Priest River, a tributary to Upper Priest Lake, and in the Hughes Fork drainage, which flows into the Upper Priest River 0.5 miles upstream of Upper

Priest Lake. Bull Trout also spawn in Trapper Creek, a tributary draining into Upper Priest Lake from the east, draining lands managed by the Idaho Department of Lands (Panhandle Basin Bull Trout TAT, 1998, pg. 9; IDFG redd surveys 1992 – 2001; Irving 1987). The headwaters of Hughes Fork lie within WRIA 62. The decline in bull trout numbers in Upper Priest Lake has been attributed to healthy lake trout populations in the lake environments that out-compete bull trout for habitat and prey on juvenile bull trout (J. Dupont, IDFG, pers. comm., August 2002). In the tributary environments, brook trout numbers are contributing to bull trout declines through competition for habitat and hybridization. As exotic fish species were introduced into the same areas that once supported strong populations of reproducing bull trout and other native trout species (prior to the 1920s – brook trout; 1925 – mackinaw/lake trout; 1942 through 1944 – kokenee; Bjornn 1957, pg. 1, 2), the natural balance between the native fish species and their environments was negatively impacted. Bull trout, which remain in tributary streams for extended periods of time after emerging from the gravels and before migrating to the lake environments to mature for four to six years, likely succumbed to the cumulative pressures of exotic fish species competition and the added impact of past tributary habitat degradation.

Of the seven drainages to the Priest River system which originate in WRIA 62 in Washington State (Lower West Branch, Upper West Branch, Binarch, Lamb, Kalispell, Granite, and Hughes Fork), only the Kalispell Creek, Granite Creek and Hughes Fork drainages are known to support bull trout. Bull trout have not been documented in Kalispell Creek since 1984, despite surveys in 1987, 1988, and 1996 by the USFS IPNF. Nor have bull trout been documented in Lower West Branch, Upper West Branch, Binarch, and Lamb creeks (all tributaries to the lower Priest River and lower Priest Lake) despite survey effort. Although bull trout have been documented in the mainstem Priest River downstream of the East River confluence to the confluence with the Pend Oreille River, bull trout have not been documented in Priest River upstream of the East River confluence to Priest Lake. Bull trout radio telemetry work initiated by the Idaho Department of Fish and Game (IDFG) in late-August 2002 in the East River system has reliably established current bull trout use of the mainstem Priest River downstream of the East River confluence.

Regarding historic use in the mainstem Priest River below Priest Lake and in tributaries to the Priest River, given that bull trout use is well documented in both Priest Lake and Upper Priest Lake (Bjornn 1957) and the East River system (IDFG electrofishing survey, August 6, 2001), it is reasonable to assume bull trout use in the rest of the Priest River drainage downstream of Priest Lake where natural barriers and natural habitat conditions did not preclude bull trout use. On Lower West Branch, Torelle Falls at RM 8.2 in Idaho is a natural barrier to upstream fish passage. On Upper West Branch, Mission Falls is located at RM 0.5 miles but is not believed to be a fish passage barrier. On portions of Binarch Creek upstream of RM 1.5, the stream goes subsurface at some times of the year. On Lamb Creek, there is only one natural fish passage barrier identified; it is in the headwaters of Lamb Creek. A natural waterfall on Kalispell Creek in the headwaters near Deerhorn Creek (RM 13.25) may be the upper extent of bull trout passage.

The USFWS has proposed designating as "Critical Habitat" the following streams or stream reaches within that portion of WRIA 62 that drains into the Priest River drainage: 1) *Gold Creek* from the confluence with Hughes Fork in Idaho upstream 7.8 miles to its headwaters in Washington; 2) *S. Fk. Granite Creek* from its confluence with Granite Creek in Idaho upstream 14.0 miles to its headwaters in Washington; 3) *N. Fk. Granite Creek* from its confluence with Granite Creek in Idaho upstream 11.8 miles to its headwaters in Washington; and 4) *Kalispell Creek* from its confluence with Priest Lake in Idaho upstream 14.5 miles to its headwaters in Washington (USFWS 2002b, pp. 77-79). Additional streams and stream reaches within the Priest River drainage are proposed for designation as "Critical Habitat" by the USFWS but the streams do not fall within the boundaries of WRIA 62 and so are not listed here.

WRIA 62 Data Gaps.

- A comprehensive fish passage barriers inventory and assessment with database and GIS coverage. The work should incorporate existing data from USFS, POPUD, KNRD, McLellan (2001), SSHEAR/WDFW, and DNR data. A comprehensive fish passage inventory and assessment should capture tributaries to the Pend Oreille River from their confluence with the Pend Oreille River upstream to their headwaters, where appropriate;

- comprehensive surveys are needed in all tributaries to Upper Priest Lake and Priest Lake to determine the distribution and abundance of brook trout to better define native fish restoration options (KNRD 2001, pg. 148);

- tributaries to the Pend Oreille River that have not yet been surveyed to determine bull trout presence or absence and habitat suitability for bull trout, should be surveyed using accepted methodologies;

- a comprehensive fish management plan for the Pend Oreille River and its tributaries. This should include both warm and coldwater species and include Washington, Idaho and Montana (POPUD 1/29/03 final draft report review comments, March 2003).

ASSESSMENT OF HABITAT LIMITING FACTORS

The 2496 Pend Oreille Technical Advisory Group (TAG) assessed habitat conditions by stream reach (Table 26) for those habitat factors identified and described in the chapter of this report titled, “Habitat Limiting Factors by WAU”. The assessment only includes streams where: (1) bull trout are known to occur; (2) suitable bull trout habitat is known to exist; (3) potential suitable bull trout habitat exists if recovered; or (4) where habitat conditions in the stream have the potential to contribute to degrading suitable bull trout habitat.

Ratings of “Good”, “Fair” or “Poor” were assigned during the assessment using the “WRIA 62 Pend Oreille 2496 TAG Bull Trout Habitat Rating Criteria” outlined in Table 27. The development of habitat rating criteria is a contentious and difficult process given the variability in ecosystem types across the State of Washington. Habitat rating criteria are developed using existing research results on ecological systems to set thresholds for determining the degree to which an ecological system is functioning or not functioning. The WRIA 62 Pend Oreille 2496 TAG used the habitat rating criteria developed by the USFWS (USFWS 1998). These habitat rating criteria are the same criteria used by the USFWS for facilitating and standardizing determinations of effects on bull trout populations under the requirements of the Endangered Species Act (ESA). In Washington State, most of the published research on ecological systems is based on habitat conditions that are found west of the Cascade Crest. This fact makes it very difficult to apply these same criteria to ecological systems found east of the Cascade Crest without misrepresenting habitat conditions. Therefore, if a habitat attribute would be rated as “Fair” or “Poor” based on the Habitat Rating Criteria but the conditions was determined to be the result of naturally occurring ecosystem processes, the attribute was given a rating of “Good” in the assessment table. This gives the user a quick and realistic view from the table of which habitat attributes are properly functioning.

The information upon which this assessment is based was derived from published sources and the combined professional knowledge of the TAG participants. Therefore, each rating incorporates how one or more biologist judged the quality of habitat for the various stream reaches based on available information. The number “1” assigned to the rating indicates quantitative studies, surveys, or published reports exist to support the rating. The number “2” assigned to the rating indicates the professional knowledge of the TAG was used to rate the condition and data analysis, data, or published reports were not available

The assessment shows where field biologists have been and what they have seen or studied. Where “**DG**” (Data Gap) appears in the table, there was so little information available on the habitat condition (published or professional knowledge) that the TAG did not feel confident making even a qualitative determination of condition for the habitat factor. The absence of a stream on the list does not mean bull trout do not occur in the stream or imply that the stream is in good health. Some streams may not be listed because they have not been documented to support bull trout or suitable bull trout habitat or have not been surveyed for stream health conditions. Others streams may show more impacts because they are easily accessible or have been the focus of more scientific study. Where a check mark (√) appears in the table, survey data is available but not in the format to allow for ready comparison with USFWS habitat rating criteria. So, a check mark may indicate that the data was collected using different metrics and/or methodologies that are not readily translated into the metrics or methodologies used in the USFWS habitat rating criteria. The available survey data may also not be assessed or interpreted within a geomorphic context and therefore only represents raw data, not providing a clear picture of the habitat's functionality.

Habitat ratings provided in the assessment table can be correlated back to habitat conditions presented in the "Habitat Limiting Factors by WAU" chapter. For example, in the Assessment Table, Temperature in Ruby Creek would be rated "**P1**" ("poor" based on qualitative studies or published reports). Turning to the Ruby Creek WAU section of the "Habitat Limiting Factors by WAU" chapter, subheading, "Temperature" (pg 173 of 477), the 7-day average maximum instream temperature was 18.4°C in Ruby Creek, representing poor temperature conditions for bull trout.

Table 26. Assessment of habitat conditions limiting bull trout performance

P = Average habitat condition considered to be poor (Not Properly Functioning)

F = Average habitat condition considered to be fair (At Risk)

G = Average habitat condition considered to be good (Properly Functioning)

NA = Not Applicable.

√ : 1) data is available but not in a format to allow for ready comparison with USFWS habitat rating criteria, and/or 2) data is not assessed in a geomorphic context.

DG = Data Gap; the stream or reach has not been surveyed, visited by members of the TAG, or so little information is available that the TAG did not feel qualified rating the condition.

1 = Quantitative studies, surveys, or published reports documenting habitat condition

2 = Professional knowledge of the TAG members

NB = Natural Barrier

STREAM NAME	WRIA INDEX	Access to Spawning and Rearing	Riparian Condition	Channel Conditions/Dynamics			Habitat Elements					Water Quality	Water Quantity	Species Competition
		Artificial Structures		Streambank Condition	Floodplain Connectivity	Channel Stability	Channel Substrate	LWD	Pool Frequency and Quality	Pool Depth	Off-Channel Habitat	Temperature	Change in Flow Regime	Non-indigenous Fish
MAINSTEM PEND OREILLE RIVER														
Pend Oreille River (Columbia RM 745.5)	62.0002													
Boundary Dam Reservoir (RM17.0/Boundary Dam - 34.4/Box Canyon Dam)														
RM 17.0 -34.4/Box Canyon Dam		P1	F2	G1	NA	DG	P1	DG	NA	NA	G1	P1	F1	P1
Box Canyon Dam Reservoir (RM 34.4 - 90.1/Albeni Falls Dam)														
RM 34.4 - 90.1/Albeni Falls Dam		P1	F2	F1	F1	DG	P1	P1	NA	NA	F1	P1	F2	P1
SOUTH SALMO WAU														
Salmo River (13.3)	Canada													
S. Fk. Salmo River (RM 7.4)	62.0002.01													
RM 8.8- 13.0		G1	G1	G1	G1	G1	G1	G1	G1	G1	G1	G2	G1	F1
SLATE CREEK WAU														
Slate Creek (RM 22.2)	62.0019													
RM 0.0 - N.Fk./S.Fk. confluence		G1	G1	G1	G1	G1	G1	G1	G1	G1	G1	G1	G1	P1
Slumber Creek (RM 2.0)	62.0022													
RM 0.0 - 0.5 or 2.3		G1	G1	G1	G1	G1	G2	G1	G1	G1	G1	G1	G1	P1
Uncas Gulch (RM 2.75)	62.0029													
RM 0.0 - 2.0		G1	G1	G1	G1	G1	G2	G1	G1	G1	G1	G1	G1	P1
Styx River (RM 4.9)	62.0038													
RM 0.0 - 2.0		P1	G1	G1	G1	G1	G2	G1	G1	G1	G1	G1	G1	P1
S. Fk. Slate Creek (RM 6.2)	62.0046													
RM 0.0 - 1.0		G1	G1	G1	G1	G1	G2	G1	G1	G1	G1	G1	G1	P1
N. Fk. Slate Creek (RM 6.2)	62.0047													
RM 0.0 - 2.5		G1	G1	G1	G1	G1	G2	G1	G1	G1	G1	G1	G1	P1

Table 26. Assessment of habitat conditions limiting bull trout performance

P = Average habitat condition considered to be poor (Not Properly Functioning)

F = Average habitat condition considered to be fair (At Risk)

G = Average habitat condition considered to be good (Properly Functioning)

NA = Not Applicable.

1 = Quantitative studies, surveys, or published reports documenting habitat condition

2 = Professional knowledge of the TAG members

NB = Natural Barrier

√ : 1) data is available but not in a format to allow for ready comparison with USFWS habitat rating criteria, and/or 2) data is not assessed in a geomorphic context.

DG = Data Gap; the stream or reach has not been surveyed, visited by members of the TAG, or so little information is available that the TAG did not feel qualified rating the condition.

		Access to Spawning and Rearing	Riparian Condition	Channel Conditions/Dynamics			Habitat Elements					Water Quality	Water Quantity	Species Competition
STREAM NAME	WRIA INDEX	Artificial Structures		Streambank Condition	Floodplain Connectivity	Channel Stability	Channel Substrate	LWD	Pool Frequency and Quality	Pool Depth	Off-Channel Habitat	Temperature	Change in Flow Regime	Non-indigenous Fish
SULLIVAN CREEK WATERSHED														
SULLIVAN CREEK WAU														
Sullivan Creek (RM 26.9)	62.0074													
RM 0.0 - RM 3.25/Mill Pond Dam		G1	G1	F1	G1	DG	G2	P1	F1	G1	NA	P1	P1	P1
RM 3.25 - ?/headwaters		P1	F1	F1	G1	DG	DG	P1	P1	F1	NA	F1	F1	P1
N. Fk. Sullivan Creek (RM 2.35)	62.0075													
RM 0.0 - 0.25		P1	G1	DG	DG	G1	DG	G1	G1	G1	G1	G1	G1	F1
Outlet Creek (RM 5.3)	62.0093													
RM 0.0 -0.5		G1	F2	F2	DG	DG	F2	DG	G1	G1	DG	DG	P1	P1
Sullivan Lake (RM 0.5)	62.0093a													
RM 0.0 - 4.0/length of lake		P1	F1	G1	G1	NA	NA	DG	NA	NA	NA	DG	P1	P1
Pass Creek (RM 8.9)	62.0142													
RM 0.0 - headwaters		G1	DG	DG	DG	DG	DG	DG	G1	G1	DG	DG	DG	F1
Gypsy Creek (RM 13.8)	62.0190													
RM 0.0 - 2.0		G1	DG	DG	DG	DG	DG	DG	G1	G1	DG	DG	DG	P1
Leola Creek (RM 17.6)	62.0203													
RM 0.0 - 3.0		G1	G1	G1	G1	F1	DG	G1	F1	G1	G1	DG	DG	F1
Deemer Creek	62.0203a													
RM 0.0 - 2.0		G1	√	G1	√	F1	DG	G1	P1	P1	G1	DG	DG	P1
SULLIVAN CREEK WATERSHED (cont.)														
HARVEY CREEK WAU														
Harvey Creek (RM 4.0/Lk. Sullivan inlet)	62.0093b													
RM 0.0 - headwaters		G1	F1	F1	√	G1	DG	F1	P1	P1	NA	F1	DG	P2
M. Fk. Harvey Creek (RM 10.0)	62.0119													

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STREAM NAME	WRIA INDEX	Access to Spawning and Rearing	Riparian Condition	Channel Conditions/Dynamics			Habitat Elements					Water Quality	Water Quantity	Species Competition
		Artificial Structures		Streambank Condition	Floodplain Connectivity	Channel Stability	Channel Substrate	LWD	Pool Frequency and Quality	Pool Depth	Off-Channel Habitat	Temperature	Change in Flow Regime	Non-indigenous Fish
RM 0.0 - 1.5		G1	√	F1	√	G1	DG	G1	P1	F1	NA	DG	DG	F1
N. Fk. Harvey Creek (RM 0.5)	62.0119a													
RM 0.0 -2.3/headwaters		G1	√	F1	√	G1	DG	G1	P1	P1	NA	DG	DG	F1
BOX CANYON WAU														
Flume Creek (RM 25.8)	62.0054													
RM 0.0 - 0.2		G1	DG	DG	DG	DG	DG	DG	DG	DG	DG	F1	DG	P1
Sweet Creek (RM 30.9)	62.0224													
RM 0.0 - 0.6/NB		P1	DG	DG	DG	DG	DG	DG	DG	DG	DG	P1	DG	P1
Sand Creek (RM 31.6)	62.0242													
RM 0.0 -1.25/NB		P1	G1	F1	G1	F1	P1	G1	P1	F1	NA	P1	DG	P1
Cedar Creek (RM 37.7)	62.0262													
RM 0.0 -1.5/municipal dam		G1	F1	F2	F2	DG	DG	F2	DG	DG	NA	P1	DG	P1
RM 1.5 - 8.3		P1	G1	F1	G1	DG	P1	G1	F1	P1	G1	P1	DG	P1
Jim Creek (RM?)	62.0262a													
RM 0.0 - 1.25/NB		G1	√	G1	DG	G1	G1	G1	P1	F1	NA	P1	DG	DG
Muddy Creek WAU														
Little Muddy Creek (RM 38.0)	62.0278													
RM 0.0 - 1.25		G1	DG	DG	DG	DG	DG	DG	DG	DG	DG	P1	DG	P1
RM 1.25 - 6.75		G1	P1	F1	F1	G1	P1	G1	P1	F1	NA	P1	DG	P1
Big Muddy Creek (RM 38.0)	62.0279													
RM 0.0 - headwaters		P1	P1	F1	G1	G1	P1	P1	G1	F1	G1	P1	DG	P1
RUBY CREEK WAU														
Lost Creek (RM 47.8)	62.0322													
S. Fk. Lost Creek (RM 0.1)	62.0323													
RM 0.0 - 3.8		G1	√	DG	√	G1	DG	G1	P1	F1	NA	P1	DG	DG

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		Artificial Structures		Streambank Condition	Floodplain Connectivity	Channel Stability	Channel Substrate	LWD	Pool Frequency and Quality	Pool Depth	Off-Channel Habitat	Temperature	Change in Flow Regime	Non-indigenous Fish
Ruby Creek (RM 52.0)	62.0368													
RM 0.0 - 13.1/headwaters		P1	F2	G1	DG	F1	P1	G1	P1	F1	NA	P1	DG	P1
N. Fk. Ruby Creek	62.0368a													
RM 0.0 - 1.5		G1	F2	P1	G1	G1	P1	G1	G1	NA	G1	DG	DG	DG
Little Ruby Creek	62.0368b													
RM 0.0 - 1.5		G1	√	F1	G1	F1	F1	G1	P1	F1	G1	DG	DG	DG
LECLERC CREEK WAU														
LeClerc Creek (RM 56.2)	62.0415													
RM 0.0 - 1.0		G1	F2	F2	G2	DG	DG	DG	DG	DG	G1	DG	DG	P1
W. Br. LeClerc Creek (RM1.0)	62.0419													
RM 0.0 - 8.0/diversion dam		G1	DG	G1	G2	G1	P1	P1	P1	F1	G1	G1	DG	P1
RM 8.0 - 12.0		P1	DG	G1	G2	G1	P1	G1	P1	F1	G1	DG	DG	P1
Whiteman Creek (RM 8.85)	62.0424													
RM 0.0 -2.0		G1	F1	G1	G2	G1	P1	DG	P1	P1	G1	DG	DG	P1
Mineral Creek (RM 10.4)	62.0430													
RM 0.0 -2.0		G1	F2	P1	G2	F1	P1	DG	P1	P1	NA	DG	DG	P1
Saucon Creek (RM 11.9)	62.0439													
RM 0.0 -1.0/culvert barrier		G1	G1	G1	NA	G1	P1	P1	P1	NA	NA	G1	DG	F1
E. Br. LeClerc Creek (RM 1.0)	62.0420													
RM 0.0 - 12.9/ bedrock falls		G1	P1	F1	G2	F1	P1	P1	P1	F1	DG	P1	DG	P1
Fourth of July Creek (RM 2.8)	62.0449													
RM 0.0 - 0.25/NB		G1	DG	G2	G2	G2	P1	DG	F1	NA	NA	DG	DG	P1
M. Br. LeClerc Creek (RM 5.1)	62.0462													
RM 0.0 - 5.0		P1	P1	F1	F1	DG	P1	P1	P1	NA	DG	P1	DG	P1
Seco Creek (RM 8.7)	62.0475													
RM 0.0 -2.5		G1	DG	G1	G2	G1	P1	G1	P1	NA	NA	F1	DG	P1

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		Artificial Structures		Streambank Condition	Floodplain Connectivity	Channel Stability	Channel Substrate	LWD	Pool Frequency and Quality	Pool Depth	Off-Channel Habitat	Temperature	Change in Flow Regime	Non-indigenous Fish
MIDDLE CREEK WAU														
Middle Creek (RM 57.6)	62.0493													
RM 0.0 - 6.0		P1	P1	G1	G1	DG	P1	G1	P1	P1	G1	F1	DG	P1
Mill Creek (RM 58.3)	62.0503													
RM 0.0 - 1.3 / NB		G1	P1	P1	G1	P1	P1	DG	P1	P1	DG	F1	DG	P1
CEE CEE AH CREEK WAU														
Cee Cee Ah Creek (RM 66.29)	62.0608													
RM 0.0 - 3.5/NB		P1	P1	P1	G1	G1	P1	F1	P1	P1	DG	P1	DG	P1
Browns Creek (RM 2.0)	62.0608a													
RM 0.0 - 3.0		G1	F1	G1	NA	G1	G1	G1	F1	DG	G1	DG	G1	P1
TACOMA CREEK WAU														
Cusick Creek (RM 61.6)	62.0524													
RM 0.0 - 4.2		P1	DG	DG	DG	F1	DG	DG	DG	DG	DG	DG	DG	P1
RM 4.2 - 8.9		P1	F1	F1	F1	F1	P1	P1	F1	F1	G1	P1	DG	P1
Tacoma Creek (RM 66.3)	62.0547													
RM 0.0 - 11.0		G1	F1	G1	G1	G1	P1	P1	P1	F1	G1	P1	DG	P1
S. Fk. Tacoma Creek	62.0571													
RM 0.0 - 9.0		P1	F1	G1	G1	G1	P1	G1	P1	F1	G1	F1	F1	P1
N Fk of S. Fk. Tacoma Creek	62.0572													
RM 0.0 - 6.25		P1	G1	G1	G1	G1	P1	G1	F1	F1	G1	F1	DG	P1
CALISPEL CREEK WATERSHED														
WINCHESTER CREEK WAU														
Calispell Creek (RM 69.6)	62.0628													
RM 0.0 - 6.0/Duck Club Dam		P1	DG	F1	P1	G1	P1	P2	P2	P1	P1	P2	P1	P1
RM 6.0 - 7.5/length of Calispell Lake		F1	G2	NA	P1	NA	P1	P1	NA	NA	NA	P1	P1	P1

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		Artificial Structures		Streambank Condition	Floodplain Connectivity	Channel Stability	Channel Substrate	LWD	Pool Frequency and Quality	Pool Depth	Off-Channel Habitat	Temperature	Change in Flow Regime	Non-indigenous Fish
RM 7.5 - S.Fk./N. Fk. Power Creek confluence		G1	G1	F2	F2	G1	G2	F2	P2	DG	F2	DG	F1	P1
Smalle Creek (RM 2.5)	62.0631													
RM 0.0 - 2.5/W. Calispell Rd.		G1	F2	F1	P1	F1	P1	P1	P2	P1	P1	P1	DG	P1
RM 2.5 - 6.6/NB (Smalle Falls)		G1	F1	G1	P1	F1	P1	DG	P1	F1	NA	P1	DG	P1
E. Fk. Smalle Creek	62.0631a													
RM 0.0 - 3.7/NB		G1	F1	G1	F1	F1	P1	G1	P1	P1	NA	P1	DG	P1
Winchester Creek (RM 8.0)	62.0666													
RM 0.0 - 10.1/NB		P1	F1	G1	G1	G1	P1	G1	F1	F1	DG	P1	DG	P1
Graham Creek	62.0666a													
RM 0.0 - headwaters		G1	G1	G1	G1	G1	P1	G1	P1	NA	DG	DG	G2	P1
CALISPELL CREEK WATERSHED (cont.)														
TENMILE CREEK WAU														
S. Fk. Calispell Creek (RM 12.1)	62.0689													
RM 0.0 - 1.3		G1	G1	G1	G1	G1	DG	P1	DG	DG	DG	DG	F2	P1
Power Creek (RM 12.1)	62.0690													
RM 0.0 - 0.2 /NB		G1	G1	G1	G1	G1	DG	P1	DG	DG	DG	DG	F1	P2
SKOOKUM CREEK WAU														
Skookum Creek (RM 73.2)	62.0786													
RM 0.0 - 5.0/Best Chance Rd.		G1	DG	DG	DG	DG	DG	DG	DG	DG	DG	P1	DG	P1
RM 5.0 - 9.5		G1	F1	G1	√	P1	P1	G1	DG	F1	DG	DG	DG	P1
N. Fk. Skookum Creek (RM 3.6)	62.0793													
RM 0.0 - 2.0		DG	DG	DG	DG	F1	F1	DG	DG	DG	DG	P1	DG	DG
Indian Creek (RM 81.2)	62.0836													
RM 0.0 - 2.25		P2	F2	DG	NA	G1	P1	P1	P1	P1	DG	F1	DG	P1
DEER VALLEY WAU														

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		Artificial Structures		Streambank Condition	Floodplain Connectivity	Channel Stability	Channel Substrate	LWD	Pool Frequency and Quality	Pool Depth	Off-Channel Habitat	Temperature	Change in Flow Regime	Non-indigenous Fish
Kent Creek (RM 78.5)	62.0819													
RM 0.0 - 2.25		G1	F1	DG	DG	F1	DG	DG	DG	DG	DG	DG	F1	P1
McCloud Creek (RM 78.9)	62.0828													
RM 0.0 - headwaters		G1	F1	DG	F1	DG	DG	DG	DG	DG	DG	DG	DG	P1
PRIEST RIVER TRIBUTARIES														
PRIEST RIVER WAU														
Priest River (RM 96.6)														
Lower W. Br. Priest River (5.0)	62.0861													
RM 0.0 - 8.2/Torelle Falls		G1	P1	P1	F1	P1	P1	P1	F1	G1	F1	P1	F1	P1
8.2 - headwaters		P1	P1	F1	F1	P1	P1	P1	F1	G1	F1	P1	F1	P1
KALISPELL CREEK WAU														
Upper W. Br. Priest River (35.3)	62.0919													
RM 0.0 - Tola Creek		G1	F1	P1	P1	P1	P1	P1	F1	F1	F1	DG	F1	P1
Tola Creek - headwaters		G1	F1	P1	G1	F1	P1	F1	F1	F1	G1	DG	G1	P1
Binarch Creek (42.0)	62.0962													
RM 0.0 - headwaters		G1	G1	F1	G1	G1	F1	G1	F1	F1	G1	DG	G1	P1
Priest Lake														
Lamb Creek (0.0)	62.0964													
RM 0.0 - 9.0/NB falls		P2	P1	P1	P1	F1	F1	P1	F1	F1	F1	DG	F1	P1
Kalispell Creek (4.5)	62.0965													
RM 0.0 - RM 6.5/Hwy. 57 crossing		G1	F1	F1	F1	F1	P1	P1	F1	G1	G1	DG	F1	P1
RM 6.5 - RM 12.5/ Mush Crk. confluence		G1	F1	F1	F1	F1	F1	F1	F1	F1	F1	DG	F1	P1
RM 12.5 - 13.25/NB		F1	F1	G1	G1	G1	F1	F1	F1	F1	G1	DG	F1	P1
GRANITE CREEK WAU														

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		Artificial Structures		Streambank Condition	Floodplain Connectivity	Channel Stability	Channel Substrate	LWD	Pool Frequency and Quality	Pool Depth	Off-Channel Habitat	Temperature	Change in Flow Regime	Non-indigenous Fish
Granite Creek (10.0)	62.0990													
RM 0.0 - N./S. Fk. confluence		G1	P1	F1	G1	G1	F1	F1	F1	F1	G1	DG	F1	P1
S. Fk. Granite Creek (10.7)	62.0992													
RM 0.0 - headwaters		G1	G1	G1	G1	G1	G1	G2	F1	F1	G1	DG	G1	P1
Cache Creek	62.0998													
RM 0.0 - 3.0		G1	G1	G1	NA	G1	G1	G1	F1	F1	NA	DG	G1	P1
Sema Creek	62.1005													
RM 0.0 - headwaters		G1	G1	G1	G1	G1	G1	G1	G1	G1	G1	DG	G1	P1
N. Fk. Granite Creek (10.7)	62.1034													
RM 0.0 - 6.8/Granite Falls (NB)		G1	P1	G1	G1	G1	F2	F2	F1	F1	F1	DG	F1	P1
Tillicum Creek	62.1038													
RM 0.0 - headwaters		G1	G1	G1	G1	G1	G1	G1	G1	G1	G1	DG	G1	P1
GOLD CREEK WAU														
Upper Priest River (70.2)	62.1070													
Hughes Fork (0.5)	62.1070													
RM 0.0 - Gold Crk. confluence		G1	G1	F1	G1	F1	F1	G1	F1	F1	F1	DG	F1	P1
Gold Crk. confl. - Jackson Crk. confl.		G1	G1	F1	G1	F1	F1	F1	F1	F1	G1	DG	F1	P1
Jackson Crk. confl. - headwaters		G1	G1	P1	F1	F1	F1	F2	F1	F1	F1	DG	F1	P1
Gold Creek (RM 5.25)	62.1071													
RM 0.0 - Muskegon Crk. confluence		G1	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	P1
Muskegon Crk. confluence - headwaters		G1	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	P1
Muskegon Creek	62.1075													
RM 0.0 - headwaters		DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG
Helmer Creek	62.1077													
RM 0.0 - 1.0		DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG
Jackson Creek (RM 9.25)	62.1080													

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		Artificial Structures		Streambank Condition	Floodplain Connectivity	Channel Stability	Channel Substrate	LWD	Pool Frequency and Quality	Pool Depth	Off-Channel Habitat	Temperature	Change in Flow Regime	Non-indigenous Fish
RM 0.0 - headwaters		G2	G2	F1	G2	F1	F1	G2	G2	F2	G2	DG	F2	P1
Bench Creek (RM 10.5)	62.1085													
RM 0.0 - headwaters		G2	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	DG	P1

NOTES:

1. **All River Miles are approximate.**
2. **Habitat ratings reflect the current condition of the habitat attribute relative to its geomorphological potential.**

Table 27: WRIA 62 Pend Oreille 2496 TAG Bull Trout Habitat Rating Criteria

Habitat Factor	Parameter/Unit	Channel Type	Poor (Not Properly Functioning)	Fair (At Risk)	Good (Properly Functioning)	Source
Access to Spawning and Rearing Habitat						
Artificial Structures (i.e. culverts, dams, dikes)	Man-made physical barriers (address subsurface flows or dewatering where they impede fish passage under water quality attributes)	All	Man-made barriers present in reaches do not allow upstream and /or downstream fish passage at a range of flows.	Man-made barriers present in the reach do not allow upstream and/or downstream fish passage at base/low flows.	Man-made barriers present in the reach allow upstream and downstream fish passage at all flows.	USFWS Guidelines
Riparian Condition						
Riparian Condition	Riparian Habitat Conservation Areas (RHCAs): Riparian corridors, wetlands, intermittent headwater streams, and other areas where proper ecological functioning is crucial to maintenance of the stream's water, sediment, woody debris and nutrient delivery systems (definition taken from INFISH)	All – Eastside	riparian areas are fragmented, poorly connected, or provide inadequate protection of habitats for sensitive aquatic species (<70% intact, refugia does not occur), and adequately buffer impacts on rangelands; percent similarity of riparian vegetation to the potential natural community/composition is <25%.	moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian areas, or incomplete protection of habitats and refugia for sensitive aquatic species (≈ 70-80% intact) and adequately buffers impacts on rangelands: percent similarity of riparian vegetation to the potential natural community/composition is 25-50% or better.	the riparian areas provide adequate shade, LWD recruitment, and habitat protection and connectivity in subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact) and adequately buffers impacts on rangelands: percent similarity of riparian vegetation to the potential natural community/composition is >50%.	USFWS Guidelines

Table 27. WRIA 62 Pend Oreille 2496 TAG Bull Trout Habitat Rating Criteria (Continued)

Habitat Factor	Parameter/Unit	Channel Type	Poor (Not Properly Functioning)	Fair (At Risk)	Good (Properly Functioning)	Source
Channel Conditions/Dynamics						
Streambank Condition	% of stream reach in stable condition	All - Eastside	<50% of any stream reach has ≥90% stability	50–80% of any stream reach has ≥90% stability	>80% of any stream reach has ≥90% stability	USFWS Guidelines
Floodplain Connectivity	Stream and off-channel habitat length with lost floodplain connectivity due to incision, roads, dikes, flood protection, or other	All - Eastside	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetlands extent drastically reduced and riparian vegetation/succession altered significantly.	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function and riparian vegetation/succession.	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession.	USFWS Guidelines
Channel Stability		All	W/D or Entrenchment ratio is inappropriate for geo-morphologically correct Rosgen stream type	W/D or Entrenchment ratio is increasing/decreasing beyond range of acceptable for geo-morphologically correct Rosgen stream type	W/D and Entrenchment ratio is appropriate for geo-morphologically correct Rosgen stream type	TAG 2002 and Rosgen 1996

Table 27. WRIA 62 Pend Oreille 2496 TAG Bull Trout Habitat Rating Criteria (Continued)

Habitat Factor	Parameter/Unit	Channel Type	Poor (Not Properly Functioning)	Fair (At Risk)	Good (Properly Functioning)	Source
Habitat Elements						
Channel Substrate	Substrate condition as it relates to rearing habitat and spawning and incubation habitat, including but not limited to, the degree of substrate embeddedness, substrate mobility, and percent fines.	All – Eastside	>30% embeddedness (rearing) or >17% fines <0.85mm (spawning/incubation)	20 – 30% embeddedness (rearing) or 12 - 17% fines <0.85mm (spawning/incubation)	<20% embeddedness (rearing) or <12% fines <0.85mm (spawning/incubation)	USFWS Guidelines
Large Woody Debris	Pieces/mile that are >12" in diameter and >35 ft. in length with at least one end of piece within the OHWL (Ordinary High Water Line); also adequate sources of woody debris are available for both long and short-term recruitment	All – Eastside	Current levels are not at those desired values for "Good/Properly Functioning", and potential sources of woody debris for short and /or long term recruitment are lacking	Current values are being maintained at minimum levels desired for "Good/Functioning Appropriately", but potential sources for long-term woody debris recruitment are lacking to maintain these minimum values	Current values are being maintained at greater than >20 pieces/mile, >12" in diameter and >35" ft. in length.	USFWS Guidelines

Table 27. WRIA 62 Pend Oreille 2496 TAG Bull Trout Habitat Rating Criteria (Continued)

Habitat Factor	Parameter/Unit	Channel Type	Poor (Not Properly Functioning)	Fair (At Risk)	Good (Properly Functioning)	Source
Habitat Elements (continued)						
Pool Frequency and Quality	% wetted channel surface area comprising pools	All	Pool frequency is considerably lower than values desired for "good/properly functioning"; also cover/temperature is inadequate, and there has been a major reduction of pool volume by fine sediment.	Pool frequency is similar to values in "good/ properly functioning" but pools have inadequate cover/temperature and /or there has been a moderate reduction of pool volume by fine sediment.	Pool frequency in a reach closely approximates: Wetted Width (ft) # Pools/ mile 0–5 39 5-10 60 10-15 48 15-20 39 20-30 23 30-35 18 35-40 10 40-65 9 65-100 4 (can use formula: pools/ mile = 5,280/ wetted channel width ÷ # channel widths per pool	USFWS Guidelines
Pool Depth	Pools >1 meter deep	Streams >3m in wetted width	No pools	few pools	many pools present	USFWS Guidelines

Table 27. WRIA 62 Pend Oreille 2496 TAG Bull Trout Habitat Rating Criteria (Continued)

Habitat Factor	Parameter/Unit	Channel Type	Poor (Not Properly Functioning)	Fair (At Risk)	Good (Properly Functioning)	Source
Habitat Elements (continued)						
Off-channel Habitat	Area within the channel migration zone which is also accessible during peak flow events.	Reaches with average gradient <2%	Reach has no ponds, oxbows, backwaters, or other off-channel areas	Reach has some ponds, oxbows, backwaters, and other off-channel areas with cover; but side-channel areas are generally high energy areas	Reach has many ponds, oxbows, backwaters, and other off-channel areas with cover; and side-channels are low energy areas	USFWS Guidelines

Table 27. WRIA 62 Pend Oreille 2496 TAG Bull Trout Habitat Rating Criteria (Continued)

Habitat Factor	Parameter/Unit	Channel Type	Poor (Not Properly Functioning)	Fair (At Risk)	Good (Properly Functioning)	Source
Water Quality						
Temperature	degrees Celsius/ degrees Fahrenheit	All	7-day average maximum temperature in a reach during the following life history stages: • >15°C/ >59°F (rearing) • <4°C or >10°C/ <39°F or >50°F (spawning) • <1°C or >6°C/ <34°F or >43ºF (incubation) also temperatures in areas used by adults during migration regularly exceed 15ºC/59ºF (thermal barriers present)	7-day average maximum temperature in a reach during the following life history stages: • <4°C or 13-15ºC/ <39°F or 55º-59ºF (rearing) • <4°C or 10°C/ <39°F or 50°F (spawning) • <2°C or 6°C/ <36°F or 43ºF (incubation) also temperatures in areas used by adults during migration sometimes exceed 15ºC/59ºF	7-day average maximum temperature in a reach during the following life history stages: • 4°-12ºC/ 39°-54ºF (rearing) • 4° - 9ºC/ 39°-48°F (spawning) • 2°-5°C/ 36°-41ºF (incubation) also temperatures do not exceed 15ºC/59ºF in areas used by adults during migration (no thermal barriers)	USFWS Guidelines

Table 27. WRIA 62 Pend Oreille 2496 TAG Bull Trout Habitat Rating Criteria (Continued)

Habitat Factor	Parameter/Unit	Channel Type	Poor (Not Properly Functioning)	Fair (At Risk)	Good (Properly Functioning)	Source
Water Quantity						
Change in Flow Regime	Change in Peak/Base Flows	All	pronounced changes in peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	some evidence of altered peak flow, base flow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography	USFWS Guidelines
Species Competition						
Non-indigenous fish species	Presence/ Absence	All	Present in the drainage	Present in an adjacent drainage and have access to the drainage	Absent in the drainage and there is not opportunity for access to the drainage	TAG 2002

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GLOSSARY

303 (d) List: The federal Clean Water Act requires states to maintain a list of stream segments that do not meet water quality standards. The list is called the 303(d) list because of the section of the Clean Water Act that makes the requirement.

