Coeur d'Alene Tribe Fisheries Program

Implementation of Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation

2003 ANNUAL REPORT

Coeur d'Alene Tribe Department of Natural Resources
Fisheries Program
401 Anne Antelope Road
Plummer, ID 83851-0408

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INTRODUCTION

BACKGROUND

Historically, the Coeur d'Alene Indian Tribe depended on runs of anadromous salmon and steelhead along the Spokane River and Hangman Creek, as well as resident and adfluvial forms of trout and char in Coeur d'Alene Lake, for survival. Dams constructed in the early 1900s on the Spokane River in the City of Spokane and at Little Falls (further downstream) were the first dams that initially cut-off the anadromous fish runs from the Coeur d'Alene Tribe. These fisheries were further removed following the construction of Chief Joseph and Grand Coulee Dams on the Columbia River. Together, these actions forced the Tribe to rely solely on the resident fish resources of Coeur d'Alene Lake for their subsistence needs.

The Coeur d'Alene Tribe is estimated to have historically harvested around 42,000 westslope cutthroat trout (*Oncorhynchus clarki*) per year (Scholz et al. 1985). In 1967, Mallet (1969) reported that 3,329 cutthroat trout were harvested from the St. Joe River, and a catch of 887 was reported from Coeur d'Alene Lake. This catch is far less than the 42,000 fish per year the tribe harvested historically. Today, only limited opportunities exist to harvest cutthroat trout in the Coeur d'Alene Basin.

The declines in native salmonid fish populations, particularly cutthroat and bull trout (*Salvelinus confluentus*), in the Coeur d'Alene basin have been the focus of study by the Coeur d'Alene Tribe's Fisheries and Water Resources programs since 1990. It appears that there are a number of factors contributing to the decline of resident salmonid stocks within Coeur d'Alene Lake and its low elevation tributaries (Ellis 1932; Oien 1957; Mallet 1969; Scholz et. al. 1985, Lillengreen et. al. 1993). These factors include: construction of Post Falls Dam in 1906; major changes in land cover types, agricultural activities and introduction of exotic fish species.

In 1994, the Northwest Power Planning Council adopted the recommendations set forth by the Coeur d'Alene Tribe to improve the Reservation fishery (NWPPC Program Measures 10.8B.20). These recommended actions included: 1) Implement habitat restoration and enhancement measures in Alder, Benewah, Evans, and Lake Creeks; 2) Purchase critical watershed areas for protection of fisheries habitat; 3) Conduct an educational/outreach program for the general public within the Coeur d'Alene Reservation to facilitate a "holistic" watershed protection process; 4) Develop an interim fishery for tribal and non-tribal members of the reservation through construction, operation and maintenance of five trout ponds; 5) Design, construct, operate and maintain a trout production facility; and 6) Implement a five-year monitoring program to evaluate the effectiveness of the hatchery and habitat improvement projects.

Since that time, much of the mitigation activities occurring within the Coeur d'Alene sub-basin have had a connection to the project entitled "Implement of Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation", which is sponsored and implemented by the Coeur d'Alene Tribe Fisheries Program and is the subject of this report. These activities provide partial mitigation for the extirpation of anadromous fish resources from usual and accustomed harvest areas and Reservation lands.

STUDY AREA

The study area addressed by this report consists of the southern portion of Coeur d'Alene Lake and four 3^{rd} – 4^{th} order tributaries which feed the lake (see *Figure 1*). These areas are part of the larger Coeur d'Alene sub-basin, which lies in three northern Idaho counties Shoshone, Kootenai and Benewah. The basin is approximately 9,946 square kilometers and extends from the Coeur d'Alene Lake upstream to the Bitterroot Divide along the Idaho-Montana border. Elevations range from 646 meters at the lake to over 2,130 meters along the divide. This area formed the heart of the Coeur d'Alene Tribe's aboriginal territory, and a portion of the sub-basin lies within the current boundaries of the Coeur d'Alene Indian Reservation.

Coeur d'Alene Lake is the principle waterbody in the sub-basin. The lake is the second largest in Idaho and is located in the northern panhandle section of the state. The lake lies in a naturally dammed river valley with the outflow currently controlled by Post Falls Dam. The lake covers 129 square kilometers at full pool with a mean depth of 22 meters and a maximum depth of 63.7 meters.

The four tributaries currently targeted by the Tribe for restoration are located almost exclusively on the Reservation (*Figure 1*) and have a combined basin area of 34,853 hectares and include 529 kilometers of intermittent and perennial stream channels. The climate and hydrology of the target watersheds are similar in that they are influenced by the maritime air masses from the pacific coast, which are modified by continental air masses from Canada. Summers are mild and relatively dry, while fall, winter, and spring brings abundant moisture in the form of both rain and snow. A seasonal snowpack generally covers the landscape at elevations above 1,372 meters from late November to May. Snowpack between elevations of 915 and 1,372 meters falls within the "rain-on-snow zone" and may accumulate and deplete several times during a given winter due to mild storms (US Forest Service 1998). The precipitation that often accompanies these mild storms is added directly to the runoff, since the soils are either saturated or frozen, causing significant flooding.

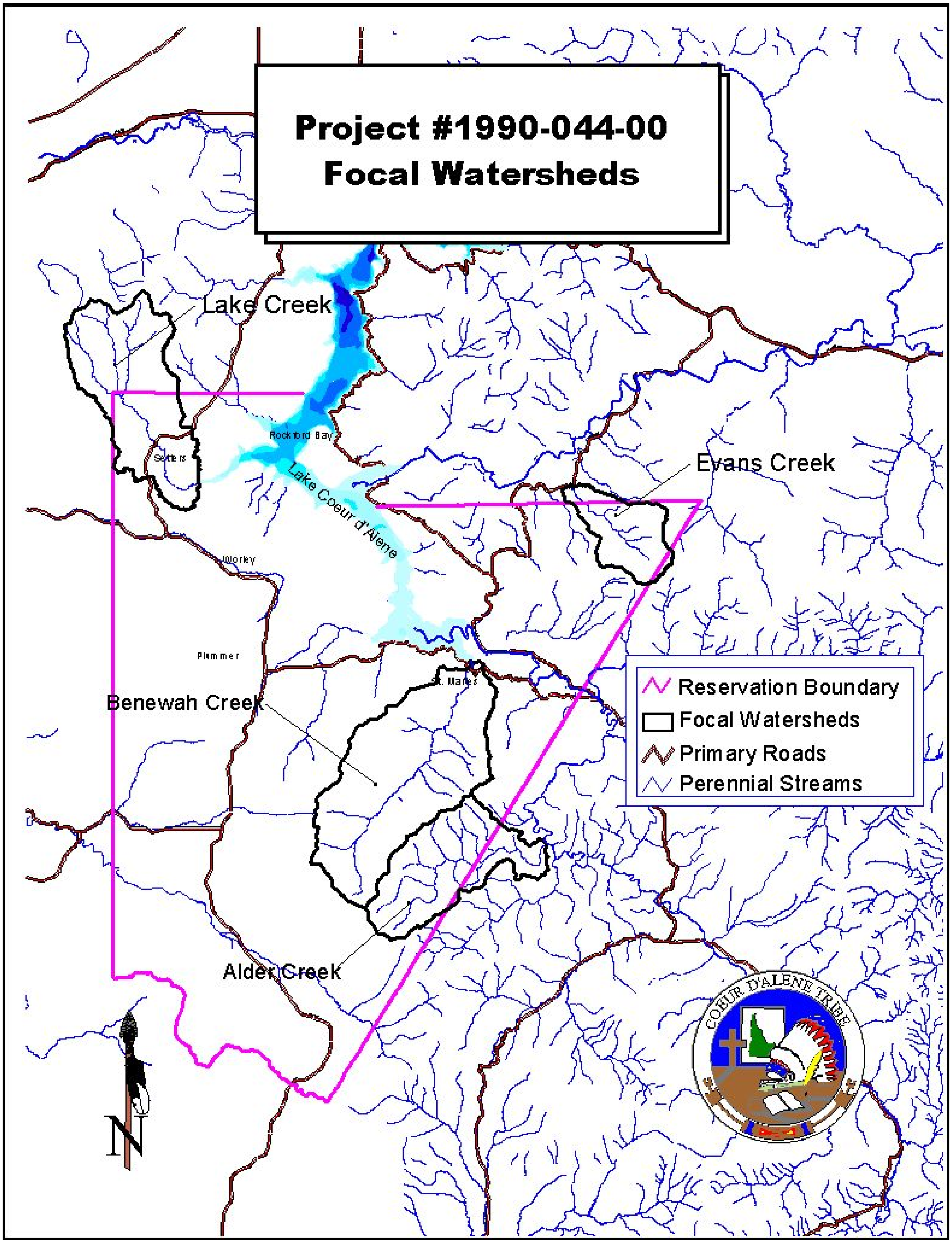


Figure 1. Locations of BPA Project 90-044-00 Focal Watersheds on the Coeur d'Alene Indian Reservation.

STUDY OBJECTIVES

This 2003 Annual Report summarizes previously unreported data collected to fulfill the contractual obligations for this project (BPA Project #1990-044-00) during the 2003 calendar year. The report is formatted into four primary sections that respectively describe: 1) the monitoring of biological, chemical and physical habitat indicators; 2) implementation of restoration and enhancement projects; 3) development and refinement of monitoring protocols and monitoring results for constructed wetlands in Lake Creek; and 4) a discussion of education and outreach work performed during 2003. The study objectives and related tasks listed below are excerpted from the document titled: *2004 Scope of Work and Budget Request, April 2003 - March 2004. Implement Fisheries Enhancement Opportunities on the Coeur d'Alene Indian Reservation*.

Section 1: Monitoring and Evaluation

<u>Objective 1</u>: Conduct routine trend monitoring to quantify changes in biological and chemical attributes in target tributaries over time.

Task 1a: Measure abundance, distribution and other biological data related to cutthroat trout and other salmonids at a number of index sites in mainstem and tributary reaches within the four target watersheds.

Task 1b: Reevaluate the power analysis using data on trout abundance and distribution from a total of 52 index sites within the four target watersheds.

Task 1c: Monitor stream flow, water temperature, nitrate and Hydrolab parameters at 21 sites in the restoration target drainages as described in the RM& E Plan.

<u>Objective 2</u>: Conduct effectiveness and statistical monitoring to provide inferences on fisheries/habitat relationships to larger areas and longer time periods.

Task 2a: Select appropriate control sites for each of the existing restoration/enhancement treatment sites.

Task 2b: Measure physical habitat indicators at up to 15 treatment sites that are representative of each restoration/enhancement strategy to test the assumptions of habitat restoration and enhancement.

Section 2: Restoration and Enhancement Activities

<u>Objective 1</u>: Complete advanced project planning.

Task 1a: Complete NEPA requirements and obtain necessary permits and authorization to ensure compliance with federal laws and guidelines.

Task 1b: Complete detailed design work for restoration measures on the Johnson property in the Benewah Creek watershed.

<u>Objective 2</u>: Monitor the completion of tasks described in the construction and implementation phase for this project.

Task 2a: Conduct implementation monitoring for all new projects described in the construction and implementation phase of the project.

<u>Objective 3</u>: Implement projects to improve instream habitat quality and quantity and restore watershed processes.

Task 3a: Implement the preliminary phase of enhancement activities on the Johnson property.

Task 3b: Perform routine operations and maintenance activities at established sites to protect project investments and enhance natural processes in riparian plant communities in target watersheds.

Section 3: Operation and Maintenance Phase

Objective 1: Conduct effectiveness monitoring for constructed wetlands in Lake Creek.

Task 1a: Measure sediment retention of constructed sediment ponds and effectiveness of sediment ponds to ameliorate temperature and augment flow to stream reaches. Develop monitoring protocols and draft a monitoring plan for constructed ponds.

Section 4: Education and Outreach

Objective 1: Improve awareness of Program activities within the Reservation community.

Task 1a: Publish a quarterly newsletter that highlights Program activities, recognizes cooperative efforts and serves as a forum for discussing land management issues.

Task 1b: Continue meeting with watershed work groups comprised of private landowners, agency representatives and other interested parties to discuss restoration and cooperative opportunities.

Objective 2: Provide cultural and educational opportunities to improve student/teacher involvement in Program activities.

Task 2a: Continue to participate in and develop an educational forum for the local community regarding stream restoration opportunities on the Reservation and the need to provide for wild fish in the areas being restored.

Task 2b: Provide summer internships for high school students to assist with implementation of project activities.

Task 2c: Recruit four to seven school students to participate in the annual Natural Resources Camp sponsored by the US Forest service.

Task 2d: Work with the University of Idaho Extension Agent to develop and implement educational programs focusing on fish, water and wildlife resources and protection of Reservation watersheds.

SECTION 1: MONITORING AND EVALUATION

METHODS

Biological Monitoring

Trout Population Estimation
The channel types delineated during previous surveys (Lillengreen et al. 1996) served as the basic geomorphic units for selecting sample sites for conducting fish population surveys. In these early channel type surveys, stream reaches were stratified into relatively homogeneous types according to broad geomorphologic characteristics of stream morphology, such as channel slope and shape, channel patterns and channel materials, as defined by Rosgen (1994). Stream reaches were further stratified by basin area to ensure that both mainstem and tributary habitats were represented in the stratification scheme. Sample locations within each strata were randomly selected in proportion to the total reach length. The length of each sample unit was 200 feet in length.

Sites were electrofished in the summer to quantify the abundance and distribution of fishes during base flow conditions occurring between July and September. Trout populations were estimated using the removal-depletion method (Seber and LeCren 1967, Zippen 1958). Block nets were placed at the upstream and downstream boundaries to prevent immigration and emigration during sampling. Each sample site was electrofished using the standard guidelines and procedures described by Reynolds (1983). Fish were collected by spot shocking using a Smith-Root Type VII pulsed-DC backpack electrofisher. Two electrofishing passes were made for each sample site as the standard procedure. If the capture probability during the initial passes was less than or equal to 50 percent, then a third and/or fourth pass were generally made to increase the precision of the population estimate. Salmonid species, including cutthroat trout, brook trout, and bull trout, were the target species for this study. Captured fish were identified, enumerated, measured (TL to nearest mm), and weighed (g). Cutthroat trout greater than 200 mm in length were tagged with a Floy FD-6B numbered anchor tag. Other species such as longnose dace, redside shiner, longnose sucker, and sculpin (spp.) were considered incidental catch and were only counted.

Population estimates were calculated using the following equation for two pass removals (Armour et al. 1983):

$$N = \frac{U_1}{1-(U_2 / U_1)}$$

where:
N = estimated population size;
U_1= number of fish collected in the first pass; and
U_2= number of fish collected in the second pass.
The standard error of the estimate was calculated as:

$$se(N) = \sqrt{\frac{M(1-M/N)}{A-\left[(2p)^2(U_2/U_1)\right]}}$$

where:
se(N) = standard error of the population estimate;
M= $U_1 + U_{2;}$
A= $(M/N)^2$; and

p= $1-\frac{U_2}{U_1}$.

Population estimates when more than two passes were necessary were calculated using the following equation (Armour et al. 1983):

$$N = \frac{M}{1-(1-p)^t}$$

where: N = estimated population size

M = sum of all removals ($U_1 + U_2 + \ldots U_t$)

t = the number of removal occasions

U_i = the number of fish in the i^{th} removal pass

C = $(1)U_1 + (2)U_2 + (3)U_3 + \ldots (t)U_t$

R = (C-M)/M

p = $(a_0)1 + (a_1)R + (a_2)R^2 + (a_3)R^3 + (a_4)R^4$

a_i = Polynomial coefficient from Table 8 (Armour et al. 1983).

The standard error was calculated as:

$$se(N) = \sqrt{\frac{N(N-M)M}{M^2 - \frac{N(N-M)(tp)^2}{(1-p)}}}$$

where: se(N) = standard error of population estimate. The approximate 95% confidence interval on the unknown population size was calculated as follows (Armour et al. 1983):

$$95\%CI = N \pm 2 * \sqrt{\text{var}(N)}$$

The population estimates were converted into density values (# fish/100 square meters) for each sample site then extrapolated to the reach in which the samples were collected to estimate the total number of fish in the reach. The confidence intervals were converted in the same manner (Johnson and Bhattacharyya 2001). Total reach areas were obtained from the digital data layer maintained by the Tribal GIS Program.

Trout Age and Growth

Raw scales were used for age determination and calculating growth rates. Salmonid scales were taken from the side of the body just behind the dorsal fin and above the lateral line (Jearld 1983). Scale samples were sorted by watershed to allow for independent determination of age and growth rate. In the laboratory, several dried scales were mounted between two glass microscope slides and viewed using a Realist, Inc., Vantage 5 microfiche reader. Age was determined by counting the number of annuli (Lux 1971, Jearld 1983). All trout scales were read by the same person. To estimate the accuracy (repeatability) of the person reading the scales, a 10% subsample of randomly selected fish, were re-analyzed six months after the first analysis. The person had no knowledge of length, weight or trout origin to bias the exercise. The percent repeatability for the age determination was 86% (42 repeats out of 50). These QA/QC methods will be repeated every year and a second person verify age.

Simultaneous to age determination, a measurement was made from the center of the focus to the furthest edge of the scale. Along this line, measurements were made to each annulus under a constant magnification. Annual growth was then back calculated using the Lee method as described by Carlander (1981):

$$L_i = a + \left(\frac{L_c - a}{S_c}\right) S_i$$

where:
L_i = length of fish (in mm) at each annulus;
a = intercept of the body scale regression line;
L_c = length of fish (in mm) at time of capture;
S_c = distance (in mm) from the focus to the edge of the scale; and
S_i = scale measurement to each annulus.

The intercept (a) was obtained from the linear regression of body length versus scale length at time of capture. The proportional method of back-calculation was used for species with small sample sizes with R^2 values less than 0.95. The following equation was used:

$$L_i = \left(\frac{S_i}{S_c}\right) L_c$$

This formula does not take into account the size of fish at scale formation as does the Lee method. A linear regression of body length versus age was calculated independently for fish from each subject watershed and the resulting equation was used to determine the age of fish for which scale samples were not taken.

Growth, size and condition of westslope cutthroat and brook trout were analyzed in two ways. First, length, weight and condition factor were separated by age (from scale analysis) and compared across the stream systems. The analysis by age class allows for comparisons of cohorts providing a finer-scale detection differences between the systems. Second, all age classes of westslope and brook trout were combined and length to weight relationships were compared across the systems. The length to weight relationship integrates growth over time relating fish condition over a broader time scale.

Trout Migration
Migration traps were installed in Lake and Benewah creeks in 2003 to assess migratory life history patterns, length and age frequency distribution, relative abundance and condition factors of adfluvial cutthroat trout. In the past, both the feasibility of installing and maintaining traps and the ultimate efficiency of trapping efforts has largely been determined by the runoff patterns of the respective watersheds. Traps consisted of a weir, runway and a holding box. The design was a modification of the juvenile downstream trap found in Conlin and Tuty (1979). Two traps were installed at each location to capture both fish moving upstream from the lake and fish moving downstream from the upper watershed. Paired traps were placed approximately 10 meters apart. Traps were checked and cleaned at least once daily during peak spawning periods from April through the early-June. Fish captured in the traps were identified, counted, measured, and weighed. A scale sample was taken to assess the age, growth, and condition of the fish.

Power Analysis
The program MONITOR (Gibbs 1995) was used to estimate the power to detect a positive or negative change of westslope cutthroat and brook trout densities from annual population

estimates in Alder, Benewah, Evans and Lake Creeks over an eight-year period from 1996-2003. The MONITOR program uses Monte Carlo simulations to model variation in count surveys over time. The program then generates detection rates produced from route-regression analysis.

The annual density (mean ± 1 sd, n = 8 years) of westslope cutthroat and brook trout from each population estimate site was used as input for the power analysis. Stratified, randomly selected sites were located along the longitudinal profile of each stream (Alder Cr. n = 13, Benewah Cr. n = 16, Evans Cr. n = 10 and Lake Cr. n = 8), (refer to population estimate methods section). The results of the power analysis apply to detecting percentage of change at the stream scale. An alpha level of 0.05 and 1000 iterations were used for all Monte Carlo simulations. Results were interpreted and discussed in relation to detection ranges that were defined as fine-scale (-3% to 3%) and coarse-scale (-10% to -4%, and 4% to 10%). Results were interpreted relative to past power analyses using simulations of increased sample sites, sampling frequencies and more years (Vitale et al. 2002).

Water Quality Monitoring

Stream Studies

Water quality monitoring was conducted at 20 stream sites during 2003. Table 1 lists these sites in order from mouth to headwaters for each of the four project watersheds. Locations of water quality monitoring sites are presented in Appendix B, (*Figures B1-B-4*). Nine of these sites had RL 100 continuous temperature monitoring devices placed during the March through October period (*Table 1*). The planned monitoring schedule was to visit all sites bi-weekly from March-October to perform discharge and field (Hydrolab) sampling. Samples for laboratory analyses were to be collected monthly from March-October and during rain-on-snow events during November-March. Due to staff changes and other conflicts, actual monitoring took place only during January, July, August and September.

<u>Monitored Parameters</u>

Each stream site was monitored for discharge, temperature, dissolved oxygen (DO), pH, specific conductance, total suspended solids (TSS), turbidity and nutrients. Nutrients included nitrogen forms (nitrate, nitrite and total Kjeldahl nitrogen (TKN)), phosphorus forms (dissolved "ortho" and total phosphorus), sulfate, chloride and fluoride. The discharge, temperature, DO, pH and specific conductance were measured *in-situ*, while TSS, turbidity and nutrients were determined in samples collected and sent to a contract laboratory.

<u>Sampling and Analysis Techniques</u>

The devices used for the *in-situ* water analyses were the Price Model 625 velocity meter with a Teledyne Gurley Model 1100 digital flow velocity indicator and a Hydrolab MiniSonde® water quality testing probe with a PRO4000® or Allegro® datalogger. Information on calibration and use of the velocity meter and flow velocity indicator is presented in Rantz 1983. MiniSonde® use is described in Hydrolab Corporation (1997) and datalogger use in Juniper Systems (1997). Quality control for the *in-situ* monitoring was maintained through strict adherence to the standard operating procedures outlined in the device manuals.

Stream discharge measurements were made following a "Velocity-Area Procedure" adapted from USEPA 2001. Hydrolab measurements were taken while holding the probe end of the unit at mid-depth at each site as described in Hydrolab Corporation (1997).

Table 1. Stream water quality sites and monitoring parameters.

PARAMETERS:	Discharge	Temperature	Dissolved Oxygen	pH	Specific Conductance	Total Suspended Solids	Turbidity	Nutrients*
STREAM SITES								
Alder Cr.	X	X **	X	X	X	X	X	X
N. Fork Alder Cr.	X	X	X	X	X	X	X	X
Three Mile Benewah Cr.	X	X	X	X	X	X	X	X
Cable Cr.	X	X	X	X	X	X	X	X
Coon Cr.	X	X	X	X	X	X	X	X
Bull Cr.	X	X	X	X	X	X	X	X
Waddel Cr.	X	X	X	X	X	X	X	X
Wittrock Cr.	X	X	X	X	X	X	X	X
Nine Mile Benewah Cr.	X	X **	X	X	X	X	X	X
Whitetail Cr.	X	X	X	X	X	X	X	X
Gore Cr.	X	X	X	X	X	X	X	X
Windfall Cr.	X	X	X	X	X	X	X	X
Schoolhouse Cr.	X	X **	X	X	X	X	X	X
Upper Benewah Cr.	X	X **	X	X	X	X	X	X
W. Fork Benewah Cr.	X	X	X	X	X	X	X	X
Evans Cr	X	X **	X	X	X	X	X	X
E. Fork Evans Cr.	X	X **	X	X	X	X	X	X
Upper Evans Cr.	X	X **	X	X	X	X	X	X
Lower Lake Cr.	X	X **	X	X	X	X	X	X
Upper Lake Cr.	X	X	X	X	X	X	X	X
Bozard Cr.	X	X **	X	X	X	X	X	X

* Nutrients include nitrogen forms (nitrate, nitrite and Total Kjeldahl Nitrogen), phosphorus forms (dissolved "ortho" and total phosphorus), sulfate, chloride and fluoride.
** continuous temperature monitors placed at these sites.

Water samples submitted for laboratory analysis were collected using a DH-48 water sampler to obtain a depth-integrated sample, in most cases. Certain shallow stream sites (ie. lass than six inches) were sampled by dipping the sample bottle into the flow to collect a simple grab sample. All samples were handled according to Standard Methods for the Examination of Water and Wastewater, 18th Ed. (APHA 1992), procedure 1060: *Collection and preservation of samples*. Strict chain of custody procedures were followed, as outlined in section 1060.B.1: *Chain of custody procedures* (APHA 1992). All containers used were prepared by the contract laboratory.

Total suspended solids (TSS) were analyzed using EPA method 160.2: *Gravimetric determination of Total Suspended Solids* (USEPA 1979). TSS is defined as the residue left on a filter paper of 2µm or smaller pore size after a portion of sample has been filtered and dried.

A qualified contract laboratory completed turbidity analysis in accordance with EPA method 180.1 (USEPA 1993). Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines (APHA, 1992).

The contract laboratory analyzed certain nutrient samples with an ion chromatograph (IC) using EPA method 300.0 (USEPA 1993). The following nutrient compounds were tested for using this method: nitrate, nitrite chloride, fluoride and sulfate. Total and "ortho" phosphorus and TKN were analyzed using Semi-automated Colorimetry (EPA method 365.1 for phosphorus and EPA method 350.1 for nitrogen) (USEPA 1993).

Physical Habitat Evaluation

The implementation of restoration efforts on the Coeur d'Alene Reservation is one means the Tribe is using to partially mitigate for lost anadromous fisheries through restoration of key habitats for westslope cutthroat trout. At the reach scale, habitat capacity is affected by biotic (e.g., riparian vegetation) and physical (e.g., flooding) processes. Superimposed on the natural biotic and physical processes are anthropogenic stressors (e.g., logging, roads and grazing) that suppress habitat capacity and can result in simplified, degraded stream reaches. The effectiveness of habitat restoration, measured as an increase in native trout abundance, is dependent on reducing limiting factors (e.g., passage barriers, high water temperatures, sediment transport from source areas) in areas that are critical for spawning and rearing life stages.

In 2002 the Tribe completed a Research Monitoring and Evaluation (RM&E) Plan which described the rational, goals, objectives and procedures to be followed in determining the effectiveness of implemented restoration measures. While the protocols for these and other monitoring efforts are detailed in the RM&E Plan (Coeur d'Alene Tribe 2002), a summary of those protocols used for the 2003 monitoring is presented below.

Sites and Parameters Monitored

An important aspect of the proposed monitoring and evaluation program is the study of certain physical, chemical and biological characteristics of select treated (ie. restored or enhanced) sites and similar but untreated "control" sites. The comparison of treated and control site characteristics can provide an important measure of changes (improvements or lack thereof) brought about by the treatments. Table 2 provides a listing of the restoration / enhancement projects completed through 2002 that were selected to be monitored, along with the respective project category (treatment type) and the associated treatment and control monitoring sites. Restoration / enhancement project monitoring site locations are shown in *Figures 2 - 5*.

There were seven basic physical characteristics measured at each of the paired treatment-control sites during 2003, including: the habitat type distribution, longitudinal (thalweg) profile of the site, six cross section profiles at each site, the substrate materials ("pebble counts"), the canopy cover, organic materials and sinuosity (valley length determination). All parameters were measured at each site and all data was input into a single Reference Reach Spreadsheet (River4m, Ltd. 1999) for each site.

Habitat Typing

The first effort to be undertaken upon arrival at a monitoring site was to establish the downstream end of the study reach. This was at a boundary between two habitat types, if possible. The start was marked by the placement of a labeled wooden stake and lath at the top of the bank on each side of the channel with surveyor's ribbon on the lath and on nearby trees/shrubs.

After the reach start is marked, a 500-foot tape (zero end) was attached near the water surface and spooled out along the thalweg. Care was taken to keep the tape over the thalweg, especially around bends in the channel. This was accomplished by running the tape over or around existing woody debris or rocks. If no in-stream stationary items are found where needed, the tape was tied the appropriate distance from shoreline rocks or vegetation using surveyors ribbon. When the 500-foot mark was reached this was the end of the reach. This location was marked as was the start with stakes, lath and flagging.

As the tape was being placed along the thalweg, the station (distance from start) of the beginning of each successive habitat type was recorded on a blank sheet of paper. Definitions of the habitat types are provided in *Table 3*, however, visual determination of habitat type depends to some extent on the flow at the time of the habitat typing. Therefore, this effort was performed at a time when the stream is in a low flow condition. The objective of the habitat typing was to document both the stationing of the habitat type boundaries and also the total length of each type within the reach. From the total length of each observed type, the percentage of that type was calculated and the cross sections were assigned (see ***Cross Section Profiles*** section below). The 500-foot tape was left in place in the stream until all monitoring work was completed.

Table 2. Coeur d'Alene Tribe, BPA-funded restoration / enhancement project sites with associated treatment and control monitoring sites. Initial site monitoring began in 2003 except as noted.

Restoration / enhancement Project ID	Project Category / Treatment Type	Treatment Monitoring Site #	Control Monitoring Site #
B_6.5	Channel reconstruction	Benewah 12 *	Benewah 13
B_8.1	Streambank stabilization & riparian planting	Benewah 14L	Benewah 9
B_8.5	Streambank stabilization & riparian planting	Benewah 14U	Benewah 17 **
E_0.1/0.0	Riparian planting	Evans 1	Evans 2
E_1.3	Streambank stabilization	Evans 3	Alder 12
E_1.6	Streambank stabilization	Evans 5	Evans 4
L_6.0	Riparian planting	Lake 8	Lake 7
L_7.3	Riparian planting	Lake 9U	Lake 10
L_8.2	Instream structures & riparian planting	Lake 11	EF Bozard 1 **
L_8.2/0.0	Riparian planting	WF Lake 2	Bozard 3
L_8.5	Riparian planting	Lake 12	Bozard 2
L_8.8	Riparian planting	Lake 13	Bozard 1

* Site monitored in 2002. ** Sites not yet monitored

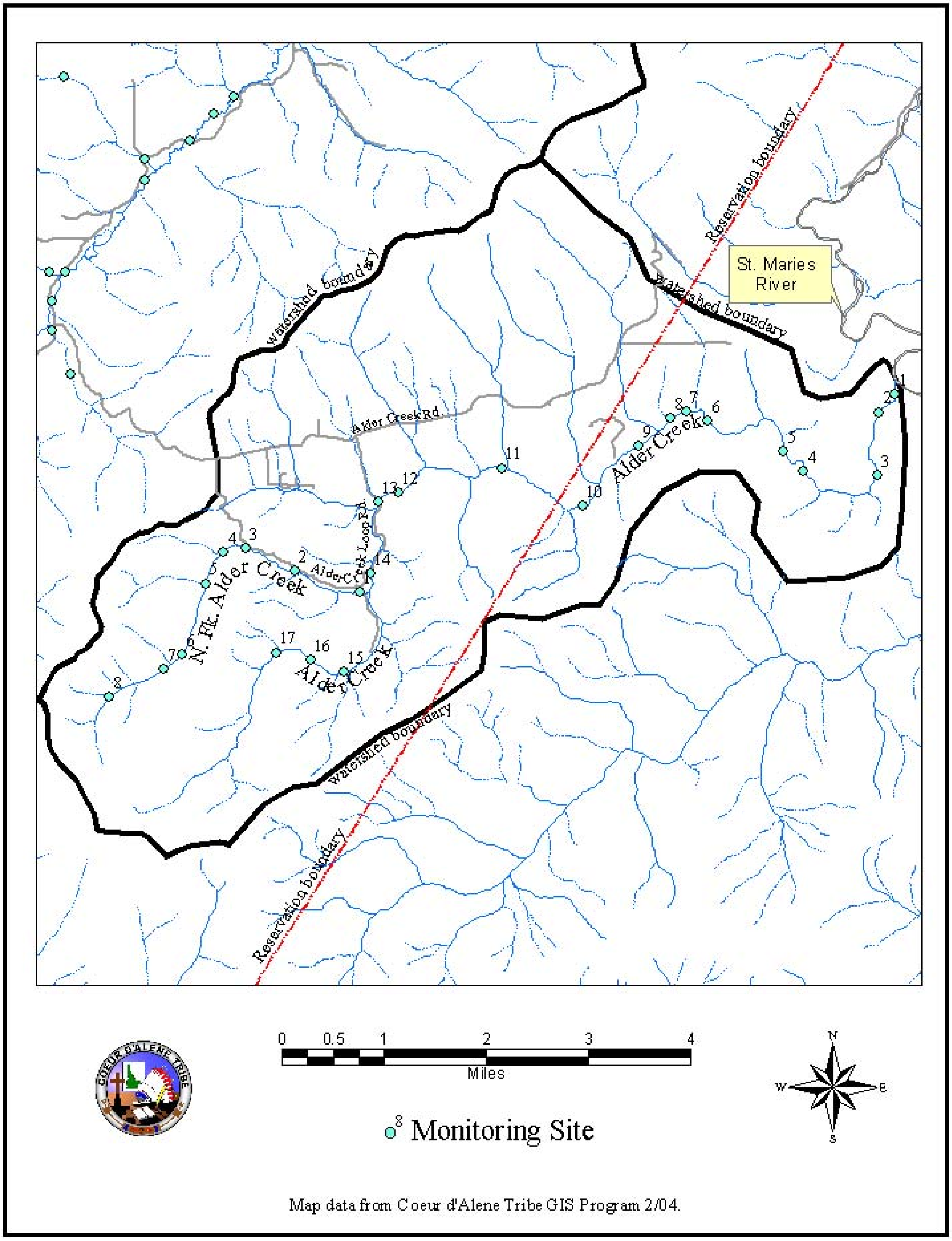


Figure 2. Map of Alder Creek watershed showing fish population and stream habitat monitoring sites.

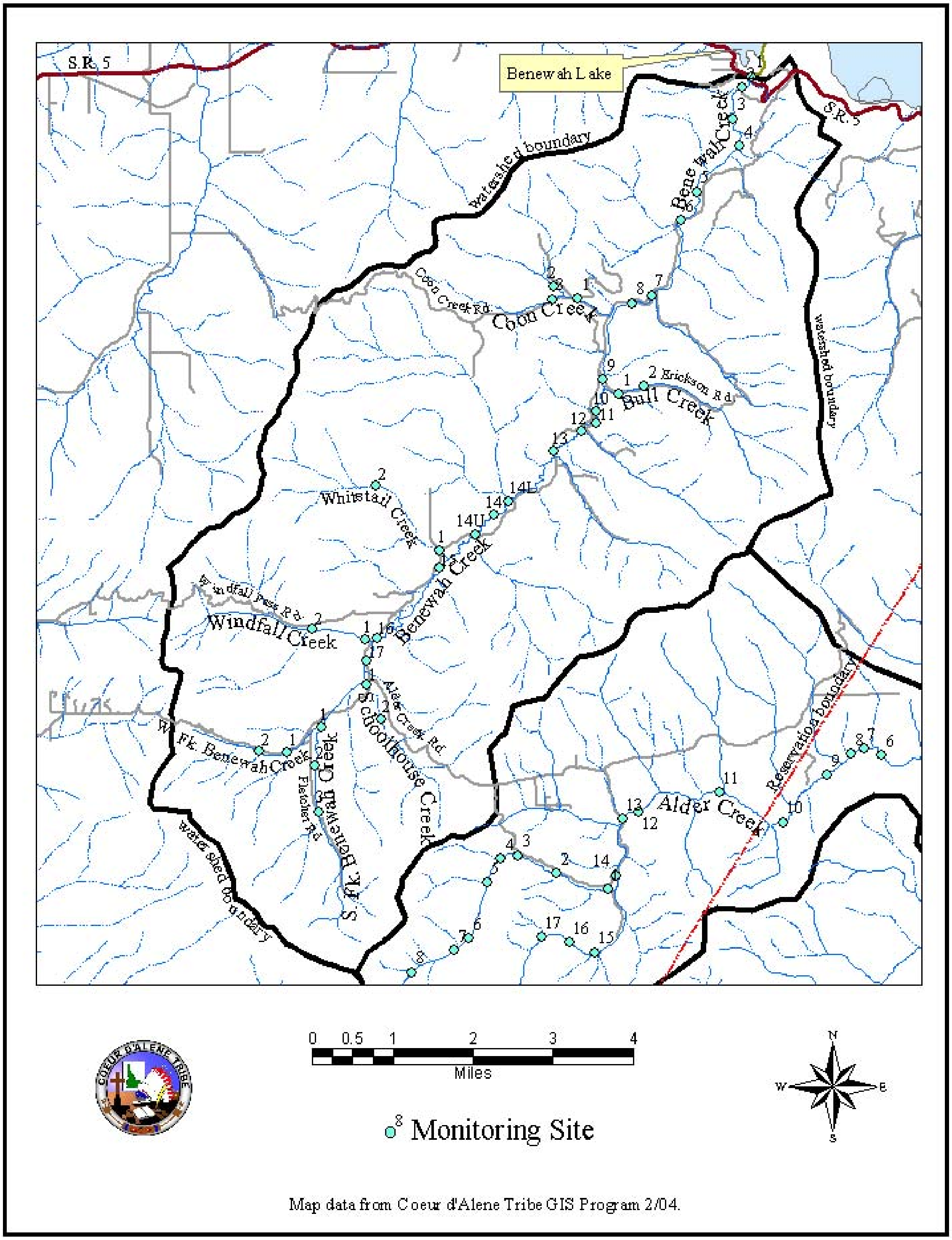


Figure 3. Map of Benewah Creek watershed showing fish population and stream habitat monitoring sites.

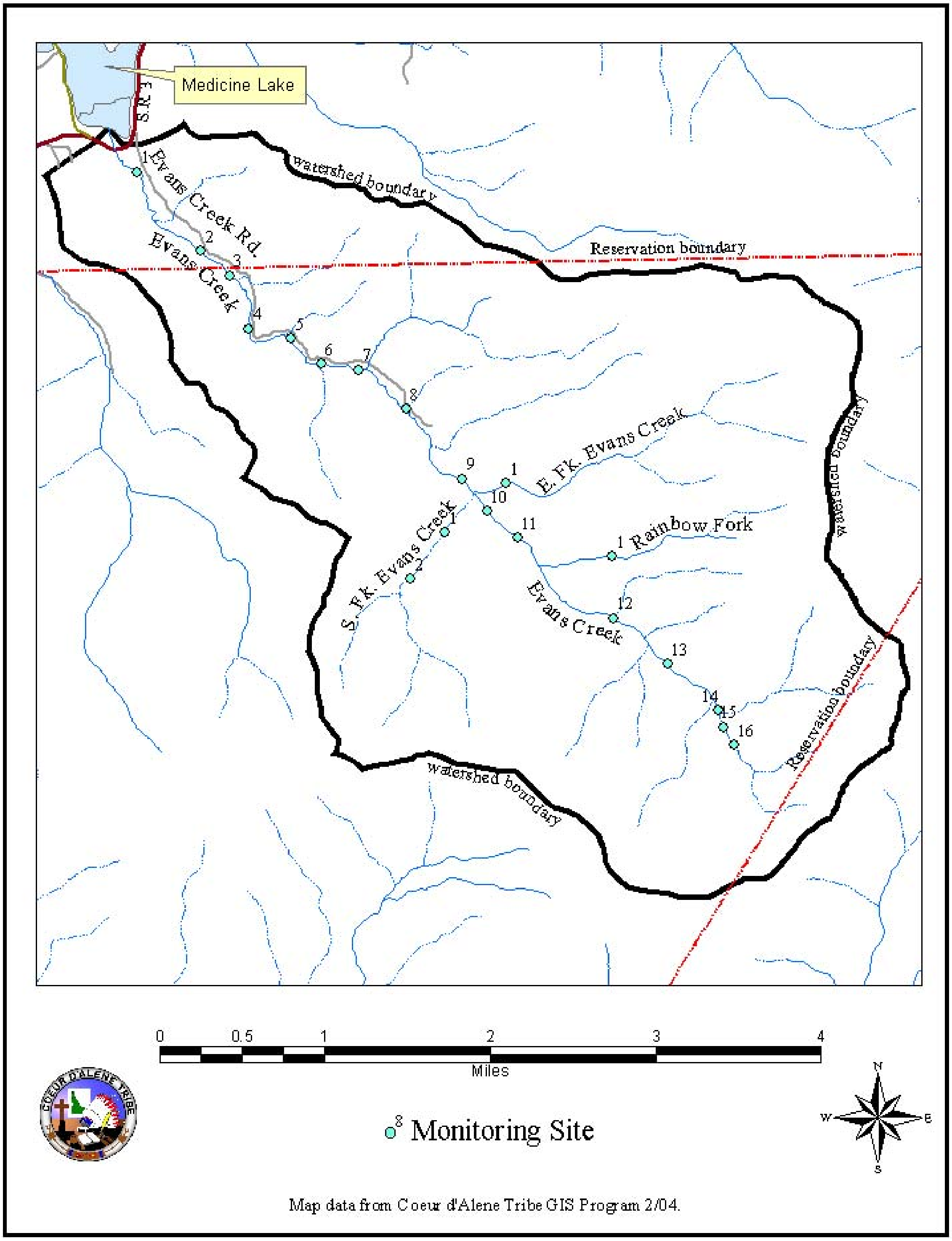


Figure 4. Map of Evans Creek watershed showing fish population and stream habitat monitoring sites.

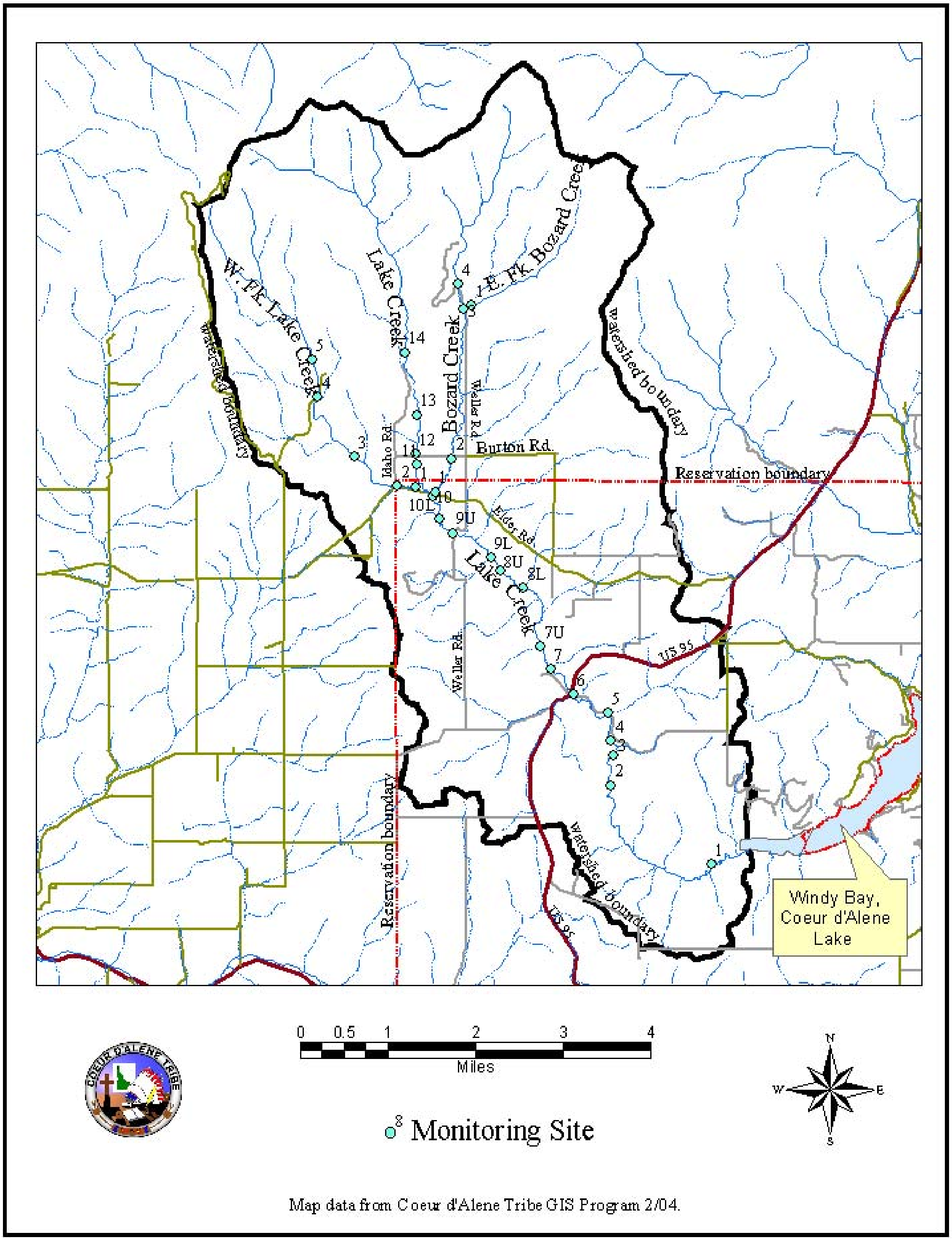


Figure 5. Map of Lake creek watershed showing fish population and stream habitat monitoring sites.

Longitudinal "Thalweg" Profile
The slope of the water surface is a major determinant of river channel morphology, and of the related sediment, hydraulic, and biological functions (Leopold 1994). A longitudinal profile surveyed along a selected channel reach is recommended for slope and channel typing determinations (Rosgen 1996).

This effort (modified from Peck et al. 2001) involved the determination of the water surface and channel bottom elevations along the "thalweg" of each 500-foot study reach. "Thalweg" refers to the flow path of the deepest water in a stream channel. The longitudinal thalweg profile, therefore, is a survey of the lowest stream bottom elevations (and associated water depths) along the reach. Measurements require the use of a surveyor's level and rod, and the 500-foot measuring tape described above. Operating and note taking procedures for this equipment are described in the RM&E Plan. Since most reaches are longer than could be seen from a single level setup, it was necessary to use "turning points" to move the level through the reach.

Profile surveying was begun once a Bench Mark was established for the site; this permanent reference point (top of a section of one-inch rebar driven firmly into the ground) was given the assumed elevation of 100.00 feet. From the Bench Mark, the level was set up and shots taken along the thalweg. A sufficient number of shots were taken to capture all changes in channel bottom slope and habitat types along the reach. Collected survey data was input into a "Reference Reach Spreadsheet" (Ohio Department of Natural Resources 1999) for each site, which automatically graphed the profiles and also calculated pertinent descriptive criteria such as water surface slope.

Cross Section Profiles
The cross section profiles were measured using a surveyor's level and rod at six locations along each studied reach. This information was necessary to complete the determination of channel type for each monitored reach (see ***Channel Typing*** section, below). The cross section profiles were used to verify the bankfull depth and to calculate the bankfull cross sectional area, wetted perimeter, average and maximum depth and width-to-depth ratio. The flood-prone width, which is defined as the valley width at twice the maximum depth at bankfull, and entrenchment ratio, defined as the flood-prone width divided by the bankfull width, were not determined as part of this effort. The flood-prone width will be determined in the future to allow a verification of the channel type (see below).

The key to locating the cross sections was to make sure that they were distributed in proportion to the primary habitat types found in the reach. Once the delineation of habitat types was completed, as described above, the cross section locations were placed within the longest section(s) of each respective type. All cross sections were monumented with permanent pins (rebar), stakes, lath and flagging to allow for repeat surveying of the profiles in the future. The Bench Mark established for the thalweg profile surveying was also used as the reference point for each of the six cross sections.

Collected cross section survey data, which included water depths where appropriate, was input into the "Reference Reach Spreadsheet" (Ohio Department of Natural Resources 1999), along with the longitudinal profile data, which automatically graphed the profiles and also calculated pertinent descriptive criteria such as bankfull elevation, cross sectional area, wetted perimeter and flood prone elevation.

Table 3. Stream habitat type descriptions (IDEQ 1999).

Habitat type	Description
Riffle	A portion of the stream with swiftly flowing, shallow water. The water surface in a riffle is turbulent and this is caused by completely or partially submerged obstructions. Cascades are one class of riffle characterized by swift current, exposed rocks and boulders, considerable turbulence and stepped drops over steep slopes. Riffle areas with standing waves are called rapids.
Pool	A portion of the stream with reduced current velocity (average velocity is generally less than 1 foot per second), and often, but not always, with water deeper than surrounding areas. Pools usually have flat water surfaces with no surface agitation and often the bottom is concave such that it would hold water if there was no flow. Pools usually occur at outside bends in the channel and around large obstructions. Water impounded upstream of channel blockages, typically a log jam or beaver dam, is classed as a dammed pool. Pools end where the stream bottom approaches the water surface and this is also known as a "pool tailout".
Run / glide	A portion of the stream with moderate to swift velocity and without surface agitation (runs display "laminar" or uniform flow patterns). Runs and glides typically occur immediately upstream and downstream of riffles. Pool tailouts are typically classed as runs in small high-gradient streams. Glides also occur where the channel widens allowing the stream to shallow and slow. Glides are most commonly found in low gradient streams associated with elongated pools.
Shallows or side channels	A portion of the stream where side channels enter or leave the main channel and shallow, border areas used by young fish.

Channel Substrate

Channel bed and bank materials influence the cross-sectional form, plan-view, and longitudinal profile of rivers; they also determine the extent of sediment transport and provide the means of resistance to hydraulic stress (Ritter 1967). Channel substrate was measured using a modified version of Wolman's (1954) pebble count method as described by Rosgen (1993). The modified method adjusts the material sampling locations so that streambed materials are sampled on a proportional basis along a given stream reach. This requires that the six cross sections be located as described above. The pebble count substrate analysis was performed along each of the six cross sections within the monitored reach.

At each cross section the actual substrate materials were determined at 20 points spaced uniformly across the bankfull width. At each of these points a measuring stick or finger was placed on the substrate and the one particle the tip touched was picked up and the size measured. Following the original method, particle size was determined as the length of the "intermediate axis" of the particle; that is the middle dimension of its length, width and height. Substrate size classes that were recorded are shown in *Table 4*.

Collected pebble count data was input into the Reference Reach Spreadsheets (Ohio Department of Natural Resources 1999) which automatically graphed the distribution of particle sizes and calculated pertinent descriptive criteria such as percent by substrate class (size) and a particle size index (D value) for each habitat type for which data is indicated.

Table 4. Stream channel substrate particle size classes (from Rosgen 1996).

Class Name	Size Range*	Description
Silt/Clay	<0.062 mm	Silt / Clay
Sand	0.062 - 0.125 mm	Very fine sand
"	0.125 - 0.25 mm	Fine sand
"	0.25 - 0.50 mm	Medium sand
"	0.50 - 1.0 mm	Coarse sand
"	1.0 - 2.0 mm	Very coarse sand
Gravel	2.0 - 4.0 mm	Very fine gravel
"	4.0 - 5.7 mm	Fine grave
"	5.7 - 8.0 mm	Fine gravel
"	8.0 - 11.3 mm	Medium gravel
"	11.3 - 16.0 mm	Medium gravel
"	16.0 - 22.6 mm	Coarse gravel
"	22.6 - 32.0 mm	Coarse gravel
"	32.0 - 45.0 mm	Very coarse gravel
"	45.0 - 64.0 mm	Very coarse gravel
Cobble	64.0 - 90.0 mm	Small cobble
"	90.0 - 128 mm	Small cobble
"	128 - 180 mm	Large cobble
"	180 - 256 mm	Large cobble
Boulder	256 - 362 mm	Small boulder
"	362 - 512 mm	Small boulder
"	512 - 1024 mm	Medium boulder
"	1024 - 2048 mm	Large - very large boulder
Bedrock	>2048 mm	Bedrock

* Measured as median dimension, not largest or smallest)

Canopy Cover

Vegetative canopy cover (or shade) was determined using a conical spherical densiometer, as described by Platts et al. (1987). The densiometer determines relative canopy "closure" or canopy density, depending on how the readings are taken. This monitoring was only for canopy density, which is the amount of the sky that is blocked within the closure by vegetation, and this is measured in percent. Canopy density can change drastically through the year if the canopy vegetation is deciduous.

Canopy cover over the stream was determined at each of the six cross sections established following the habitat typing survey. At each cross section, densiometer readings were taken one foot above the water surface at the following locations: once facing the left bank, once facing upstream at the middle of the channel, once facing downstream at the middle of the channel and once facing the right bank. Percent density was calculated by multiplying the sum of the four readings by 1.5. If the result was between 30 and 65%, 1.0 % was subtracted; if the result is greater than 65, 2% was subtracted. The adjusted density readings were then averaged for the entire reach.

Instream Organic Materials
Organic materials play an important role in the character and productivity of stream habitats. This survey of monitored stream reaches was an inventory of the number and size of individual pieces of woody material observed along a longitudinal transect through the reach. For the Large Woody Debris (LWD) these data were converted into volumes of material so it was necessary to collect data on the lengths and diameters of the material to allow this calculation. Tree root wads were tallied separately as these typically provide additional habitat benefits because of their size and complexity. For this protocol the definition of a root wad was that it was dead, that it was detached from its original position, that it has a diameter where the tree trunk meets the roots of at least eight inches and that it was less than six feet long from the base of the root ball to the farthest extent of the trunk (Schuett-Hames, 1999).

