WATER QUALITY STATUS REPORT NO. 89

BIG CANYON CREEK

Clearwater, Lewis, Nez Perce Counties, Idaho
1988

Idaho Department of Health and Welfare
Division of Environmental Quality
Water Quality Bureau
Boise, Idaho

1989

ABSTRACT

The Nez Perce Soil and Water Conservation District (SWCD) applied for an Idaho Agriculture Nonpoint Source Pollution Abatement planning grant with the Idaho Division of Environmental Quality (DEQ) in November of 1988. Big Canyon Creek had been identified by the DEQ and SWCD as a first priority stream segment in the Nonpoint Source Pollution Abatement program. Current designated beneficial uses as presented in the Idaho Water Quality Standards and Wastewater Treatment Requirements for Big Canyon Creek are domestic and agricultural water supply, primary and secondary contact recreation, cold water biota, as well as salmonid spawning.

A water quality study was conducted from February 3, 1987 to February 23, 1988. The objectives of the study were to: 1) determine water quality in various reaches and subwatersheds; 2) document the effects of snowmelt and storm event runoff on the water quality of Big Canyon Creek.

Big Canyon Creek is located in North Central Idaho, and is a fourth order tributary to the Clearwater River. The headwaters are located in Lewis County which originate from Mason Butte, elevation 4639 feet. Mason Butte is located between the farming communities of Craigmont and Winchester. Big Canyon Creek flows in a northerly direction for 31 miles to its confluence with the Clearwater River about two miles north of the community of Peck, elevation 950 feet.

Designated beneficial uses are adversely affected by pollutants from nonpoint sources. Primary pollutants are suspended sediment, ammonia, nitrite and nitrate, total Kjeldahl nitrogen, total phosphorus, fecal coliform and fecal streptococcus bacteria. The majority of sediment and nutrient transport occurs during the spring snowmelt period. Cattle are the likely source of bacterial contamination in the upper watershed. Agricultural practices affecting stations S-5, S-6, S-7, S-8, and S-9 have increased nitrogen and phosphorus concentrations. The headwaters are the primary contributors of water pollutants to the watershed. Little Canyon Creek has been impacted more from nonpoint sediment sources than Big Canyon Creek. Higher sediment and nutrient discharges may have been measured in the watershed during a normal precipitation year.

An Agricultural Nonpoint Source Pollution Abatement Program targeted to implement Best Management Practices should mitigate some of the impacts of agriculture on water quality on Big Canyon Creek. An implementation plan submitted by the Nez Perce SWCD should emphasize the following actions: 1) use appropriate conservation practices to reduce soil erosion from critical acreages; 2) implement methods to reduce excessive phosphorus and nitrogen loads to Big Canyon Creek from dryland agriculture and livestock sources; 3) mitigate bacterial sources affecting the water quality of Big Canyon Creek; 4) stabilize eroded streambanks within the watershed; and 5) enhance and increase the vegetative diversity of riparian areas.

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INTRODUCTION

The Nez Perce Soil and Water Conservation District (SWCD) applied for an Idaho Agriculture Nonpoint Source Pollution Abatement planning grant with the Idaho Division of Environmental Quality (DEQ) in November of 1988. Big Canyon Creek had been identified by the DEQ and SWCD as a first priority stream segment in the Nonpoint Source Pollution Abatement program. The planning grant process was designed to determine the suitability of the Big Canyon Creek watershed for implementation of agricultural best management practices. Part of the planning process included a water quality monitoring study of Big Canyon Creek during the period of February 8, 1987 to February 23, 1988.

Current designated benefical uses as presented in the Idaho Water Quality Standards and Wastewater Treatment Requirements for Big Canyon Creek are domestic and agricultural water supply, primary and secondary contact recreation, cold water biota, as well as salmonid spawning.