Adaptive management: Monitoring or assessing the progress toward meeting objectives and incorporating what is learned into future management plans.

Adfluvial: Migratory between lakes and rivers or streams or, life history strategy in which adult fish spawn and juveniles subsequently rear in streams but migrate to lakes for feeding as subadults and adults. Compare fluvial.

Administratively Withdrawn Areas: A land management designation for federally-administered lands within the range of the northern spotted owl (USFS and BLM 1994). Administratively Withdrawn Areas are identified in current Forest and District Plans or draft plan preferred alternatives and include recreation and visual areas, back county, and other areas where management emphasis precludes scheduled timber harvest.

Aggradation: The geologic process of filling and raising the level of the streambed or floodplain by deposition of material eroded and transported from other areas.

Alevins (also sac fry or yolk-sac fry): Larval salmonid that has hatched but has not fully absorbed its yolk sac, and generally has not yet emerged from the spawning gravel. Absorption of the yolk sac, the alevin's initial energy source, occurs as the larva develops its mouth, digestive tract, and excretory organs and otherwise prepares to feed on natural prey.

Alluvial: Deposited by running water.

Alluvial fan: A relatively flat to gently sloping landform composed of predominantly coarse grained soils, shaped like an open fan or a segment of a cone, deposited by a stream where it flows from a mountain valley onto a plain or broader valley, or wherever the stream gradient suddenly decreases. Alluvial fans typically contain several to many unconfined, distributary channels that migrate back and forth across the fan over time. This distribution of flow across several stream channels provide for less erosive water velocities, maintaining and creating suitable rearing salmonid habitat over a wide range in flows. This landform has high subsurface water storage capacity. They frequently adjoin terraces or floodplains.

Alluvial Plain: An expanse of land formed, at least in part, by deposited materials through which an alluvial stream meanders.

Anadromous fish: Species that are hatched in freshwater mature in saltwater, and return to freshwater to spawn.

Anchor ice: Forms along the channel bottom form the accumulation of frazil ice particles on the rough surfaces of coarse bottom sediments and on the lee sides of pebble, cobbles, and boulders.

Aquifer:

1. A subsurface layer of rock permeable by water. Although gravel, sand sandstone and limestone are the best conveyors of water, the bulk of the earth's rock is composed of clay, shale and crystalline.

2. A saturated permeable material (often sand, gravel, sandstone or limestone) that contains or carries groundwater.

3. An underground, water-bearing layer of earth, porous rock, sand, or gravel, through which water can seep or be held in natural storage. Aquifers generally hold sufficient water to be used as a water supply.

Basin: The area of land that drains water, sediment and dissolved materials to a common point along a stream channel.

Basin flow: Portion of stream discharge derived from such natural storage sources as groundwater, large lakes, and swamps but does not include direct runoff or flow from stream regulation, water diversion, or other human activities.

Bioengineering: Combining structural, biological, and ecological concepts to construct living structures for erosion, sediment, or flood control.

Biological Diversity (biodiversity): Variety and variability among living organisms and the ecological complexes in which they occur; encompasses different ecosystems, species, and genes.

Biotic Integrity: Capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region; a system's ability to generate and maintain adaptive biotic elements through natural evolutionary processes.

Braided stream: Stream that forms an interlacing network of branching and recombining channels separated by branch islands or channel bars.

Buffer: An area of intact vegetation maintained between human activities and a particular natural feature, such as a stream. The buffer reduces potential negative impacts by providing an area around the feature that is unaffected by this activity.

Capacity: the amount of available habitat for a specific species or lifestage within a given area. Capacity is a density-dependent measure of habitat quantity.

Carrying capacity: Maximum average number or biomass of organisms that can be sustained in a habitat over the long term. Usually refers to a particular species, but can be applied to more than one.

Channelization: Straightening the meanders of a river; often accompanied by placing riprap or concrete along banks to stabilize the system.

Channelized stream: A stream that has been straightened, runs through pipes or revetments, or is otherwise artificially altered from its natural, meandering course.

Channel Migration Zone: the lateral movement of a channel leads to a sequence of events through time where terraces are formed and new floodplain areas are defined. The channel migration zone is an area in the vicinity of an active channel, within which the channel has the potential to move into or through over the course of time and range of natural conditions, given the streams hydrology and geomorphology.

Channel Stability: Measure of the resistance of a stream to erosion that determines how well a stream will adjust and recover from changes in flow or sediment transport.

Check dams: Series of small dams placed in gullies or small streams in an effort to control erosion; commonly built during the 1900s.

Confinement: When a channel is fixed in a specific location restricting its pattern of channel erosion and migration

Confluence: the flowing together of two or more streams, or the combined stream formed by the conjunction.

Congressionally Reserved Areas: A land management designation for federally-administered lands within the range of the northern spotted owl (USFS and BLM 1994). These areas include Wildernesses, Wild and Scenic Rivers, National Monuments, as well as other federal lands not administered by the Forest Service or BLM.

Connectivity: Unbroken linkages in a landscape, typified by streams and riparian areas.

Constriction: The narrowing of a channel that impedes the downstream movement of water or debris, as in a small culvert crossing.

Critical Stock: A stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred.

Depressed Stock: A stock of fish whose production is below expected levels based on available habitat and natural variations in survival levels, but above the level where permanent damage to the stock is likely.

Debris torrent: A type of landslide characterized by water-charged, predominantly coarse grained soil and rock fragments, and sometimes large organic material, flowing rapidly down a pre-existing channel.

Degradation: The lowering of the streambed or widening of the stream channel by erosion.

Deposition: The settlement of material out of the water column and onto the streambed.

Distributaries: A river branch flowing away from the main stream.

Diurnal: (1) Refers to events, processes, or changes that occur every day. (2) May be applied to organisms that are active during the day.

Diversity: Variation that occurs in plant and animal taxa (i.e., species composition), habitats, or ecosystems. See *species richness.*

Ecological restoration: Involves replacing lost or damaged biological elements (populations, species) and reestablishing ecological processes (dispersal, succession) at historical rates.

Ecosystem: Biological community together with the chemical and physical environment with which it interacts.

Ecosystem management: Management that integrates ecological relationships with sociopolitical values toward the general goal of protecting or returning ecosystem integrity over the long term.

Emigration: to leave a place

Endangered Species Act: A 1973 Act of Congress that mandated the protection and restoration of endangered and threatened species of fish, wildlife and plants.

Endangered Species: Any species which is in danger of extinction throughout all, or a significant portion of its range, other than a species of the Class Insecta, as determined by the Secretary to constitute a pest.

Escapement: Those fish that have survived all fisheries and will make up a spawning population.

Estuarine: Of, or relating to, or formed in an estuary.

Estuary: A partly enclosed coastal body of water that has free connection to open sea, and within which seawater is measurably diluted by fresh river water.

Eutrophic: Pertaining to a lake or other body of water rich in dissolved nutrients, photosynthetically productive, and often deficient in oxygen during warm periods. Compare *oligotrophic.*

Evapotranspiration: Movement of moisture from the earth to the atmosphere as water vapor by the evaporation of surface water and the transpiration of water from plants.

Evolutionary Significant Unit (ESU): A definition of a species used by National Marine Fisheries Service (NMFS) in administering the Endangered Species Act. An ESU is a population (or group of populations) that is reproductively isolated from other conspecific population units, and (2) represents an important component in the evolutionary legacy of the species.

Extirpation: The elimination of a species from a particular local area.

Flood: A rising and overflowing of a body of water especially onto normally dry land.

Floodplain: The low-lying, topographically flat area adjacent to a stream channel which is regularly flooded by stream water on a periodic basis and which shows evidence of the action of flowing water, such as active or inactive flood channels, recent fluvial soils, rafted debris or tree scarring. It varies in width depending on size of river, relative rates of downcutting and resistance of the bedrock in the valley walls.

Flood-prone area: Generally includes the active floodplain and the low terrace (Rosgen 1996).

Flow regime: Characteristics of stream discharge over time. Natural flow regime is the regime that occurred historically.

Fluvial: Of or pertaining to, or living in streams or rivers; also, organisms that migrate between main rivers and tributaries. Compare *adfluvial*.

Frazil ice: Thin particles of ice suspended in the water. Produced where extensive channel ice is formed and the freezing supercools the stream water producing nuclei of “frazil ice” particles.

Genetic Diversity Unit (GDU) is defined as: A group of genetically similar stocks that is genetically distinct from other such groups. The stocks typically exhibit similar life histories and occupy ecologically, geographically and geologically similar habitats. A GDU may consist of a single stock

Geomorphology: Study of the form and origins of surface features of the Earth. Geomorphology deals with the general configuration of the earth surface and the changes that take place as landforms develop (history).

Glacial Outwash/Glacial Fluvial Outwash: Nearly level terraces and floodplains in large valley bottoms. Slope is generally less than 10%. The terraces and floodplains were leveled by river flooding induced by melting of glaciers. They are dissected by high-energy, low-gradient, perennial streams. Channels may be braided. Channel deposits are usually comprised of moderately to well sorted sand to cobble size deposits but may include boulders. Ponds, marshes and overflow channels occur with a range of finer grained deposits. This landform is subject to frequent flooding. It has a high subsurface flow rate. Subsurface and instream flow may be in continuity. They are stable but soils on terrace escarpments may unravel. This landform commonly adjoins but can include alluvial fans and colluvial deposits along valley sides.

Glacial Till: A very dense, poorly sorted mixture of clay, silt, sand and gravel deposited directly beneath glacial ice.

Glides: Stream habitat having a slow, relatively shallow run of water with little or no surface turbulence.

Headcut: Upstream migration or deepening of a stream channel that results from cutting (i.e., erosion) of the streambank by high water velocities.

Healthy Stock: A stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock.

Hydrologic Unit Code (HUC): classification system used to describe the sub-division of hydrologic units. The codes represent the four levels of classification in the hydrologic unit system. The first level divides the US into 21 major geographic areas, or regions, based on surface topography, containing the drainage area of a major river or series of rivers. The second level divides the 21 regions into 222 sub-regions, which includes the area drained by a river system, a reach of a river and its tributaries in that reach, a closed basin or, a group of streams forming a coastal drainage area. The third level subdivides many of the subregions into accounting units. These 352 units nest within, or are equivalent to, the sub-regions. The fourth level is the cataloging unit, a geographic area representing part or all of a surface drainage basin, a combination of basins, or a distinct hydrologic feature. These units subdivide the sub-regions and accounting units into approximately 2150 smaller areas.

Hydrograph: A graphic representation or plot of changes in the flow of water or in the elevation of water levels plotted against time.

Hydrology: Study of the properties, distribution, and effects of water on the Earth's surface, subsurface, and atmosphere.

Indigenous: A fish or other aquatic organism native to a particular water body, basin, or region.

Intermittent stream: Stream that has interrupted flow or does not flow continuously. Compare *perennial stream*.

Interstitial spaces: Space or openings in substrates that provide habitat and cover for bottom dwelling organisms, like young salmonids.

Intraspecific interactions: Interactions within a species.

Large Woody Debris (LWD): Any large piece of relatively stable woody material having a diameter greater than 10 cm and a length greater than 3 meters. LWD is an important part of the structural diversity of streams. The nature and abundance of LWD in a stream channel reflects past and present recruitment rates. This is largely determined by the age and composition of past and present adjacent riparian stands. Synonyms include: Large Organic Debris (LOD) and Coarse Woody Debris (CWD). Specific types of large woody debris include:

> Affixed logs: Singe logs or groups of logs that are firmly embedded, lodged, or rooted in a stream channel.
>
> Deadheads: Logs that are not embedded, lodged or rooted in the stream channel but are submerged and close to the surface.
>
> Digger log: Log anchored to the stream banks and/or channel bottom in such a way that a scour pool is formed.
>
> Free logs: Logs or groups of logs that are not embedded, lodged or rooted in the stream channel.
>
> Rootwad: The root mass of the tree.
>
> Snag: A standing dead tree, or, a sometimes a submerged fallen tree in large streams. The top of the tree is exposed or only slightly submerged.
>
> Sweeper log: Fallen tree whose bole or branches form an obstruction to floating objects.

Large Woody Debris Recruitment: The standing timber adjacent to the stream that is available to become large woody debris. Activities that disturb riparian vegetation including timber removal in riparian areas can reduce LWD recruitment. In addition, current conditions also reflect the past history of both natural and management-related channel disturbances such as flood events, debris flows, splash damming and stream clean-out.

Lateral Moraine: Hummocky, rolling glacial till deposits typically located in recesses along the mid-slopes of glacial trough walls. Slope is generally 25-40%. These deposits are usually not compacted. The slopes are dissected by poorly defined streams in a dendritic to deranged drainage pattern. They have a high subsurface water storage capacity and may be good shallow aquifers. Surface runoff is limited. Wet areas commonly occur in swales. Subsurface water is often diverted to depressional areas.

Late-Successional Reserves (LSR's): A land management designation for federally-administered lands within the range of the northern spotted owl (USFS and BLM 1994). Late-Successional Reserves are managed to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including he northern spotted owl. Limited stand management is permitted.

Limiting Factor: Single factor that limits a system or population from reaching its highest potential.

Littoral: Shallow shore areas (less than about 20 feet deep) of a water body where light can usually penetrate to the bottom and that is often occupied by rooted macrophytes.

Macroinvertebrates: Invertebrates large enough to be seen with the naked eye (e.g., most aquatic insects, snails, and amphipods).

Macrophyte: A plant that can be seen without the aid of optics.

Managed Late-Successional Reserves (MLSR): A land management designation for federally-administered lands within the range of the northern spotted owl (USFS and BLM 1994). Managed Late-Successional Reserves are identified for certain locations in drier provinces where regular and frequent fire is a natural part of the ecosystem. Like LSRs, MLSRs are managed to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including he northern spotted owl. Certain silvicultural treatments and fire hazard reduction treatments are allowed to help prevent complete stand destruction from large catastrophic events such as high intensity, high severity fires; or diseased or insect epidemics.

Mass wasting: Landslide processes, including debris falls, debris slides, debris avalanches, debris flows, debris torrents, rockfalls, rockslides, slumps and earthflows, and all the small scale slumping collapse and raveling of road cuts and fills.

Matrix: A land management designation for federally-administered lands within the range of the northern spotted owl (USFS and BLM 1994). The matrix consists of those federal lands outside of the six categories of designated areas (Congressionally Reserved Areas, Late –Successional Reserves, Adaptive Management Areas, Managed Late-Successional Area, Administratively Withdrawn Areas, and Riparian Reserves). Most timber harvest and other silvicultural activities would be conducted in that portion of the matrix with suitable forest lands, according to standards and guidelines. Most timber harvest takes place in the matrix.

Moraine: See "Terminal Moraine".

Native: Occurring naturally in a habitat or region; not introduced by humans.

Non-Point Source Pollution: Polluted runoff from sources that cannot be defined as discrete points, such as areas of timber harvesting, surface mining, agriculture, and livestock grazing.

Oligotrophic: water body characterized by low dissolved nutrients and organic matter, dissolved oxygen near saturation, and chlorophyll levels typically at less that 4 mg/cubic meters during the growing season.

Parr: Young trout or salmon actively feeding in freshwater; usually refers to young anadromous salmonids before they migrate to the sea. See *smolt*.

Periphyton: Attached microflora growing on the bottom, or on submerged substrates, including higher plants.

Photic zone: Lighted region in a body of water that extends vertically from the surface to the depth at which light is sufficient to enable photosynthesis to exceed respiration of phytoplankton.

Plunge pool: A pool created by water passing over or through a complete or nearly complete channel obstruction, and dropping vertically, scouring out a basin in which the flow radiates from the point of water entry.

Pocket water: A series of small pools surrounded by swiftly flowing water, usually caused by eddies behind boulders, rubble, or logs, or by potholes in the streambed.

Pool: Portion of a stream with reduced current velocity, often with deeper water than surrounding areas and with a smooth surface.

Pool:riffle ratio: Ratio of the surface area or length of pools to the surface area or length of riffles in a given stream reach, frequently expressed as the relative percentage of each category.

Population: Organisms of the same species that occur in a particular place at a given time. A population may contain several discrete breeding groups or stocks.

Production: (1) Process of producing organic material. (2) Increase in biomass by individuals, species, or communities with time (e.g., the total amount of fish tissue produced by a population of fish within a specified period of time).

> Net Primary Production. Rate of storage of organic matter in plant tissues in excess of the respiratory use by the plants during the measurement period.
>
> Secondary Production. Total energy storage at the consumer and decomposer trophic levels. Consumers and decomposers utilize food materials that have already been produced and convert this matter in different tissues with energy loss to respiration. Efficiency of conversion in secondary production decreases with trophic levels.

Productivity: A measure of habitat quality which varies by species and lifestage. Productivity is a density-independent measure of habitat quality. Examples include, water temperature, water discharge, channel complexity, riparian condition, etc.

Rain-on-snow events: The rapid melting of snow as a result of rainfall and warming ambient air temperatures. The combined effect of rainfall and snow melt can cause high overland stream flows resulting in severe hillslope and channel erosion.

Rearing habitat: Areas required for the successful survival to adulthood by young animals.

Recovery: The return of an ecosystem to a defined condition after a disturbance.

Redds: Nests made in gravel (particularly by salmonids) for egg deposition consisting of a depression that is created and the covered.

Refugia: (1) Habitats that support sustainable populations of organisms that are limited to fragments of their previous historic and geographic range. (2) Habitats that sustain organisms during periods when ecological conditions are not suitable elsewhere. For example, trout in alpine areas use the deeper pools in a stream during winter. (3) Waters where threatened or endangered fishes are placed for safe-keeping or where a portion of the population is maintained to prevent extinction.

Rehabilitation: Returning to a state of ecological productivity and useful structure, using techniques similar or homologus in concept; producing conditions more favorable to a group of organisms or species complex, especially that economically and aesthetically desirable flora and fauna, without achieving the undisturbed condition.

Resident fish: Fish species that complete their entire life cycle in freshwater.

Riffle: Stream habitat having a broken or choppy surface (white water), moderate or swift current, and shallow depth.

Riparian: Pertaining to the banks and other adjacent, terrestrial (as opposed to aquatic) environs of freshwater bodies, watercourses, and surface-emergent aquifers, whose imported waters provide soil moisture significantly in excess of that otherwise available through local precipitation – soil moisture to potentially support a mesic vegetation distinguishable from that of the adjacent more xeric upland.

Riparian Area: The area between a stream or other body of water and the adjacent upland identified by soil characteristics and distinctive vegetation. It includes wetlands and those portions of floodplains which support riparian vegetation.

Riparian Habitat Conservation Areas (RHCA): Portions of watersheds where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. The RHCAs include traditional riparian corridors, wetlands, intermittent headwater streams, and other areas where proper ecological functioning is crucial to maintenance of the stream’s water, sediment, woody debris and nutrient delivery systems (USFS AND BLM 1995/ PACFISH)

Riparian Reserves: A land management designation for federally-administered lands within the range of the northern spotted owl (USFS and BLM 1994/ Northwest Forest Plan). The Riparian Reserves provide an area along all stream, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis.

Riparian Vegetation: Terrestrial vegetation that grows beside rivers, streams and other freshwater bodies and that depends on these water sources for soil moisture greater than would otherwise be available from local precipitation.

Riprap: Large rocks, broken concrete, or other structure used to stabilize streambanks and other slopes.

Rootwad: Exposed root system of an uprooted or washed-out tree.

Run: An area of swiftly flowing water, without surface agitation or waves, which approximates uniform flow and in which the slope of the water surface is roughly parallel to the overall gradient of the stream reach.

SaSI (Salmonid Stock Inventory): A list of Washington's naturally reproducing salmonid stocks and their origin, production type, and status. Developed in 1998 as an appendix to SASSI to include bull trout and Dolly Varden; formerly named SASSI.

SASSI (Salmon and Steelhead Stock Inventory): A list of Washington's naturally reproducing salmon and steelhead stocks and their origin, production type, and status; developed in 1992.

> Healthy Stocks – A stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock.
>
> Depressed Stocks – A stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely.
>
> Critical Stocks – A stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred.
>
> Unknown Stocks – There is insufficient information to rate stock status.

SSHIAP (Salmon, Steelhead Habitat Inventory and Assessment Project): A partnership based information system that characterizes distribution and freshwater habitat conditions of salmonid stocks in Washington.

Salmonid: Fish of the family salmonidae, including salmon, trout chars, and bull trout.

Salmon: Includes all species of the family Salmonid

Sediment: Material carried in suspension by water, which will eventually settle to the bottom.

Sedimentation: The process of subsidence and deposition of suspended matter carried in water by gravity; usually the result of the reduction in water velocity below the point at which it can transport the material in suspended form.

Seral stages: Series of relatively transitory plant communities that develop with ecological succession from bare ground to the climax plant community stage.

Side channel: Lateral channel with an axis of flow roughly parallel to the mainstem, which is fed by water from the mainstem; a braid of a river with flow appreciably lower than the main channel. Side channel habitat may exist either in well defined secondary (overflow) channels or in poorly defined watercourses flowing through partially submerged gravel bars and islands along the margins of the mainstem.

Sinuosity: Degree to which a stream channel curves or meanders laterally across the land surface. Can be determined by the ratio of the stream length to valley floor, or, the ratio of the channel length between two points on a channel to the straight line distance between the same points.

Slope: Water surface slope is determined by measuring the difference in water surface elevation per unit stream length. Typically measured through at least twenty channel widths or two meander wavelengths.

Slope stability: The degree to which a slope resists the downward pull of gravity.

Smolt: Juvenile salmonid, 1 or more years old, migrating seaward; a young anadromous trout, salmon, or char undergoing physiological changes that will allow it to change from life in freshwater to life in the sea. The smolt stage follows the parr stage. See *parr*.

Stock: Group of fish that is genetically self-sustaining and isolated geographically or temporally during reproduction. Generally, a local population of fish. More specifically, a local population – especially that of salmon, steelhead (rainbow trout), or other anadromous fish – that originates from specific watersheds as juveniles and generally returns to its birth streams to spawn as adults.

Stream Number: A unique six-digit numerical stream identifier, with the first two digits representing the WRIA and the last four digits representing the unique stream identifier from the WDF Stream Catalog (Williams et al. 1975) where available. For streams where the Stream Catalog does not provide a stream identified: (1) unassigned numbers in the sequence are used; or (2) an additional single-character alpha extension may be added to the end of the four-digit stream identifier for the next downstream numbered stream. Alpha extensions are generally used for tributaries to a numerically identified stream proceeding from downstream to upstream.

Stream Order: A classification system for streams based on the number of tributaries it has. The smallest unbranched tributary in a watershed is designated Order 1. A stream formed by the confluence of two order 1 streams is designated Order 2. A stream formed by the confluence of two order 2 streams is designated Order 3; and so on.

Stream Reach: a homogeneous segment of a drainage network characterized by uniform channel pattern, gradient, substrate and channel confinement.

Substrate: mineral and organic material forming the bottom of a waterway or water body.

Subwatershed: One of the smaller watersheds that combine to form a larger watershed.

Supplementation: the collection, rearing, and release of locally adapted salmon in ways that promote ecologic and genetic compatibility with the naturally produced fish.

Terminal Moraine: A low-relief, linear deposit of glacial till. These occur on valley bottoms and are laid down at the terminal end of a glacier as forward progress ends and marks the furthest extension of the glacier. Moraines have moderate to high subsurface water storage capacity.

Terrace: Abandoned floodplain.

Thalweg: The path of maximum depth in a river or stream.

Watershed: An area so sloped as to drain a river and all its tributaries to a single point or particular area. The total area above a given point on a watercourse that contributes water to its flow.

Watershed restoration: Reestablishing the structure and function of an ecosystem, including its natural diversity; a comprehensive, long-term program to return watershed health, riparian ecosystems, and fish habitats to a close approximation of their condition prior to human disturbance.

Watershed-scale approach: Consideration of the entire watershed in a project or plan.

Weir: Device across a stream to divert fish into a trap or to raise the water level or divert its flow. Also a notch or depression in a dam or other water barrier through which the flow of water is measured or regulated.

Width-depth ratio: Describes the dimension and shape factor as the ratio of bankfull channel width to bankfull mean depth.

Wild Stock: A stock that is sustained by natural spawning and rearing in the natural habitat regardless.

APPENDIX A

BULL TROUT LIFE HISTORY INFORMATION

Following is a summary of bull trout life history information as derived from a study of bull trout populations in the Flathead Lake and river system, Montana* as presented in: Fraley and Shepard (1989). Life history, ecology and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and River System, Montana. Northwest Science, Vol. 63(4): 133-143.

***Note of Caution**: The following information reflects parameters that apply to bull trout populations in the Flathead Lake and River System, Montana. The extent to which these parameters are applicable to bull trout populations in the Pend Oreille River System is unknown.

SENSITIVITY TO ENVIRONMENTAL DISTURBANCE

1. Long overwinter incubation and development phase leaves bull trout embryos and alevins particularly vulnerable to increases in fine sediment and water quality degradation (which could include low flow/dewatering impacts and high flow impacts like scouring).

   - In lab experiments, survival was shown to be inversely related to percent fine material (<6.35mm) in the gravels.
   - Survival to emergence ranged from nearly 50% in substrates which contained 10% fines, to 0% in mixtures which contained 50% fines.
   - Since juveniles are so closely associated with the substrate, they can be affected by the level of embeddedness.

LAKE RESIDENCE:

- Most bull trout that spawn in the North and Middle Fork drainages mature in Flathead Lake. There are a few populations of bull trout in tributaries of the North Fork that spend their entire lives in the streams.

- The 28 tributaries used by spawning bull trout in the North and Middle Fork drainages are characterized by gravel-rubble substrate, low flows of 0.057-1.70 m^3/sec (2 – 60 cfs) and maximum summer water temperatures less than 15ºC (59ºF).

- Lake populations of bull trout included: recently arrived juveniles; subadult fish <450mm (10 in); and mature fish 5 to 6 years or more in age (most bull trout in Flathead Lake mature at age 6).

- Diet of lake residents consisted almost exclusively of fish; whitefish species and perch followed by kokanee and then nongame species. Small bull trout have been found to feed on *Mysis* in Flathead Lake.

- Annual growth of lake-resident fish was relatively constant after age 4.

- Not all mature bull trout spawned annually. An average of 57% of adult-sized fish left the lake each spring and summer to spawn.

UPSTREAM MIGRATION:

- Bull trout in Flathead Lake begin spawning migration into the river system during April, moving slowly upstream arriving in the N. and M. Forks during late June and early July (2 – 3 month migration period).

- Adults remain at the mouths of spawning tributaries for 2-4 weeks during which time feeding is thought to be limited.

- Most adults enter tributaries at night from July through August, with majority entering in August (1 month tributary entry period).

- Adults hold in tributaries for up to a month or more in deeper holes or near log or debris cover before spawning.

SPAWNING:

- Most bull trout spawn during September and early October in the Flathead River system (4-week period).

- Initiation of spawning appears to be largely related to water temperature, although photoperiod and streamflow probably also played a part.

- Spawning in the Flathead River system began when water temperatures dropped below 9-10ºC (48-50ºF).

- Spawners selected areas in the stream channel characterized by; 1) gravel substrates, 2) low compaction, and 3) low gradient. Groundwater influence and proximity to cover also were important factors influencing spawning site selection. These relatively specific requirements resulted in a restricted distribution of spawning in the Flathead drainage.

- Average length of adult spawners in the Flathead River system was 628 mm (25 in).

- Female remained near the redd an average of 2 weeks.

- After spawning, the spent adults moved out of the tributaries and downstream to the lake.

INCUBATION AND EMERGENCE:

- From egg deposition to fry emergence takes about 200 days in the Flathead River system (about 6.5 months, October - January).
  - After egg deposition in early October, embryos incubated in the redd for several months before hatching in January in the Flathead River system (3.5 month incubation period).
  - Alevins remained in the gravel and absorbed the yolk sac, with the first fry appearing in electrofishing samples in April (3.5 months to emerge).
- Incubation time is dependent on temperature. McPhail and Murray (1979) reported that the best survival of bull trout embryos is 2-4ºC (35.6-39ºF).
- Newly emerged fry averaged 23-28 mm (0.92 inches).

JUVENILE OCCURRENCE AND EMIGRATION:

- Juveniles were present in many reaches that were not used by adult spawners; they apparently swim upstream to these sections to grow.
- Distribution of juveniles is influenced by water temperature. Juveniles were rarely observed in streams with summer maximum temperatures exceeding 15ºC (59ºF).
- Juvenile young-of-the-year bull trout were generally found in side channel areas and along the stream margins in Flathead tributaries (low velocity areas).
  - Juvenile bull trout densities in Flathead tributaries were greatest in pools, and lower but generally similar in runs, riffles, and pocketwater habitat.
- Juvenile bull trout (<100mm/ 4 inch) usually remained near the stream bottom, close to streambed materials and submerged fine debris.
- Juvenile bull trout (≥100mm/ 4 inch) also remained near cover, including larger instream debris. As the juveniles grow, they become less associated with the streambed.
- During stream residence, juvenile bull trout were opportunistic feeders, mainly ingesting aquatic vertebrates. Bull trout >110 mm (4.4 inches) also ate small trout or sculpin.

(JUVENILE OCCURRENCE AND EMIGRATION, continued:)

- Snorkeling estimates of juvenile bull trout densities in Flathead drainage tributaries averaged 1.5 fish/100 m^2. Electrofishing estimates ranged as high as 15.5 fish/100m^2. This is thought to be a factor of how difficult juvenile bull trout are to observe because of their close association with the stream bottom.

- Emigration of juveniles from tributaries into the Flathead River system took place largely from June through August (3 month period). After entering the mainstem Flathead River from the tributaries, juveniles appeared to move rapidly downstream. Although juvenile were captured by electrofishing in the mainstem Flathead River throughout the year, their numbers peaked during the fall months.

Table A1: Bull Trout Life History (From: Fraley & Shepard, 1989)

***GOOD** 4°-12ºC/ 39°- 54ºF (*rearing*); 4°- 9ºC/ 39°- 48°F (*spawning*); 2°- 5°C/ 36°- 41ºF (*incubation*); also temperatures do not exceed 15ºC/59ºF in areas used by adults during migration (no thermal barriers)

***FAIR** <4°C or 13-15ºC/ <39º or 55º- 59ºF (*rearing*); <4ºC or 10ºC/ <39ºF or 50ºF (*spawning*) <2ºC or 6ºC/ <36ºF or 43ºF (*incubation*); also temperatures in areas used by adults during migration sometimes exceed 15ºC/59ºF

***POOR** >15ºC/ >59ºF (*rearing*); <4ºC or >10ºC/<39ºF or >50ºF (*spawning*); <1ºC or >6ºC/ <34ºF or >43ºF (*incubation*); also temperatures in areas used by adults during migration regularly exceed 15ºC/59ºF (thermal barriers present)

*7-day average maximum temperature in a reach during the following life history stages

	January	February	March	April	May	June	July	August	September	October	November	December
ADULTS (trib and lake use)	lake maturation	lake maturation	lake maturation	adult migrate into river sytem; lake maturation	adult migrate into river sytem; lake maturation	adult migrate into river sytem; lake maturation	adults migrate into river sytem (early July); adults hold at mouths of tribs (late July); adults enter tribs; lake maturation	adults hold at mouth of tribs (early Aug); adults enter tribs; adults hold in tribs; lake maturation	spawning in tributary habitat; lake maturation	spawning in tributary habitat (early Oct); spent adults move out of tributaries; lake maturation	Spent adults move out of tributaries; lake maturation	lake maturation
INCUBATION/ EMERGENCE (trib use)	hatching	alevins remain in gravel	alevins remain in gravel	emergence of fry						egg deposition/ incubation (early Oct);	incubation	Incubation
JUVENILES (trib and lake use)	trib rearing; lake maturation	trib rearing; lake maturation	trib rearing; lake maturation	trib rearing; lake maturation	trib rearing; lake maturation	juvenile emigration out of tribs; trib rearing; lake maturation	juvenile emigration out of tribs; trib rearing; lake maturation	juvenile emigration out of tribs; trib rearing; lake maturation	trib rearing; lake maturation	trib rearing; lake maturation	trib rearing; lake maturation	trib rearing; lake maturation

APPENDIX B

ANECDOTAL HISTORIC ACCOUNTS OF BULL TROUT OBSERVATIONS IN WRIA 62

Anecdotal Historic Accounts of Bull Trout Observations in WRIA 62

(Contributing author: Sandy Lembcke)

Rob Cole
Kent, Washington (formerly of Newport area)
Source: Newport Miner; June 24, 1998

I have caught my fair share of bull trout, from Newport area to the Ione area. I have seen many fish come out of the [Pend Oreille] river, from 3 to 14 pounds. I tagged lake trout ant bull trout on Priest Lake for many years – lake trout to 34 pounds and bull trout to 13 pounds.