The organic materials survey transect was walked along the thalweg starting at the downstream end of the reach. All coarse material, 1 inch to 4 inches in diameter, that crossed the line of the thalweg was counted and recorded. All LWD (organic material that is greater than 4 inches in diameter at the small end) was tallied and measured whether or not it crossed the line of the transect. This included material that was suspended above the water surface and extended outside of the wetted stream width; it is not intended to include living trees or shrubs that hung over the water.

For all observed LWD, orientation was noted by taking a compass heading (degrees) looking from the large end of the piece towards the small end. Other measurements taken of all LWD were the diameter at the large end, diameter at the small end and the length between these two ends. The large end diameter shall be measured immediately above the roots, if there are roots attached.

Data handling included the tallying of all course material seen crossing the thalweg and calculation of the total volume and density of LWD found within the bankfull width of each studied reach. These calculations were performed in a spreadsheet worksheet added to the Reference Reach Spreadsheet.

Sinuosity
The sinuosity of a stream reach is estimated as the ratio of the stream channel length to the direct basin (valley) length. Rosgen (1996) describes the procedure for determining sinuosity of the entire stream basin but this also applies to a monitored stream reach. For a large scale determination of sinuosity, a 1:24,000 map or orthophoto and a ruler, or GIS map in measure option or GPS is used to measure the length of the basin as the straight line distance from the where the stream enters the study reach to where it leaves the reach. For the RM&E monitored stream segments, the "total stream length" in the study reach is that measured for the longitudinal thalweg profile (ie. 500 feet) and the valley length is measured (estimated) by pulling a hip chain as straight as possible between the upstream and downstream ends of the 500-foot reach. Sinuosity is calculated by dividing the stream length (500 feet) by the valley length.

Stream Typing
The classification of stream channel types followed guidelines presented by Rosgen (1996) and used data collected during the thalweg profile, cross section profile and sinuosity surveying efforts. The objective of classifying streams on the basis of channel morphology was to use discrete categories of stream types to develop consistent, reproducible descriptions of the stream

reaches. These descriptions must provide a consistent frame of reference to document changes in the stream channels over time and to allow comparison between different streams. The different Rosgen classifications are described in *Table 5*. In addition to the parameters shown in *Table 5*, the dominant substrate type (ie. slit/clay, sand, gravel, cobble) was included as a modifier to the channel type. The numbering for this (from Rosgen 1996) is 1 for bedrock, 2 for boulder, 3 for cobble, 4 for gravel, 5 for sand and 6 for silt and clay.

The delineative criteria described by Rosgen (1996) are entrenchment ratio, width-to-depth (W/D) ratio, sinuosity and slope. Entrenchment ratio is estimated as the typical flood-prone width divided by the bankfull channel width. Bankfull width, or the stream width and depth at bankfull stage, is determined by the elevation of the top of the "highest depositional feature"; this could be a change in size distribution of substrate or bank particles, a stain on rocks in the bank, or, most frequently, a break in the slope of the bank. When the bankfull elevation was not evident in the field, this could usually be determined by looking at the plotted cross section profiles. Flood-prone width is frequently not evident, especially where floodplain features have been obscured by agriculture or other human activities. However, flood-prone width has been defined by Rosgen as the width at the elevation that is twice the bankfull depth. That is, twice the distance between the thalweg and the bankfull height. As indicated above, the flood-prone widths were not determined in 2003 because the cross sections did not extend far enough from the stream to intersect the valley floor so the Entrenchment Ratio could not be calculated. This resulted in some uncertainty in the stream types identified; this uncertainty will be removed and channel types verified when cross section profiles are extended.

Table 5. General stream type descriptions and delineative criteria for broad-level classification (from Rosgen 1996).

Stream Type	General description	Entrenchment ratio	W/D ratio	Sinuosity	Slope %	Landform/soils/ features
Aa+	Very steep, deeply entrenched, debris transport streams.	< 1.4	< 12	1.0 to 1.1	>10	Very high relief. Erosional, bedrock or depositional features; debris flow potential. Deeply entrenched streams. Vertical steps with deep scour pools; waterfalls.
A	Steep, entrenched, cascading, step/pool streams. High energy/debris transport associated with depositional soils. Very stable if bedrock or boulder dominated channel.	< 1.4	< 12	1.0 to 1.2	>10	High relief. /erosional or depositional and bedrock forms. Entrenched and confined streams with cascading reaches. Frequently spaced, deep pools in associated step/pool bed morphology.
B	Moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools. Very stable plan and profile. Stable banks.	1.4 to 2.2	>12	>1.2	2 to 3.9	Moderate relief, colluvial deposition, and/or structural. Moderate entrenchment and W/D ratio. Narrow, gently sloping valleys. Rapids predominate with scour pools.

C	Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplains.	>2.2	>12	>1.2	<2	Broad valleys with terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. Riffle/pool bed morphology.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks.	n/a	>40	n/a	<4	Broad valleys with alluvium, steeper fans. Glacial debris and depositional features. Active lateral adjustment with abundance of sediment supply. Convergence/divergence bed features, aggradational processes, high bedload and bank erosion.
DA	Anastomosing (multiple channels) narrow and deep with extensive, well vegetated floodplains and associated wetlands. Very gentle relief with highly variable sinuosities and W/D ratios. Very stable streambanks.	>2.2	highly variable	highly variable	<0.5	Broad, low-gradient valleys with fine alluvium and/or lacustrine soils. Anastomosed geologic control creating fine deposition with well vegetated bars that are laterally stable with broad wetland floodplains. Very low bedload, high wash load sediment.
E	Low gradient, meandering riffle/pool stream with low W/D ratio and little deposition. Very efficient and stable. High meander width ratio.	>2.2	<12	>1.5	<2	Broad valley/meadows. Alluvial materials with floodplains. Highly sinuous with stable, well vegetated banks. Riffle/pool morphology with very low W/D ratios.
F	Entrenched meandering riffle/pool channel on low gradients with high W/D ratio.	<1.4	>12	>1.2	<2	Entrenched in highly weathered material. Gentle gradients with a high W/D ratio. Meandering laterally unstable with high bank erosion rates. Riffle/pool morphology.
G	Entrenched "gully" step/pool and low W/D ratio on moderate gradients	<1.4	<12	>1.2	2 to 3.9	Gullies, step/pool morphology with moderate slopes and low W/D ratio. Narrow valleys or deeply incised in alluvial or colluvial materials, I.e. fans or deltas. Unstable, with grade control problems and high bank erosion rates.

Width-to-depth ratio is the bankfull width divided by the bankfull height. The overall width-to-depth ratio for each monitored reach was calculated as the average of that at each of the cross sections. Sinuosity is the length of reach (500 ft) divided by the straight-line distance between the upstream and downstream ends of the reach. Slope is the drop in elevation of the water surface divided by the length of the reach and was determined from the upstream end of one habitat type (preferably a riffle) near the upstream end of the study reach, to the upstream end of a like habitat type near the downstream end of the study reach.

RESULTS

Biological Monitoring

Trout Population Estimation
Westslope cutthroat trout were widely distributed in the Benewah, Evans, and Lake Creek watersheds during base flow conditions in the summer, but had limited distribution in the Alder Creek watershed (*Tables 6 and 7*). Cutthroat trout were found in 92 of the 111 sites that were sampled and occupied approximately 85% of the combined available habitat in the target watersheds. In Alder Creek, only 50% of the available habitat was occupied by cutthroat trout and much of the upper mainstem and North Fork contained no cutthroat in the sample. Mean densities were greatest in Evans Creek (11.5/100 sq. meters), followed by Lake Creek (6.9/100 sq. meters), Benewah Creek (4.1/100 sq. meters) then Alder Creek (1.3/100 sq. meters). Cutthroat trout densities were not correlated to basin area because of the high variability in abundance among sites and slightly different patterns of distribution between watersheds, however densities were generally greater in second order tributaries than in adjacent mainstem reaches in the Benewah (15.5 fish/100 sq. m versus 0.9 fish/100 sq. m.), Evans (14.8 fish/100 sq. m. versus 10.4 fish/100 sq. m.) and Lake Creek (11.7 fish/100 sq. m versus 3.4 fish/100 sq. m.) watersheds. The index sites where densities were greater than or equal to 5.0 fish/100 square meters had a mean patch size of 15.3 sq. km (±5.3).

Brook trout were found only in the Alder Creek and Benewah Creek watersheds (*Table 8*). In Alder Creek brook trout were distributed throughout the North Fork and upper mainstem reaches; there was relatively little spatial overlap between brook trout and cutthroat trout and brook trout were found in higher densities where overlap did occur. Brook trout had a mean density of 6.9 fish/100 sq. meters throughout the watershed with a range of 0.0-17.6 fish/100 sq. meters. The distribution of brook trout in Benewah Creek was limited to two tributaries, the South and West forks, and the upper mainstem. Densities ranged from 0.0-16.1 fish/100 sq. meters and the mean density for the entire watershed was 0.65 fish/100 sq. meters.

Total fish population estimates by watershed for an 8-year time series of data ending with 2003 were summarized for this report to examine population trends at the watershed scale (*Figures 6 and 7)*. Linear regressions of total estimated population by year were calculated to consider the statistical properties of the data set. The population trends are generally not well described by linear regressions due to the high between year variability in the data and the correlation coefficients ranged from 0.09 – 0.52. Regression trends indicated generally increasing numbers of cutthroat in Evans and Lake Creeks and for brook trout in both Alder and Benewah creeks. Trends for cutthroat trout in Alder and Benewah Creeks were decreasing and stable, respectively. Brook trout numbers in the Alder Creek watershed increased significantly (P=0.042) during the 8-year time series. Cutthroat trout numbers in Evans Creek increased significantly (P=0.068) at the 90% confidence level. High between-year variability masked significant differences for other populations.

Table 6. Cutthroat trout population estimates for the Alder and Benewah Creek watersheds on the Coeur d'Alene Reservation, 2003

Alder Creek - Cutthroat Trout								**2003**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 sq. m.**	**Total N**	**95 % CI**
Mainstem	1	7052	539	3	0	0.6	39	0
	2	1825	316	1	0	0.3	6	0
	3	9446	260	4	0	1.5	145	0
	4	4158	242	11	3	4.6	189	+48/-17
	5	5064	780	18	5	2.3	117	+39/-7
	6	1823	520	11	3	2.1	39	+10/-0
	7	16860	799	15	2	1.9	317	+32/-0
	8	4916	390	0	0	0.0	0	0
	9	12635	334	0	0	0.0	0	0
N.F. Alder	1	4475	372	0	0	0.0	0	0
	2	1403	316	0	0	0.0	0	0
	3	2058	260	0	0	0.0	0	0
	4	2503	74	0	0	0.0	0	0
Total		**55895**	**4088**	**55**	**12**		**661**	**+129/-23**

Benewah Creek – Cutthroat trout								**2003**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 sq. m.**	**Total N**	**±95 % CI**
Mainstem	1	7422	297	2	0	0.7	50	0
	2	9419	446	3	0	0.7	63	0
	3	5588	483	11	3	2.3	127	+30/-0
	4	16104	576	8	6	1.4	224	+164/-28
	5	2318	353	0	0	0.0	0	0
	8	5656	669	0	0	0.0	0	0
	9	5648	520	2	0	0.4	22	0
	10	25981	1282	16	1	1.2	324	+26/-0
	11	1399	334	6	0	1.8	25	0
Bull	1	3685	149	44	23	29.6	1091	+570/-273
Coon	1	2149	167	14	0	8.4	180	0
School House	1	2741	167	11	1	6.6	180	+15/-0
SE Benewah	1	6915	297	47	5	15.8	1093	+116/-23
WF Benewah	1, 2	3205	130	38	7	29.2	936	+174/-49
Whitetail	1	5204	204	18	2	8.8	458	+62/-25
Windfall	1	5531	242	39	9	16.1	891	+210/-91
Total		**108965**	**6318**	**259**	**57**		**5666**	**+1367/-489**

Table 7. Cutthroat trout population estimates for the Evans and Lake Creek watersheds on the Coeur d'Alene Reservation, 2003.

Evans Creek – Cutthroat Trout								**2003**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 sq. m.**	**Total N**	**±95 % CI**
Mainstem	1	4977	N/S					
	2	7227	595	44	16	7.4	535	+190/-61
	3	1970	836	23	8	2.8	54	+19/-7
	4	10127	465	79	31	17.0	1722	+665/-261
	5	2692	297	26	14	8.7	235	+125/-36
	6	1178	242	82	30	33.9	400	+146/-73
	7	2231	409	38	11	9.3	207	+58/-27
EF Evans	1	3990	93	30	5	32.3	1288	+215/-85
RF Evans	1	2099	74	27	7	36.3	763	+208/-85
SF Evans	1, 2	1126	167	15	8	9.0	101	+56/-13
Total		**37617**	**3177**	**364**	**129**		**5306**	**+1682/-648**

Lake Creek – Cutthroat Trout								**2003**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 sq. m.**	**Total N**	**±95 % CI**
Mainstem	1	5396	204	5	3	2.4	132	+79/-26
	4	2696	223	0	0	0.0	0	0
	5	2555	242	1	0	0.4	11	0
	6	11668	650	29	5	4.5	520	+81/-18
	7	13284	1059	47	12	4.4	590	+151/-38
	8	9715	706	33	13	4.7	454	+181/-69
WF Lake	1,2, 3	6270	427	76	30	17.8	1115	+434/191
Bozard	1	11085	520	86	20	16.5	1833	+426/-171
Total		**62669**	**4032**	**277**	**82**		**4655**	**+1352/-513**

Table 8. Eastern brook trout population estimates for the Alder and Benewah Creek watersheds on the Coeur d'Alene Reservation, 2003

Alder Creek - Eastern Brook Trout								**2003**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 sq. m.**	**Total N**	**95 % CI**
Mainstem	1	7052	539	0	0	0.0	0	0
	2	1825	316	0	0	0.0	0	0
	3	9446	260	0	0	0.0	0	0
	4	4158	242	0	0	0.0	0	0
	5	5064	780	2	0	0.3	13	0
	6	1823	520	0	0	0.0	0	0
	7	16860	799	77	31	9.6	1625	+654/-190
	8	4916	390	48	11	12.3	605	+139/-51
	9	12635	334	59	19	17.6	2229	+718/-264
N.F. Alder	1	4475	372	31	6	8.3	373	+72/-12
	2	1403	316	30	5	9.5	133	+22/-4
	3	2058	260	25	4	9.6	198	+32/-8
	4	2503	74	10	0	13.5	337	0
Total		**55895**	**4088**	**282**	**76**		**5513**	**+1637/-529**

Table 8. Cont.

Benewah Creek - Eastern Brook Trout								**2003**
Tributary	**Reach**	**Total Area (sq. m)**	**Area sampled (sq. m)**	**N**	**95% CI**	**#/100 sq. m.**	**Total N**	**±95 % CI**
Mainstem	1	7422	297	0	0	0.0	0	0
	2	9419	818	0	0	0.0	0	0
	3	5588	483	0	0	0.0	0	0
	4	16104	669	0	0	0.0	0	0
	5	2318	353	0	0	0.0	0	0
	8	5656	669	0	0	0.0	0	0
	9	5648	520	0	0	0.0	0	0
	10	25981	966	2	0	0.2	54	0
	11	1399	186	28	7	15.1	211	+53/-23
Bull	1	3685	149	0	0	0.0	0	0
Coon	1, 2	2149	167	0	0	0.0	0	0
School House	1	2741	167	0	0	0.0	0	0
SE Benewah	1	6915	186	1	0	0.5	37	0
WF Benewah	1,2	3205	56	9	4	16.1	517	+230/-57
Whitetail	1	5204	204	0	0	0.0	0	0
Windfall	1	5531	242	0	0	0.0	0	0
Total		**108965**	**6131**	**40**	**11**		**819**	**+283/-80**

A power analysis was done to evaluate the power to detect annual changes of cutthroat and brook trout populations at the stream scale. The eight-year population estimate data set was used including the 2003 results. The power to detect changes in cutthroat trout populations is highest in Benewah and Evans creeks (*Figure 8*). However, the higher power is associated with only coarse-scale detection (-10% to -4%, and 4% to 10%) and does not meet the criteria of detecting fine-scale changes (–3% to +3%) with 0.80 power at α 0.10 (Vitale et al. 2002A). The power to detect changes in the brook trout population of Alder Creek is nearly twice that of Benewah Creek (*Figure 9*). The current power to detect population changes of brook trout does not meet the criteria for detecting fine-scale changes as outlined by Vitale et al. (2002A).

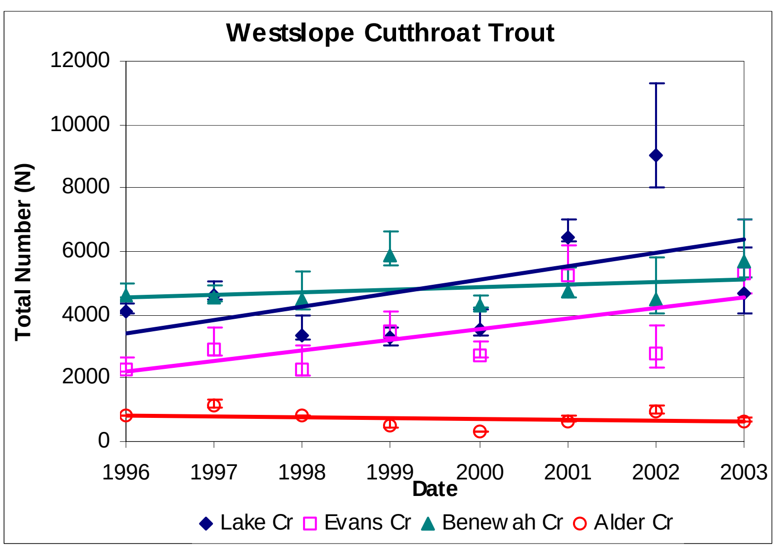


Figure 6. Total estimated Cutthroat Trout population by watershed, 1996-2003. Error bars indicate ±95% CI.

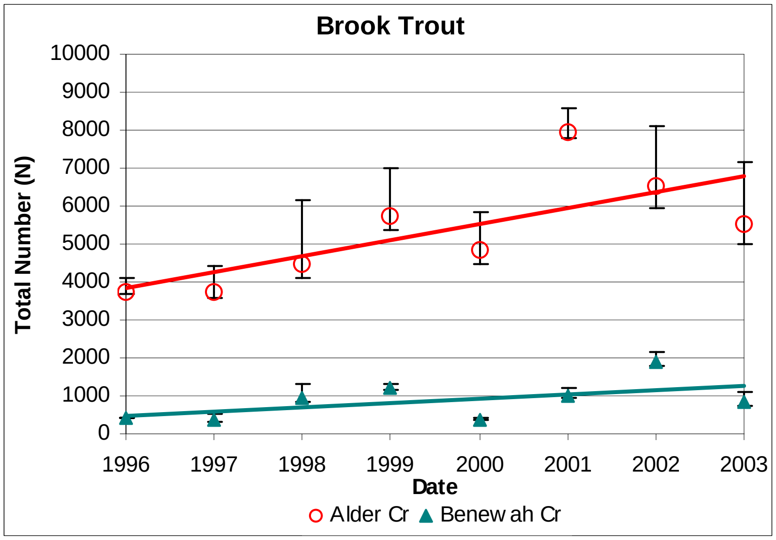


Figure 7. Total estimated Brook Trout population by watershed, 1996-2003. Error bars indicate ±95% CI..

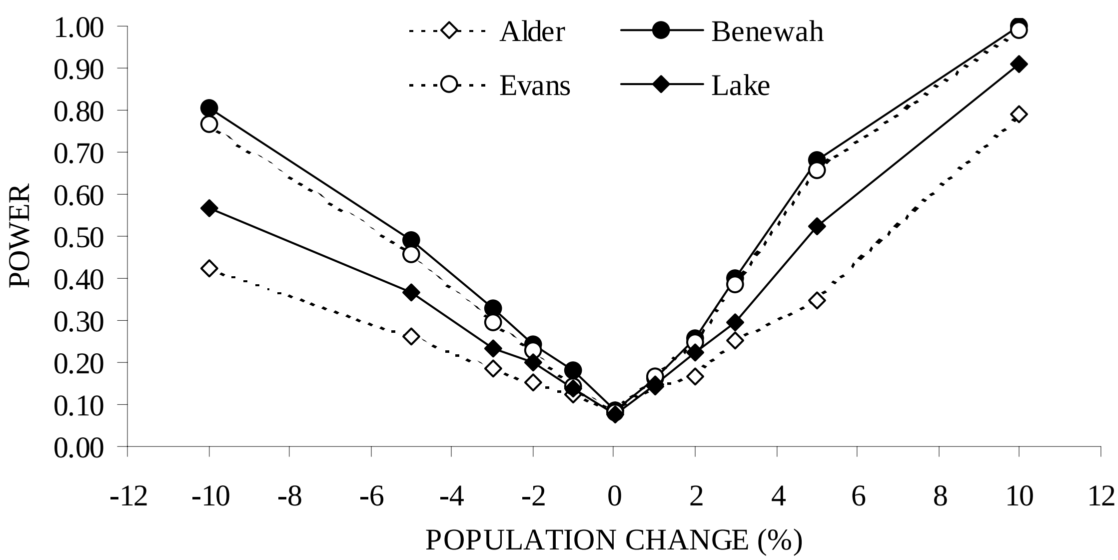


Figure 8. Power to detect annual changes in westslope cutthroat trout populations in four streams on the Coeurd' Alene Tribe Reservation (n=8 yrs, α level = 0.10).

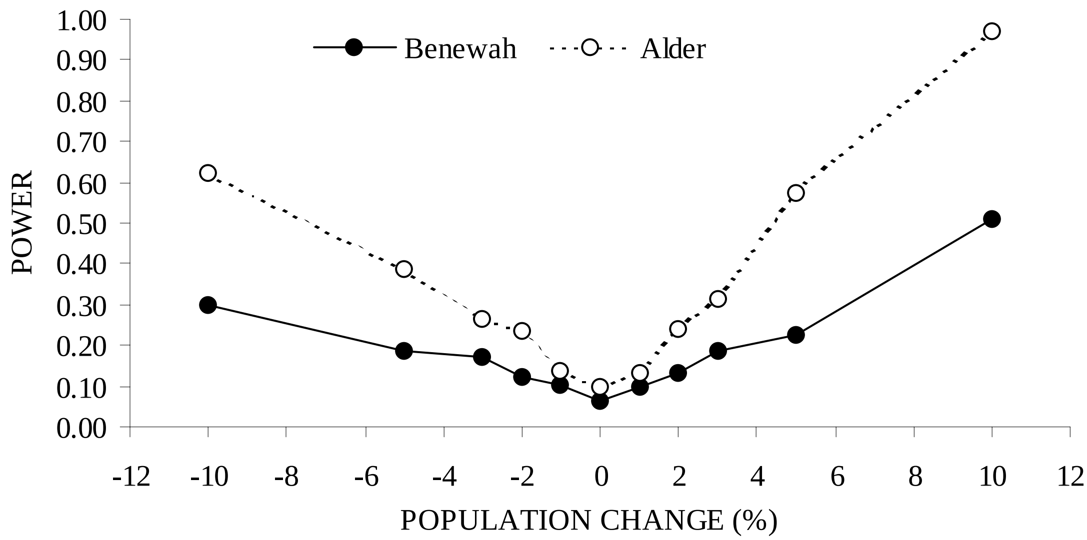


Figure 9. Power to detect annual changes in brook trout populations in two streams on the Coeurd' Alene Tribe Reservation (n=8 yrs, α level = 0.10).

Trout Migration

Migrant traps were installed in Lake and Benewah creeks beginning with upstream traps being deployed March 15 in both creeks (*Table 9*). Downstream migrant traps were installed in both creeks one month later (*Table 9*). The upstream traps were not fished or were not effectively fishing due to high discharge for most days from March 15 through April 10 in both creeks. The Benewah and Lake Creek downstream traps were fishing was 100% and 99% of the time respectively (*Table 9*).

Table 9. Dates of trap deployment and trapping effort for adfluvial westslope cutthroat trout in Benewah and Lake creeks, 2003.

System	Trap Direction	Installed	Removed	Days Fishing (% of total)	Days Not Fishing (% of total)
Benewah	Upstream	3/15/03	6/15/03	81 (88%)	11 (12%)
	Downstream	4/12/03	6/15/03	64 (100%)	0 (0%)
Lake	Upstream	3/15/03	6/17/03	83 (88%)	11 (12%)
	Downstream	4/12/03	6/17/03	67 (99%)	1 (1%)

A total of 2,760 juvenile westslope cutthroat trout were captured in the downstream (outmigrant) trap in Lake Creek. The number of juvenile outmigrants captured per day at the downstream trap was negatively correlated with water temperature, r= –0.546, P<0.001, n=60 (*Figure 10*). Thirty-seven westslope cutthroat trout were captured the first day of trap deployment suggesting that earlier migrants were not captured. The highest number of juvenile Westslope cutthroat trout caught in a 24-hour period was 151 on May 2 (*Figure 10*). The number of juvenile outmigrants declined in early June and only one fish was captured in the downstream trap during the last week the trap was deployed (*Figure 10*). The age composition of outmigrating juvenile westslope cutthroat trout was; age 1+ (2.8%), age 2+ (78.7%), age 3+ (18.2%) and age 4+

(0.3%), (*Figure 11*). The number of age 1+ fish is likely underestimated due to the mesh size of the weir, which likely does not capture the smallest one-year old fish. Age 3+ westslope cutthroat trout migrated sooner than the age 2+ and 1+ fish (*Figure 12*). Fifty and ninety percent of the age 3+ fish were captured in the trap by April 28 and May 18 respectively (*Figure 12*). In contrast, fifty and ninety percent of the age 2+ fish were captured in the trap by May 5 and May 27 respectively (*Figure 12*).

Although trapping effort and trap deployment timing was nearly identical in Benewah and Lake creeks, the total number of juvenile outmigrants captured in Benewah Creek (31) was only 1.1% of the number of fish caught in Lake Creek (*Figure 13*). The age composition of outmigrating juvenile in Benewah Creek was age 1+ (0.0%), age 2+ (35.5%), age 3+ (54.8%) and age 4+ (9.7%). Even though age composition in Benewah juvenile outmigrants differs from Lake Creek, the small sample size from Benewah Creek confounds any statistical comparison.

In Lake Creek 105 adult westslope cutthroat trout were caught in the downstream (outmigrant) trap compared to one fish being caught in the upstream trap. The adults caught in downstream trap were post-spawn fish assumed to be leaving Lake Creek and entering Coeur d'Alene Lake. Four westslope cutthroat trout were captured the first day of trap deployment suggesting that earlier post-spawn migrants were not captured. The number of post-spawn outmigrants captured per day was not significantly correlated with water temperature, $r=0.085$, $P> 0.50$, $n=66$ (*Figure 14*). In addition, outmigration timing was spread across a broad time and temperature range Forty two percent of the total 105 adults captured in the outmigrant trap were caught prior to May 1 (*Figure 14*). The highest number of post-spawn adults caught in a 24-hour period was 20 fish on two occasions, April 29 and May 30 respectively (*Figure 14*). The age composition of post-spawn adults westslope cutthroat trout was; age 6+ (39.0 %), 7+ (57.1%) and 8+ (3.9%), (*Figure 15*). No age 5+ fish were captured in downstream or upstream traps. Older fish (age 8+) migrated out of Lake Creek later than age 7+ and 6+ fish (*Figure 16*).

In Benewah Creek 27 adult westslope cutthroat trout were caught in the outmigrant trap compared to four fish being caught in the upstream trap. The number of post-spawn outmigrants captured per day was not significantly correlated with water temperature, $r= -0.14$, $0.2< P< 0.50$, $n=63$ (*Figure 17*). Sixty seven percent of the total 27 adults captured in the outmigrant trap in Benewah Creek were captured prior to May 1, with 13 fish being captured on April 29 (*Figure 17*). Unlike Lake Creek, only 10% of the post-spawn outmigrants in Benewah Creek were caught in late May and into June. The age composition of post-spawn adults westslope cutthroat trout was; age 5+ (14.8 %), 6+ (59.3 %), 7+ (14.8%) and 8+ (11.1%).

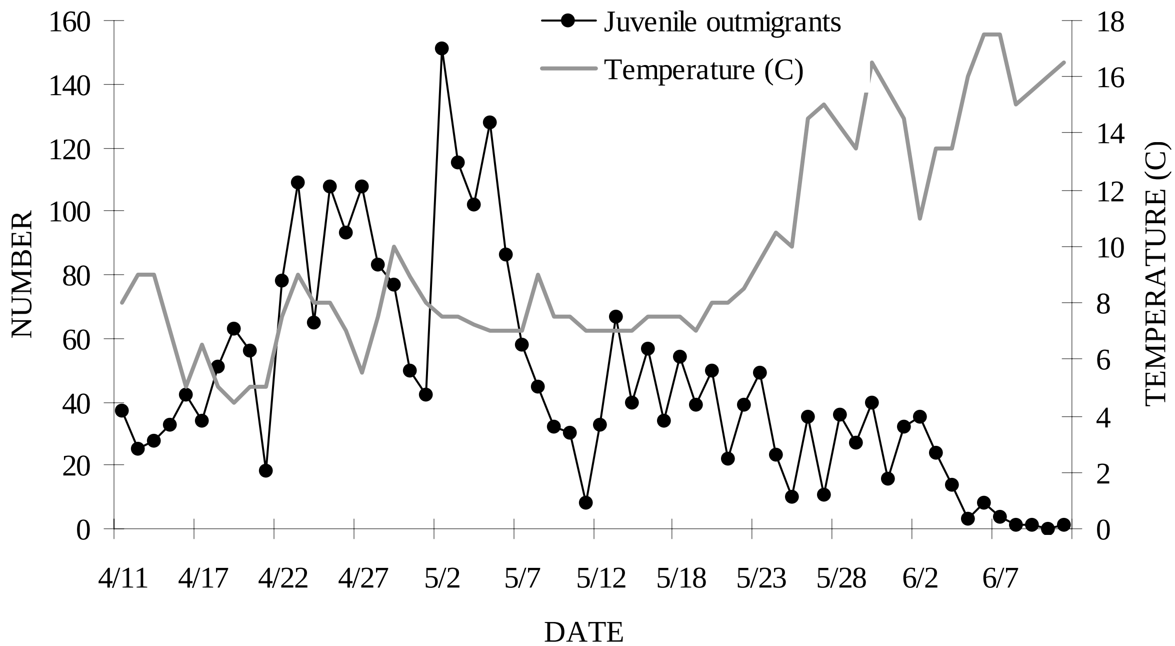


Figure 10. Number of outmigrating juvenile westslope cutthroat trout captured per day in the downstream trap in relation to water temperature in Lake Creek, 2003. Total number

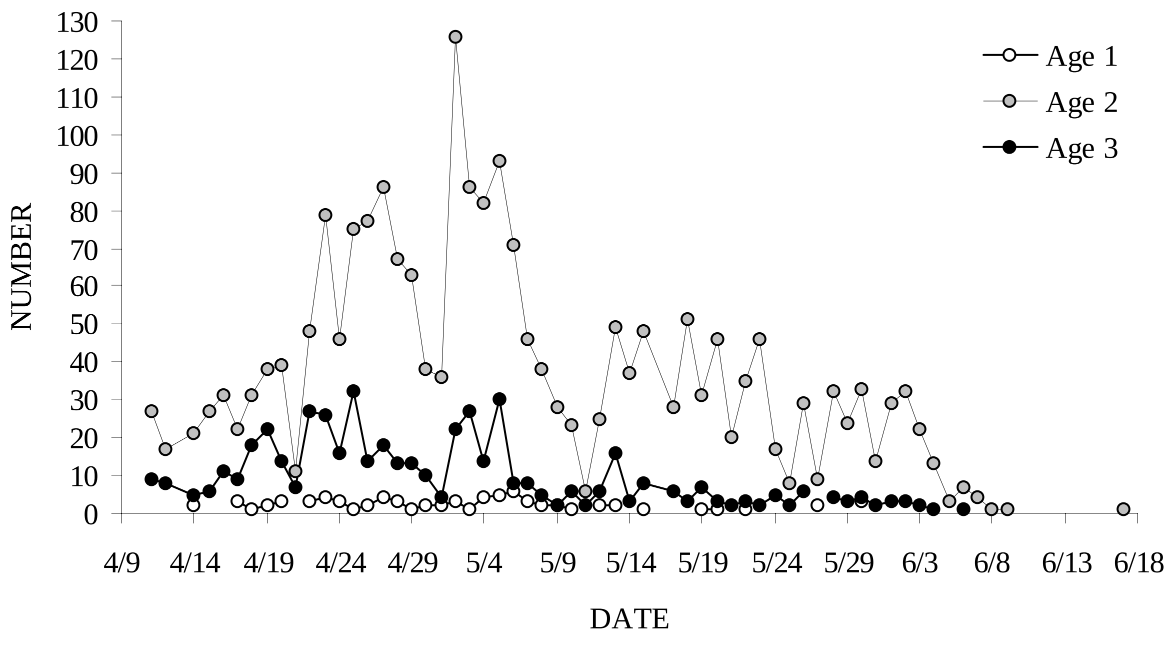


Figure 11. Number of juvenile westslope cutthroat trout captured in the outmigration trap in lower Lake Creek, 2003. An additional ten age 4+ juveniles were captured but not included in the figure. Age 1+ (n=76), age 2+ (n=2,173), age 3+ (n=501), age 4+ (n=10).

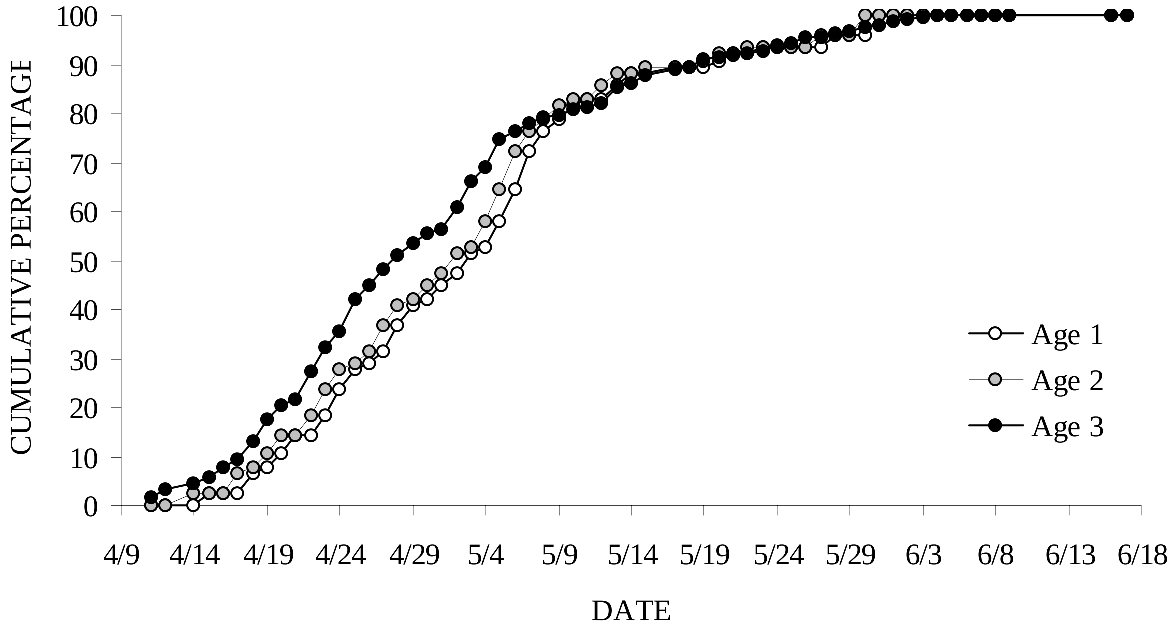


Figure 12. Timing of outmigrating juvenile westslope cutthroat trout in Lake Creek, 2003.

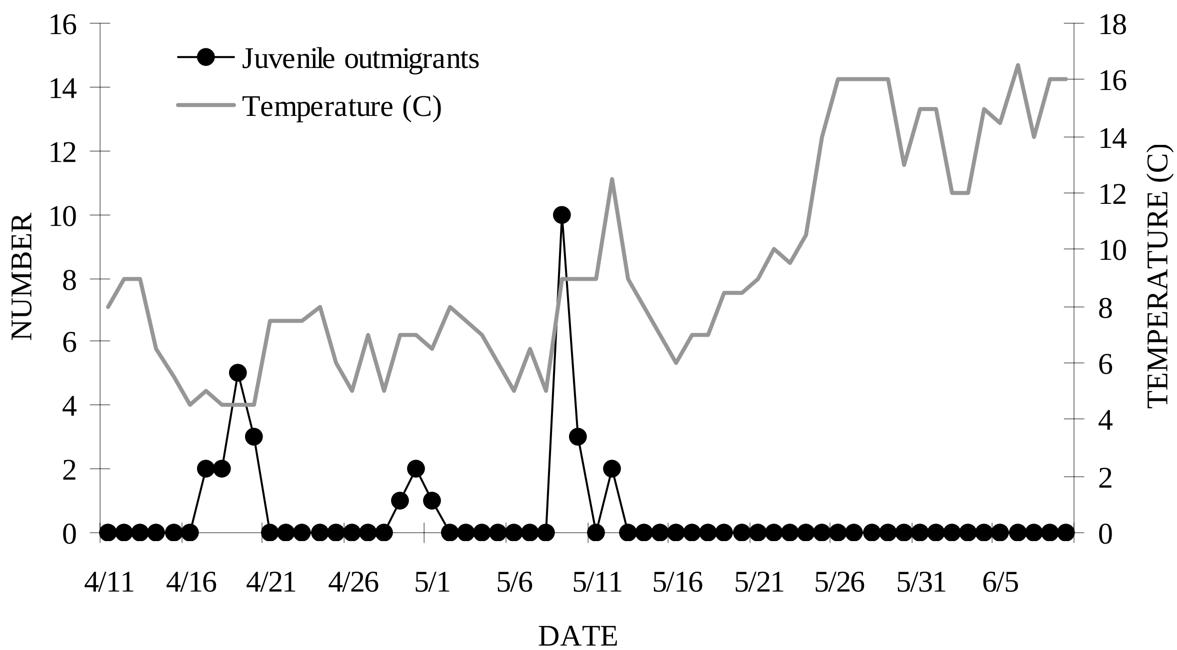


Figure 13. Number of outmigrating juvenile westslope cutthroat trout captured per day (ages 1-4) in relation to water temperature in Benewah Creek, 2003. Total number captured = 30 (ages 1-4).

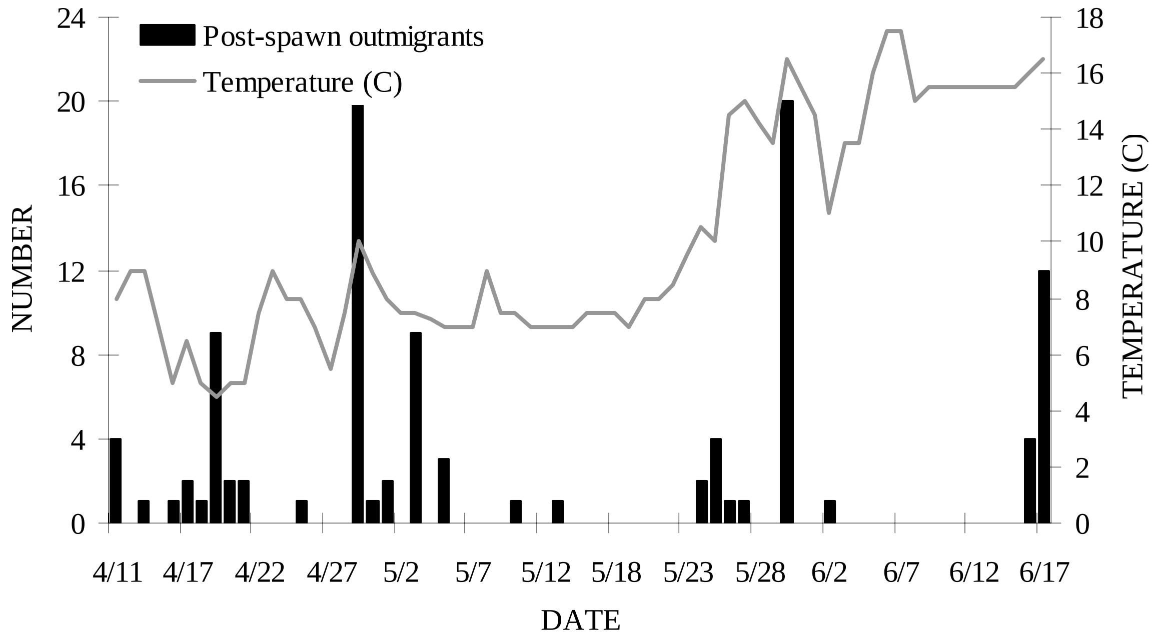


Figure 14. Number of outmigrating, post-spawn westslope cutthroat trout captured per day in relation to temperature of Lake Creek, 2003. Total number captured = 105 (ages 6-8).

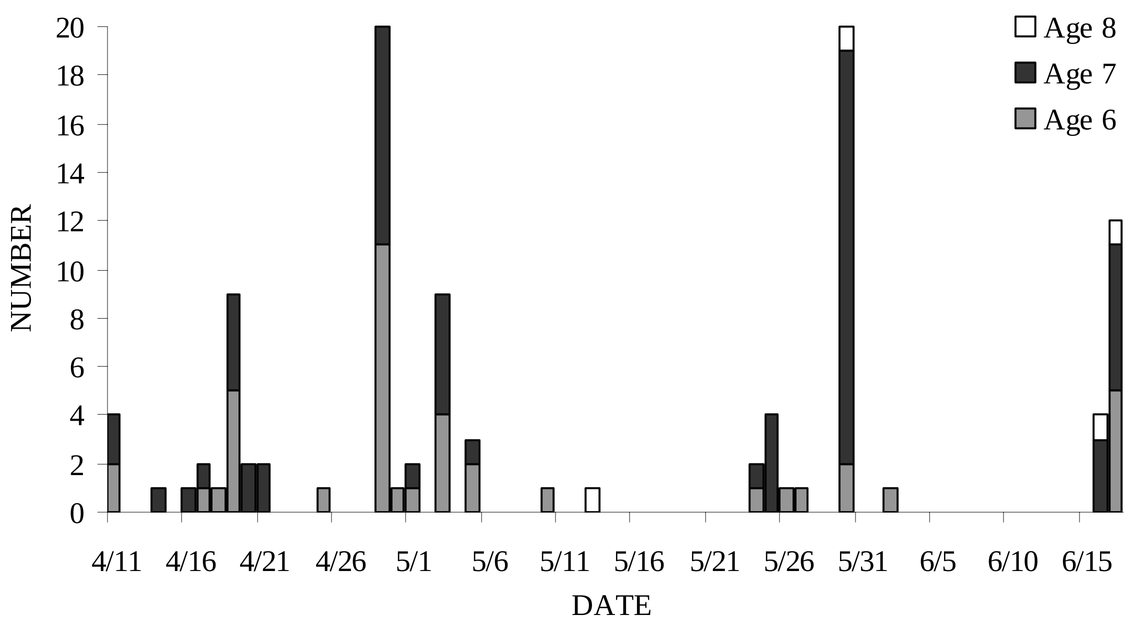


Figure 15. Number of post-spawn westslope cutthroat trout captured in the outmigration trap in lower Lake Creek, 2003. Age 6+ (n=41), age 7+ (n=60), age 8+ (n=4).

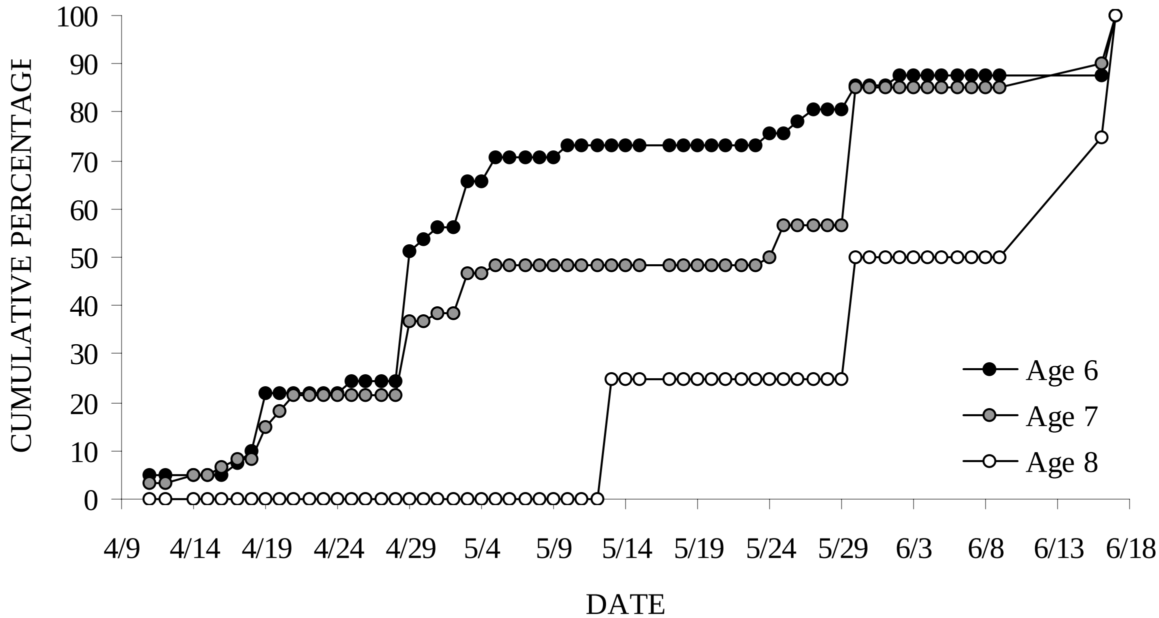


Figure 16. Timing of outmigrating, post-spawn westslope cutthroat trout in Lake Creek, 2003.

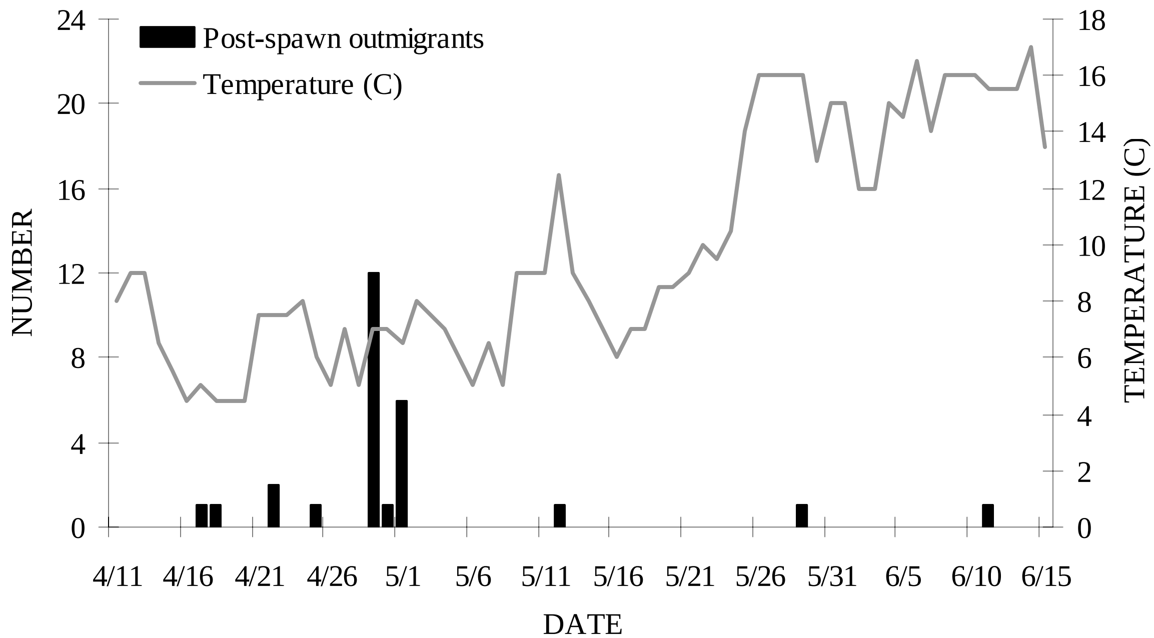


Figure 17. Timing of outmigrating post-spawn westslope cutthroat trout in relation to temperature of Benewah Creek, 2003.

Trout Growth

The length, weight and condition factor separated by age for westslope cutthroat and brook trout sampled during population estimates is presented in ***Appendix Tables A1-A4*** and *Figures 18-20*. Length, weight and condition factor data was tested for normality prior to applying statistical tests. Most data sets were non-normal and the non-parametric Kruskall-Wallis test was selected to compare age classes between the four streams. Although a few age 5+ and age 6+ fish were captured, sample size was too small to perform statistics ***Appendix Tables A1-A4.*** Thus, age 1+ through age 4+ fish were included in the statistical analyses. Total length of age1+ and age 3+ fish was significantly different between the systems with age 1+ Benewah cutthroat trout being larger than Alder, Evans and Lake creeks (*Figure 18*). Age 3+ cutthroat trout from Evans Creek were significantly larger than Benewah and Lake creeks but not different from Alder Creek fish (*Figure 18*). Length did not differ between systems for age 2+ and 4+ fish (*Figure 18*). Weight of age1+ and age 3+ fish was significantly different between the systems with age 1+ Benewah cutthroat trout weighing less than trout in Alder, Evans and Lake creeks (*Figure 19*). Age 3+ cutthroat trout from Evans Creek weighed significantly more than trout from Benewah, Lake and Alder creeks (*Figure 19*). Weight did not differ between systems for age 2+ and 4+ fish (*Figure 19*). Condition factor of age3+ fish was significantly different between Benewah and Lake creeks (*Figure 20*). Condition factor did not differ between systems for age 1+, 2+ and 4+ fish (Figure 20).

The length, weight and condition factor separated by age for brook trout sampled during population estimates is presented in ***appendix tables A5 and A6*** and *Figures 21-23*. Length, weight and condition factor data was tested for normality prior to applying statistical tests. The data brook trout data sets from Benewah Creek were not normally distributed and the non-parametric Mann-Whitney test was selected to compare age classes between Benewah and Alder Creeks. Similar to the cutthroat trout analysis only age 1+ through age 4+ fish were included in the statistical analyses. Total length of brook trout did not differ between Benewah and Alder creeks for any of the age classes tested (*Figure 21*). Brook trout in Benewah Creek were consistently heavier than Alder Creek fish for all age classes (*Figure 22*), and significantly heavier for age 1+ and 4+ fish (*Figure 22*). The condition factor of all age classes of brook trout in Benewah Creek was significantly higher compared to Alder Creek fish (*Figure 23*).

All age classes of westslope cutthroat and brook trout from each stream were combined for the length to weight regression analysis presented in (*Table 10*)**.** The analysis of covariance (ANCOVA) of westslope cutthroat trout length to weight regression slopes revealed a significant difference between the four systems, F= 3.81, $0.005<P<0.01$. A Tukey multiple comparisons test (Zar 1999) revealed the length to weight relationship slope of Alder Creek cutthroat trout was significantly different from the other three systems (*Table 11*). The ANCOVA of brook trout length to weight regression slopes between Benewah and Alder Creek was not significantly different, t= 1.70, $0.05<P<0.10$.