Purpose

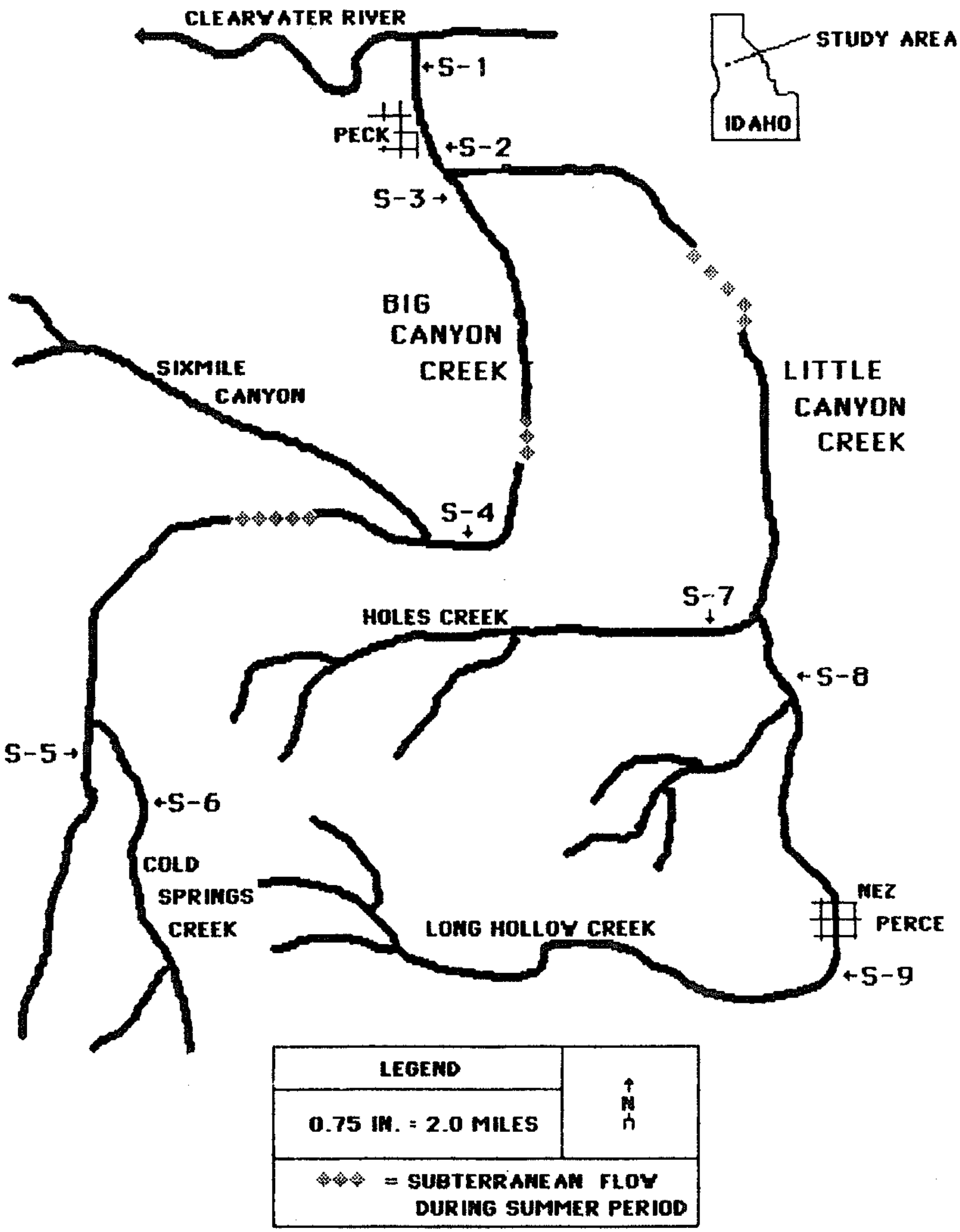
Big Canyon Creek, a tributary of the Clearwater River, has been identified as a First Priority Stream Segment (No. CB-151) through the Idaho Agriculture Pollution Abatement process. As such, it is considered to have significant water quality impacts which may be attributable to agricultural practices.