Rob Cole
Kent, Washington (formerly of Newport area)
Source: Personal interview on July 1, 1998 with Tom Shuhda, Colville National Forest

[Rob] *grew up in the LeClerc Creek watershed. His uncle, Leonard DeVez, still owns land at the confluence of the East and West Branches. Originally, it was his grandmother's land. Rob fished the creek and the Pend Oreille valley in Washington since 1954 when he was a kid.*

…there were heavy concentrations of whitefish and Dolly Vardens (bull trout) at the mouth of [LeClerc] *creek" in the early 1950s. "At the mouth, a Mr. Carl Doughty operated a wooden powerhouse at Camp 1 Panhandle. The powerhouse hung partially over the water. You could find large D. Vardens using it for cover. You could have loaded a pickup truck full of all the D. Vardens you could have caught at the mouth. As a kid, Rob snagged illegally D. Vardens 5 to 15 pounds and as long as your arm here and elsewhere. He does not remember catchy any D. Vardens in the branches of LeClerc Creek. The West Branch was best for 6 to 9 inch brook and 10 to 14 inch westslope cutthroat trout. The West Branch had colder water. The East Branch was comfortable to wade in the summer. Rob was positive that D. Vardens spawned in LeClerc Creek as he would see them at the mouth in September but not there in July.*

…Rob caught lots of huge 5 to 10 pound D. Vardens at Charr Springs and near the mouth of Indian Creek [on the Pend Oreille River] *because the waters were cold. Also off the northern tip of Brown's Island (house there now) there is a small spring. Rob caught D. Vardens 10 to 15 pounds here from 1972-1974.*

Rob remembers catching westslope cutthroat at any rocky point in the [Pend Oreille] *river. Every major stream had a gravel bar below its confluence with the river. Below LeClerc Creek, at what was called Ruby Bar, he used to catch 12 to 15 inch cutthroat. You could catch cutthroat trout up and down the river. He used to catch them around the Newport sewer outlet pipe. He also caught rainbows at rocky points on the river particularly at Reese's point. Below Albeni Falls dam was a good place to fish for D. Vardens and cutthroat trout until Box Canyon* [Dam] *raised the water levels. Bass were prolific at Miltner's slough on the north side of the river a few miles downstream of the Newport bridge – every 20 feet, as bass spawning bed. The bass fishing was excellent until Box Canyon Dam raised the water levels.*

Kermit West (deceased)
Ione, Washington
Source: Personal interview on April 9, 1996 with Tom Shuhda, Colville National Forest

Mr. West has fished in the area since 1921 when he was 6 years old. His first memory of fishing was in Sullivan Creek. He remembers catching rainbow and native brook or creek trout. He did not catch any anadromous fish in Sullivan Creek or above Metaline Falls. His dad used to catch a few salmon below Metaline Falls – 5 to 10 fish over a period of time, 16-18" long. His dad fished the pool under Washington Rock at Metaline Falls. He said his dad also caught steelhead somewhere below Metaline Falls. He does not remember any salmon or steelhead making it past these falls. Most of the salmon went up the Salmo River in Canada. It was loaded with salmon.

When asked about the fish ladders [on Sullivan Creek], he remembers them on Mill Pond and Sullivan Lake Dams. He said they were not replaced when the dams were rebuilt in the 1920s. He did not know what kind of fish they were built for.

When asked about fish elsewhere, he said that he used to fish Mill Pond and Sullivan Lake and caught mainly rainbow and eastern brook trout and a few cutthroats. This was before the state stocked the lake with brown trout.

Mr. West said that he had fished the Pend Oreille River and about every stream between Slate Creek and Box Canyon. He remembers catching rainbow, cutthroat, eastern brook and bull trout in the Pend Oreille River. He specifically remembers catching bull trout in the river near the mouth of Slate Creek. He caught primarily native brook trout and cutthroat trout in the tributary streams, specifically he remembers cutthroat trout in Sand and Slate Creeks.

When asked about the native brook trout, Mr. West described the fish as being skinny or lengthy, about 6 to 9" long with the longest about 10". The fish was not thick like a cutthroat. The midline of the fish was like a rainbow trout only blank and broken up by white and gray spots. In between these spots were spots of red or bluish red mix. He did not catch these fish in the river, but only in the tributaries. He believed these were native and not planted by the state. When asked if these native brook trout were still around, he did not know but did not think so.

Lynn Gray
U.S. Fish and Wildlife Service
Source: USFWS internal files; May 26, 1999

During the summer of 1959, I was fishing on Ruby Creek, just up from its confluence with the Pend Oreille River. During this fishing excursion with my family, numerous fish were caught of which 6 were Dolly Varden (bull trout). The fish were approximately 17 to 19 inches in length. As I recall, of the Dolly Varden caught, 2 were female and 4 were males. I remember this detail because these fish were the first I had ever caught and my first lesson distinguishing different species of trout and sexing [them]. Also, this information was recently brought to mind after a conversation with my 88 year old father who was with us during this excursion. All of these fish were healthy and well fed as I recall.

Dan Pool
Colville, Washington
Source: Personal interview on March 23, 2001 with Tom Shuhda, Colville National Forest

Dan was born in Minnesota. His family moved to Colville in 1916 when he was 5 years old. They lived at a homestead at Park Rapids. He fished the Pend Oreille River from 1916 through 1929 and then back from 1958 on after a career with the Army.

Dan moved to Diamond City on the West Branch LeClerc Creek and then to Blueslide by Ruby from 1918-1922. He worked in Ione in 1928 and fought fires in the valley. He fished LeClerc Creek from 1918-1920 for brook and rainbow trout. Lots of beaver ponds but more in the East Branch. He fished Yocum Lake from cutthroat trout during this time. Dan also [caught] *quite a few Dolly Vardens (bull trout) in the P.O. River, but not in the tributaries. He fished from Ione to Albeni Falls. Dan would catch large Dolly Vardens, many over 5 pounds from the log booms at Newport, Dalkena, and Usk as well as at Albeni Falls during the spawning season. Other fish that Dam caught on the river included squawfish, rainbows, cutthroats, a few bullhead catfish and whitefish in the riffle areas in the wintertime.*

Bill Piper
Newport, Washington
Source: Personal interview on May 21, 1997 with Tom Shuhda, Colville National Forest

Mr. Piper lived on LeClerc Creek in the late 20s and 30s and in the area all his life. I questioned him about fishing in the Pend Oreille River and tributaries.

[Mr. Piper] *fished LeClerc Creek mostly for cutthroat and eastern brook trout. He did not recall catching any, what he called, Dolly Varden. He used to fish the mouth of LeClerc Ck., in the summer when the river had dropped off, from rock points. The whitefish were so thick, you could drop a hook and snag them off the bottom. His mother canned them. There was a dam at Camp C on the East Branch of LeClerc Creek about 2 miles above the confluence of the East Branch and main LeClerc, where 4th of July Ck. enters. The dam formed a pond about 2 to 3 acres. He caught brook and cutthroat trout here. The dam was originally built to run a flume. He thinks the East Branch may have been dewatered when flume was in use but this was before his time.*

He did not recall catching any Dolly Varden in the Pend Oreille River or any of its tributaries. He also fish Mill and Middle creeks for brook trout and cutthroat trout. He fished the river for cutthroat trout, whitefish, bass, squawfish, perch and peamouth. He said that salmon or steelhead made it past Z Canyon. He remembers fish ladders on Mill Pond and Sullivan Lake dams but does not know what fish used them. Bill thought that perhaps it was law that required fish passage around dams regardless of species. He recollected building a log dam on LeClerc Creek in 1932 to power a generator. Ralph Johnson, the game warden, told him that he could not build a dam that blocked fish passage. The dam allowed fish passage so it was okay.

When asked about the size of fish in creeks, Bill said that 9 to 10 inches was a good size fish. He did not remember any trout greater than 12 inches long. The fish were much bigger in the Pend Oreille River. There was good habitat – rocky bars with eddies forming good pools to fish.

Margaret Liebing
Cusick, Washington
Source: Personal interview on March 27, 2002 with Sandy Lembcke, Washington Dept. of Fish and Wildlife

Margaret was born in 1920 and was raised in Spokane. She had relatives in Pend Oreille County and she visited them frequently during her childhood. She moved to the Cusick area in the early 1940s and has lived there since. Her husband was an avid fisherman and they fished local lakes and streams often.

When she was between 40 and 50 (about 1960-70), she caught a large "dolly" in "Big Lightening Creek" in the Clark Fork. The fish was as "long as a gunny sack". She does not recall the time of year, but thought it must have been summer because they were camping. The fish was so impressive that it was put on display at the local sports shop for the weekend.

She does not recall ever catching bull trout or Dolly Varden in the Pend Oreille River.

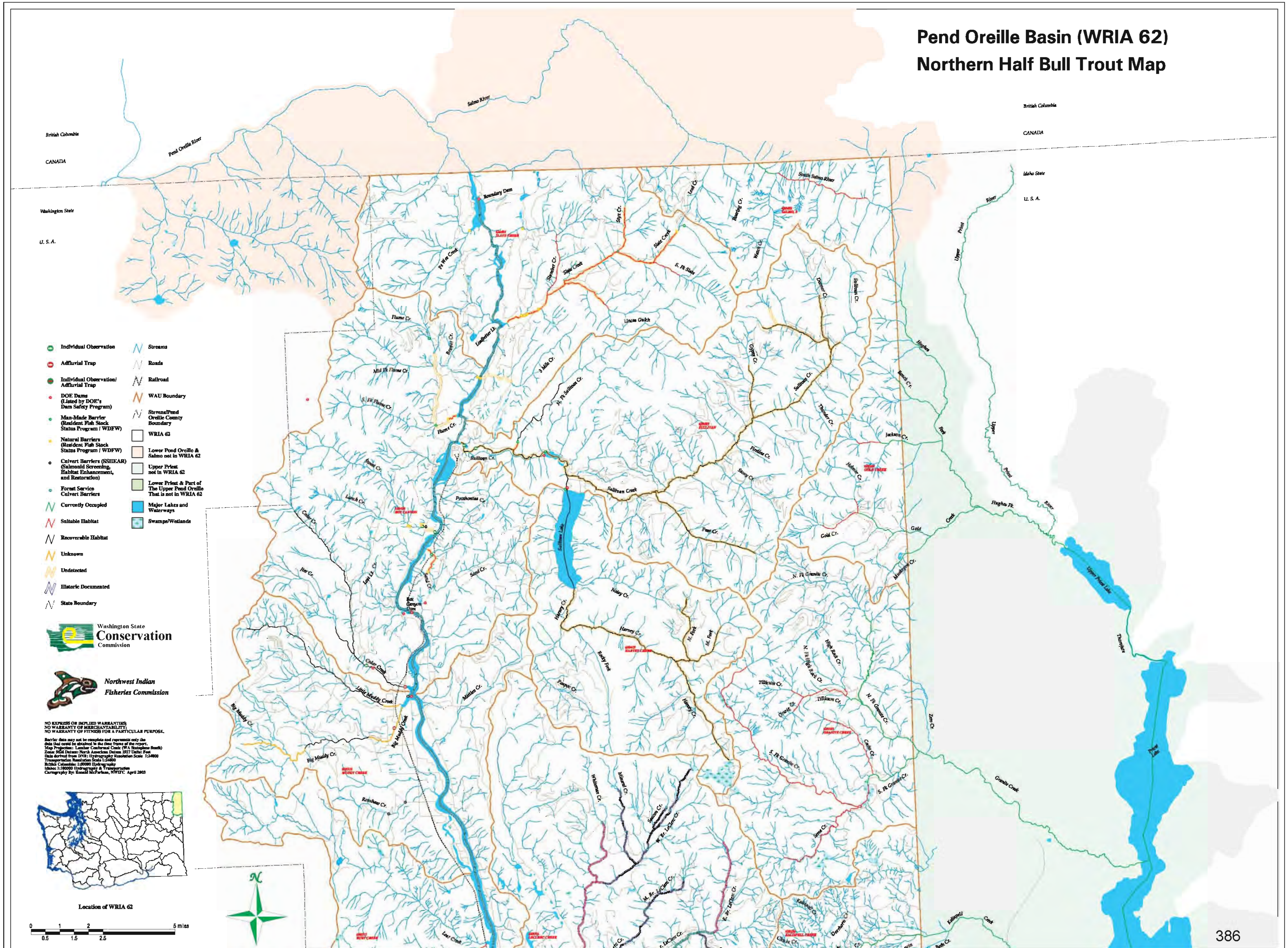
She considered Winchester Creek (near the headwaters) to be the best place to catch cutthroat trout. The fish averaged "14 inches long and 3inches across the belly".

She recalls catching "silvers" at the south end of Davis Lake. They averaged 12" long and ran every May. She assumed they were spawning.

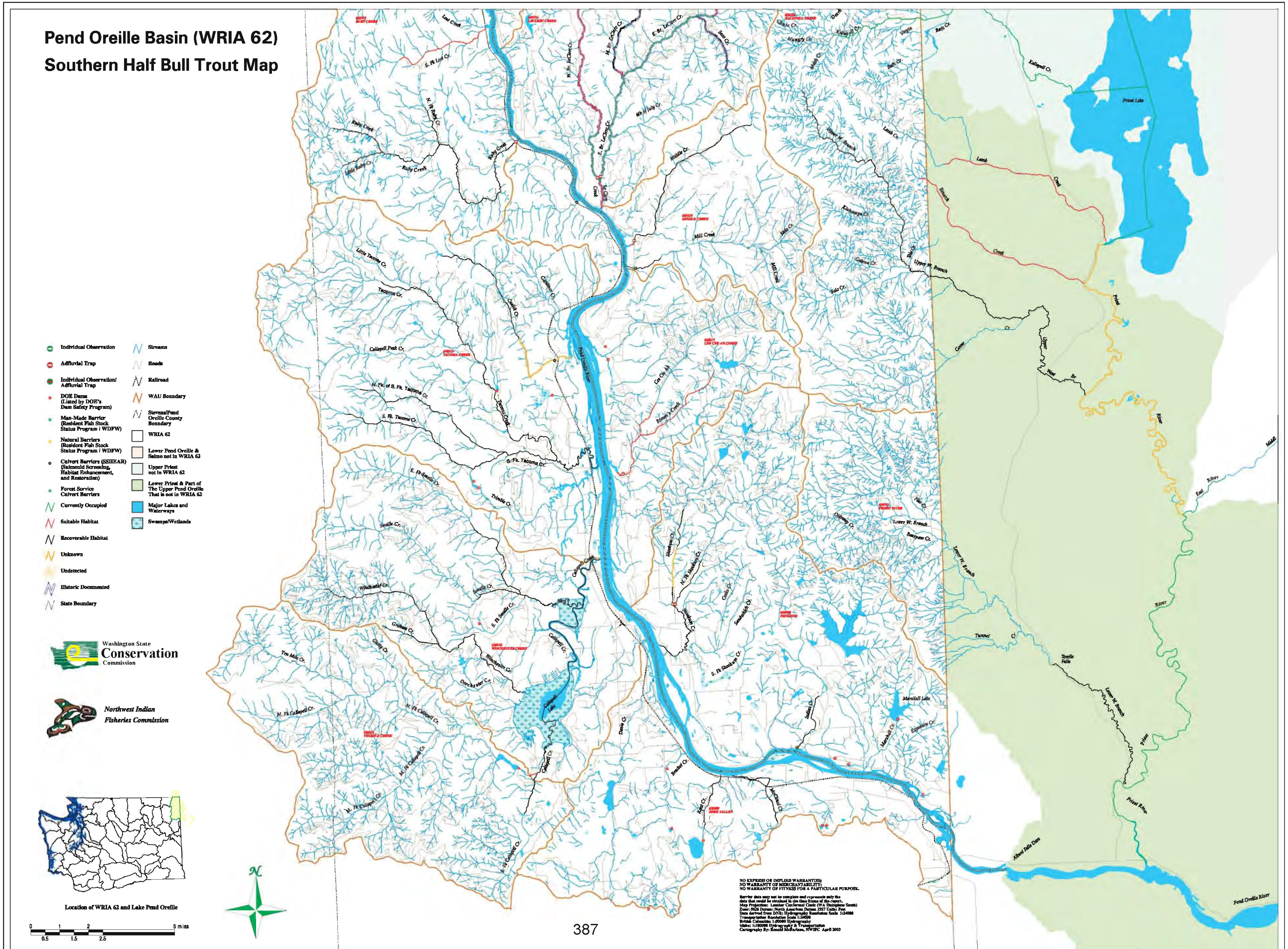
Margaret and her husband like to fish for whitefish at the pilings on the west side of the river near the Usk bridge. The fish averaged 12-14". Fly fishing for cutthroat trout was good at Browns Lake. She caught large brown trout in Skookum Creek.

APPENDIX C

FISH DISTRIBUTION MAPS



Pend Oreille Basin (WRIA 62)
Northern Half Bull Trout Map
Individual Observation
Adfluvial Trap
Individual Observation/ Adfluvial Trap
DOE Dams (Listed by DOE's Dam Safety Program)
Man-Made Barrier (Resident Fish Stock Status Program / WDFW)
Natural Barriers (Resident Fish Stock Status Program / WDFW)
Culvert Barriers (SSHEAR) (Salmonid Screening, Habitat Enhancement, and Restoration)
Forest Service Culvert Barriers
Currently Occupied
Suitable Habitat
Recoverable Habitat
Unknown
Undetected
Historic Documented
State Boundary
Streams
Roads
Railroad
WAU Boundary
Stevens/Pend Oreille County Boundary
WRIA 62
Lower Pend Oreille & Salmo not in WRIA 62
Upper Priest not in WRIA 62
Lower Priest & Part of The Upper Pend Oreille That is not in WRIA 62
Major Lakes and Waterways
Swamps/Wetlands
Washington State Conservation Commission
Northwest Indian Fisheries Commission
Location of WRIA 62
British Columbia
CANADA
Washington State
U. S. A.
Idaho State
Pend Oreille River
Salmo River
Boundary Dam
Sullivan Lake
Sullivan Creek
Upper Priest Lake
Priest Lake



Pend Oreille Basin (WRIA 62)
Southern Half Bull Trout Map
Individual Observation
Adfluvial Trap
Individual Observation/ Adfluvial Trap
DOE Dams (Listed by DOE's Dam Safety Program)
Man-Made Barrier (Resident Fish Stock Status Program / WDFW)
Natural Barriers (Resident Fish Stock Status Program / WDFW)
Culvert Barriers (SSHEAR) (Salmonid Screening, Habitat Enhancement, and Restoration)
Forest Service Culvert Barriers
Currently Occupied
Suitable Habitat
Recoverable Habitat
Unknown
Undetected
Historic Documented
State Boundary
Streams
Roads
Railroad
WAU Boundary
Stevens/Pend Oreille County Boundary
WRIA 62
Lower Pend Oreille & Salmo not in WRIA 62
Upper Priest not in WRIA 62
Lower Priest & Part of The Upper Pend Oreille That is not in WRIA 62
Major Lakes and Waterways
Swamps/Wetlands
Washington State Conservation Commission
Northwest Indian Fisheries Commission
Location of WRIA 62 and Lake Pend Oreille
0 1 2 5 miles
0.5 1.5 2.5
N
Priest Lake
Pend Oreille River
Albeni Falls Dam
Marshall Lake
Calispell Lake
NO EXPRESS OR IMPLIED WARRANTIES;
NO WARRANTY OF MERCHANTABILITY;
NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.
Cartography By: Ronald McFarlane, NWIFC April 2003

WASHINGTON CONSERVATION COMMISSION 2496 TAG GUIDELINES FOR MAPPED BULL TROUT PRESENCE/HABITAT

(adapted from WDFW Procedures for mapping bull trout, June 7, 2000)

Note: Categories are not mutually exclusive. Areas may contain multiple identifiers

Individual observations
Defined reach(es) where a single observation of bull trout occurred. May also include qualifiers regarding other surveys that have been conducted and have not detected any bull trout.

Currently Occupied
Defined reach(es) where bull trout are known to occur based on multiple observations of bull trout occurrence from 1980 to present. These areas can be further refined using the best available data to distinguish specific habitat.

A. **Known Spawning-** "Currently Occupied" areas where bull trout are known to spawn.
B. **Pioneering Spawning-** "Currently Occupied" areas where spawning activity or evidence has been observed, but successful incubation and rearing are considered unlikely at this time.
C. **Known Juvenile Rearing-** "Currently Occupied" areas where bull trout up to 150 mm in total length are known to rear.

Suitable Habitat
Defined reach(es) where, based on the best biological data, suitable bull trout habitat exists. Best biological data includes consideration of life history strategies, proximity and connectivity to adjacent areas of known occupied habitat, and logical extrapolation of range from similar systems. Suitable habitat is defined by the bull trout requirements for cold, clean, complex and connected habitat (USFWS Bull Trout Interim Conservation Guidance 1998). Habitat upstream of human-made barriers may be identified as suitable if the habitat meets the definition of suitable habitat. This category may also include qualifiers as to the type of habitat that is available (i.e. migratory, spawning, rearing, overwintering) if data is available to define specific habitat.

Recoverable Habitat
Defined reach(es) where, based on the best biological data, potential for suitable bull trout habitat exists, and recovery efforts would upgrade the habitat to suitable. Best biological data includes consideration of life history strategies, proximity and connectivity to areas of known historical or known occupied habitat, and logical extrapolation of range from similar systems. Suitable habitat is defined by the bull trout requirements for cold, clean, complex and connected habitat (USFWS Bull Trout Interim Conservation Guidance 1998). This category may also include qualifiers as to the type of habitat that is available (i.e. migratory, spawning, rearing, overwintering) if data is available to define specific habitat.

Undetected
Reach(es) where bull trout are undetected, based on adequate sampling. Choose one of the following:

A. Undetected-AFS 2000 for areas in which sampling followed the AFS-2000 protocols or

B. Undetected-Other for areas in which sampling consisted formal surveys done prior to the year 2000.

Historically Documented
Reach(es) where, based on reliable data (compiled prior to 1980), bull trout have existed/occurred.

Unknown
Reach(es) where no reliable data concerning the suitability or lack of suitability of habitat for bull trout currently exists.

APPENDIX D

BULL TROUT DISTRIBUTION TABLE

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Box Canyon	Cedar Creek	Pend Oreille River	Recoverable	0.0 - 1.5/ municipal dam	T. Shuhda; KNRD 1997b, Fig. 6.	"Recoverable" bull trout habitat exists from the mouth upstream to the municipal dam (RM 1.5) which is a full barrier to fish passage (T. Shuhda, USFS, pers. comm., 2002). KNRD surveyed Cedar Creek from about RM 0.5 upstream to the headwaters (RM 8.3; 1997b).
Box Canyon	Cedar Creek	Pend Oreille River	Recoverable	1.5 - 3.0	USFS 1992 Stream Survey; KNRD 1997b, Fig. 6	"Recoverable" bull trout habitat exists from the mouth upstream to RM 3.0 based on USFS 1992 stream survey and KNRD 1995 survey.
Box Canyon	Cedar Creek	Pend Oreille River	Individual Observation	1.5 (in pool just upstream of the municipal dam)	KNRD 1997b, pg. 29, 43	In the pool just above the municipal dam, in 1995 WDFW and Kalispel Tribe biologists observed one 18 to 19 inch bull trout.
Box Canyon	Cedar Creek	Pend Oreille River	Recoverable	3.0 - 8.3	KNRD 1997b, Fig. 6	"Recoverable" bull trout habitat exists from RM 3.0 upstream to its headwaters (RM 8.3) based on KNRD survey data.
Box Canyon	Flume Creek	Pend Oreille River	Suitable	0.0 - 0.2	R2 Resource Consultants 1998	At RM 0.2 there is a 13 ft. natural falls fish passage barrier. From the mouth upstream to RM 0.2, trout species (although not bull trout) and "Suitable" bull trout habitat exists (R2 1998).
Box Canyon	Flume Creek	Pend Oreille River	Undetected	0.0 - 4.5	R2 Resource Consultants 1998	Snorkeling surveys were conducted in Aug. - Oct. 1997 following the sampling protocols of Hillman and Platts (1993) and the watershed sampling approach described by Bonar et al. (1997; R2 1998, pg. 4-1). No bull trout were detected (R2 1998, pg. 2-15, 16 and 4-1), nor were bull trout detected in 1997 during electrofishing surveys (R2 1998, pg. 4-3).
Box Canyon	Flume Creek	Pend Oreille River	Undetected	1.5 - 2.0	Terrapin Environmental and Taylor Associates 2000, pg. 1, 3	Using a modified Bonar survey methodology (Bonar et al. 1997), snorkeling efforts during the first week of November 2000 included day-only snorkeling surveys of 100m reaches followed by electrofishing if no bull trout were observed while snorkeling.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Box Canyon	Jim Creek	Cedar Creek	Recoverable	0.0 - 1.25/NB	KNRD 1995 Habitat Survey; USFS 1992 Stream Survey	"Recoverable" bull trout habitat exists from the mouth upstream to RM 1.25 based on habitat surveys in 1995 by KNRD and a stream surveys in 1992 by USFS.
Box Canyon	Sand Creek	Pend Oreille River	Undetected	0.0 - 1.25 (natural falls barrier)	R2 1998, pg. 4-1	Snorkeling efforts in 1997 all conducted during daylight hours on 100m reaches, from August - October. Surveys followed the sampling protocols of Hillman and Platts (1993) and the watershed sampling approach described by Bonar et al (1997).
Box Canyon	Sand Creek	Pend Oreille River	Suitable	0.0 - 1.25 (natural falls barrier)	McLellan 2001; USFS 1992 Stream Survey; USFS 1999bf.	From the mouth upstream to a 16.5 foot vertical falls at RM 1.25 (McLellan 2001, pg. 65), "Suitable" bull trout habitat exists. A culvert fish passage barrier was identified at about RM 0.25 where the railroad track crosses the creek (McLellan 2001, pg. 65). Dewatering has been observed in the lower 0.25 miles (USFSbf).
Box Canyon	Sweet Creek	Pend Oreille River	Individual Observation	0.0	POCD 2001b, Appendix 2-A	In the fall around 1980, '81 or '82, Bob Peck, retired WDFW fish biologist, caught an adult bull trout (about 20") in a gill net at the mouth.
Box Canyon	Sweet Creek	Pend Oreille River	Individual Observation	0.0	POCD 2001b, Appendix 2-A	In the fall around 1980, '81 or '82, Bob Peck, retired WDFW fish biologist, found a dead bull trout (34") along the streambank upstream from the mouth.
Box Canyon	Sweet Creek	Pend Oreille River	Individual Observation	0.60	McLellan 2001, pg. 91	In 2000, a single bull trout (300 mm/ 12 inches) was observed in the plunge pool just downstream of the waterfall (RM 0.6), approximately 400 meters upstream of State Hwy. 31.
Box Canyon	Sweet Creek	Pend Oreille River	Undetected	0.0 - 0.6	R2 Resource Consultants 1998, pg. 2-15.	Snorkeling efforts in 1996 on two separate trips, Oct. 1-4 & Nov. 19 - 22, and conducted during day and night on 1st trip and only during daylight during the second survey trip. Sites sampled were 100m long and followed protocols of Hillman and Platts (1993). Snorkeling efforts in 1997 all conducted during daylight hours on 100m reaches, from August through October. Surveys followed the sampling protocols of Hillman and Platts (1993) and the watershed sampling approach described by Bonar et al. (1997).
Calispell Creek Watershed	Calispell Creek	Pend Oreille River	Recoverable	0.0 (the pumps at the mouth) - 6.0 (Calispell Lake outlet)	DE&S 2001b; POPUD 200b; POCD 2001a	"Recoverable" bull trout habitat exists in Calispell Creek downstream of Lake Calispell based on steam survey work.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Calispell Creek Watershed	Calispell Creek	Calispell Lake	Recoverable	7.5 (inlet to Calispell Lake) - to N. Fk./S. Fk. Confl.	DE&S Feb. 2001, Vol. 2 of 2, Comment #8, Appendix A, pg.3.	"Recoverable" bull trout habitat exists based on DE&S 2001.
Calispell Creek Watershed	Calispell Lake	Calispell Creek	Recoverable	6.0 - 7.5 (length of the Lake)	DE&S 2001b; POPUD 200b; POCD 2001a	"Recoverable" bull trout habitat exists in Lake Calispell based on steam survey work.
Calispell Creek Watershed	E. Fk. Smalle Creek	Smalle Creek	Recoverable	0.0 - 3.7 (natural falls)	Andersen and Maroney 2001c	From the mouth upstream to a natural falls, "Recoverable" bull trout habitat exists. Brook trout were only observed downstream of the falls; the only salmonids observed upstream of the falls were cutthroat trout.
Calispell Creek Watershed	Graham Creek	Winchester Creek	Recoverable	0.0 - headwaters	Andersen and Maroney 2001c	"Recoverable" bull trout habitat exists based on KNRD 2000 habitat survey.
Calispell Creek Watershed	Power Creek	Calispell Creek	Suitable	0.0 - 0.2	DE&S 2001b.	"Suitable bull trout habitat exists up to RM 0.2 (515 ft.) where there is a series of natural cascades/falls that are barriers to fish passage (DE&S 2001b, pg. 5, 6). The barrier is 7.5 feet wide, with an above-water vertical rise of 5.1 ft. The pool at the base of the falls is 1.4 ft. deep (2001b, pg. 6).
Calispell Creek Watershed	S. Fk. Calispell Creek	Calispell Creek	Recoverable	0.0 - 1.3	DE&S Feb. 2001, Vol. 2 of 2, Comment #8, Appendix A, pg. 4; DE&S 2001b.	"Recoverable" bull trout habitat exists from the Power Creek confluence upstream for approximately 1.3 miles to a natural boulder-cascades barrier. Begin at RM 1.56, the channel appears to flow underground for approximately 1,500 feet and remair dry for most of the year (DE&S 2001b).
Calispell Creek Watershed	Smalle Creek	Calispell Creek	Recoverable	0.0 - 2.5	J. Maroney; C. Vail; T. Shuhda	"Recoverable" bull trout habitat exists based on professional knowledge.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Calispell Creek Watershed	Smalle Creek	Calispell Creek	Recoverable	2.5 - 6.6/ NB	Andersen and Maroney 2001c	"Recoverable" bull trout habitat exists from the confluence of S. Fk. Smalle Creek upstream to a natural barrier falls (RM 6.6) based on KNRD 2000 habitat survey.
Calispell Creek Watershed	Winchester Creek	Calispell Lake	Recoverable	0.0 - 10.1/ NB	DE&S 2001, Appendix C, pg. 2; KNRD 2000; USFS 1990	"Recoverable" bull trout habitat exists from the mouth upstream to a natural barrier at RM 10.1 based on DE&S 2001 surveys, KNRD 2000 habitat survey, and USFS 1990 stream survey.
Cee Cee Ah	Browns Creek	Cee Cee Ah	Suitable	0.0 - 3.0	USFS 1995 Stream Survey	"Suitable" bull trout habitat exists from the mouth upstream to RM 3.0 based on KNRD 1995 habitat survey. There is a potentially blocking USFS Rd. culvert at RM 1.1 and 3.0 and the stream dewaters naturally at about the Browns Lake outlet.
Cee Cee Ah	Cee Cee Ah Creek	Pend Oreille River	Suitable	0.0 - 3.5/ NB falls	KNRD 1999 Habitat Survey	From the mouth upstream to a natural falls barrier (RM 3.5).
Deer Valley	Kent Creek	Pend Oreille River	Recoverable	0.0 - 2.25	WDFW/KNRD 2001 Resident Fish Stock Status surveys	"Recoverable" bull trout habitat exists based on WDFW/KNRD 2001 fish and habitat surveys.
Deer Valley	McCloud Creek	Pend Oreille River	Recoverable	0.0 - headwaters	WDFW/KNRD 2001 Resident Fish Stock Status surveys	"Recoverable" bull trout habitat exists based on WDFW/KNRD 2001 fish and habitat surveys.
Gold	Bench Creek	Hughes Fork	Currently Occupied	0.0 - headwaters	USFS/IPNF Stream Surveys 1984, 1992, 1996	1984 fish surveys using multiple survey methods, 1992 redd count at the Trail 312 crossing, and 1996 electrofishing survey (USFS/IPNF fisheries database).
Gold	Gold Creek	Hughes Fork	Suitable	Confluence Helmer Creek - headwaters	J. Cobb & M. Davis, USFS; T. Anderson, KNRD.	Upper extent of "Suitable" bull trout habitat based on professional knowledge.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Gold	Gold Creek	Hughes Fork	Currently Occupied	0.0 - Helmer Creek confluence	Irving 1984, Table W-6; USFS IPNF Stream Surveys 1982, 1984; IDEQ 2001, Table 2-10.	Juveniles observed in 1982 snorkeling fish survey (Irving 1984); 1982 bull trout at FS Road 1013 crossing, and in 1984 using multiple fish survey techniques (USFS/IPNF fisheries database).
Gold	Helmer Creek	Gold Creek	Suitable	0.0 - 1.0	Jill Cobb, USFS Hydrologist.	Suitable bt habitat presumed based on visits to stream to work on a culvert removal project (J. Cobb); 1996 electrofish survey observed no fish in T45E, R38N. Sec 02 (USFS/IPNF fisheries database).
Gold	Hughes Fork	Upper Priest River	Currently Occupied	0.0 - headwaters	Irving 1984, Table W-5; USFS/OPNF fisheries database; IDEQ 2001, Table 2-10.	Juveniles observed in 1982 snorkeling fish survey (Irving 1984); bt observed in 1984 using multiple survey efforts and in 1987 & 1988 using electrofishing (Irving 1987). Distribution extends from the mouth upstream to the headwaters where the stream steepens.
Gold	Jackson Creek	Hughes Fork	Currently Occupied	0.0 - unnamed stream (LB) just up from Ledge Crk.	USFS/IPNF fisheries database; USFS/IPNF Stream Survey 1998	Bull trout have been observed to currently use Jackson Creek from the mouth to just upstream of the Ledge Creek confluence based on 1984 fish surveys using multiple survey methods, 1992 redd count at the confluence of Ledge Creek, and 1996 electrofishing survey (USFS/IPNF fisheries database).
Gold	Jackson Creek	Hughes Fork	Suitable	Ist unnamed stream (LB) up from Ledge Crk - headwaters	USFS 1998, Priest Lake R.D., Aug. Jackson Crk. Stream Survey, Wingert and Fuhrmann.	Although bull trout were not observed in this upper reach, suitable bull trout habitat exists from just upstream of the Ledge Creek confluence with Jackson Creek to where the stream gets too small and narrow (USFS 1998, Jackson Crk. Stream Survey).

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Gold	Muskegon Creek	Gold Creek	Currently Occupied	0.0 - headwaters	USFS/IPNF Fish Survey database	1984 observations using multiple survey methods.
Granite	Granite Creek	Priest Lake	Currently Occupied	0.0 - S. Fk./ N. Fk. Granite Crk. confluence	IDEQ 2001, Table 2-10.	Bull trout observed in Granite Creek during 1987, 1988 & 1989 electrofishing surveys. (USFS/IPNF fisheries database).
Granite	Cache Creek	S. Fk. Granite Creek	Suitable	0.0 - 3.0	M. Davis, USFS, Fish Biologist	"Suitable" bull trout habitat exists in Cache Creek from the mouth upstream to RM 3.0 (M. Davis, USFS, pers. comm., 2002)
Granite	High Rock Creek	Tillicum Creek	Suitable	0.0 - 0.25	J. Cobb, USFS Hydrologist; T. Anderson, KNRD Fish Program Mgr.	"Suitable" bull trout habitat exists from the mouth upstream to the confluence of N. Fk. High Rock Creek, based on professional knowledge.
Granite	N. Fk. Granite Creek	Granite Creek	Currently Occupied	0.0 - 6.8	Irving 1984, Irving 1987	1982 & 1983 juvenile bull trout observed during snorkeling survey (Irving 1984); 1983 bt observed using electrofishing and other survey techniques and in 1984 bt observed using multiple survey techniques (Irving 1987). Distribution extends up to the a naturals falls at approximately RM 6.8.
Granite	Orwig Creek	Tillicum Creek	Suitable	0.0 - 0.5	J. Cobb, USFS Hydrologist.	"Suitable" bull trout habitat exists based on professional knowledge.
Granite	S. Fk. Granite Creek	Granite Creek	Suitable	3.0 - headwaters	KNRD 1997	"Suitable" bull trout habitat exists based on stream survey data in 1997. No bull trout were observed using snorkeling technique.
Granite	S. Fk. Granite Creek	Granite Creek	Currently Occupied	0.0 - 3.0	Irving 1984, Table W-10; IDEQ 2001, Table 2-10.	1982 & 1983 juvenile bull trout observed during snorkeling survey (Irving 1984); 1983, 1984, 1987 & 1988 bt observed using electrofishing (Irving 1987).