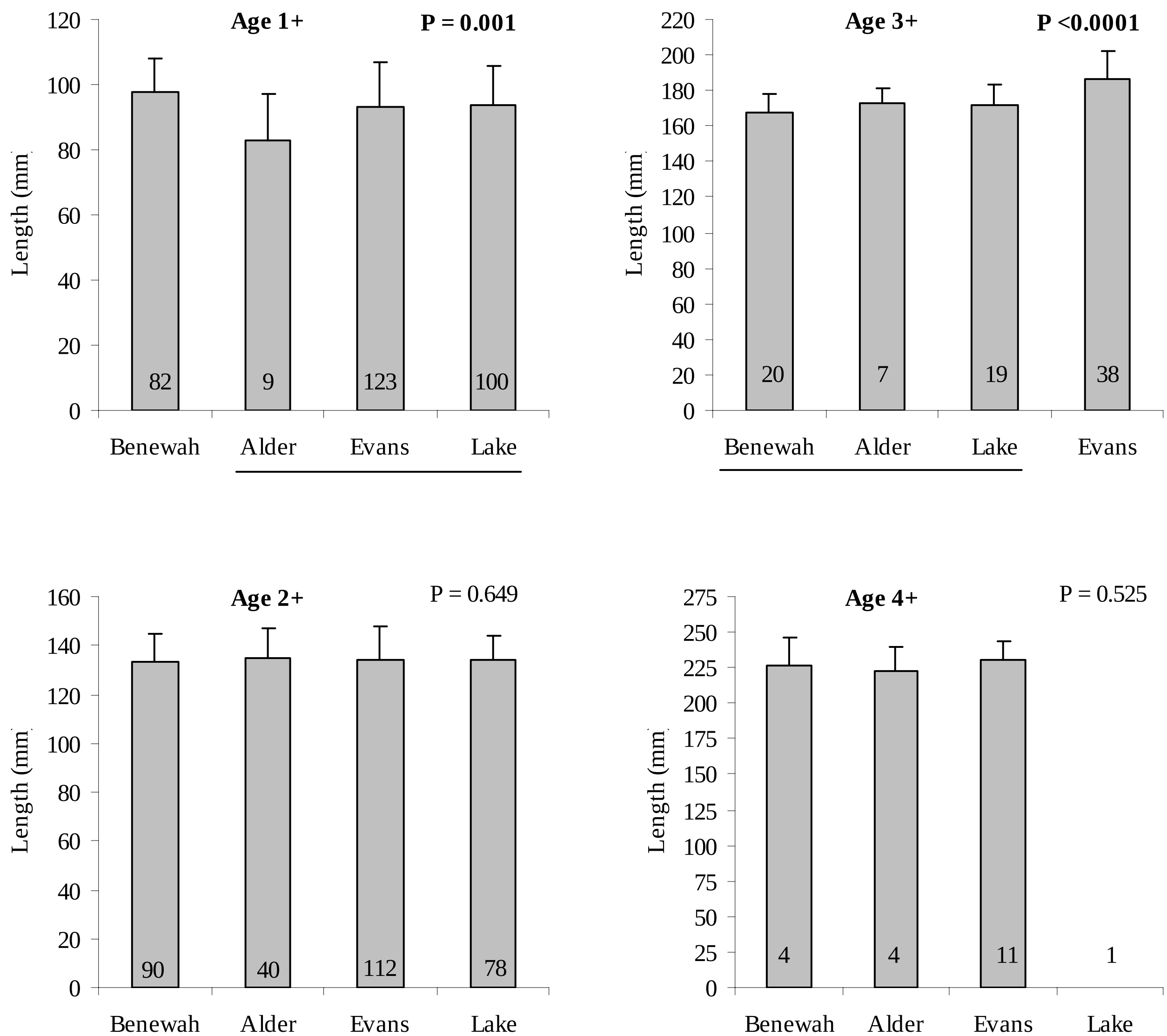


Figure 18. Total length (mean ± SD) of westslope cutthroat trout collected during summer population estimate surveys in Benewah, Alder, Evans and Lake creeks. The sample size for each age is located in individual bars. A Kruskall-Wallis test (α=0.05) was done for each age category (significant P-values in bold). A significant result was followed by a non-parametric multiple comparisons to separate differences among the streams. Horizontal lines under the x-axis labels indicate the streams where cutthroat trout length did not differ.

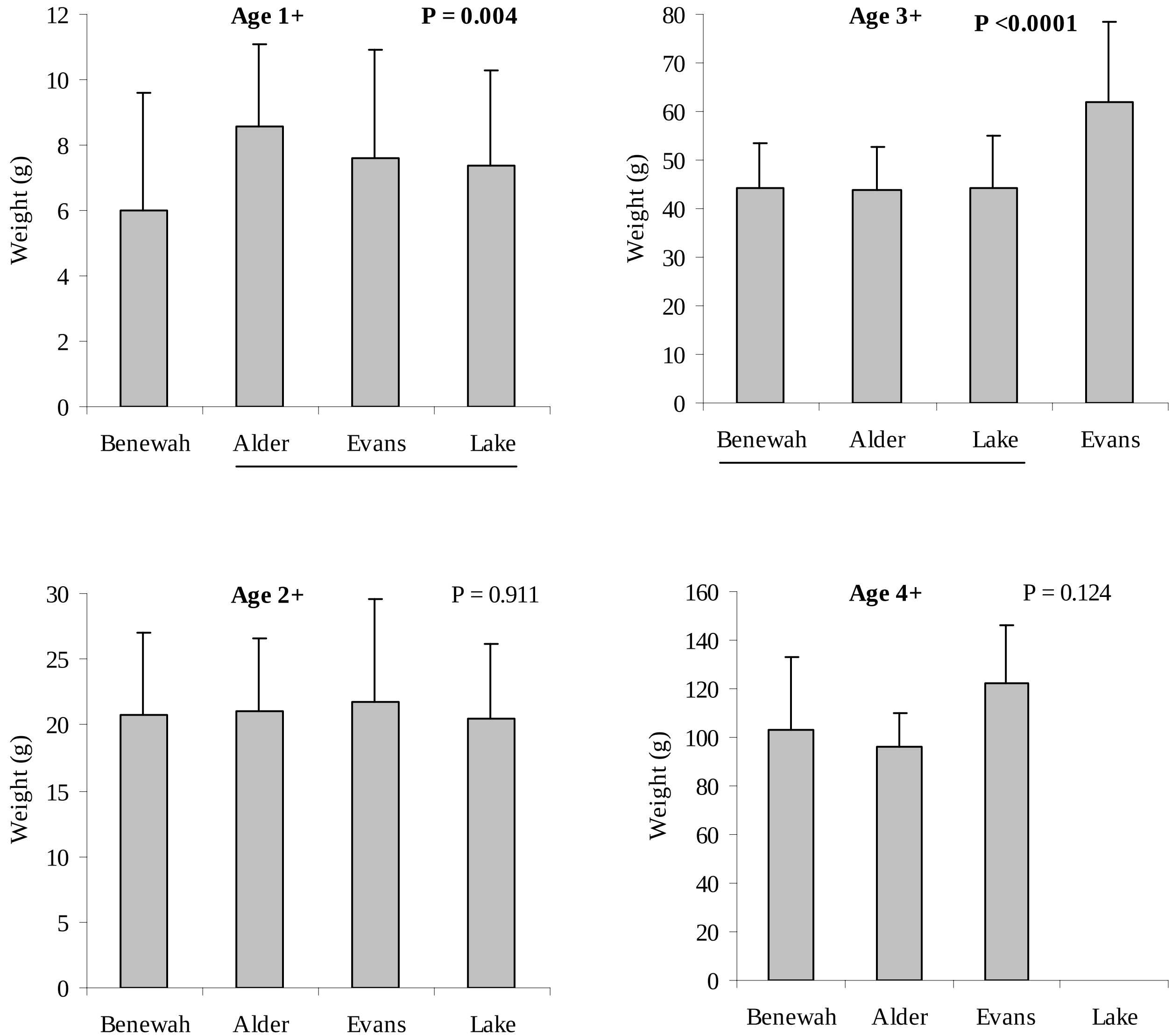


Figure 19. Weight (mean ± SD) of westslope cutthroat trout collected during summer population estimate surveys in Benewah, Alder, Evans and Lake creeks. Sample size is the same as reported in Figure 18. A Kruskall-Wallis test (α=0.05) was done for each age category (significant P-values in bold). A significant result was followed by a non-parametric multiple comparisons test to separate differences among the streams. Horizontal lines under the x-axis labels indicate the streams where cutthroat trout weight did not differ.

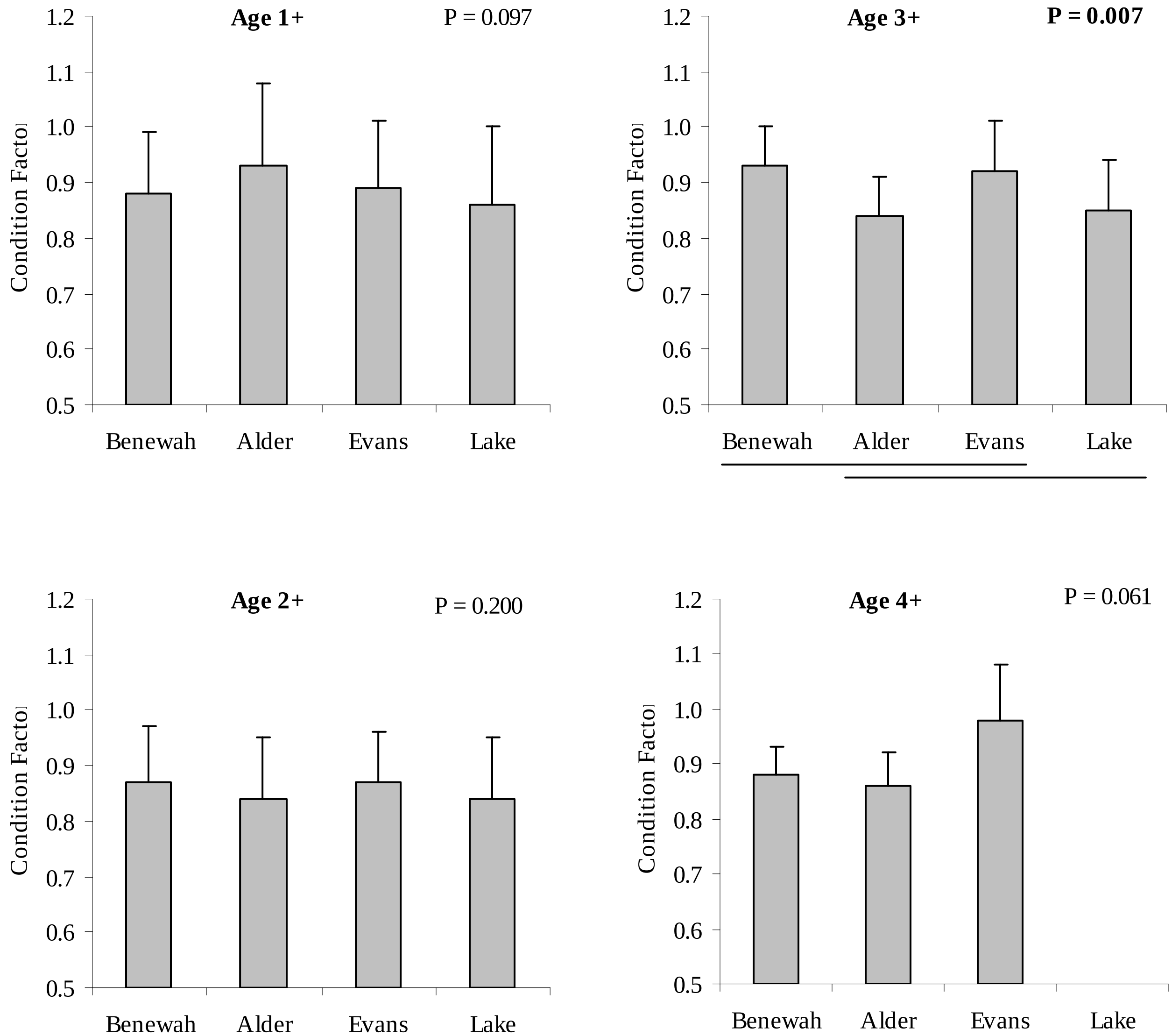


Figure 20. Condition factor (mean ± SD) of westslope cutthroat trout collected during summer population estimate surveys in Benewah, Alder, Evans and Lake creeks. Sample size is the same as reported in Figure 18. A Kruskall-WalliS (α=0.05) test was done for each age category (significant P-values in bold). A significant result was followed by a non-parametric multiple comparisons to separate differences among the streams. Horizontal lines under the x-axis labels indicate the streams where cutthroat trout condition factor did not differ.

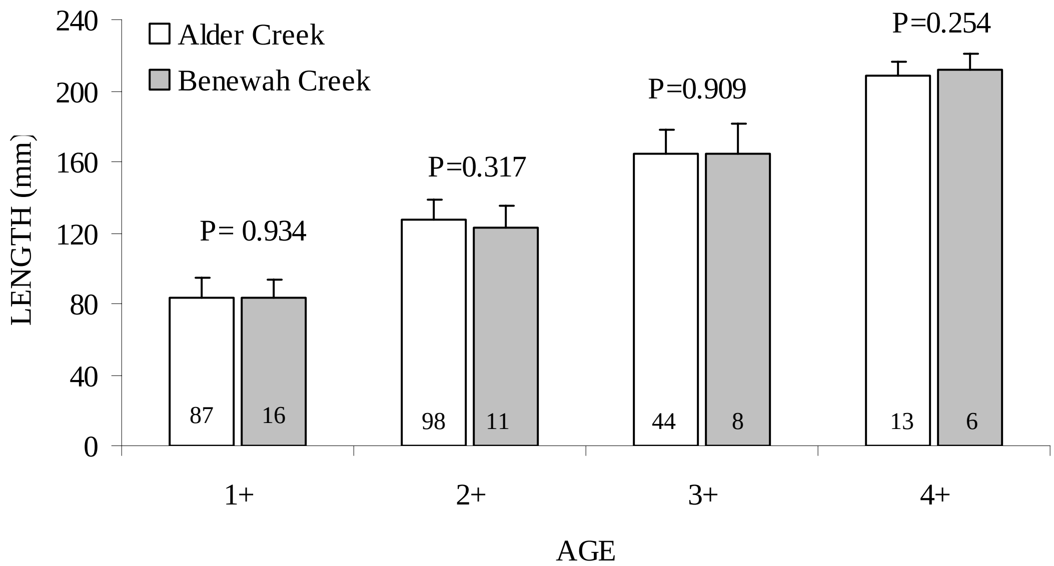


Figure 21. Total length (mean ± SD) of brook trout collected during summer population estimate surveys in Benewah, and Alder creeks. Sample size is located in individual bars. A Mann-Whitney test (α=0.05) was done for each age (significant P-values in bold).

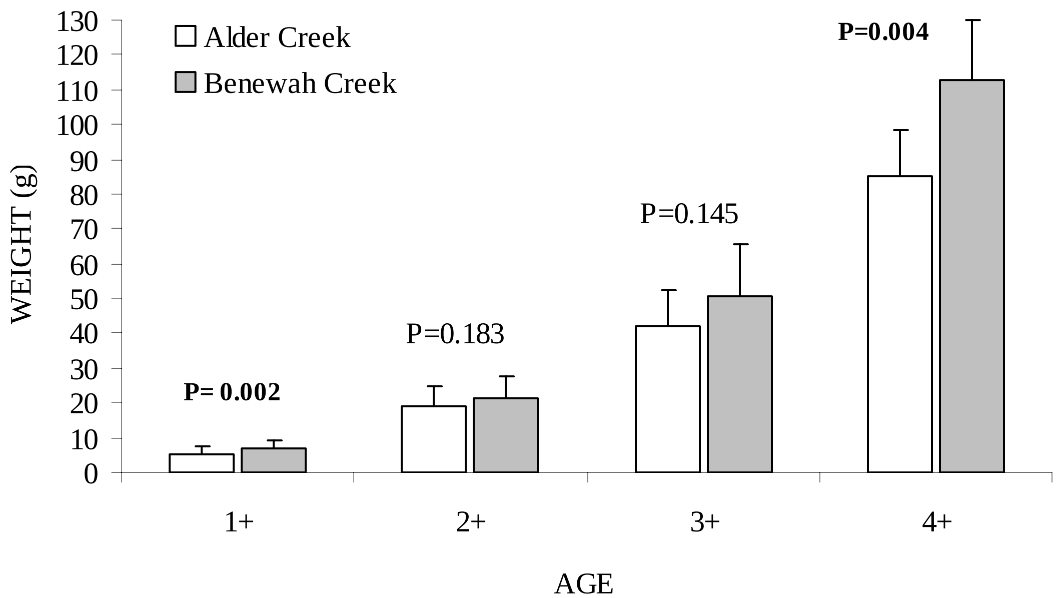


Figure 22. Weight (mean ± SD) of brook trout collected during summer population estimate surveys in Benewah, and Alder creeks. Sample size is the same as reported in Figure 21. A Mann-Whitney test (α=0.05) was done for each age (significant P-values in bold).

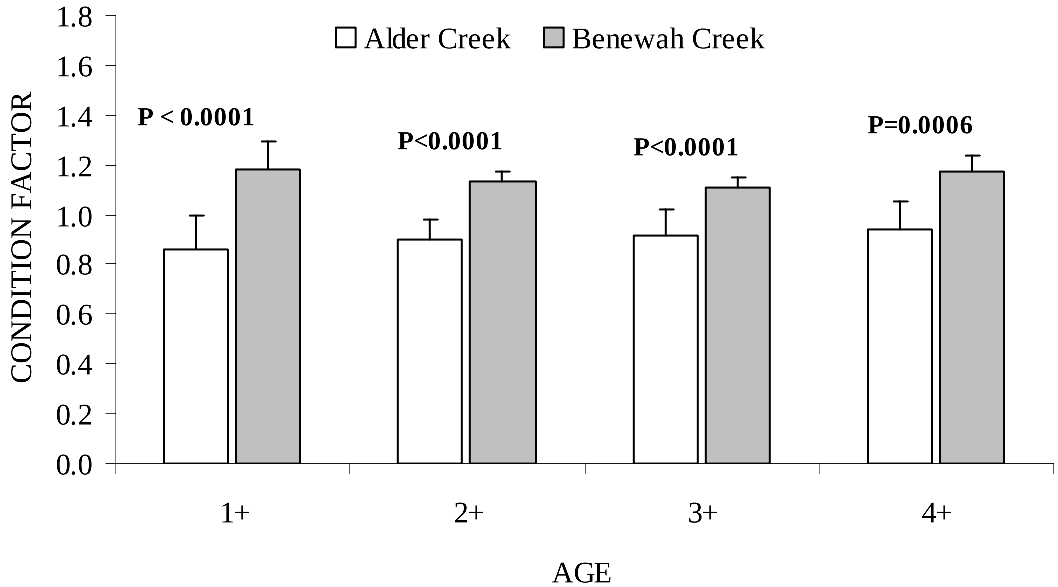


Figure 23. Condition factor (mean ± SD) of brook trout collected during summer population estimate surveys in Benewah, and Alder creeks. Sample size is the same as reported in Figure 21. A Mann-Whitney test (α=0.05) was done for each age (significant P-values in bold).

Table 10. Relationship between $\log_{10}$ total length and $\log_{10}$ weight for westslope cutthroat and brook trout sampled by electrofishing four streams during summer 2003.

System	Species	n	Intercept	Slope	r^2	P
Alder	westslope cutthroat trout	61	-5.043	2.988	0.979	<0.0001
Benewah		236	-4.934	2.942	0.989	<0.0001
Evans		387	-5.010	2.981	0.988	<0.0001
Lake		247	-5.199	3.060	0.982	<0.0001
Alder	brook trout	258	-5.172	3.059	0.985	<0.0001
Benewah		47	-4.899	2.980	0.997	<0.0001

Table 11. Multiple comparisons (Tukey test) of the slopes from the length to weight relationships of cutthroat trout sampled during population estimate surveys in Alder, Benewah, Evans and Lake creeks, summer 2003. Critical q value at α 0.05, = 3.63, significance in bold.

Ho: $\beta_A=\beta_B$	Pooled residual MS	SE	q	Accept Ho:
Alder = Benewah	0.129	0.017	**6.07**	reject
Alder = Evans	0.235	0.022	**5.50**	reject
Alder = Lake	0.158	0.019	**7.95**	reject
Benewah = Evans	0.213	0.013	1.32	accept
Benewah = Lake	0.158	0.013	**3.69**	reject
Evans = Lake	0.225	0.014	2.15	accept

Water Quality Monitoring

Stream Water Quality

Stream flow

There were 16 stream sites monitored for discharge during 2003. Summarized instantaneous flow measurements for all sites with data are given in ***Table B-1*** in Appendix B. Due to scheduling problems and personnel changes, only four dates were sampled: one each in late January, late July, mid-August and late September. Also, since only five sites were measured in January, it is not possible to make a complete analysis of annual variations in most cases. The highest recorded discharge was 1,160 cfs on 1/29/03 at the Three Mile Benewah Creek site. This value was not measured, it was calculated based on a staff gauge reading and cross sectional profile. As seen in ***Table B-1***, however, measured January discharges were highest for all stations that were monitored at this time: Alder Creek was 145.9 cfs, N.F. Alder was 18.14 cfs, Evans Creek was 35.48 cfs and Lower Lake Creek was 157.00 cfs. During the July to September period, stream discharges were 0.20 to 0.48 cfs in the Alder Creek system, 0.03 to 1.59 cfs in the Benewah Creek sites, 0.15 to 2.11 in the Evans Creek system and 0.07 to 0.54 in Lake Creek sites (only two measurements).

Temperature

Discrete temperature data was collected using the Hydrolab on at least one date at all 20 sites during 2003 (see ***Table B-2***). As would be expected, temperatures were lowest during January, within the range 3.01 to 6.05 ºC at the eight sites monitored at that time. The highest temperatures in this limited data set were seen during the July monitoring event, these falling within the range 12.15 to 22.36 ºC overall (18 sites). The highest temperature was seen at the Three Mile Benewah site. Stream temperatures fell slightly (1.4 ºC on average) between July and August at all sites except Three Mile Benewah and Evans Creek. The highest recorded temperature during the August sampling was 22.78 ºC at Three Mile Benewah. Temperatures dropped more noticeably between August and September (6.3 ºC on average) with the highest recorded temperature being 12.46 ºC at the N.F. Alder Creek site. (Note that there were no monitoring data from the Evans or Lake Creek sites in September).

Continuous temperature recorders (RL100's) were placed at the nine sites listed in *Table 12*. Note that RL100's collecting hourly data reach their available memory capacity in approximately 75 days with readings every hour. Due to staffing changes, there was a gap in the data during June 2003 because RL 100 units were not collected, downloaded and replaced as quickly as planned.

The graphs of the seven-day averages of maximum daily temperatures appear in Figures B-5 through B-13 in Appendix B. High temperatures seen in the continuous data set are summarized in Table 12. From this it can be seen that seasonal highs occurred consistently during the period 7/21 through 8/6 at all continuously monitored sites except Schoolhouse Creek, where the highs were somewhat earlier; between 6/30 and 7/18. This consistency shows the overwhelming influence of regional weather patterns. Seasonal high temperatures exceeded 20 ºC at the Alder, Nine Mile Benewah, Upper Benewah, Lower Lake and Bozard Creek sites. Cutthroat trout Suitability Index values (following Hickman & Raleigh 1982) are less than 0.4 at these temperatures. Seasonal high temperatures were generally between 14 ºC and 16 ºC at the Schoolhouse, Upper Evans and E. Fork Evans Creek sites; these temperatures yielding Suitability Index values near 1.0 for cutthroat trout.

Table 12. Seasonal high temperatures from continuous recorders in stream sites monitored by the Coeur d'Alene Tribe, 2003.

STREAM SITES	**General High Temp. (deg. C)**	**Dates**	**Single Highest Temp. (deg. C)**	**Dates**
Alder Cr.	> 24	7/22 - 8/1	24.5	7/23
Nine Mile Benewah Cr.	> 23	7/21 - 8/1	23.6	7/27
Schoolhouse Cr.	> 15	6/30 - 7/4 & 7/11 - 7/18	15.6	7/2 & 7/13-14
Upper Benewah Cr.	> 21	8/1 - 8/2	21.6	8/1
Evans Cr	> 18	7/22 - 8/2	18.7	7/28
Upper Evans Cr.	> 14	7/24 - 8/5	14.4	7/27 - 8/1
E. Fork Evans Cr.	> 15	7/23 - 8/6	15.9	8/1
Lower Lake Cr.	> 24	7/24 - 8/2	24.9	8/1
Bozard Cr.	> 21	8/1 - 8/2	21.6	8/1

Dissolved Oxygen

Dissolved oxygen (DO) values measured at the stream sites were highest in January; within the range 11.44 to 13.11 mg/L, and an overall mean of 12.26 mg/L, at the eight sites monitored (see Table B-3). During July, the DO of most sites was still high -- between 9 and 10 mg/L, although the overall mean had dropped to 9.09 mg/L. Notable exceptions to the 9 to 10 mg/L range were a 3.05 mg/L in Schoolhouse Creek, a 7.06 mg/L at Whitetail Creek and 8 to 9 mg/L at the three Lake Creek sites. These exceptions continued into August with a 2.13 mg/L DO at Schoolhouse, a 5.16 mg/L at Whitetail and, again 8 to 9 mg/L at the Lake Cr. sites. Otherwise the range in measured DO in August was 9 to 10 mg/L. DO values appeared to rise somewhat in September, although neither the Evans Creek or Lake Creek sites were monitored then. Except for a 4.8 mg/L reading at the Schoolhouse Creek site, most other readings were in the range of 10 to 12 mg/L. These DO levels generally would be supportive for cutthroat trout since DO values above 9.0 mg/L provide a Suitability Index of 1.0. The DO values less than 5.0 mg/L during the late growing season when temperatures are high result in Suitability Index values of 0.

pH

The overall range in pH values recorded at the stream sites during 2003 was 6.10 to 8.72 (see Table B-4). The lowest values (6.1 to 6.6) were measured during January and the highest (6.8 to 8.7) were during both July and August. Only two values above 8.0 were measured: 8.66 in Three Mile Benewah in July, and 8.72 at that same site in August. The range of pH values measured during the reporting period are not considered limiting to cutthroat trout and yield Suitability Index values greater than 0.7.

Specific Conductance

The overall (all sites) mean of measured Specific Conductance (SC) values was lower during January than during the July through September period: 17 µS/cm versus 41 - 50 µS/cm (see Table B-5). The low value in January was 9.4 µS/cm at the N.F. Alder Creek site and the high at this time was 47.7 µS/cm at the Lower Lake Creek site. During July through September the low values was 12.9 µS/cm at the Upper Evans Creek site in July and the high was 146.3 µS/cm at Whitetail Creek in August. There was a notable consistency (i.e. limited range of values) in the SC seen at each site during the July through September period. As examples, the Alder Creek site ranged from 56 to 63 µS/cm, the Three Mile Benewah ranged from 33 to 43 µS/cm, Whitetail Creek ranged from 91 to 146 µS/cm and Upper Benewah ranged from 20 to 27 µS/cm. (This consistency could not be seen in the Evans or Lake Creek sites since there was no monitoring conducted at these sites in September. The overall range in SC seen during 2003 is not expected to adversely effect trout habitat although no Suitability Index information exists to measure this.

Total Suspended Solids
Sampling for laboratory analyses, including Total Suspended Solids (TSS), was conducted only sporadically during 2003 so few overall conclusions can be drawn from the data (see Table B-6). The overall range in TSS values seen was <2 mg/L, at several sites during August and September, to 126 mg/L at the Gore Creek site in September.

Turbidity
Turbidity data collected for this project is shown in Table B-7. The overall range in values seen was 0.63 to 98.1 NTUs, with both of these being from August. While there was a great variation in values seen across the dates and sites, the majority of results were less than 5 NTUs.

Nitrate
Nitrate nitrogen data (Table B-8) were highest during January 2003 and decreased through September. This is illustrated by the monthly high values: in January the highest nitrate result was 2.38 mg/L at the Lower Lake Creek site, in August the highest was 0.10 mg/L at the W.F. Benewah and in September the highest was 0.01 mg/L also at W.F. Benewah. In January no results were below the analytical detection limit of 0.01 mg/L. During August, however, five out of 14 results were below detection (<0.01 mg/L) while in September eight out of nine results were below detection.

Nitrite
All samples collected for laboratory analyses had nitrite nitrogen concentrations below the analytical detection limit (<0.01 mg/L, see Table B-9).

Total Kjeldahl Nitrogen
Nitrogen present in organic compounds is determined using the Kjeldahl analysis. The results of this seen in the 2003 data (Table B-10) were somewhat higher in January samples than in August or September (there were no results from July). The range of values seen in January was 0.08 to 0.85 mg/L (with an average of 0.40 mg/L); the range in August was 0.11 to 0.56 mg/L (with an average of 0.33 mg/L) and the range in September was 0.09 to 0.50 mg/L (with an average of 0.21 mg/L. There was no apparent consistency in the location of either the high or low values.

Total Phosphorus
Total phosphorus data is shown on Table B-11. The range in values seen in the limited data set was 0.012 to 0.226 mg/L. The highest value was found at the Three Mile Benewah Creek site in January and the second highest was at the N.F. Alder Creek site in September.

Dissolved "ortho" Phosphorus
Ortho Phosphorus data are presented in Table B-12. Twenty three of the 31 test results (including all results from August samples) were below the analytical detection limit of 0.01 mg/L. Of the remainder, the highest apparent concentration was 0.03 mg/L, this being found at several sites in both January and September.

Chloride
Compiled chloride data is shown in Table B-13. Most of the reported values were less than 1.0 mg/L, typically 0.40 to 0.90 mg/L. Two sites had more than one result that was greater than 1.0 mg/L: Whitetail Creek was 2.06 and 1.63 mg/L in August and September, respectively, and Lower Lake Creek was 3.00 and 3.38 in January and August, respectively. The Lower Lake results were the highest chloride concentrations seen during 2003.

Fluoride
Fluoride levels, shown in Table B-14 were low and in 18 of the 32 total samples submitted for analysis, were below the analytical detection limit of 0.05 mg/L. The highest result seen was in the January samples was 0.06 mg/L at the Evans Creek site; the highest in August was 0.013 mg/L at the Lower Lake Creek site and the highest in September was 0.019 mg/L at the Schoolhouse Creek site.

Sulfate
Sulfate data are shown in Table B-15. All results for the year were within the range 0.97 to 5.42 mg/L and the averages of the three months that had more than one result were 2.0 to 2.1 mg/L. The highest sulfate concentration seen in the January and August data (5.42 and 4.92 mg/L, respectively) were found at the Lower Lake Creek site. The highest from September was 4.19 mg/L at the Whitetail Creek site, which also had a high value (4.77 mg/L) in August. The stated range of values is not expected to have an adverse impact on trout growth or habitat.

Physical Habitat Monitoring

The channel characteristics described below were summarized from the Spreadsheets graphs and calculations. All data will eventually be used to document the effectiveness of restoration measures implemented for the BPA project. The descriptions below are intended to provide an overview of the ranges of parameter values seen in the 2003 data.

Habitat Typing
Table 13 presents a summary of the habitat typing work performed at the 22 stream monitoring sites during 2003. The one Alder Creek site monitored was a run dominated site with almost 62% of the 500-foot length being classified as run habitat. Riffles were secondary at this site occupying 36 % with pools occupying only 2 %. There were no glides identified at this site.

The four Benewah Creek sites were split as far as dominant habitat type: two sites (9U and 14L) were run-dominated and two (13 and 14U) were pool dominated. Site 9 was interesting in that there was neither pool or glide habitat noted; this likely due to the bedrock that was present in the channel and also its slope (see below).

Four of the five Evans Creek sites (2, 3, 4 and 5) were riffle-dominated, while site 1 (the most downstream) was run-pool co-dominated. The dominance of riffle habitats in this watershed is most likely due to the slope, although this may not apply to site 4 (see below).

The Lake Creek sites were primarily pool dominated, in fact 10 out of the 12 sites monitored (all except Lake 7L and Bozard 3). Secondary habitat types were most frequently runs or glides although the two run-dominated sites had riffles as secondary types.

Table 13. Coeur d'Alene Tribe monitored stream sites and habitat typing results.

SITE	Riffle		Run		Pool		Glide	
	Length (ft)	Percent	Length (ft)	Percent	Length (ft)	Percent	Length (ft)	Percent
Alder, Site 12	180	36.0	309	61.8	11	2.2	0	0.0
Benewah, Site 9	224	44.8	276	55.2	0	0.0	0	0.0
Benewah, Site 13	81	16.2	40	8.0	306	61.2	73	14.6
Benewah, Site 14	69	13.8	112	22.4	278	55.6	41	8.2
Benewah, Site 14L	125	25.0	281	56.2	94	18.8	0	0.0
Evans, Site 1	50	10.0	236	47.2	214	42.8	0	0.0
Evans, Site 2	282	56.4	196	39.2	22	4.4	0	0.0
Evans, Site 3	240	48.0	67	13.4	179	35.8	14	2.8
Evans, Site 4	318	63.6	108	21.6	14	2.8	60	12.0
Evans, Site 5	323	64.6	66	13.2	55	11.0	56	11.2
Lake, Site 7L	134	26.8	181	36.2	54	10.8	131	26.2
Lake, Site 8U	0	0.0	0	0.0	432	87.3	63	12.7
Lake, Site 9U	39	7.8	27	5.4	335	67.3	97	19.5
Lake, Site 10	10	2	84	17.1	360	73.2	38	7.7
Lake, Site 11	6	1.2	233	46.6	261	52.2	0	0
Lake, Site 12	40	8.1	160	32.6	249	50.7	42	8.6
Lake, Site 13	26	5.3	19	3.9	438	90.1	3	0.6
Bozard, Site 1	64	13.2	92	18.9	260	53.5	70	14.4
Bozard, Site 2	94	18.8	93	18.6	204	40.8	109	21.8
Bozard, Site 3	138	28.2	209	42.7	83	16.9	60	12.2
W. Fk. Lake, Site 2	96	19.2	109	21.8	213	42.6	82	16.4
W. Fk. Lake, Site 3	102	20.4	119	23.8	244	48.8	35	7

Longitudinal Thalweg Profiles
The graphed longitudinal thalweg profiles appear in Appendix C. The data used to generate these graphs was also used to determine the channel slope within these study reaches. The slope, as described in the METHODS section, above, is based on the water surface elevation at similar habitat types located at, or near, the downstream and upstream ends of the study reach. While

the habitat types are identified in the field, the longitudinal profile graphs allow a verification of both the habitat type and the water depth so that the slope calculation is accurate.

The range of slopes seen in the longitudinal profiles was between 0.02% and 3.01%. The one Alder Creek site monitored had a slope of 1.1%. The four Benewah Creek sites had slopes between 0.29 and 0.67 so are considered fairly uniform. This would be expected since the four sites are all within the central portion of the watershed. The monitored sites in the Evans Creek watershed started with the low value stated above at Site 1, was between 1.36% to 1.43% at Sites 2, 3 and 4, and then increased to 2.04% at Site 5. The slope at Site 1 was actually controlled by the level of Medicine Lake throughout the studied reach. The Lake Creek main stem sites started at 0.68% at Site 7L, dropped to 0.37% at Site 8U and then 0.07% at Site 9U. Above Site 9U the slopes were 0.27 to 0.69% with the highest being at Site 12. The Bozard Creek slopes were essentially the same at Sites 1 and 2 (0.37% - 0.38%) but Site 3 had the highest slope of any monitored site (3.01%). The two West Fork Lake Creek sites had very similar slopes: 0.50% at Site 2 and 0.48% at Site 3.

Another stream morphological feature that becomes evident in the longitudinal profiles is the frequency, extent and depth of pools, relative to shallower water riffle, run or glide areas. The monitoring sites that were found to have a predominance of pool habitats were found primarily in the Benewah and Lake Creek watersheds. Exceptions were seen at Benewah, Site 9 and Bozard Site 3 which had minimal pool areas. Other sites that had minimal pools were Alder Creek, Site 1 and Evans Creek Sites 2, 3, 4 and 5. The Evans Site 1, Lake Site 7 and the two West Fork Lake Creek sites had intermediate levels of pool habitats.

Cross Section Profiles
Six cross sections were surveyed in each of the monitoring sites. The cross section locations are indicated on the longitudinal profile graphs included in Appendix C. Each of these cross sections was graphed in the Reference Reach Spreadsheet and certain key morphological parameters were calculated. Not all of the cross section graphs are included in this report in an effort to conserve space and the size of this document. Selected typical or exceptional cross section graphs are included in the text, below, and the averaged parameters are included in *Table 14*.

The data presented in *Table 14* are average values based on the bankfull elevation determined at each cross section. The exception to this is the wetted widths which are simply relics of the amount of water in the stream channel at the time of the survey, which was the low flow period. Wetted Width is not a morphological indicator and does not show on the cross section graphs, but is included in order to show how this compared with the bankfull width at one point in time.

The wetted widths of the monitored sites ranged from an average of 4.0 ft. at Lake, Site 13 to an average of 19.1 ft. at Benewah, Site 13. The individual minimum was 1.6 ft at cross section # 3 (a deeply entrenched area) and the individual maximum was 39.2 ft at cross section #2. The Benewah sites, overall, had the widest wetted widths while Bozard Creek and W. Fk. Lake Creek had the narrowest. The mean of all cross section wetted widths was 11.4 ft.

The bankfull widths ranged from a low site average of 8.0 ft at W. Fk. Lake Site 2, to a high of 51.9 ft at Evans, Site 2. Individual low and high values were 6.1 ft. at cross section #4 (see

Figure 22) and 69.9 ft at cross section #6 (see *Figure 23*). The average of all bankfull widths was 22.1 ft, or very close to twice the wetted widths, overall.

Table 14. Stream morphological characteristics determined from cross section survey data at Coeur d'Alene Tribe monitored sites, 2003. Stated values are the average of six cross sections per monitored reach. Measurement units in feet except Cross Sectional Area in square feet.

SITE	Wetted Width	Bankfull Width	Bankfull Wetted Perimeter	Bankfull Mean Depth	Cross Sectional Area
Alder, Site 12	12.2	24.4	25.7	1.1	25.1
Benewah, Site 9	18.7	39.2	40.4	1.8	68.0
Benewah, Site 13	19.1	24.9	27.8	2.0	48.1
Benewah, Site 14L	8.9	16.8	19.6	1.8	31.7
Benewah, Site 14U	16.6	28.7	31.4	2.2	62.0
Evans, Site 1	16.3	22.0	25.2	2.7	56.3
Evans, Site 2	14.0	51.9	52.0	0.9	41.1
Evans, Site 3	17.5	48.0	49.8	1.0	47.7
Evans, Site 4	13.1	26.2	27.9	1.5	39.1
Evans, Site 5	11.1	27.3	28.9	1.0	27.4
Lake, Site 7L	12.2	16.1	17.4	1.1	17.7
Lake, Site 8U	16.2	19.7	22.7	2.2	43.1
Lake, Site 9U	11.3	17.6	23.8	2.9	50.4
Lake, Site 10	13.2	18.4	23.5	3.1	57.4
Lake, Site 11	11.1	25.2	26.8	1.2	30.3
Lake, Site 12	6.9	14.3	19.6	2.1	27.6
Lake, Site 13	4.0	14.8	18.4	1.2	14.9
Bozard, Site 1	7.8	12.0	14.9	2.1	24.5
Bozard, Site 2	5.5	9.7	13.2	2.2	20.3
Bozard, Site 3	4.6	9.9	11.5	1.0	9.1
W.Fk. Lake, Site 2	4.9	8.2	11.3	1.2	9.5
W.Fk. Lake, Site 3	5.0	10.5	12.3	1.2	12.4

The wetted perimeter is the perimeter of the channel cross section formed by the bed and banks. Monitored site wetted perimeters ranged from a low average of 11.3 ft at W. Fk. Lake, Site 2 up to a high average of 52.0 ft. at Evans Creek, Site 2. Thus, wetted perimeters in these shallow streams are typically within a foot or two of the bankfull widths. Correspondingly, the lowest site mean depth was seen at Evans Creek, Site 2, where the maximum bankfull width and wetted perimeter were found. The highest mean depth, however, was at Lake Creek, Site 10, where the average was 3.1 ft and the highest individual measurement was 3.8 ft at cross section #4 (see

Figure 24). The average bankfull width and wetted perimeter at this site were 18.4 ft and 23.5 ft, respectively.

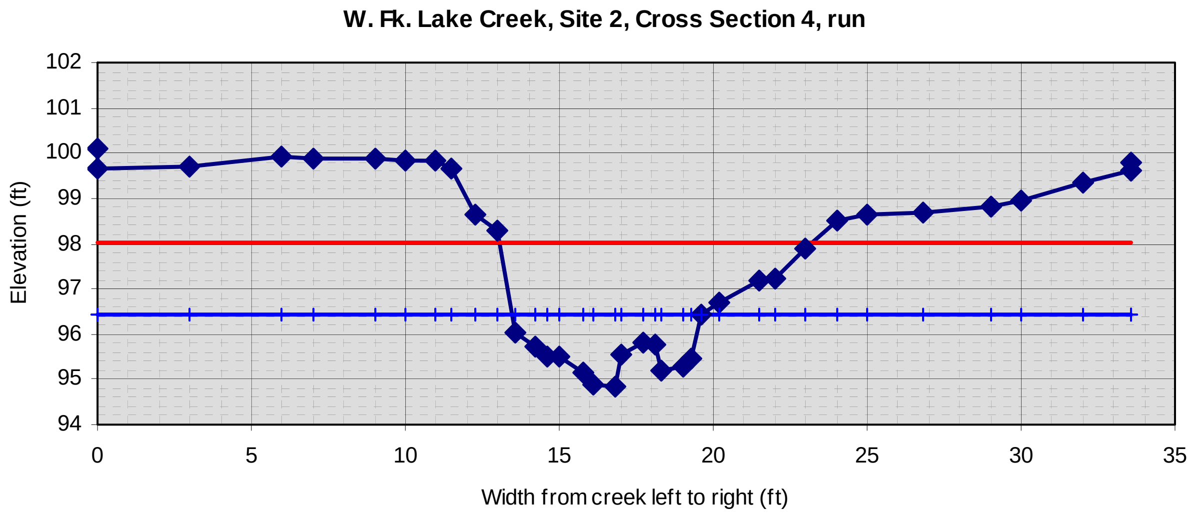


Figure 22. Cross section profile of W. Fk. Lake Creek, Site 2, cross section #4. Blue line indicates bankfull elevation and red line indicates flood prone elevation.

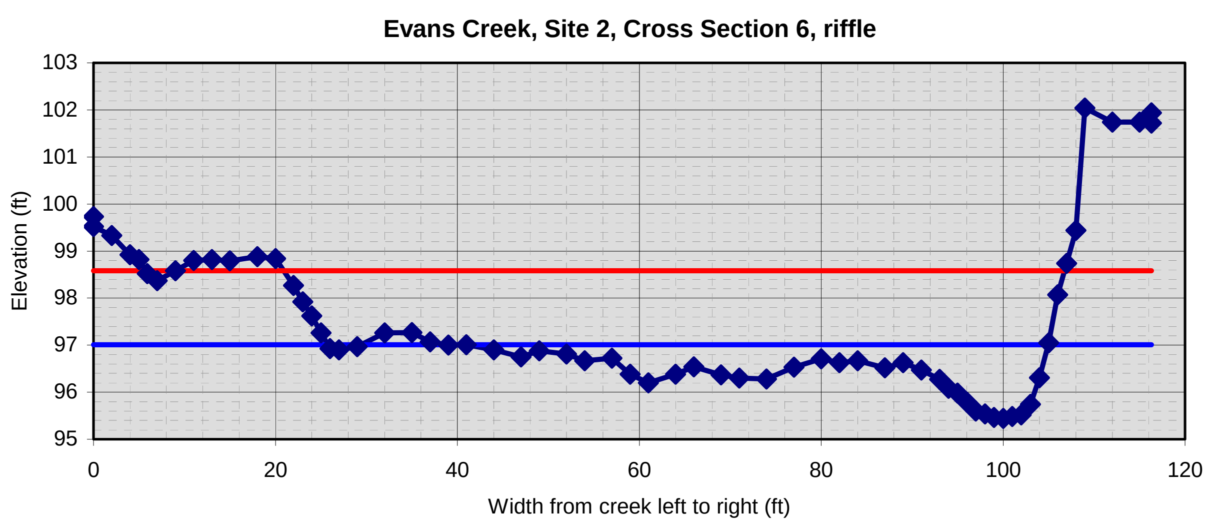


Figure 23. Cross section profile of Evans Creek, Site 2, cross section #6. Blue line indicates bankfull elevation and red line indicates flood prone elevation.

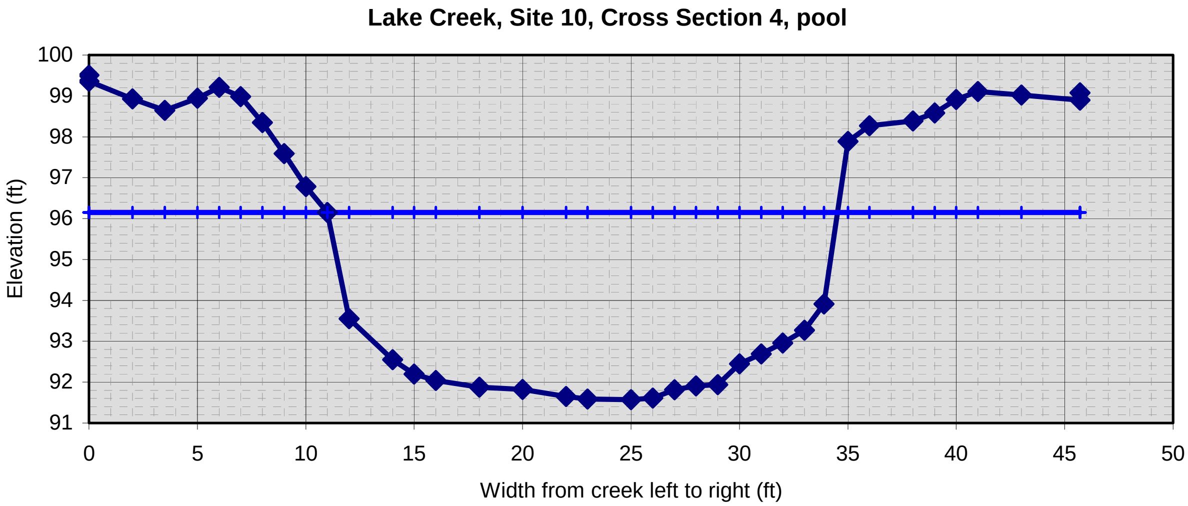


Figure 24. Cross section profile of Lake Creek, Site 10, cross section #4. Blue line indicates bankfull elevation.

The area of the monitored cross sections was calculated based on the surveyed profile of bed and banks and the estimated bankfull elevation. Cross sectional area generally increases as drainage area increases but error in identifying the bankfull elevation or including pool cross sections in the reach level average can mask this relationship. As seen in *Table 14*, this relationship was not always evident when cross sectional area was averaged at the reach level (this was also only generally true within each reach). This is likely due to observer bias in identifying bankfull elevation. Evans Creek fit this view the most closely, with a high (average of six cross sections) of 56.3 ft^2 at Site 1 and low of 27.4 ft^2 at Site 5. In between these two, however, Site 3 was somewhat higher than Site 2 (47.7 ft^2 versus 41.1 ft^2, respectively).

The four Benewah Creek monitored reaches also only generally increased in cross section area with increasing drainage area. Site 9 had the highest average area (68.0 ft^2), Site 13 was 48.1 ft^2 and Site 14L was 31.7 ft^2. And then Site 14U was 62.0 ft^2. The slightly entrenched nature of the channel at site 14U may have resulted in overestimating the bankfull elevation. *Figure 25* shows the profile of cross section 3 from Benewah Creek, Site 9, which had the largest cross section of all studied reaches.

Within the Lake Creek mainstem sites, the highest average cross sectional area (57.4 ft^2) was found at Site 10, the middle site of the seven monitored. The lowest average was seen at the upstream most site (Site 13, 14.9 ft^2) but the downstream most site (Site 7L, 17.7 ft^2) had almost as low an average area.

The lowest individual cross sectional area was cross section #1 at Bozard Creek, Site 3 (see *Figure 26*). The two downstream reaches of this creek had average areas of 24.5 and 20.3 ft^2 (Sites 1 and 2, respectively). The W. Fk. of Lake Creek had average areas of 9.5 and 12.4 ft^2 (Sites 2 and 3, respectively) and the single Alder Creek site had an average area of 25.1 ft^2.

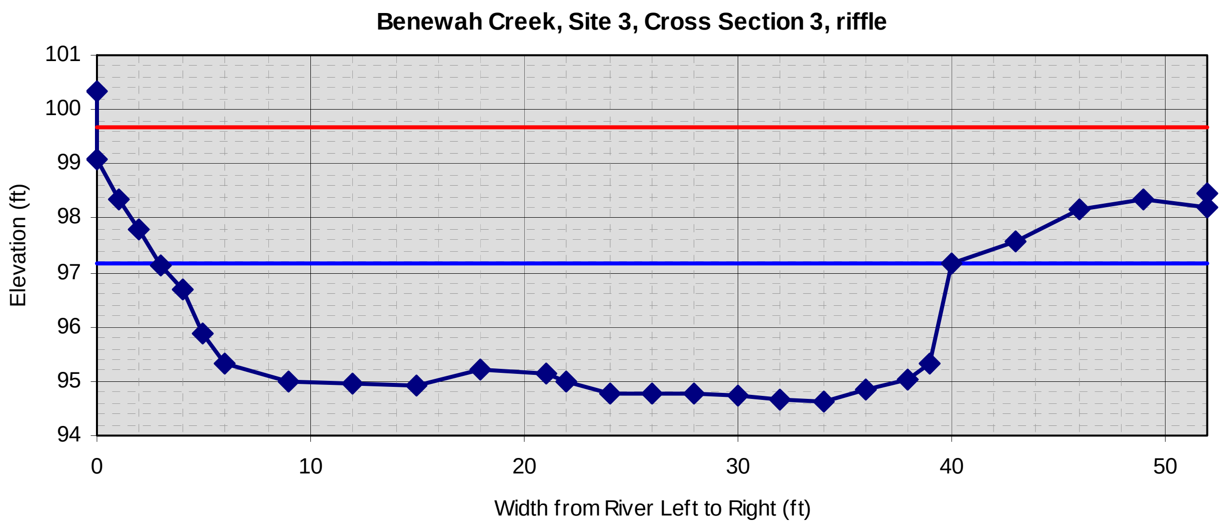


Figure 25. Cross section profile of Benewah Creek, Site 3, cross section #3. Blue line indicates bankfull elevation and red line indicates flood prone elevation.

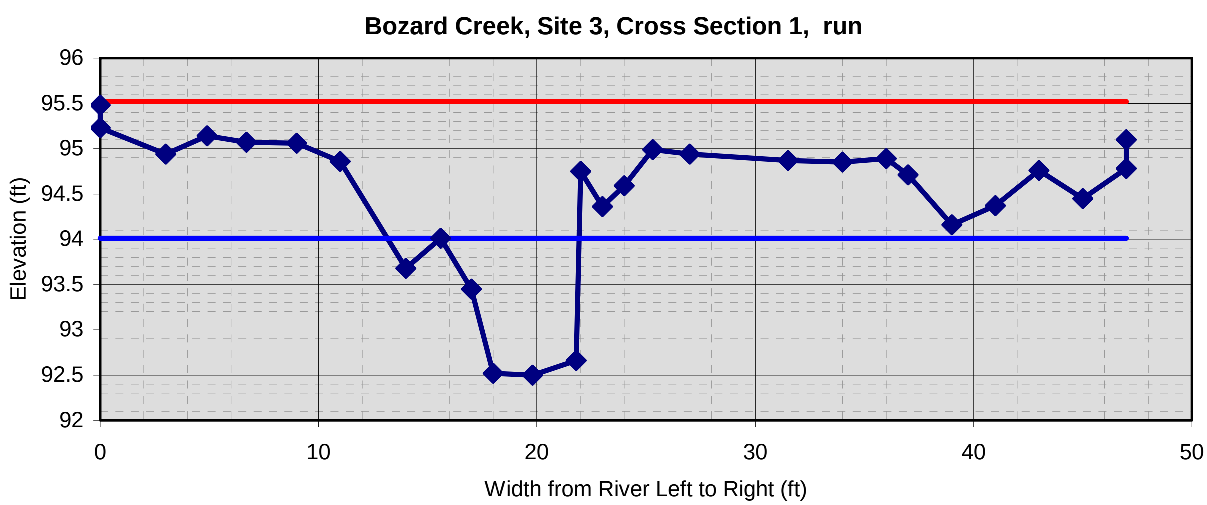
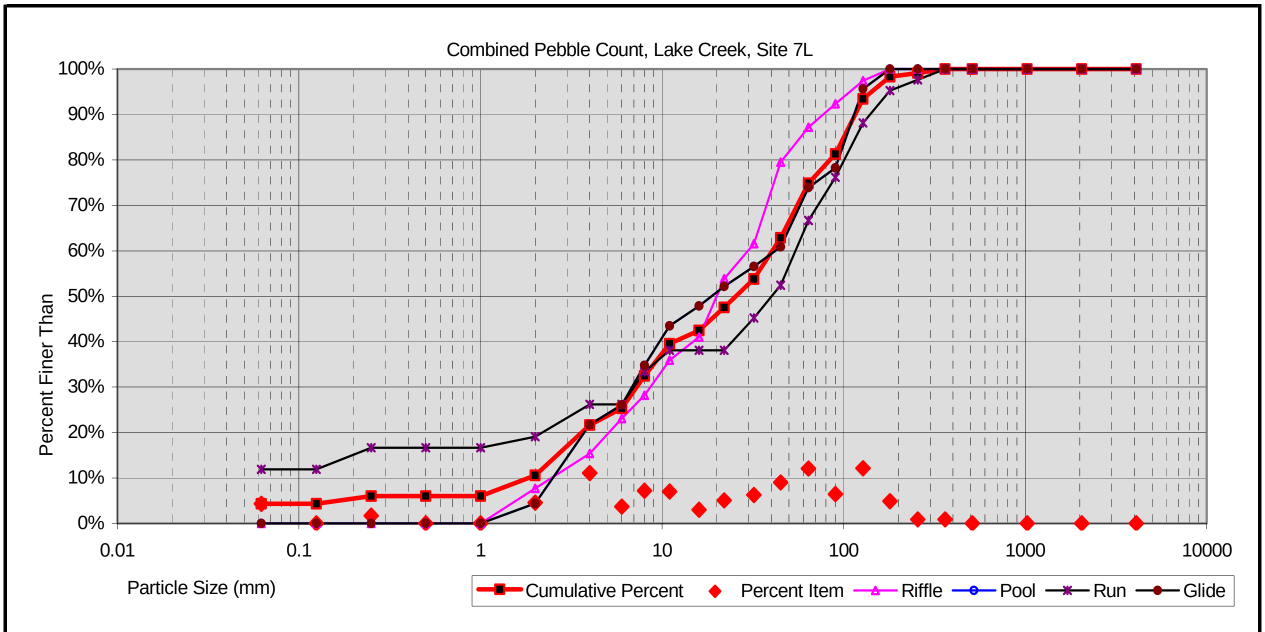


Figure 26. Cross section profile of Bozard Creek, Site 3, cross section #1. Blue line indicates bankfull elevation and red line indicates flood prone elevation.