The Nez Perce Soil and Water Conservation District submitted a preapplication for planning in the Big Canyon Creek watershed. The Lewiston Field Office of the Division of Environmental Quality conducted a water quality study in anticipation of future planning and implementation of conservation practices in the watershed.

Background

Big Canyon Creek (Figure 1) is located in North Central Idaho, and is a fourth order tributary to the Clearwater River. The headwaters are located in Lewis County which originate from Mason Butte, elevation 4639 feet. Mason Butte is located between the farming communities of Craigmont and Winchester. Big Canyon Creek flows in a northerly direction for 31 miles to its confluence with the Clearwater River about two miles north of the community of Peck, elevation 950 feet. The Clearwater River then flows freely for 30 miles before entering the backwaters formed by Lower Granite Dam.

FIGURE 1. MAP OF MONITORING STATIONS FOR BIG CANYON CREEK STUDY DURING 1987 AND 1988



The Big Canyon Creek watershed extends over 90,000 acres, with 57% in non-irrigated cropland, 21% in woodland and range, and the remainder in grazeable woodland. Private ownership accounts for 85% of the watershed, while Bureau of Indian Affairs, Bureau of Land Management, and the State of Idaho control 9%, 4%, and 2% respectively.

Little Canyon Creek is the major tributary to Big Canyon Creek originating between Craigmont and Nezperce, eventually joining Big Canyon Creek approximately 2 miles upstream of its confluence with the Clearwater River. It accounts for 47,200 acres of additional drainage area. Thus, the entire Big Canyon Creek watershed occupies over 137,000 acres spread over three counties. Land use and ownership in the Little Canyon Creek watershed are similar to those in the Big Canyon Creek portion. Non-irrigated cropland accounts for 85% of land use, followed by 9% range, 5% forest, and 1% urban. Private ownership holds 93% of the watershed, followed by Bureau of Indian Affairs, Bureau of Land Management, and State of Idaho controlling 4%, 2%, and 1%, respectively.

Fifty farming operations have divided the private lands into the following uses: 9040 acres (48%) of cropland, 1580 acres (8%) of hay and pasture, 7580 acres (41%) of woodland, and 470 acres (3%) for other uses. The state and federal lands are all woodland. The watershed soils can be divided into three groups: nearly level silt loam soils on valley floors, moderately steep silt loams on uplands, and very steep loams on canyons and mountains. Soils are typically deep and silty on the top of the Camas Prairie, and become shallow to deep and rocky on the steep canyon slopes. Slopes range from 0-20%. Precipitation ranges from 20 inches at the lower elevations to 28 inches in the headwaters.

An estimated 2.2 million cubic yards of sediment enter Lower Granite Reservoir annually, according to the U.S. Army Corps of Engineers (1984). At least 20% of the sediment is estimated to originate from the Clearwater River. Top priorities for the U.S. Army Corps of Engineers (1985) are maintaining navigational channels and flood control both of which are being adversely affected by deposition of sediment into Lower Granite Reservoir.

Two water quality studies were conducted on Big Canyon Creek by the Division of Environment during the 1979 water year. The purpose of the studies were to obtain background information for development of effluent limitations for the cities of Peck and Nezperce. Sampling noted high nutrient levels and low seasonal dissolved oxygen concentrations (IDHW/DOE,1980).

The stream supports a naturally reproducing population of steelhead trout. Juvenile fish densities of 1.8 fish/meter squared rank the Big Canyon Creek drainage as one of the most productive anadromous fisheries in a lower Clearwater River tributary (Nez Perce Tribe,1984). Fish habitat condition has been evaluated for stream substrate and macroinvertebrate quality by the USDI Bureau of Land Management (USDI,1988). Substrate fines were measured using the coring method, (Platts, 1983). Fines <9.5 millimeter were found to comprise 16.7 percent of the spawning substrate of Little Canyon Creek at stream mile 11.1. USDA (1985) investigations of Big Canyon Creek stream substrate at stream mile 8.8 using the same coring method found fines <9.5 millimeter to make up 6.4 percent of the spawning substrate. USDI, 1988 found cobble embeddedness levels using Burns, 1983 method in Big and Little Canyon Creek to have 18.6 and 31.0 percent embeddedness respectively. USDI cobble embeddedness sampling sites were located at the same stream mile as the substrate fines sampling.