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Granite	Sema Creek	S. Fk. Granite Creek	Suitable	0.0 - headwaters	J. Cobb, USFS Hydrologist; Irving 1984, Table W-11; KNRD 1997a	"Suitable" bull trout habitat exists based on professional knowledge (J. Cobb). No bull trout have been observed using snorkeling technique in 1983 (Irving 1984) or using multiple survey techniques in 1983 and 1984 (Irving 1987).
Granite	Tillicum Creek	N. Fk. Granite Creek	Suitable	0.2 - upper reaches	J. Cobb, USFS Hydrologist; T. Anderson, KNRD Fish Program Mgr.	"Suitable" bull trout habitat exists from the confluence with Orwig Creek upstream to where the stream narrows based on professional knowledge.
Granite	Tillicum Creek	N. Fk. Granite Creek	Currently Occupied	0.0 - 0.2/ NB	Irving 1984, Table W-14.	1982 & 1983 juvenile bull trout observed during snorkeling survey (Irving 1984); 1982, 1983 & 1984 bt observed using multiple survey efforts (Irving 1987).
Kalispell	Binarch Creek	Priest River	Suitable	0.0 - headwaters	USFS 1998, Priest Lake R.D., Oct. Binarch Creek Stream Survey, Wingert and Hamilton.	"Suitable" bull trout habitat based on USFS 1998 stream survey; bull trout were not observed using multiple fish survey techniques in 1986 (USFS/IPNF fisheries database). Seasonal dewatering occurs in reaches of Binarch Creek upstream of the mouth where the valley widens and the floodplain becomes contained. The USFS stream survey refers to this as Reach 2 (USFS Oct. 1998 Oct. Binarch Crk. Stream Survey).
Kalispell	Kalispell Creek	Priest Lake	Currently Occupied	0.0 - Mush Creek confluence	Irving 1987, Table 5; USFS/IPNF fisheries database; IDEQ 2001, Table 2-10; J. Cobb and M. Davis, USFS, pers. comm., 2002.	During a snorkling survey efforts in 1982, 1983 and 1984, bull trout were observed in very low densities (Irving 1987); bull trout were not observed during subsequent electrofishing survey efforts in 1987, 1988 and 1996 (USFS IPNF fisheries database).

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Kalispell	Lamb Creek	Priest River	Suitable	0.0 - 9.0/NB	IDEQ 2001, Table 2-10.	"Suitable" bull trout habitat from the mouth up to natural barrier (15 ft. waterfall).
Kalispell	Upper West Branch	Priest River	Recoverable	0.0 - headwaters	J. Cobb, USFS; T. Anderson, KNRD.	From the mouth upstream to the headwaters, "Recoverable" bull trout habitat would exist on the Upper West Branch (J. Cobb and M. Davis, USFS, pers. comm., 2002).
LeClerc	E. Br. LeClerc Creek	LeClerc Creek	Currently Occupied	0.0 - 6.5	Plum Crk 1993 sampling records; Andersen 2001, Fig. 13; KNRD 1999; USFS 1991 Stream Survey; WDNR 1997.	In 1993, two juvenile bull trout were found by Plum Creek (Plum Creek Timber Company Records, 1993). In 1995, a Kalispel biologist and a WDFW biologist found one adult bull trout in the same reach where the two juvenile bull trout were found in 1993 by Plum Creek personnel. In 1998 a juvenile bull trout was found by KNRD during a snorkeling survey (KNRD 1999). The WDNR Watershed Analysis (1997) identifies a bedrock falls at the upper end of Segment D4 (Sement D4 ends at the M. BR. LeClerc Crk. confluence/RM 5.1). This was not brought to the attention of the TAG and therefore not discussed.
LeClerc	E. Br. LeClerc Creek	LeClerc Creek	Historic	0.0 - 12.9/ headwaters	Smith 1983, pg. 203	Across "the large, swift creek now known as Le Clerc Creek", one family of the Kalispel Tribe maintained a brush weir site and caught "trout and char exclusively". The WDNR Watershed Analysis (1997) identifies a bedrock falls at the upper end of Segment D4 (Sement D4 ends at the M. BR. LeClerc Crk. confluence/RM 5.1). This was not brought to the attention of the TAG and therefore not discussed.
LeClerc	E. Br. LeClerc Creek	LeClerc Creek	Suitable	6.5 - 12.9/ headwaters	T. Shuhda	From RM 6.5 upstream to the headwaters (RM 12.9), suitable habitat exists based on personal observation of trout species (although not bull trout) and suitable habitat.
LeClerc	Fourth of July Creek	E. Br. LeClerc Creek	Currently Occupied	0.0 - 0.25	KNRD 1999 Habitat Survey	From the mouth upstream to a steep gradient/falls believed to be a fish passage barrier (T. Shuhda, USFS). In 1998, a 10-inch juvenile bull trout was found while snorkeling and in 1999 a 6-inch bull trout was found while snorkeling, both at the mouth of Fourth of July Creek (confluence with E. Fk. LeClerc Creek is at RM 2.8; Andersen 2001).
LeClerc	Fourth of July Creek	E. Br. LeClerc Creek	Historic	0.0 - 0.25	Smith 1983, pg. 203	Across "the large, swift creek now known as Le Clerc Creek", one family of the Kalispel Tribe maintained a brush weir site and caught "trout and char exclusively".

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
LeClerc	LeClerc Creek	Pend Oreille River	Suitable	0.0 - 1.2	T. Anderson; C. Vail	From the mouth upstream to the confluence of the West Branch LeClerc Creek and the East Branch LeClerc Creek, suitable habitat exists.
LeClerc	LeClerc Creek	Pend Oreille River	Historic	0.0 -1.2	Smith 1983, pg. 203	Across "the large, swift creek now known as Le Clerc Creek", one family of the Kalispel Tribe maintained a brush weir site and caught "trout and char exclusively".
LeClerc	Middle Br. LeClerc Creek	E. Br. LeClerc Creek	Suitable	0.0 - 0.5	KNRD 1999 Habitat Survey	Suitable habitat exists from the mouth upstream to a culvert barrier at a USFS road (RM 0.5).
LeClerc	Middle Br. LeClerc Creek	E. Br. LeClerc Creek	Historic	0.0 - 5.0	Smith 1983, pg. 203	Across "the large, swift creek now known as Le Clerc Creek", one family of the Kalispel Tribe maintained a brush weir site and caught "trout and char exclusively".
LeClerc	Middle Br. LeClerc Creek	E. Br. LeClerc Creek	Recoverable	0.5 - 5.0	KNRD 1999 Habitat Survey	From the culvert barrier at RM 0.5 upstream to RM 5.0, "Recoverable" bull trout habitat exists based on KNRD 1999 habitat surveys. There are multiple fish barrier culverts in the lower 5.0 miles of M. Br. LeClerc Creek.
LeClerc	Mineral Creek	W. Br. LeClerc Creek	Historic	0.0 - 2.0	Smith 1983, pg. 203	Across "the large, swift creek now known as Le Clerc Creek", one family of the Kalispel Tribe maintained a brush weir site and caught "trout and char exclusively".
LeClerc	Mineral Creek	W. Br. LeClerc Creek	Recoverable	0.0 - 2.0	KNRD 1995 Habitat Survey	"Recoverable" bull trout habitat exists from the mouth upstream to RM 2.0 based on KNRD 1995 habitat survey. There is a full fish passage barrier downstream at RM 1.4.
LeClerc	Saucon Creek	W. Br. LeClerc Creek	Historic	0.0 - 1.0	Smith 1983, pg. 203	Across "the large, swift creek now known as Le Clerc Creek", one family of the Kalispel Tribe maintained a brush weir site and caught "trout and char exclusively".
LeClerc	Saucon Creek	W. Br. LeClerc Creek	Recoverable	0.0 - 1.0	KNRD 1999 Habitat Survey	Suitable habitat exists from the mouth upstream to a barrier at RM 1.0 based on KNRD 1999 habitat survey.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
LeClerc	Seco Creek	E. Br. LeClerc Creek	Historic	0.0 - 2.5	Smith 1983, pg. 203	Across "the large, swift creek now known as Le Clerc Creek", one family of the Kalispel Tribe maintained a brush weir site and caught "trout and char exclusively".
LeClerc	Seco Creek	E. Br. LeClerc Creek	Recoverable	0.0 - 2.5	KNRD 1999 Habitat Survey	Suitable habitat exists from the mouth upstream to RM 2.5 based on KNRD 1999 habitat survey.
LeClerc	W. Br. LeClerc Creek	LeClerc Creek	Historic	0.0 - 12.0	Smith 1983, pg. 203	Across "the large, swift creek now known as Le Clerc Creek", one family of the Kalispel Tribe maintained a brush weir site and caught "trout and char exclusively".
LeClerc	W. Br. LeClerc Creek	LeClerc Creek	Currently Occupied	0.0 - 2.0	Plum Crk 1993 sampling records; KNRD 1999 Habitat Survey; USFS 1991 Stream Survey	In 1993, two juvenile bull trout were found by Plum Creek. In 2001, one large adult female bull trout and a redd were found near the County Rd. 3503 crossing by a Kalispel Tribe biologist. "Suitable" bull trout habitat exists throughout this reach based on USFS 1991 stream survey and KNRD 1999 habitat survey.
LeClerc	W. Br. LeClerc Creek	LeClerc Creek	Suitable	2.0 - 8.0	KNRD 1999 Habitat Survey; USFS 1991 Stream Survey	From RM 2.0 upstream to the old diversion dam (RM 8.0), suitable bull trout habitat exists based on KNRD 1999 habitat survey and USFS 1991 stream survey. This segment has a loosing reach at the lower end (about RM 2.0) that was observed to dewater in 2001 and 2002 but not in 1999. The dewatering is considered a natural occurrence (J. Gross, KNRD, pers. comm., 2002).
LeClerc	W. Br. LeClerc Creek	LeClerc Creek	Recoverable	8.0 - 12.0	KNRD 1999 Habitat Survey; USFS 1991 Stream Survey	From the old diversion dam (RM 8.0) upstream to RM 12.0, if restored, bull trout habitat exists based on KNRD 1999 habitat survey and USFS 1991 stream survey.
LeClerc	Whiteman Creek	W. Br. LeClerc Creek	Historic	0.0 - 2.0	Smith 1983, pg. 203	Across "the large, swift creek now known as Le Clerc Creek", one family of the Kalispel Tribe maintained a brush weir site and caught "trout and char exclusively".

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
LeClerc	Whiteman Creek	W. Br. LeClerc Creek	Suitable	0.0 - 2.0	KNRD 1995 Habitat Survey	Suitable habitat and no barriers exist from the mouth upstream to RM 2.0 based on KNRD 1995 habitat survey.
Mainstem Pend Oreille River	Pend Oreille River	Columbia River	Currently Occupied	17.0 (Boundary Dam) - 34.5 (Box Canyon Dam)	R2 Resource Consultants 1998	From Boundary Dam upstream to Box Canyon Dam. In 1994, two bull trout were captured in Boundary reservoir by the mouth of Slate Creek by WDFW (C. Vail) and USFS (T. Shuhda) fish biologists during exploratory hook-and-line sampling (Curt Vail and T. Shuhda, pers. comm., 2002). In 1995, C. Vail (WDFW) and Karen Vail captured three bull trout (17-19") using hook and line in Boundary Reservoir. Using various survey methods (snorkling, hydroacoustics, live traps, and hook-and-line) from the summer of 1996 to the fall of 1997, a single bull trout was captured twice in 1997 near the outlet of Slate Creek (RM 22.2) in the Boundary Reservoir portion of the Pend Oreille River (R2 Consultants 1998).
Mainstem Pend Oreille River	Pend Oreille River	Columbia River	Historic	17.0 (Boundary Dam) - 90.1 (Albeni Falls)	Gilbert and Evermann 1895, pg. 201	From Boundary Dam upstream to Box Canyon Dam. Bull trout were "abundant in the Pend d'Oreille River. At La Claires we saw in the possession of an Indian several fine specimens, the largest of which was 26 inches long, 11 inches in greatest circumference, and weighed 5 pounds and 1 ounce" (Gilbert and Evermann 1895). Gilbert and Evermann (1895) conformed to the salmonid identification characteristics used in the Catalogue of Fisheres of North America (1885), to identify salmonid species.
Mainstem Pend Oreille River	Pend Oreille River	Columbia River	Currently Occupied	34.5 (Box Canyon Dam) - 90.1 (Albeni Falls Dam)	Ashe et al. 1991; Bennet and Liter 1991; Barber et al 1989; Barber et al. 1990.	From Box Canyon Dam upstream to Albeny Falls Dam. During a 3-yr study by the Upper Columbia United Tribes Fisheries Center at Eastern WA Univ: 1988 one bull trout was captured electrofishing (Ashe et al. 1991, Table 4.1. cites Barber et al. 1989); Sept. 1989, during relative abundance electrofishing surveys, 2 bull trout were captured (1 in Cee Cee Ah Slough and 1 in Skookum Slough; Barber et al. 1990, Table 3.3 & A.19.); in Aug. 1989, during a selective electrofishing survey targeted at bull trout, 3 bull trout were captured at Char Springs (Barber et al. 1990, Table 3.9.); June 1990, one bull trout was captured near the mouth of Cee Cee Ah Slough during relative abundance electrofishing surveys (Ashe et al. 1991, Table 3.3). During a 2-yr, study by the University of Idaho, of 15,887 fish captured in 1989, one bull trout was captured by electrofishing (Bennett and Liter 1991, Table 3-2). Of 13,326 fish captured in 1990, one bull trout was captured by gill net (Bennett and Liter 1991, Table 3-3). In 2000, an angler reported to the POCD that he caught a 25 inch bull trout near the mouth of Marshall Creek.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Mainstem Priest River	East River	Priest River	Currently Occupied	lower East River	N. Horner, IDFG, email comm., Oct. 15, 2002; Horner et al. 1987	IDFG radio tagged 20 bull trout in the East River August 2002 and are currently monitoring their movements. As of October 15, 2002, the bull trout have been observed using the lower East River and East River tributaries; Middle Fork East River, Tarlac, and Uleda creeks. During an electofishing survey on August 6, 2000, adult and juvenile bull trout were observed by Mark Liter, IDFG, in Uleda Creek, a tributary to the East River. The fish were suspected to be downstream migrating adfuvial fish from Lake Pend Oreille (S. Deeds, USFWS, email comm., August 13, 2001). Bull trout were documented to occure in M.Fk. East River and its tributaries Tarlac and Uleda creeks, in 1986 (Horner et al. 1987, IDFG Job Performance Report).
Mainstem Priest River	Priest Lake	Priest River	Currently Occupied	45.0 / lake outlet - 64.5/Thorofare	IDEQ 2001, Table 2-10.	Randy Phelps (citizen, retired), working with Ned Horner (IDF&G), has captured and seen bull trout in this work as volunteer for IDF&G tagging fish.
Mainstem Priest River	Priest River	Pend Oreille River	Currently Occupied	0.0 - 23.0/ East River confluence	J. Dupont, IDFG, pers. comm., 2002.	IDFG radio tagged 20 bull trout in the East River, a tributary to the Priest River, in August 2002, and are currently monitoring their movements. As of October 15, 2002, the bull trout had been observed using the lower East River and East River tributaries; Middle Fork East River, Tarlac, and Uleda creeks. As of October 28, 2002, two radio-tagged bull trout were tracked moving from the East River drainage down into the mainstem Priest River. Prior to the 2002 telemetry work, adult and juvenile bull trout were observed in Uleda Creek, a tributary to the East River, by Mark Liter (IDFG) during an electofishing survey on August 6, 2000. The fish were suspected to be downstream migrating adfuvial fish from Lake Pend Oreille (S. Deeds, USFWS, email comm., August 13, 2001).
Mainstem Priest River	Priest River	Pend Oreille River	Unknown	23.0 - 45.0/ Priest Lake outlet dam	J. Dupont and N. Horner, IDFG, pers. comm., 2002.	Neither Joe Dupont nor Ned Horner, IDFG have any knowledge of bull trout observations, historic or current, in the Priest River upstream of the East River confluence (RM 23.0). In 2001, the IDFG did document bull trout in Uleda Creek, a tributary to the East River and telemetry work is planned for August of 2002 to try to determine the extent of Uleda bull trout use in the downstream drainage network connected to Uleda Creek, which includes the East River, the Priest River and Priest River tributaries.
Mainstem Priest River	Thorofare	Priest Lake	Currently Occupied	64.5/ Priest Lake inlet - 67.2/ Upper Priest Lake outlet	Panhandle Basin Bull Trout TAG 1998, Dec. Draft, Table 1.	There are no barriers to bull trout movement from Priest Lake up into the Thorofare and up into Upper Priest Lake and Upper Priest River. Bull trout are known to occur in Priest Lake, Upper Priest Lake and Upper Priest River.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Mainstem Priest River	Upper Priest Lake	Thorofare	Currently Occupied	67.2/ lake outlet - 70.2/ lake inlet	IDEQ 2001, Table 2-10.	
Mainstem Priest River	Upper Priest River	Upper Priest Lake	Currently Occupied	70.2 - natural falls barrier	IDEQ 2001, Table 2-10; J. Cobb, USFS.	From the mouth at Upper Priest Lake upstream to Upper Priest Falls (0.5 miles south of the Canada border), bull trout are known to occur (IDEQ 2001). A bull trout redd was observed Oct. 10, 2002 upstream of the Rock Creek confluence (J. Cobb, USFS, pers. comm., 2002).
Middle	Middle Creek	Pend Oreille River	Suitable	0.0 - 0.25	KNRD 1999 Habitat Survey	"Suitable" habitat exists from the mouth upstream to RM 0.25 based on KNRD 1999 habitat survey. There is a culvert fish passage barrier at the LeClerc County Road crossing (RM 0.25; A. Scott, Framatome ANP).
Middle	Middle Creek	Pend Oreille River	Recoverable	0.25 - 6.0	KNRD 1999 Habitat Survey; Maroney and Andersen 2000b, pg. 21.	"Recoverable" bull trout habitat exists from RM 0.25 at the LeClerc County Road culvert barrier, upstream to RM 6.0, based on KNRD 1999 habitat survey. Beginning at RM 0.25, there is a 0.8 mile stretch of high-gradient (average 13.4%) stream reach that is a potential barrier to bull trout. It is a known barrier to brook trout (T. Andersen, KNRD, pers. comm., 2002).
Middle	Mill Creek	Pend Oreille River	Individual Observation	0.25	J. Maroney, KNRD, pers. comm., 2002	In 1995, a Kalispel Tribe biologist found a bull trout 200 yards upstream from the LeClerc Road crossing.
Middle	Mill Creek	Pend Oreille River	Recoverable	0.0 - 1.3	KNRD 1995 Habitat Survey; J. Maroney.	From the mouth upstream to a RM 1.3, "Recoverable" bull trout habitat exists. At RM 1.3 there is a natural falls that is a full barrier to fish passage (J. Maroney, KNRD, pers. observation, 2002).
Muddy	Big Muddy Creek	Pend Oreille River	Unknown	0.0 - USFS boundary	T. Anderson, T. Shuhda, C. Viola	From the mouth upstream to the USFS land boundary is private land. Habitat surveys have not been conducted and habitat conditions are unknown (Anderson, Shuhda, Viola), although the County Road 2705 culvert at RM 1.2 is a known fish passage barriers (T. Shuhda, USFS).
Muddy	Big Muddy Creek	Pend Oreille River	Recoverable	USFS - State land boundary	USFS 1992 Stream Survey	From the start of USFS land upstream to where state land starts, if restored, "Recoverable" bull trout habitat exists based on 1992 USFS stream surveys.
Muddy	Big Muddy Creek	Pend Oreille River	Unknown	State/USFS boundary - headwaters	T. Shuhda	Habitat conditions upstream of the State/USFS land boundary are unknown; it has not been surveyed.

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Muddy	Little Muddy Creek	Pend Oreille River	Unknown	0.0 - 1.25	T. Anderson, T. Shuhda, C. Vail	Habitat conditions on the lower 1.25 rivermiles are unknown. This reach is on private land downstream of USFS managed land and has not been surveyed.
Muddy	Little Muddy Creek	Pend Oreille River	Recoverable	1.25 - 6.75	USFS 1994 Stream Survey	From the mouth upstream to RM 6.75, "Recoverable" bull trout habitat exists based on USFS 1994 stream survey.
Priest River	Lower West Branch	Priest River	Recoverable	0.0 - 8.2	Jill Cobb, USFS; Todd Anderson, KNRD.	From the mouth up to Terrell Falls (RM 8.2) habitat is highly degraded (J. Cobb, USFS, T. Andersen, KNRD, pers. comm., 2002).
Ruby	Little Ruby Creek	Ruby Creek	Recoverable	0.0 - 1.5	USFS 1992 Stream Survey	"Recoverable" bull trout habitat exists based on USFS 1992 stream survey.
Ruby	N. Fk. Ruby Creek	Ruby Creek	Recoverable	0.0 - 1.5	USFS 1993 Stream Survey	"Recoverable" bull trout habitat exists from the mouth upstream to RM 1.5 based on USFS 1993 stream survey.
Ruby	Ruby Creek	Pend Oreille River	Recoverable	0.0 - 13.1/ headwaters	USFS 1992 Stream Survey	From the mouth upstream to the headwaters (RM 13.1), "Recoverable" bull trout habitat exists based on USFS 1992 habitat surveys.
Ruby	S. Fk. Lost Creek	Lost Creek	Suitable	0.0 - 3.8/NB falls	USFS 1994 Stream Survey	From the mouth upstream to a natural falls at RM 3.8, "Suitable" bull trout habitat exists based on 1994 USFS stream surveys. In 1994 the USFS did electrofish (not using any standardized methodology) but did not locate any bull trout.
Skookum	Indian Creek	Pend Oreille River	Individual Observation	0.0	POPUD 2000 Appendix E3.1-4; POPUD 2001b; Andersen 2001, pg. 39.	In Sept. 1999 at the mouth of Indian Creek, Duke Engineering captured one 25 - 27" female, adult bull trout in an adfluvial trap. An adipose fin clip showed it to be from Trestle Creek in Idaho, a tributary to Priest River. The female was tagged by KNRD and released (Andersen 2001). The same female was recaptured in June 2000 by an angler, near the mouth of Marshall Creek and again released (POCD 2001b).
Skookum	Indian Creek	Pend Oreille River	Recoverable	0.0 - 2.25	KNRD 1995 Habitat Survey	"Recoverable" bull trout habitat exists based on KNRD 1995 habitat survey.

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Skookum	N. Fk. Skookum Creek	Skookum Creek	Recoverable	0.0 - 2.0	J. Blum, Framatome ANP, pers. comm., 2002	From the mouth upstream to RM 2.0. "Recoverable" bull trout habitat would exist based on personal observations (J. Blum, Framatome ANP, pers. comm., 2002).
Skookum	Skookum Creek	Pend Oreille River	Recoverable	0.0 - Best Chance County Rd. crossing	J. Blum, Framatome ANP	From the mouth upstream the Best Chance County Road stream crossing, "Recoverable" bull trout habitat would exist based on J. Blum (Framatome ANP, pers. comm., 2002).
Skookum	Skookum Creek	Pend Oreille River	Unknown	Best Chance County Rd. crossing - southern boundary of Sec.15 T58N R44E	TAG 2002	Habitat conditions from the Best Chance County Road stream crossing upstream to the lower extent of the USFS stream survey reach (southern boundary of Sec.15 T58N R44E) are unknown. There is no information in the literature, no stream surveys, nor do TAG members have knowledge habitat condition in this reach.
Skookum	Skookum Creek	Pend Oreille River	Recoverable	southern boundary of Sec.15 T58N R44E - middle of Sec.35 T59N R44E	USFS 1993 Stream Survey	"Recoverable" bull trout habitat exists in the USFS reach of Skookum Creek (southern boundary of Sec.15 T58N R44E to the middle of Sec.35 T59N R44E) based on habitat survey data.
Slate	N. Fk. Slate Creek	Slate Creek	Suitable	0.0 - ?	USFS 1997 Stream Survey; McLellan 2001.	The 1997 USFS stream survey located suitable habitat and no fish passage blockages up to the headwaters. McLellan (2001) identified a chute (18% gradient, 27.5m long) 300m up from the USFS Rd. 209 crossing.
Slate	N. Fk. Slate Creek	Slate Creek	Undetected	0.0 - ?	Terrapin Environmental and Taylor Associates 2000, pg. 1, 3	Using a modified Bonar survey methodology (Bonar et al. 1997), snorkeling efforts during the first week of November 2000 including day-only snorkeling surveys of 100m reaches followed by electrofishing if no bull trout were observed .

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Slate	S. Fk. Slate Creek	Slate Creek	Suitable	0.0 - 1.0	USFS 1996 snorkeling	From the mouth upstream to RM 1.0, "Suitable" bull trout habitat exists. Trout species (other than bull trout) were located during USFS 1996 snorkeling.
Slate	Slate Creek	Pend Oreille River	Undetected	0.0 - N. Fk./ S. Fk. confluence	R2 1998, pg. 4-1	Snorkeling efforts in 1996 on two separate trips, Oct. 1-4 & Nov. 19 - 22, and conducted during day and night on 1st trip and only during daylight during the second survey trip. Sites sampled were 100m long and followed protocols of Hillman and Platts (1993). Snorkeling efforts in 1997 were recorded by the USFS during the summer and fall of 1997(R2 1998, pg. 4-1).
Slate	Slate Creek	Pend Oreille River	Suitable	0.0 -N. Fk./ S. Fk. confluence	POCD 2001b, Appendix 2-A; R2 1998; USFS 1997 Stream Survey; T. Shuhda (USFS)	At about RM 0.75 there is a natural cascade; the extent to which this is a barrier to fish passage is unknown (R2, pg. 2-12). In July 1994 and in 1995, two bull trout (16" & 18") were captured in Boundary Reservoir near the mouth of Slate Creek during exploratory hook-and-line sampling efforts by T. Shuhda (USFS) and C. Vail (WDFW) (R2 1998, pg. 1-2; POCD 2001b, Appendix 2-A). In August 1997, R2 Resource Consultants captured a bull trout (8.6") in the mouth of Slate Creek in a live trap; in Nov. 1997 the same fish was recaptured by live trap (R2 1998, pg. 3-5). In August 1999, one adult bull trout was captured by R2 Consultants within 100 feet of the mouth. Earlier in Aug. 1999, an angler reported capturing and releasing an 18" bull trout at the mouth (POCD 2001b, Appendix 2-A). 1996 USFS snorkeling located trout species (other than bull trout; T. Shuhda) and a 1997 USFS stream survey located suitable habitat and no fish passage blockages up to the headwaters.
Slate	Slumber Creek	Slate Creek	Suitable	0.0 - 2.3	USFS 1997 Stream Survey	From the mouth upstream to RM 2.3 where the stream goes intermittent, "Suitable" bull trout habitat exists based on USFS 1997 stream survey.
Slate	Styx Creek	Slate Creek	Suitable	0.0 - 2.0	USFS 1991 Stream Survey	From the mouth upstream to RM 2.0, "Suitable" bull trout habitat exists based on USFS 1991 stream survey.
Slate	Styx Creek	Slate Creek	Undetected	0.0 - 2.0	Terrapin Environmental and Taylor Associates 2000, pg. 1, 3	Using a modified Bonar survey methodology (Bonar et al. 1997), snorkeling efforts during the first week of November 2000 including day-only snorkeling surveys of 100m reaches followed by electrofishing if no bull trout were observed .

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Slate	Threemile Creek	Pend Oreille River	Undetected	0.0 - 1.25 (Hwy. 31 crossing)	Terrapin Environmental and Taylor Associates 2000, pg. 1, 3; McLellan 2001.	Using a modified Bonar survey methodology (Bonar et al. 1997), snorkeling efforts during the first week of November 2000 including day-only snorkeling surveys of 100m reaches followed by electrofishing if no bull trout were observed. There is a 5m waterfall at the mouth of Threemile Creek (McLellan 2001).
Slate	Uncas Gulch	Slate Creek	Undetected	0.0 - 1.5	Terrapin Environmental and Taylor Associates 2000, pg. 3	Using a modified Bonar survey methodology (Bonar et al. 1997), snorkeling efforts during the first week of November 2000 including day-only snorkeling surveys of 100m reaches followed by electrofishing if no bull trout were observed .
Slate	Uncas Gulch	Slate Creek	Suitable	0.0 - 2.0	USFS 1991 Stream Survey	From the mouth upstream to RM 2.0, "Suitable" bull trout habitat exists. Trout species (other than bull trout) were located during USFS 1991 stream survey.
South Salmo	S. Fk. Salmo River	Salmo River	Currently Occupied	8.8 - 9.9	T. Shuhda, USFS; Baxter and Nellestijn 2000; J. Baxter, Consultant, email, 2002.	From Canada/US border (Rm 8.8) upstream to Watch Creek confluence (Rm 9.9) - In 1974 & 1976, Tom Burke, former USFS biologist, reported taking ttwo bull trout ranging from 10-14 inches in length, from the S. Fk. Salmo. In 1995, an angler reported catching 2 bull trout (20-25 inches in length) in S. Fk. Salmo. In 1999, 2 of 10 bull trout radio tagged in the Salmo River by Jim Baxter, consultant for BC Hydropower, migrated into the US portion of the S. Fk. Salmo as far upstream as Watch Creek. They returned to the Salmo River after the spawning season. In 2000, two of the 1999 radio-tagged bull trout returned to the S. Fk. Salmo River again migrating as far upstream as Watch Creek, then returning to the Salmo River by the end of September of 2000. A third bull trout, radio tagged in 2000 along with 5 other bull trout, also migrated into the S. Fk. Salmo River, migrating 0.9 miles (1.5 km) upstream of the Watch Creek confluence, before returning to the Salmo River by the end of August, continuing on into the Seven Mile Reservoir (in Canada) in early October. In fall 2002, approximately 10 bull trout and 4 redds
South Salmo	S. Fk. Salmo River	Salmo River	Suitable	9.9 - 13.0	T. Shuhda; Baxter and Nellestijn 2000	From Watch Creek (RM 9.9) upstream to RM 13.0. Shuhda (USFS) and staff have snorkeled this reach and located trout species (other than bull trout), no fish passage blockages, and suitable habitat up to RM 13.0 near the headwaters.

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Sullivan Creek Watershed	Deemer Creek	Sullivan Creek	Undetected	0.0 - ?	CES 1996, pg. 7, 9, 11	Fish surveys were done by DE&S using the Hillman and Platts (1983) methodology.
Sullivan Creek Watershed	Deemer Creek	Sullivan Creek	Recoverable	0.0 - ?	CES 1996; USFS 1996 Fish survey; USFS 1994 Stream Survey	"Recoverable" bull trout habitat exists based on CES 1996 and USFS 1994 stream survey.
Sullivan Creek Watershed	Gypsy Creek	Sullivan Creek	Undetected	0.0 - ?	CES 1996, pg. 7, 9, 11; USFS 1996 Fish survey	Fish surveys were done by DE&S using the Hillman and Platts (1983) methodology.
Sullivan Creek Watershed	Gypsy Creek	Sullivan Creek	Recoverable	0.0 - ?	CES 1996; USFS 1996 Fish survey; USFS 1994 Stream Survey	"Recoverable" bull trout habitat exists based on CES 1996 and USFS 1994 stream survey.
Sullivan Creek Watershed	Harvey Creek	Sullivan Lake	Recoverable	0.0 - headwaters	CES 1996; USFS 1991 Stream Survey	From the inlet to Sullivan Lake upstream to Bunchgrass Meadows in the headwaters.
Sullivan Creek Watershed	Harvey Creek	Sullivan Lake	Undetected	0.0 - headwaters	CES 1996, pg. 7, 9, 11	Fish surveys were done by DE&S using the Hillman and Platts (1983) methodology.
Sullivan Creek Watershed	Leola Creek	Sullivan Creek	Recoverable	0.0 - ?	CES 1996; USFS 1994 Stream Survey	"Recoverable" bull trout habitat exists based on CES 1996 and USFS 1994 stream survey.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Sullivan Creek Watershed	Leola Creek	Sullivan Creek	Undetected	0.0 - ?	CES 1996, pg. 7, 9, 11	Fish surveys were done by DE&S using the Hillman and Platts (1983) methodology.
Sullivan Creek Watershed	M. Fk. Harvey Creek	Harvey Creek	Recoverable	0.0 - 1.5	CES 1996; USFS 1992 Stream Survey; USFS 1996 snorkeling	"Recoverable" bull trout habitat exists based on CES 1996 and USFS 1992 stream survey.
Sullivan Creek Watershed	M. Fk. Harvey Creek	Harvey Creek	Undetected	0.0 - 1.5	CES 1996; USFS 1992 Stream Survey	Fish surveys were done by DE&S using the Hillman and Platts (1983) methodology.
Sullivan Creek Watershed	N. Fk. Harvey Creek	Harvey Creek	Recoverable	0.0 - 2.3	CES 1996; USFS 1992 Stream Survey	"Recoverable" bull trout habitat exists based on CES 1996 and USFS 1992 stream survey.
Sullivan Creek Watershed	N. Fk. Harvey Creek	Harvey Creek	Undetected	0.0 - 2.3	CES 1996, pg. 7; USFS 1992 survey	From the mouth upstream to RM 2.3, fish surveys were done by DE&S using the Hillman and Platts (1983) methodology, and by USFS.
Sullivan Creek Watershed	N. Fk. Sullivan Creek	Sullivan Creek	Suitable	0.0 - 0.2 (natural falls)	T. Shuhda	"Suitable" bull trout habitat exists from the mouth upstream to RM 0.2 where there is a natural falls just downstream of the N. Fk. Sullivan Creek Dam (RM 0.25). The N. Fk. Sullivan Creek dam is not equipped for fish passage.
Sullivan Creek Watershed	N. Fk. Sullivan Creek	Sullivan Creek	Undetected	0.0 - 0.25 (N. Fk. Dam)	CES 1996, pg. 7, 9, 11	From the mouth upstream to RM 0.25 (N. Fk. Dam), which is a full barrier to fish passage. Fish surveys were done by DE&S using the Hillman and Platts (1983) methodology.
Sullivan Creek Watershed	Outlet Creek	Sullivan Creek	Recoverable	0.0 - 0.5 (Sullivan Lake outlet)	C. Vail, T. Shuhda, T. Anderson	Outlet Creek serves as a migratory corridor from the confluence of Sullivan Creek upstream to the outlet of Sullivan Lake (RM 0.5). There is an impassable dam at the outlet of Sullivan Lake.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Sullivan Creek Watershed	Pass Creek	Sullivan Creek	Recoverable	0.0 - headwaters	CES 1996; USFS 1996 snorkeling	From the mouth upstream to the headwaters, "Recoverable" bull trout habitat exists (CES 1996).
Sullivan Creek Watershed	Pass Creek	Sullivan Creek	Undetected	0.0 - headwaters	CES 1996, pg. 7, 9, 11	From the mouth upstream to the headwaters. Fish surveys were done by DE&S using the Hillman and Platts (1983) methodology.
Sullivan Creek Watershed	Sullivan Creek	Pend Oreille River	Individual Observation	0.02	CES 1996, pg. 11	In September 1993, one dead, gutted female bull trout (several pounds in size) was found below the powerhouse, 150 ft upstream from the mouth (50 ft upstream from the State Hwy. 31 stream crossing) during a snorkling survey by John Blum of Framatome ANP (previously Cascades Environmental Services), consultant for the Pend Oreille PUD.
Sullivan Creek Watershed	Sullivan Creek	Pend Oreille River	Individual Observation	0.65	J. Blum, Framatome ANP	CES (now Framatome ANP) observed a large salmonid in 1993 holding under a boulder below the barrier at RM 0.65. After repeated diving at the site, CES was not able to positively identify the species of the observed fish due to high water velocities, water depth, and turbulence at the location. CES reported the finding immediately to the USFS, which sent staff to the site to identify the fish as well. They were not able to locate the fish during their subsequent survey (J. Blum, Framatome ANP, pers. comm., 2002).
Sullivan Creek Watershed	Sullivan Creek	Pend Oreille River	Undetected	0.0 - 22.0/ headwaters	R2 1998; CES 1996; USFS 1995	No bull trout were detected using various fish sampling survey methods conducted by R2 Resource Consultants in 1997, the Hillman and Platts (1993) methodology by CES (1996), and USFS snorkeling in 1995.
Sullivan Creek Watershed	Sullivan Creek	Pend Oreille River	Recoverable	0.0 - 3.25/Mill Pond dam	TAG 2002	"Recoverable" bull trout habitat exists from the mouth upstream Mill Pond dam (RM 3.25).
Sullivan Creek Watershed	Sullivan Creek	Pend Oreille River	Recoverable	3.25 - 22.0/ headwaters	McLellan 2001; USFS 1993 Stream Survey	From Mill Pond Dam (RM 3.25) upstream to the headwaters (RM 22.0), suitable habitat exists based on USFS 1993 stream survey. There are no known fish passage barriers on Sullivan Creek upstream of the Mill Pond Dam.
Sullivan Creek Watershed	Sullivan Lake	Outlet Creek	Recoverable	0.0 - 4.0 (length of Sullivan Lake)	C. Vail, T. Shuhda, T. Anderson	Sullivan Lake has "Recoverable" bull trout habitat.