Stream Substrate (Pebble Counts)
The Reference Reach Spreadsheets that all stream monitoring data was incorporated into contain a worksheet which summarizes and graphs the stream substrate materials distribution. The data from the six cross sections in each study reach is graphed to indicate particle size distribution by habitat type as well as cumulative particle size. An example of this combined graph is presented for Lake Creek, Site 7L in *Figure 27*. This graph contains curves for riffle, pool and run habitat types; there were no cross sections or pebble counts made in glide habitats at this site.



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
2.814	8.97	25.5	97	143	4%	6%	64%	24%	1%	0%

Figure 27. Combined pebble count graph for Lake Creek, Site 7 from Reference Reach Spreadsheet.

The spreadsheet worksheet also calculates the "Size Percent Less Than" (various 'D' values) and "Percent by Substrate Type" as shown at the bottom of *Figure 27*. These breakdowns by substrate type for each monitored site have been combined into *Table 15* to provide an overview of all the sites.

As can be seen in *Table 15*, the Alder, Benewah and Evans Creek sites are all dominated (greater than 60%) by gravel and cobble substrate. These represent particle sizes between 2 and 256 mm in median diameter. The only site that had a substrate type other than gravel / cobble that occupied more than 20% of a count was Evans Creek, Site 1 which had bedrock as almost 34%.

The Lake Creek watershed sites were noticeably different. While five of these 12 sites were dominated 60% or more by gravel, there was only one site (Lake, Site 7L) with 20% or more cobble. The co-dominance at these sites was strongly shifted to the sand and silt/clay materials. Thus, three sites (Lake 8U, 9U, and 10) were sand - gravel dominated (particle sizes 0.062 to 64 mm) and five were silt/clay - sand dominated (0 to 2 mm). One site, the W. Fk. Lake, Site 2 was dominated by silt/clay and gravel.

Table 15. Stream substrate type breakdown for Coeur d'Alene Tribe-monitored sites, 2003.

SITE	Percent by substrate type					
	silt/clay	sand	gravel	cobble	boulder	bedrock
Alder, Site 12	0.0%	1.6%	55.7%	31.7%	11.0%	0.0%
Benewah, Site 9	0.0%	1.7%	62.6%	29.1%	0.9%	5.7%
Benewah, Site 13	18.3%	8.8%	70.2%	2.8%	0.0%	0.0%
Benewah, Site 14L	0.0%	0.0%	81.3%	18.7%	0.0%	0.0%
Benewah, Site 14U	12.8%	2.9%	68.4%	14.9%	1.0%	0.0%
Evans, Site 1	6.0%	15.6%	32.9%	11.6%	0.0%	33.9%
Evans, Site 2	0.0%	0.0%	51.1%	48.0%	1.0%	0.0%
Evans, Site 3	0.0%	0.0%	60.4%	39.6%	0.0%	0.0%
Evans, Site 4	0.0%	1.9%	61.6%	36.6%	0.0%	0.0%
Evans, Site 5	3.6%	0.0%	62.9%	33.2%	0.3%	0.0%
Lake, Site 7L	4.3%	6.3%	64.3%	24.3%	0.9%	0.0%
Lake, Site 8U	11.0%	22.1%	47.8%	14.7%	4.4%	0.0%
Lake, Site 9U	8.1%	42.9%	39.3%	4.1%	0.0%	5.6%
Lake, Site 10	0.0%	31.4%	68.6%	0.0%	0.0%	0.0%
Lake, Site 11	58.6%	31.5%	9.9%	0.0%	0.0%	0.0%
Lake, Site 12	22.2%	77.8%	0.0%	0.0%	0.0%	0.0%
Lake, Site 13	87.9%	12.1%	0.0%	0.0%	0.0%	0.0%
Bozard, Site 1	6.2%	17.9%	70.8%	5.2%	0.0%	0.0%
Bozard, Site 2	51.1%	23.1%	25.8%	0.0%	0.0%	0.0%
Bozard, Site 3	0.0%	4.3%	81.1%	14.6%	0.0%	0.0%
W.Fk. Lake, Site 2	23.1%	6.1%	70.8%	0.0%	0.0%	0.0%
W.Fk. Lake, Site 3	36.3%	52.0%	11.8%	0.0%	0.0%	0.0%

Canopy Cover

The procedure for calculating the average canopy cover for the studied reaches is described in the **METHODS** section, above. *Table 16* presents Alder Creek, Site 12 data to illustrate how the four densiometer readings at each cross section are totaled, converted to density (%) and corrected.

Table 17 presents the combined canopy cover data for the sites monitored during 2003. From this it can be seen that the range of canopy densities was between 8.8% (at Evans, Site 2) and 86.5% (at Bozard, Site 2). The average of all corrected densities is 45.1%. The Benewah Creek sites had the lowest overall canopy density (31.2 % average) with Evans next at 32.3%. The single Alder Creek site was obviously above the overall average and the Lake Creek watershed sites were also above the average (54.5%).

Table 16. Example of stream site densiometer readings and overall canopy cover density calculation; from Alder Creek, Site 12.

Cross Section	Densiometer Readings: Left Bank	Center facing upstream	Center facing downstream	Right Bank	Total
1	13	10	3	16	42
2	0	6	4	17	27
3	17	6	7	16	46
4	15	4	0	16	35
5	17	0	7	5	29
6	17	3	4	5	29
Grand Total =					208
Converted to Density (x1.5) =					312
Average for reach (/6) =					52
Corrected (-1 if ave is between 30 and 60, -2 if ave is above 60) =					51

Table 17. Stream canopy cover data for all sites monitored by Coeur d'Alene Tribe Fisheries staff during 2003.

SITE	**Conical densiometer readings** (total of four readings; uncorrected, unconverted) XS 1	XS 2	XS 3	XS 4	XS 5	XS 6	Overall Total	Converted to Density (x1.5) (%)	Average for reach (/6) (%)	Corrected Canopy Density (%)
Alder, Site 12	42	27	46	35	29	29	208	312.0	52.0	**51.0**
Benewah, Site 9	17	0	5	1	10	17	50	75.0	12.5	**12.5**
Benewah, Site 13	16	13	0	34	14	42	119	178.5	29.8	**29.8**
Benewah, Site 14L	8	47	64	30	13	36	198	297.0	49.5	**48.5**
Benewah, Site 14U	26	34	14	48	9	8	139	208.5	34.8	**33.8**
Evans, Site 1	38	21	37	23	10	28	157	235.5	39.3	**38.3**
Evans, Site 2	0	4	1	5	18	7	35	52.5	8.8	**8.8**
Evans, Site 3	3	7	19	5	3	23	60	90.0	15.0	**15.0**
Evans, Site 4	42	30	14	28	19	41	174	261.0	43.5	**42.5**
Evans, Site 5	13	29	51	37	63	39	232	348.0	58.0	**57.0**
Lake, Site 7L	41	32	36	42	32	43	226	339.0	56.5	**55.5**
Lake, Site 8U	40	34	36	50	27	25	212	318.0	53.0	**52.0**
Lake, Site 9U	36	41	36	35	38	29	215	322.5	53.8	**52.8**
Lake, Site 10	51	34	32	31	41	57	246	369.0	61.5	**59.5**
Lake, Site 11	0	8	32	4	5	11	60	90.0	15.0	**15.0**
Lake, Site 12	22	17	23	37	40	32	171	256.5	42.8	**41.8**
Lake, Site 13	37	63	27	56	60	63	306	459.0	76.5	**74.5**
Bozard, Site 1	62	50	47	29	46	37	271	406.5	67.8	**65.8**
Bozard, Site 2	64	64	64	64	34	64	354	531.0	88.5	**86.5**
Bozard, Site 3	19	21	68	49	33	37	227	340.5	56.8	**55.8**
W.Fk. Lake, Site 2	9	31	41	30	41	54	206	309.0	51.5	**50.5**
W.Fk. Lake, Site 3	40	4	49	7	18	64	182	273.0	45.5	**44.5**

It is of interest to consider the sources of the canopy measured using the densiometer. In only a few cases was canopy provided by tall coniferous trees; only the Alder Creek site and the two upper Evans Creek sites had some component of their canopy in adjacent coniferous forest. The primary source of canopy throughout the monitored watershed areas was medium sized shrubs, primarily alder and hawthorn, which were growing along the streambanks. In some cases the "canopy" was simply from tall grasses, primarily Reeds Canary Grass, which was growing on the stream banks and in the channel. The three sites where this was predominant were the upper Lake Creek sites (11, 12 and 13) where there was essentially no tree or shrub cover. As seen in *Table 17*, grasses can provide fairly high densities of canopy but because the grasses are low growing (relative to trees and shrubs) the cover does not extend far across the channel. The wider the channel is, the lower the canopy density from grasses is (see Lake Sites 12 or 13 versus Site 11) and the less benefit this canopy provides to the stream habitat.

Stream Typing

As described in the **METHODS** section, stream typing involves considering a number of criteria; specifically entrenchment ratio, width-to-depth ratio, sinuosity, slope and dominant substrate. The slope comes from the longitudinal profile. The entrenchment and width-to-depth ratios come from the cross section profiles. The sinuosity comes from the valley length measurement and the dominant substrate from the pebble counts. The values for each of these for the monitored sites are summarized in *Table 18*. Note that entrenchment ratios could not be determined because the cross section profiles did not extend out to the valley walls so the flood prone widths necessary for the calculation could not be determined. While stream types could be estimated based on the three available criteria, these should be considered preliminary at this time. The extension of the cross-sections is planned to be surveyed during 2004 and final stream types determined after that.

Once the various criteria are assembled, a comparison is made to the delineative limits of these criteria presented in *Table 5* from Rosgen 1996. The result of these comparisons with the addition of the dominant substrate is shown in *Table 18*. From this it can be seen that the monitored sites fell into three stream types; 'B', 'C' and 'E'. The Alder Creek site was a 'B', the Benewah sites were consistently 'C', the Evans sites were 'B', 'C' or 'E' and the Lake Creek main stem sites were either 'C' or 'E'. The Bozard and West Fork of Lake sites were 'E' except the upper Bozard (#3) which was a 'B'. Following the substrate description, above, most of the sites were a '4' for gravel dominated. Exceptions were seen in the Lake Creek sites where silt/clay or sand predominated.

Instream Organic Materials

Organic material studied at the monitored stream sites were the "Coarse Material" (1" to 4" diameter) and Large Woody Debris (LWD, greater than 4" diameter at the small end). As indicated in the **METHODS** section, above, the organic materials survey was performed along the entire length of each monitored reach; Coarse Material had to actually cross the thalweg to be counted but LWD could be anywhere within the bankfull limits of the channel. Data on in-stream organic materials collected or calculated for this project is summarized in *Table 19*.

The Coarse Material counts for the monitored sites ranged from 0 (no woody material) at Benewah, Site 9 to 103 at Bozard, Site 1. The average count for all sites was 26.6 pieces, which is considered to be fairly low and indicative of stream reaches with altered or modified riparian plant communities.

Table 18. Stream type determinations for sites monitored during 2003 by Coeur d'Alene Tribe Fisheries Program staff.

SITE	Entrench-ment Ratio	Width to Depth Ratio	Sinuo-sity	Slope (%)	Dominant Substrate	Stream Type
Alder, Site 12	*	28	1.2	1.14	Gravel	B4
Benewah, Site 9	*	23	1.1	0.67	Gravel	C4
Benewah, Site 13	*	15	1.3	0.29	Gravel	C4
Benewah, Site 14L	*	13	1.7	0.56	Gravel	C4
Benewah, Site 14U	*	16	1.1	0.65	Gravel	C4
Evans, Site 1	*	9	1.4	0.02 **	Gravel	E4
Evans, Site 2	*	67	1.1	1.32	Gravel	C4
Evans, Site 3	*	54	1.1	1.43	Gravel	C4
Evans, Site 4	*	24	1.0	1.36	Gravel	C4
Evans, Site 5	*	29	1.1	2.04	Gravel	B4
Lake, Site 7L	*	16	1.0	0.68	Gravel	C4
Lake, Site 8U	*	10	1.1	0.37	Gravel	E4
Lake, Site 9U	*	6	1.2	0.07	Gravel	E4
Lake, Site 10	*	6	1.6	0.27	Gravel	E4
Lake, Site 11	*	23	1.1	0.27	Silt/clay	C6
Lake, Site 12	*	8	1.1	0.69	Sand	E5
Lake, Site 13	*	15	1.3	0.27	Silt/clay	C6
Bozard, Site 1	*	6	1.3	0.38	Gravel	E4
Bozard, Site 2	*	5	1.8	0.37	Silt/clay	E6
Bozard, Site 3	*	11	1.2	3.01	Gravel	B4
W.Fk. Lake, Site 2	*	8	1.2	0.50	Gravel	E4
W.Fk. Lake, Site 3	*	9	1.2	0.48	Sand	E5

* Entrenchment ratio could not be determined because cross sections did not intersect both valley sides.

** Water surface elevation controlled by downstream lake through entire reach.

Table 19. Summary of organic materials data collected from 22 stream monitoring sites on the Coeur d'Alene Reservation in 2003.

		Large Woody Debris					
SITE	**Course Material (count)**	**Total count**	**Volume (ft^3)**	**Volume Density (ft^3/ft^2)**	**Biomass (lbs)**	**Biomass Density (lbs/ft^2)**
Alder, Site 12	11	8	31.58	0.003	1,705.07	0.140
Benewah, Site 9	0	0	0.00	0.000	0.00	0.000
Benewah, Site 13	2	2	10.72	0.001	578.97	0.046
Benewah, Site 14L	13	4	9.36	0.001	505.67	0.060
Benewah, Site 14U	19	23	45.52	0.003	2,458.07	0.171
Evans, Site 1	26	19	23.92	0.002	1,291.50	0.117
Evans, Site 2	11	11	23.85	0.003	1,287.66	0.184
Evans, Site 3	4	8	146.70	0.017	7,921.75	0.907
Evans, Site 4	3	32	150.57	0.023	8,130.55	1.246
Evans, Site 5	13	23	103.82	0.019	5,606.15	1.009
Lake, Site 7L	7	3	2.36	0.000	127.33	0.021
Lake, Site 8U	48	19	24.79	0.003	1,338.67	0.165
Lake, Site 9U	12	17	28.02	0.005	1,512.86	0.268
Lake, Site 10	73	23	126.73	0.019	6,843.68	1.038
Lake, Site 11	11	18	347.54	0.063	18,767.32	3.387
Lake, Site 12	6	9	58.95	0.017	3,183.36	0.929
Lake, Site 13	7	9	4.61	0.002	249.07	0.124
Bozard, Site 1	103	23	132.00	0.022	7,127.88	1.824
Bozard, Site 2	43	8	21.67	0.004	1,170.01	0.241
Bozard, Site 3	56	13	9.93	0.002	536.12	0.108
W.Fk. Lake, Site 2	65	17	12.54	0.005	677.01	0.279
W.Fk. Lake, Site 3	52	8	17.31	0.007	934.97	0.375

The total counts of Large Woody Debris in the monitored sites ranged from 0 at Benewah, Site 9, to 32 at Evans, Site 4. The average count at all sites was 13.5 pieces, one half of the coarse material average count. The measurement of diameter at both ends an length enabled calculation of individual and total piece volumes. Using a typical, average density of 0.5 (specific gravity), it was possible to estimate the weight, or "biomass" of each piece. Total volumes and biomasses for each monitored site are shown in *Table 19*.

The largest volume of LWD recorded at a single site (500 ft. reach) was 347.5 ft^3 (9.8 m^3) at Lake Creek, Site 11, a restoration site where LWD was placed. The next highest volume was 150.57 ft^3 at Evans Creek, Site 4. All totaled there were only six sites (including Lake, Site 11) that had LWD volumes greater than 100 ft^3 (*Table 19*). There was one site with a volume between 50 and 100 ft^3 and 15 sites with volumes less than 50 ft^3. The watershed-wide average volumes were: Alder Creek (one site) 31.6 ft^3 (0.9 m^3), Benewah Creek (four sites) 16.4 ft^3 (0.5 m^3), Evans Creek (five sites) 89.8 ft^3 (2.5 m^3) and Lake Creek overall (12 sites) 65.5 ft^3 (1.9 m^3). Within the Lake Creek watershed, the main stem (seven sites) had an average of 84.7 ft^3 (2.4 m^3), Bozard Creek (three sites) 54.5 ft^3 (1.5 m^3) and West Fork Lake Creek (two sites) 14.9 ft^3 (0.4 m^3).

Large Woody Debris Comparison with Other Systems

The highest density (ft^3/ft^2 or m^3/ha) estimated was 0.063 ft^3/f^2 (191.5 m^3/ha) at Lake, Site 11. The mean densities from the four watersheds were: 0.003 ft^3/f^2 (9.1 m^3/ha) in Alder Creek, 0.0013 ft^3/f^2 (4.0 m^3/ha) in Benewah, 0.0128 ft^3/f^2 (38.9 m^3/ha) in Evans and 0.0156 ft^3/f^2 (47.4 m^3/ha) in the Lake Creek main stem sites (*Table 19*). Table 20 presents a comparison of mean LWD density from four tributaries on the CDA Tribe Reservation with other systems in the Pacific Northwest and Rocky Mountains. Although there was a wide variation in reported LWD volumes the LWD volumes in CDA Tribe streams were one to three orders of magnitude lower than those reported in the other studies (Table 20). The exception to this was the "disturbed" streams described by Richmond and Fausch (1995), which had a LWD volume in the range of the CDA Tribe streams.

Habitat/Cutthroat Trout Relationships

No significant correlation existed between cutthroat trout density and either LWD density or canopy cover, $r = -0.07$, $P > 0.50$ and $r = 0.18$, $P > 0.50$, $n=19$, respectively. Nevertheless, sites supporting moderate to high densities of trout (>5/100m2) generally had canopy cover densities of greater than 40%. The analysis was not performed for non-native brook trout because they were absent from most of the reaches where habitat was measured.

Table 20. Summary of Large Woody debris (LWD) data from the CDA Tribe's 2003 monitoring and other published studies.

	Large Woody Debris	
	Volume	Density
Researchers	m^3/m	m^3/ha
CDA Tribe Fisheries, 2003		
Single maximum (Lake Creek, Site 11)	0.064	192
Alder Creek average	0.006	9
Benewah Creek average	0.003	4
Evans Creek average	0.016	39
Lake Creek main stem & tribs. average	0.013	38
Hauer et al., 1999		
Maximum reported	7.3	nd
Unlogged, wilderness streams	1.9	nd
Logged watershed, unlogged riparian	2.6	nd
Logged watershed and riparian	4.8	nd
McGreer and Andrus, 1992		
Unconstricted, low gradient reaches	0.181	nd
Moderately constricted, higher gradient	0.153	nd
Constricted, high gradient reaches	0.328	nd
Nakamura & Swanson, 1994		
Wide, sinuous reach	1.248	337
Wide, straight reach	0.846	284
Narrow, sinuous reach	0.514	352
Narrow, straight reach	0.240	177
Richmond & Fausch, 1995		
Undisturbed old-growth streams	0.133	139.5
Disturbed streams	0.029	nd

nd = not determined or reported

DISCUSSION

Population Trends

Population trends of westslope cutthroat trout at the watershed scale from the current eight-year data set revealed increasing numbers of cutthroat trout in Lake and Evans creeks, decreasing numbers in Alder Creek and no changes in Benewah Creek. Brook trout were present in Alder and Benewah creeks but the population in Alder Creek is increasing at a much higher rate compared to the Benewah Creek population. The interannual variability at the site level from the current eight-year data set produces low power to detect annual changes in the populations. The current power to detect population changes does not meet the criteria established by Vitale et al. (2002A), which is a power of 0.80 at α level 0.10 to detect a +/- 3% annual change in a population. However, the power to detect population changes in the four target streams is expected to increase dramatically following additional annual population estimates (Vitale et al. 2002A). Vitale et al. (2002A) concluded that an additional 10 years of annual population estimates were required to achieve the criteria of a power of 0.80 at α level 0.10 to detect a +/- 3% annual change in a population. Meeting the power criteria will increase confidence when inferring cause and affect from management strategies and restoration measures. Thus, even though the power to detect population change is currently low, it is important to maintain a long-term population survey database in order to increase the power to detect trends in the populations at finer scales.

An important factor that affects the power to detect changes in westslope cutthroat trout populations in the four target watersheds is the combination of two different life history strategies expressed by westslope cutthroat trout in two of the four systems. Resident life history forms comprise the westslope cutthroat population in Alder and Evans Creeks. However, resident and adfluvial life histories comprise the populations in Benewah and Lake creeks. The population estimates in Benewah and Lake creeks incorporate juvenile production from adults from both life histories. Benewah and Lake creeks exhibit higher annual variability compared to Alder and Evans creeks. The higher annual variability is likely being driven by differing annual survival and fecundity of spawning adults from the two distinct life histories. The instream biotic and physical factors that have a greater influence on resident adults are likely fluctuating on different time and spatial scales compared to the lake food web dynamics and predation pressures that affect the adfluvial life histories. Thus, caution should be exercised when drawing inferences from the current population estimate data set.

Effects of Competition on Production

One obvious stressor affecting westslope cutthroat trout production is the establishment and dominance of non-native brook trout in Alder Creek and the expanding invasion of brook trout in Benewah Creek. Brook trout negatively impact westslope cutthroat trout, displacing westslope cutthroat trout when they overlap (Griffith 1988, Adams et al. 2001, Peterson and Fausch 2003). Alder Creek provides an example of a system where the native cutthroat trout population is being affected by non-native brook trout. The brook trout population in Alder Creek is much larger than the suppressed cutthroat trout population. The large population and complete overlapping distribution of brook trout and cutthroat trout throughout Alder Creek indicate that brook trout have become well established and will continue to impact cutthroat trout. The growth rate of westslope cutthroat trout in Alder Creek is significantly different from the other three target streams, further evidence of the effects from brook trout. The smaller population and lower density of brook trout in relation to cutthroat trout in the Benewah Creek system indicates that brook trout are still invading the Benewah Creek system. The distribution of brook trout in the upper watershed and upper lateral tributaries is consistent with the rapid upstream invasion behavior described by Peterson and Fausch (2003) and indicates that without intervention, brook trout in Benewah Creek may eventually become dominant as in Alder Creek. Brook trout condition factor is significantly higher for all age classes in Benewah Creek compared to Alder Creek. The high condition factor will likely translate into higher fecundity and drive increased production of brook trout hastening the population increase and adverse effects on westslope cutthroat trout in Benewah Creek. Hence, it is important to begin brook trout control in the Benewah Creek system to reduce the overlap and decrease the competition and predation on westslope cutthroat trout.

An aggressive brook trout control strategy will be initiated in the late summer of 2004 in Benewah Creek. The upper mainstem and entire segments of West Fork, Southeast Fork, Schoolhouse and Bull creeks will be electroshocked and all brook trout captured will be removed. All brook trout will be weighed and measured, aged and eggs from mature females counted to estimate the production removed on an annual basis. The effects of the brook trout removal on the westslope cutthroat and brook trout populations will be measured using the population estimates done annually at sites throughout Benewah Creek. This will allow tracking of the effectiveness of the removal strategy and allow for modification of methods or adjustment of effort spent on brook trout removal in the future. We predict it will take several years to remove a large enough fraction of the brook trout population to reduce the negative impacts on cutthroat trout. However, after the brook trout population has been reduced, likely less effort will be needed to maintain the population at acceptable levels. The Alder Creek brook trout population will be used as a control to compare the effectiveness of the brook trout removal strategy.

Habitat Quality and Trout Density

The habitat measurement results reported earlier were the product of the first complete year of measurements following the Coeur d'Alene Tribe Fisheries Program RM&E Plan (Vitale et al. 2002). The "core" set of variables (described in Vitale et al. 2002) will be measure annually at 13 reference (control) and 13 restored (treatment) sites. The reference reaches were selected from a larger set of reaches randomly selected for past habitat measures and ongoing trout population estimates. Reference reaches were selected following a hierarchical approach using physical variables encompassing multiple spatial scales (Hillman and Giorgi 2002). Applying the hierarchical approach enabled stratification and selection of reference reaches that have similar geology, and experience similar physical and climactic effects as the treatment reaches. The changes over time of physical variables in reference and treatment reaches will be measured and statistically compared to assess the effectiveness of restoration methods. The program goal is to detect "fine-scale" (+/-3%) changes in physical variables at reference and treatment reaches with a power of 0.80 and alpha level of 0.10. The number of annual repeated measures of physical variables at the reference and treatment sites will depend on the components of variation (site, year, interaction and residual) that affect the power to detect trends (Larsen et al. 2004). Depending on the components of variation it may require a decade or more of annual measures to meet the power goal. For example, Larsen et al. (2004) reported that detection of a 2% change in residual pool depth at 20 sites with a power of 0.80 and alpha level of 0.05 would require 13 years of annual measures. The streams used in the analysis by Larsen et al. (2004) were coastal and Cascade Mountain systems from the Pacific northwest and likely have different magnitudes of variance components than the streams on the Coeur d'Alene Tribe lands.

The first year of habitat data was used for a preliminary evaluation of the hierarchical reach stratification and channel type selection of reference sites out (Vitale et al. 2002). The analysis revealed the channel typing and reach stratification process was generally accurate, except some E-type channels were switched to C Types and vice-versa. However, these changes in channel types do not compromise the use of the reference reaches because comparable treatment reaches still exist. One notable exception is Benewah Site 9, a bedrock and boulder-controlled reach that currently is not an adequate reference reach because no treatment reaches of this type exist to date. A weakness of the analysis is the lack of an entrenchment ratio, which was not estimated because flood-prone width was not measured. The entrenchment ratio is an important channel-type indicator and without it, all channel typing should be considered preliminary. In 2004 entrenchment ratio will be calculated allowing for a more accurate channel type designation for reference and treatment reaches.

The most obvious result from the first complete year of habitat measurements is the low density of large woody debris (LWD) in all four streams sampled. Large woody debris volume in tribal streams was one to three orders of magnitude lower than other forested streams reported by Hauer et al. (1999), McGreer and Andrus (1992) and Richmond and Fausch (1995). An exception was the "disturbed" streams described by Richmond and Fausch (1995), which had a LWD volume in the range of those values measured in the four Coeur d'Alene Tribe streams. A higher percentage of the Evans Creek drainage remains forested and LWD density in Evans Creek was highest among all four Coeur d'Alene Tribe streams, albeit much lower than the studies mentioned above. The low volume of LWD is especially evident in the main stems of Benewah and Lake Creeks, both heavily de-forested and converted to agriculture and grazing in the early 1900s. Larger coniferous trees are lacking in the riparian zones of most sampled reaches in Benewah and Lake Creeks, and most of the LWD in the channel is from recruitment decades ago. Given the lack of large conifers in the riparian zones, recruitment of any coniferous LWD will not happen for decades. Thus, restoration of these streams will require large amounts of wood placement in the channel and riparian zones until natural LWD recruitment happens.

A preliminary analysis of data grouped from all four streams revealed no significant relationship between westslope trout density and LWD or percent canopy cover. Other habitat variables including residual pool depth, mean thalweg depth and other geomorphic variables were not included. In addition, the analysis did not include stream temperature and thermal heterogeneity, important factors influencing salmonid distribution in the summer season (Torgersen et al. 1999, Ebersole et al. 2003). The importance of temperature is evident when considering stream reaches such as Evans Site 2 where maximum summer temperature does not exceed 17°C, and high densities of trout are found despite low densities of large wood and low canopy density. Future analyses of the affects that physical habitat variables have on trout density will follow the recommendations of Rosenfeld (2003) and analytical methods of Dunham et al. (2002) and will include temperature, temperature heterogeneity, and residual pool depth.

Measuring Population Responses to Restoration

To accurately measure the response of westslope cutthroat trout from restoration and management actions it will be necessary to separate resident and adfluvial production in Benewah and Lake Creeks. The program has concentrated on estimating the population in late summer that includes juveniles with resident and adfluvial life histories in Benewah and Lake Creeks. The instream biotic and physical factors that have a greater influence on resident adults are likely fluctuating on different time and spatial scales compared to the lake food web dynamics and predation pressures that affect the adfluvial life histories. The estimate of outmigrant juveniles per spawner (smolts/spawner) is an important metric that would enable the separation of resident and adfluvial production. An outmigrant produced per spawner relationship would provide evidence if a stream system had reached carrying capacity. The trapping program has not been effective at capturing spawners as they migrate up Benewah and Lake Creeks. The past trap design did not allow the trap to be fished during high flows. Late winter rain–on-snow events produce higher flows and at this time trapping efficiency of spawners migrating into Benewah and Lake creeks is low and at times the traps cannot be deployed. It is suspected that the spawners are actively migrating on the rising limb of high flows when the traps are not efficient or not deployed. This is evidenced by the fact that many more post-spawn fish are captured in downstream traps later in the season during low flows compared to upstream migrants caught earlier in the season during the higher flows. To improve the estimate of adult spawners, flood–tolerant resistance-board weir traps (Tobin 1994, Stewart

2002) will be used to capture spawners migrating upstream. The resistance-board weir traps are designed to handle high flows and debris loading much better than the conventional design currently used. The conventional design will still be used for downstream (outmigrant) trapping because the juvenile outmigrants actively move later in the spring during lower flow periods.

The monitoring and research program has mostly focused on in-stream westslope cutthroat trout production through population estimates. However, survival, growth and life history attributes of adfluvial cutthroat trout in Coeurd'Alene Lake have not been adequately studied. Results from fishery studies on Coeur d'Alene Lake reveal that non-native piscivorous species, especially northern pike prey on adfluvial westslope cutthroat trout (Rich 1992, Anders 2003). The in-lake survival of adfluvial westslope cutthroat trout is a critical knowledge gap that affects management decisions for recovery of the trout in the Coeur d'Alene system. Predators in Coeur d'Alene Lake may have a large impact on the adfluvial component and may be limiting population size. Past attempts of the fisheries program to measure in-lake survival of adfluvial westslope cutthroat trout consisted of tagging outmigrants with numbered FLOY tags with the intent to capture the fish in the trap when the fish returns to spawn in future years. This method has not been successful due to the low trap efficiency caused from high flow events that coincide with increased upstream spawner movements. As stated above, the use of resistance-board weir traps will increase trap efficiency and provide a better estimate of the number of returning spawners. Additionally, to fill the survival estimate gap, a within lake survival study using PIT tag technology is being developed and will begin in 2005. The use of more efficient traps and PIT tag detection systems will dramatically increase the knowledge base of the adfluvial component of westslope cutthroat trout in Benewah and Lake creeks.

SECTION 2: RESTORATION AND ENHANCEMENT ACTIVITIES

OVERVIEW

The focal point of restoration/enhancement activities during the 2003 field season was the property in the Benewah Creek watershed that was secured through the Albeni Falls Wildlife Mitigation Project (BPA project #9206100) in 2001. This purchase represented a significant development in the evolution of this project in several regards. First, the property is both large, encompassing 420 acres of critical habitat with nearly 3 miles of stream, and strategically located with regard to the production and enhancement opportunities for westslope cutthroat trout in the watershed. Two of the principle spawning tributaries, Windfall and Whitetail creeks, flow directly onto the property and its location effectively links several established enhancement sites with the most productive tributary reaches. Secondly, this property was identified as the highest priority for enhancement based on the limiting factor analysis presented in the Habitat Protection Plan, which was developed as a guidance document for this project (Vitale et al. 2002B).

An initial assessment of geomorphic and hydraulic processes on this property was conducted in 2002 and led to the development of several long-term restoration prescriptions for the property (Inter-Fluve, Inc. 2002). Through implementation of these prescriptions the Tribe envisions realizing incremental benefits to fisheries resources over the span of several generations to meet Tribal management objectives. During the first year of implementation of this plan, design work included hydraulic analysis of flows and culvert designs to improve fish passage at Windfall Creek; modeling the hydraulic connection of side channel habitats and anticipated flood forces to maximize wetland area and over winter rearing habitats for cutthroat trout; and finalizing conceptual designs for placement of large wood to stabilize avulsion channel headcuts. Implementation was planned for riparian plantings, side-channel habitat construction, and floodplain/terrace wood additions (*Table 21*). These tasks are described in more detail in the summaries provided below.

Table 21. Summary of restoration/enhancement activities for BPA Project #1990-044-00, 2003.

Projects			Activity By Year					
Project ID	**Location**	**Treatments**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
B_8.9	T45N, 4W, S13 & S24; T45N, 3W, S18	Riparian planting, 23 hectares	Population monitoring upstream and downstream	Population monitoring upstream and downstream	Hydrologic analysis completed 6/00; Population monitoring upstream and downstream	Population monitoring upstream and downstream	Channel assessment and development of restoration prescriptions; planted 8,957 trees; physical habitat monitoring;	Planted 13,611 conifers and 2,013 deciduous trees
B_8.9	T45N, R4W, S13 SE ¼	Side Channel Construction, 495 meters	Population monitoring upstream and downstream	Population monitoring upstream and downstream	Population monitoring upstream and downstream	Population monitoring upstream and downstream	Preliminary assessment and restoration prescriptions completed	Finalized design; NEPA completed; constructed 495m of side channel habitat; placed ~4MBF of LWD; planted 1,275 containerized plants
B_8.9	T45N, R4W, S13 SE ¼	Floodplain wood additions, 50MBF					Preliminary assessment and restoration prescriptions completed	Designs finalized; NEPA completed; placed and anchored ~50MBF in high risk areas

SUMMARY OF RESTORATION PROJECTS

Project B_8.9: Riparian/Planting

Project Location:

Watershed: Benewah Sub Basin (River Mile): RM 8.9-11.9.	Legal: T45N, R4W, S24, NW¼ T45N, R4W, S13, SE¼ T45N, R3W, S18, N½

Site Characteristics:

Slope/gradient: <1%	Aspect: N	Elevations: 2,650-2,760
Valley/Channel type: B2/C4	Proximity to water: Floodplain	

Other: Project treats 2,326 meters of stream channel and 23 hectares of associated floodplain.

Problem Description: The Benewah valley has a history of anthropogenic disturbance by logging and agricultural activities that date to the early twentieth century. Logging removed many of the coniferous trees in the valley bottom between 1915-1930. Splash dams and flumes were developed in the creek to facilitate the movement of harvested logs to down valley mill sites. The combination of direct land clearing adjacent to the creek and the construction and operation of splash dams had a direct affect on channel form and function with negative implications for the productivity of habitats for juvenile rearing. In the most recent past, dating from approximately the 1940's through 2000, the property was managed for grazing and/or hay production, which has precluded the regeneration and establishment of a diverse native riparian plant community along much of the 3.2 miles of streams associated with this property.

Current riparian function is degraded as evidenced by low stream canopy closure, little overhanging vegetation, and low volumes of LWD. The wood that is present in the channel is mostly comprised of small pieces that generally do not function to shape channel morphology or maintain habitat diversity. Also, the existing riparian community offers little potential for providing recruitment of large wood in the future. Currently, discharges greater than the 5-year return interval flood begin to exit the existing channel in a non-uniform manner. As a result several avulsion channels have developed as a direct result of low roughness and lack of root mass in floodplain soils. Active avulsions have the potential to cut-off remaining channel length and lead to abandonment of relatively high quality habitat.

This stream reach is located in a portion of the watershed that historically provided important summer rearing habitat for westslope cutthroat. Mainstem reaches of the property were likely utilized as over-winter habitat as well.

Description of Treatment: Riparian plantings have been undertaken to re-establish forest plant communities adjacent to the stream channel and provide long-term roughness across the valley bottom. Restoring a forested valley bottom will improve structural habitat conditions in the coming decades and is fundamental to the long-term restoration and enhancement of this site. An estimated 387 acres will be planted over the next several years as monies for implementation are secured.

A total of 8,957 deciduous and coniferous plants were installed in 2002, treating an area of approximately 21 acres and a little more than 2,000 linear feet of stream channel (*Figure 28*). An additional 13,611 conifers and 2,013 deciduous trees and shrubs were planted in 2003 (*Figure 28*).

Plantings have consisted of Engelmann spruce, western white pine, ponderosa pine, western larch, lodgepole pine, red-osier dogwood, alder, water birch, black cottonwood and willow. Plant materials have generally been small tublings, containerized plants and live cuttings.

Project Timeline: Preliminary restoration prescriptions were developed for this project site following completion of a detailed stream channel assessment in October 2002. The prescriptions were outlined in a report entitled, "Benewah Creek Assessment and Restoration Prescriptions (December 2002)" and will be implemented concurrently with the planting efforts described in this summary over the next several years.

Spring planting work was completed June 2, 2003. Delays in contracting and a temporary hold on project expenditures delayed planting efforts for approximately seven weeks. The project supervisor performed periodic inspections of the planting work. A conifer survival inspection was conducted on October 6, 2003, at which time the overall survival was determined to be only 45 – 55% for the two planting units that were surveyed. Delays in planting and prolonged drought throughout the summer are thought to have been the primary cause for mortality.
Several monitoring activities have been ongoing on this site to support the evaluation of future restoration/enhancement activities. Fish abundance and distribution has been monitored at 4 sites within this stream reach since 1996 and populations were estimated again in 2003. Also, detailed physical habitat surveys were completed at three locations on the property in 2002 and 2003. Monitoring parameters included channel profiles and cross sections, LWD volume, canopy density, and substrate characterization among others.

Project Goals & Objectives: Goals for this project include 1) increase stream shading; 2) provide a long-term source of large woody debris for natural recruitment; 3) promote bank stabilization; 4) increase riparian species diversity and cover; and 5) enhance stream buffer capacity. Provide for significant increases in canopy density and overhanging vegetation over the next 20 years. Target canopy closure is 92%.

Relationship to Scope of Work: This project fulfills the Program commitments for implementation Objective 1, task 1a, sub task 1.a.i in the FY 2004 Scope of Work and Budget Request (Inter-Governmental Contract #10885), which extends from June 2003 - May 2004.

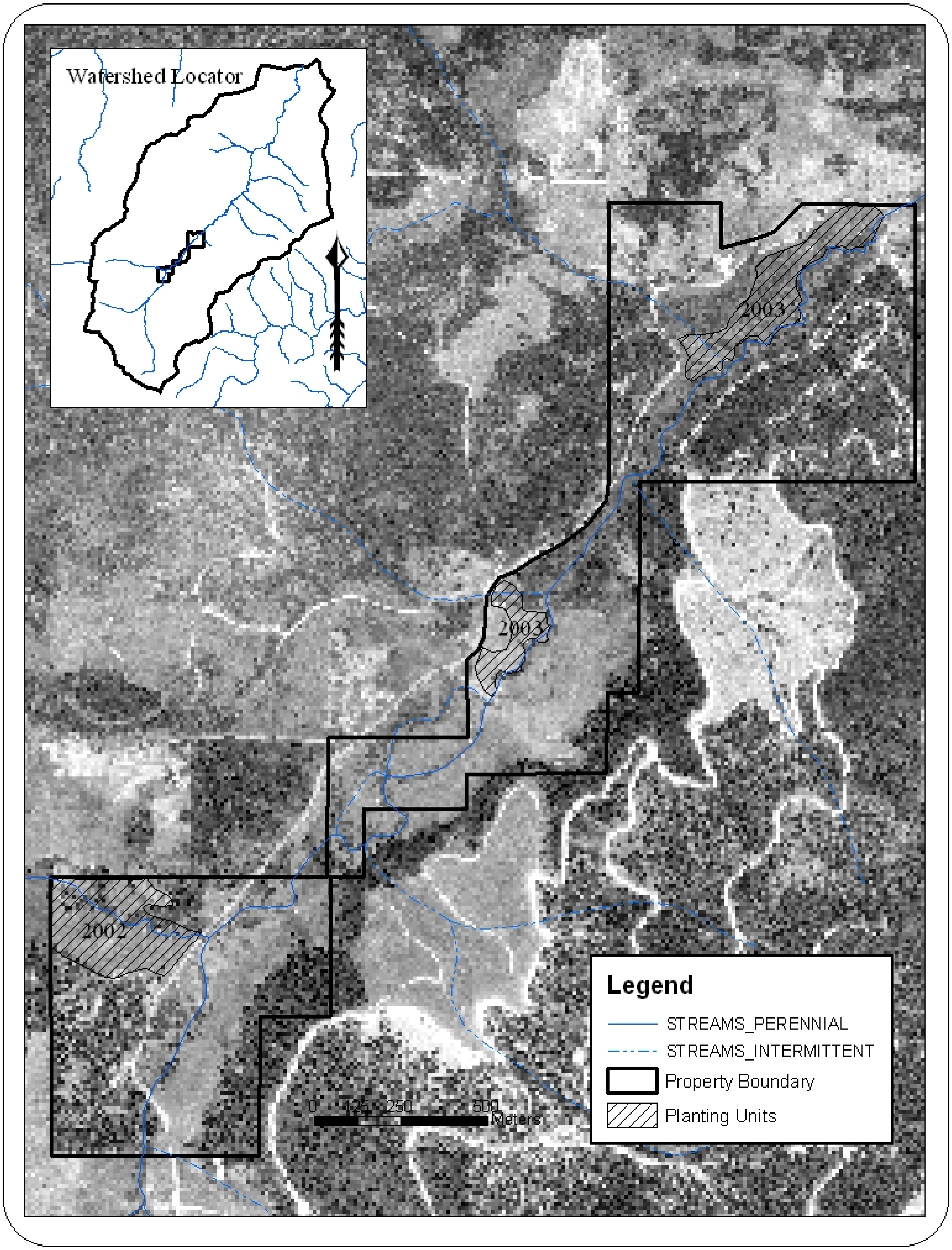


Figure 28. Locations of planting units in the Benewah valley, 2002-2003.

Project B_8.9: Instream / Side-channel Construction

Project Location:

Watershed: Benewah	Legal: T45N, R4W, S13, SE¼;
Sub Basin (River Mile): RM 8.9-11.9.	

Site Characteristics:

Slope/Valley gradient: <1%	Aspect: N	Elevations: 2,650-2,760
Valley/Channel type: B2/C4	Proximity to water: Floodplain	
Other: Project creates approximately 760 meters of side-channel habitats.		

Problem Description: The Benewah valley between river miles 8.9 and 11.9 can be broken into three general reaches that relate to the level of sinuosity or the degree of channel avulsion activity that has taken place. The lower 1.4 miles and upper 0.5 miles have experienced more avulsions and channel straightening than the middle 1.3 miles. The valley slope is 0.007 throughout, however sinuosity in the lower and upper reaches is 1.38 and 1.3, respectively, compared to 1.8 in the middle reach. Downstream avulsions and head cutting have moved upstream through this middle reach causing it to be become entrenched within its historical alignment and substantially reducing the access to its old floodplain.

Hydraulic analysis of representative channel cross-sections show the overall level of entrenchment is approximately equivalent to the capacity of a 5-year return interval peak flow event with some areas exhibiting a level of entrenchment approaching the 10-year peak flow. Several avulsion channels and to a lesser extent, remnant historical channels have left portions of the valley bottom with some wetland habitat. However, it appears that groundwater tables have dropped along with the stream channel bed, as many of the wetland areas are only marginal in size. The entrenched channel is further characterized by unstable streambanks with high erosion potential.

This stream reach is located in a portion of the watershed that historically provided important summer and winter rearing habitats for westslope cutthroat trout. Existing conditions currently support low densities of cutthroat trout (<2 fish/100 sq. meters). Lack of habitat diversity, reduced infiltration of water from adjacent wetlands, and elevated water temperatures are all factors that limit the productivity of these reaches.

Description of Treatment: The project design calls for increasing instream and near-channel wetland habitats by utilizing several existing avulsion channels and upland or drier wetland sites and enlarging them to increase wetland and floodplain areas and provide backwater habitat for fish. These excavated areas are to be connected to the existing channel inverts and become inundated as stage increases in Benewah Creek. These areas are designed in part to emulate beaver activity.

Four backwater sites have been designed to create high-flow backwater habitat for westslope cutthroat trout (*Figure 31*). In many stable natural channels, floodplain and natural backwater habitat become active near the 2-year flood discharge. As the floodplain becomes wetted, juvenile fish can migrate from the lateral margins of the channel to the floodplain and backwater areas. These relatively low-velocity areas have been shown to provide important winter refuge and habitat capacity for salmonids during migratory periods (Peterson 1985; Cederholm and Scarlett 1982). The design targets for backwater habitats were equated to the elevations associated with the 2-year discharge because these flows replicate the conditions that provide velocity-refuge habitat at a frequency that trout have evolved with in natural, undisturbed streams.

All NEPA analysis and permitting requirements, including CWA certification, 404 and 401 authorizations, NPDES permits and the supplemental analysis for the BPA Watershed Management Program EIS, were completed for the project in 2003. Construction on two of the four planned sites was completed by the end of the 2003 field season (see photographs, *Figures 29 and 30*). Approximately 12,200 cubic meters of material were excavated and moved to a stockpile area away from the valley bottom. Nearly 4MBF of large wood was placed in the excavated channels to provide habitat diversity and cover opportunities for fish and a total of 1,275 containerized plants, including a mix of dogwood, alder, water birch and cottonwood, were planted at the completed sites.

<u>Project Timeline</u>: Preliminary restoration prescriptions were developed for this project site following completion of a detailed stream channel assessment in October 2002. The prescriptions were outlined in a report entitled, "Benewah Creek Assessment and Restoration Prescriptions" (Inter-Fluve, Inc. 2002). Designs and specifications were finalized by July 2003 and permits for all activities were received by September 2003. Implementation of the full project design is approximately 66% completed as of November 2003, and the remaining work has been rescheduled for completion in summer 2004. Monitoring of habitat conditions and utilization will be ongoing.

<u>Project Goals & Objectives</u>: Create a total of 760 meters of high-flow backwater habitat with 2.9 hectares of associated emergent wetlands accessible to cutthroat trout. Convert meadow plant communities dominated by grass and herb species to a more diverse array of tree, scrub/shrub, and emergent wetland plant types. Provide measurable increases in habitat diversity, wetland functions and values, and trout density within 5-7 years.

<u>Relationship to Scope of Work</u>: This project fulfills a portion of the Program commitments for implementation Objective 1, Task 1a, Sub-task 1.a.ii in the FY 2004 Scope of Work and Budget Request (Inter-Governmental Contract #10885), which extends from June 2003 - May 2004.

Figure 29. Photograph of side channel at site 1 completed to finish grade (9/30/03) taken from the lower end of the side channel near its confluence with Benewah Creek.

Figure 30. Photograph of completed side channel at site 1 following seeding, mulching and planting, but prior to placement of LWD (10/29/03). Benewah Creek is pictured in the background.

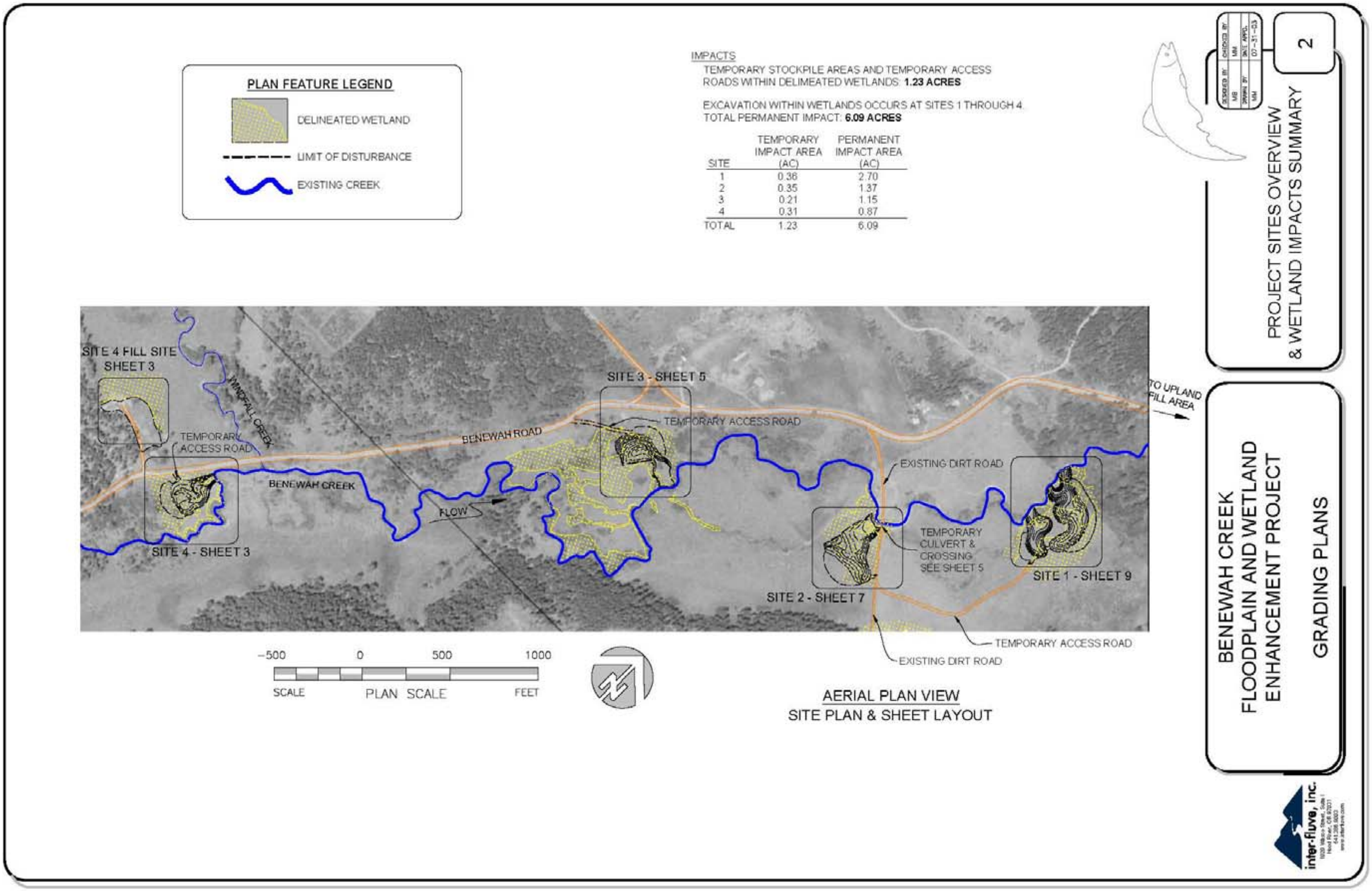


Figure 31. Locations of planned side-channel habitats in the Benewah Valley.

Project B_8/9: Riparian / Floodplain Wood Additions

Project Location:

Watershed: Benewah	Legal: T45N, R4W, S13, SE ¼
Sub Basin (River Mile): RM 10.5-11.5.	

Site Characteristics:

Slope/gradient: <1%	Aspect: N	Elevations: 2,650-2,760
Valley/Channel type: B2/C4	Proximity to water: Floodplain	

Other: Project treats 627 meters of active avulsion channels and 9.3 hectares of associated floodplain.

Problem Description: The reach targeted for this treatment has incised within its pre-disturbance channel alignment. Hydraulic analysis of representative channel cross-sections show the overall level of entrenchment is approximately equivalent to the capacity of a 5-year return interval peak flow event with some areas exhibiting a level of entrenchment approaching the 10-year peak flow. Within this reach, several avulsion channels have begun to develop on the floodplain during past out-of-bank floods. This development has been accelerated by past management practices that cleared forest and riparian plant communities and overgrazed the remaining vegetation. The relatively low root density of existing grass and forb species is insufficient to arrest floodplain erosion.

The avulsion channels are in the process of headward migration, which will ultimately short-circuit portions of the existing low-flow channel. Once an avulsion channel captures the active low-flow channel, the relatively good low-gradient habitat will be abandoned in place of a higher gradient and shorter channel with minimal riparian habitat and complexity.

Description of Treatment: The project design uses large wood material to increase floodplain roughness near and within avulsion channels. The woody debris will help dissipate energy and reduce local scour, which will retard the headward migration of these features. Wood is to be placed above and below identified avulsion channel head cuts and across the valley in appropriate locations (see *Figures 33 and 34*). Many of the logs will be anchored following placement to keep them in place during flooding. Duckbill anchoring will be used to establish anchor points.

The placement of approximately 50,000 BF of large wood in channel avulsions and high-risk areas was completed by 9/2003 (see photograph, *Figure 32*). Anchoring of all key pieces of wood was completed by 11/2003 using Duckbill #88DB1 earth anchors. All disturbed areas were seeded and mulched according to specifications identified in the Storm Water Pollution Prevention Plan (SWPPP) prepared for this project by the Fisheries Program and Inter-Fluve (CDA Tribe, 2003c). Placement and anchoring of an additional 4,000 BF has been rescheduled for summer 2004.