An aquatic macroinvertebrate community evaluation by USDI, 1986 of Big Canyon Creek at stream mile 2.7 found macroinvertebrate indicators of relatively good water quality and high fisheries potential. Taxa analysis indicates a good diversity index of 16.0, an excellent standing crop of 12.1 grams invertebrates/meter squared, g/m^2, and a fair biotic index of 77. Macroinvertebrate samples from Little Canyon Creek at stream mile 0.2 indicated somewhat similar aquatic conditions as Big Canyon Creek. However, macroinvertebrate community structure of Little Canyon Creek suggested some impact from sedimentation. Taxa analysis found a good diversity index of 13.8, an excellent standing crop of 8.2 g/m^2, and a fair biotic condition index.

Stream Classification

Lower Big Canyon Creek is classified as a B2 stream type using Rosgen's (1986) morphological stream classification. The B2 stream type applies to the lower 10.5 miles of the stream from station S-5 downstream to the mouth.

The B2 stream type is characterized by a gradient of about 2.0 percent, sinuosity of 1.4, width to depth ratio of 14 , substrate of large cobble mixed with small boulders and course gravel, and a moderately entrenched channel with moderate valley confinement. Valleys have stable, steep side slopes. Flood plain terraces are of course textured alluvium. Additional stream sub-type modifiers include the following: 1) organic debris is moderate in frequency and affects < 10% of the active channel (D-3); 2) riparian vegetation is grass, brush, and deciduous trees (V-5, 6, 9 respectively); 3) stream size at bankfull width is 90 feet (S-7); 4) the flow regimen is perennial dominated by snowmelt runoff except for some reaches of subterranean flow (P-1); and 5) depositional features include point bar formation, B-2, with regular meander (M-1).

The lower 8.0 miles of Little Canyon Creek could be classified as a B2 stream type. Sub-types are also similar except for stream size which is 60 feet wide at bankfull stage (S-6).

From the headwaters of Big and Little Canyon Creek watersheds downstream 14.5 and 16.5 miles, respectively, the stream is classified as a C3 channel type. Much of the stream has been altered by dryland agriculture. Therefore, classification may not accurately reflect pre-agricultural channel types. Sub-type criteria for the headwaters of both streams are the following: 1) streams with infrequent organic debris (D-2); 2) riparian vegetation ranges from bare soil and grass to low and high brush (V-2, 5, 6, 7 respectively); 3) stream bankfull width varies from less than one foot to 30 feet (S-1, 2, 3, 4 respectively); 4) flow regimen can be ephemeral, intermittent, or perennial depending on stream order which is fed by snowmelt runoff (E, I, P-1 respectively); and 5) the streams have regular meander (M-1).

Study Objectives

The objectives of the study were to: 1) determine water quality in various reaches and subwatersheds; 2) document the effects of snowmelt and storm event runoff on the water quality of Big Canyon Creek.

METHODS

Sample Stations

Nine sample sites were chosen to divide the watershed according to predominant land use (Figure 1). STORET (Storage and Retrieval computer data system) descriptions are listed in Table 1.

Station 1, S-1, Big Canyon Creek located at U.S. Highway 12 bridge reflects water quality exported out of the watershed and into the Clearwater River and Lower Granite Reservoir. The station lies approximately 250 yards above the confluence. Map coordinates are T36N, R1W, Sec. 3, NE 1/4, NE 1/4.

Station 2, S-2, Big Canyon Creek below Little Canyon Creek is located on Dryden Grade (State Road 329). It, in conjunction with S-, reflects the water quality of the Little Canyon Creek watershed (there is no monitoring access for Little Canyon Creek during high water). The station is directly upstream of the City of Peck, and its coordinates are T36N, R1W, Sec. 14, NE 1/4, NW 1/4.