Table D1. WRIA 62 Bull Trout Distribution

WAU	STREAM NAME	TRIBUTARY TO:	BULL TROUT PRESENCE/ USE	EXTENT (RM)	SOURCE	COMMENTS
Sullivan Creek Watershed	Unnamed	Leola Creek	Undetected	0.0 - ?	CES 1996, pg. 7, 9, 11	Fish surveys were done by DE&S using the Hillman and Platts (1983) methodology.
Tacoma	Cusick Creek	Pend Oreille River	Unknown	0.0 - 4.2	TAG 2002	From the mouth upstream to RM 4.2, habitat conditions are unknown. The reach is on private land, has not been surveyed, and no TAG members have knowledge of the habitat conditions.
Tacoma	Cusick Creek	Pend Oreille River	Recoverable	4.2 - 8.9	USFS 1995 Stream Survey	From RM 4.2 upstream to RM 8.9, "Recoverable" bull trout habitat exists.
Tacoma	N. Fk. of S. Fk. Tacoma Creek	S. Fk. Tacoma Creek	Recoverable	0.0 - 6.25	USFS 1996 Stream Survey	From the USFS land boundary upstream to RM 6.25, "Recoverable" bull trout habitat exists based on USFS 1996 Stream Survey.
Tacoma	S. Fk. Tacoma Creek	Tacoma Creek	Recoverable	0.0 - 1.25	In Prep., Olsen et al.	"Recoverable" bull trout habitat exists in the lower 1.25 miles base on KNRD 2001 stream survey work.
Tacoma	S. Fk. Tacoma Creek	N. Fk. Tacoma Creek	Recoverable	1.25 - 9.0	In Prep., Olsen et al.; USFS 1996 Stream Survey	From the USFS land boundary upstream to RM 9.0, "Recoverable" bull trout habitat exists based on USFS 1996 Stream Survey and KNRD 2001 habitat survey work.
Tacoma Creek	Tacoma Creek	Pend Oreille River	Recoverable	0.0 - 5.0	In Prep., T. Andersen, KNRD	From the mouth upstream to RM 5.0, "Recoverable" bull trout migratory corridor habitat exists.
Tacoma Creek	Tacoma Creek	Pend Oreille River	Recoverable	5.0 - 11.0	USFS 1991 Stream Survey	"Recoverable" bull trout habitat exists based on USFS 1991 stream survey.

APPENDIX E

BULL TROUT BARRIERS

Table E 1: WRIA 62 Known Barriers

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Box Canyon	Beaver Creek	Pend Oreille River	Waterfall	0.0	McLellan 2001, pg. 92	There is a 25 meter waterfall at the mouth of Beaver Creek.
Box Canyon	Cedar Creek	Pend Oreille River	Dam	1.5	MWH 2002, pg. 2	The Cedar Creek Dam at RM 1.5 is a full barrier to fish passage. Originally constructed in the early 1900s, it was replaced in 1950. It is an un-reinforced concrete arch dam approximately 19-ft high. The reservoir served as the water supply source for the town of Ione until 1988 when Ione switched to a well supply.
Box Canyon	Flume Creek	Pend Oreille River	Falls	0.2	McLellan 2001, pg. 63; R2 Resource Consultants 1998, pg. 2-12.	There is a 13-ft vertical waterfall located at the mouth. It is a barrier to fish passage.
Box Canyon	Flume Creek	Pend Oreille River	Culvert	1.0	McLellan 2001, pg. 63	The culvert under Boundary Road (RM 1.0) is a potential fish passage barrier. The culvert outlet was approximately 2.5 m (8 feet) vertically above the surface of the plunge pool.
Box Canyon	Flume Creek	Pend Oreille River	Culvert	4.75	McLellan 2001, pg. 63	The culvert at the USFS Rd. 350 crossing is a potential fish passage barrier. The culvert outlet is 1.5 m (5 feet) high and there is no plunge pool below it
Box Canyon	Jim Creek	Cedar Creek	Falls	1.25	USFS 1999ae, pg. 8	At RM 1.25, there is a natural, 50 foot falls/cascade that is a barrier to fish passage.
Box Canyon	Jim Creek	Cedar Creek	Falls	1.75	USFS 1999ae, pg. 8	At RM 1.75, there is a natural, 66 foot falls/cascade that is a barrier to fish passage.
Box Canyon	Sand Creek	Pend Oreille River	Culvert	0.25	McLellan 2001, pg. 65	The culvert under the railroad track near USFS Rd. 3669 is a barrier to fish passage. The culvert is 75.0 m (247 ft.) long and has a 2 m (6 ft) vertical drop.
Box Canyon	Sand Creek	Pend Oreille River	Falls	1.2	McLellan 2001, pg. 65	At RM 1.2, there is a 5.0 m (16.5 ft) vertical waterfall.
Box Canyon	Sand Creek	Pend Oreille River	Culvert	1.8	USFS 2002 culvert barrier database	The culvert (Culvert_id # 301) at RM 1.8 at the USFS Rd. 3310160 creek crossing (road mile 2.9) is a full barrier to fish passage.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Box Canyon	Sand Creek	Pend Oreille River	Dewatering	0.0 -0.25	USFS 1999bf, pg. 9	In the lower reach of the stream, on September 17, 1979, a portion of the streambed was dry (RM 0.0 - 0.25) with water going subsurface. The stream was observed earlier in September 28, 1977 and also found to be dry. It is unclear whether the stream continues to go subsurface for part of its length each year. Flow recorded at the mouth on June 3, 1992 was 0.83 cfs. This is very low for that time of year. Estimated flow during the placement of the a thermograph on August 15, 1996 was <1 cfs and no channel areas exceeding 1 ft in depth was observed in the lower 0.25 miles (R2 Resource Consultants 1998, pg. 2-14).
Box Canyon	Sweet Creek	Pend Oreille River	Culvert	0.5	SSHEAR database	The SSHEAR database lists the State Hwy. 31 road crossing as a fish passage barrier. However, an adult bull trout was observed upstream of the culvert in 2000 (McLellan 2001, pg. 91). Juvenile whitefish have also been observed upstream of the State Hwy. 31 crossing indicating there is at least some degree of passage at the crossing (C. Vail, WDFW, pers. comm., 2002).
Box Canyon	Sweet Creek	Pend Oreille River	Falls	0.6	McLellan 2001, pg. 63	There is a series of four natural waterfalls, each a fish passage barrier. The first waterfall is a 6.0 m (20 foot) falls located 200 m (700 feet) upstream from the State Hwy. 31 bridge. The second waterfall is a also a 6 m (20 foot) falls located 20 m (70 feet) upstream of the first waterfall. The third waterfall is also a 6.0 m (20 foot) falls and located 500 m (1,650 feet) upstream of the second waterfall. The fourth waterfall has an 8.2 m (27 foot) vertical height and is located 150 m (500 feet) upstream of the third waterfall.
Calispell Creek Watershed	Calispell Creek	Pend Oreille River	Dike	0.5	POCD 2001a, Calispell and Trimble Creek Flood Hazard Plan, pg. 11; USFS 1999, pg 1	At RM 0.5 pumps and floodgates in the railroad dike act as a barrier to fish passage. In 1909 the Idaho and Washington Northern Railroad constructed a rail line on the west side of the Pend Oreille River. Part of the railroad embankment serves as a dike in this reach of the river during flood conditions.
Calispell Creek Watershed	Calispell Creek	Pend Oreille River	Dam	6.0	DES 2001b, pg 2	At RM 6.0 the Calispell Duck Club maintains a low-head dam at the outlet of Calispell Lake. During summer low flows, passage over this dam is difficult due to limited water quantities and high water temperatures. Boards to regulate lake levels are installed in the dam at the start of September to bring water levels up in Calispell Lake, and removed when the lake begins to freeze, in an effort to keep open water (POCD 2001a, pg. 18). When boards are in place, fish passage can be obstructed if flows are low.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Calispell Creek Watershed	Calispell Creek	Pend Oreille River	Thermal	0.0 - 6.0	DES 2001b, pg 6, Table 1; USFWS 1998	Mean annual summer temperatures in the lower 6.0 miles of Calispell Creek exceed the upper lethal limits of many salmonids. Mean and maximum water temperatures recorded at Calispell pumps and at the Calispell Lake outlet also exceed properly functioning conditions established for bull trout use . The extent to which elevated water temperatures could form a seasonal thermal barrier to upstream and downstream migration is unknown.
Calispell Creek Watershed	Dorchester Creek	Calispell Lake	Flow	0.0 - 1.0	DES 2001b, pg. 2, Dorchester Creek section	0.3 miles downstream of Westside Calispell Road, the Dorchester Creek goes into a cattail marsh, continuing downstream through the marsh for approximately one mile before entering Calispell Lake.
Calispell Creek Watershed	Dorchester Creek	Calispell Lake	Culvert	1.0 - 1.3	DES 2001b, pg. 2, Dorchester Creek section	Between Westside Calispell Road (RM 1.3) and where Dorchester Creek flows into the cattail marsh (RM 1.0), Dorchester Creek flows through three-to-four constructed, instream, farm ponds. The ponds are linked by a series of culverts that create barriers to upstream migration. The most extreme of these culverts has a drop height of at least 4 feet. The other culverts have similar drops and all are impassable to fish migrating upstream from Calispell Lake.
Calispell Creek Watershed	Dorchester Creek	Calispell Lake	Debris Jam	1.6	DES 2001b, pg. 2, Dorchester Creek section	At RM 1.6, there is a stump in the stream that creates a barrier at low flow barrier. This is upstream of Westside Calispell Road. The stump creates a 2.2-foot high falls with inadequate jumping and landing areas. At higher flows the barrier may become passable. At least three other similar partial barriers (at low flow conditions) were found upstream of the stump at RM 1.6. In general, Dorchester Creek is very small upstream of the Westside Calipell Road.
Calispell Creek Watershed	E. Fk. Smalle Creek	Smalle Creek	Cascades	3.7	Andersen and Maroney 2001c	At RM 3.7, there is a natural barrier made up of a large boulder/cascade.
Calispell Creek Watershed	M. Fk. Calispell Creek	N. Fk. Calispell Creek	Type not indicated	0.1	Andersen and Maroney 2002a, pg 17	There are three identified natural barriers at RM 0.1.
Calispell Creek Watershed	N. Fk. Calispell Creek	Calispell Creek	Type not indicated	2.95	Andersen and Maroney 2002b, pg. 24	A natural fish barrier was identified at RM 2.95.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Calispell Creek Watershed	Power Creek	Calispell Creek	Falls/Cascade	0.2	DES 2001b, pg. 5, Calispell Creek section	At RM 0.2, a natural falls/cascade barrier exists on Power Creek. The assessment was made using Powers and Orsborne (1984) criteria for assessing fish passage at waterfalls. The natural falls/cascade is 7.5 feet wide, with an above water vertical rise of 5.1 feet. The pool at the base of the falls has a depth of 1.4 feet. Power Creek flows out of Power Lake (RM 0.5) and meets with the South Fork Calispell Creek one-half mile below the Power Creek hydroelectric plant.
Calispell Creek Watershed	Power Creek	Calispell Creek	Falls/Cascade	0.2 - 0.5	DES 2001b, pg. 56	Larger barriers exist immediately upstream of the natural falls/cascade barrier at RM 0.2, but were not surveyed
Calispell Creek Watershed	Power Creek	Calispell Creek	Dam	0.5	P. Buckley, POPUD, pers. comm., 2003	Power Lake Dam (RM 0.5) does not provide fish passage and is a full barrier. It is owned and operated by the POPUD.
Calispell Creek Watershed	S. Fk. Calispell Creek	Calispell Creek	Cascades	1.3	D&ES 2001b, pg 4, Calispell Creek section.	At 1.3 miles above the confluence with Power Creek, a naturally occurring boulder-cascade barrier exists. This boulder-formed cascades limits upstream passage. The assessment was made using Powers and Orsborne (1984) criteria for assessing fish passage at waterfalls. The landing pool above the barrier is short and shallow (0.3 feet) further hindering upstream progress. At higher flows this barrier may be passable, although increased water velocities at higher flows may further impede passage.
Calispell Creek Watershed	S. Fk. Calispell Creek	Calispell Creek	Dewatering	1.56	D&ES 2001b, pg 4, Calispell Creek section.	At 1.56 miles upstream of the confluence with Power Creek, the channel appears to naturally flow underground for approximately 1,500 feet. Local farmers claim it is dry most of the year
Calispell Creek Watershed	S. Fk. Calispell Creek	Calispell Creek	Culvert	3.2	D&ES 2001b, pg 4, Calispell Creek section.	An impassible road culvert exists 3.2 miles upstream from the Power Creek confluence.
Calispell Creek Watershed	S. Fk. Calispell Creek	Calispell Creek	Type not indicated	4.0 & 4.1	Andersen and Maroney 2002c, pg 19	Natural barriers occur at RM 4.0 and RM 4.1.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Calispell Creek Watershed	Smalle Creek	Calispell Creek	Beaver Dams	2.5	A. Scott, Framatome ANP, pers. comm., 2002	Downstream of the West Calispell Road (RM 2.5) there are beaver dams that may reduce fish passage.
Calispell Creek Watershed	Smalle Creek	Calispell Creek	Falls	6.6	DE&S 2001b, KNRD 2000	There is a natural waterfall barrier at RM 6.6.
Calispell Creek Watershed	Winchester Creek	Calispell Creek	Culvert	0.9	DE&S 2001b	At RM 0.9, double culverts on the Westside Calispell Road present a migration barrier for upstream fish passage. The square, larger of the two culverts has a width of 11 feet, a depth of 0.2 feet and a vertical drop of 2.1 feet. The plunge pool underneath the culvert had a depth of 1.2 feet in April 2001, with a plume which extended downstream 3.4 feet. Fish would not be able to successfully leap into this culvert and negotiate to the upstream side of the road. The smaller culvert was circular, and 5.4 feet in diameter. The drop form the culvert was 0.9 feet onto a flat apron. Water in the culvert was only 0.4 feet deep, with velocities exceeding 3.0 ft/second.
Calispell Creek Watershed	Winchester Creek	Calispell Creek	Dam	1.5	DE&S 2001b, pg 2, Winchester Creek section	At RM 1.5, in April of 2001, there was a small human-made partial boulder barrier (at low flows).
Calispell Creek Watershed	Winchester Creek	Calispell Creek	Debris Jam	1.6	DE&S 2001b, pg 2, Winchester Creek section	At RM 1.6, in April of 2001, there was a natural log barrier with a jump height of 2.3 feet and a downstream pool depth of 2 feet with no suitable areas for launching or landing.
Calispell Creek Watershed	Winchester Creek	Calispell Creek	Culvert	6.7	USFS 2002 culvert barrier database	The culvert (Culvert_id # 170) at RM 6.7 at the County Rd. 12110 creek crossing (road mile 3.8) is a full barrier to fish passage.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Calispell Creek Watershed	Winchester Creek	Calispell Creek	Falls	10.1	DE&S 2001b, pg. 2, Winchester Creek section; USFS 1999ad	At RM 10.1, there are two low falls (about 3 feet high) followed by a long, 35-foot chute that drops approximately 20 feet. The USFS identified this natural chute/cascade as a barrier.
Cee Cee Ah	Browns Creek	Cee Cee Ah	Culvert	1.1	USFS 2002 culvert barrier database	At RM 1.1 at the USFS Rd. 500032 creek crossing (road mile 5.45) there is a partially blocking culvert (USFS Cul_id # 350).
Cee Cee Ah	Browns Creek	Cee Cee Ah	Culvert	3.0	USFS 2002 culvert barrier database	At RM 3.0 at the USFS Rd. 5030039 creek crossing (road mile 5.15) there is a partially blocking culvert (USFS Cul_id # 115).
Cee Cee Ah	Browns Creek	Cee Cee Ah	Dewatering	3.00	USFS 1999ab, Cee Cee Ah B.E., pg. 8	The outlet from Browns Lakes (RM 3.0) goes subsurface due to the underlying geology.
Cee Cee Ah	Cee Cee Ah Creek	Pend Oreille River	Culvert	2.0	USFS 2002 culvert barrier database; USFS 1999ab, Cee Cee Ah B.E., pg. 8, 11	A poorly placed culvert at RM 2.0, where USFS Rd. 1921000 crosses Cee Cee Ah Creek (road mile 0.25) immediately above the confluence with Brown's Creek, is a year-round barrier to fish passage (USFS Cul_id # 112).
Cee Cee Ah	Cee Cee Ah Creek	Pend Oreille River	Falls	3.5	KNRD 1997b, Kalispel Res. Fish Proj. Annual Rpt. 1995, pg. 7; USFS 1999ab, Cee Cee Ah B.E., pg. 8	An 8 foot natural falls at RM 3.5 is a full barrier to fish passage.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Cee Cee Ah	Cee Cee Ah Creek	Pend Oreille River	Culvert	5.5	USFS culvert barriers database, 2002, Newport RD, Colville NF	At RM 5.5 on USFS Rd. 1920380 (road mile 0.14) there is a culvert that is a full barrier to fish passage (Cul-id #111).
Cee Cee Ah	Cee Cee Ah Creek	Pend Oreille River	Culvert	6.3	USFS culvert barriers database, 2002, Newport RD, Colville NF	At RM 6.3 on USFS Rd. 192000 (road mile 5.0) there is a culvert that is a full barrier to fish passage (Cul-id #262).
Deer Valley	Kent Creek	Pend Oreille River	Dam	2.75	POCD 2001c, pg. 23.	There is an earthen dam at the outlet of Mountain Meadows Lake. Drainage from the area upstream of Mountain Meadows Lake only reaches Kent Creek when water levels in the dammed lake are high enough to reach the lake's overflow pipe, primarily during March and April (POCD 2001c, pg. 23).
Gold Creek	Bench Creek	Hughes Fork	Log jam/falls	0.5	Irving 1987, pg. 26, Table 4	Based on his best professional knowledge, Irving identified the upper extent of fish passage to be RM 0.5 at a 3-foot rock and log jams falls.
Gold Creek	Gold Creek	Hughes Fork	Falls	3.5	J. Maroney, KNRD, pers. comm., 2003; Irving 1987, pg. 26, Table 4	Based on his best professional knowledge, Irving identified the upper extent of fish passage to be RM 2.7 at a 20-foot falls. J. Maroney (KNRD) identified a 5-to-6 meter (15-20 foot) natural falls about 500 feet upstream of the Washington/Idaho border (RM 3.5) on Gold Creek. In regards to Irving's observation of a falls at RM 2.7, driving the Muskegon Road up Gold Creek Maroney did not observe any falls downstream of the falls he reported in the headwaters of Gold Creek. Nor is there any indication on the topographic map of the Gold Creek drainage of a gradient break that could indicate a falls downstream of the Washington/Idaho border (J. Maroney, KNRD, pers. comm., 2003). It is possible Irving's rivermile estimate was incorrect.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Gold Creek	Jackson Creek	Hughes Fork	Log jam/falls	1.1	Irving 1987, pg. 26, Table 4	Based on his best professional knowledge, Irving identified the upper extent of fish passage to be RM 1.1 at a 4-foot rock and log jams falls.
Granite Creek	N. Fk. Granite Creek	Granite Creek	Falls	6.8	Irving 1987, pg. 26, Table 4	Granite Falls on North Fork Granite Creek within Washington State is a 9.1 m (30 foot) falls that marks the upper extent of fish distribution on N. Fk. Granite Creek.
Granite Creek	S. Fk. Granite Creek	Granite Creek	Gradient/ Intermittent flows	?	KNRD 1997a, pg. 19, 26, 45, Appendices C, D, and G	Based on stream survey information, steep gradients (32.5% at the first recorded steep gradient) and intermittent flows were likely to begin limiting fish passage.
Granite Creek	Tillicum Creek	N. Fk. Granite Creek	Falls	0.2	Irving 1987, pg. 26, Table 4	A 30-foot falls at RM 0.2 on Tillicum Creek marks the upper extent of bull trout use.
Kalispell Creek	Binarch Creek	Priest River	Dewatering	1.5 - XX	USFS 1999af, pg. III-455; Wingert 2001, USFS Binarch Creek August 2001 stream survey	In the lower to mid-elevations Binarch Creek goes subsurface except during the periods of heavy annual spring runoff (USFS 1999AFaf). The subsurface flows are predominantly evident at old beaver dam sites, all of which were large, abandoned, filling-in, and forming highly vegetated land forms (Wingert 2001).
Kalispell Creek	Kalispell Creek	Priest Lake	Culvert	12.5/ Mush Crk. Rd.	USFS 2002, pg. 5; M. Davis, USFS, pers. comm., 2002	Beaver dams are quite large and numerous in the upper portion of the stream reach which extends from just upstream of Virgin Creek to just below the confluence with Chute Creek. During the stream survey (USFS 2002 Stream Survey, pg. 5), the culvert on Kalispell Creek near the Mush Creek confluence was observed to be dammed by beaver. The resulting reservoir upstream of the culvert was very large. A flood event caused by backwatering at the culvert has the potential to cause stream channel damage downstream (USFS 2002a, pg. 5). The beaver-dammed culvert also has the potential to be a fish passage barrier to fish at low flows (M. Davis, USFS, pers. comm., 2002).

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Kalispell Creek	Kalispell Creek	Priest Lake	Falls	13.25	USFS Kalispell Stream Survey 200s, pg. 6; Irving 1987, pg. 26, Table 4	Just upstream of the confluence with Deerhorn Creek (RM 13.25), there is a waterfall that is most likely a barrier to fish passage. Irving (1987, pg. 126) mentions a 20-foot rock falls on Kalispell Creek near the confluence of Chute Creek. This is likely the same one observed by the USFS near Deerhorn Creek on Kalispell Creek.
Kalispell Creek	Chute Creek	Priest Lake	Falls	0.30	Irving 1987, pg. 126	There is a 70-foot falls on Chute Creek about one-third of a mile upstream from its confluence with Kalispell Creek (J. Cobb, M. Davis, USFS, pers. comm., 2002).
Kalispell Creek	Lamb Creek	Priest River	Culvert	0.25	J. Cobb, USFS, pers. comm., 2002	The culvert on Outlet Bay Road (RM 0.25) is a potential velocity barrier to fish passage at high flows.
Kalispell Creek	Lamb Creek	Priest River	Falls	9.00	J. Cobb, USFS, pers. comm., 2002	There is a 15 foot waterfall on Lamb Creek about 2 miles downstream of the Washington/Idaho border (J. Cobb, USFS, pers. comm., 2002).
Kalispell Creek	Upper West Branch	Priest River	Falls	0.5	J. Cobb, USFS, pers. comm., 2002	At RM 0.5, there is a natural falls named Mission Falls, however this falls is not thought to be a barrier to upstream fish migration.
LeClerc Creek	E. Br. LeClerc Creek	LeClerc Creek	Falls	5.10	WDNR 1997, pg. 4F-6	At RM 5.1, at the upper end of Segment D4 (M. Br. LeClerc Creek confluence), there is a bedrock falls that precludes upstream fish passage.
LeClerc Creek	Fourth of July Creek	E. Br. LeClerc Creek	Gradient	0.25	T. Shuhda, USFS, pers. comm., 2002; KNRD 1997c	Four consecutive stream reaches surveyed upstream of RM 0.25 have gradients of 5%, 14%, 10% and 10%, respectively. Brook trout were observed in Fourth of July Creek downstream of these steep reaches but not upstream. The steep reaches beginning at RM 0.25 are a potential barrier to bull trout passage (T. Shuhda, USFS, pers. comm., 2002; KNRD 1997c, Kalispel Resident Fish Project Annual Report 1996).

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
LeClerc Creek	M. Br. LeClerc Creek	E. Br. LeClerc Creek	Culvert	0.5	Maroney and Andersen 2000a, pg. 25	At RM 0.5 the culvert under County Road 308 may be a fish passage barrier. The culvert is perched relatively high and the water plunges onto boulders where there is no step pool present.
LeClerc Creek	M. Br. LeClerc Creek	LeClerc Creek	Culvert	1.0	USFS 2002 culvert barrier database	The culvert (Culvert_id # 131) at RM 1.0 at the USFS Rd. 1935115 creek crossing (road mile 0.0) is a full barrier to fish passage.
LeClerc Creek	M. Br. LeClerc Creek	LeClerc Creek	Culvert	1.3	USFS 2002 culvert barrier database	The culvert (Culvert_id # 256) at RM 1.3 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage.
LeClerc Creek	M. Br. LeClerc Creek	LeClerc Creek	Culvert	2.1	USFS 2002 culvert barrier database	The culvert (Culvert_id # 255) at RM 2.2 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage.
LeClerc Creek	M. Br. LeClerc Creek	LeClerc Creek	Culvert	3.74	USFS 2002 culvert barrier database	The culvert (Culvert_id # 302) at RM 3.74 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage.
LeClerc Creek	M. Br. LeClerc Creek	LeClerc Creek	Culvert	3.76	USFS 2002 culvert barrier database	The culvert (Culvert_id # 254) at RM 3.76 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage.
LeClerc Creek	M. Br. LeClerc Creek	LeClerc Creek	Culvert	5.2	USFS 2002 culvert barrier database	The culvert (Culvert_id # 253) at RM 5.2 at the USFS Rd. 1935011 creek crossing (road mile 1.4) is a full barrier to fish passage.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
LeClerc Creek	M. Br. LeClerc Creek	LeClerc Creek	Culvert	5.8	USFS 2002 culvert barrier database	The culvert (Culvert_id # 252) at RM 5.8 at the USFS Rd. 1935011 creek crossing (road mile 2.3) is a full barrier to fish passage.
LeClerc Creek	Saucon Creek	W. Br. LeClerc Creek	Culvert	1.0	USFS 2002 culvert barrier database; WDNR 1997, pg. 4F-2, 6	The culvert (Culvert_id # 407) at RM 1.0 at the USFS Rd. 1935000 creek crossing (road mile 15.5) is a full barrier to fish passage (USFS 2002 culvert barrier database). The culvert is a fish passage barrier due to gradient, water velocity, and lack of a holding pool at the culvert mouth. Brook trout and cutthroat currently occupy reaches upstream of this culvert (WDNR 1997).
LeClerc Creek	Unnamed tributary to the Pend Oreille River	Pend Oreille River	Culvert	0.0	WDNR 1997, pg. 4F-3	Near the mouth, the LeClerc Creek Road culvert (stream segment L1) is a barrier to upstream fish passage. The downstream end of the culvert is perched high enough above the surface of the tributary so as to prevent fish access. This unnamed tributary is the first stream entering (river right) the Pend Oreille River downstream of LeClerc Creek.
LeClerc Creek	Unnamed tributary to the Pend Oreille River	Pend Oreille River	Culvert	0.0	WDNR 1997, pg. 4F-8	This unnamed tributary originates at Yokum Lake. Upstream fish passage is impeded in the lower 0.25 miles (stream segment L12). Then, the LeClerc Creek Road culvert at RM 0.25 (stream segment L12) is a barrier to upstream fish passage. The downstream end of the culvert is perched high enough above the surface of the tributary so as to prevent fish access (WDNR 1997, pg. 4F-3). Upstream fish passage is prevented in the portion of the creek upstream of RM 0.25 by the presence of many cascades and small waterfalls (stream segment L13) (WDNR 1997, pg. 4F-8).
LeClerc Creek	W. Br. LeClerc Creek	LeClerc Creek	Dewatering	1.5 - 3.0	WDNR 1997, pg. 4F-5; J. Gross, KNRD.	In the vicinity of the W. Branch LeClerc Creek Road crossing (approximately RM 1.5 – 3.0), the creek dewaters in most years with flows going subsurface (J. Gross, KNRD, 2002, pers. comm.; WDNR 1997, pg. 4F-5).
LeClerc Creek	W. Br. LeClerc Creek	LeClerc Creek	Diversion Structure	8.0	WDNR 1997, pg. 4F-2; Maroney and Andersen 2000d, pg. 22	At RM 8.0 (upstream of the Whiteman confluence, near juncture of J1 & J2), a log-crib diversion structure precludes upstream fish passage. Cutthroat and bull trout are currently found upstream of here. The integrity of this structure is questionable and it is likely to decay and fail within the next decade. Maroney and Andersen (2000d, pg. 22) identify this as a splash dam that is holding back a large amount of sediment. Maroney and Andersen (2000d) also agree it has the potential to fail within the next decade.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
LeClerc Creek	W. Br. LeClerc Creek	LeClerc Creek	Culvert	11.8	USFS 2002 culvert barrier database; Maroney and Andersen 2000d, pg. 19	The culvert (Culvert_id # 409) at RM 11.8 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage (USFS database). The culvert has a gradient of 13.5% and is a potential velocity barrier to fish (3m/second; Maroney and Andersen 2000d).
LeClerc Creek	W. Br. LeClerc Creek	LeClerc Creek	Culvert	13.6	USFS 2002 culvert barrier database	The culvert (Culvert_id # 408) at RM 13.6 at the USFS Rd. 1935000 creek crossing is a full barrier to fish passage.
LeClerc Creek	Whiteman Creek	W. Br. LeClerc Creek	Culvert	2.7	USFS 2002 culvert barrier database	The culvert (Culvert_id # 405) at RM 2.7 at the USFS Rd. 1936000 creek crossing (road mile 2.7) is a full barrier to fish passage.
LeClerc Creek	Mineral Creek	W. Br. LeClerc Creek	Culvert	1.4	USFS 2002 culvert barrier database	The culvert (Culvert_id # 406) at RM 1.4 at the USFS Rd. 1936000 creek crossing (road mile 19.0) is a full barrier to fish passage.
Mainstem Pend Oreille River	Pend Oreille River	Columbia River	Dam	17.0		Boundary Hydroelectric Dam, located in Washington State, U.S.A, construction completed in 1967, owned by City of Seattle, and operated by Seattle City Lights. No fish passage facilities.
Mainstem Pend Oreille River	Pend Oreille River	Columbia River	Dam	34.4		Box Canyon Hydroelectric Dam, located in Washington State, U.S.A, construction completed in 1955, owned and operated by the Pend Oreille Public Utility District. No fish passage facilities.
Mainstem Pend Oreille River	Pend Oreille River	Columbia River	Dam	90.1		Albeni Falls Hydroelectric Dam, located in Idaho State, U.S.A, construction completed in 1952, owned and operated by the U.S. Army Corps of Engineers. No fish passage facilities. Lies 2.3 miles upstream (east) of the Washington/Idaho border and controls outflow from Lake Pend Oreille.
Mainstem Pend Oreille River	Pend Oreille River	Columbia River	Dam	0.2		Waneta Hydroelectric Dam, located in British Columbia, Canada, is operated by Teck Cominco. No fish passage facilities.
Mainstem Pend Oreille River	Pend Oreille River	Columbia River	Dam	9.0		Seven Mile Hydroelectric Dam, located in British Columbia, Canada, is operated by B.C. Hydro. No fish passage facilities.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Middle Creek	Middle Creek	Pend Oreille River	Culvert	0.25	A. Scott, Framatome ANP, pers. comm., 2002	A culvert at the LeClerc County Road crossing (RM 0.25) is a fish passage barrier.
Middle Creek	Middle Creek	Pend Oreille River	Gradient	0.25 - 1.0	Maroney and Andersen 2000b, pg. 21	Upstream of the LeClerc Road crossing (RM 0.25) for approximately 0.8 miles, Mill Creek is an Aa2 type channel. The average gradient in this reach was high (13.4%; Maroney and Andersen 2000b, pg. 21). This is a known barrier to brook trout and a potential barrier to bull trout (T. Andersen, KNRD, pers. comm., 2002).
Middle Creek	Mill Creek	Pend Oreille River	Culvert	0.3	USFS 2002 culvert barrier database	The culvert (Culvert_id # 106) at RM 0.3 at the County Rd. 9329 creek crossing (road mile 18.76) is a full barrier to fish passage.
Middle Creek	Mill Creek	Pend Oreille River	Falls	1.3	J. Maroney, KNRD, pers. comm., 2002	A natural falls located approximately 1.3 miles upstream from the mouth of Mill Creek is a natural, year-round blockage to fish passage.
Middle Creek	Mill Creek	Pend Oreille River	Culvert	4.9	USFS 2002 culvert barrier database	The culvert (Culvert_id # 110) at RM 4.9 at the USFS Rd. 1200400 creek crossing (road mile 0.1) is a full barrier to fish passage.
Middle Creek	Mill Creek	Pend Oreille River	Culvert	5.4	USFS 2002 culvert barrier database	The culvert (Culvert_id # 108) at RM 5.4 at the USFS Rd. 1200420 creek crossing (road mile 0.2) is a full barrier to fish passage.
Middle Creek	Mill Creek	Pend Oreille River	Culvert	7.9	USFS 2002 culvert barrier database	The culvert (Culvert_id # 109) at RM 7.9 at the USFS Rd. 1920000 creek crossing (road mile 9.3) is a full barrier to fish passage.
Muddy Creek	Big Muddy Creek	Pend Oreille River	Culvert	0.0	B. Heiner, WDFW engineer, email corresp., March 28, 2002	At the mouth, the concrete box culvert under State Hwy. 31 is a partial barrier to fish passage based on flows observed on July 14, 2000 (B. Heiner, WDFW engineer, email correspondence, 3/28/02).
Muddy Creek	Big Muddy Creek	Pend Oreille River	Culvert	1.2	T. Shuhda, USFS, pers. comm., 2002	At RM 1.2, the County Rd. 2705 (Greenhouse Rd.) crossing is a fish passage barrier.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Muddy Creek	Big Muddy Creek	Pend Oreille River	Debris Jam	0.1	A. Scott, Framatome ANP, pers. comm, 2002	At the railroad trestle crossing, a large debris jam was observed in 1998. It was still in place in 2000. There was a four to five foot drop below the log jam. It is unknown to what extent the LWD jam acts as a fish passage barrier.
Priest River	Lower West Branch	Priest River	Falls	8.2	IDEQ 2001, pg. 114	At RM 8.2, Torrelle Falls is a complete barrier to fish passage.
Ruby Creek	Ruby Creek	Pend Oreille River	Culvert	9.4	USFS 2002 culvert barrier database	The culvert (Culvert_id # 152) at RM 9.4 at the USFS Rd. 2700910 creek crossing (road mile 0.1) is a full barrier to fish passage.
Ruby Creek	N. Fk. Ruby Creek	Ruby Creek	Culvert	0.2	USFS 2002 culvert barrier database	The culvert (Culvert_id # 150) at RM 0.2 at the County Road 2489 creek crossing (road mile 3.9) is a full barrier to fish passage.
Ruby Creek	N. Fk. Ruby Creek	Ruby Creek	Culvert	1.7	USFS 2002 culvert barrier database	The culvert (Culvert_id # 149) at RM 1.7 at the USFS Rd. 2700423 creek crossing (road mile 1.5) is a full barrier to fish passage.
Ruby Creek	Little Ruby Creek	Ruby Creek	Culvert	0.8	USFS 2002 culvert barrier database	The culvert (Culvert_id # 151) at RM 0.8 at the County Road 2489 creek crossing (road mile 6.5) is a full barrier to fish passage.
Ruby Creek	S. Fk. Lost Creek	Lost Creek	Falls	3.8	USFSc 1999. S. Fk. Lost Creek Biological Evaluation.	At RM 3.8 on S. Fk. Lost Creek, a natural falls is a blockage to fish passage. The falls is approximately 8 feet in vertical height (USFS 1999c).
Skookum Creek	Skookum Creek	Pend Oreille River	Culvert	9.4	USFS 2002 culvert barrier database	The culvert (Culvert_id # 118) at RM 9.4 at the USFS Rd. 5000541 creek crossing (road mile 6.8) is a full barrier to fish passage.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Skookum Creek	Indian Creek	Pend Oreille River	Beaver Dams	0.0	KNRD 1997b, pg. 8	A series of beaver dams are constructed at the mouth of this stream create potential migration barriers.
Skookum Creek	Indian Creek	Pend Oreille River	Type not indicated	0.3	R. Fletcher, POCD, pers. comm., 2002	Upstream about 300 yards from the LeClerc Creek Road crossing, a private landowner landscaping project has modified the stream reach in such a way that may pose a potential barrier to fish passage (R. Fletcher, POCD, pers. comm., 2002).
Skookum Creek	Indian Creek	Pend Oreille River	Culvert	0.75	T. Andersen, KNRD	A culvert at RM 0.75 on private land may be a barrier to fish passage.
Skookum Creek	Marshall Creek	Pend Oreille River	Dam	outlet of Marshall Lake	USFS 1999 Marshall Creek Biological Evaluation	At the outlet of Marshall Lake there is a man-made stabilizing dam with a fish screen. This is a yearlong blockage. Neither Marshall Creek nor Burnt Creek, a tributary to Marshall Lake, have been surveyed for the presence of bull trout. Marshall Lake was surveyed with the use of gill nets in 1995 specifically in the search for pygmy whitefish. No bull trout were found during these surveys (P.Mongillo, WDFW, pers. comm.). The lake has also been rehabilitated with the use of rotenone at least once this century (C.Vail, WDFW, pers. comm.).
Slate Creek	Lime Creek	Pend Oreille River	Subsurface flows	1.25	McLellan 2001, pg. 65	Just downstream of the Lake Lucerne tributary, and downstream of Hwy. 31, Lime Creek goes subsurface for approximately 100 meters (330 feet).
Slate Creek	Pewee Creek	Pend Oreille River	Falls	0.0	McLellan 2001, pg. 64	At the mouth there is a 50m (165 ft) vertical waterfall. It is considered a fish passage barrier.
Slate Creek	Slate Creek	Pend Oreille River	Cascades	0.75	USFS 1999, pg. 8; McLellan 2001	At approximately RM 0.75, there is a 30 foot high series of cascades that may be a seasonal natural barrier to fish passage. The USFS does not consider this series of cascades to be a full barrier to upstream fish passage (USFA 1999, pg. 8). This is contradicted by survey information in McLellan 2001 which identified the series of four natural falls and a chute on Slate Creek and concluded the series of falls and the chute combined prevent fish passage upstream in Slate Creek (McLellan 2001, pg. 75).