Project Timeline: Preliminary restoration prescriptions were developed for this project site following completion of a detailed stream channel assessment in October 2002. The prescriptions were outlined in a report entitled, “Benewah Creek Assessment and Restoration Prescriptions (December 2002)”. Designs and specifications were finalized by 7/2003 and permits for all activities were received by 9/2003. Implementation of the full project design is approximately 90%

completed as of 11/2003, and the remaining work has been rescheduled for completion in summer 2004. Monitoring of erosion processes at active headcuts through photo documentation will be ongoing.

Project Goals & Objectives: Reduce headward migration of active avulsion channels and prevent capture of active low-flow stream channel. Increase floodplain roughness near and within avulsion channels and provide stable substrate for natural regeneration of plant materials and for active plantings.

Relationship to Scope of Work: This project fulfills a portion of the Program commitments for implementation Objective 1, task 1a, sub task 1.a.iii in the FY 2004 Scope of Work and Budget Request (Inter-Governmental Contract #10885), which extends from June 2003 - May 2004.

Figure 32. Photograph of engineered woody debris jam completed on Tribal restoration site in Benewah Creek watershed (9/30/03).

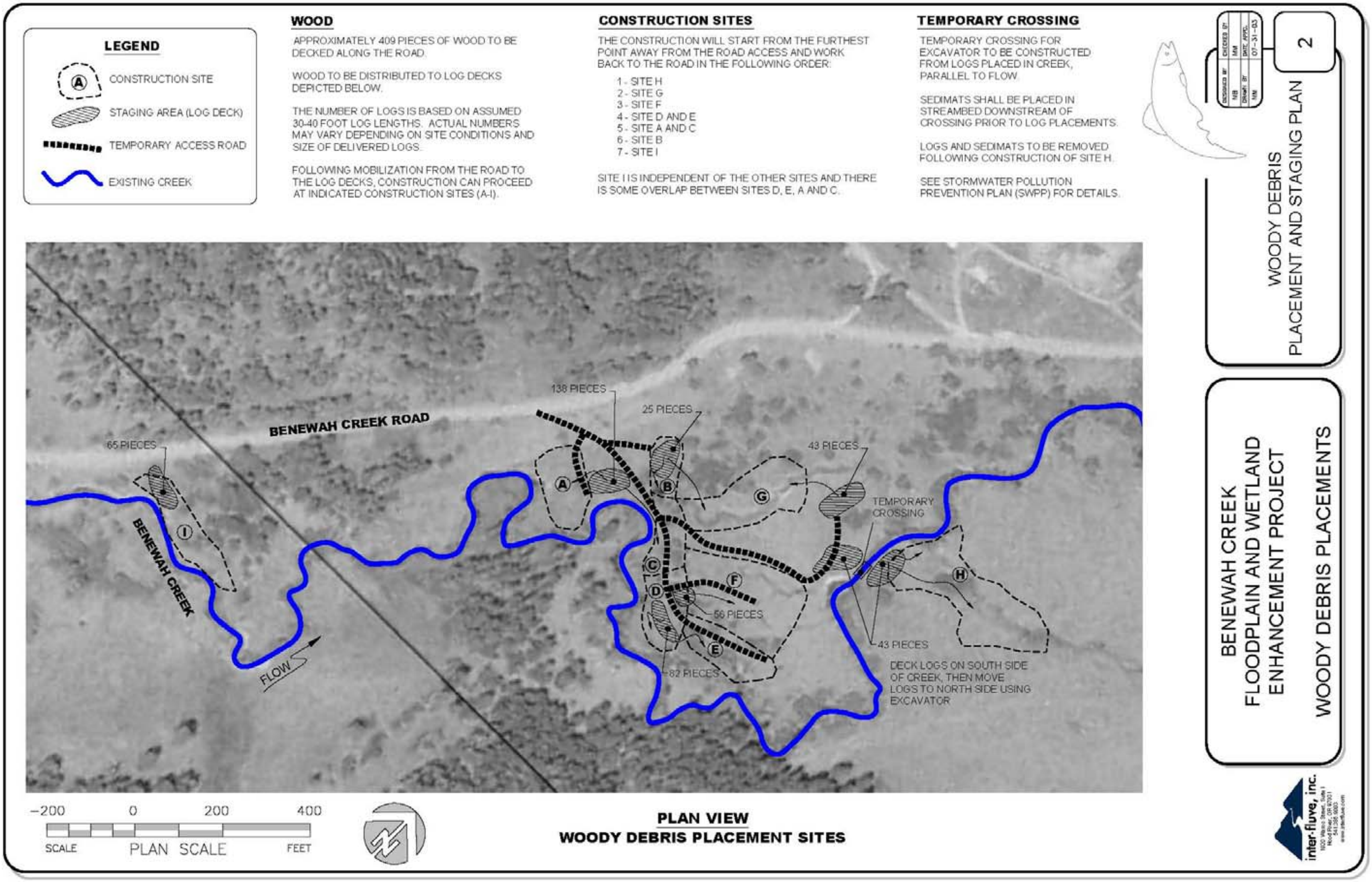


Figure 33. Plan view of floodplain wood placement sites in the Benewah Valley.

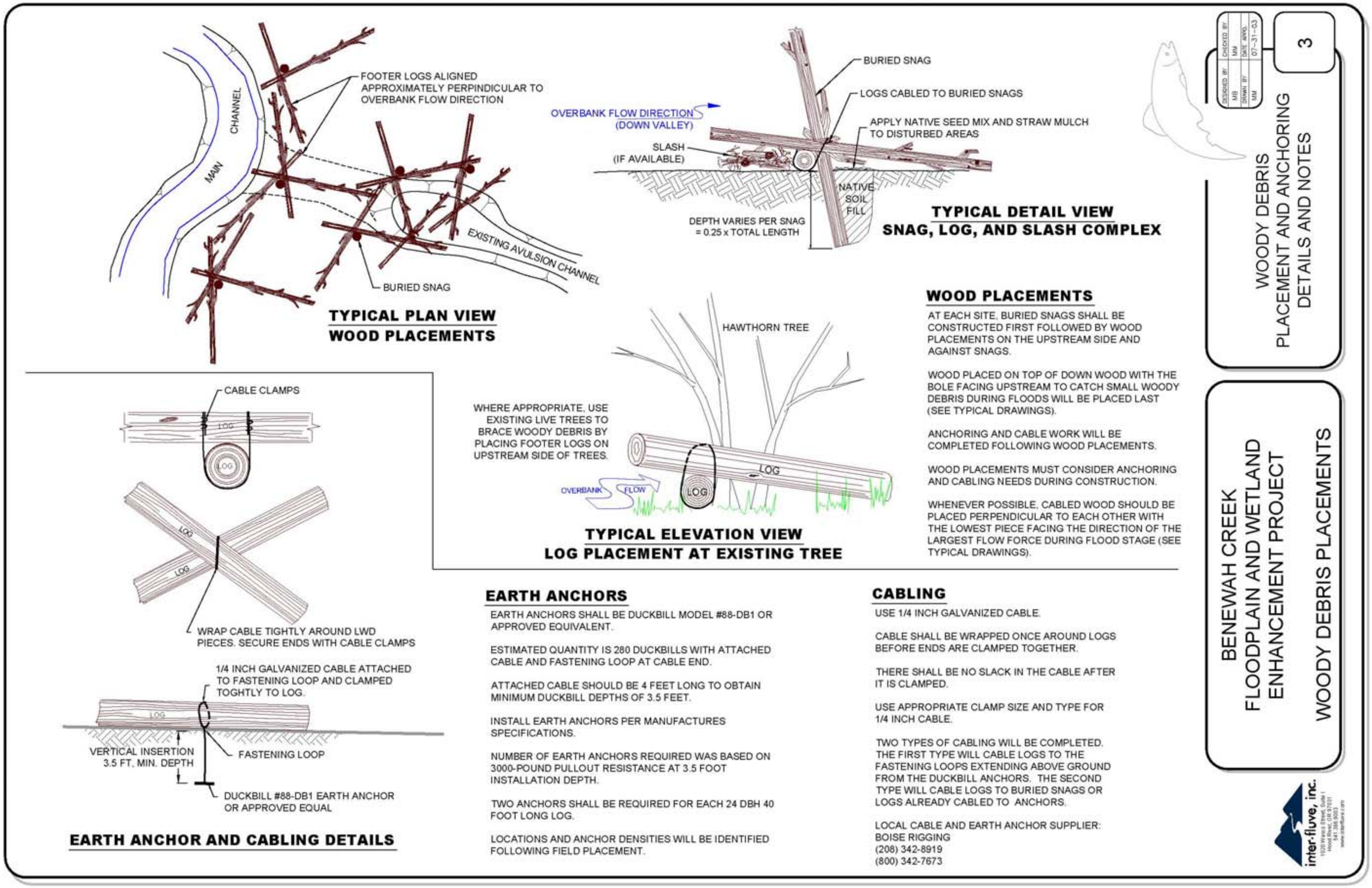


Figure 34. Details and specifications for floodplain wood placements in the Benewah Valley.

O&M SITE INVENTORY

Inventories were conducted at a number of established project sites during this contract period to evaluate the operations and maintenance needs for the immediate future. The primary purpose of these inventories was to identify any deficiencies that have developed over time that either inhibit the proper functioning of a given project or constitute an imminent threat to the investments made at the project site and to prescribe corrective actions. As such these inventories were not intended to substitute for effectiveness or project level monitoring whose respective purposes are to evaluate whether the specified activities had the desired effect (e.g., assessments describing habitat utilization or physical habitat changes) and to assess the impact of several projects on the function of ecological processes and the overall response of target populations.

Inventories were completed at thirteen sites encompassing a variety of treatment types, including five constructed wetland sites, five riparian planting sites, two upland sites where slope stabilization was a primary concern, and a channel construction project. Eleven of the inventoried sites were located in Lake Creek and two in Benewah Creek (*Figures 36 and 37*). The results of inventories are described below and summarized in *Table 22*.

Five wetland sites were constructed in Lake Creek between 1997-2001 with the primary objective of storing and treating runoff from agricultural lands to ameliorate the impacts on fishes and stream habitats of sediment, nutrients, and other non-point source pollutants, as well as creating opportunities to recharge shallow ground water tables to improve base flow conditions in downstream reaches. The inventories indicated that the dikes and primary/secondary spillways were in good condition at four of the five sites and wetland plant communities existed in various stages of successional development. At each site some degree of cropping had occurred right up to edge of the ponds, effectively limiting the development of vegetative buffers and resulting in increased transport of sediments directly into the ponds (*Figure 35*). At one site (L_8.7/0.1), substantial rill erosion was noted on the downstream face of the dike, threatening the long-term stability of the structure. At this same site, discharged water spreads out over a wide, flat, grassed waterway resulting in substantial warming of the water before it enters Lake Creek.

Figure 35. Typical cropping scenario adjacent to constructed wetland in Lake Creek (site L_6.7/0.2/0.0).

The O&M recommendations for these sites include: 1) install vegetated buffers, at least 50’ wide, at each location where cropping occurs adjacent to the ponds and negotiate modifications in existing landowner contracts to preserve these buffers; 2) repair the face of the dam at pond L_8.7/0.1, then reseed and mulch; and 3) at the same site, reconfigure the existing grassed waterway to provide a more direct pathway for discharged water to Lake Creek, and/or construct a French drain to facilitate the transfer of surface water runoff to the ground water table during summer release periods.

At the five riparian planting sites that were inventoried, three in Lake Creek and one in Benewah Creek, project goals consisted of increasing stream shading, providing a long-term source of large woody debris for natural recruitment, promoting bank stabilization, increasing riparian species diversity and cover, and enhancing stream buffer capacity. Measurable objectives were to provide for statistically significant increases in canopy density and overhanging vegetation within a 10-20 year time frame with specific targets set for each site. Inventories indicated that plant survival was highly variable, ranging from 15-85%. Approximately 7.3 hectares exhibited survival rates that were less than 50%, while 21.2 hectares had survival rates exceeding 50%. The principle causes of mortality were competition with established grasses, forbs and woody plants (primarily introduced species), with animal damage also accounting for ongoing losses of both newly planted trees as well as more established plantings at some sites. The inventory results suggested that achieving the riparian targets for a given site were unlikely where overall survival has been less than 50%.

The O&M recommendations for riparian planting sites are to replant 7.3 hectares in Benewah and Lake creeks including portions of sites B_8.9, L_7.3 and L_7.6/0.0, where survival was less than 50%. At each of these sites, chemical and/or mechanical treatment should occur prior to restocking to reduce competition with established vegetation. Mechanical treatment should consist of hand scalping around planting sites for individual trees to expose mineral soils, followed by planting, then placement of VisPore® tree mats to reduce colonization and regrowth by species that would compete with trees for either nutrients or moisture. At sites where animal damage was a significant source of mortality, including portions of sites L_8.2, L_8.2/0.0, L_7.3, and B_8.9, installation of Tubex® tree shelters is warranted to provide an addition measure of protection to ensure that survival rates remain above 50%. These measures are expected to increase planting costs by approximately $2.52/tree when both tree mats and tree shelters are used versus unprotected plantings.

Two sites were inventoried in Lake Creek (L_5.9/0.4/0.0 and L_7.3/0.2) where slope stabilization and reduction of gully erosion were primary objectives. Both of these sites had been taken out of farm production due to excessively steep slopes and extreme erosion hazard ratings. Estimates of gully erosion at the sites indicated that an estimated 3 tons of sediment were generated each year with a delivery rate of approximately 45% to downstream channel segments. Treatments included planting conifers and seeding and mulching bare soils associated with active gullies. At each site, survival of plantings exceeded 80% and there was no evidence of enlargement of mapped gullies. No further work was recommended at either site.

The inventory completed at the channel construction site (B_6.5), indicated generally stable conditions at all constructed riffles and grade control structures. Some lateral extension was noted at meander 7, which threatened an existing fence line and posed some long-term risk to the project by threatening to bypass the constructed riffle immediately below the meander. Some additional minor erosion of streambanks was noted at meanders 3 and 4. Identified O&M needs consisted of construction of a single J-hook structure to reduce erosion at meander 7. A 404 permit application was completed and submitted a to the Army Corps of Engineers on 7/29 to authorize project activities for the site. Authorization was received 10/11/03 (USACOE permit NWW No. 001201070) and O&M work was completed on 10/24/03.

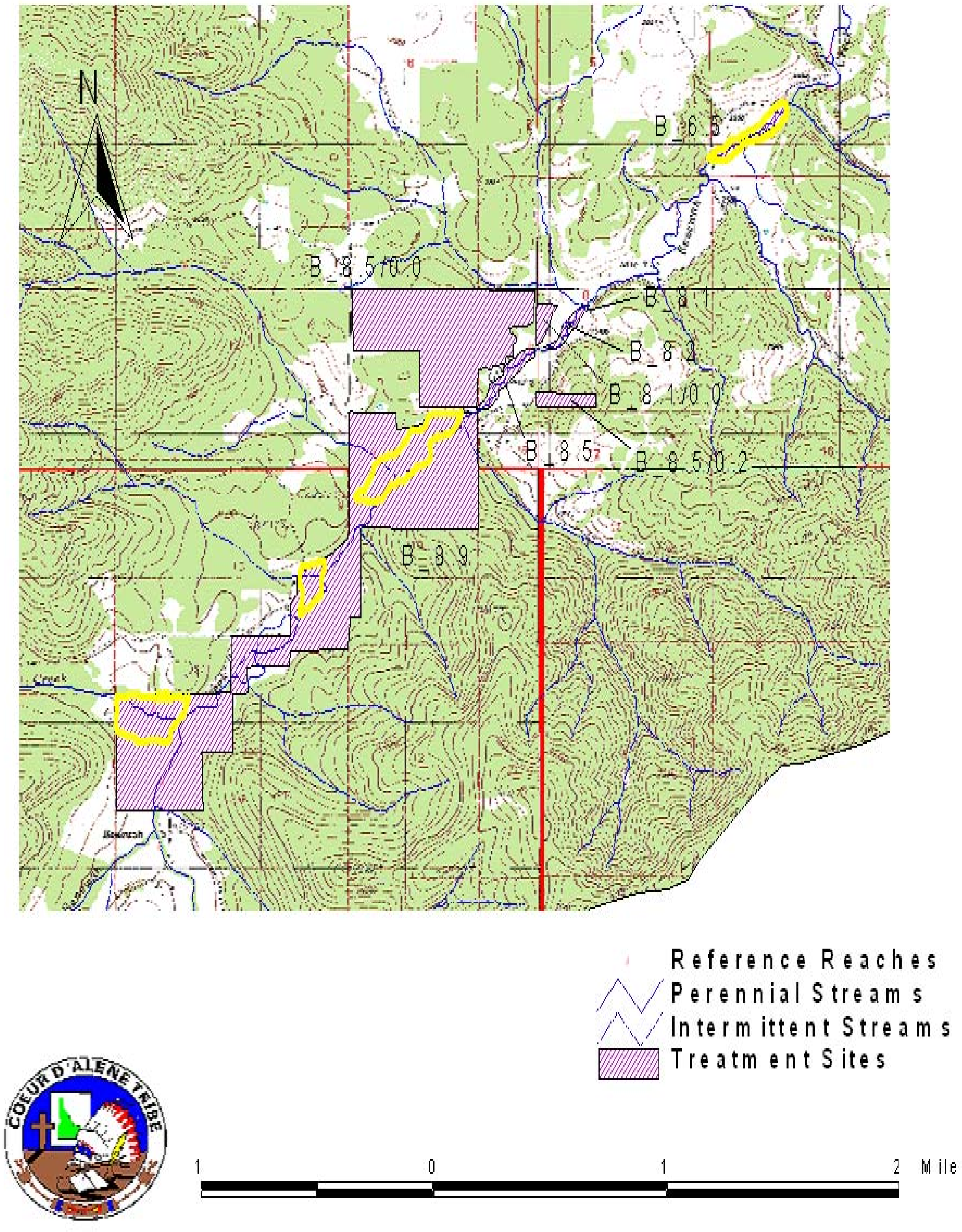


Figure 36. Locations of project sites (highlighted in yellow) in Benewah Creek where O&M inventories were conducted in 2003.

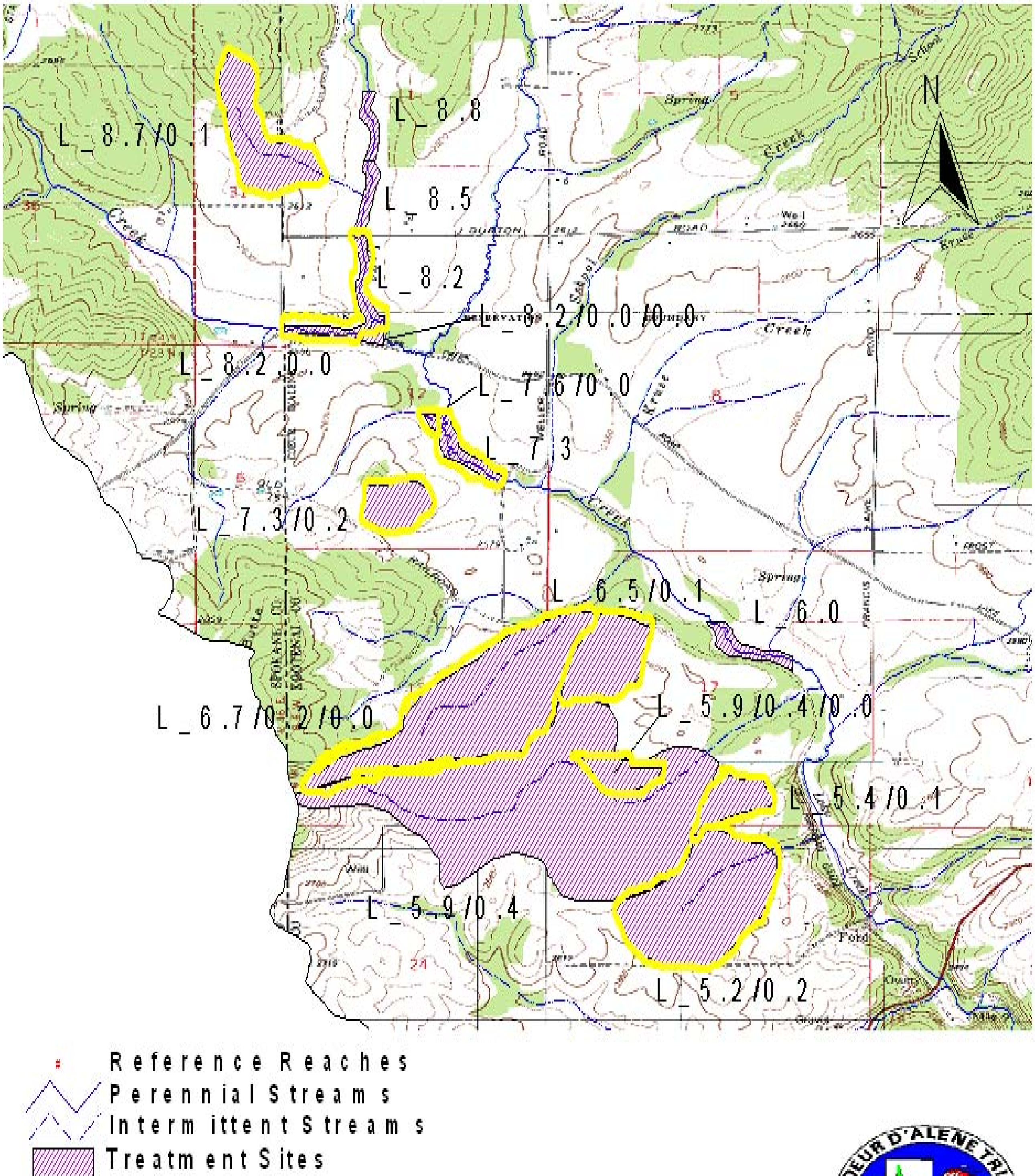


Figure 37. Locations of project sites (highlighted in yellow) in Lake Creek where O&M inventories were conducted in 2003.

Table 22. Summary of O&M inventories and recommendations, 2003.

Project ID	Location	Treatment	Inventory Summary	Recommendations/Prescription
L_5.2/0.2	T48N, R5W, S20, NE ¼	Water/sediment storage	Some sediment delivered through sheet/rill erosion directly to pond; dike and riser in good condition	Establish 16-meter wide vegetated buffer on south side of pond
L_5.4/0.1	T48N, R5W, S17, SE ¼	Water/sediment storage	Sediment delivered through sheet/rill erosion directly to pond; dike and riser in good condition	Establish 16-meter wide vegetated buffer on all sides of pond
L_5.9/0.4/0.0	T48N, R5W, S17, SW ¼	Slope stabilization	Plant survival greater than 80%, existing gullies not enlarging, long-term stabilization achievable	No immediate O&M needs
L_6.5/0.1	T48N, R5W, S17, NW ¼	Water/sediment storage	Sediment delivered through sheet/rill erosion directly to pond; dike and riser in good condition	Establish 16-meter wide vegetated buffer on all sides of pond
L_6.7/0.2/0.0	T48N, R5W, S17, NW ¼	Water/sediment storage	Sediment delivered through sheet/rill erosion directly to pond; dike and riser in good condition	Establish 16-meter wide vegetated buffer on east side of pond
L_7.3	RM 7.3-7.6	Riparian planting	▪ Survival on north side of channel greater than 65%, riparian targets attainable; ▪ Survival on south side of channel less than 50%, competition occurring with common tansy	▪ No immediate O&M needs on north side; ▪ Restock south side following mechanical or chemical treatment, improve survival by using tree tubes and weed mats
L_7.3/0.2	T48N, R5W, S12, SW ¼	Slope stabilization	Plant survival greater than 80%, no recent gully/rill erosion evident	No immediate O&M needs
L_7.6/0.0	RM 7.3-7.6	Riparian planting	Plant survival less than 20%, competition with established canary grass	Mechanical or chemical treatment of site needed prior to replanting, improve survival by using tree tubes and weed mats
L_8.2 L_8.2/0.0	RM 8.2-8.5	Riparian planting	Survival greater than 65%, some ongoing mortality by animal damage; riparian targets still attainable	Improve survival over next 2-3 years by reinstalling tree tubes and/or weed mats
L_8.7/0.1	T48N, R6W, S1, SW ¼	Water/sediment storage	▪ Erosion evident on face of dam; ▪ Sediment delivered through sheet/rill erosion directly to pond; ▪ Slow leak in primary spillway; ▪ Discharged water warms up prior to entering Lake Creek	▪ Repair dam face, then seed and mulch; ▪ Establish 16-meter wide vegetated buffer on all sides of pond; ▪ Replace defective dam board in primary spillway; ▪ Enhance grassed waterway below outflow to improve temperature amelioration potential
B_6.5	RM 6.5-6.9	Channel construction	▪ Lateral extension occurring at meander 7 threatens fence line; ▪ Additional minor bank erosion noted at meander 3 and 4; ▪ Constructed riffles and other grade control structures functioning properly	▪ Initiate immediate repairs at meander 7; reslope bank, reinforce toe of slope and revegetate; ▪ Continue to monitor site
B_8.9	RM 8.9-11.9	Riparian planting	▪ Survival at 2002 planting unit less than 40%, riparian targets currently not attainable ▪ Survival at 2003 planting units 50-60%, targets still attainable	▪ Replant up to 4 hectares associated with the 2002 planting unit, locally reduce competition to improve survival ▪ Improve survival at 2003 units over next 2-3 years by using tree tubes and weed mats

SECTION 3: LAKE CREEK POND MONITORING

OVERVIEW

Lake Creek, a tributary to Coeur d'Alene Lake, has been determined to be one of the four streams on the Coeur d'Alene Reservation best suited for cutthroat trout habitat improvement (Lillengreen et al., 1993). Westslope cutthroat trout (*Oncorhynchus clarki*) is one of two salmonid species native to Coeur d'Alene Lake and once the most abundant trout species in this system (Graves et al. 1990). The overall impact of grazing, farming, logging, overfishing, mining and construction of the Post Falls dam was the significant decline in cutthroat populations. These factors have led to a variety of habitat improvements being implemented in the four priority watersheds as part of the Coeur d'Alene Tribe's BPA-funded Fish Enhancement Project. This project includes five ponds constructed in the Lake Creek watershed.

The Lake Creek ponds were designed and built to act as settling basins for surface water runoff and to store water for late-summer release for flow and temperature augmentation in Lake Creek. Each pond project included tree and shrub plantings to provide additional erosion control around the ponds, increase habitat value for wildlife and, ultimately, provide shading of the pond for temperature control. The pond characteristics measured in 2003 are shown in *Table 23*. Additional details of each pond configuration and photographs from the 2003 inspection are presented in **CDA Tribe 2003**.

Table 23. Summary of constructed pond characteristics in the Lake Creek watershed.

Pond Name	Project ID	Pond Depth* ft.	Pond Surface Area* ac	Pond Volume** cu. ft.	Pond Volume** Gal	Distance to Lake Cr. (ft.)
South	L_5.2/0.2	7.5	0.8	182,775	1,367,157	1,218
Second	L_5.4/0.1	9.7	0.6	173,183	1,295,412	705
Third	L_6.5/0.1	9.6	0.8	171,101	1,279,838	942
Corner	L_6.7/0.2/0.0	12.6	1.2	460,256	3,442,714	1,958
North	L_8.7/0.1	12.6	0.9	228,665	1,710,414	732

* at typical full pool, assuming no overflow ** above primary spillway invert

The five ponds are located varying distances from Lake Creek, as shown in *Table 24*. The southern four ponds are placed across existing drainageways, adjacent to forested margins of actively cultivated fields. The pond outflow channels for these southern four ponds have, generally, stable gravelly or stony bottoms and ample overstory canopy. An exception to this is the lower 400 feet of the Third Pond outflow which crosses a hay field with no defined channel and no canopy. The North Pond is quite different from the other four in its location, being completely surrounded by actively cultivated areas. Outflow from the primary spillway of this pond passes along approximately 300 feet of a grassed waterway, across a cultivated field and into the wide, Reeds Canary Grass-dominated riparian corridor of Lake Creek. The cultivated field and riparian grassland are very flat so flow from the pond spreads widely north and south, with surface flow entering Lake Creek at numerous spots over approximately one half mile of its length.

Maximum summer water temperature and sediment are thought to be the two most significant limiting factors for cutthroat trout in the watershed (Lillengreen et al. 1996). From Hickman and

Raleigh (1982), optimum temperature for riverine cutthroat trout during the warmest period of the year is 11 - 15.5 °C. Data from the Upper Lake Creek site (located near Elder Road between the North pond and the Corner pond) during 2000 - 2001 exceeded the 15.5 ° limit only once (15.85 °C) on August 7, 2000. However, the Lower Lake Creek site exceeded 15.5 °C on almost all dates monitored during July, August and September, with a high value of 20.28 °C recorded on August 7, 2000. Summaries of continuous temperature data for the period 1998 - 2001 indicate that instream water temperatures exceed the 15.5 °C level in the lower watershed between July and August in most years (Appendix C).

Also, measured fine sediment in spawning gravels and riffles was found to generally exceed the recommended levels for high quality trout habitat. In the mainstem of Lake Creek the proportions of both small and coarse fines were considered above the levels for these particle sizes (10% and 30%, respectively) shown to adversely affect salmonid emergence success (Vitale et al. 1999). Earlier assessments also indicated that highly embedded substrates had the effect of generally reducing habitat diversity in mainstem habitats (Lillengreen et al. 1996).

Late summer stream flow in the main stem of Lake Creek is thought to be a secondary limiting factor for production of cutthroat as a function of decreasing habitat availability as flows decrease. Instantaneous flow data reported in the Fisheries Program's 1999 - 2001 Annual Report included seasonal low flows between 0.06 and 7.14 cfs during the July to September period (CDA Tribe 2003). Although published literature (Hickman and Raleigh 1982) indicates that these base flows are less than optimal, the resident fish population at this time of year is comprised mostly of cutthroat fry or juveniles (ages 0-2+) that reside and feed in riffle-pool areas and are typically associated with low velocity habitats at the margin of channels that are widely available.

TEMPERATURE AMELIORATION

The lower four constructed ponds are located where the release of water could effect a decrease in stream temperature given sufficiently cool water in the ponds. This monitoring plan outlines a procedure for determining pond water temperature profiles, for scheduling release of this water and for monitoring the effect of this release on Lake Creek.

Temperature Amelioration Goals/Objectives

The goal of the pond water release is to moderate the seasonal high temperatures in Lake Creek, to the extent possible, to improve cutthroat trout habitat. The primary objectives in achieving this goal are to monitor water temperature in the ponds (through vertical temperature profiles) and in Lake Creek (through continuous temperature recorders placed at the lower monitoring site) so that release timing can be coordinated. Further objectives are to monitor the release of water through flow and temperature measurements, downstream of the ponds and in Lake Creek, so that the effect of the releases are documented and adjustments made as necessary.

The criterion to be used to determine when pond water releases are necessary is the average daily temperature in Lake Creek that exceeds 15.5 °C for at least three days out of the preceeding seven-day period. Once started, the release of water from any given pond should be continued until the water temperature in Lake Creek above the confluence with the pond release is below 15.5 °C for three successive days and / or until the temperature of the water being released reaches 15 °C (measured just above the confluence).

The sequence of release shall be to start with the South pond and proceed north. This will allow for determinations of upstream (background) water temperature in Lake Creek without influence from upstream ponds and will take advantage of the water available in the smaller southern ponds first. Water should be released from only one pond at a time but release rate can be adjusted to achieve a reduction in the Lake Creek temperature. The water release rate from any given pond should be such that does not cause erosion of surface channels but does result in a lowering of the temperature in Lake Creek to below 15.5 °C. Because there is insufficient data available to prepare a specific release protocol for all situations, it is important to document all releases so that constructive modifications to this Plan can be made.

Temperature Monitoring

The original proposal for the pond water release monitoring included the use of shallow groundwater monitoring wells (peizometers). This is not considered necessary at this time although this may be considered in the future.

As indicated above, temperature in Lake Creek should be monitored using continuous recorders placed at the lower monitoring site. These should be retrieved and replaced on a weekly basis from the middle of June through the middle of September, or until the creek temperature remains consistently below 15 °C. Temperature recorders should be downloaded promptly upon return to the office and recorded hourly temperatures reduced to daily averages.

Pond water quality profiles should be determined using a Hydrolab® multi-parameter analyzer or other equivalent device that allows measurement of several parameters in place. Parameters to be determined should include at least temperature, dissolved oxygen, conductivity and pH. The profiles should be performed near the pond outlet (primary spillway) at the deepest point possible. Samples for laboratory analysis of nutrients and pesticides should be collected using a Kemmerer sample collector at one meter below the surface and one meter above the bottom. Parameters to be tested include total and dissolved (ortho) phosphorus, nitrate, nitrite, ammonia and Kjeldahl nitrogen, chloride and a scan for pesticides. While the complete profile can be determined anytime after the runoff season is over (i.e. after April), an additional temperature profile should be obtained immediately prior to the release of water from each pond.

Pond outflow should be monitored for temperature and flow and pond drawdown at least twice weekly during release. If water release is accomplished by raising the splashboards, these should be inspected daily to maintain the desired flow. Flow and temperature measurements should be made near the pond outlet pipe, just before the pond flow enters Lake Creek and in Lake Creek 15 - 20 feet above and below the confluence. Flow measurements should be made using a portable flow meter (Gurley model 625 "pygmy" velocity meter or equivalent with Gurley model 1100 digital readout, or equivalent) and temperature with a standard or digital thermometer.

It may be possible to utilize a portable weir or flume to facilitate pond release or Lake Creek flow measurements. Once installed, these allow flow to be determined quickly based on the depth of water flowing through them. Installation of portable weirs and flumes must be made based on specific criteria which should be determined prior to purchasing them.

Pond Water Testing and Water Release Trials

During the summers of 1998, 1999 and 2001, Fisheries Program staff conducted baseline water quality monitoring in the South and Corner ponds, and then performed the first trial release of water from these two ponds in 2001. From this work it was shown that the water in these two ponds was quite similar, although with some notable differences. The effect of the release on Lake Creek was also notable.

There were four key water quality parameters that were measured in the field through the water column using a Hydrolab® multi-parameter analyzer: temperature, dissolved oxygen, conductivity and pH. In both ponds the temperature, pH and dissolved oxygen were seen to decrease from surface to bottom and conductivity was seen to increase, surface to bottom. The surface to bottom ranges of values seen in 1998 (June 26, South pond only) were: temperature between 18.5 and 13.7 °C; pH between 7.4 and 6.6; conductivity between 166 and 179 µS/cm; and dissolved oxygen between 7.6 and 0.4 mg/L. Total dissolved solids (TDS) at this time were uniform surface to bottom, i.e. between 0.11 and 0.12. There was a noticeable stratification at about the 2.0 m depth below which dissolved oxygen levels were depressed to below 1.0 mg/L.

On July 30, 1999 both the South And Corner ponds were monitored. At this time the range of temperatures at both ponds was approximately 22 to 12 °C while other parameters varied between the two ponds. The surface to bottom pH values measured at the South pond were between 9.3 and 6.7 while those from the Corner pond were between 7.2 and 6.8. Conductivity was between 317 and 461 µS/cm in the South pond and between 165 and 203 µS/cm in the Corner pond. Total Dissolved Solids in the South pond were between 0.2 and 0.3 while those measured in the Corner pond were 0.11 to 0.13 mg/L. Finally, dissolved oxygen in the South pond was 7.6 to 0.4 mg/L and 4.2 to 0.4 in the corner pond. Thus, the chemical character of the water in the Corner pond in 1999 was very similar to that in the South pond during 1998; the reasons for the differences in the South pond between 1998 and 1999 are not known. Stratification and deep water anoxia (dissolved oxygen less than 1.0 mg/L) was present in both ponds, at about the 2.5 m depth in the South pond and about the 1.0 m depth in the Corner pond

No pond water monitoring was performed during 2000 but on August 24, 2001, just before the first trial water release, both the South and Corner ponds were monitored. At this time the temperature of both ponds was similar: between 22 °C at the surface and 11 °C near the bottom, while other parameters were dissimilar. The pH range in the South pond at this time was 9.8 to 6.3, while in the corner pond this was 7.6 to 6.9. Conductivity ranged between 251 and 406 µS/cm in the South pond and between 295 and 447 µS/cm in the Corner pond. Total dissolved solids were not measured and dissolved oxygen 10.6 to 0.2 mg/L in the South pond and 8.5 to 0.3 mg/L in the Corner pond. Stratification was apparent at about the 2.0 m depth in the South pond and at the 4.0 m depth in the Corner pond.

In 1999, water samples were also collected from near the surface and near the bottom of these ponds for limited laboratory analyses. Parameters tested for were total suspended solids, turbidity, chloride, fluoride, nitrate and nitrite, dissolved ("ortho") phosphorus, sulfate and total Kjeldahl nitrogen. All total suspended solids results were within the range of 2.2 to 9.4 mg/L. Turbidity values were between 2.2 and 6.6 NTU. These represent low levels of suspended matter which would be expected several months after the end of the runoff season. Nitrate and nitrite levels were similar in both ponds and at or below the analytical detection limit of 0.005 mg/L except for slightly elevated concentrations (to a high of 0.039 mg/L) of nitrate near each pond bottom. Total Kjeldahl nitrogen (a measure of nitrogen in organic materials) was also low (0.20 to 0.27 mg/L) in all samples.

The remaining lab-analyzed parameters showed differences between the two ponds. Both chloride and fluoride were higher in the South pond: chloride was 35.2 - 35.3 mg/L in the South pond and 0.6 - 0.7 mg/L in the Corner pond while fluoride was 0.4 mg/L in the south pond and 0.1 mg/L in the Corner. Ortho phosphorus and sulfate, on the other hand were higher in the Corner pond: 0.03 mg/L phosphorus in the South versus <0.01 mg/L in the Corner and 3.2 mg/L sulfate in the South versus 6.0-7.4 mg/L in the Corner pond. The most significant of these differences is the chloride but the reasons for these differences is not apparent.

Of the parameters tested for in these two constructed ponds, only the high pH seen in the South pond and the low dissolved oxygen seen in both ponds below the stratification could be said to present a potential for water quality degradation in Lake Creek during water release. Of these two parameters, the oxygen levels would be expected to be replenished during a release as the water flows along the outlet channel. With this aeration, it is possible that the high pH levels may also moderate.

A test of the impact of released pond water on Lake Creek was conducted with the trial release from the Corner pond during August and September, 2001. The pond discharge flow was 25 gallons per minute (0.06 cubic feet per second, cfs). Flow in Lake Creek near the confluence was not determined during the pond release. This release was accomplished by opening the 2 inch valve that had been installed in the bottom splash board of the primary spillway. This valve was connected to a section of plastic pipe which was set up to draw water from the deepest part of the pond to obtain the coolest water available. Table 4 in Appendix C provides the results of the field analyses performed at the outlet of the Corner pond and at the confluence of this discharge with Lake Creek. To test the effect of pond discharge reaching Lake Creek, a series of monitoring points were laid out at one to two meter intervals along the centerline of the Lake Creek channel, above and below the confluence with the pond discharge. At the pond outlet and at each of these eight points the temperature, pH, conductivity and dissolved oxygen were measured using the Hydrolab®. While it can be seen that this data set is not a conclusive assessment, there are indications that the release of water from these ponds is a feasible habitat management tool.

Initially, the temperature of the discharge was found to be 14.6 °C, the average temperature of the four points above the confluence was 13.4 °C and the average temperature of the four points below the confluence was 13.2 °C. While this would appear to indicate that the temperature was lowered slightly by the addition of the discharge, the fact that the discharge water had a higher temperature than that in the creek (either above or below the confluence) makes this conclusion suspect. There was, however, one temperature reading above the confluence that was inordinately high (14.8 °C) which is unlikely given the proximity of these readings (and the similarity of the readings below the confluence). If this high reading is removed from the mean calculation the result for above the confluence becomes 12.9 °C which would allow the conclusion that the discharge actually increased the temperature in Lake Creek slightly, which seems more reasonable (especially in light of the 2003 release trials, see below).

The available pH data yields the same conclusion as that from the adjusted temperature data; that the pond water did effect a minor change in Lake Creek. The pH of the pond discharge was measured to be 7.7, the mean pH above the confluence was 7.8 and that below the confluence was 7.6. The conductivity data included 366 μS/cm in the pond discharge, an average of 60.1 μS/cm in Lake Creek above the confluence and an average of 53.4 μS/cm below the confluence. This data does not lead to a logical conclusion (except the possibility that the data from above the confluence was switched with that from below the confluence). The dissolved oxygen data does not include the oxygen level in the pond discharge so no conclusion can be drawn from this. It is apparent, however, that the oxygen levels below the confluence are slightly higher than above, that is 5.3 above and 5.6 below.

During September 2003 all five ponds were inspected for the purpose of verifying pond volumes and the status of the primary spillways prior to the second trial water release. The result of this inspection, including measured pond dimensions at normal full pool and volume calculations, are presented in CDA Tribe 2003 and *Table 24*. At the time of this inspection, the South and Second ponds were found to be essentially empty (water level at or below the primary spillway invert) so trial release of water from these was not possible. The Third, Corner and North ponds were each approximately 70% full at this time. It was considered desirable to leave at least one pond full so that sediment traps (see below) could be set up prior to the fall / winter runoff season so the Corner and North ponds were selected for trial release. (Selection of these two ponds was also based on the Corner pond being the longest distance from Lake Creek and the North pond having no defined outflow channel.)

During the water release from these two ponds, the drop in water level was monitored in the primary spillway using a weighted measuring tape. Flow and temperature were monitored near the pond outfall and just above the confluence with Lake Creek. Temperature only was also monitored in Lake Creek above and below the confluence. Flow was measured using a Gurley pygmy meter following the "velocity-area procedure" described in the Fisheries Program's RM & E Plan (CDA Tribe 2002b) and temperature was measured using a standard field thermometer. Flow could not be determined at the end of the pond outflow pipes due to the high velocities and turbulence at these points; nor could flow be measured in Lake Creek due to lack of movement in the pool at the confluence and shallow flow in the nearest downstream riffle. In addition, the floodplain below the North pond was very flat, which resulted in the released water spreading out widely and entering Lake Creek at a number of locations. Due to the dense grasses in the riparian corridor, it was also not possible to measure these flows entering Lake Creek although flow was estimated wherever it was seen.

The Corner pond water release was accomplished by raising the 24 inch wide by 5 or 7 inch high splashboards in the primary spillway 0.3 ft (3.6 inches). This allowed significantly more water to exit the pond than the previous releases, typically between 2 and 3 cfs (15 to 22 gallons per second). Due to the structure of the primary spillway once a splashboard was raised that initiated flow release, it was difficult to raise more than two additional boards. Therefore the release had to be re-started after the water level had dropped to the top of the lowest open board (i.e. the next day) and this limited the height of water above the release point (head) to a maximum of 19 inches (two 7 inch boards plus one 5 inch board). Following this procedure, it took four days to drop the pond 7.8 feet. The daily rate of drop was calculated to be between 0.2 and 0.4 feet per hour.

Water released from the Corner pond was measured to loose between 0.2 and 0.5 cfs between the pond outlet and the confluence with Lake Creek, almost 2,000 feet away. The temperature also decreases an average of 0.45 °C, from 13.5 - 16.0 °C at the pond outfall to 13.0 - 15.0 °C above the confluence. Thus, as with the previous water release trials, the water was actually too warm to reduce the temperature in Lake Creek. In fact, measured temperatures above the confluence in Lake Creek were 11 - 12 °C while those below the confluence were 12 - 14 °C. This point, again, to the importance of measuring temperature throughout the pond profile prior to releasing water.

The North pond release was also accomplished by raising the splashboards 0.3 feet, in this case these were 12 inches wide by 5 or 7 inches high. Again, only two to three boards could be opened at a time. It was not possible to measure the released flow rate but the daily pond drawdown rate was similar to that of the corner pond: 0.37 to 0.46 feet per hour. This is due to the smaller size of this pond.

Limited temperature monitoring indicated that increases between 0.5 and 4 °C occurred; from a release temperature of 15 °C to a maximum of 19 °C adjacent to Burton Road. Again, the water in the pond was too warm to achieve a decrease in the creek temperature and increases from a background of 8 °C in Lake Creek above any pond water influence to a high of 15.5 °C occurred.

Conclusions and Recommendations for Pond Water Release

There are several conclusions that can be drawn from these water release trials. First, it is of paramount importance to determine the temperature profile of a pond prior to release of any water for temperature augmentation. No water should be released from the lower four ponds that is above 15 °C. Second, it is important to determine the temperature in Lake creek to determine when pond releases are needed. This should be accomplished using continuous temperature recorders at the lower Lake Creek site and weekly data downloads should be performed in order to calculate daily average temperatures.

Further conclusions relate to the volume of water that is released. It appears from the available data that the lower release rate (25 gpm, or that available from the valve installed in the lowest spashboard) can effect a reduction in temperature in Lake Creek. However, it is not currently possible to open these valves without someone entering the primary spillway; this considered to be impractical and a safety hazard due to the confined space. Therefore a long-handled key should be fabricated that can be used to open these valves from the top of the spillway box. It still appears appropriate to attach a pipe to these valves in order to draw the coolest water from the bottom of the ponds. It is therefore recommended that all ponds not currently having valve and pipe systems have those installed.

Regarding the North pond, it is considered critical that a channel leading from the pond outfall to Lake Creek be constructed before any water release in attempted. Such a channel should be as shallow as possible and should be grassed to prevent erosion. This channel must be constructed with landowner consent as it would likely block vehicle / farm implement passage between the northern and southern portions of the field below the pond.

Finally, it is recommended that periodic water quality testing be performed on the pond water following the runoff season. Hydrolab vertical profiles should be performed on two to three year intervals in all ponds, and other laboratory analyses, including pesticides and nutrients, should be performed on five to six year intervals.

POND SEDIMENT TRAPPING MONITORING

As indicated in the previous section, Lake Creek is limited in its water quality and cutthroat trout habitat potential primarily by sediment. This fact is documented by the inclusion of Lake Creek on the State's 303d list of water quality limited water bodies for sediment. As a result of this listing, the US EPA and Tribe's Water Resources Program are preparing a TMDL assessment and Implementation Plan for this watershed (the TMDL is expected to be completed before the end of 2003). Following completion of the Tribe's fish habitat evaluation work in 1991, it was concluded that the major potential limiting factor restricting the fisheries resources in Lake Creek is the excessive amount of fine sediment accumulated in the spawning and rearing substrate (CDA Tribe 1993).

One of the expected benefits of constructing off-channel ponds is the trapping of silt that would otherwise enter main stem channels through tributaries. Sediment has been determined to be a primary pollutant of concern in this watershed as documented by the Idaho 303d list of water bodies not meeting water quality standards (USEPA 1998). While ponds appear to have utility in intercepting silt and sediment from agricultural areas (NRCS 2000) it is important to document this as an effort to validate this approach in this watershed.

This Sediment Trapping Assessment Plan describes the collection of pond inlet / outlet grab samples and flow determinations as a means of partially quantifying the trapping efficiency of the ponds. Because it is difficult to accurately determine the timing and overall flows of the runoff season, however, these grab samples are not seen as a complete picture. Therefore, an alternative of placing full season, fixed position sediment traps within the pond water column is also described. This represents a simple design that will allow for the collection of particulate matter which will be submitted to analysis for total solids. When the surface area of the collectors are totaled and averaged (and corrected for depth of placement if necessary) the total sediment trapping capacity of the pond on a seasonal basis can be seen.

This monitoring plan outlines a procedure for monitoring the effectiveness of the Lake Creek ponds in trapping sediment that might otherwise be carried into Lake Creek.

Sediment Trapping Goals/Objectives

The goal of this monitoring effort is to determine the sediment trapping efficiency of ponds constructed for fish habitat enhancement by the Coeur d'Alene Tribe. The objectives are to monitor surface inflows and outflows using grab sampling techniques and to monitor sediment deposition using fixed position sediment traps. All collected samples will be submitted to a State-accredited laboratory for solids determinations following standard methodologies.

Inlet / Outlet Sediment Sampling

Inlet / Outlet sampling should be attempted on all ponds during the first monitored runoff season. Based on the results of the first year, and the ease or difficulty in catching runoff / overflow events, subsequent years' sampling effort may be targeted to certain ponds. During the first year, two sample sets are desirable from each pond, for a total of 26 samples if all apparent inlets are flowing. Inlets and outlet for each pond should be sampled simultaneously and concurrent with flow measurements.

Manual Grab Sampling
Grab sample techniques are described by APHA (1992) and the Tribe's Quality Assurance Project Plan (QAPP) for the Water Resources Program (CDA Tribe 2003b). Inlet / outlet samples will be taken using a DH-48 water sampler. A depth-integrated approach will be used for most samples, especially those where the flow is greater than one foot wide and greater than 0.5 feet deep. The sampler will be lowered into the stream from surface to bottom in at least but not limited to five different equal-distant stations along a perpendicular transect across the stream. In the event that a depth integrated sample is not necessary a grab sample will be taken using the following procedure: Grab samples will be collected as close to mid-stream and mid-depth as practical using a clean container fixed to a six foot pole. Collected samples will be immediately transferred to containers provided by the analytical laboratory. Wide mouth, 1L bottles should be provided by the analytical laboratory and labeled to identify the sample location prior to filling. Defined inlet locations are shown on Figures 2 - 6 and these should be sampled as close to the pond as possible.

Surface water flow into and out of each pond should be determined as accurately as possible. Flow measurement techniques are described in CDA Tribe 2002b using either the "velocity-area procedure", which involves the use of a flow meter to measure water velocity, or the "neutrally buoyant object procedure" which involves the use of a floating object and stopwatch to determine velocity. In both cases the cross sectional area (total width and depths at intervals) of the flow must be determined. Note that it may be possible to measure the flow out of the pond more efficiently at the mouth of the outlet pipe using a bucket of known volume and a stopwatch. If the outlet flow is too great to capture it all in a bucket in a measurable time, however, one of the other methods will have to be used in the actual channel. Do not attempt to use the flow meter method at the mouth of the outlet pipe because the drop and turbulence will give erroneous readings.

Automated Grab Sampling
To help eliminate the need for sampling personnel to have to monitor the occurrence of runoff events and mobilize to the pond site to collect samples for sediment analysis, automated samplers may be used. The Tribe's Water Resources Program currently owns two ISCO, Inc. Model 3700 automatic samplers that are available for this. These units are battery powered and programmable to provide various options for their installation and sample collection (ISCO 1999). These units have the capability of initiating sampling only when water is flowing in a given channel but do not currently include flow measurement capability (for flow-weighted sampling).

The ISCO Model 3700 units use a peristaltic pump for sample collection. Each sampling cycle includes a pre-sample purge and post-sample purge which uses air to clear the suction line before and after sampling. This minimizes the potential for cross contamination between samples. The sampling pump speed is approximately 250 rpm which generates a velocity sufficient to obtain representative sediment samples.

ISCO automatic samplers can be placed on any near-level surface close to the flow channel. The proper placement of the sampler tubing and intake is important to assure the collection of representative samples. The intake has a weighted inlet strainer which can be removed if heavy suspended solids are expected in the runoff (which is possible in pond inlets). The intake, with or without the strainer, should be suspended in the main flow, not in an eddy or near the edge of a channel. The intake should be held just off the bottom of the channel to avoid drawing sediment materials off the bottom, but low enough to collect shallow flow (i.e. one inch). It may be necessary to place the intake in a false channel or weir, to constrict the flow and facilitate the sampling. If this is used, it is important to install this such that flow does not leak underneath it causing a washout where flow would be diverted away from the intake.

A liquid level "actuator" (ISCO Model 1640) must be used for automatic pond inflow - outflow sampling. This is a probe that sends a signal through a cable to the sampler controller to initiate a pre-programmed sampling routine (i.e. timed interval sample collection) when flow begins or when it reaches a certain height above the channel bottom. The actuator probe assembly should be rigidly mounted above the flow stream using weather resistant hardware (as shown in ISCO 1993). The mounting should be such that the stainless steel ring, located under a plastic rain deflector, is at the height where the sampler is to be activated. The actuator can be operated in three modes (as programmed on the sampler controller). Typically for this pond inflow-outflow sampling, mode 3 - "toggle/reset" should be used, where the sampler behaves as though it is operating except it is not collecting samples. When the water level rises to the level of the actuator probe, sample collection will begin according to the program. This allows sampling to begin following the programmed delay to the first sample. Sampling will then proceed according to the programmed schedule (one sample every hour, for example) as long as water in the channel is touching the probe ring.

Additional details of the programming and operation of the ISCO sampler and actuator are presented in the Instruction manuals (ISCO 1999 and 1993). These manuals should be thoroughly reviewed prior to setting up the samplers.

In-Pond Sediment Trapping

A major challenge with using the inlet / outlet sampling to estimate sediment trapping, even with the automated sampler, is that the discrete sampling does not shed light on the total amount of water or sediment that is delivered to, or exits from, the ponds in the runoff season. This would require the installation of an automated, flow recording device that could operate 24 hours a day / seven days a week for the full runoff period. In addition, because of the configuration of the primary spillways that draw water from the depth of the pond (as opposed to the surface), it is possible that outlet sediment concentrations may be higher than inlet samples collected at the same time. For these reasons, it is considered that an in-pond sediment trap procedure is likely to provide a better estimate of overall sediment trapping performance.

The sediment trap sampling will follow the design described in the RM&E Plan (CDA Tribe 2002 and 2002b). *Figure 38* shows a typical sediment trap setup although this does not clearly illustrate the vertical spacing of the traps. Each sediment trap, or collector, consists of a funnel and a plastic tube that fits snugly over the spout of the funnel and has a rubber stopper plugging the bottom. This rests in a 1L bottle which is in turn attached to a suspension rope that is anchored to the pond bottom. The suspension rope and collector(s) are held vertical by a float which is attached one to two feet under the water surface. A detailed materials list follows; numbers of items are totals needed if all ponds were monitored concurrently.

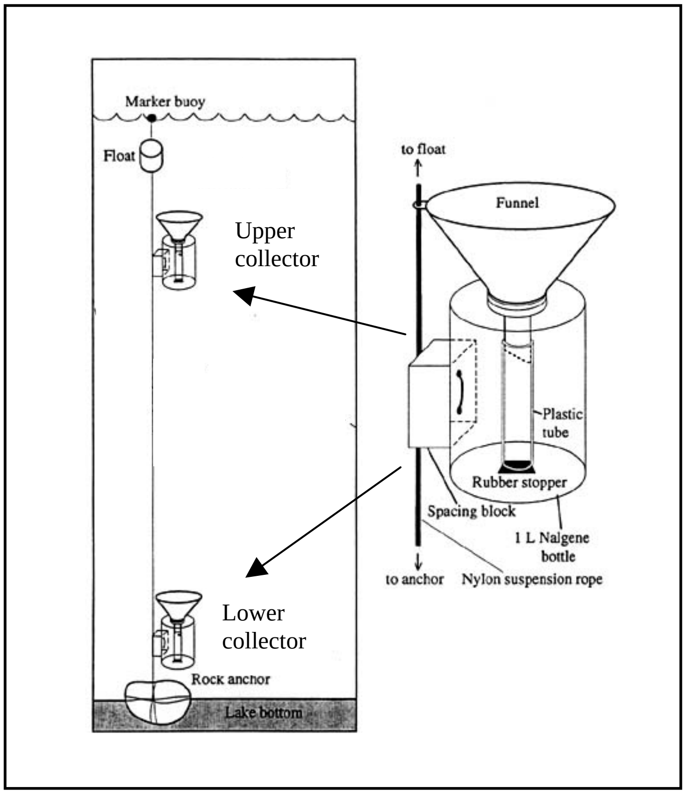


Figure 38. Schematic of sediment trap setup (after Hardy et al. 1996).

Sediment trap locations for each pond are shown on the attached diagrams (*Figures 39 - 43*). At each location the depth at full pool must be determined in order to determine the number of collectors (one or two) to be placed there. The general guideline for the placement of collectors on a setup line is that no collector should be closer than 3.0 feet from either the water surface or from the pond bottom. Following this, collector setups should not be placed where the total depth is less than 6.0 feet. More specifically, the following collector depths are based on the total depth:

For total depth less than 6.0 feet:	no collectors
For total depths between 6.0 and 12.0 feet:	place one collector at 1/2 depth
For total depths greater than 12.0 feet:	place collectors at 1/4 depth and 3/4 depth

Sediment samplers are to be placed initially in Third pond due to need to install when pond is full. Traps should be placed in each pond, if possible, to determine the range of trapping efficiencies obtainable with the various pond and drainage basin configurations.

Pond Bottom Topography Surveying

An additional technique that can be used to determine the trapping of sediment by these ponds involves the use of Total Station or Theodolite survey equipment to determine change in elevations of the pond bottom. The results of initial investigations into these options are summarized below, but no formal survey protocol has been developed for this version of the Pond Monitoring Plan.

With either of the survey techniques described below it will be necessary to establish a control point (or "bench mark") which will be the base for all horizontal and vertical measurements taken from year to year. As with the stream habitat surveying described in the RM&E Plan / Field Technician Training Manual, this bench mark is usually composed of a section of one-inch rebar which is pounded into the ground at a location that can be easily seen from the all areas of the pond.

Typically this rebar should be at least three feet long so that when pounded into the ground so that the top is near the ground surface, it is unlikely to be moved. An alternative to using rebar at the ponds is to use another fixed object, such as a corner of the primary spillway box (underneath the lid is better than on top). The top of the bench mark is given an assumed elevation of 100.00 feet and it is the reference from which all elevations and horizontal distances are measured. The bench mark should be well flagged with surveyor's ribbon and painted lath so that it can be relocated into the future. Good notes and a site map should also be kept to help in the relocation of this feature in the future.

Total Station Surveying
Total Station units use a laser beam and a reflective target to measure horizontal and vertical angles between the bench mark and any desired point, and an external data collector unit (or office computer) to calculate distances and slopes between the bench mark and each point, and to store the data. (The Total Station unit itself has the capability of storing measured angles and distances but does not perform calculations that would be necessary to determine elevations and location of the survey points.) The Total Station unit is mounted on a tripod and operated by one surveyor. The target is mounted on a surveyor's rod and this is held by a second surveyor on the bench mark and each successive measuring point while a Total Station shot is taken to obtain the data needed for the calculations. The reported horizontal and vertical accuracy of the Total Station unit researched (Sokkia model SET530) is within five seconds, or approximately 1/16 inch.

The total station surveying is considered best for surveying points laid out on a grid across the pond bottom. A grid having a two to three meter node interval (grid line intersection) is recommended for the Lake Creek ponds. Areas of the pond which are underwater at the time of the survey will likely not be surveyable because they will likely be too soft to accurately determine the bottom elevation. For this reason, it is important to allow the pond sufficient time to dry following drawdown to provide a firm base for this surveying.

Theodolite Surveying
Theodolites utilize an optical telescope to sight a target and then turn angles which can be used to determine relative horizontal and vertical location. The horizontal and vertical accuracy of the angle measurements is comparable to those obtained with the Total Stations (within five seconds, approximately 1/16 inch) but theodolites do not measure distance. Thus a theodolite should only be used if specific survey points are located (i.e. with a permanent marker) to be periodically re-surveyed. The use of set points is recommended as a check to the grid point survey described above but set points can also be surveyed using a Total Station. The digital theodolites that are available for rental do store the raw data points (angles) but any needed calculations must be performed externally (i.e. using a data collector or an office computer).

Analytical Methods for Sediment Quantification

Grab Samples
The standard laboratory method to be used for the sediment trapping assessment using grab sampling will be Standard Method #2540D: Total Suspended Solids Dried to 103-105 °C (APHA, 1992). For this analysis, collected samples are shaken to thoroughly mix the collected sediment and water, and a sub-sample of this mixture is filtered through a weighed glass-fiber filter to eliminate most of the water in the sub-sample. The filter is then dried to a constant weight in a drying oven at 103 - 105 °C. The increase in weight of the filter represents the total suspended solids in the volume of sub-sample, for a weight per volume result (typically mg/L).

Trap Samples
The standard laboratory method to be used for the sediment trapping assessment using the sediment traps will be Standard Method #2540B: Total Solids Dried to 103-105 °C (APHA, 1992). For this analysis, collected samples are shaken to thoroughly mix the collected sediment and a sub-sample of this mixture is placed in an evaporating dish. The dish is then dried to a constant weight in a drying oven at 103 - 105 °C. The increase in weight of the drying dish represents the total solids collected by the trap and the top dimension of the trap funnel gives that area over which the sediments were collected. The final result will be the weight of sediment per area (typically mg/cm^2).

Data Analysis

Grab Samples
An initial comparison that will be made using the grab sample results is simply the relationship between inflowing and out flowing solids concentrations. For each sampling event, sediment retention is calculated by the difference between inflow and outflow concentrations divided by the outflow concentration (times 100 yields percent retained). If more than one sample set has been obtained for the season, the percentages can be averaged to obtain an estimate of seasonal trapping.

If the seasonal total runoff flow could be determined (either measured or estimated), this volume (in L or m^3) could be multiplied by the average of all inflowing or out flowing TSS results to yield the amount (weight) of sediment delivered to and carried out of the pond. These seasonal loads of sediment can also be used to calculate sediment retained in the pond by following the previous method of subtracting the outflow from the inflow load and dividing this by the outflow load.

Trap Samples
The results of all trap samples will be combined through averaging for shallow and deep samples separately. The shallow and deep sample results will then be combined through a depth-weighted average (an adjustment that accounts for different numbers of samples at the two depths) to obtain an overall pond average. To obtain an estimate of the weight (mg, g or kg) of sediment captured in the pond over the deployment period, this weighted average is applied to the surface area of the pond at full pool.

Pond Bottom Surveying
Survey data (angles and distances from a Total Station unit and angles from a theodolite unit) should be reduced to relative elevation of surveyed points. Distances determined by a Total Station could also be used to prepare graphic representation of the pond bottom (e.g. a topographic map) and/or to be submitted to statistical analyses to show year-to-year variations. Research into available map generating software and statistical analyses has not been performed for this version of the Pond Monitoring Plan; this should be done along with the selection of the specific Total Station or theodolite units to be used for these surveys.

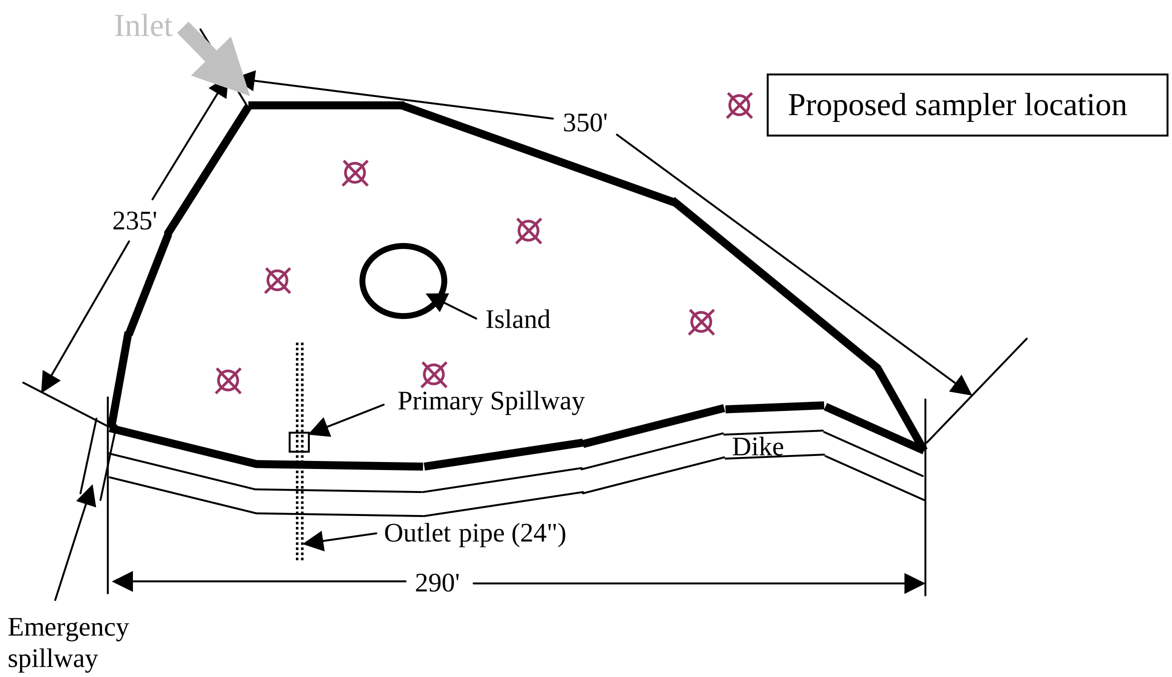


Figure 39. Schematic of South Pond (Project ID: L_5.2/0.2) showing proposed locations of sediment traps.

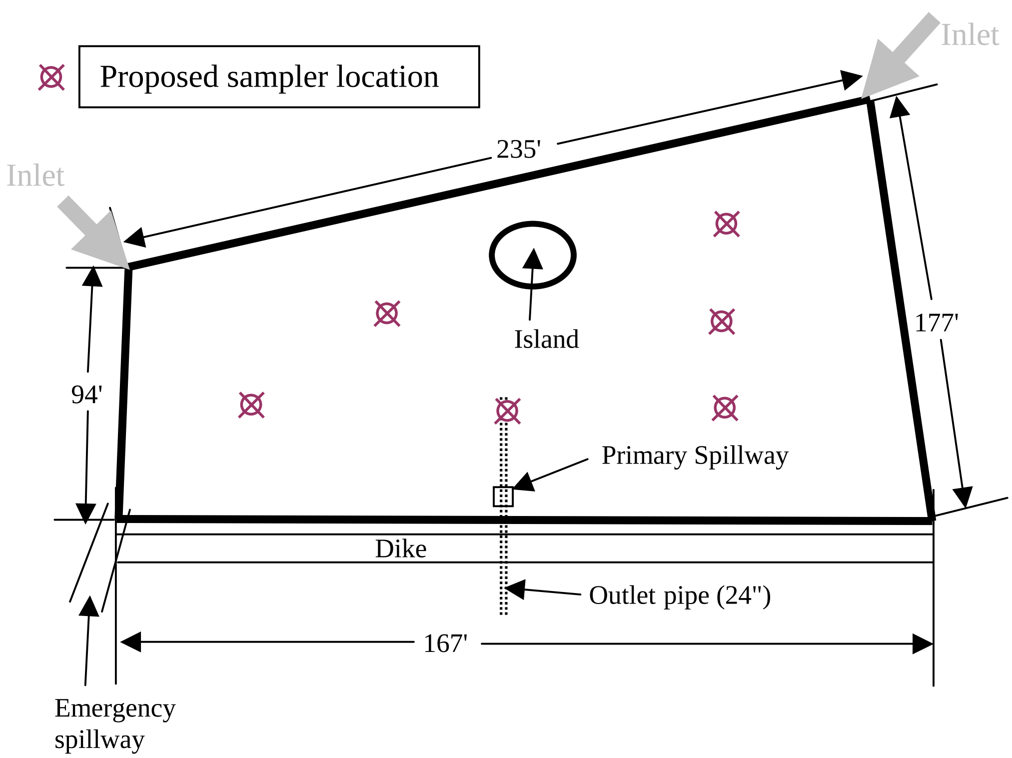


Figure 40. Schematic of Second Pond (Project ID: L_5.4/0.1) showing proposed locations of sediment traps.

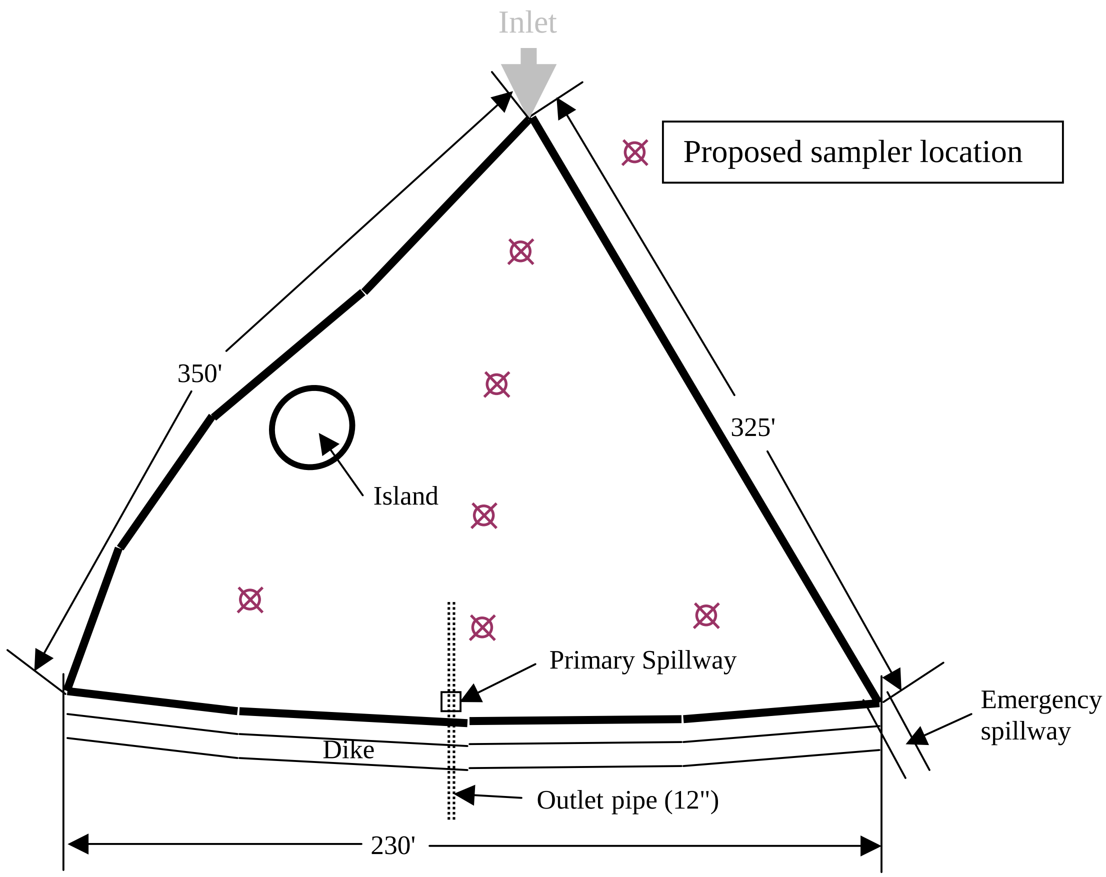


Figure 41. Schematic of Third Pond (Project ID: L_6.5/0.1) showing proposed locations of sediment traps.

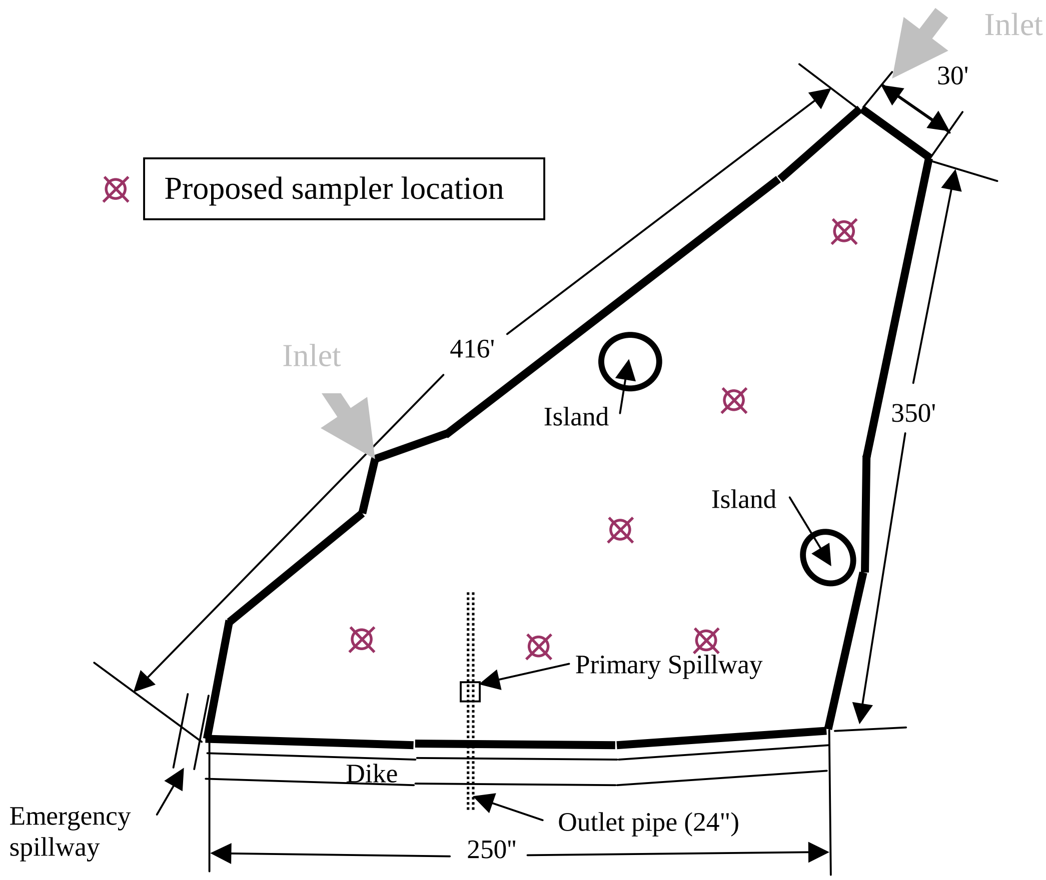


Figure 42. Schematic of Corner Pond (Project ID: L_6.7/0.2/0.0) showing proposed locations of sediment traps.

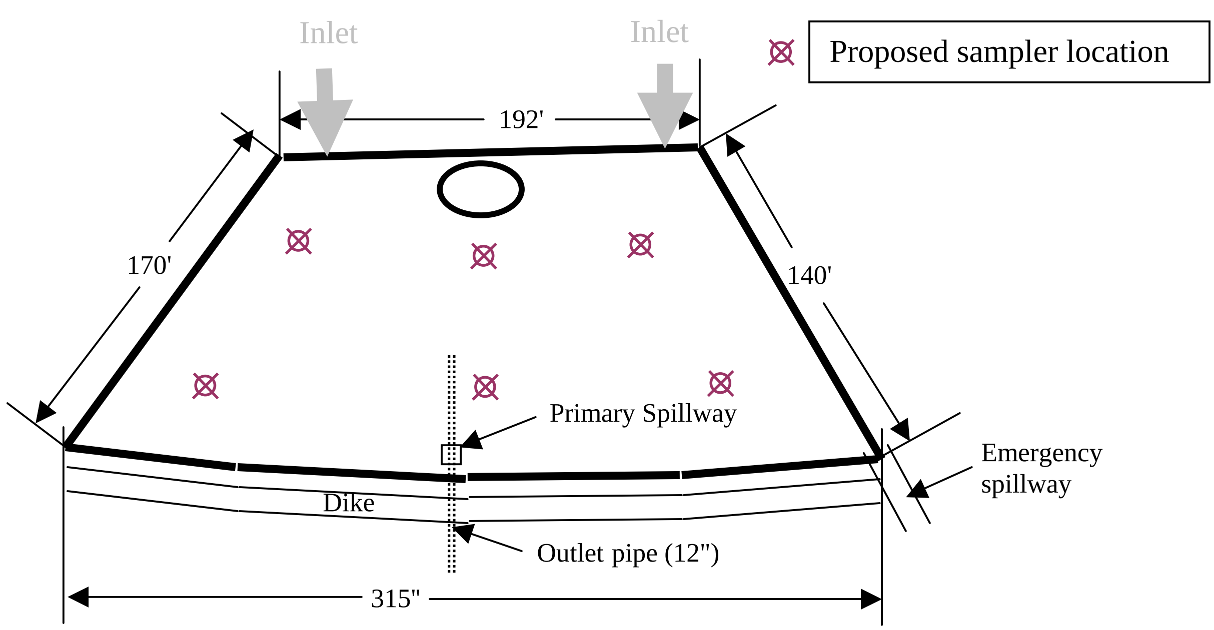


Figure 43. Schematic of North Pond (Project ID: L_8.7/0.1) showing proposed locations of sediment traps.

SECTION 4: OUTREACH AND EDUCATION

OVERVIEW

Early in the planning stages of this project, Tribal staff envisioned the use of outreach to the general public and the development of educational opportunities related to the natural resources as a means to facilitate a holistic watershed protection process on the Reservation. The staff held a common belief that responsible management must address the needs of the larger community that collectively affects fish and their habitats. By adopting Tribal recommendations, the Northwest Power Planning Council (NPPC) concurred with this concept and recognized public education and outreach to be a necessary and integral component of fisheries enhancement efforts on the Coeur d' Alene Reservation (NWPPC 1995).

Several related objectives and tasks were pursued in 2003 to address the general goals for the education and outreach portion of BPA project #1990-044-00, *Implement Fisheries Enhancement Opportunities on the Coeur d'Alene Reservation*. The first objective focuses to improve awareness of project activities within the Reservation community. This objective is accomplished through several tasks, including publishing a quarterly newsletter and through participation in watershed and inter-agency work groups. The second objective focuses on providing education and raising the awareness of natural resource issues in the local schools and communities of northern Idaho. This objective is accomplished through continual participation and development in an educational forum to share projects, encouraging community participation in and garnering landowner support for stream restoration opportunities on Reservation lands, and providing opportunity for summer internships to local high school students. This report discusses accomplishments associated with each objective and task, evaluates the overall effectiveness of education and outreach efforts, and provides performance criteria to use in the future to evaluate this portion of the contract.

METHODS AND RESULTS

The text below presents details of the Outreach and Education work performed by the Fisheries Program and other cooperators during 2003. The methods and results are presented in a manner that is consistent with the outline found in the *2004 Scope of Work and Budget Request* for this project. *Table 25* presents a summary of the outreach efforts and associated completion dates.

Planning and Design Phase

Objective 2: Coordinate restoration and management activities.
Task 2a: Coordinate and facilitate meetings with an Interagency Work Group.

The Tribe's Fisheries Outreach Specialist arranged for meetings of the Interagency Work Group to be held three times during 2003, on February 18, May 27 and November 8. This year the group was still working on developing a matrix that everybody could use to track project goals, plans and completions. This matrix will identify work being planned or conducted in various areas (both geographic and project type), and who is responsible for the various projects. This information will help all groups involved not to duplicate efforts on the their projects and also see where further needs are.

At each meeting the participants shared information on what had been accomplished on their projects and what additional resources might be needed to follow up. Through these meetings, the groups develop an understanding of how they can better manage the natural resources in the

Reservation area and how they can promote education regarding land stewardship. Participation in this planning process is a critical step in applying uniform management standards in watersheds targeted by the BPA project and in forming partnerships that improve the cost-effectiveness of implementation efforts.

From each meeting, records were kept and minutes taken along with a list of participants.

Task 2b: Participate in internal Tribal interdisciplinary team (IDT) processes during the development of Tribal management plans.

The Tribe's Fisheries Outreach Specialist and Biologists participated in a series of meetings in support of the development of an Integrated Resource Management Plan (IRMP) for the Reservation. Meetings were held on a more or less monthly basis. The initial work conducted at these meetings was to continue the development of a Draft Programmatic Environmental Impact Statement started during 2002. This was completed in May 2003. The project sponsor (the Tribe's Environmental Program) then presented the document to the Tribal Council and then to the Citizens Advisory Committee. Subsequent IDT meetings were held to review comments that the CAC and other outside agencies (US EPA, US Fish and Wildlife Service, Bureau of Indian Affairs) had on the IRMP.

Operation and Maintenance Phase

Objective 1: Improve awareness of Program activities within the Reservation community.
Task 1a: Publish a quarterly newsletter that highlights Program activities, recognizes cooperative efforts, and serves as a forum for discussing land management issues.

The *Watershed Wrap* newsletter was published every quarter of this past year. Publication dates correspond to the spring and fall equinox and the summer and winter solstice. The Fisheries Program prints between 1,900 and 2,200 copies of each issue. Approximately 1,200 to 1,500 are distributed by U.S. mail to all the local Tribes, landowners, and natural resources organizations, US Fish and Wildlife Service and US Forest Service. The remaining 500 newsletters are hand distributed for customer pick up at various local area businesses in Northern Idaho.

This last year's Newsletter described projects that were being done to further fish and wildlife, different types of methods being used to help restore and protect the watersheds and natural resource educational efforts. The Fisheries Program made a big effort to help explain to the local community about all the activities the Outreach & Education Specialist does with the community and the local schools on and around the Coeur d'Alene Reservation. The newsletter explains the types of restoration efforts done by the Fisheries and Wildlife Programs, introduces new employees, fish and wildlife profiles, as well as research studies conducted in Reservation lakes, streams, and creeks.

Some examples of the interesting articles that were included in the *Watershed Wrap* during 2003 are: "The Benewah Creek Fish Enhancement Project", "The Albeni Falls Wildlife Mitigation Program", "The Watershed Assessment Completed for the N. Fk. of Rock Creek", "Summer Youth Intern Activities", "Water Awareness Week Activities Summary", "The Fisheries RM& E Plan", "Cutthroat Trout Habitat Use in CDA Lake" and "Water Potato Day Activities".

Table 20. Summary of Outreach and Education efforts of the Coeur d'Alene Tribe Fisheries Program for 2003.

Task	Product	Completion Dates (2003)	Completed	Not Completed
Planning and Design Phase				
Objective 2:	***Coordinate restoration and management Activities.***			
Task 2a:	Coordinate and facilitate meetings with an Interagency Work Group.	2/19, 6/23, 12/10	X	
Task 2b:	Participate in the internal Tribal interdisciplinary team (IDT) processes during the development of Tribal management plans.	1/28, 5/24, 8/26 11/18	X	
Operation & Maintenance Phase				
Objective 1:	***Improve Awareness of Program activities within the Reservation community.***			
Task 1a:	Publish a Quarterly Newsletter to coincide with the spring and fall equinoxes and the summer and winter solstices. Approximately 2000 newsletter sent out.	3/19, 6/19, 9/19 & 12/19	X	
Task 1b:	Continue meeting with watershed working groups and provide a forum for local stakeholders to participate in restoration activities..	3/19, 6/18, 10/15 Benewah Creek	X	
Objective 2:	***Provide educational opportunities in the local schools to improve student/teacher involvement in Program activities.***			
Task 2a:	Continue to participate in and develop an education forum for the local community regarding stream restoration opportunities on the Reservation.	On-going through-out the school year.	X	
Task 2b:	Provide summer internships for high school students to assist with implementation of restoration projects.	6/16 to 9/5	X	
Task 2c:	Natural Resource Camp was held in Clarkia, ID	Plan camp 2/12, 4/17, 6/15; Held 6/15 to 6/20	X	
Task 2d:	Work with the University of Idaho Extension Agent.	12/8	X	

Task 1b: Continue meeting with watershed work groups comprised of private landowners, agency representatives, and other interested parties to discuss restoration and cooperative opportunities.

Fisheries Program Biologists and the Outreach Specialist met with different watershed working groups during 2003. Benewah Creek Watershed Working Group is a very highly organized group with very active participants. They have their own regular meetings and Tribe participates when there is new information to present to the group. The Lake Creek WWG receives updated information on projects through our newsletter. The Tribe is planning to have two meetings with Lake Creek WWG during 2004. The Hangman Creek Watershed Working Group finally got going this past year and the Tribal team had three meetings with them to discuss the findings of the watershed assessment.

Direct mailing was the primary way that the public was informed about what was going on in the project watersheds. This past year, the Outreach Specialist also encouraged participation by local landowners through local advertising and the *Watershed Wrap*. This next year we will be calling and mailing out questionnaires about how to better serve the needs of all who live in the watersheds and help educate the public about our projects, and through these efforts make new partnerships for our restoration effects here on the Reservation.

A lot of information was exchanged and explained to the community concerning the various management activities planned by the Coeur d'Alene Tribe and other agencies. Fisheries program personnel presented pertinent information to the group as project phases occurred. Approximately twelve to twenty-five residents attended these meetings quarterly. Topics discussed at these meetings included: restoration projects being done and updates, Idaho Department of Transportation highway realignment from Mica to Worley, Lake Creek TMDL Issues, University of Idaho - USDA grants, soil erosion, NRCS - State funded programs, updates on Lake Creek stream restoration projects, research and activities, and identifying opportunities and concerns.

<u>Objective 2</u>: Provide cultural and educational opportunities to improve student/teacher involvement in Program activities.

Task 2a: Continue to participate in and develop an educational forum for the local community regarding stream restoration opportunities on the Reservation and the need to provide for wild fish in the areas being restored.

Water Awareness Week was a big success, as usual. We had over 450 students and teacher participate in the workshop this year, which took place May 12-16, 2003. They came from all over northern Idaho: Sandpoint (Sagle), Coeur d'Alene (four classes from Lakes Middle School), Southside, St. Maries, Harrison, and the Coeur d'Alene Tribal school. All the schools that have participated over the years say they will be back next year because it has a lot of hands-on involvement that they can't get in the classroom. The participants rotate through a series of stations each presenting a different aspect of a stream and its interrelated habitats. The Fisheries, Wildlife and Water Resources Program staff as well as the University of Idaho extension agent from Plummer ran the stations. The 2003 stations were Tribal culture and language, trout life cycle, water quality measurements, riparian functions/plant identification, macroinvertebrate sampling and analysis, wildlife habitat usage and soils analysis.

The Fisheries Outreach Specialist has been working closely with the Coeur d'Alene Tribal school to implement a wide variety of projects. One such project during 2003 was a field trip to Wolf Lodge

Bay (at the north end of Coeur d'Alene Lake) on January 6 to look at eagles in their natural environment. Information on the importance of the Kokanee and other fish in the area, as the main food supply for the winter, was presented. Also the importance of habitat to the eagle and his cousins the animals and others birds that live in the area, was discussed.

The Western Forestry and Conservation Nursery Association and Tribal nurseries from around the northwest held a conference at the Coeur d'Alene Resort June 8 and 9, 2003. For this conference, the Tribe was asked to host a workshop at one of the Benewah Creek restoration work sites. The Outreach Specialist arraigned and facilitated the fisheries restoration part of that workshop. There was a big group (85) that attended this. A Fisheries Biologist explained the types of plantings that were being installed at this specific site and what are final goals are to help re-establish fish habitats in this watershed.

The Fisheries Program worked with Benewah Medical Center to put on a workshop (Youth Diabetic Camp) to help educate Reservation youth. The participants went on a walk through Heyburn State Park on the Indian Cliff trail April 1st. The Outreach Specialist talked about the different trees species on the trail and showed the youth what types of vegetation was edible. The types of trees and vegetation groups that grow near creeks were also discussed and how important these are for the survival of the Cutthroat Trout.

The Outreach Specialist worked closely with representatives of the University of Idaho Extension office to assist in running their 4-H curriculum. In that, local schools (Kootenai, St. Maries, Worley, Plummer, Coeur d'Alene Tribal) classes were introduced to curriculum from the book titled *Project Wild*. Some of the topics included in this book are: 'Hooks and Ladders', 'How to catch a fish' and 'How do trees help fish'. The Outreach Specialist talked to students about the local fish in the Rocky Point (Chatcolet Lake) area, and told them about the difference between native and non-native fish species. This took place May 22 and 29, 2003.

The Fisheries Program worked closely with Kootenai High School (near Harrison) on classroom teaching about the environment and how important it is to take care of what we have today. Lectures / demonstrations were presented ot the Science / Forestry class on five days; topics covered included plant and tree identification, timber cruising / scaling, safety in the woods, fire fighting and reforestation / restoration. The Kootenai students came down for Water Potato Day (see below) to participate and learn about trees, shrubs, animals, birds, Tribal culture and people.

The Outreach Specialist worked with faculty and students of St. Maries High School to help plant water potatoes (*Sagitaria latifolia*) around the shoreline of Cottonwood Bay (Coeur d'Alene Lake) on May 20th. Plummer youth also planted water potatoes in the fish ponds at the Agency and Worley on May 21st. It was a very good learning experience, because they had to plant the water potatoes in about one foot of water. The class really enjoyed themselves, learning what a water potato was, how they are used and where they grow.

The Outreach Specialist worked with Dave Clark and Cheryl Lockhart of the University of Idaho Extension offices (housed in Plummer and St. Maries, respectively) to prepare for giving the "Choices" curriculum presentation to the eight grade students at Plummer/Worley Middle School. Dates May 28, 29th. This curriculum was developed by an independent non-profit group to "empower students with vital tools that will increase their career and life opportunities".

The Western Forestry and Conservation Nursery Association and Tribal nurseries from around the northwest held a conference at the Coeur d'Alene Resort June 8 and 9, 2003. For this conference, the Tribe was asked to host a workshop at one of the Benewah Creek restoration work sites. The Outreach Specialist arranged and facilitated the fisheries restoration part of that workshop. There was a big group (85) that attended this. A Fisheries Biologist (Angelo Vitale) explained the types of plantings that were being installed at this specific site and what are final goals are to help re-establish fish habitats in this watershed.

Attendance at this year's WATER POTATO DAY was one of the largest with approximately 500 people attending. In order to accommodate the large number of students who wanted to attend, the celebration was held on two successive days, October 23rd and 24th. The two-day celebration had many schools attending like Plummer/Worley Middle & Senior High schools, St. Maries and Kootenai High schools, Worley, Harrison and Oaksdale 4th grade classes, and the Coeur d'Alene Tribal school. We also had students and faculty members from two colleges participate, the University of Idaho and Spokane Community College. We even invited the local communities to participate and one family had invited their visitors from Scotland to get muddy with the youth digging water potatoes. In addition, Tribal members and staff led the participants in native songs and stories (including a "Simon Says" in Coeur d'Alene language), tree / shrub identification and wetland functions educational walks.

The Tribe also helped host an environmental workshop called *Elders, Youth and Culture in the Environment!* At that workshop, held Oct 23 and 24, the Fisheries Outreach Specialist made a presentation about how important it is to teach our youth about the water, land, and animals in coexistences with the environment.

Task 2b: Provide summer internships for high school students to assist with implementation of project activities.

During the summer of 2003 the Fisheries Program employed three summer youth, ages 14 to17. These youth worked all summer (June 16 through Sept 5) with Fisheries Biologists and Technicians staff. The youth planted trees, watered trees, built fences, assisted with fish population and stream habitat monitoring, collected water quality data, and assisted with data input into computer spreadsheets.

Task 2c: Recruit 4-7 high school students to participate in the annual Natural Resource Camp sponsored by the US Forest Service.

During the summer of 2003 the Coeur d'Alene Tribe worked with the US Forest Service, Panhandle Ranger District to host a Natural Resource Camp in Clarkia, ID, held June 15 - 20, 2003. The Outreach Specialist played a big part in setting up the agenda for the week long camp. He also taught the students about the environment and how important the habitat, that we all live in, to our fish and wildlife. The youth learned different types of skills and knowledge to gain a better understanding of the employment opportunities in natural resource related fields.

Task 2d: Work with the University of Idaho Extension Agent to develop and implement educational programs focusing on fish, water and wildlife resources and protection of Reservation watersheds.

The Outreach Specialist worked closely with the Extension Agent to go to the local schools and communities to present educational programs. This team also helped with a youth camp at the Benewah County fair grounds on July 8. This included several activities (Fish Ladder game, Fish Habitat game, Fish printing). The team also went to the Plummer preschool (Head Start) to talk to the youth about the fish and wildlife habitat and culture. Examples of topics presented in 2003 are: 'What is a tree?', 'Where do they grow?', 'What are shrubs?', 'What does restoration mean in a watershed"', and Choices. One example, the Choices program, will help students make better choices in order to excel and make a difference in the community and perhaps go to college to be a Fisheries Biologist.

EVALUATION OF EFFECTIVENESS

There are several ways in which the effectiveness of outreach and education programs is traditionally evaluated. One such measure is the number of engagements that the Outreach Specialist accomplished, based on work dates available in the calendar year. A second measure is the variety of forums made available locally for education and outreach (i.e., K-12 and college students and teachers, Reservation communities and rural landowners, professionals from local/regional agencies and other stakeholders). Also, the number of participants in organized activities provides another measure of effectiveness. One additional measure that is perhaps more difficult to address is the individual participants' awareness, understanding and interest in the processes and needs of the habitat restoration, lake and stream studies, water quality, and other natural resource management activities undertaken by a particular project.

Performance criteria for the outreach/education component of this project were satisfied based on deliverables outlined in the 2003 Scope-of-Work, as described below. The measure of these criteria is primarily the documentation of the numbers of individuals contacted through mailings, attendance at events, and community participation in educational forums held on and around the Reservation. It is intended that effectiveness criteria for future activities also be based on questionnaires and/or surveys administered to the participants. The responses to these questionnaires and/or surveys will be used to develop activity-specific performance criteria so that all activities can be evaluated, modified as needed or deleted if found to be ineffective.

Planning and Design Phase

<u>Objective 2</u>: Coordinate restoration and management activities.
Task 2a: Coordinate and facilitate meetings with an Interagency Work Group.

Criteria: Are inter-agency work group meetings beneficial to the natural resources programs that participate?.
Effectiveness: Three meetings held, 10 to 16 participants each meeting. Regular attendees include representatives of the following organizations: CDA Tribe Environmental, Fisheries, Wildlife, and Land Services Programs, NRCS, Farm Services Association, UI Extension, and the Benewah - Kootenai Soil and Water conservation District.

The future performance criteria will be documented in meeting sign-in sheets, agendas and written notes, by written letters of support, and executed memoranda of agreement.

Task 2b: Participate in internal Tribal interdisciplinary team (IDT) processes during the development of Tribal management plans.

Criteria: Is participation in the IDT meetings beneficial to the planning process and to other natural resources programs that participate?
Effectiveness: The participation of the Fisheries Program staff was very effective in bringing awareness of fisheries and fish habitat protection issues to the IRMP process. Three Fisheries Program participants contributed important perspectives on habitat protection and other topics. Representatives of the following Tribal programs were typically also present: Environmental Program (responsible for the development of the IRMP), Forestry, Wildlife, Lake Management, TREO, Planning, Land Services, Development Corporation, and GIS.

Operation and Maintenance Phase

Objective 1: Improve awareness of Program activities within the Reservation community.
Task 1a: Publish a quarterly newsletter that highlights Program activities, recognizes cooperative efforts, and serves as a forum for discussing land management issues.

Criteria: Did the newsletter improve awareness within the local communities and businesses about fisheries habitat restoration?
Effectiveness: The Newsletter was effective in getting pertinent and interesting information out to the public on and off the Reservation. This conclusion was based on the number of newsletters mailed (1,900 to 2,200 per issue) and on oral feedback from participants at the different educational forums. In the future performance criteria for the newsletter will be supported by providing recipients an opportunity to comment on the newsletter in writing, via a postcard insert, back to the program.

Task 1b: Continue meeting with watershed work groups comprised of private landowners, agency representatives, and other interested parties to discuss restoration and cooperative opportunities.

Criteria: Are watershed working group meetings effective forums to educate and outreach to the Reservation community?
Effectiveness: These meetings were effective in bringing awareness of fish habitat improvement projects and needs to watershed landowners. The attendance logs kept with meeting minutes indicate that there are 15 to 20 landowners present at each of these meetings.

The future effectiveness of these meetings will be measured through the use of questionnaires or survey forms that will be developed and made available at the Watershed Working Group meetings for participants to provide comments, suggestions, or questions regarding the activities of the program.

Objective 2: Provide cultural and educational opportunities to improve student/teacher involvement in Program activities.
Task 2a: Continue to participate in and develop an educational forum for the local community regarding stream restoration opportunities on the Reservation and the need to provide for wild fish in the areas being restored.

Criteria: Does the Outreach Specialist's attendance to miscellaneous meetings (as outlined above) promote the education and outreach cause?
Effectiveness: The Outreach Specialist's attendance at all workshops, classes, and events provided many opportunities to make presentations about fisheries program activities. The effectiveness of each of the primary activities that the Outreach Specialist was involved in is outlined below.

In the future, performance of these or other educational forums will be measured by a questionnaire or survey to be made available at each workshop, class and event to measure the quality of the experience provided.

Water Awareness Week.
Criteria: Was the Water Awareness Workshop an effective educational forum to increase awareness?
Effectiveness: This is one of the most important events that the Tribal Natural Resource programs put on for the regional community. In 2003, 450 students and teachers attended with each school having approximately one half day to work through the seven stations.

Wolf Lodge Bay field trip
Criteria: Was this trip an effective educational forum to increase awareness?
Effectiveness: Approximately 70 Tribal School students attended.

Youth Diabetic Camp
Criteria: Was this nature walk an effective educational forum to increase awareness?
Effectiveness: 45 students attended.

Kootenai High School Classroom Teaching
Criteria: Were these lecture sessions effective educational forums to increase awareness?
Effectiveness: Ten to twelve students attended each of the five lectures.

St. Maries High School Water Potato Planting
Criteria: Was this an effective educational forum to increase awareness?
Effectiveness: Twelve students and their teachers attended.

Western Forestry Conference
Criteria: Was the conference an effective educational forum to increase awareness?
Effectiveness: There were over 75 people that attended the Benewah Creek restoration site visit.

Water Potato Day
Criteria: Was this an effective educational forum to increase awareness?
Effectiveness: Water Potato Day is the largest event that is sponsored by the Fisheries Program and is particularly pertinent to Tribal culture. Approximately 500 students, teachers and others attended this year's event.

Elders, Youth and Culture in the Environment workshop
Criteria: Was this workshop an effective educational forum to increase awareness?
Effectiveness:40 students participated in workshop; the total that attended conference was over 200, including elders from all over the US and a lot of natives from Alaska and Navaho. They had a lot of different kinds of information to offer local people.

Task 2b: Provide summer internships for high school students to assist with implementation of project activities.

Criteria: Were these internships an effective educational forum to increase awareness?

Effectiveness: Three students participated and each remained for the entire summer period.

Task 2c: Recruit 4-7 high school students to participate in the annual Natural Resource Camp sponsored by the US Forest Service.

Criteria: Was this camp an effective educational forum to increase awareness?
Effectiveness: 30 students attended. This year the Coeur d'Alene Tribe co-sponsored this years NR Camp. It was the first time the Tribe sponsored this event since it started 12 years ago.

Task 2d: Work with the University of Idaho Extension Agent to develop and implement educational programs focusing on fish, water and wildlife resources and protection of Reservation watersheds.

Criteria: Does the Outreach Specialist's work with University of Idaho extension staff promote the education and outreach cause?
Effectiveness: The UI Extension has a number of programs oriented to the understanding of natural resources issues and participation by the Outreach Specialist in these benefits both programs. Effectiveness of specific activities undertaken with the UI Extension is listed below.

In the future, the effectiveness of these or other educational forums will be measured by a questionnaire or survey to be made available at each workshop, class or event to measure the quality of the experience provided.

<u>Choices curriculum</u>
Criteria: Was this curriculum an effective educational forum to increase awareness?
Effectiveness: 70 students attended.

<u>4-H Workshops</u>
Criteria: Were these workshops effective educational forums to increase awareness?
Effectiveness: 20 to 30 students attended each session

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APPENDIX A. MEAN LENGTHS, WEIGHTS AND FULTON TYPE CONDITION FACTORS FOR TROUT SPECIES SAMPLED BY ELECTROFISHING AND CAPTURED IN TRAPS

Table A-1. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for various age groups of westslope cutthroat trout from Alder Creek sampled by electrofishing summer 2003.

Age	n	Statistics	Length (mm)	Weight (g)	K_{TL}
0	0	Mean	-	-	-
		SD	-	-	-
		Range	-	-	-
1	9	Mean	83	6.0	0.93
		SD	14	3.6	0.15
		Range	64-103	1.8-12.2	0.69-1.18
2	40	Mean	135	21.1	0.84
		SD	12	5.5	0.11
		Range	110-155	10.8-32.8	0.69-1.33
3	7	Mean	173	43.7	0.84
		SD	8	9.0	0.07
		Range	161-185	31.1-57.1	0.75-0.92
4	4	Mean	223	95.9	0.86
		SD	16	14.1	0.06
		Range	200-235	76.3-109.2	0.82-0.95
5	1	Mean	284	249	1.09
		SD	-	-	-
		Range	-	-	-

Table A-2. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for various age groups of cutthroat trout from Benewah Creek sampled by electrofishing summer 2003.

Age	n	Statistics	Length (mm)	Weight (g)	K_{TL}
		Mean	57	1.9	0.97
0	39	SD	7	0.8	0.17
		Range	45-68	0.8-3.4	0.71-1.26
		Mean	98	8.6	0.88
1	82	SD	10	2.5	0.11
		Range	71-112	3.7-15.1	0.61-1.35
		Mean	133	20.8	0.87
2	90	SD	12	6.2	0.10
		Range	113-156	12.0-36.2	0.68-1.12
		Mean	168	44.4	0.93
3	20	SD	10	9.2	0.07
		Range	154-191	31.5-66.2	0.78-1.00
		Mean	226	103.2	0.88
4	4	SD	20	29.9	0.05
		Range	205-247	79.1-140.8	0.82-0.93
		Mean	-	-	-
5	0	SD	-	-	-
		Range	-	-	-
		Mean	326	446.3	1.29
6	1	SD	-	-	-
		Range	-	-	-

Table A-3. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for cutthroat trout from Evans Creek sampled by electrofishing summer 2003.

Age	n	Statistics	Length (mm)	Weight (g)	K_{TL}
0	103	Mean	54	1.5	0.95
		SD	7	0.5	0.19
		Range	40-64	0.5-2.8	0.51-1.36
1	124	Mean	93	7.6	0.89
		SD	14	3.3	0.12
		Range	65-131	2.0-18.9	0.61-1.29
2	112	Mean	134	21.8	0.87
		SD	14	7.8	0.09
		Range	115-163	11.2-43.4	0.59-1.18
3	38	Mean	187	61.8	0.92
		SD	15	16.6	0.09
		Range	158-214	31.4-92.0	0.72-1.11
4	11	Mean	231	122.3	0.98
		SD	13	23.5	0.10
		Range	206-254	79.8-155.7	0.84-1.15
5	6	Mean	277	220.4	1.02
		SD	15	53.5	0.12
		Range	255-293	155.1-275.7	0.87-1.22
6	1	Mean	320	298.6	0.91
		SD	-	-	-
		Range	-	-	-

Table A-4. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for various age groups of cutthroat trout from Lake Creek sampled by electrofishing summer 2003.

Age	n	Statistics	Length (mm)	Weight (g)	K_{TL}
0	54	Mean	56	1.6	0.81
		SD	9	0.8	0.15
		Range	38-72	0.5-4.0	0.51-1.12
1	100	Mean	94	7.4	0.86
		SD	12	2.9	0.14
		Range	75-116	2.5-16.6	0.55-1.22
2	78	Mean	134	20.5	0.84
		SD	10	5.7	0.11
		Range	117-154	11.0-33.4	0.61-1.12
3	19	Mean	172	44.2	0.85
		SD	11	10.8	0.09
		Range	158-191	31.1-66.5	0.71-1.06
4	1	Mean	205	73.9	0.86
		SD	-	-	-
		Range	-	-	-
5	1	Mean	233	137.0	1.08
		SD	-	-	-
		Range	-	-	-

Table A-5. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for various age groups of brook trout from Alder Creek sampled by electrofishing summer 2003.

Age	n	Statistics	Length (mm)	Weight (g)	K_{TL}
		Mean	54	1.8	0.91
0	20	SD	11	0.4	0.11
		Range	25-63	1.3 –2.6	0.63-1.04
		Mean	83	5.2	0.86
1	87	SD	12	2.5	0.14
		Range	61-117	1.6-15.2	0.45-1.07
		Mean	127	18.8	0.90
2	98	SD	12	5.7	0.08
		Range	106-147	9.8-32.9	0.72-1.06
		Mean	165	42.2	0.92
3	44	SD	13	10.2	0.10
		Range	142-186	25.3-61.1	0.67-1.07
		Mean	209	85.1	0.94
4	13	SD	7	13.5	0.11
		Range	197-219	66.6-103.3	0.76-1.06

Table A-6. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for various age groups of brook trout from Benewah Creek sampled by electrofishing summer 2003.

Age	**n**	**Statistics**	**Length (mm)**	**Weight (g)**	**K_{TL}**
		Mean	59	2.5	1.13
0	8	SD	14.5	0.5	0.07
					1.
		Range	51-63	1.7-3.1	1.07-1.24
		Mean	83	6.9	1.18
1	16	SD	10.6	2.5	0.11
		Range	65-100	3.1 –11.3	1.07-1.39
		Mean	123	21.5	1.13
2	11	SD	12	6.3	0.04
		Range	106-147	13.0-35.1	1.07-1.20
		Mean	165	50.7	1.11
3	8	SD	16	14.7	0.04
		Range	149-190	36.5-74.0	1.07-1.20
		Mean	212	112.5	1.17
4	6	SD	9.4	17.5	0.07
		Range	194-221	81.8-131.4	1.12-1.30
		Mean	-	-	-
5	0	SD	-	-	-
		Range	-	-	-
		Mean	315	374.9	1.20
6	2	SD	-	37.7	0.12
		Range	315-315	348.2-401.5	1.11-1.28

Table A-7. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for various age groups of outmigrating juvenile cutthroat trout captured in the lower trap on Benewah Creek, 2003.

Age	n	Statistics	Length (mm)	Weight (g)	K_{TL}
1	0	Mean	-	-	-
		SD	-	-	-
		Range	-	-	-
2	11	Mean	140	25.2	0.90
		SD	10	5.7	0.08
		Range	123-150	15.1-32.5	0.81-1.04
3	17	Mean	165	40.6	0.91
		SD	10	7.6	0.12
		Range	153-181	26.6-52.3	0.74-1.24
4	3	Mean	251	139	0.88
		SD	30	30.6	0.13
		Range	226-285	109.1-170.3	0.74-0.96

Table A-8. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for various age groups of outmigrating juvenile cutthroat trout captured in the lower trap on Lake Creek, 2003.