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Slate Creek	Slate Creek	Pend Oreille River	Falls/Chute	?	McLellan 2001, pg. 75, Fig. 12 and Appendix I	Moving in an upstream direction, there are a series of 4 waterfalls and a chute that were considered fish barriers by McLellan (2001). They were located near the break between reaches 8 and 9. The first waterfall was the largest with a vertical height of 6.0 m (9.3 feet). The second waterfall was approximately 4.0 m tall (132 feet). The third waterfall was 5.0 m (8.3 feet) high and the stream narrowed to 1 m (3.3 feet) before plunging through a crack in the bedrock. The water plunged through the crack, away from the concave face of the cliff. The fourth waterfall was 2.8 m high (9.24 feet). The final barrier in this 800 m (0.5 mile) stretch of Slate Creek was a chute. The chute was 30 m (100 feet) long, 2 m (6.6 feet) wide, and had a gradient of 38% with uninterrupted flow.
Slate Creek	Slate Creek	Pend Oreille River	Falls/Chute	?	McLellan 2001, pg. 75, Fig. 12 and Appendix H	Approximately 400 m (1320 ft) upstream from the State Highway 31 bridge, another natural fish passage barrier is identified in McLellan (2001). The barrier identified is a waterfall/chute which, facing upstream, had a 3.0 m (9.9 foot) waterfall on the right side and a chute that was 10 m (33 foot) long, 1 m (3.3 foot) wide, and had a gradient of 24% on the left side (facing downstream).
Slate Creek	Slate Creek	Pend Oreille River	Culvert	4.9	USFS 2002 culvert barrier database	At the confluence of Styx and Slate creeks (RM 4.9), the USFS Rd.3155000 creek culvert crossing (Culvert_id # 275; road mile 4.7) is a full barrier to fish passage.
Slate Creek	N. Fk. Slate Creek	Pend Oreille River	Chute	?	McLellan 2001	The most upstream natural barrier on the creek identified in McLellan was a chute in the headwaters (27.5 m long, 1 m wide, 18% gradient) located 300 m downstream from the USFS Rd. 209 crossing (McLellan 2001, pg. 75, Figure 12 & Appendix I).
Slate Creek	N. Fk. Slate Creek	Pend Oreille River	Culvert	?	McLellan 2001	A man-made barrier point is shown on McLellan's GIS potential barriers coverage. No further description is provided in the McLellan 2001 text.
Slate Creek	Slumber Creek	Slate Creek	Culvert	0.2	USFS 2002 culvert barrier database	The culvert (Culvert_id # 273) at RM 0.2 at the USFS Rd. 3100250 creek (road mile 1.8) crossing is a full barrier to fish passage.
Slate Creek	Slumber Creek	Slate Creek	Dewatering	2.3	T. Shuhda, USFS, pers. comm., 2002	On August 17, 1991, the stream was observed to have naturally dewatered.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Slate Creek	Styx Creek	Slate Creek	Culvert	0.1	USFS Fish Passage Access Database, 2001	The USFS Rd. 3155 culvert crossing on Styx Creek near the mouth is a fish passage barrier (USFS Colville National Forest, Newport Ranger District, Collville, WA, Fish Passage Access Database, 2001).
Slate Creek	Threemile Creek	Pend Oreille River	Falls	0.0	McLellan 2001, pg. 63	There is a 5.0 meter waterfall at the mouth of Threemile Creek.
South Salmo	S. Fk. Salmo River	Salmo River	Cascades	9.9	J. Baxter, Baxter Environmental, email correspondence, 2002	There is a canyon section upstream of Watch Creek (RM 9.9) with a number of 6-foot drops in the stream channel. This may explain why radio-tracked fish were located only to just above the Watch Creek confluence (J. Baxter, Baxter Environmental, email correspondence, September 2002). A radio-tagged adult male bull trout was tracked from the Salmo River upstream 10 miles into the South Salmo River indicating a lack of any fish passage barriers at least up to that point (Baxter and Nellestijn, 2000, pg. 18).
Sullivan Creek	N. Fk. Sullivan Creek	Sullivan Creek	Culvert	0.00	C. Vail, WDFW, pers. comm., 2003.	The culvert crossing at Sullivan Lake Road (County Rd. 9345) near the mouth is a barrier to fish passage (C. Vail, WDFW)
Sullivan Creek	N. Fk. Sullivan Creek	Sullivan Creek	Falls	0.20	C. Vail, WDFW, written comm., 2003; T. Shuhda, USFS, email comm., 2003.	Not far downstream from the N. Fk. Sullivan Creek dam (RM 0.25) there is a 6 foot vertical falls that appears to be a full barrier to upstream fish passage (T. Shuhda, USFS; C. Vail, WDFW). Shuhda (USFS) bases his determination that the natural falls is a barrier on his observations made at low flows. Shuhda notes he has not observed the falls at high flows. Vail (WDFW) bases his determination that the natural falls is a barrier due to height and lack of a plunge pool at the base, on his observations made on Feb. 3, 2003.
Sullivan Creek	N. Fk. Sullivan Creek	Sullivan Creek	Dam	0.25	USFS 1996, pg. I-39; POCD 2001, Part 2, pg. 6	The North Fork Sullivan Creek Dam was constructed in late 1950s and is located at RM 0.25. It is owned and operated by the POPUD to supply drinking water to the town of Metaline Falls and is a barrier to fish passage. The dam has no fish passage facilities.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Sullivan Creek	Noisy Creek	Sullivan Lake	Dewatering	0.0	T. Shuhda/ USFS, C. Vail/WDFW, pers. comm., 2002	At the mouth, the creek naturally dewaters annually for 9 months, from about late June/early July until spring runoff (T. Shuhda/USFS, C. Vail/WDFW, pers. comm., 2002).
Sullivan Creek	Outlet Creek	Sullivan Creek	Dam	0.5	McLellan 2001, pg. 82; USFS 1999ce, pg. 9	Sullivan Lake Dam is a barrier to upstream fish passage. It is a 29-ft high structure (McLellan called it a 20 meter dam) constructed around 1921-23 and located at the outlet to Sullivan Lake. It is owned and operated by Pend Oreille Public Utility District. The dam has no fish passage facilities.
Sullivan Creek	Sullivan Creek	Pend Oreille River	Cascades	0.6	CES 1996, pg. 21	At RM 0.6, about 500 feet upstream of the powerhouse, there is a "turbulent cascade" that is a fish passage barrier (CES 1996, pg. 21). Although Cascade Environmental Services (CES) submits that the barrier is a formidable obstruction to upstream migration of bull trout, the barrier cannot be classified, with the information available, as an absolute blockage under all conditions and flows. The cascades is not considered a barrier in McLellan (2001, pg. 82), nor is it considered a barrier by C. Vail (WDFW) or T. Shuhda (USFS).
Sullivan Creek	Sullivan Creek	Pend Oreille River	Chute/Cascade	0.65	CES 1996, pg. 22, 23, 24	Using the Powers and Orsborn methodology (1984), at RM 0.65, approximately 720 feet upstream of the powerhouse, there is barrier comprised of a complex chute with a cascades component (CES 1996, pg. 22, 23). Although CES submits that the barrier is a formidable obstruction to upstream migration of bull trout, the barrier cannot be classified, with the information available, as an absolute blockage under all conditions and flows (CES 1996, pg. 23). The chute/cascades is not considered a barrier in McLellan (2001, pg. 82) nor is it considered a barrier by C. Vail (WDFW) or T. Shuhda (USFS).
Sullivan Creek	Sullivan Creek	Pend Oreille River	Dam	3.25	McLellan 2001, pg. 82; USFS 1999ce, pg. 9	Mill Pond dam is a barrier to upstream fish passage. It is a 55-ft high concrete structure constructed in 1913 - 1914 for power production and owned by Pend Oreille Public Utility District. The dam has no fish passage facilities.
Sullivan Creek	Kinyon Creek	Sullivan Creek	Culvert	0.3	USFS 2002 culvert barrier database	The culvert (Culvert_id # 98) at RM 0.3 at the County Rd. C2220 creek crossing (road mile 1.2) is a full barrier to fish passage.

WAU NAME	STREAM NAME	TRIBUTARY TO:	BARRIER TYPE (falls, chute, culvert, dam, etc)	RIVER MILE	SOURCE	DESCRIPTION
Tacoma Creek	Cusick Creek	Pend Oreille River	Culvert	0.5	SSHEAR database	The State Hwy. 20 culvert is a fish passage barrier
Tacoma Creek	Cusick Creek	Pend Oreille River	Culvert	5.2	USFS 2002 culvert barrier database	There is a partially blocking culvert (Culvert_id # 261) at RM 5.2 at the USFS Rd. 3128070 crossing (road mile 0.02).
Tacoma Creek	Cusick Creek	Pend Oreille River	Culvert	5.7	USFS 2002 culvert barrier database	The culvert (Culvert_id # 159) at RM 5.7 at the USFS Rd. 2441000 creek crossing (road mile 3.9) is a full barrier to fish passage.
Tacoma Creek	Cusick Creek	Pend Oreille River	Culvert	7.0	USFS 2002 culvert barrier database	The culvert (Culvert_id # 156) at RM 7.0 at the County Road 2441 creek crossing (road mile 5.3) is a full barrier to fish passage.
Tacoma Creek	Cusick Creek	Pend Oreille River	Culvert	7.5	USFS 2002 culvert barrier database	The culvert (Culvert_id # 155) at RM 7.6 at the USFS Rd. 3128090 creek crossing (road mile 0.0) is a full barrier to fish passage.
Tacoma Creek	S. Fk. Tacoma Creek	Tacoma Creek	Culvert	3.6	USFS 2002 culvert barrier database	The culvert (Culvert_id # 303) at RM 3.6 at the USFS Rd. 3116501 creek crossing (road mile 0.2) is a partial barrier to fish passage.
Tacoma Creek	N. Fk. of S. Fk. Tacoma Creek	S. Fk. Tacoma Creek	Culvert	4.3	USFS 2002 culvert barrier database	The culvert (Culvert_id # 166) at RM 4.3 at the USFS Rd. 3116125 creek crossing (road mile 3.3) is a full barrier to fish passage.

APPENDIX F

1996 & 1997 WATER TEMPERATURES FOR TRIBUTARIES TO BOUNDARY RESERVOIR

Table F1: 1996 &1997 Water Temperatures for tributaries to Boundary Reservoir (data from R2 Resource Consultants 1998).

Stream Name	Year	Station	7- day ave. min. temp.(°C)	Dates	7-day ave. max. temp. (°C)	Dates	Min. Temp. Recorded (°C)	Date	Max. Temp. Recorded (°C)	Date
FLUME CREEK	1996	Lower	2.6	Oct. 21-27	11.7	Aug. 25-31	1.7	Oct. 27	12.2	Aug. 28 & 30
		Upper	3.8	Oct. 21-27	12.6	Aug. 24-30	3.2	Oct. 22	13.6	Aug. 15
FLUME CREEK	1997	Lower	4.1	Nov. 5-11	14.2	Aug. 1-7	1.7	Nov. 11	14.8	Aug. 5 & 6
		Upper	3.7	Nov. 5-11	12.5	Aug. 1-7	1.6	Nov. 11	13.2	Aug. 6
SLATE CREEK	1996	Lower	2.4	Oct. 21-27	11.9	Aug. 25-31	1.9	Oct. 22 & 26	12.3	Aug. 28-30
		Upper	2.7	Oct. 21-27	11.0	Aug. 25-31	2.0	Oct. 22	11.4	Aug. 30
SLATE CREEK	1997	Lower	3.7	Nov. 5-11	14.6	Aug. 1-7	1.2	Nov. 11	15.4	Aug. 5 & 6
		Upper	3.4	Nov. 5-11	11.7	Aug. 1-7	1.4	Nov. 11	12.3	Aug. 5
SWEET CREEK	1996	Lower	2.9	Oct. 21-27	13.6	Aug. 24-30	2.4	Oct. 26	12.3	Aug. 28-30
		Upper	2.6	Oct. 21-27	13.7	Aug. 24-30	2.1	Oct. 22 &26	11.4	Aug. 30
SWEET CREEK	1997	Lower	4.5	Oct. 23-29	15.3	Aug. 1-7	3.5	Oct. 24 & 25	16.1	Aug. 5 & 6
		Upper	3.6	Nov. 5-11	14.6	Aug. 1-7	1.1	Nov. 11	15.4	Aug. 5 & 6
SULLIVAN CREEK	1996	Lower	8.5	Oct. 21-27	16.9	Aug. 24-30	8.1	Oct. 26	17.3	Aug. 29 & 30
		[NONE]	-	-	-	-	-	-	-	-
SULLIVAN CREEK	1997	Lower	6.9	Nov. 4-10	15.8	Aug. 1-7	5.5	Nov. 10	19.4	Aug. 5
		Upper	3	Nov. 5-11	14.0	Aug. 1-7	0.8	Nov. 11	14.9	Aug. 5
SAND CREEK	1996	Lower	THERMOGRAPH DEWATERED 10 DAYS AFTER PLACEMENT							
		[NONE]	-	-	-	-	-	-	-	-
SAND CREEK	1997	Lower	3.7	Nov. 5-11	15.9	Aug. 1-7	0.8	Nov. 11	16.6	Aug. 5 & 6
		[NONE]	-	-	-	-	-	-	-	-

APPENDIX G

SELECT TABLES AND TEXT FROM THE WDNR LECLERC CREEK WATERSHED ANALYSIS (WDNR 1997)

Figure 4: A description of the ten geomorphic units (GMU) identified in the Watershed Analysis process and their relationship to habitat-forming processes (WDNR 1997, Section 4E.7, pp. 13- 45)

4E.7 Geomorphic Units and Habitat Forming Processes

Individual channel segments were categorized into geomorphic units using the interpretation of channel conditions described above, riparian landform/valley bottom type map of the watershed, position in the drainage network, and gradient/confinement class. This resulted in grouping the 200 response segments into 10 geomorphic units (Figure 4E-3). A one day reconnaissance of several segments that had not been surveyed helped to further refine the unit groupings.

Conditions observed in each geomorphic unit relative to the input factors of coarse and fine sediment, peak flow, LWD, and catastrophic damage were recorded on Form E-6 (Appendix A). Information gathered within sampled segments was then extrapolated to segments with similar characteristics and potential for response to changes in input factors. The role of riparian vegetation in providing bank stability and the potential response to changes in riparian vegetation was also evaluated for each geomorphic unit.

Descriptions of each geomorphic unit and the potential responses to change in input factors are provided. The relative response ratings are based on the following definitions:

Low ⇒ little or no change in channel morphology expected with a change in input level; often, these channels function as transport reaches
Moderate ⇒ minor change in channel morphology expected with a change in input; or, a very large, persistent increase required to trigger a change in channel morphology
High ⇒ significant change in channel morphology expected with a change in the input factor

Following the discussion of potential responses, there is a description of the habitat forming processes that affect upstream migration, spawning and incubation, rearing, and overwintering habitat for salmonids inhabiting the watershed. At the end of this section is a summary table displaying the response ratings for each geomorphic unit (Table 4E-3).

Figures 4E-4 through 4E-7 (attached following the description of geomorphic units) display a summary of the functions of large woody debris and the primary pool-forming agents for eight of the geomorphic units. This information was compiled by averaging data from all of the segments that were surveyed within each geomorphic unit. The figures do not portray summary information for the Beaver Ponds and Wetlands or the Small Tributaries to the Pend Oreille River because of the nature of these geomorphic units, as described below.

Low Gradient, Broad Depositional Valley

Includes Segments: field verified - A1, B4, C2, F1, H4, H5
extrapolated - B1, C1, D1, F15

General Description: Channels in this group include the mainstem LeClerc Creek and primary tributaries (East, Middle, and West Branches) where they flow across a relatively wide, alluvial valley bottom. Channel gradient is 1-2% within a valley that is two to more than four times as wide as the active channel width. Bankfull width of the surveyed segments ranges from 18 to 40 feet (6 to 12 meters). These broad valley bottoms have been formed by glacial scour and deposition, then overlain by alluvial deposits. In most areas the present day channels appear to be "underfit" for the size of the valley bottom. There is little evidence of channel movement across the valley bottom in the recent past and, therefore, side channels and off channel habitat are scarce.

Associated Channel Types: The unit is primarily a forced pool/riffle channel dominated by large and small gravel, with scattered boulders. Glacial deposits in segment H3 result in a mix of sand, cobble, and boulders. Plane bed reaches occur in segments A1 and H5 where roughness elements are lacking.

Conditions and Response Potential:

Coarse Sediment: *HIGH RESPONSE RATING* These channels have a relatively low transport capacity due to a gradient of less than 2% and a broad valley bottom. Point and medial bars composed of gravel typically occupy 10-30% of the active channel area. Pool spacing varies from 2 to 8 channel widths in the surveyed segments.

When sediment loads exceed transport capacity, the channel responds with deposition, resulting in reduced depth, reduced roughness, and pool filling. As exhibited in segments A1 and H5, channel morphology can be transformed to plane bed conditions (extensive monotypic glides and riffles). A very large increase in sediment loads could trigger channel widening and aggradation.

Fine Sediment: *HIGH RESPONSE RATING* The amount of fine sediment observed in pools was highly variable, depending upon the type of pool and velocity of water. A V* of 0.2-0.4 (moderate to high) was common in many segments, and a V* as high as 0.5 was measured in segment H4. Segments B2, C4, and H4 had strands of fine sediment in riffles, whereas the other surveyed segments had accumulations mostly along channel margins and behind boulders and cobbles.

Increased fine sediment loading would result in further fining of the channel bed and filling of pools. Longitudinal accumulations of fine sediment may occur in riffles. During high flow events, some of this fine sediment would be transported downstream.

Peak Flows:

MODERATE RESPONSE RATING

None of these channels are very deeply incised into the valley bottom; banks are typically vertical and 2-4 feet (0.6 - 1.2 meters) high. Little bank erosion was observed in the surveyed segments. Where present, bank erosion occurs on the outside of bends or where forced by obstructions, rather than as evidence of channel widening. Due to the large width to depth ratio and broad, unconfined floodplain, peak flows tend to spread, rather than vertically scour. No evidence of increased width or unusual channel migration was evident in historic aerial photos.

Increased peak flows would likely result in an increased bedload transport rate, decreased sediment storage, and potentially coarser channel bed. Given the fine grained nature of the valley bottom material, a very large, persistent increase could result in bank erosion, channel widening, and increased meander development.

Large Woody Debris:

HIGH RESPONSE RATING

LWD forms the majority of pools in these channels. Pools also occur at some channels bends and downstream of constrictions. In segment A1, where there is only 1 piece of LWD per 100 feet (0.3 pieces/10 m), pool spacing is very wide (8 channel widths). Where there is more LWD, pools spacing is closer together. On average for the six surveyed segments, LWD formed 56% of the large pools. LWD is also important in creating areas of substrate scour and deposition and, in some reaches, for bank protection.

LWD is critical in determining the depth and frequency of pools in this geomorphic unit. Forced pool riffle channels are extremely sensitive to the availability of flow obstructions. A reduction in the amount of LWD could reduce the amount of pools and shift some reaches to a plane bed morphology.

Riparian Vegetation:

HIGH RESPONSE RATING

The stream banks are composed of fine-grained alluvium and noncohesive glacial deposits and rely on a deep, dense root network for protection. Removal or disturbance can result in accelerated bank erosion. Furthermore, vegetation within the floodplain is important for dissipating energy of overbank flows.

Catastrophic Damage

HIGH RESPONSE RATING

The channel gradient is too low for initiation of a debris flow or dambreak flood within these channels. If a debris flow from a steeper tributary reached the channel (which is highly unlikely given the width of the valley bottom), considerable sediment and debris would be deposited in the channel. This could result in channel shift, widening, and aggradation.

Geomorphic Factors Influencing Fish Habitat:

Upstream Migration	No barriers to migration occur within the low gradient, broad depositional valleys. However, shallow water depth may impede passage through some reaches during late summer and fall in low flow years.
Spawning and Incubation Habitat	The unit is a natural area for spawning gravel accumulation. Potential spawning habitat in the unit is typically widespread. Gravel bars occupy 10-30% of the surveyed segments. Gravel of 1-3 inches diameter (2 - 8 cm) is deposited on the inside of bends, along channel margins, in pool tailouts, and in patches behind scattered large cobbles and boulders. The exception to this is in segment F1, where sand is the dominant substrate and gravel occurs only in very small patches.
Rearing Habitat	Pool formation is controlled primarily by the amount and location of large, woody debris in these channels. Where wood is abundant, pools are large, deep, and frequent. Channel bends and bank constrictions also form occasional large, deep pools. Scattered boulders remaining from glacial deposition also form smaller pocket pools.
Overwinter Habitat	True side channels with off channel habitat do not exist in these valley bottoms. However, the channels do occasionally split into two channels for a distance of 100-200 feet (30 - 60 meters). Channel splits are associated with large, old log jams. While both channels are open to high flows, they probably experience lower velocity and contain more sheltered locations than where the channel is a single thread. Accumulations of woody debris along channel margins and interstices between large cobbles and boulders also provide refuge areas during high flows. There is not any undercut bank habitat in these channels.

Low Gradient, Narrow Depositional Valley

Includes Segments: field verified - B2, J2
extrapolated - H1, H2

General Description: This unit occurs along the primary tributaries (East and West Branch LeClerc Creek) where they flow through a fairly steep-sided, V-shaped valley with a narrow floodplain. Channel gradient is 2-4% and the valley bottom width is 1.5 to 3 times the active channel width. Bankfull width is 30-35 feet (9-11 meters), and width:depth ratio 17-21, on the surveyed segments. In segments B2, H1, and H2, this unit occurs where the channel is downcutting from the level of the upper glacial terrace to the lower terrace occupied by the mainstem and the Pend Oreille River. In segment J2, this segment occurs further upstream in the basin, where the channel is cutting through deep glacial deposits to reach the level of the upper terrace.

Associated Channel Types: The unit is primarily a forced pool/riffle and plane bed channel dominated by cobbles, with more boulders in the 3-4% gradient sections. In some short reaches, there are also transverse boulder berms creating steps, with short plane bed reaches upstream.

Conditions and Response Potential:

Coarse Sediment: These channels exhibit a low to moderate amount of gravel bars (10-20% of the active area) despite a relatively wide width:depth ratio. These are mostly small point bars rather than medial bars. Spacing of large pools is 2-3 channel widths, in addition to many small boulder pocket pools and channel margin pools. Bed and banks are composed primarily of cobble and boulder.

MODERATE RESPONSE RATING

Increases in coarse sediment input would result in increased bedload transport and associated scour, as well as deposition on bars. In addition, pool filling would be probable in the event of a large, persistent increase. Substrate particle size would generally decrease, with a concurrent reduction in channel roughness.

Fine Sediment: Although no major fine sediment accumulations were observed, the frequent small deposits were surprising for the stream energy. Nearly every deep scour pool and backwater had a small pillow of fines. Deeper deposits were observed in a few dammed pools, but scour pools generally had a V* of 0.1 or less. Fines were also noted along channel margins and low gradient riffles.

MODERATE RESPONSE RATING

Increased fine sediment loading would be followed with an increase in sediment transport, but some deposition would be expected in sheltered areas of deep pools and along channel margins. However, it would require a large increase to alter the present conditions and to lead to substantial bed fining and substrate embeddedness.

Peak Flows:

MODERATE RESPONSE RATING

Due to the well armored, boulder/cobble banks, little bank erosion was noted. The small, valley bottom floodplain allows for some energy dissipation. No change in width was evident in any of these segments on the historic photos.

An increase in peak flows could lead to an increase in the rate of bedload transport, and coarsening of the channel bed. This may help to flush some of the fine sediment from pools and riffles. A very large, persistent increase could cause an increase in bank erosion and channel movement across the narrow floodplain. This could undercut the toe of the relatively steep slopes bordering the channel and initiate mass wasting of the glacial deposits.

Large woody debris:

MODERATE RESPONSE RATING

LWD was observed to play a role in substrate scour and deposition, and formed approximately 20% of the large pools in the surveyed segments. However, boulders are the primary roughness elements, forming 44% of large pools, in addition to creating steps in these channels. The amount of LWD was low, only 3-5 pieces per 100 feet (1-2 pieces/10 meters) in the surveyed segments. Flood flows are typically capable of redistributing debris in these channels, and much of the wood was pushed to the margins or perched atop boulders. Over one-third of the LWD in the surveyed segments did not appear to affect channel morphology.

A change in LWD input would not be expected to change the frequency or abundance of primary pool habitat. Large pools are formed largely by boulder clusters. However, LWD was observed to be an important element for creating local sour and trapping gravel and sand. Large diameter, long pieces of wood can also lodge among big boulders along the channel margins and increase the amount of small, channel margin pools.

Riparian Vegetation:

HIGH RESPONSE RATING

The stream banks are composed primarily of boulders bound together by a dense root network. Vegetation within the valley bottom floodplain may be important for energy dissipation during overbank flows. Perhaps of greatest importance, however, is the role of riparian vegetation in trapping sediment produced by erosion of the steep inner gorge.

Catastrophic Damage

MODERATE RESPONSE RATING

The gradient of these channels is conducive for deposition, rather than initiation or scour, of a debris flow or dambreak flood. In most of these segments, there are no steep tributaries from which a debris flow could originate and deposit material. The exception is that Fourth of July Creek enters the upper portion of segment B2. A debris flow in Fourth of July Creek would likely be deposited at the confluence with segment B2, where the old dam is located. This would cause considerable sediment and debris to enter segment B2, and effects would be as described under coarse and fine sediment, above.

Geomorphic Factors Influencing Fish Habitat:

Upstream Migration No barriers to migration occur within the low gradient, narrow depositional valleys.

Spawning and Incubation Habitat Occasional sorted deposits of 1-3 inch (2 - 8 cm) diameter gravel is typically found in small patches behind boulders in these channels. The vast majority of the gravel, however, is poorly sorted, and located across the bed in a matrix of cobbles and sand surrounding larger boulders.

Rearing Habitat Large and small pools are formed primarily by boulders in these channels. Large boulders create constrictions, forming deep scour pools. In addition, there are numerous small boulder pocket pools. Occasional channel bank constrictions also form large, deep pools.

Overwinter Habitat Boulder interstices provide the most common refuge areas from high flows. The channels do occasionally split into two channels for a distance of 60-100 feet (18- 30 meters). Channel splits are associated with large, old log jams. While both channels are open to high flows, they probably experience lower velocity and contain more sheltered locations than where the channel is a single thread.

Moderate Gradient, V-shaped Valley

Includes Segments: field verified - H6, J1
extrapolated - B3, B5, J3

General Description: This unit occurs along the West and East Branch LeClerc Creek where the channels have incised through glaciofluvial deposits. Sideslopes are generally steep, the channel gradient is 4-8%, and the valley bottom is narrow (1-2 times the active channel width). In segment H6, the channel frequently splits around debris accumulations resulting from mass wasting within the inner gorge. Bankfull width of the surveyed segments is 30-40 feet (9-12 meters) and width:depth ratio is 15-18.

Associated Channel Types: These are step pool channel types. Often, a transverse boulder bar forms a step, with a long stretch of boulder pocket water upstream before the next step.

Conditions and Response Potential:

Coarse Sediment:

MODERATE RESPONSE RATING

These segments have a relatively high transport capacity. Less than 20% of the active area is in bars, despite a large width:depth ratio. Substrate is primarily large cobble and boulders. However, in segment H6, there is considerable inner gorge erosion, resulting in the formation of medial cobble/boulder bars. Channel splitting around these bars further exacerbates the inner gorge erosion.

Increased coarse sediment would primarily be transported, with some textural response in terms of bed armoring or fining. Severe increases in sediment loads could result in pool filling, changes in step/pool spacing, and the potential for limited channel widening. While channel morphology may be re-established during flood events, the effects of widening may be more persistent. As observed in segment H6, erosion of the banks accelerates inner gorge mass wasting, and results in additional inputs of coarse sediment.

Fine Sediment:

LOW RESPONSE RATING

Despite the high transport capacity, the bed of segment J1 exhibited considerable accumulations of sand. Cobbles within riffles were observed to be 20-80% embedded . Fine sediment was common along the margins and in sheltered locations. There was little fine sediment in riffles within segment H6, and almost none in the pools of either segment.

Increased fine sediment will mostly be transported to lower gradient segments downstream. As shown in J1, fine sediment can be deposited in sheltered locations and embed larger particles. The effects of fine sediment on channel morphology, however, are negligible and temporary. Given the relatively high stream energy, high flow events will mobilize the fine sediment that temporarily accumulates on the channel bed.

Peak Flows:

MODERATE RESPONSE RATING

There is little bank erosion in the surveyed segments. The channel bed and banks are well armored by boulders. However, segment H6 does have an area where the steep inner gorge walls are being undercut, triggering mass wasting.

Increased discharge may result in flow width and height expansion without bank cutting or channel incision, as bed-forming step-pool grains are essentially static. A very large increase could trigger textural responses such as bed armoring and coarsening, as the smaller sized particles are transported downstream. However, of greatest concern is the potential for increased bank erosion, which could undermine the steep inner gorge slopes and initiate mass wasting.

Large Woody Debris:

LOW RESPONSE RATING

Boulders are the primary roughness elements in these channels. While only 4-5 pieces per 100 feet (1 to 2 pieces/10 meters) of LWD were tallied in the surveyed segments, the vast majority (75%) was not affecting channel morphology. Much of the wood has been pushed along the margins or perched atop boulders. In segment H6, most of the LWD was piled at the head of medial boulder bars. Boulders form virtually all of the large pools in these segments.

LWD does trap some gravel and cobble, and create local scour. In order to function, LWD must be large and solid. Older pieces are pummeled and splintered during flood flows unless deeply embedded in the bank.

Riparian Vegetation:

HIGH RESPONSE RATING

Banks consist primarily large boulders bound together by tree roots. Riparian vegetation is very important within the inner gorge to help reduce mass wasting and also trap sediment where inner gorge erosion does occur. Loss of riparian vegetation root strength could be accompanied by accelerated inner gorge erosion and an increase in coarse and fine sediment transported to lower gradient segments downstream.

Catastrophic Damage:

MODERATE RESPONSE RATING

The gradient is conducive to initiation of a dambreak flood. However, the valley bottom is generally wide enough to allow some channel shift around an obstruction. Furthermore, a source of LWD for creation of a dam is generally lacking in the WAU.

It is also feasible that a debris flow originating in a steeper tributary could be deposited in this segment. If such occurred, effects would be similar to that described for coarse and fine sediment, above. The actual magnitude of the effect would depend on the magnitude of the debris flow. Historic photos reveal that debris flows and dambreak floods have been very rare in the past 62 years in this WAU.

Geomorphic Factors Influencing Fish Habitat:

Upstream Migration No barriers to migration occur within the moderate gradient, V-shaped valleys.

Spawning and Incubation Habitat The vast majority of gravel is poorly sorted, and located across the bed in a matrix of cobbles and gravel surrounding larger boulders. Occasional sorted deposits of 3-6 inch (8- 20 cm) diameter large gravel is found in small patches within boulder pocket and eddy pools.

Rearing Habitat Large and small pools are formed primarily by boulders in these channels. Large boulders create constrictions, forming scour pools which typically occupy approximately one-half of the channel width. Boulder berms across the channel also create deep plunge pools. There are also numerous, smaller boulder pocket pools and channel margin eddy pools.

Overwinter Habitat Boulder interstices provide the vast majority of refuge areas from high flows. Although there are some short reaches where the channels split, the relatively high stream energy within these segments would translate to relatively high velocities in both channels during high flows. There is no undercut bank habitat within these segments.

Very Low Gradient, Broad Glacial Terrace

Includes Segments:	field verified - H3
General Description:	The West Branch LeClerc Creek meanders across a broad, flat glaciolacustrine terrace. The channel gradient is 1% or less and substrate is primarily sand. The channel is moderately entrenched into the terrace (3-5 feet deep; 1-2 meters), with a small, inner floodplain evident in places. Bankfull width is approximately 35 feet (11 meters), and width:depth ratio is 12. This is the only highly meandered, very low gradient segment on any of the primary tributaries. It is suspected that surface flow from this segment discharges into the groundwater and emerges downstream, in segment H2, where the channel begins to incise into the glacial deposits to reach the level of the lower terrace.
Associated Channel Types:	The channel exhibits both free and forced pool riffle morphology. Substrate is mostly sand, with some small gravel exposed in faster pool tails and point bars.

Conditions and Response Potential:

Coarse Sediment: ***HIGH RESPONSE RATING***	There is little coarse sediment in this segment due to the fine-grained deposits in the valley bottom. It is likely that this area was an ancient lake bed. Some small gravel does occur on point bars and a few of the faster scour pool tails. Pools are generally spaced 2-3 channel widths apart. Due to the low transport capacity, if there was any increase in coarse sediment supply the channel would be highly sensitive. Coarse sediment would be deposited, filling pools and reducing the depth of flow. This could lead to areas of subsurface flow during the low flow period. A large increase in coarse sediment would result in bank erosion, widening and aggradation.
Fine Sediment: ***HIGH RESPONSE RATING***	The channel bed and banks consist primarily of sand and finer particles. Due to the very low transport capacity, an increased supply of fine sediment would elicit a similar response to that described for coarse sediment. Increased fine sediment would fill pools, reduce the amount of existing gravel, and possibly shallow the channel to the extent that surface flows become intermittent during the low flow period. A very large increase in fine sediment could even result in channel widening and aggradation.

Peak Flows:

HIGH RESPONSE RATING

The channel is moderately entrenched into the glacial terrace. Little bank erosion was observed in the surveyed portion. Banks are silt and sand and close to vertical. Some meander cutoff was observed between the 1971 and 1979 photos, which may be related to the 1974 flood. There is also an old dike within this segment. The diversion structure is mostly disintegrated, but the dike is still evident, and the channel could shift into the dike if an obstruction developed during a runoff event.

Increased peak flows may cause bank erosion, meander cutoff, and accelerated channel movement across the valley bottom. Increased discharge could also lead to channel incision into the terrace.

Large Woody Debris:

HIGH RESPONSE RATING

Where present, LWD plays a crucial role in pool formation. In the surveyed portion, there were 7 pieces per 100 feet (2 pieces per 10 meters) that formed 60% of the pools. The pools formed by LWD tended to be deeper than those formed by bends or the bedform. LWD also creates areas of scour and deposition important for gravel retention, and aids in stabilizing channel banks. All of the LWD in this segment has been in the channel for at least 65 years. Much is clumped into jams on the inside of bends, and some is embedded in the channel bottom. The larger pieces of LWD are all in an advanced state of decay, and a significant channel response is likely in the near future as key pieces of wood disintegrate.

LWD is critical for scour of deeper pools. A reduction in LWD would decrease the depth and volume of pools, although shallow pools would still be formed at bends and by the natural pool-riffle sequence. A reduction in LWD may also increase bank erosion.

Riparian Vegetation:

HIGH RESPONSE RATING

Standing trees and shrubs appear to play a major role in stabilizing the sand/silt channel banks. A loss of riparian vegetation would increase bank erosion and may lead to channel widening and lateral shift.

Catastrophic Damage:

N/A RESPONSE RATING

The broad valley bottom and low gradient makes initiation of a dambreak flood or debris flow highly unlikely. The valley bottom is too broad for a debris flow from any tributaries to reach this channel. Furthermore, none of the valley wall tributaries adjacent to this segment actually extend to the valley floor.

Geomorphic Factors Influencing Fish Habitat:

Upstream Migration No barriers to migration occur within the low gradient, broad glacial terrace. However, shallow water depth may impede passage through some reaches during late summer and fall in low flow years.

Spawning and Incubation Habitat There is little 1-3 inch (2 - 8 cm) diameter gravel in this segment due to the fine-grained deposits in the valley bottom. Furthermore, transport capacity is very low. The faster riffles, pool tailouts, and areas of scour created by LWD do contain large patches of 0.25 - 1 inch (0.5 - 2 cm) diameter gravel. This material is mixed with sand, but is loose and not cemented. These patches of small gravel are fairly abundant within the segment.

Rearing Habitat Large pool formation is controlled primarily by the amount and location of large, woody debris. Where wood is abundant, pools are large, deep, and frequent. Freely formed pools and pools formed by channel bends also provide rearing habitat, but are typically not as deep as pools formed by LWD.

Overwinter Habitat Numerous old log jams on the inside of bends provide sheltered areas within this low gradient channel. The channel does occasionally split into two channels for a distance of 75 - 100 feet (23 - 30 meters). Channel splits are associated with large, old log jams. While both channels are open to high flows, they probably experience lower velocity and contain more sheltered locations than where the channel is a single thread. In the upper end of the segment, the channel winds through old beaver ponds, which would provide excellent overwinter habitat.

Low Gradient Tributaries Within Alluvial Valleys

Includes Segments: field verified - D3, D13, F3, I2, F5
extrapolated - A2, B10, C6, F2, F6, F10, G1, H15, I6, I10, I16, I19, J14

General Description: Included in this group are secondary tributaries flowing through a flat, valley bottom bounded by moderate sideslopes. Stream gradient is 1-3% and valley bottom width is greater than twice the active channel width. Bankfull widths in the surveyed segments range from 5-15 feet (2 to 5 meters), with a fairly narrow width:depth ratio of 4-9. The valley bottoms typically have deep, fine grained glaciolacustrine and alluvial deposits.

Associated Channel Types: Channel morphology is mostly free or forced pool-riffle. Segment I2 has some plane bed reaches. Channel substrate is dominated by sand and gravel, with the exception of segment I2 where scattered boulders remain from past glaciation.

Conditions and response potential:

Coarse Sediment:

HIGH RESPONSE RATING

These small, low gradient channels have a low transport capacity. Due to the fine-grained nature of the valley bottom deposits, there is little gravel-size material in the channels. Bars consist of mostly sand and silt. The relatively narrow width:depth ratios are not conducive to extensive bar formation. Pool spacing is fairly wide in most segments, ranging from 3 to 6 channel widths.

If there was an increase in the supply of coarse sediment, pool filling would occur, reducing bedform roughness and increasing sediment storage. Channel depth would be reduced, and widening could occur. A large, persistent increase in coarse sediment would lead to lateral movement across the valley bottom and aggradation.

Fine Sediment:

HIGH RESPONSE RATING

The channel bed and banks consist primarily of fine sediment in all segments except I2, where there is more gravel and boulders due to the nature of the glacial deposits. Pools are generally small and shallow, with measured V* ranging from 0.2 to 0.6. Segment D3 exhibited sand dunes within the riffles. Approximately 30% of the active channel area in segment F3 consisted of sand bars. These conditions portray the low transport capacity for fine sediment of channels in this geomorphic unit.

An increase in fine sediment input would lead to further fining of the channel bed and filling of pools. Sand stripes or dunes would develop in the riffles. A very large increase in fine sediment could even lead to channel widening and aggradation.

Peak Flows:

MODERATE RESPONSE RATING

The channels are slightly entrenched (less than 4 feet deep; or 1 meter) into the valley bottom. Some have a small inner floodplain below the level of the valley bottom. Segments D3 and F3 exhibited the greatest amount of bank erosion; involving approximately 20% of the surveyed reach. This was due to bends and obstructions, rather than an indication of widening. No evidence of widening or lateral migration was detected on the historic photos.

Increased discharge could cause increased bank erosion and meander development, potentially decreasing channel slope. Increased discharge could increase the bedload transport rate and bed scour. However, since the channels are only slightly entrenched, large peak flows can spread across the valley bottom, where energy would be dissipated. This would likely minimize the amount of channel scour and bank erosion.

Large Woody Debris:

HIGH RESPONSE RATING

Large woody debris was infrequent in all of these tributaries (less than 10 pieces/100 feet; or 3 pieces/10 meters) , and pool spacing was fairly wide, averaging 3-6 channel widths. In segment F5, where there is less than 1 piece of LWD per 100 feet (0.3 pieces/10 meters), pool spacing is 12 channel widths. LWD was observed to create 40% of the pools, on average within the 5 surveyed segments. Channel bends and banks created the remainder of the pools. Most pools, however, were small and shallow. Where wood was lacking in segment I2, the channel was a plane bed type due to lack of roughness elements. Due to the small size of these tributaries, even smaller branches of 2-4 inches in diameter appear to aid in scouring pools.

Wood plays a major role in channel morphology in these pool-riffle channel types. An increase in LWD could serve to increase the size, depth, and frequency of pools. Areas of faster velocity scour could also serve to cleanse gravels.

Riparian Vegetation:

HIGH RESPONSE RATING

The roots of alders and conifers appear to hold the unconsolidated, fine-grained bank material together, minimizing the amount of bank erosion. Riparian vegetation is also important in dissipating the energy of overbank flows.

Loss of root stability could lead to accelerated bank erosion and lateral shift across the valley bottom. This could further increase the amount of fine sediment within these low energy channels.

Catastrophic Damage:

HIGH RESPONSE RATING

The broad valley bottom and low gradient makes initiation of a dambreak flood or debris flow highly unlikely. If a debris flow from a steeper tributary did reach one of these channels, effects would be as described for increased fine and coarse sediment, above.

Geomorphic Factors Influencing Fish Habitat:

Upstream Migration Streamflow was subsurface within much of segment I2 by July of 1996. Many of the other low gradient segments within the Dry Canyon subbasin ("I" segments) are also of intermittent or ephemeral flow regime. Shallow water depths or dry sections may impede passage through some reaches of the other segments in this unit during late summer and fall.

Spawning and Incubation Habitat Gravel of 1-3 inches (2 - 8 cm) diameter is scarce in most of these segments due to the fine-grained deposits in the valley bottom. Furthermore, transport capacity is very low. The faster riffles, pool tailouts, and areas of scour created by LWD do contain small patches of 0.25 - 0.5 inch (0.5 - 1 cm) diameter gravel. This material is mixed with sand, but is loose and not cemented. These patches of small gravel are fairly abundant within the unit. Segment I2, which has coarser substrate than the other surveyed segments, has abundant gravel of 1-3 inches (2 - 8 cm) diameter.

Rearing Habitat Pools are formed by both the channel banks and by large and small woody debris. Pools frequently form at channel bends where channel margin vegetation has been undercut and overhangs the channel. In segment F5, pools are small, shallow, and widely spaced. This may be due to the overall lack of wood. Without roughness elements, the channel lacks the velocity necessary to scour the substrate and create pools. Where there even is smaller branches or alder stems of 2 - 4 inches diameter (5 - 10 cm), numerous small pools are formed which do provide rearing habitat.

Overwinter Habitat There are no side channels within the surveyed portions of these segments Accumulations of small and large woody debris along channel margins provide refuge areas during high flows, since the channel gradients are very low and do not generate extremely high velocities during peak flows. There was not any undercut bank habitat observed in the surveyed segments.

Moderate Gradient Tributaries Within Fluvial Basins

Includes Segments: field verified- D4, E2, G2, J10, J29, J38
extrapolated - A3, A4, C3, C12, D2, D8, D9, D12, D21, E5, E7, E9, F4, F9, F12, H11, H16, I3, I17, J5, J18, J19, J21, J22, J24, J26, J35, K6, K18

General Description: These units are small, secondary tributaries flowing through fluvial basins (broadly concave areas in the heads of major drainages) at a gradient of 4-8%. Valley bottom width is 1.5 to 3 times the active channel width. Bankfull width ranges from 5-15 feet (2 to 5 meters) in the surveyed segments, and width:depth ratios vary widely, depending on confinement. Channels are sinuous, and occasionally split around debris deposits.

Associated Channel Types: Channel morphology is typified by step pool conditions in most of the segments. Where the channel gradient is closer to 4%, there are also forced pool-riffle and plane bed morphologies. Gravel is the dominant substrate in most channels, with more cobble and boulder in the larger tributaries, such as segments D4 and J10. However, the larger channels also have greater stream energy, and so the responses to changing inputs are similar to the smaller channels in this grouping.

Conditions and response potential:

Coarse Sediment: *HIGH RESPONSE RATING* Segments E2 and G2 exhibit considerable deposition of coarse sediment; 30 and 70%, respectively, of the active channel area is comprised of gravel bars. Pool spacing is fairly wide (3 to 6 channel widths), and most pools are shallow. Despite the moderate gradient, the majority of the substrate is gravel-sized. These segments are located downstream of steeper gradient segments, so they function as areas of deposition despite gradients of up to 8%.

Increased coarse sediment input would result in pool filling, fining of the bed, reduced channel roughness, and increased sediment storage. During peak flow events, the rate of transport to downstream reaches would also be increased. A very large, persistent increase in coarse sediment could also lead to channel scour and widening in some areas.

Fine Sediment: *MODERATE RESPONSE RATING* Although these segments are inherently depositional, much of the fine sediment is transported during peak flows. However, a surprising amount of fine sediment was observed in segment E2, where measured V* was 0.5 in 2 pools. A fairly high V* of 0.2 and 0.4 was also measured in segment G2. Other surveyed segments generally had less than 10% pool filling, and fine sediment deposits only along margins and behind obstructions.

Increased fine sediment would be temporarily stored in sheltered locations, possibly leading to short term pool filling and increased embeddedness in pool tails. Fine sediment is likely flushed during high flows from most areas. However, due to the stepped nature of the channel, the distance downstream that fine sediment is routed is fairly short. There are abundant, small depositional areas in these channels. Large, persistent increases would likely lead to increased deposition in pools and bed fining.

Peak Flows:
MODERATE RESPONSE RATING

Very little bank erosion was observed in any of the five surveyed segments. These channels are not entrenched, and a small, valley bottom floodplain helps to dissipate the energy of peak flows. Despite the relatively small size of the substrate, the gravel is tightly packed.

Increased peak flows could lead to increased bedload transport, accompanied by flushing of fine sediment and bed coarsening. However, a large, persistent increase could lead to erosion of the banks and even channel incision.

Large Woody Debris:
HIGH RESPONSE RATING

LWD is a major roughness element, forming 55-80% (average of 67%) of the pools in the surveyed segments. LWD also functions to form steps important for energy dissipation, trap sediment, and protect channel banks. Most of the LWD in these segments is old and rotten, having been down for at least 65 years. Total pieces of LWD ranged from 14 pieces per 100 feet (4 pieces/10 meters) in segments E2 and G2 to 4 pieces per 100 feet (1 piece/10 meters) in segment J38.

An increase in LWD in the active channel area would serve to increase the size and frequency of pools. Increased LWD would also trap more sediment and dissipate energy by creating steps. A reduction in the amount of LWD could lead to reduced pool habitat and, perhaps, channel incision due to loss of energy dissipation structures.

Riparian Vegetation:
MODERATE RESPONSE RATING

Roots of riparian vegetation help to bind together the matrix of soil and cobble/boulders forming the channel banks. Little bank erosion was observed in any of these segments. Sideslopes are gentle to moderate, with low hazard of mass wasting.

Loss of riparian vegetation root strength could increase the amount of bank erosion, and lead to localized areas of channel widening.

Catastrophic Damage:
HIGH RESPONSE RATING

The channel gradient is conducive to initiation and scour of a dambreak flood or deposition of a debris flow. However, historic photos do not indicate any history of such within any of these segments. Initiation of a dambreak flood is unlikely, due to the lack of sources for wood.

Furthermore, there is a small valley bottom floodplain that would allow the channel to shift around obstructions. If a debris flow from a steeper tributary entered one of these channels, sediment and debris would be deposited, leading to local aggradation and effects as described for coarse sediment, above.

Geomorphic Factors Influencing Fish Habitat:

Upstream Migration No natural barriers to migration occur within most of the moderate gradient tributaries. However, segment D4 (upper East Branch) does have a bedrock waterfall consisting of a lower step approximately 15 feet (4.5 meters) high and an upper step 5 feet (1.5 meters) in height. Shallow water depth may impede passage through some of the other segments during late summer and fall. A road crossing in segment J29 has a 48 inch CMP that was put in at a fairly steep gradient which may be a barrier. In segment J38, there is a rock dam created by collapse of the old road fill that may prove difficult for upstream passage.

Spawning and Incubation Habitat Potential spawning habitat in the unit is typically abundant. There are numerous well sorted patches of gravel of 1-3 inches diameter (2 - 8 cm) located in pool tailouts. Within riffles, gravel is less sorted, and typically mixed with cobble and sand, but this is loose and not cemented. The larger channels (segments D4 and J10) also have patches of gravel behind boulders.

Rearing Habitat Pool formation is controlled primarily by the amount and location of large, woody debris in these channels. Where wood is abundant, pools are frequent. LWD forms both plunge pools below steps and lateral scour pools. Boulders also form plunge and scour pools, as well as smaller pocket pools, particularly in segments D4 and J10. Depth of pools is highly variable both within and among the segments. Typically, very large, deep pools are not common in these small streams.

Overwinter Habitat The channels do occasionally split into two channels for a distance of 25-75 feet (7- 23 meters). Channel splits are associated with large, old log jams. While both channels are open to high flows, they probably experience lower velocity and contain more sheltered locations than where the channel is a single thread. Accumulations of woody debris along channel margins and interstices between large cobbles and boulders also provide refuge areas during high flows. There is not any undercut bank habitat in these channels.

High Gradient, Boulder-dominated Tributaries

Includes Segments: field verified - I9, I15, J9, J32, K1, K9
extrapolated - C11, E1, I7, I8, I11-14, I18, J4, J11, J12, J13, J28, J41, J42, K2, K7, K11, K12, K14-17

General Description: This unit includes small, steep tributaries that have incised into granitic hill and mountain slopes. Channel gradients are typically 8-15%, but may be as steep as 20%. Bankfull width in the surveyed segments ranges from 6-20 feet (2-6 meters), with width depth ratios of 8-11. Steep to moderately steep sideslopes tightly confine these channels.

Associated Channel Types: These are step pool channel types. In the steeper portions or where bedrock is exposed, there are also cascades. The channel bed is comprised of a mix of boulders, cobble, and some sand.

Conditions and Response Potential:

Coarse Sediment: These segments are supply limited. There are few bars, and channels tend to be fairly narrow and deep. Boulder and cobble-size particles are the dominant substrate.

LOW RESPONSE RATING

Increased coarse sediment would primarily be transported, with some textural response in terms of bed armoring or fining. Severe increases in sediment loads could result in pool filling and changes in step pool spacing. However, channel morphology would likely be re-established during flood events.

Fine Sediment: Shallow deposits of sand were observed in some dammed pools and along channel margins. These deposits are likely transported during peak flow events. Elsewhere in the channel there is very little fine sediment.

LOW RESPONSE RATING

Increased fine sediment will mostly be transported to lower gradient segments downstream. Temporary deposition in some pools and in sheltered locations may occur. Given the relatively high stream energy, high flow events will flush the fine sediment downstream.

Peak Flows: There is very little bank erosion in the surveyed segments. The channel bed and banks are well armored by boulders. Channels are fairly straight and tightly confined by steep sideslopes.

LOW RESPONSE RATING

Increased discharge may result in flow width and height expansion without bank cutting or channel incision, as bed-forming step-pool grains are essentially static. Textural responses such as bed armoring and coarsening may occur as the smaller sized particles are transported downstream.

Large Woody Debris:
MODERATE RESPONSE RATING

Boulders are the primary roughness elements in these channels, forming an average of 68% of the large pools in the six surveyed segments. However, wood often lodges in with boulders to form steps and plunge pools. LWD along channel margins also creates small pools and traps sediment. The role in pool formation varied widely among the surveyed segments, ranging from creating none of the large pools in segment K1, despite 12 pieces per 100 feet (4 pieces/10 meters), to creating 50% of the large pools in segment K9, where there are 21 pieces per 100 feet (7 pieces/10 meters).

Although LWD is not the primary roughness element, it does help to form steps, which dissipate stream energy, trap sediment and create pools. In some areas, LWD is also significant in creating large pools. A reduction in LWD could lead to loss of sediment storage and an increase in the rate of bedload transport and a reduction in pool volume.

Riparian Vegetation:
HIGH RESPONSE RATING

Streambanks consist primarily of large boulders bound together by tree roots. Riparian vegetation is very important within the inner gorge to help reduce mass wasting and also trap sediment where inner gorge erosion does occur. Riparian vegetation could also be important for dissipating the energy of a dambreak flood initiating within these segments.

Loss of riparian vegetation root strength could be accompanied by accelerated inner gorge erosion and an increase in coarse and fine sediment transported to lower gradient segments downstream.

Catastrophic Damage:
HIGH RESPONSE RATING

The gradient is conducive for initiation and scour of a dambreak flood or debris flow. A dambreak flood may have occurred in segment K1 sometime between 1932 and 1954. Two large debris jams are located near the mouth, and upstream the channel is scoured to bedrock for approximately 300 feet (91 meters). The deposits are visible in the 1954 photos, but not in 1932. There is no evidence of any hillslope mass wasting or debris flows in the 1954 photos, so it is probable that the event initiated within the channel.

Geomorphic Factors Influencing Fish Habitat:

Upstream Migration	Tall boulder steps commonly form vertical drops of 3-4 feet (1.0 - 1.2 meters) in surveyed segments I15, J32 and K9. These may prove a barrier to upstream migration for juvenile trout. In other segments, where channel gradients approach 15 - 20% there are numerous tall boulder steps, cascades, and bedrock waterfalls which impede upstream migration for adult trout.
Spawning and Incubation Habitat	Gravel of 1-3 inches diameter (2 - 8 cm) is deposited in plunge and scour pools and in small patches behind boulders and along channel margins. Much of this is very loose, indicating that it is frequently transported during high flows.
Rearing Habitat	Pool formation is controlled primarily by large boulders in these channels. Channel-spanning boulder clusters create steps which form deep plunge pools. Occasionally, LWD lodges in with boulders to create dammed pools upstream of a step. Between steps, there are also numerous smaller boulder pocket pools.
Overwinter Habitat	There is not any off-channel or undercut bank habitat in these steep channels. Boulder interstices and log jams provide the only sheltered locations during high flows.

High Gradient, Gravel-dominated Tributaries

Includes Segments:	field verified - E3, E13, F7, G6, K4 extrapolated - B6-9, C4, C5, C7-10, C13-15, D5-7, D10, D11, D14-20, D22-24, E4, E6, E8, E10-12, E14-17, F8, F11, F13, F14, F16, G3-5, H12, H13, H17, H18, I1, I4, I5, J6, J8, J15-17, J20, J23, J25, J27, J30, J31, J34, J36, J37, J39, K5, K13
General Description:	This unit includes very small, steep tributaries that are only shallowly incised into granitic hillslopes. Channel gradients are typically 8-15%, but may be as steep as 20%. Sideslopes are moderately steep. Bankfull width in the surveyed segments ranges from 2-6 feet (1 to 2 meters), with width depth ratios of 3-6. These are typically first-order channels that are smaller and typically less incised than the previously described High Gradient Tributaries in V-Shaped Valleys.
Associated Channel Types:	These are step pool and cascade channel types. The channel bed is most often comprised of gravel and sand; with some scattered boulders and occasional boulder cascades.

Conditions and Response Potential:

Coarse Sediment: *MODERATE RESPONSE RATING*	Despite the steep gradient, the substrate is composed primarily of gravel. Pools are very small and shallow. The abrupt shift in substrate size from boulder to sand and small gravel suggests that the granitic parent material rapidly breaks down to sand once it is in the channel. Increased coarse sediment could lead to further fining of the channel bed and increased bedload transport during high flows. Persistent increases in sediment loads could result in pool filling, changes in step pool spacing, and the potential for bank incision. While channel morphology may be re-established during flood events, the effects of bank incision or widening may be more persistent.
Fine Sediment: *LOW RESPONSE RATING*	Shallow deposits of sand are common along margins and behind obstructions, despite the steep gradient. These deposits are likely transported during peak flow events. Increased fine sediment will mostly be transported to lower gradient segments downstream. Some temporary deposition in pools and sheltered locations may occur. However, high flow events will move most of the fine sediment downstream.

Peak Flows:

MODERATE RESPONSE RATING

There is very little bank erosion in the surveyed segments. However, a 4-foot high (1 meter), actively eroding knickpoint was observed in segment E13. The channel bed and banks are comprised of noncohesive material that can be easily eroded by these channels. Furthermore, the headwaters of this basin are fairly young, in geologic terms, and many of these tributaries may have not reached the grade necessary to maintain equilibrium in relation to the valley bottom.

Increased discharge may result in flow width and height expansion without bank cutting or channel incision, as is common in step pool channels. However, a large, persistent increase in discharge could lead to accelerated channel scour and incision.

Large Woody Debris:

HIGH RESPONSE RATING

Boulders are relatively scarce in these channels, and LWD, where present, forms the majority of pools. In segments E3 and E13, where there is 12 to 15 pieces per 100 feet (4-5 pieces/10 meters), LWD formed all of the large pools. In segment K4, where there is 9 pieces per 100 feet (3 pieces/10 meters), LWD formed 38% of the large pools, but small pieces of wood often lodged in with boulders to form the remaining pools. On average for the surveyed segments, LWD forms 81% of the large pools. Due to the small size of the channels, LWD was often bridged and not currently functioning. Smaller boles and branches of 2-4 inches diameter were forming steps and trapping sediment.

A reduction in LWD could lead to loss of sediment storage and an increase in the rate of bedload transport. This could also trigger channel incision into the hillslope. Furthermore, a reduction in LWD would reduce pool depth and frequency.

Riparian Vegetation:

HIGH RESPONSE RATING

Banks consist primarily of noncohesive material bound together by tree roots. Tree roots were even observed to trap sediment and form steps. Loss of riparian vegetation root strength could be accompanied by accelerated channel erosion and incision.

Catastrophic Damage:

HIGH RESPONSE RATING

The gradient is conducive for initiation and scour of a dambreak flood or debris flow. However, this is unlikely in these very small channels which are not deeply incised into the hillslopes. Furthermore, sideslopes are relatively gentle, and not prone to mass wasting. However, a road drainage problem did cause a debris torrent in the head of the channel leading into segment G6. If a debris flow or dambreak flood does occur, the channel would be scoured and enlarged, with deposition occurring where channel gradient is reduced below approximately 10%.

Beaver Ponds and Wetlands

Includes Segments: field verified - K10
extrapolated - J33, K3, K8

General Description: Several wet basins occur in the upper reaches of the West Branch LeClerc Creek, particularly in the Red/White Man and Upper West Branch subbasins. These broad, wet valley bottoms are located on small tributaries and bounded by higher gradient, more confined channels both upstream and downstream. Beavers once constructed a series of dams and ponds in several of these basins. Valley bottom gradient is 1-2%, although short steps of up to 4% do occur.

Associated Channel Types: The stream channel is usually poorly defined due to the dams and ponds. Substrate is primarily silt and sand. The short, flowing sections at the upper and lower end of the valley has an identifiable pool/riffle channel type with sand and small gravel substrate.

Conditions and Response Potential:

Coarse Sediment: There is little coarse sediment in these units. Some exposed gravel occurs where flow is contained within a defined channel at the inlet and outlet. Transport capacity is very low.

HIGH RESPONSE RATING Due to the low transport capacity, if there was any increase in coarse sediment supply, the material would be deposited close to where it enters the unit. Deposited material would fill pools and reduce the depth of water. A large increase in coarse sediment supply could fill the ponds and wetlands.

Fine Sediment: There are deep deposits of sand and muck behind old beaver dams in the surveyed segment. This is a natural depositional area for fine sediment.

MODERATE RESPONSE RATING Similar to the response to coarse sediment, fine sediment would also be deposited only a short distance from where it enters these wet basins. A slight increase in fine sediment would not be detectable, since substrate consists of sand, silt and muck. A very large, persistent increase in fine sediment could fill pools and reduce the depth of water.

Peak Flows: The valley bottom is wide in relation to the size of the upstream channel.

LOW RESPONSE RATING There are numerous ponds and dams which would dampen peak flows, in a similar fashion to a lake.
Increased discharge would likely be spread across the valley bottom, with little effect on the ponds and dams. It is possible that a very large peak flow could overtop and undermine one of the beaver dams, leading to release of stored water and sediment. However, there are a series of dams within the each wet basin, and it is unlikely that they would all fail simultaneously.

Large Woody Debris: LWD is fairly abundant in the surveyed segment. There are numerous standing snags and down trees within the valley bottom. Fallen trees from adjacent sideslopes also reach into the ponds.

LOW RESPONSE RATING While these trees do provide cover, they have no effect on channel morphology, except in the short flowing sections of the inlet and outlets.

Riparian Vegetation: MODERATE RESPONSE RATING — Defined streambanks are located only on the short inlet and outlet sections. Otherwise, the lack of a defined channel precludes development of defined banks or any potential for bank erosion. However, riparian vegetation may help to buffer any sediment moving off the adjacent hillslopes.

Catastrophic Damage: HIGH RESPONSE RATING — The gradient is too low for initiation and scour of a dambreak flood or debris flow. The most likely catastrophic event in these segments is failure of a beaver dam, which would result in release of stored water or sediment. Most likely, the sediment would be trapped in the next pond downstream. Failure of a dam would reduce the amount of ponded area, but may actually result in establishment of a flowing channel with a pool-riffle sequence upstream of the failed dam.

If a debris flow or dambreak flood from a steeper channel upstream entered these segments, sediment and debris would be deposited quickly upon reaching the wet basin. Effects would be as described for fine and coarse sediment, above.

Geomorphic Factors Influencing Fish Habitat:

Upstream Migration — No barriers to migration occur within the beaver ponds and wetlands. There is usually passage around or through a beaver dam during most flow conditions.

Spawning and Incubation Habitat — The beaver ponds and wetlands are composed primarily of sand and silt substrate. At the upper and lower end of segment K10, there is a flowing inlet and outlet which contains abundant small gravel of 0.5 - 2 inches diameter (1 to 5 cm). Small gravel is the dominant substrate within the short, flowing sections of this unit. This gravel is quite stable due to the low stream energy.

Rearing Habitat — Rearing habitat is abundant within the beaver ponds. The ponds are large and deep, with cover provided by fallen trees and overhanging brush along the margins.

Overwinter Habitat — The beaver ponds offer a safe haven during high flows. The broad valley bottoms and large pools dampen peak flows and offer low velocity refuge areas.

Small Tributaries to the Pend Oreille River

Includes Segments:	field verified - L1, L11 extrapolated -L2-10, L12-19
General Description:	This unit includes very small tributaries that are incised into granitic hillslopes draining directly into the Pend Oreille River. Also included are two tributaries that flow into Anderson Lake, which has no outlet but is situated within the Pend Oreille subbasin. The majority of these channels are 8-15% gradient, with a decrease to 2-4% gradient upon exiting the steeper hillslopes and entering the low terrace adjacent to the river. The channels have incised into this terrace to meet the present level of the Pend Oreille River and are, therefore, tightly confined throughout the entire length. Bankfull width in the surveyed segments is less than 3 feet (1 meter). All of these tributaries have ephemeral or intermittent flow regimes. The contribution of these channels to water quality and quantity in the large, dammed Pend Oreille River is negligible.
Associated Channel Types:	These are predominantly step pool channel types. The channel bed is most often comprised of gravel.

Conditions and Response Potential:

Coarse Sediment: HIGH RESPONSE RATING	Despite the steep gradient, the substrate is composed primarily of gravel. Pools are very small and shallow. Bed materials are poorly sorted, indicating infrequent fluvial transport. Despite the steep gradient, transport capacity is relatively low due to the low volume of flow. Increased coarse sediment could lead to fining of the channel bed and decreased channel depth. Persistent increases in sediment loads could result in pool filling, changes in step/pool spacing, and the potential for bank erosion. Large deposits of coarse sediment may extend the duration and extent of subsurface flow.
Fine Sediment: LOW RESPONSE RATING	Shallow deposits of sand were common along margins and behind obstructions, despite the steep gradient. These deposits are likely transported during peak flow events. Increased fine sediment will mostly be transported during peak runoff events. Some temporary deposition in pools and in sheltered locations may occur. However, high flow events will move most of the fine sediment downstream.

Peak Flows:

LOW RESPONSE RATING

There is very little bank erosion in the surveyed segments. Where they exit the hillslopes, the channels have incised into the valley bottom terrace to meet the baselevel of the Pend Oreille River. Active or recent erosion into terrace materials was not observed, and the channels appear to be at grade with the level of the river.

Increased discharge may result in flow width and height expansion without bank cutting or channel incision, as is common in step pool channels. However, a large, persistent increase in discharge could lead to accelerated channel scour and bedload transport. The potential for incision is limited by the baselevel of the Pend Oreille River (and Anderson Lake for segments L17-L19).

Large Woody Debris:

HIGH RESPONSE RATING

Boulders are relatively scarce in these channels, and LWD, where present, forms the majority of pools. In segment L1 there was 12 pieces per 100 feet (4 pieces/10 meters), and it formed all of the large pools. In these small channels, smaller boles and branches 2-4 inches (5-10 cm) diameter, as well as larger pieces of 4-12 inches (5-30 cm) diameter were observed to scour pools, trap sediment and create steps.

A reduction in LWD could lead to loss of sediment storage and an increase in the rate of bedload transport. Reduced LWD could also reduce the depth, size, and frequency of pools.

Riparian Vegetation:

HIGH RESPONSE RATING

Banks are primarily noncohesive material bound together by tree roots. Tree roots were even observed to trap sediment and form steps. In the steeper portions, riparian vegetation is also important for reducing mass wasting within the inner gorge.

Loss of riparian vegetation root strength could be accompanied by accelerated channel bank erosion and increased fine and coarse sediment inputs.

Catastrophic Damage:

HIGH RESPONSE RATING

The gradient is conducive for initiation and scour of a dambreak flood or debris flow in the upper reaches of these tributaries. There is no history of such an event in the historic photo record, however.

If a debris flow or dambreak flood did occur, the channel would be scoured and enlarged, with deposition occurring near the highway crossing where the channel enters the Pend Oreille River terrace.

Geomorphic Factors Influencing Fish Habitat:

Upstream Migration	Due to the ephemeral or intermittent flow regime, fish movement is impeded during later summer and fall in these channels. Furthermore, where gradients approach 10-15%, there are cascades and tall steps which would prove difficult for upstream migration, especially given the shallow depth of flow during most of the year.
Spawning and Incubation Habitat	Despite the steep channel gradient, gravel is abundant in these channels. Most this material is less than 2 inches (5 cm) in diameter, and appears to be quite stable. In the lower gradient sections, the gravel is poorly sorted, indicating infrequent fluvial transport.
Rearing Habitat	Pools tend to be small and shallow. The vast majority of pools are formed by large and small woody debris. Due to the small size of the channels, pieces of wood only 2-4 inches (5-10 cm) diameter appear to function in these channels.
Overwinter Habitat	Overwinter habitat is scarce due to the lack of boulder- and cobble-size material. Large and small woody debris offers some limited refuge during high flows. There is no off-channel or undercut bank habitat in these tributaries

4E.8 Confidence in Work Products

Confidence in the aerial photo assessment is high. The 1932 aerial photos were taken shortly after the period of greatest disturbance from fire and timber harvest. There is a gap of twenty years between the next two photo sets, but the remaining sets were spaced at nearly ten year intervals. A large flood in 1974 was bracketed by photos in 1971/72 and 1979. Coverage for all photos sets was mostly complete for the entire WAU. Gaps in the 1971 photo set were patched in with 1972 photos. Gaps in the 1985 photo set were patched with 1984 photos. Although no major changes in channel width, pattern, or location, were detected, the analyst has considerable experience detecting such changes. The analyst has previously completed the assessment of historic trends for the Tolt, Silver Lake, Alps, and Lester Watershed Analyses, and documented numerous channel changes in those WAUs. However, it should also be noted that assessment of aerial photos provides for detection of fairly major channel width or riparian opening changes. Changes in bed texture, pool spacing, and width and depth adjustments beneath a closed canopy cannot be determined using the aerial photos available.

Confidence in the field surveys is high. Approximately 20 percent of the 184 segments less than 20% gradient were sampled for information specific to channel morphology. Sampling was stratified between the different gradient/confinement classes and geomorphic units.

Confidence in the geomorphic unit groupings, response to changes in inputs, and habitat forming processes is fairly high. The relatively simple and uniform geology of the watershed (glacial deposits overlying granitic parent material) creates a low variability in the geomorphology of fluvial systems within the watershed. Channel conditions are consistent within the different

Figure 5: Written summaries of the general attributes of fish habitat and species use by GMU (WDNR 1997, Section 4F.6.1-10, pp. 4F-3 thru 4F-8)

to gradient, water velocity and lack of a holding pool at its mouth. Brook trout and cutthroat currently occupy reaches upstream of this culvert. Two culverts under the Pend Oreille highway currently prevent upstream migration from the Pend Oreille River into small fish bearing tributaries. These culverts are located in segments L12 and L1. The downstream ends of both culverts are perched high enough above the water surface elevations of the respective tributaries so as to prevent access to fish. Juvenile rainbow trout occur upstream of the culvert in segment L12. These fish have likely migrated downstream from Yokum Lake. Resident brook trout were observed upstream of the culvert barrier in segment L1.