Age	n	Statistics	Length (mm)	Weight (g)	K_{TL}
1	76	Mean	108	11.8	0.92
		SD	6	2.3	0.12
		Range	92-125	7.0 –21.0	0.60-1.22
2	2173	Mean	138	23.2	0.87
		SD	13	6.6	0.10
		Range	111-161	7.8-45.8	0.48-1.39
3	501	Mean	174	44.8	0.85
		SD	10	9.2	0.09
		Range	150-210	24.4-90.1	0.58-1.31
4	10	Mean	230	110.7	0.90
		SD	15	24.6	0.05
		Range	213-255	85.2-152.0	0.82-1.00

Table A-9. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for various age groups of post-spawn cutthroat trout captured in the lower trap on Benewah Creek, 2003.

Age	n	Statistics	Length (mm)	Weight (g)	K_{TL}
5	4	Mean	272	184.4	0.93
		SD	29	31.6	0.15
		Range	232-300	144.0-221.0	0.82-1.15
6	16	Mean	333	302.8	0.83
		SD	14	40.9	0.13
		Range	297-355	241.5 –365.0	0.73-0.93
7	4	Mean	366	369.1	0.75
		SD	15	63.5	0.07
		Range	351-386	291.6-424.8	0.67-0.85
8	3	Mean	402	507.8	0.78
		SD	15	47.1	0.08
		Range	385-412	476.4-562.0	0.70-0.85

Table A-10. Mean lengths, weights and Fulton type condition factors (KTL) with standard deviations and ranges for various age groups of post-spawn cutthroat trout captured in the lower trap on Lake Creek, 2003.

Age	n	Statistics	Length (mm)	Weight (g)	K_{TL}
6	41	Mean	345	340.1	0.82
		SD	18	61.0	0.09
		Range	320-390	233.7-492.0	0.69-1.10
7	60	Mean	388	453.0	0.77
		SD	17	79.6	0.09
		Range	338-425	324.8-722.4	0.60-1.08
8	4	Mean	422	499.9	0.68
		SD	16	114.2	0.22
		Range	400-436	375.0-597.1	0.45-0.93

APPENDIX B. STREAM WATER QUALITY DATA

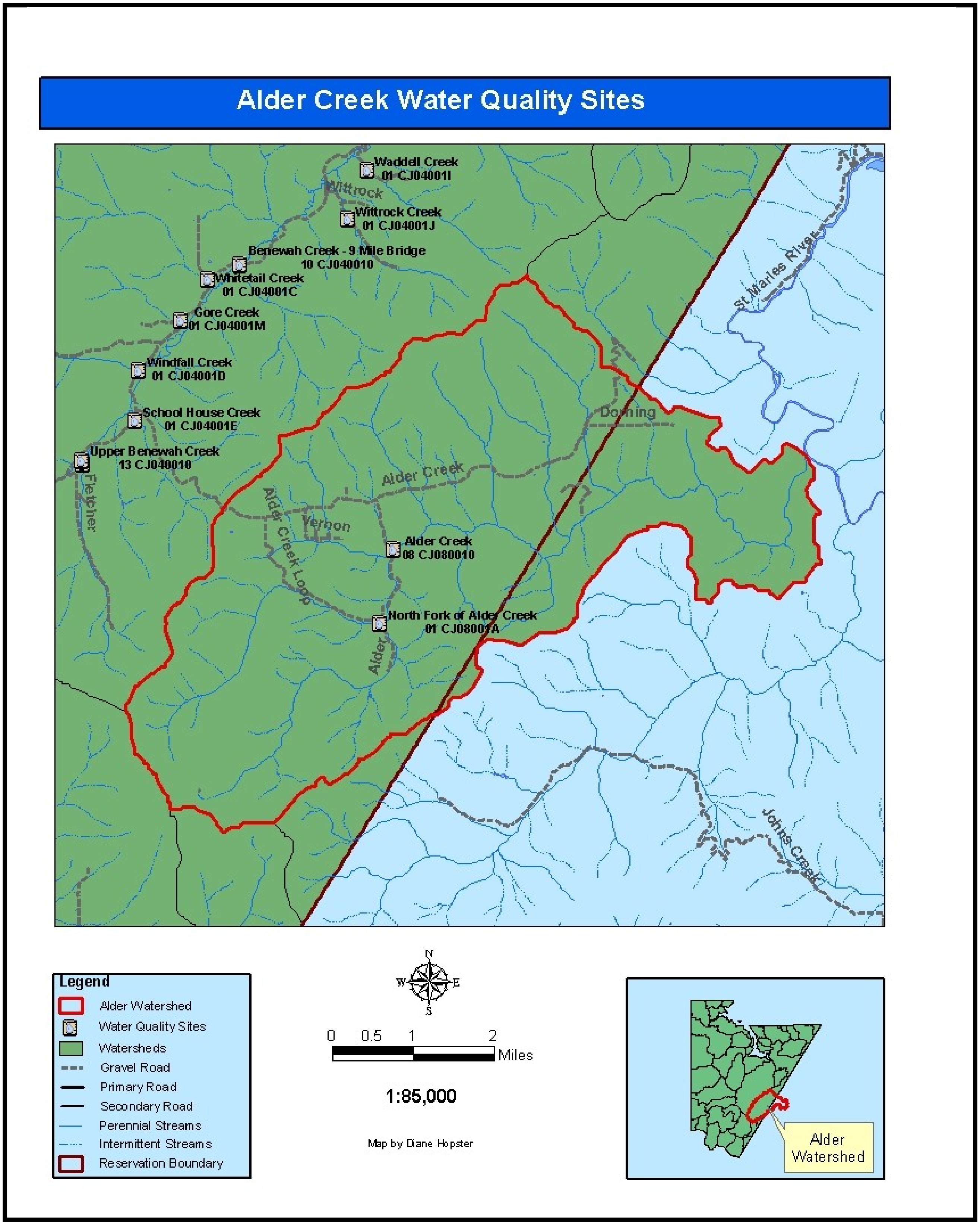


Figure B-1. Alder Creek watershed water quality monitoring sites.

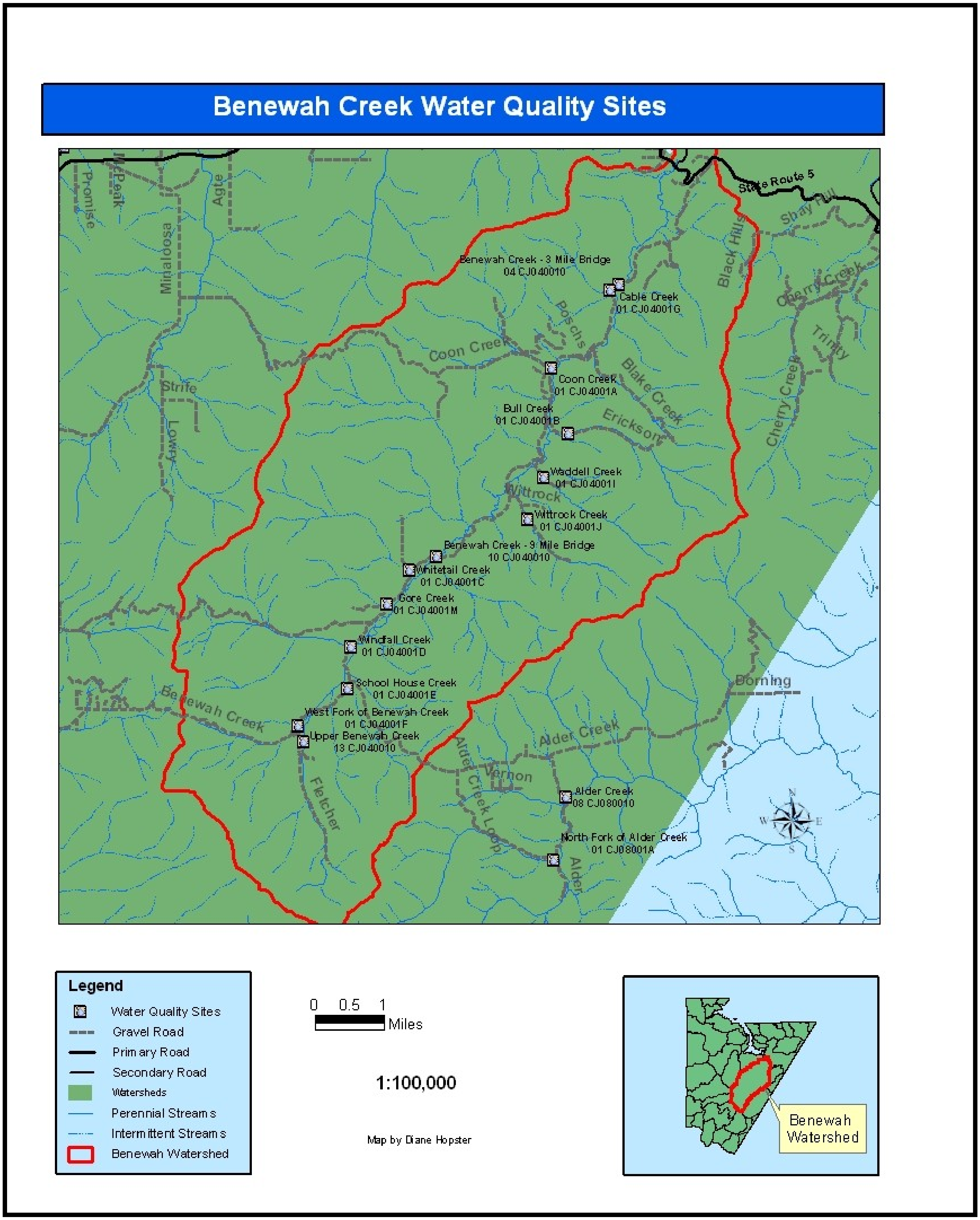


Figure B-2. Benewah Creek watershed water quality monitoring sites.

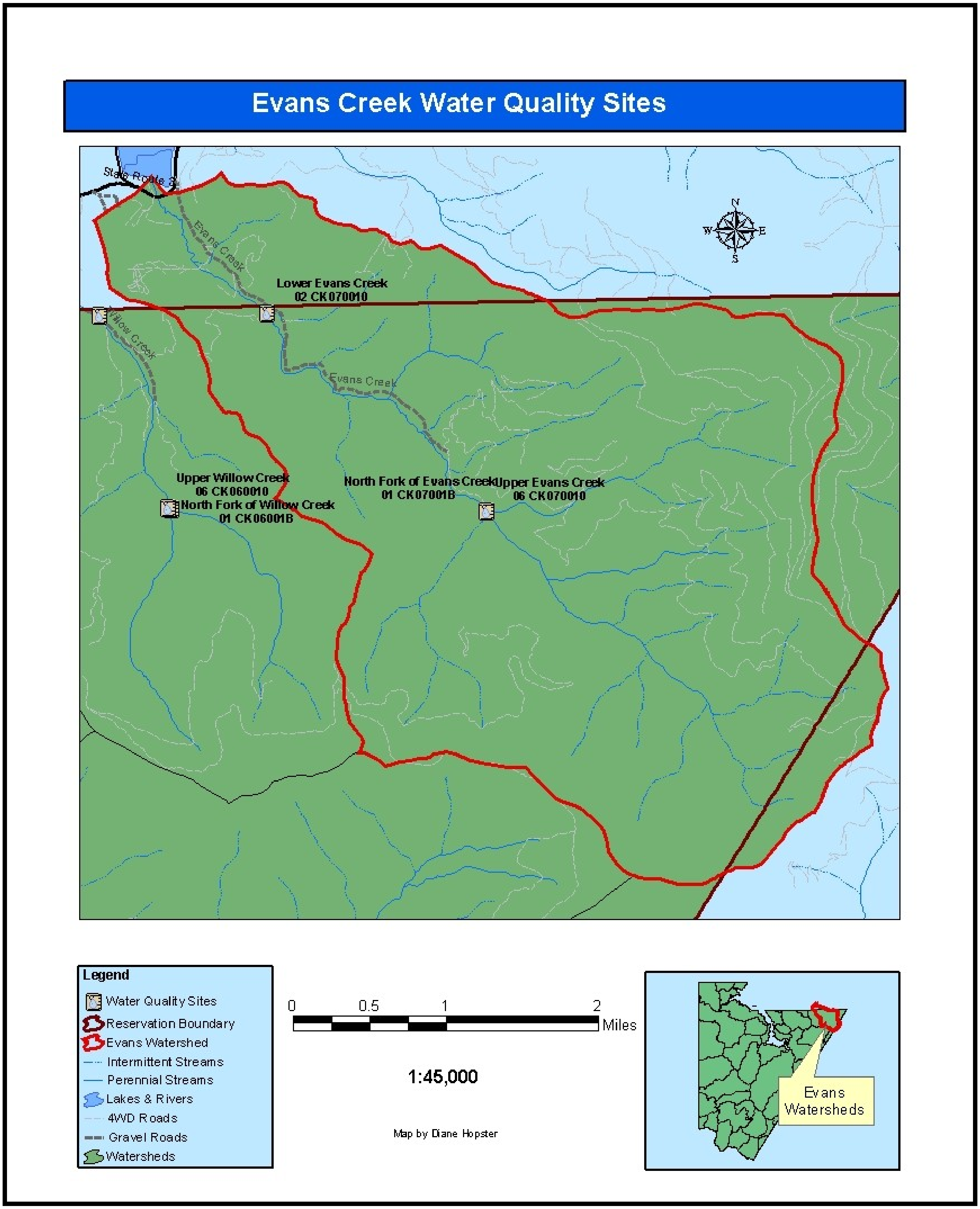


Figure B-3. Evans Creek watershed water quality monitoring sites.

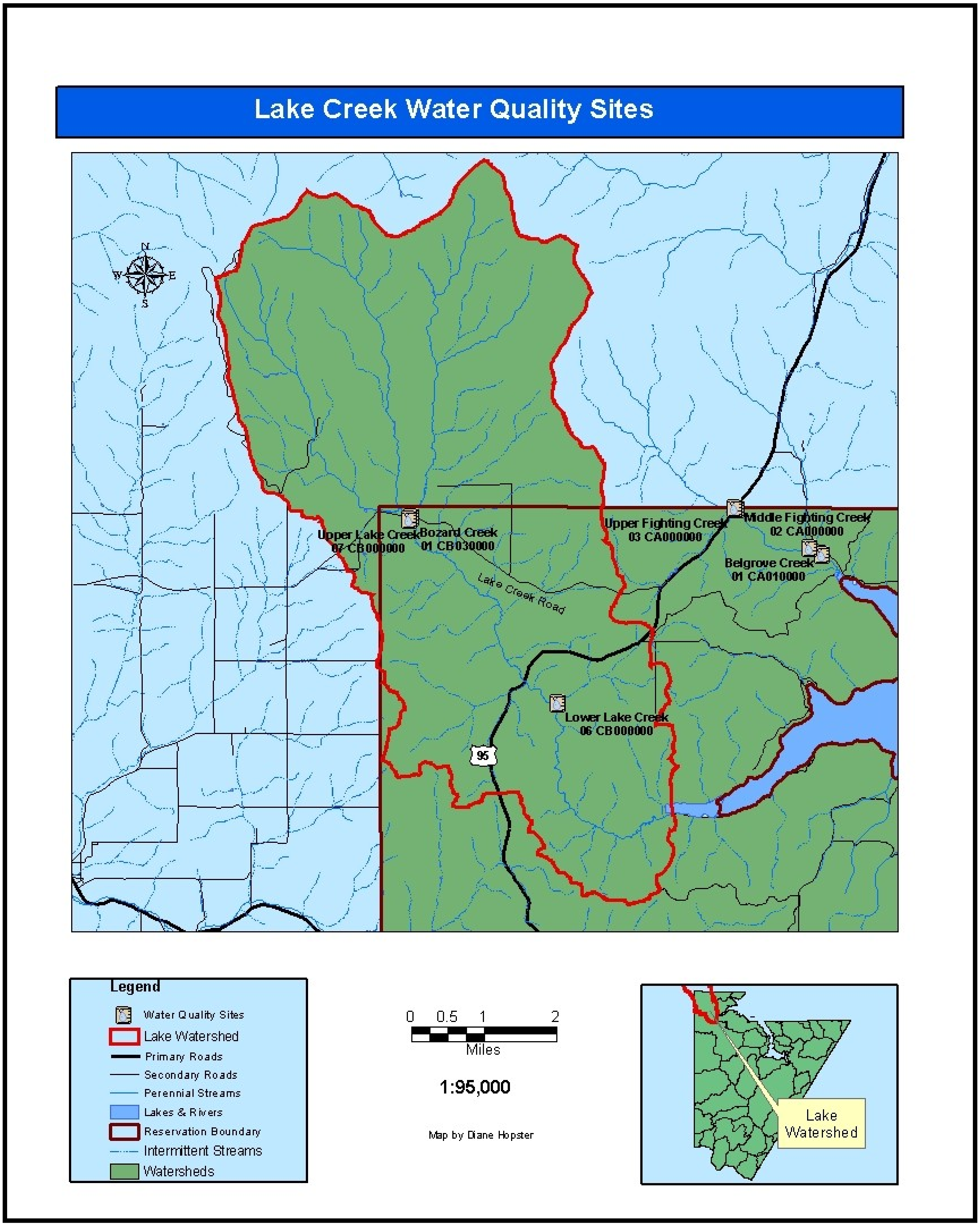


Figure B-4. Lake Creek watershed water quality monitoring sites.

Table B-1. 2003 Compiled stream flow data for Coeur d'Alene Tribe monitored stream stations.

DATES:	1/29/03	7/23/03	8/11/03	9/29/03
STREAM SITES				
Alder Cr.	145.9	0.46	0.38	0.48
N. Fork Alder Cr.	18.14	0.20	0.23	0.28
Three Mile Benewah Cr.	**1160**	0.62	0.64	1.59
Cable Cr.	nd	0.03	0.03	0.03
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	0.20	0.16	0.19
Waddel Cr.	nd	0.08	0.08	0.11
Wittrock Cr.	nd	0.12	0.07	0.15
Nine Mile Benewah Cr.	nd	0.12	0.28	0.52
Whitetail Cr.	nd	nd	nd	nd
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	0.02
Schoolhouse Cr.	nd	nd	nd	nd
Upper Benewah Cr.	nd	0.29	0.27	0.12
W. Fork Benewah Cr.	nd	0.08	0.05	0.04
Evans Cr	35.48	2.11	0.91	nd
Upper Evans Cr.	nd	1.58	nd	nd
E. Fork Evans Cr.	nd	0.21	0.15	nd
Lower Lake Cr.	157	0.07	nd	nd
Upper Lake Cr.	nd	nd	nd	nd
Bozard Cr.	nd	nd	0.54	nd

Note: Since monitoring typically takes place over two to three days, the dates given are the earliest date shown in the original data.

Measurement units = cubic feet per second (cfs)   nd = no data

* Bolded discharge was determined using BARC based on a staff gauge reading

Table B-2. 2003 Compiled stream Temperature data for Coeur d'Alene Tribe monitored stream stations.

DATES :	1/29/03	7/23/03	8/11/03	9/29/03
STREAM SITES				
Alder Cr.	4.13	19.48	18.37	11.76
N. Fork Alder Cr	4.17	19.94	18.37	12.46
Three Mile Benewah Cr.	6.05	22.36	22.78	7.33
Cable Cr.	nd	14.52	13.81	7.94
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	16.29	16.03	9.22
Waddel Cr.	nd	15.53	14.29	8.00
Wittrock Cr.	nd	12.15	12.04	7.110
Nine Mile Benewah Cr.	5.41	21.77	16	9.24
Whitetail Cr.	nd	18.13	13.31	9.36
Gore Cr.	nd	nd	nd	11.93
Windfall Cr.	nd	nd	nd	10.72
Schoolhouse Cr.	nd	14.02	12.46	8.91
Upper Benewah Cr.	nd	15.31	15.05	10.16
W. Fork Benewah Cr.	nd	15.47	14.89	10.27
Evans Cr	3.73	15.53	17.20	nd
E. Fork Evans Cr.	nd	15.53	nd	nd
Upper Evans Cr.	nd	14.36	13.74	nd
Lower Lake Cr.	3.39	16.69	15.97	nd
Upper Lake Cr.	3.01	15.91	15.58	nd
Bozard Cr.	3.04	15.27	13.97	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = degrees C nd = no data

Table B-3. 2003 Compiled stream Dissolved Oxygen data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/29/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	12.10	10.31	9.99	12.10
N. Fork Alder Cr	12.10	9.69	9.99	10.41
Three Mile Benewah Cr.	12.48	9.68	9.74	12.25
Cable Cr.	nd	9.88	10.26	12.05
Coon Cr.	nd	nd	nd	8.89
Bull Cr.	nd	9.34	9.56	11.82
Waddel Cr.	nd	9.48	9.85	11.23
Wittrock Cr.	nd	10.45	10.66	12.00
Nine Mile Benewah Cr.	11.44	9.55	8.93	10.51
Whitetail Cr.	nd	7.06	5.16	8.94
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	10.06
Schoolhouse Cr.	nd	3.05	2.13	4.80
Upper Benewah Cr.	nd	9.86	9.93	11.40
W. Fork Benewah Cr.	nd	9.64	9.67	10.97
Evans Cr	12.84	9.90	10.20	nd
E. Fork Evans Cr.	nd	9.88	nd	nd
Upper Evans Cr.	nd	10.11	10.82	nd
Lower Lake Cr.	13.11	8.81	8.46	nd
Upper Lake Cr.	11.84	7.98	7.70	nd
Bozard Cr.	12.15	8.99	9.42	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = mg/L nd = no data

Table B-4. 2003 Compiled stream pH data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	6.22	7.85	7.61	7.62
N. Fork Alder Cr	6.15	7.77	7.61	7.33
Three Mile Benewah Cr.	6.57	8.66	8.72	7.57
Cable Cr.	nd	7.52	7.39	7.52
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	7.23	7.09	7.39
Waddel Cr.	nd	7.38	7.25	7.34
Wittrock Cr.	nd	7.22	7.2	7.37
Nine Mile Benewah Cr.	6.38	7.34	6.95	7.21
Whitetail Cr.	nd	7.37	7.03	7.01
Gore Cr.	nd	nd	nd	6.85
Windfall Cr.	nd	nd	nd	6.88
Schoolhouse Cr.	nd	7.11	6.62	6.68
Upper Benewah Cr.	nd	7.12	7.14	7.13
W. Fork Benewah Cr.	nd	7.10	6.92	6.91
Evans Cr	6.22	7.16	6.95	nd
E. Fork Evans Cr.	nd	7.15	nd	nd
Upper Evans Cr.	nd	6.93	6.97	nd
Lower Lake Cr.	6.63	7.31	7.30	nd
Upper Lake Cr.	6.17	6.84	6.82	nd
Bozard Cr.	6.10	7.01	7.02	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = pH units nd = no data

Table B-5. 2003 Compiled stream Specific Conductance data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	10.7	56.1	60.9	62.9
N. Fork Alder Cr	9.4	44.9	60.9	53.7
Three Mile Benewah Cr.	13.8	33.8	43	40.6
Cable Cr.	nd	44.1	56.6	47.9
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	20.3	25.9	25.2
Waddel Cr.	nd	28.6	36.2	31.7
Wittrock Cr.	nd	27.9	35.8	33.2
Nine Mile Benewah Cr.	11.9	34.3	46.8	39.9
Whitetail Cr.	nd	103.5	146.3	91.4
Gore Cr.	nd	nd	nd	97.4
Windfall Cr.	nd	nd	nd	46.3
Schoolhouse Cr.	nd	54.9	84.0	55.2
Upper Benewah Cr.	nd	20.6	26.6	27.2
W. Fork Benewah Cr.	nd	18.2	21.6	23.2
Evans Cr	9.9	21.0	15.1	nd
E. Fork Evans Cr.	nd	21.0	nd	nd
Upper Evans Cr.	nd	12.9	13.4	nd
Lower Lake Cr.	47.7	114.5	111.6	nd
Upper Lake Cr.	17.1	42.1	34.2	nd
Bozard Cr.	15.4	41.9	33.8	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.

Measurement units = μS/cm

nd = no data

Table B-6. 2003 Compiled stream Total Suspended Solids data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	37	nd	7	8
N. Fork Alder Cr	53	nd	18	7
Three Mile Benewah Cr.	nd	nd	5	24
Cable Cr.	nd	nd	<2	<2
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	14	6
Waddel Cr.	nd	nd	21	<2
Wittrock Cr.	nd	nd	3	4
Nine Mile Benewah Cr.	nd	nd	4	3
Whitetail Cr.	nd	nd	nd	nd
Gore Cr.	nd	nd	nd	126
Windfall Cr.	nd	nd	nd	nd
Schoolhouse Cr.	nd	nd	nd	nd
Upper Benewah Cr.	nd	nd	<2	<2
W. Fork Benewah Cr.	nd	nd	58	<2
		3/18/03		
Evans Cr	2	3	3	nd
E. Fork Evans Cr.	nd	nd	6	nd
Upper Evans Cr.	nd	nd	5	nd
Lower Lake Cr.	14	nd	39	nd
Upper Lake Cr.	nd	nd	nd	nd
Bozard Cr.	13	nd	50	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = mg/L nd = no data

Table B-7. 2003 Compiled stream Turbidity data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	20.30	nd	3.78	3.45
N. Fork Alder Cr	21.30	nd	7.45	30.2
Three Mile Benewah Cr.	nd	nd	2.01	1.57
Cable Cr.	nd	nd	0.803	1.66
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	4.36	2.37
Waddel Cr.	nd	nd	7.45	2.67
Wittrock Cr.	nd	nd	2.57	1.83
Nine Mile Benewah Cr.	nd	nd	2.15	2.94
Whitetail Cr.	nd	nd	nd	nd
Gore Cr.	nd	nd	nd	4.92
Windfall Cr.	nd	nd	nd	nd
Schoolhouse Cr.	nd	nd	nd	nd
Upper Benewah Cr.	nd	nd	1.52	0.827
W. Fork Benewah Cr.	nd	nd	98.1	2.92
		3/18/03		
Evans Cr	2.72	2.86	0.628	nd
E. Fork Evans Cr.	nd	nd	0.648	nd
Upper Evans Cr.	nd	nd	1.94	nd
Lower Lake Cr.	12.50	nd	6.71	nd
Upper Lake Cr.	10.20	nd	13.1	nd
Bozard Cr.	7.50	nd	10.9	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = NTUs nd = no data

Table B-8. 2003 Compiled stream Nitrate data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	0.04	nd	<0.01	<0.01
N. Fork Alder Cr	0.04	nd	0.01	<0.01
Three Mile Benewah Cr.	0.09	nd	<0.01	<0.01
Cable Cr.	nd	nd	nd	nd
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	nd	nd
Waddel Cr.	nd	nd	nd	nd
Wittrock Cr.	nd	nd	nd	nd
Nine Mile Benewah Cr.	0.04	nd	<0.01	<0.01
Whitetail Cr.	nd	nd	<0.01	<0.01
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	<0.01
Schoolhouse Cr.	nd	nd	0.02	<0.01
Upper Benewah cr.	nd	nd	0.04	<0.01
W. Fork Benewah	nd	nd	0.10	0.01
		3/18/03		
Evans Cr	0.03	0.02	<0.01	nd
E. Fork Evans Cr.	nd	nd	0.02	nd
Upper Evans Cr.	nd	nd	0.02	nd
Lower Lake Cr.	2.38	nd	0.04	nd
Upper Lake Cr.	0.21	nd	0.08	nd
Bozard Cr.	0.07	nd	0.08	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = mg/L nd = no data

Table B-9. 2003 Compiled stream Nitrite data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	<0.01	nd	<0.01	<0.01
N. Fork Alder Cr	<0.01	nd	<0.01	<0.01
Three Mile Benewah Cr.	nd	nd	<0.01	<0.01
Cable Cr.	nd	nd	nd	nd
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	nd	nd
Waddel Cr.	nd	nd	nd	nd
Wittrock Cr.	nd	nd	nd	nd
Nine Mile Benewah Cr.	nd	nd	<0.01	<0.01
Whitetail Cr.	nd	nd	<0.01	<0.01
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	<0.01
Schoolhouse Cr.	nd	nd	<0.01	<0.01
Upper Benewah Cr.	nd	nd	<0.01	<0.01
W. Fork Benewah Cr.	nd	nd	<0.01	<0.01
		3/18/03		
Evans Cr	<0.01	<0.01	<0.01	nd
E. Fork Evans Cr.	nd	nd	<0.01	nd
Upper Evans Cr.	nd	nd	<0.01	nd
Lower Lake Cr.	<0.01	nd	<0.01	nd
Upper Lake Cr.	<0.01	nd	<0.01	nd
Bozard Cr.	<0.01	nd	<0.01	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = mg/L nd = no data

Table B-10. 2003 Compiled stream Total Kjeldahl Nitrogen (TKN) data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	0.27	nd	0.33	0.21
N. Fork Alder Cr	0.27	nd	0.39	0.50
Three Mile Benewah Cr.	0.85	nd	0.31	0.15
Cable Cr.	nd	nd	nd	nd
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	nd	nd
Waddel Cr.	nd	nd	nd	nd
Wittrock Cr.	nd	nd	nd	nd
Nine Mile Benewah Cr.	0.47	nd	0.22	0.19
Whitetail Cr.	nd	nd	0.34	0.18
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	0.15
Schoolhouse Cr.	nd	nd	nd	nd
Upper Benewah Cr.	nd	nd	0.16	0.09
W. Fork Benewah Cr.	nd	nd	0.56	0.19
Evans Cr	0.08	nd	0.16	nd
E. Fork Evans Cr.	nd	nd	0.14	nd
Upper Evans Cr.	nd	nd	0.11	nd
Lower Lake Cr.	0.64	nd	0.56	nd
Upper Lake Cr.	0.32	nd	0.51	nd
Bozard Cr.	0.26	nd	0.55	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = mg/L nd = no data

Table B-11. 2003 Compiled stream Total Phosphorus data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	0.051	nd	0.029	0.019
N. Fork Alder Cr	0.050	nd	0.048	0.158
Three Mile Benewah Cr.	0.226	nd	0.028	0.013
Cable Cr.	nd	nd	nd	nd
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	nd	nd
Waddel Cr.	nd	nd	nd	nd
Wittrock Cr.	nd	nd	nd	nd
Nine Mile Benewah Cr.	0.089	nd	0.029	0.016
Whitetail Cr.	nd	nd	nd	nd
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	nd
Schoolhouse Cr.	nd	nd	nd	nd
Upper Benewah Cr.	nd	nd	0.024	0.012
W. Fork Benewah Cr.	nd	nd	nd	nd
Evans Cr	0.012	nd	nd	nd
E. Fork Evans Cr.	nd	nd	nd	nd
Upper Evans Cr.	nd	nd	nd	nd
Lower Lake Cr.	nd	nd	nd	nd
Upper Lake Cr.	nd	nd	nd	nd
Bozard Cr.	nd	nd	nd	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = mg/L nd = no data

Table B-12. 2003 Compiled stream Dissolved "ortho" Phosphorus data for Coeur d'Alene Tribe monitored stream stations.

DATES:	1/31/03	7/23/03	8/11/03	9/29/03
STREAM SITES				
Alder Cr.	0.03	nd	<0.01	<0.01
N. Fork Alder Cr	<0.01	nd	<0.01	<0.01
Three Mile Benewah Cr.	0.03	nd	<0.01	0.02
Cable Cr.	nd	nd	nd	nd
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	nd	nd
Waddel Cr.	nd	nd	nd	nd
Wittrock Cr.	nd	nd	nd	nd
Nine Mile Benewah Cr.	<0.01	nd	<0.01	0.03
Whitetail Cr.	nd	nd	<0.01	0.02
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	0.02
Schoolhouse Cr.	nd	nd	<0.01	<0.01
Upper Benewah Cr.	nd	nd	<0.01	0.03
W. Fork Benewah Cr.	nd	nd	<0.01	<0.01
		3/18/03		
Evans Cr	<0.01	<0.01	<0.01	nd
E. Fork Evans Cr.	nd	nd	<0.01	nd
Upper Evans Cr.	nd	nd	<0.01	nd
Lower Lake Cr.	<0.01	nd	<0.01	nd
Upper Lake Cr.	<0.01	nd	<0.01	nd
Bozard Cr.	0.02	nd	<0.01	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = mg/L nd = no data

Table B-13. 2003 Compiled stream Chloride data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	0.49	nd	0.44	0.50
N. Fork Alder Cr	0.47	nd	0.56	0.45
Three Mile Benewah Cr.	0.73	nd	0.89	0.93
Cable Cr.	nd	nd	nd	nd
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	nd	nd
Waddel Cr.	nd	nd	nd	nd
Wittrock Cr.	nd	nd	nd	nd
Nine Mile Benewah Cr.	0.67	nd	0.74	0.72
Whitetail Cr.	nd	nd	2.06	1.63
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	<0.05
Schoolhouse Cr.	nd	nd	0.93	0.81
Upper Benewah Cr.	nd	nd	0.68	0.63
W. Fork Benewah Cr.	1.35	nd	0.68	0.65
		3/18/03		
Evans Cr	0.43	0.67	0.47	nd
E. Fork Evans Cr.	nd	nd	0.63	nd
Upper Evans Cr.	nd	nd	0.47	nd
Lower Lake Cr.	3.00	nd	3.38	nd
Upper Lake Cr.	1.18	nd	0.67	nd
Bozard Cr.	0.75	nd	0.81	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.

Measurement units = mg/L nd = no data

Table B-14. 2003 Compiled stream Fluoride data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	0.06	nd	<0.05	<0.05
N. Fork Alder Cr	0.06	nd	<0.05	<0.05
Three Mile Benewah Cr.	0.05	nd	0.10	<0.05
Cable Cr.	nd	nd	nd	nd
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	nd	nd
Waddel Cr.	nd	nd	nd	nd
Wittrock Cr.	nd	nd	nd	nd
Nine Mile Benewah Cr.	<0.05	nd	<0.05	<0.05
Whitetail Cr.	nd	nd	0.10	0.10
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	<0.05
Schoolhouse Cr.	nd	nd	0.07	0.19
Upper Benewah Cr.	nd	nd	<0.05	<0.05
W. Fork Benewah Cr.	nd	nd	<0.05	<0.05
		3/18/03		
Evans Cr	0.06	<0.05	0.08	nd
E. Fork Evans Cr.	nd	nd	<0.05	nd
Upper Evans Cr.	nd	nd	0.08	nd
Lower Lake Cr.	<0.05	nd	0.13	nd
Upper Lake Cr.	<0.05	nd	0.09	nd
Bozard Cr.	<0.05	nd	0.09	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = mg/L nd = no data

Table B-15. 2003 Compiled stream Sulfate data for Coeur d'Alene Tribe monitored stream stations.

DATES:	**1/31/03**	**7/23/03**	**8/11/03**	**9/29/03**
STREAM SITES				
Alder Cr.	0.98	nd	1.11	1.58
N. Fork Alder Cr	1.07	nd	0.97	1.43
Three Mile Benewah Cr.	1.06	nd	1.20	1.55
Cable Cr.	nd	nd	nd	nd
Coon Cr.	nd	nd	nd	nd
Bull Cr.	nd	nd	nd	nd
Waddel Cr.	nd	nd	nd	nd
Wittrock Cr.	nd	nd	nd	nd
Nine Mile Benewah Cr.	1.30	nd	1.59	1.89
Whitetail Cr.	nd	nd	4.77	4.19
Gore Cr.	nd	nd	nd	nd
Windfall Cr.	nd	nd	nd	2.79
Schoolhouse Cr.	nd	nd	2.62	1.83
Upper Benewah Cr.	nd	nd	1.35	1.49
W. Fork Benewah Cr.	nd	nd	1.02	1.07
		3/15/03		
Evans Cr	2.48	2.48	2.32	nd
E. Fork Evans Cr.	nd	nd	2.63	nd
Upper Evans Cr.	nd	nd	1.74	nd
Lower Lake Cr.	5.42	nd	4.92	nd
Upper Lake Cr.	2.39	nd	0.647	nd
Bozard Cr.	1.97	nd	0.786	nd

Note: Since monitoring typically takes place over two to three days, the dates given below are the earliest date shown in the original data.
Measurement units = mg/L nd = no data

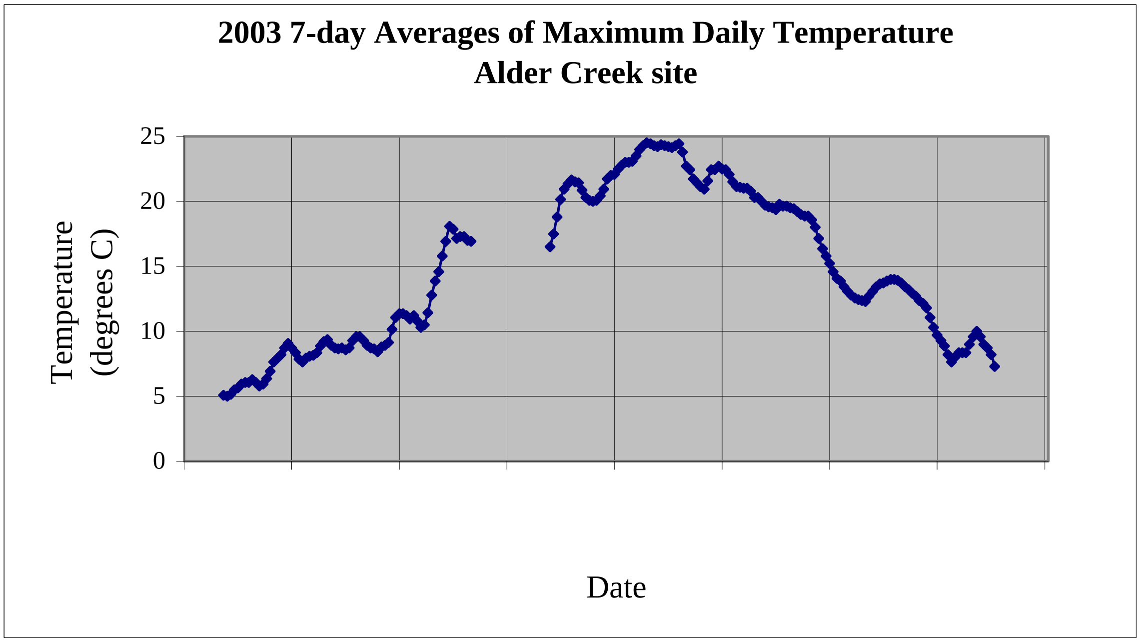


Figure B-5. 7-day averages of the maximum daily temperature for the Alder Creek site, 2003.

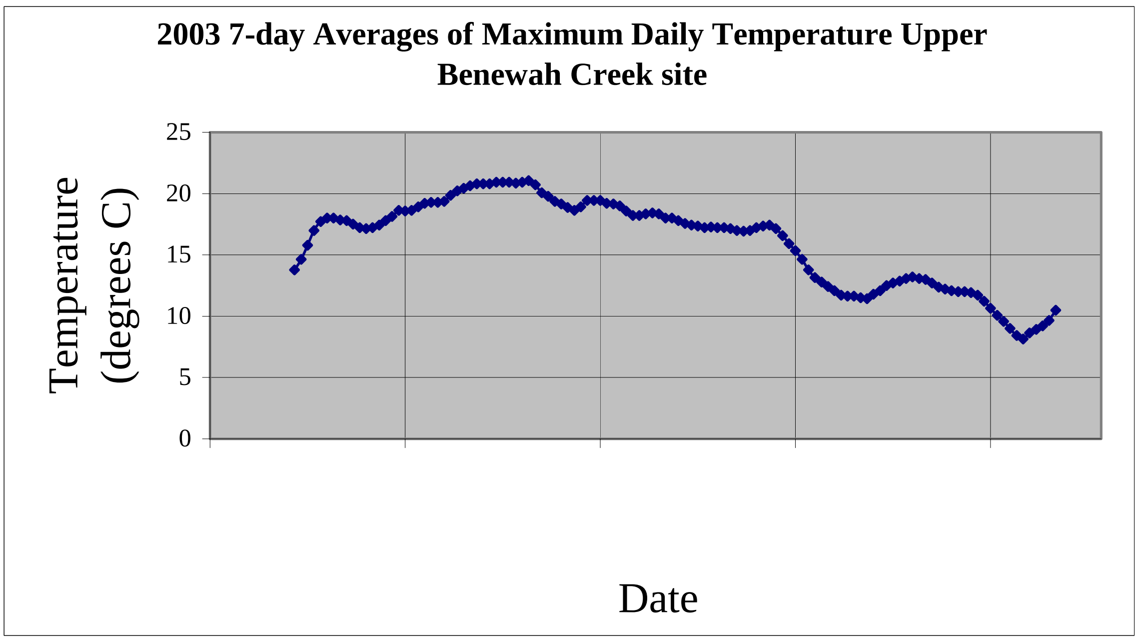


Figure B-6. 7-day average of the maximum daily temperature for the Upper Benewah Creek site, 2003.

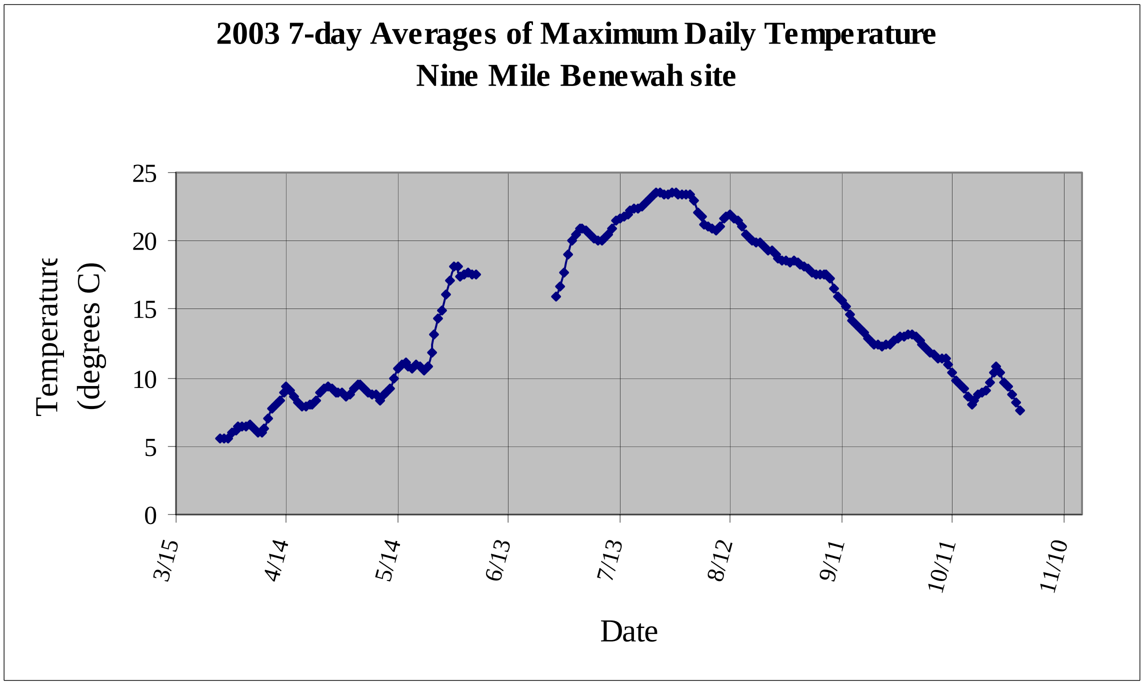


Figure B-7. 7-day averages of maximum daily temperature for the Nine Mile Benewah site.

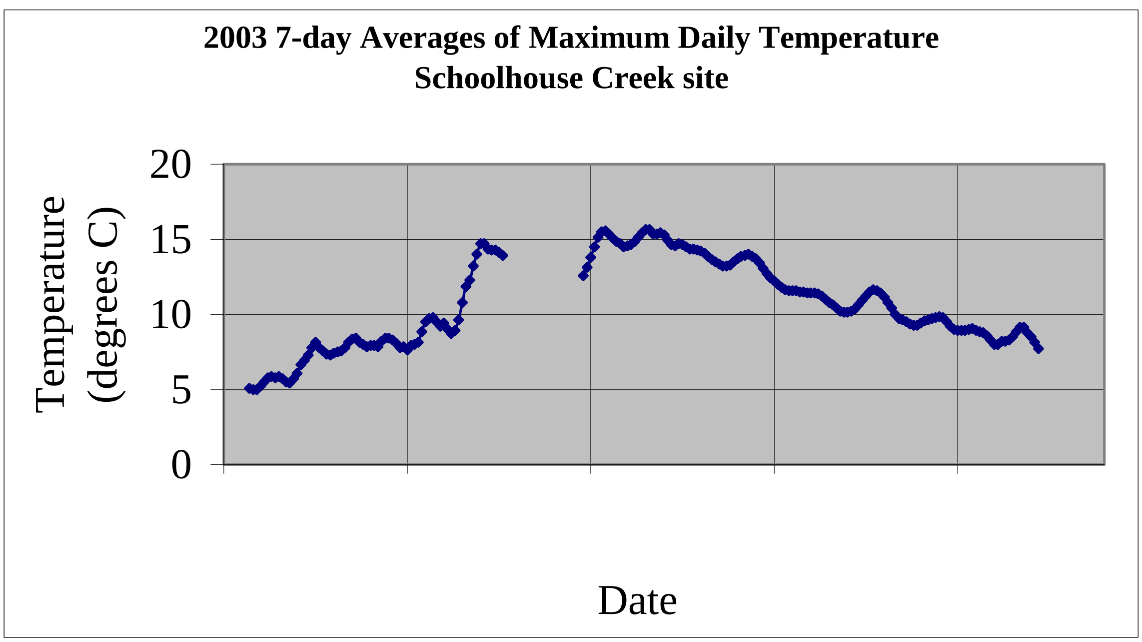


Figure B-8. 7-day averages of maximum daily temperature for the Schoolhouse Creek site.

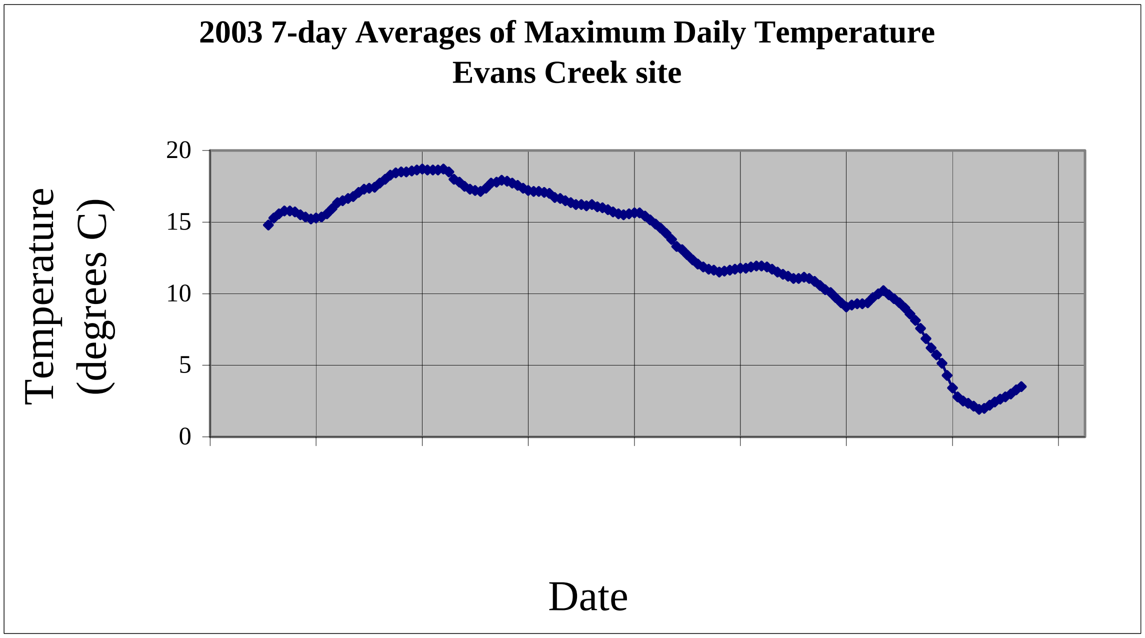


Figure B-9. 7-day averages of maximum daily temperature for the Evans Creek site.

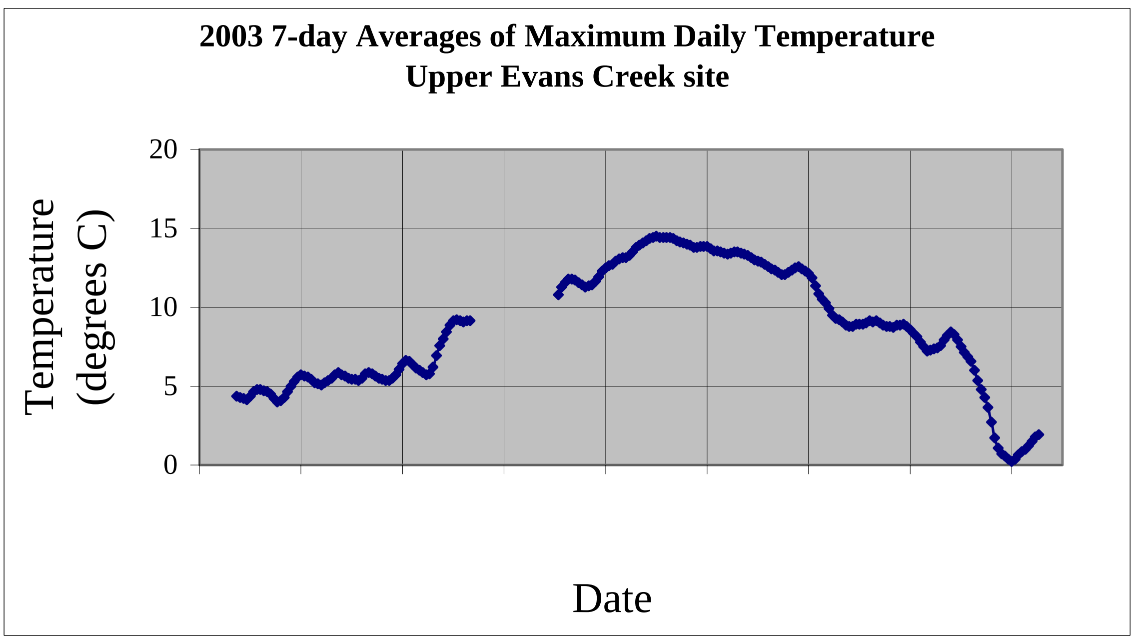


Figure B-10. 7-day averages of maximum daily temperature for the Upper Evans Creek site.

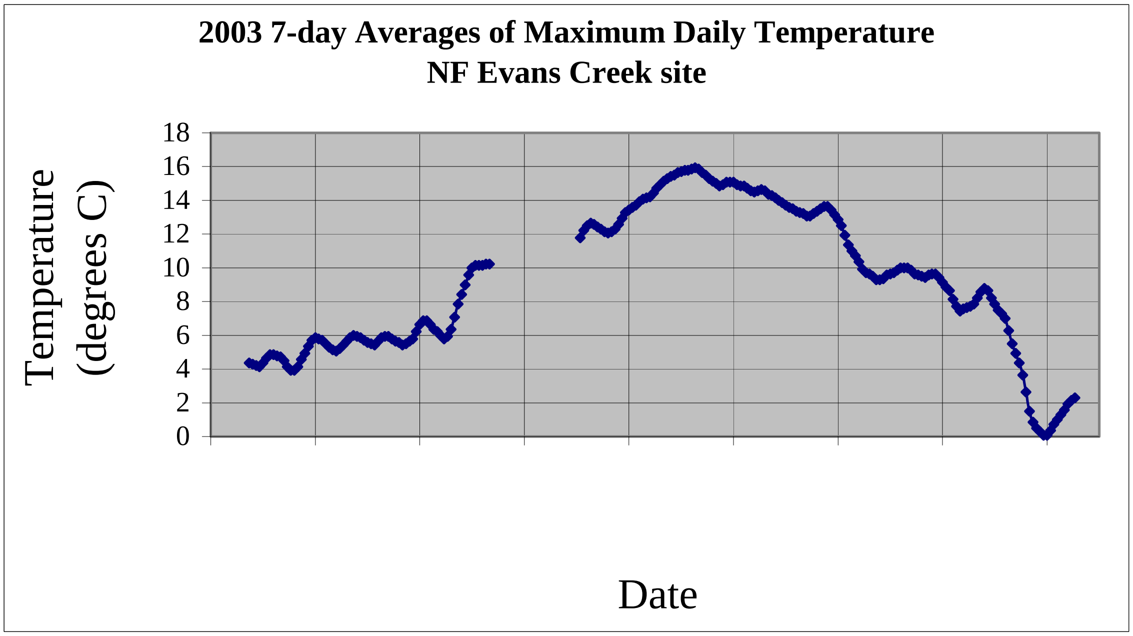


Figure B-11. 7-day averages of maximum daily temperature for the North Fork Evans Creek site.

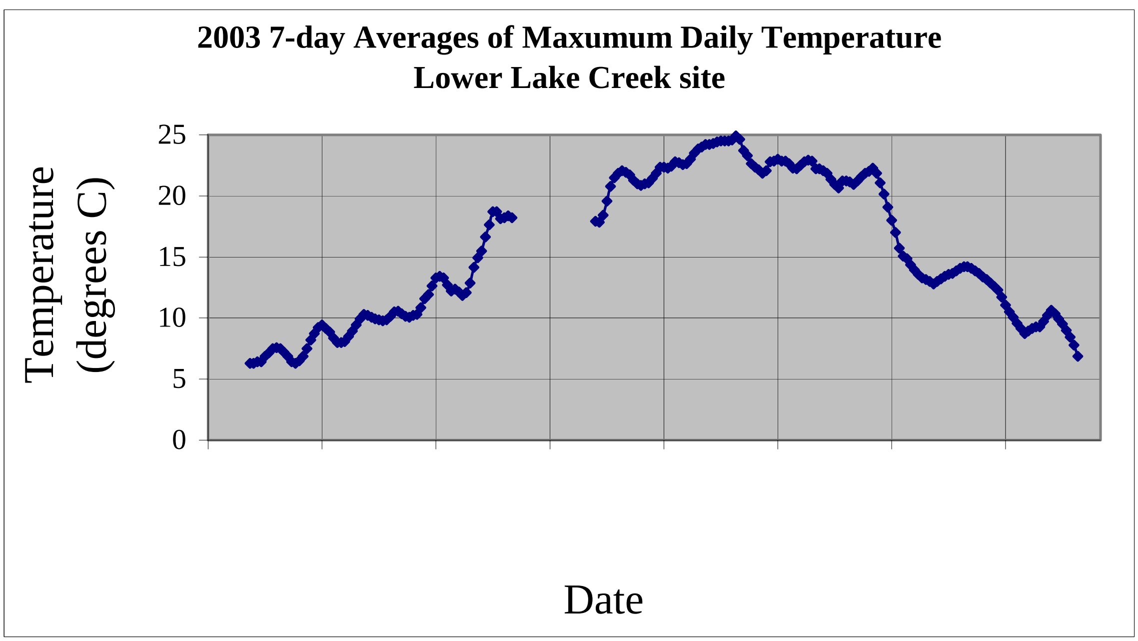


Figure B-12. 7-day averages of maximum daily temperature for the Lower Lake Creek site.

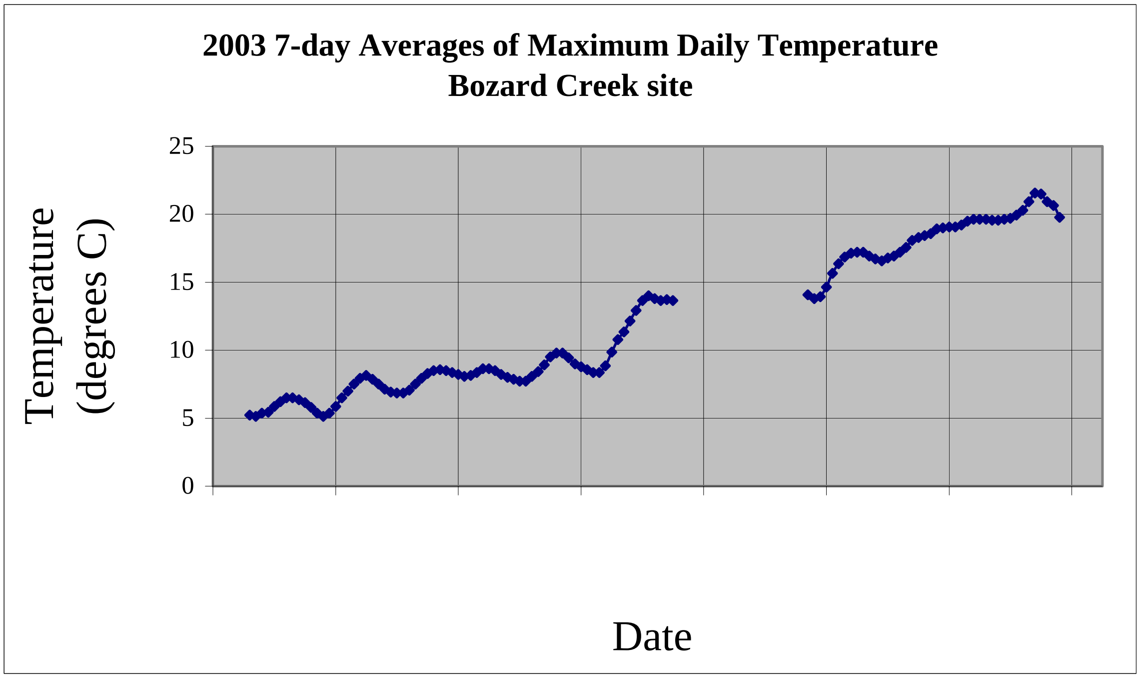
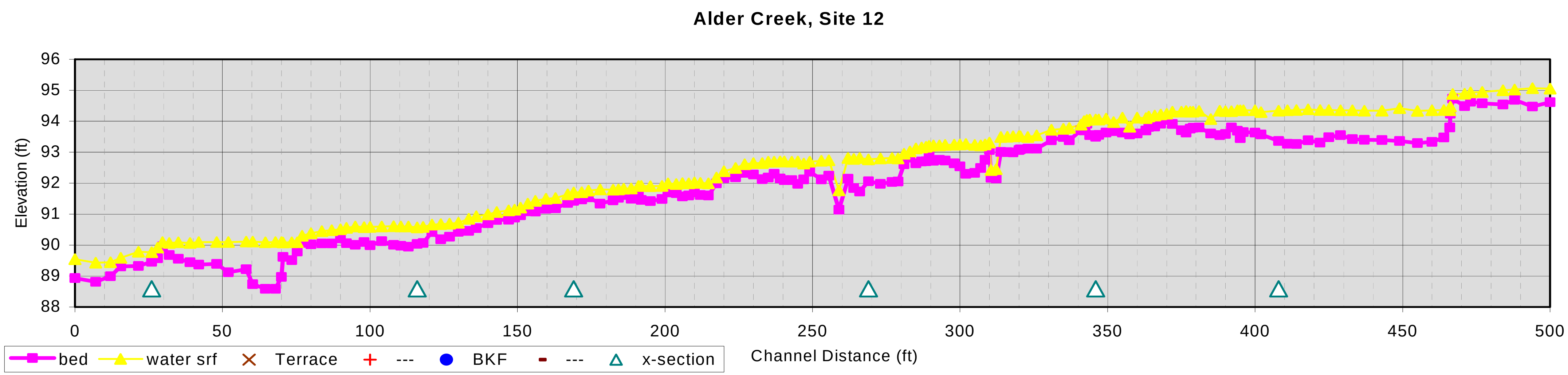


Figure B-13. 7-day averages of maximum daily temperature for the Bozard Creek site.

APPENDIX C. STREAM PHYSICAL HABITAT MONITORING DATA


Alder Creek, Site 12
Elevation (ft)
Channel Distance (ft)
bed
water srf
Terrace

BKF
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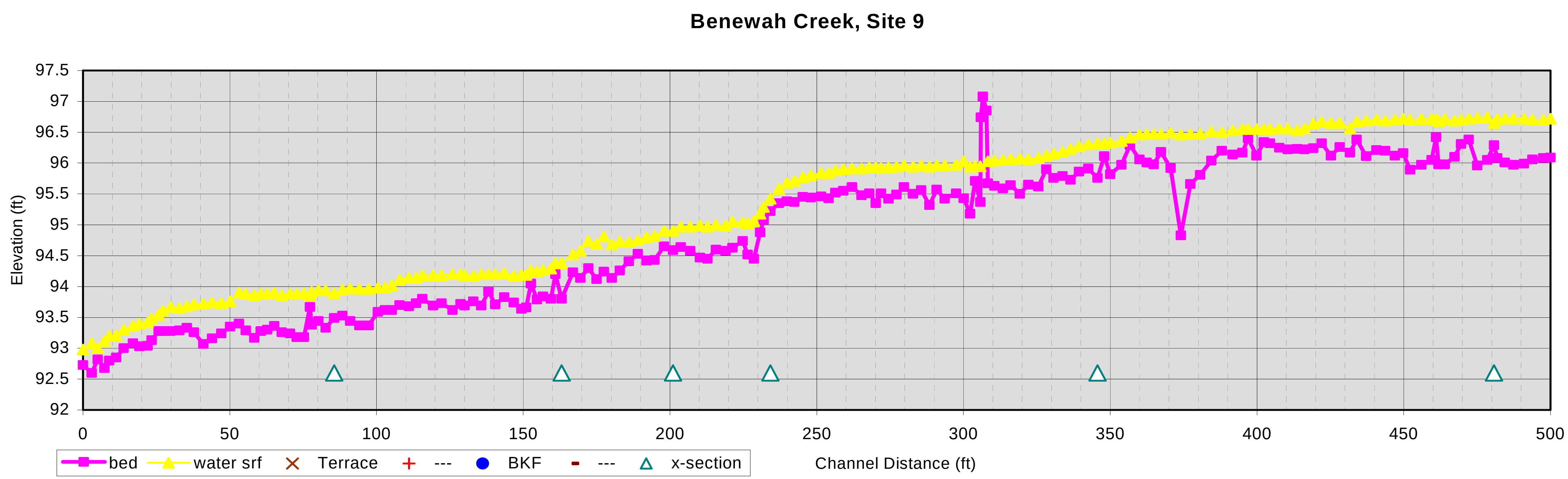
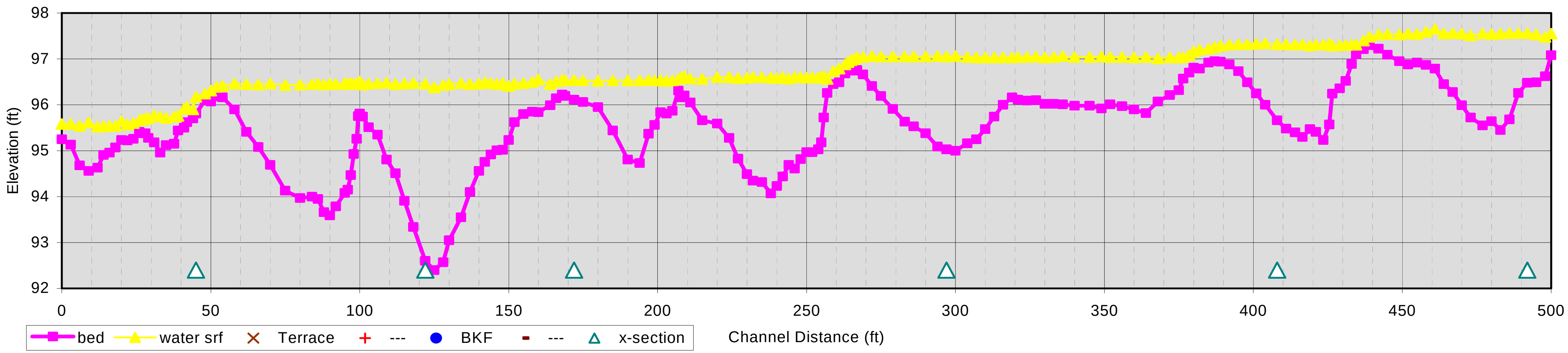
x-section

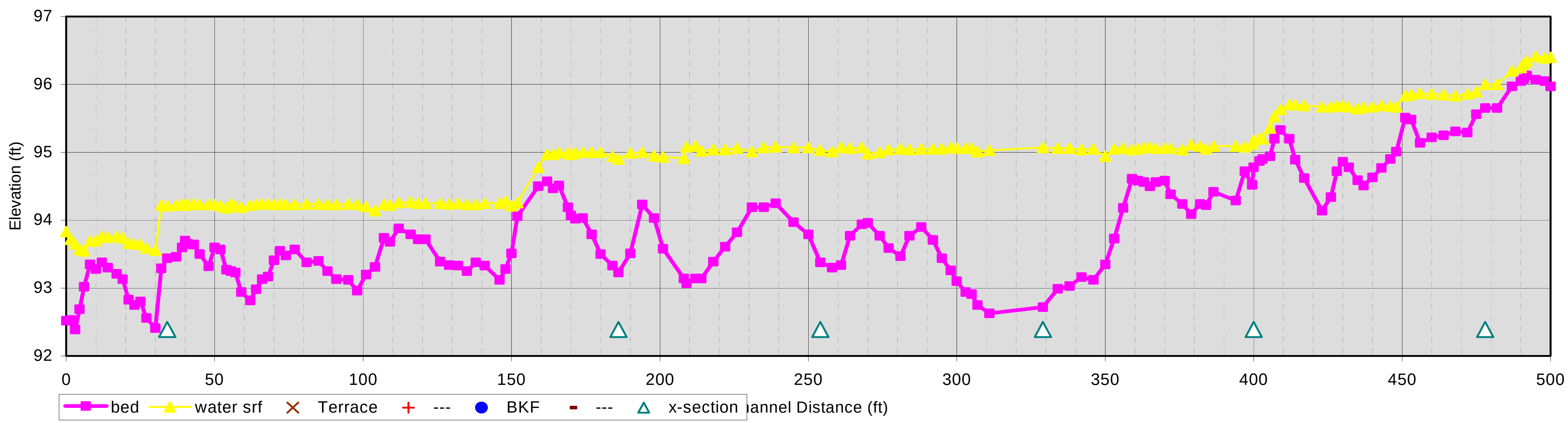

Benewah Creek, Site 9
Elevation (ft)
Channel Distance (ft)
bed
water srf
Terrace

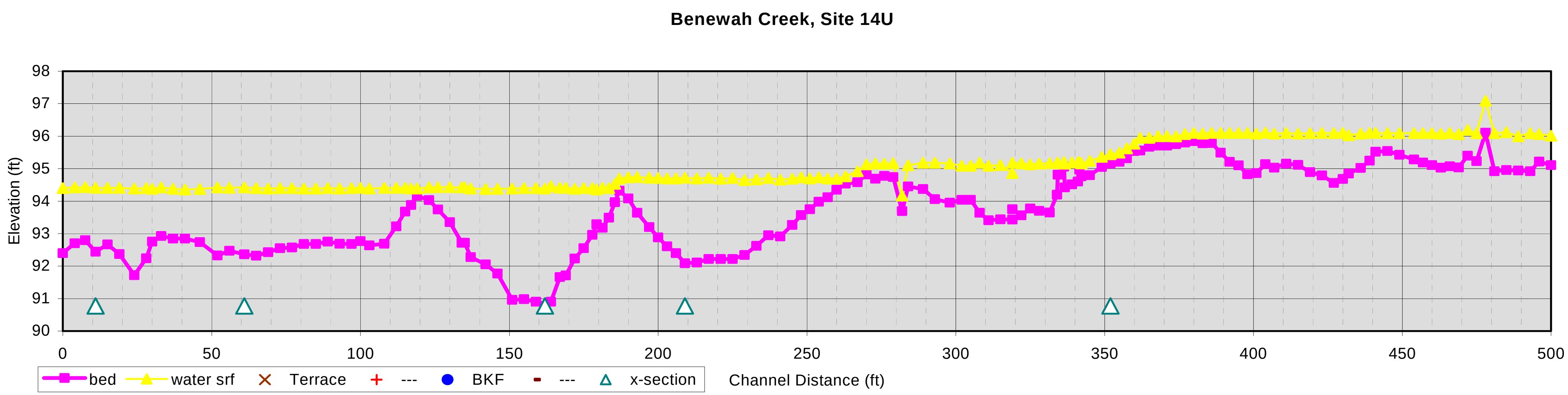
BKF
---
x-section

Benewah Creek, Site 13

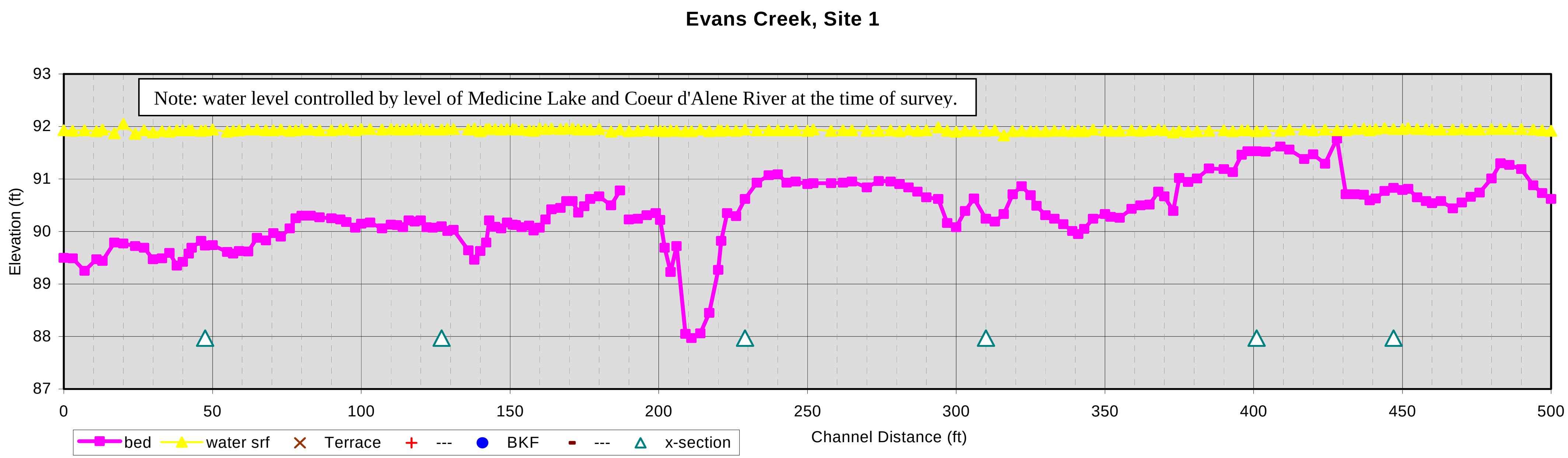


Benewah Creek, Site 14L

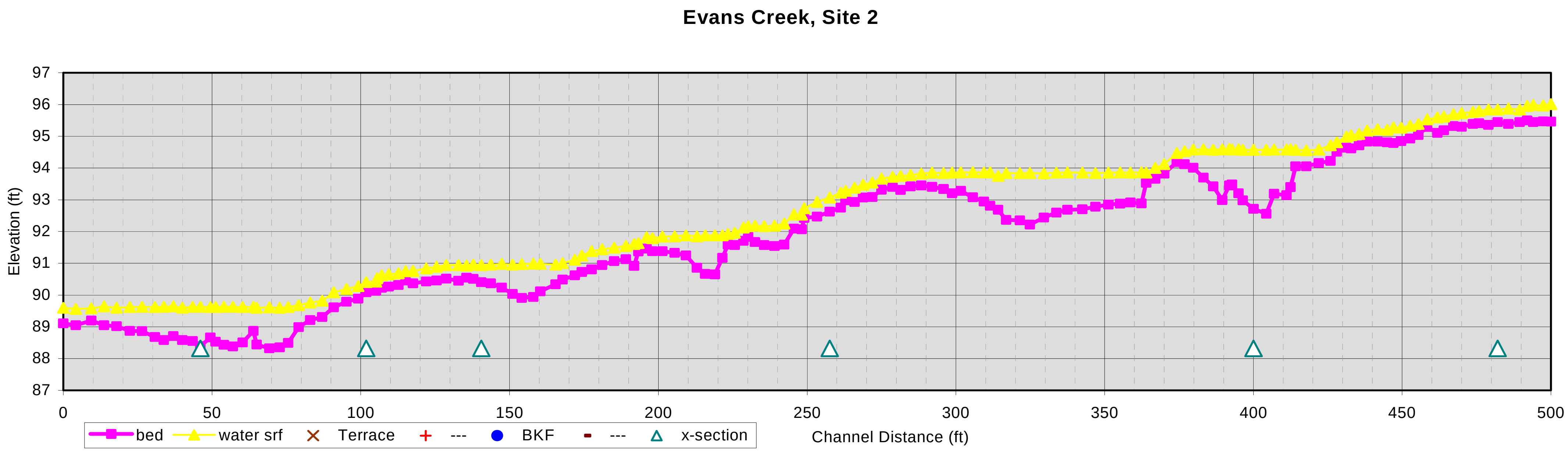



Benewah Creek, Site 14U
Elevation (ft)
98
97
96
95
94
93
92
91
90
0
50
100
150
200
250
300
350
400
450
500
bed
water srf
Terrace

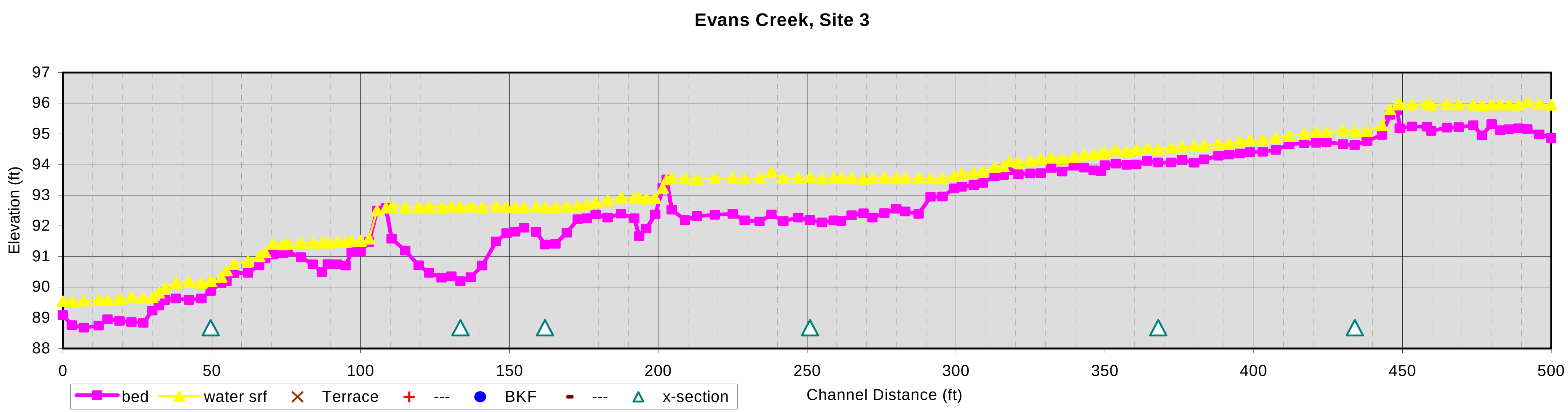
BKF
---
x-section
Channel Distance (ft)


Evans Creek, Site 1
Note: water level controlled by level of Medicine Lake and Coeur d'Alene River at the time of survey.
Elevation (ft)
93
92
91
90
89
88
87
0
50
100
150
200
250
300
350
400
450
500
bed
water srf
Terrace

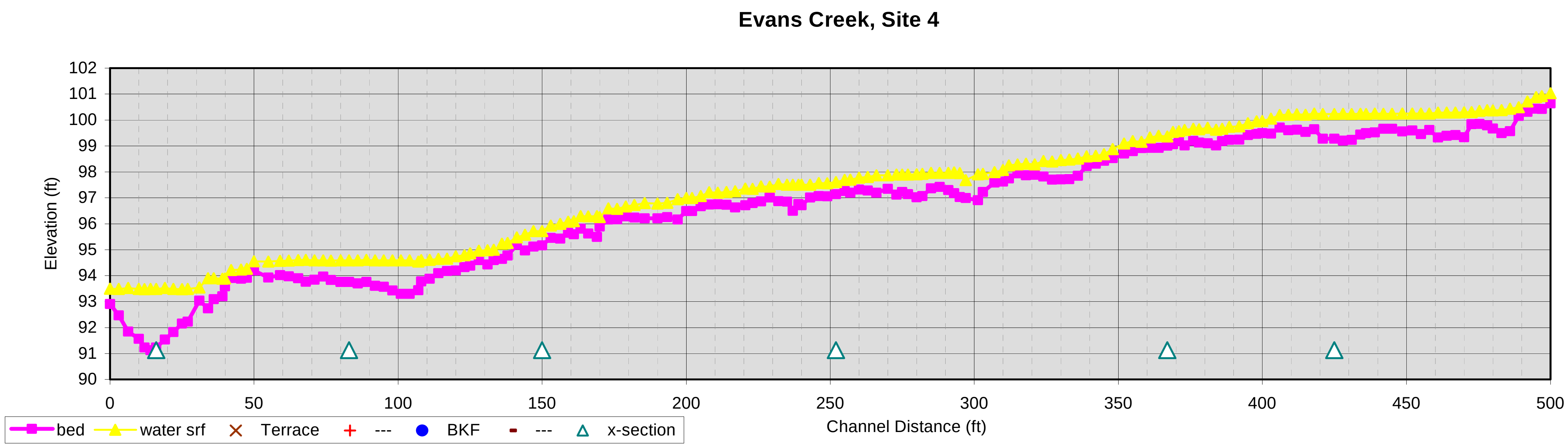
BKF
---
x-section
Channel Distance (ft)


Evans Creek, Site 2
97
96
95
94
93
92
91
90
89
88
87
Elevation (ft)
0
50
100
150
200
250
300
350
400
450
500
Channel Distance (ft)
bed
water srf
Terrace

BKF
---
x-section

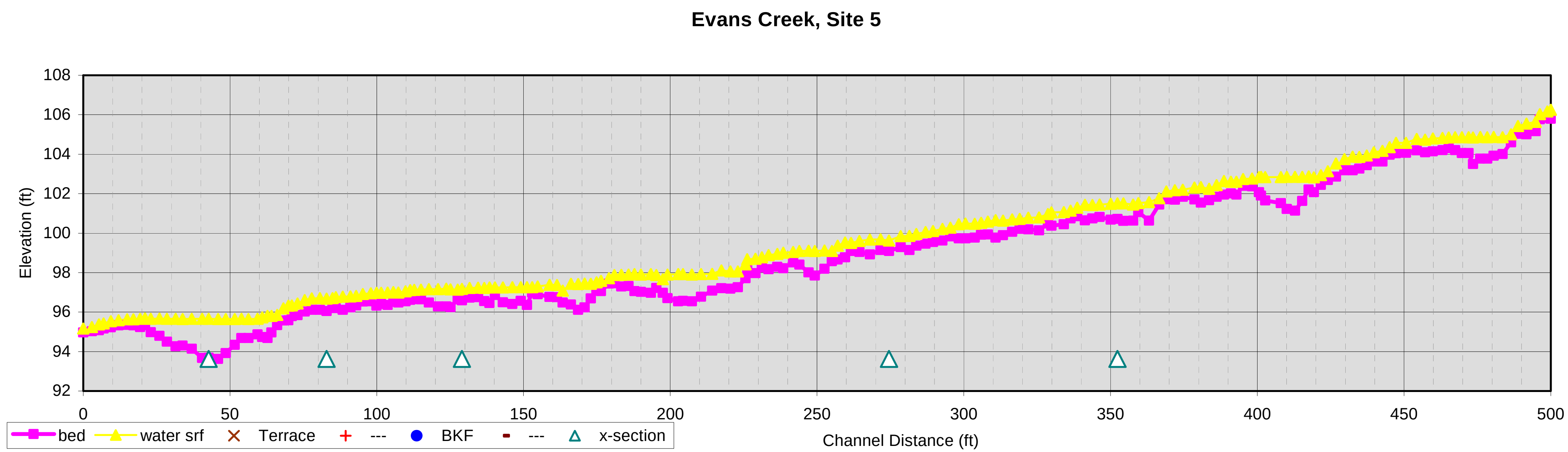

Evans Creek, Site 3
97
96
95
94
93
92
91
90
89
88
Elevation (ft)
0
50
100
150
200
250
300
350
400
450
500
Channel Distance (ft)
bed
water srf
Terrace

BKF
---
x-section



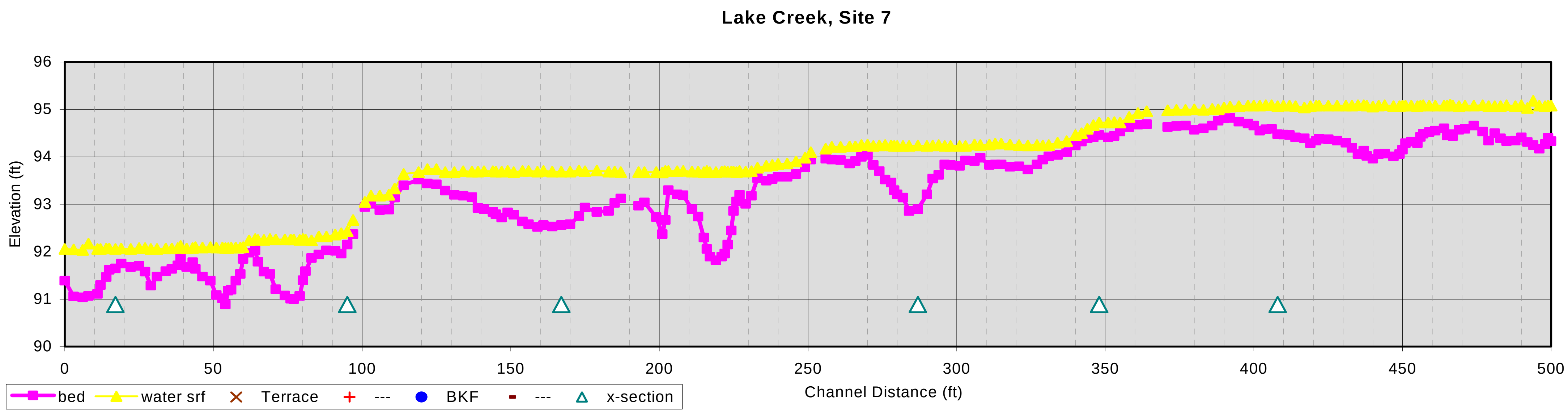
Evans Creek, Site 4
Elevation (ft)
102
101
100
99
98
97
96
95
94
93
92
91
90
0
50
100
150
200
250
300
350
400
450
500
Channel Distance (ft)
bed
water srf
Terrace

BKF
---
x-section

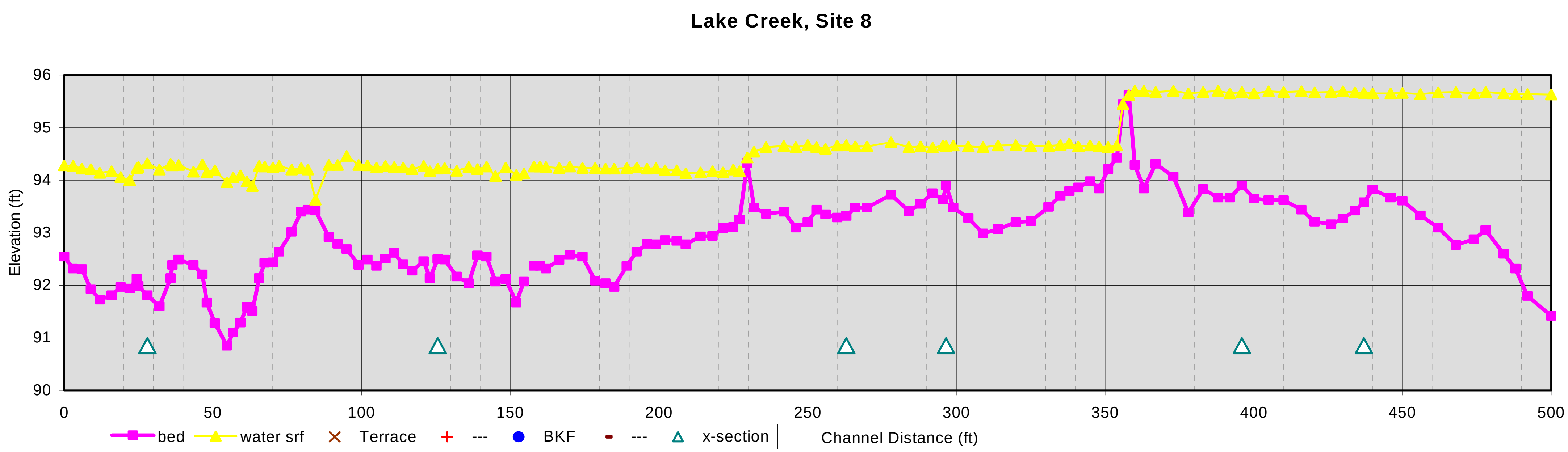


Evans Creek, Site 5
Elevation (ft)
108
106
104
102
100
98
96
94
92
0
50
100
150
200
250
300
350
400
450
500
Channel Distance (ft)
bed
water srf
Terrace

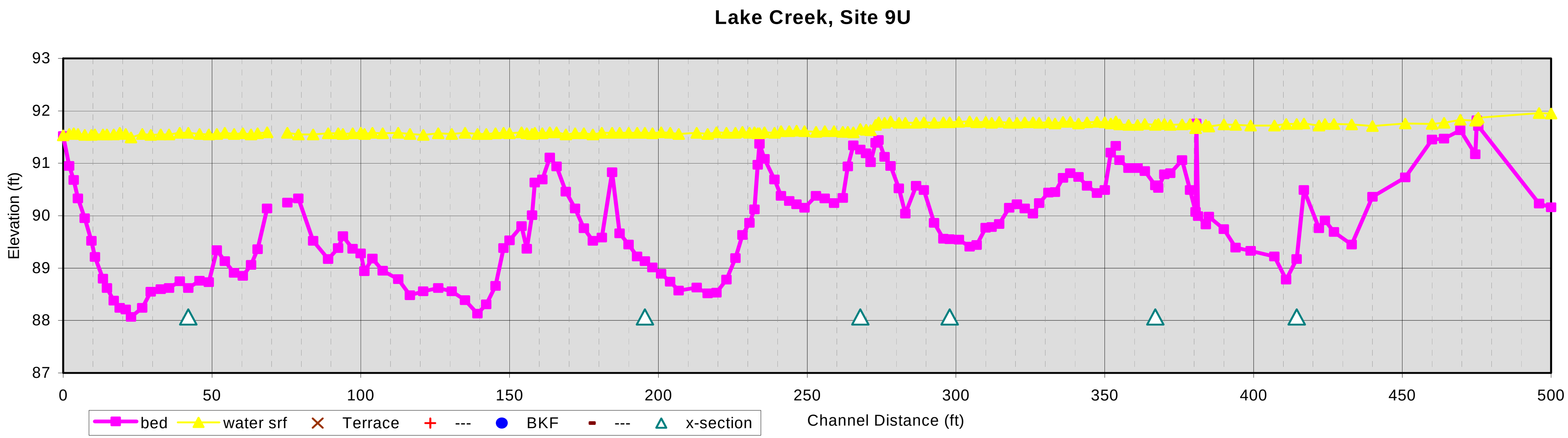
BKF
---
x-section


Lake Creek, Site 7
Elevation (ft)
96
95
94
93
92
91
90
0
50
100
150
200
250
300
350
400
450
500
Channel Distance (ft)
bed
water srf
Terrace

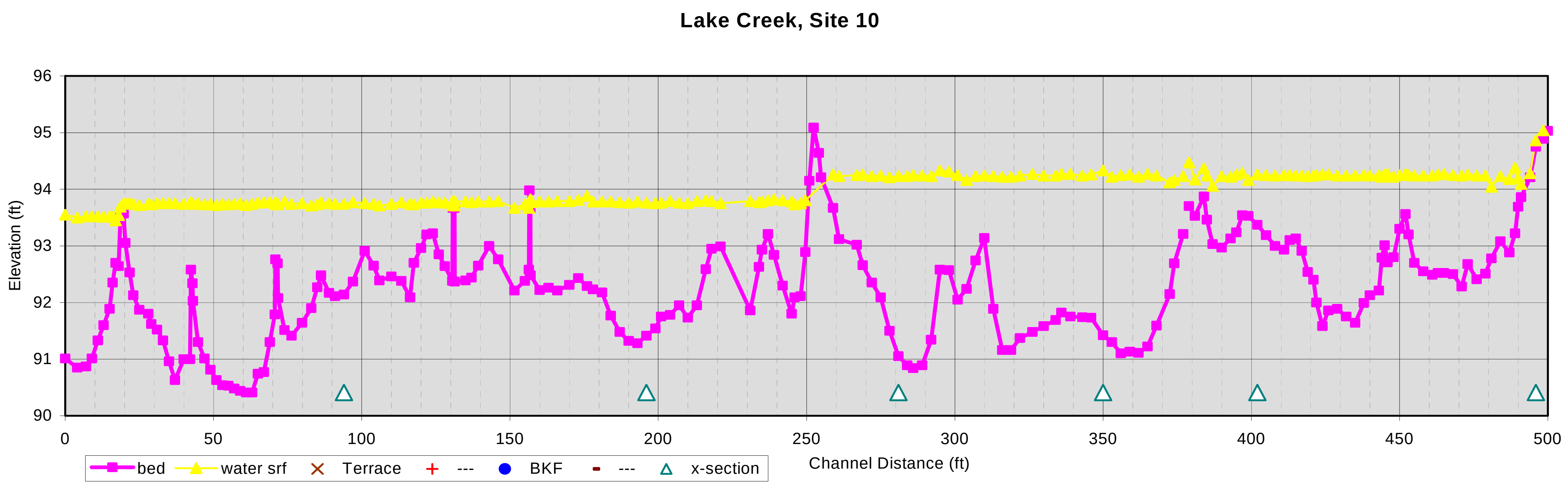
BKF
---
x-section


Lake Creek, Site 8
Elevation (ft)
96
95
94
93
92
91
90
0
50
100
150
200
250
300
350
400
450
500
Channel Distance (ft)
bed
water srf
Terrace

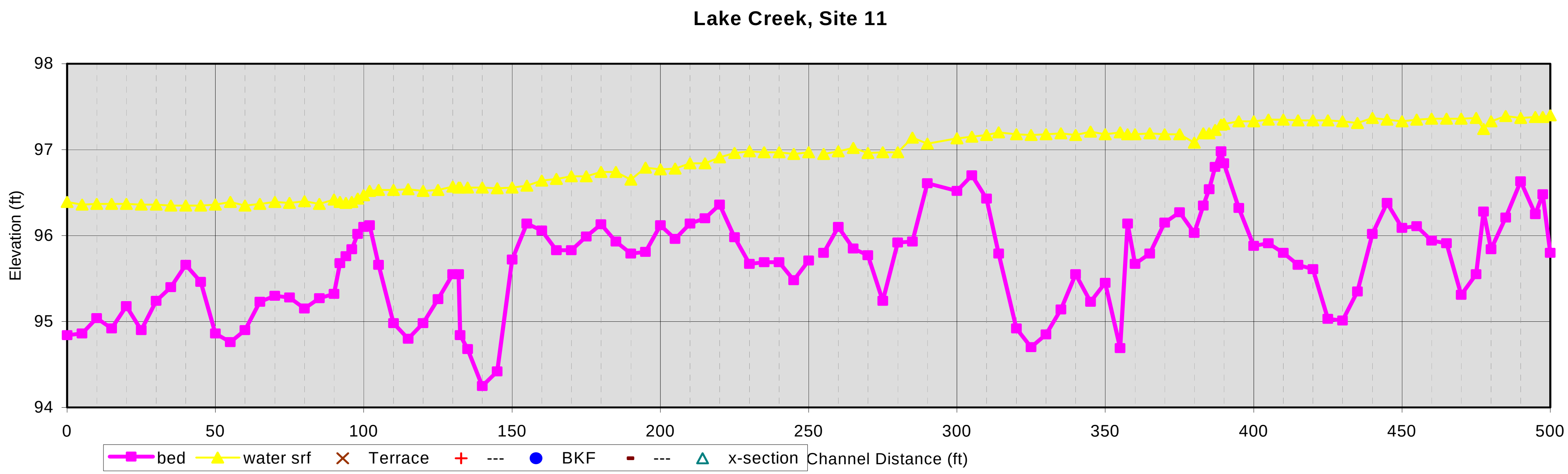
BKF
---
x-section


Lake Creek, Site 9U
Elevation (ft)
Channel Distance (ft)
93
92
91
90
89
88
87
0
50
100
150
200
250
300
350
400
450
500
bed
water srf
Terrace

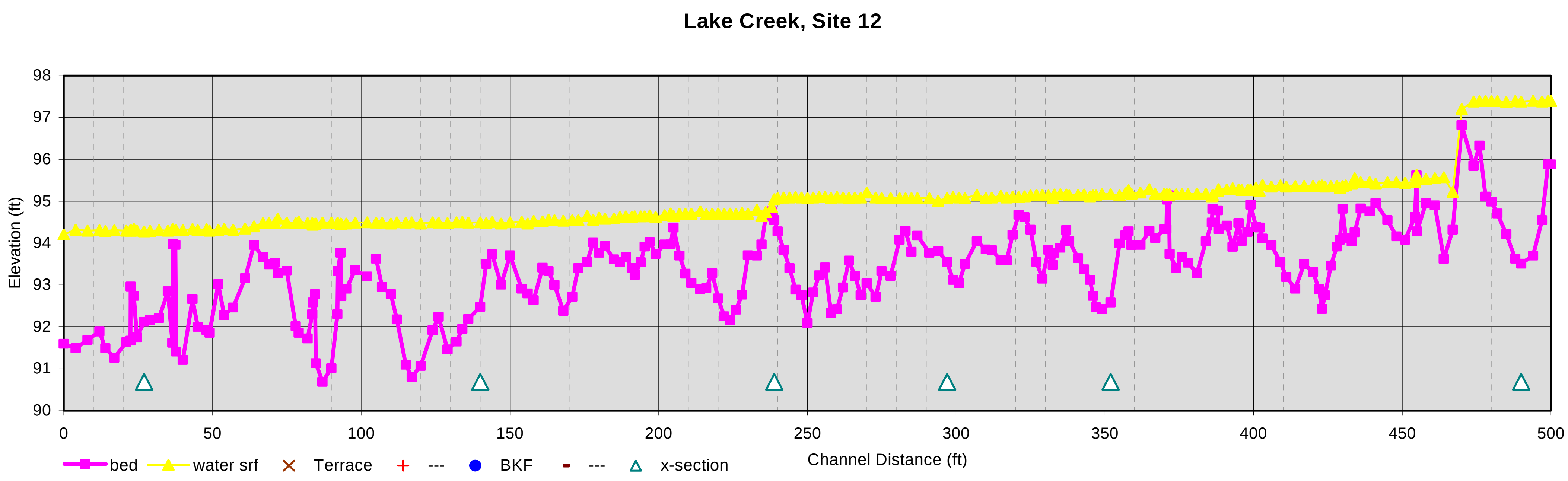
BKF
---
x-section


Lake Creek, Site 10
Elevation (ft)
Channel Distance (ft)
96
95
94
93
92
91
90
0
50
100
150
200
250
300
350
400
450
500
bed
water srf
Terrace

BKF
---
x-section

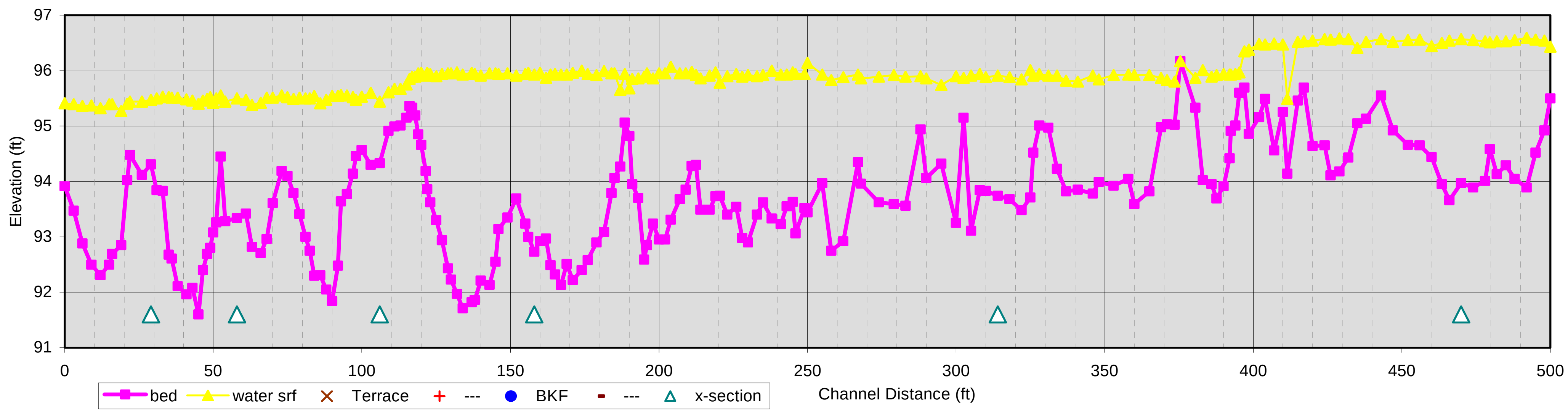

Lake Creek, Site 11
Elevation (ft)
98
97
96
95
94
0
50
100
150
200
250
300
350
400
450
500
Channel Distance (ft)
bed
water srf
Terrace

BKF
---
x-section

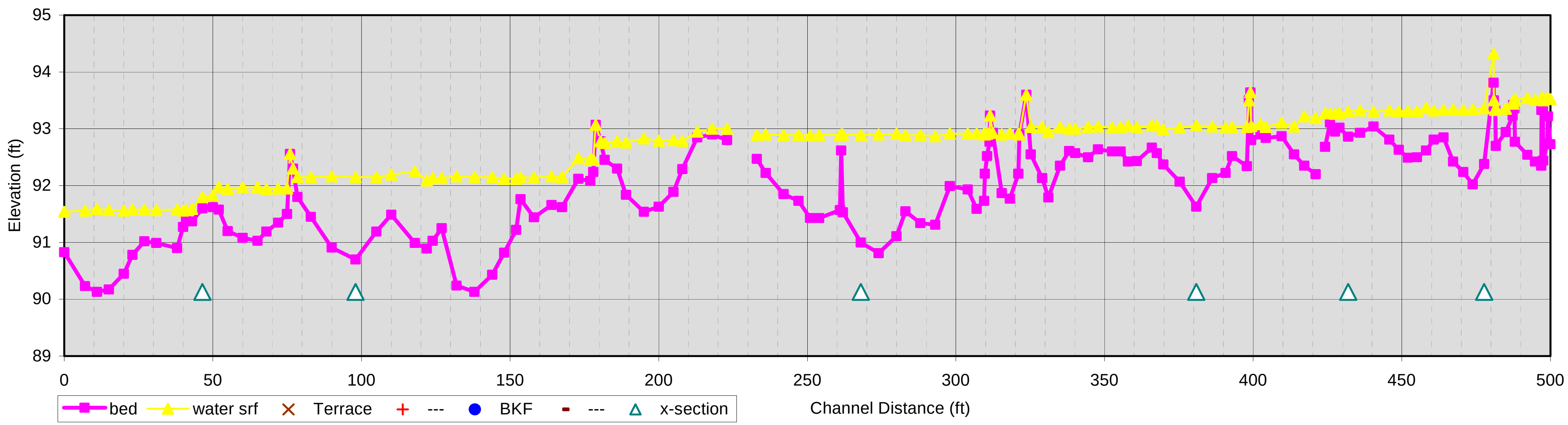

Lake Creek, Site 12
Elevation (ft)
98
97
96
95
94
93
92
91
90
0
50
100
150
200
250
300
350
400
450
500
Channel Distance (ft)
bed
water srf
Terrace

BKF
---
x-section

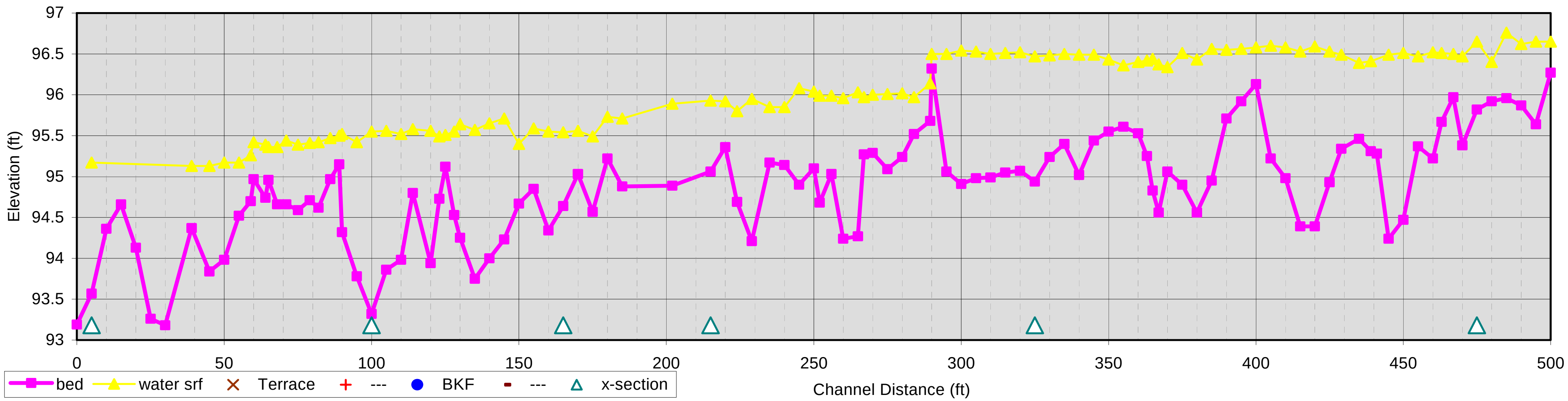
Lake Creek, Site 13



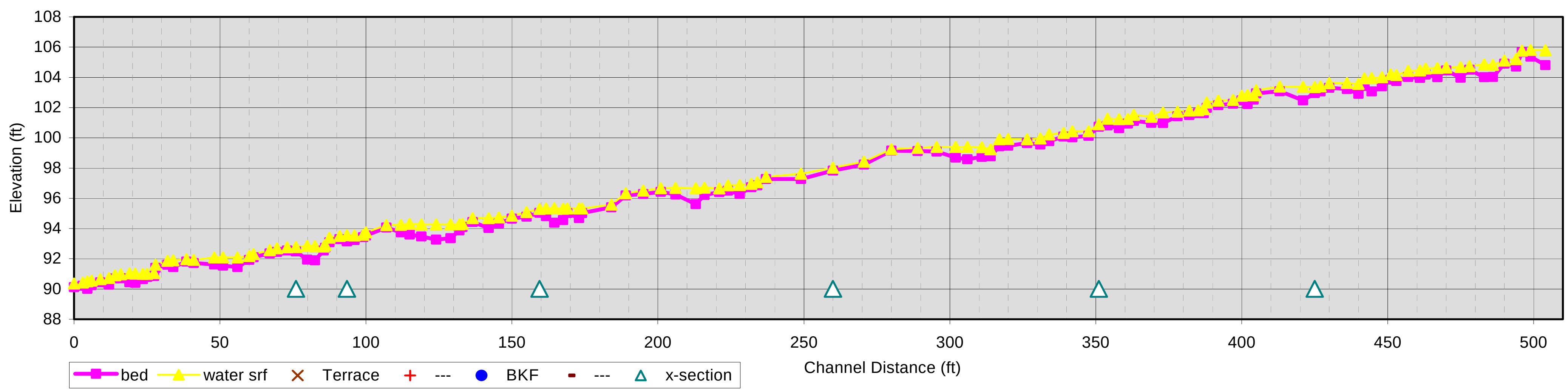
Bozard Creek, Site 1



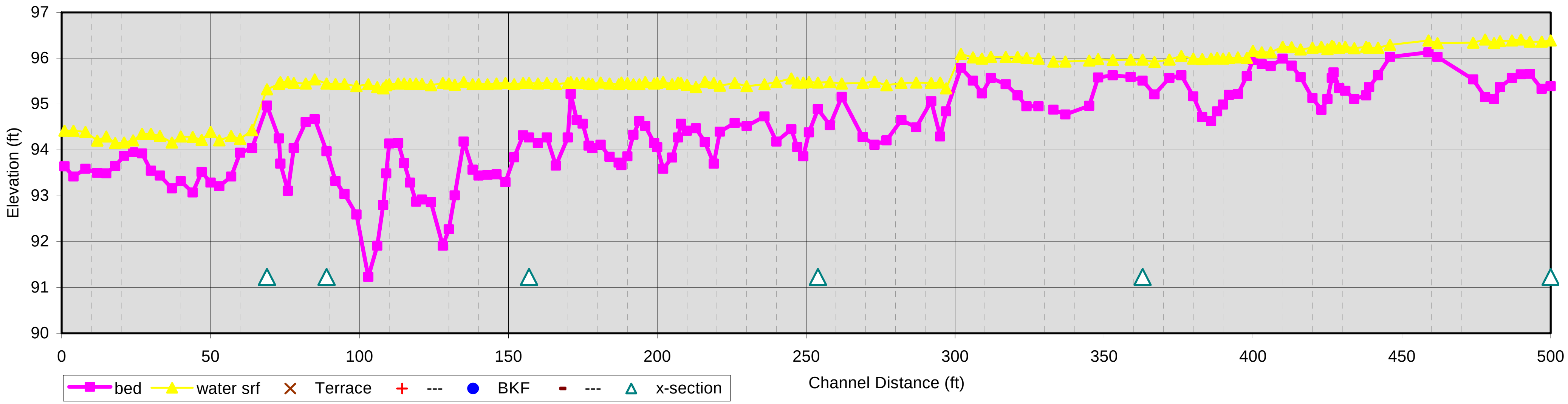
Bozard Creek, Site 2



Bozard Creek, Site 3



W.Fk. Lake Creek, Site 2



W. Fk. Lake Creek, Site 3