Relative longitudinal species distribution in the LeClerc Creek watershed is generally what would be expected, given the habitat preferences associations of the species in question. Rainbow trout occupy only the lowest reaches of the LeClerc Creek drainage in channel segments exhibiting cobble/boulder substrate, relatively large wetted widths, and many turbulent water habitat units. Brown trout are more widely distributed, occurring from the mouth up into the lower segments of the three major branches. These channel segments generally exhibit wider cross-sectional area and lower gradients with a diversity of substrates. Bull trout have been found only in channel segments C2 and H1. These fish were found as juveniles at very low densities and it is not known if they are members of a resident or fluvial population. It is possible that bull trout were found only in these two channel segments because of selection for cooler water temperatures resulting from plumes of upwelling groundwater immediately upstream (see Riparian and Channel Modules). The association between bull trout and upwelling zones has been documented elsewhere (Goetz 1989). Brook trout and cutthroat trout occur throughout the fish-bearing network in the LeClerc Creek watershed. However, in terms of observed population densities, brook trout tend to far outnumber cutthroat throughout the basin. The ability of brook trout to invade and exploit habitats over a wide range of environmental gradients, normally to the detriment of other species, is widely discussed in fisheries literature (DeStaso and Rahel 1994, Griffith 1972, Lassuy 1995). Moderate populations of cutthroat only occur in limited areas in the watershed. These areas are in the upper reaches of Fourth of July Creek and the higher-gradient segments (> 4%) of tributaries to the West Branch LeClerc upstream of the confluence with Red Man/White Man Creek. It is likely that these segments are the only areas within the drainage where physical habitat attributes may provide a competitive advantage to native cutthroat which allows them to successfully co-exist in the presence of brook trout invasion.

4F.6 Fish Habitat Attributes of Geomorphic Units

Once channel segments were delineated by Channel Module analysts, habitat conditions were assessed by compiling and analyzing all available data. Data were stratified by channel segment and geomorphic unit (GMU) and condensed to generate metrics for assessment as defined by Table F-2 of the fish habitat module methodology (Washington Forest Practice Board 1995).

These metrics are summarized in Table 4F-1. Data collection and assessments were focused on channel segments in the LeClerc WAU that comprise the majority of available fish habitat in the watershed. This section summaries the general attributes of fish habitat and species use in the respective GMUs. GMU definitions are found in the Channel Module.

4F.6.1 Low Gradient, Broad Depositional Valley (GMU 1)

Fish-Bearing Segments: A1, B1, B4, C1, C2, D1, F1, F15, H4, H5

This GMU supports the widest variety of fish species in the WAU. All species and life stages of salmonids found in the watershed occur in these channel segments. Hence, this GMU likely supports all life requisites (spawning and incubation, migration, summer and winter rearing) for all species. Spawning gravel is commonly available in pool tail-outs, on bars and behind obstructions. Spawning gravel quality is questionable, however, due to significant quantities of fine materials accumulated in the gravels. Hence, incubation success is expected to be poor. Rearing habitat is provided by larger substrate (predominantly cobble), wood cover and pools. Pools tend to be formed mostly by wood with bed scour acting as the secondary pool forming mechanisms. When wood is available in sufficient quantities, pools tend to be deeper and more abundant. The availability of rearing habitat is likely limited by the availability of wood to form pools and cover, and by fine sediments filling interstitial spaces between large substrate particles. No barriers to migration exist in this GMU.

4F.6.2 Low Gradient, Narrow Depositional Valley (GMU 2)

Fish-Bearing Segments: B2, H1, H2, J2

This GMU supports all species in the WAU with the exception of rainbow trout. A variety of sizes classes of salmonids occur in these channel segments, suggesting that all life requisites are supported. Spawning gravel is available, found on bars and behind obstructions. Spawning gravel quality is fair in terms of fine sediments but redds of spring spawners are likely vulnerable to scour from high flows. Incubation success is expected to be fair for fall spawners and moderate for spring spawners. Rearing habitat is provided by larger substrate in the form of boulders and cobbles, and scour pools. Pools are formed primarily by boulder accumulations with associated scour. Infrequent log jams also form pools and accumulate spawning gravel. Only large pieces of woody debris tend to function individually to form habitat features. The availability of low energy rearing habitat is limited due to high water velocities in this GMU. Winter rearing is also limited by pool depths but may be accommodated for by readily available interstitial spaces between large boulders. No migration barriers are evident in this GMU.

4F.6.3 Moderate Gradient, V-Shaped Valley (GMU 3)

Fish-Bearing Segments: B3, B5, H6, J1, J3

Fish species found in this GMU are predominantly brook and cutthroat trout, with brown trout also found in segments B3 and B5. Fish sizes found in the GMU are generally greater than three inches long, indicating that this GMU does not support significant and is primarily used as rearing. Spawning gravel is available periodically, primarily associated with log jams. Where gravels accumulate, quality is poor because of fine sediments. Incubation success is expected to be poor. Rearing habitat is provided by larger substrate in the form of boulders and cobbles, and scour pools. Pools are infrequent, but of good depth when available. Several pocket pools associated with boulders were observed. Infrequent log jams and large individual wood pieces also form habitat features. Low primary pool frequency indicates that this GMU provides poor to intermediate rearing. No migration barriers occur in this GMU.

4F.6.4 Low Gradient, Broad Glacial Terrace (GMU 4)

Fish-Bearing Segments: H3

This GMU consists of one unique channel segment in the West Branch LeClerc. It supports various size classes of brown and brook trout, with cutthroat being rare. Spawning gravels are commonly available in riffle units, however the accumulation of fine sediments is very high, suggesting low embryo survival to emergence. Rearing habitat is provided throughout this GMU by pools formed by bedform and primarily by wood. Wood also provides complex cover in pools and glides. This segment may be particularly important to brown trout for rearing as indicated by the high densities of juvenile fish encountered. Even though pools and other low-energy habitats are commonly available, winter rearing may be compromised by the fine grained nature and embeddedness of the substrate. Wood found in this segment created habitat by functioning individually and in jams and was in a very advanced state of decay. Large woody debris available for near-term recruitment is non-existent. Old beaver dams in the upper portion of this segment may function as impediments to migration but do not constitute barriers. Local personnel observed that flow in a portion of this segment goes subsurface periodically during dry years.

4F.6.5 Low Gradient Tributaries Within Alluvial Valleys (GMU 5)

Fish-Bearing Segments: D3, D13, F2, F3, F5, F6, F10, G1

This GMU supports high to moderate densities of brook trout and low densities of cutthroat trout. All size classes were encountered, suggesting all life requisites are supported. Spawning gravel is infrequently available in this GMU. Small patches do occur in pool tailouts and in accumulation behind woody debris obstructions. Sand is commonly mixed with gravel in these areas and embryo survival is likely diminished. Rearing habitat is provided by scour and dam pools formed by woody debris of all sizes. When wood is available in sufficient quantities, pools tend to be deeper and more abundant. The availability of rearing habitat is likely limited by the availability of wood to form pools and cover, and by course and fine sediments filling pools, reducing residual depths. Winter rearing is limited by shallow pool depths and the lack of large substrate particles. No passage barriers to migration were observed in the fish- bearing segments of this GMU.

4F.6.6 Moderate Gradient Tributaries Within Fluvial Basins (GMU 6)

Fish-Bearing Segments: D2, D4, D8, E2, F4, F9, J5, J10, J18, J19, J21, J29, J35

This GMU supports moderate densities of brook trout and moderate to high densities of cutthroat trout. Segment E2 is the only channel segment within the WAU found to exclusively contain cutthroat trout. All size classes of both species were observed in this GMU, indicating all life requisites are supported. Spawning gravel is commonly available in this GMU, primarily in pool tailouts and behind boulder obstructions. Spawning habitat quality is compromised by significant accumulations of fine sediments intermingled with gravels. Rearing habitat is provided by scour pools formed primarily by woody debris but also by boulders. When sufficient wood is available, pools tend to be deeper and more abundant. The availability of rearing habitat is likely limited by the availability of wood to form numerous pools with sufficient depth. The dominant substrate in this GMU is cobble generally embedded by sand. High quality winter rearing habitat is generally limited in channels, except in those segments that contain complexes of old beaver-ponds that provide good winter rearing habitat. In general, fish passage in this GMU is of no concern. However, a culvert in segment J29 and a bedrock falls in the upper end of segment D4 preclude upstream fish passage. Segments in this GMU are likely critical to support the remaining cutthroat population in the LeClerc WAU.

4F.6.7 High Gradient, Boulder-Dominated Tributaries (GMU 7)

Fish-Bearing Segments: C11, E1, J4, J9, J11, J28, J32, K1, K2, K7, K9, K14, K15

This GMU supports relatively low densities of brook trout and low to moderate densities of cutthroat trout. Generally fish greater than three inches are found in this GMU, suggesting spawning and rearing by young-of-the-year is limited. Spawning gravel is rare and only found in small accumulations behind boulders and in the bottoms of pools. Fine sediment is of low concern, but gravel accumulation are vulnerable to scour. Rearing habitat is provided by infrequent scour pools formed primarily by boulders and rarely by woody debris. The dominant substrate is commonly boulders and cobble . Low-energy rearing habitat is limited in this GMU due to high gradients. Winter rearing is compromised since pools are infrequent and shallow and off-channel habitat is missing. Interstitial spaces between boulders provide some winter rearing. Upstream passage in this GMU is difficult for smaller resident trout because of high gradients and several boulder cascades throughout channel segments. This is another GMU that is likely critical for cutthroat trout since it provides habitat conditions (i.e. gradient and velocity) that select against brook trout occupancy.

4F.6.8 High Gradient, Gravel-Dominated Tributaries (GMU 8)

Fish-Bearing Segments: C10, D7, D15, F7

Channel segments within this GMU are generally too steep (>16%) and/or too small (< 1 m channel width) to support fish. Fish-bearing channel segments contain brook trout and cutthroat trout at low densities. Deposits of small gravel are common in this GMU. However, areas where patches of gravel tend to occur also accumulate sand which likely results in low quality spawning habitat. Rearing habitat in this GMU is provided by shallow plunge pools formed by wood. Pools are formed almost exclusively by wood and only rarely by boulders and rock outcrops. Winter rearing is very limited because of the fine-grained substrate and lack of deep pools. Fish passage in this GMU is limiting because of steep gradients, bedrock outcrops, and low flows.

4F.6.9 Beaver Ponds and Wetlands (GMU 9)

Fish-Bearing Segments: J33, K3, K8, K10

The low-energy segments in this GMU support moderate to low densities of brook trout and low densities of cutthroat trout. Spawning habitat is very limited due to significant accumulations of fine sediment throughout the channel segments. Small patches of gravel are exposed at pond inlets and/or outlets but high concentrations of fine sediments diminish habitat quality. Frequent, deep beaver ponds provide abundant summer and winter rearing habitat. Fish passage is not likely to be restricted in this GMU.

4F.6.10 Small Tributaries To The Pend Oreille River (GMU 10)

Fish-Bearing Segments: L1, L2, L12, L13

Channel segments within this GMU are generally too steep (>16%) and/or too small (< 1 m channel width) to support fish. Fish were detected in two tributaries, however. Adult brook trout were found in segment L1 and the lower portion of segment L2 and juvenile rainbow trout were found in segments L12 and L13. As stated earlier, it is likely that brook trout were planted in the tributary containing segments L1 and L2 and the juvenile rainbow trout in segments L12 and L13 probably migrated downstream from the population in Yokum Lake. Spawning gravels are available in segments within this GMU and occur in the tailouts and bottoms of small pools. In terms of rearing habitat, almost all pools are formed by wood of various sizes and are generally shallow. Field evaluation by the analyst indicates that winter rearing is available in segment L1, but pools in the other segments are too shallow (< 0.3 m residual depth) to provide effective depth for winter rearing. Substrate conducive to winter rearing does not exist. Upstream migration from the Pend Oreille River into both of these tributaries is prevented due to perched culverts under the highway. Upstream migration within this GMU is prevented in segment L13 impeded in segment L2 due to the presence of many cascades and small waterfalls. Additionally, segment L13 was found to go intermittent in the summer of 1996.

4F.7 Fish Habitat Condition

Habitat metrics (Table 4F-1) and field observations were evaluated via the criteria in Table 4F-2 of the methodology (Washington Forest Practice Board 1995) to generate habitat condition calls for life phases by channel segment and GMU. Table 4F-2 summarizes habitat condition calls for channel segments and GMUs. Analysts used the condition calls, field evaluation, and knowledge of species distribution to designate the channel segments' relative importance for life phases of salmonid species found in the LeClerc Creek WAU. Important channel segments were rated as primary or secondary habitat for life phases. A rating of primary for any channel segments indicates that this segment is considered critical in providing the specific habitat element(s) necessary for the continued success of the given species. A rating of secondary indicates that the channel segments are currently utilized by the given species for the specific life phase to a moderate extent and that these segments, while still important to the respective populations, are not of the habitat quality of "primary" segments and exhibit less potential for fish production.

4F.7.1 Spawning and Incubation Habitat

Spawning habitat is evaluated by assessment of the quantity, quality, and likely stability of the gravels during the season that embryos are expected to be in the redd environment. Generally, spring spawning species (rainbow trout, cutthroat trout) are vulnerable to redd scour during high flow and fall spawning species (brown trout, brook trout, bull trout) are vulnerable to the accumulation of fine sediments in the redd environment. Bull trout redds are also vulnerable to winter scour events. Using these diagnostics as prescribed by the manual resulted in habitat condition calls of either poor or fair for all channel segments evaluated. Spawning gravels throughout the LeClerc WAU tend to exhibit high levels of fine sediment, especially sand. Where gravels were found to be relatively free of fine sediment, they we generally considered to be vulnerable to redd scour.

Figure 6: Habitat conditions rating for life stages by channel segment according to the Washington Forest Practices Board habitat rating criteria (Washington Forest Practices Board 1997) and habitat attribute type (WDNR 1997, Table 4F-2, pp. 4F-17 thru 4F-19

Table 4F-2. Habitat condition calls by channel segment.

	Segment Number									
	F15	B1	H4	C1	B4	D1	C2	F1	H5	A1
Summer/Winter Rearing										
Percent Pool	Poor	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Pool Frequency	Poor	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Debris Pieces/Channel Width	Poor	Poor	Good	Poor	Fair	N/A	Poor	Poor	Poor	Poor
% Wood Cover in Pools	Poor	Poor	Fair	Poor	Fair	N/A	Poor	Poor	Poor	Good
Habitat Condition Call	*Poor*	*Poor*	*Fair*	*Poor*	*Poor/Fair*	*Poor*	*Poor*	*Poor*	*Poor*	*Fair*
Winter Rearing										
Substrate	Poor	Fair	Good	Poor	Poor	Poor	Poor	Poor	Good	Good
Off - Channel	Poor	Poor	Fair	Poor	Poor	Poor	Fair	Poor	Poor	Poor
Habitat Condition Call	*Poor*	*Poor/Fair*	*Fair*	*Poor*	*Poor*	*Poor*	*Poor/Fair*	*Poor*	*Fair*	*Fair*
Upstream Adult Migration										
Holding Pools	Poor	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Access to Spawning	Fair	Good	Fair	Good	Fair	Fair	Good	Fair	Fair	Poor
Habitat Condition Call	*Poor/Fair*	*Fair*	*Fair*	*Fair*	*Poor/Fair*	*Poor/Fair*	*Fair*	*Poor/Fair*	*Fair*	*Fair*
Spawning and Incubation										
Gravel Quality	Poor	Poor	Fair	Poor	Poor	Poor	Fair	Poor	Fair	Fair
Fines in Gravel	Poor	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Fair	Fair
Redd Scour	Poor	Fair	Fair	Fair	Poor	N/A	Fair	Fair	Fair	Poor
Gravel Quantity	Poor	Fair	Poor	Fair	Poor	Fair	Fair	Poor	Fair	Fair
Habitat Condition Call	*Poor*	*Poor/Fair*	*Fair*	*Poor/Fair*	*Poor*	*Poor*	*Fair*	*Poor*	*Fair*	*Fair*

	Segment Number									
	GMU 1	B2	H1	J2	GMU 2	H8	J1	J3	B5	GMU 3
Summer/Winter Rearing										
Percent Pool	Poor	Poor	Poor	Poor	Poor	Poor.	Poor	Poor	Poor	Poor
Pool Frequency	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Debris Pieces/Channel Width	Poor	Poor	Fair	Fair	Poor/Fair	Poor	Poor	Poor	Poor	Poor
% Wood Cover in Pools	Poor	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Habitat Condition Call	*Poor*	*Poor*	*Poor/Fair*	*Poor*	*Poor*	*Poor*	*Poor*	*Poor*	*Poor*	*Poor*
Winter Rearing										
Substrate	Poor/Fair	Fair	Fair	Fair	Fair	Good	Poor	Fair	Fair	Fair
Off - Channel	Poor	Fair	Fair	Poor	Fair	Poor	Poor	Poor	Poor	Poor
Habitat Condition Call	*Poor*	*Fair*	*Fair*	*Poor/Fair*	*Fair*	*Fair*	*Poor*	*Poor/Fair*	*Poor/Fair*	*Poor/Fair*
Upstream Adult Migration										
Holding Pools	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor
Access to Spawning	Fair/Good	Fair	Good	Poor	Fair	Fair	Fair	Fair	Good	Fair
Habitat Condition Call	*Fair*	*Poor/Fair*	*Fair*	*Poor*	*Fair*	*Poor/Fair*	*Poor/Fair*	*Poor/Fair*	*Fair*	*Poor/Fair*
Spawning and Incubation										
Gravel Quality	Poor/Fair	Poor	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Poor
Fines in Gravel	Poor	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Poor
Redd Scour	Poor/Fair	Fair	Poor	Poor	Poor	Poor	Poor	Poor	Fair	Poor
Gravel Quantity	Poor/Fair	Poor	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor/Fair
Habitat Condition Call	*Poor/Fair*	*Poor/Fair*	*Fair*	*Fair*	*Fair*	*Poor*	*Poor*	*Poor/Fair*	*Poor/Fair*	*Poor*

Table 4F-2. Habitat condition calls by channel segment (continued).

	Segment Number									
	H3	GMU 4	F3	D13	I2	D3	G1	F2	GMU 5	K8
Summer/Winter Rearing										
Percent Pool	Poor	Poor	Poor	Poor	Good	Poor	Poor/Fair	Poor	Poor	Poor
Pool Frequency	Poor	Poor	Poor	Poor	Fair	Poor	Poor/Fair	Poor	Poor	Poor
Debris Pieces/Channel Width	Good	Good	Poor	Fair	Poor	Fair	Fair	Fair	Poor/Fair	Fair
% Wood Cover in Pools	Good	Good	Poor	Poor	Good	N/A	Fair/Good	Poor	Poor/Fair	N/A
Habitat Condition Call	*Fair*	*Fair*	*Poor*	*Poor*	*Fair*	*Poor*	*Fair*	*Poor*	*Poor/Fair*	*Poor*
Winter Rearing										
Substrate	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Fair
Off - Channel	Fair	Fair	Poor	Fair	Poor	Poor	Poor	Poor	Poor	Poor
Habitat Condition Call	*Poor/Fair*	*Poor/Fair*	*Poor*	*Poor/Fair*	*Poor*	*Poor/Fair*	*Poor*	*Poor*	*Poor*	*Poor/Fair*
Upstream Adult Migration										
Holding Pools	Fair	Fair	Poor	Poor	Good	Poor	Poor	Poor	Poor	Poor
Access to Spawning	Poor	Poor	Fair	Poor	Poor	Fair	Fair	Fair	Fair	Fair
Habitat Condition Call	*Poor/Fair*	*Poor/Fair*	*Poor/Fair*	*Poor*	*Fair*	*Poor/Fair*	*Poor/Fair*	*Poor/Fair*	*Poor/Fair*	*Poor/Fair*
Spawning and Incubation										
Gravel Quality	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Poor
Fines in Gravel	Poor	Poor	Poor	Poor	Poor	N/A	Poor	Poor	Poor	Poor
Redd Scour	Poor	Poor	Poor	Poor	Fair	N/A	Fair	Fair	Poor/Fair	Poor
Gravel Quantity	Poor	Poor	Poor	Poor	Fair	Poor	Fair	Poor	Poor/Fair	Poor
Habitat Condition Call	*Poor*	*Poor*	*Poor*	*Poor*	*Poor/Fair*	*Poor*	*Poor/Fair*	*Poor*	*Poor*	*Poor*

	Segment Number									
	D8	E2	J10	J5	D2	D4	F4	GMU 6	J4	K14
Summer/Winter Rearing										
Percent Pool	Poor	Poor	Poor	Good	Poor	Poor	Poor	Poor	Poor	Poor
Pool Frequency	Poor	Poor	N/A	Poor	Poor	Poor/Fair	Poor	Poor	Poor	Poor
Debris Pieces/Channel Width	Poor	Fair	N/A	Poor	Fair	Fair	Poor	Poor/Fair	Poor	Fair
% Wood Cover in Pools	Good	N/A	N/A	Poor	N/A	N/A	Poor	Poor/Fair	Poor	N/A
Habitat Condition Call	*Poor/Fair*	*Poor*	*Poor*	*Poor/Fair*	*Poor*	*Poor/Fair*	*Poor*	*Poor*	*Poor*	*Poor*
Winter Rearing										
Substrate	Poor	Poor	Fair	Fair	N/A	Poor	Poor	Poor	Fair	Fair
Off - Channel	Poor	N/A	Poor	Fair	N/A	N/A	Poor	Poor	Poor	N/A
Habitat Condition Call	*Poor*	*Poor*	*Poor/Fair*	*Fair*	*N/A*	*Poor*	*Poor*	*Poor*	*Poor*	*Fair*
Upstream Adult Migration										
Holding Pools	Poor	Poor	Fair	Good	N/A	Poor/Fair	Poor	Poor/Fair	Poor	Poor
Access to Spawning	Fair	N/A	Fair	Fair	N/A	N/A	Fair	Fair	Fair	N/A
Habitat Condition Call	*Poor/Fair*	*Poor*	*Fair*	*Fair/Good*	*N/A*	*Poor/Fair*	*Poor/Fair*	*Fair*	*Poor*	*Poor*
Spawning and Incubation										
Gravel Quality	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Poor/Fair	Poor	Poor
Fines in Gravel	Poor	Poor	Fair	Poor	N/A	N/A	Poor	Poor	Poor	Poor
Redd Scour	Fair	N/A	N/A	Fair	N/A	N/A	Poor	Poor/Fair	Poor	N/A
Gravel Quantity	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Poor/Fair	Poor	Poor
Habitat Condition Call	*Poor/Fair*	*Fair*	*Fair*	*Fair*	*Poor*	*Poor*	*Poor*	*Poor/Fair*	*Poor*	*Poor*

Table 4F-2. Habitat condition calls by channel segment (continued).

	Segment Number					
	E1	K1	J9	GMU 7	K10	GMU 9
Summer/Winter Rearing						
Percent Pool	Poor	Poor	Poor	Poor	Good	Good
Pool Frequency	Poor	Poor	Poor	Poor	Fair	Fair
Debris Pieces/Channel Width	Good	Fair	Fair/Good	Fair	Good	Good
% Wood Cover in Pools	N/A	N/A	N/A	Poor	Fair	Fair
Habitat Condition Call	*Poor*	*Poor*	*Poor/Fair*	*Poor*	*Fair/Good*	*Fair/Good*
Winter Rearing						
Substrate	Fair	Fair	Poor	Fair	Poor	Poor
Off - Channel	N/A	N/A	N/A	N/A	Good	Good
Habitat Condition Call	*Fair*	*Fair*	*Poor*	*Poor/Fair*	*Fair*	*Fair*
Upstream Adult Migration						
Holding Pools	Poor	Poor	Poor	Poor	Good	Good
Access to Spawning	Fair	N/A	N/A	Fair	Poor	Poor
Habitat Condition Call	*Poor/Fair*	*Poor*	*Poor*	*Poor/Fair*	*Fair*	*Fair*
Spawning and Incubation						
Gravel Quality	Poor	Poor	Poor	Poor	Poor	Poor
Fines in Gravel	Poor	Poor	Poor	Poor	Poor	Poor
Redd Scour	N/A	N/A	N/A	N/A	Fair	Fair
Gravel Quantity	Poor	Poor	Fair	Poor	Fair	Fair
Habitat Condition Call	*Poor*	*Poor*	*Poor*	*Poor*	*Poor/Fair*	*Poor/Fair*

Figure 7: Written text evaluating channel segments relative benefit by life history stage (WDNR 1997, Section 4F.7.1-3, pg. 4F-8 thru 4F-10)

tributary containing segments L1 and L2 and the juvenile rainbow trout in segments L12 and L13 probably migrated downstream from the population in Yokum Lake. Spawning gravels are available in segments within this GMU and occur in the tailouts and bottoms of small pools. In terms of rearing habitat, almost all pools are formed by wood of various sizes and are generally shallow. Field evaluation by the analyst indicates that winter rearing is available in segment L1, but pools in the other segments are too shallow (< 0.3 m residual depth) to provide effective depth for winter rearing. Substrate conducive to winter rearing does not exist. Upstream migration from the Pend Oreille River into both of these tributaries is prevented due to perched culverts under the highway. Upstream migration within this GMU is prevented in segment L13 impeded in segment L2 due to the presence of many cascades and small waterfalls. Additionally, segment L13 was found to go intermittent in the summer of 1996.

4F.7 Fish Habitat Condition

Habitat metrics (Table 4F-1) and field observations were evaluated via the criteria in Table 4F-2 of the methodology (Washington Forest Practice Board 1995) to generate habitat condition calls for life phases by channel segment and GMU. Table 4F-2 summarizes habitat condition calls for channel segments and GMUs. Analysts used the condition calls, field evaluation, and knowledge of species distribution to designate the channel segments' relative importance for life phases of salmonid species found in the LeClerc Creek WAU. Important channel segments were rated as primary or secondary habitat for life phases. A rating of primary for any channel segments indicates that this segment is considered critical in providing the specific habitat element(s) necessary for the continued success of the given species. A rating of secondary indicates that the channel segments are currently utilized by the given species for the specific life phase to a moderate extent and that these segments, while still important to the respective populations, are not of the habitat quality of "primary" segments and exhibit less potential for fish production.

4F.7.1 Spawning and Incubation Habitat

Spawning habitat is evaluated by assessment of the quantity, quality, and likely stability of the gravels during the season that embryos are expected to be in the redd environment. Generally, spring spawning species (rainbow trout, cutthroat trout) are vulnerable to redd scour during high flow and fall spawning species (brown trout, brook trout, bull trout) are vulnerable to the accumulation of fine sediments in the redd environment. Bull trout redds are also vulnerable to winter scour events. Using these diagnostics as prescribed by the manual resulted in habitat condition calls of either poor or fair for all channel segments evaluated. Spawning gravels throughout the LeClerc WAU tend to exhibit high levels of fine sediment, especially sand. Where gravels were found to be relatively free of fine sediment, they we generally considered to be vulnerable to redd scour.

Through utilization of available data and field reconnaissance, analysts rated spawning habitats based on perceived importance to salmonid species. Fish distribution, spawning habitat availability, and spawning habitat quality were evaluated to designate channel segments as primary, or secondary spawning habitat. For rainbow trout, the following channel segments were deemed important: Primary Spawning - Segment B1; Secondary Spawning - Segment A1. For brown trout: Primary Spawning - Segments H1, B1; Secondary Spawning - Segments A1, B2. For bull trout - Primary Spawning - Segments C2, H2; Secondary Spawning - Segment H1. For cutthroat trout - Primary Spawning - Segments E2, J10, J5; Secondary Spawning - D4, B4, H6, E1. For brook trout - Primary Spawning - Segments F2, F3, D13, H5: Secondary Spawning - H6, J29, G1, C2, J3.

4F.7.2 Summer/Winter Rearing Habitat

Diagnostic analysis for summer/winter rearing habitat is primarily based on two factors, pool frequency and the amount of in-channel large woody debris. Using these diagnostics as prescribed resulted in habitat condition calls of either poor or fair for all channel segments evaluated, most being rated as poor. The LeClerc Creek WAU generally exhibits a paucity of in-channel wood, especially in low gradient (< 4%) channel segments where wood is critical for the formation of pools and complex cover. Those channel segments within virtually all GMUs exhibiting close to sufficient quantities of wood tended to support the highest densities of fish.

Another issue that needs to be considered in terms of summer rearing habitat is that of water temperature. The effect of shade on maintaining water temperatures is discussed in the Riparian Module. Findings by the riparian module analysts suggest that temperatures in many of the lower-elevation channel segments approach or exceed tolerance limits for some species. Optimum temperature ranges for rainbow trout and cutthroat trout are 12.2-18.8° C and 9.4-12.8° C, respectively (Bell 1991). Bull trout exhibit even lower optimal ranges (Goetz 1989). Conversely, brown trout and brook trout exhibit tolerances for higher water temperatures (Bell 1991). This response to temperature may provide a partial explanation of fish distribution patterns in the WAU. Cutthroat trout are generally at highest densities in the higher elevation, cooler stream segments and the two segments where bull trout have been found are immediately downstream of areas where significant groundwater upwelling is suspected.

Available data and field reconnaissance were used to rate rearing habitats based on perceived importance to salmonid species. Fish distribution, rearing habitat availability, and rearing habitat quality were evaluated to designate channel segments as primary, or secondary rearing habitat. For rainbow trout, the following channel segments were deemed important: Primary Rearing - Segment A1; Secondary Rearing - Segment B1. For brown trout: Primary Rearing - Segments H3, B4, A1; Secondary Rearing - Segments H1, B3, C1. For bull trout - Primary Rearing - Segments C2, H1; Secondary Rearing - Segment H2, A1. For cutthroat trout - Primary Rearing -

Segments E2, J10, J5, J9, D8, K2; Secondary Rearing - D4, B4, J2, E1, J3, J18, J35. For brook trout - Primary Rearing - Segments C2, H3, H4, B4, D2, H5, F3, D13, G1, F5 : Secondary Rearing - D3, F2, F5, F6, D4, F4, H6, J3, F1, J10, C1.

4F.7.3 Winter Rearing Habitat

Winter rearing habitat is evaluated for channel segments by assessing the quality and availability of two major components utilized by salmonid species during low flow, cold water periods. Several studies have noted winter concentrations of juvenile salmonids in side channel habitats and in stream reaches with significant amounts of large substrate. Side channels are commonly influenced by springs that allow them to remain ice-free. Large substrate provides interstitial spaces that allow fish to avoid anchor ice and to minimize energy expenditures. Even though not required by watershed analysis diagnostics, analysts also considered the availability of large, deep pools and the degree of substrate embeddedness. As with other habitat elements, winter rearing habitats are categorized by channel segment within the general context of geomorphic features exhibited in the LeClerc Creek WAU.

All channel segments that were evaluated for winter rearing habitat were rated as poor or fair. Most channel types in the WAU lack off-channel rearing features. This is probably due to the incised nature of these channels. Deep pools are infrequent in most segments encountered and the high supply of sand throughout the watershed generally results in filling of interstitial spaces between large substrate particles. The highest quality winter rearing habitat in the WAU is provided by channel segments containing complexes of old beaver-ponds. These areas exhibit the highest frequency of deep pools available in the watershed. Even though substrate is generally of fine materials, water velocities are low, resulting in minimal energy expenditures for fish during the winter months.

Available data and field reconnaissance were used to rate winter rearing habitats based on perceived importance to salmonid species. Fish distribution, habitat availability, and habitat quality were evaluated to designate channel segments as primary, or secondary winter rearing habitat. For rainbow trout, the following channel segments were deemed important: Primary Winter Rearing - Segment A1; Secondary Winter Rearing - Segment B1. For brown trout: Primary Winter Rearing - Segments H3, H1, A1; Secondary Winter Rearing - Segments B2, B1, B5. For bull trout - Primary Winter Rearing - Segments C2, H1; Secondary Winter Rearing - Segment H2, A1. For cutthroat trout - Primary Winter Rearing - Segments E1, J33, K10, J33, J35, J5, J19; Secondary Winter Rearing - K4, K8, J29, K3, J10. For brook trout - Primary Winter Rearing - Segments H3, J29, K8, H4, J5, K10, H5, B2, H6; Secondary Winter Rearing - B1, C2, H1, J2, J3, B5, D13, D3, K1, F15.

Figure 8: Habitat condition rating criteria in the WDNR Watershed Analysis (WDNR 1997, Table F-2, pg. F-24,25).

Table F-2: Indices of resource condition for interpretation of field survey results and habitat analysis.

Note: these indices may be applied to channel types not indicated in the table but with a lower degree of confidence. Also, these are not the only parameters that can be used to describe the condition of habitat in a reach. Other indices or habitat descriptions can be used when they are clearly documented.

Habitat Parameter	Channel Type	Life Phase Influenced	Habitat Quality		
			Poor	Fair	Good
Percent Pool	< 2%; < 15 m wide	Summer/winter rearing habitat	< 40%	40 thru 55%	>55%
	2-5%; < 15 m wide	Summer/winter rearing habitat	<30%	30 thru 40%	>40%
	> 5%; < 15 m wide	Summer/winter rearing habitat	< 20 %	20 thru 30%	>30%
Pool Frequency	< 2%; < 15 m wide	Summer/winter rearing habitat	> 4 channel widths per pool	2 - 4 channel widths per pool	< 2 channel widths per pool
	2-5%; < 15 m wide	Summer/winter rearing habitat	> 4 channel widths per pool	2 - 4 channel widths per pool	< 2 channel widths per pool
	> 5%; < 15 m wide	Summer/winter rearing habitat	> 4 channel widths per pool	2 - 4 channel widths per pool	< 2 channel widths per pool
Debris pieces / channel width * (> 10 cm diam. x 2m length)	< 20 m wide	Summer/winter rearing habitat	< 1	1 thru 2	> 2
Key pieces / channel width (for Western Washington only)	BFW < 10 m	Summer/winter rearing habitat	< .15	.15 thru .30	> .30
	BFW 10 - 20 m	Summer/winter rearing habitat	< .20	.20 thru .50	> .50
% wood cover in pools	< 2%; < 15 m wide	Summer/winter rearing habitat	Most pools in low category	Most pools in moderate category	Most pools in high category
	2-5%; < 15 m wide	Summer/winter rearing habitat	Most pools in low category 0-5%	Most pools in moderate category 6-20%	Most pools in high category > 20%
Substrate	all	Winter rearing habitat	Sand or small gravel is sub-dominant in boulder or cobble dominant units (i.e. interstices filled)	Sand is sub-dominant in some units with cobble or boulder dominant (interstices reduced)	Sand or small gravel is rarely sub-dominant in any unit (interstices clean)

Table F-2: Continued

Habitat Parameter	Channel Type	Life Phase Influenced	Habitat Quality		
			Poor	Fair	Good
Off-channel	< 3%, all widths	Winter rearing habitat, especially coho salmon	Few or no backwaters, no off-channel ponds	Some backwaters and high energy side-channels	Backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.)
Holding Pools	all types	Upstream Adult Migration	Few pools/km (> 1 m deep with good cover, cool)		Sufficient pools / km (> 1 m deep with good cover, cool)
Access to Spawning Areas	all types	Upstream Adult Migration	Access blocked by low water, culvert, falls, temperature, etc.		No blockages
Gravel Quality	all types	Spawning and Incubation	Absent or infrequent		Frequent spawnable areas
Fines in Gravel	all types	Spawning and Incubation	> 17% (< 0.85 mm)	12 - 17% (< 0.85 mm)	< 12 % (< 0.85 mm)
Gravel Quality	all types	Spawning and Incubation	Sand is dominant substrate in some units	Sand is sub-dominant substrate in some units	Sand is never dominant or sub-dominant
Redd Scour	all types	Spawning and Incubation	Evidence and/or potential for extensive redd scour	Some scour evidence, or may have potential for scour	Relatively stable, low potential for scour