Station 3, S-3, Big Canyon Creek above Little Canyon Creek was sampled at the Central Ridge Road (Highway 392) bridge directly upstream of the confluence of Big and Little Canyon Creeks. Comparison with S-2 which is less than 1/4 mile downstream should be reflective of Little Canyon Creek's contribution to water quality. It is located by the following coordinates: T36N, R1W, Sec. 14, NE 1/4, SW 1/4.

Station 4, S-4, This station, Big Canyon Creek below Six Mile Canyon Creek, was not sampled due to its remote location and resulting time limitations.

Station 5, S-5, Big Canyon Creek near Craig Junction reflects the several square miles of farming activity directly above the station. It is approximately 11 miles upstream of S-4 and 25 miles from the mouth of Big Canyon Creek. Map coordinates are T34N, R2W, Sec. 23, NE 1/4, NW 1/4.

Station 6, S-6, Coldsprings Creek is the second major tributary in the headwaters of Big Canyon Creek. The effect of 11 square mile watershed will be monitored from a bridge. T34N, R2W, Sec. 25, SW 1/4, NE 1/4.

Station 7, S-7, Holes Creek near mouth is at a bridge crossing on a county road by Idaho Highway 64 and represents one of the two primary tributaries to Little Canyon Creek. Holes Creek drains 22 square miles of intensively farmed land. The station is located approximately 18 miles from the mouth of Little Canyon and its coordinates are T34N, R1E, Sec. 23, NW 1/4, SW 1/4.

Station 8, S-8, Long Hollow Creek near mouth is at a bridge crossing on Russell Ridge Road (Highway 7 near the junction with Highway 64), 4 miles NW of Nezperce. The station is located approximately 1 mile from the confluence with Holes Creek; those two creeks then form Little Canyon Creek. Long Hollow Creek drains an area of over 17,000 acres with 90% of the area cultivated. Map coordinates are T34N, R2E, Sec. 19, NW 1/4, NW 1/4.

Station 9, S-9, Long Hollow Creek above Nezperce assesses effects from the upper end of the Long Hollow watershed. A United States Geological Survey gauging station is located about 1/2 mile downstream. Map coordinates are T33N, R2E, Sec. 6, SE 1/4, NE 1/4.

Sampling Frequency

The study was designed to monitor water quality during spring and storm runoff events when the maximum loadings of nutrients and suspended sediment usually occur. Typically peak events occur in the spring from rain on snow events.

A flexible sampling schedule was established to measure major events. During snowmelt, samples were collected approximately every two weeks to characterize the hydrograph. Two additional samples were taken in the summer to characterize ambient conditions at low flows. Seven to ten sample sets were collected from each station.

TABLE 1: List of Big Canyon Creek monitoring stations, Clearwater, Lewis, Nez Perce Counties, Idaho

Station	Description	Latitude/Longitude	River Mile	Elevation	Storet Numbers
S-1	Big Canyon Cr. at mouth	46°29'45"/ 116°26'500"	324.3/139.3/35.3 0.1	960'	2020138
S-2	Big Canyon Cr. below Little Canyon Cr.	46°28'15"/ 116°25'10"	324.3/139.3/35.3 2.1	1080'	2020308
S-3	Big Canyon Cr. above Little Canyon Cr.	46°28'03"/ 116°25'36"	324.3/139.3/35.3 2.6	1120'	2020140
S-4	Big Canyon Cr. below Six-Mile Canyon	46°21'49"/ 116°21'36"	324.3/139.3/35.3 11.6	1800'	2020310
S-5	Big Canyon Cr. near Craig Junction	46°15'51"/ 116°32'35"	324.3/139.3/35.3 28.4	3720'	2020311
S-6	Cold Springs Cr. at mouth Big Canyon Cr. Tributary	46°16'41"/ 116°17'35"	324.3/139.3/35.3 2.5/18.4/1.5	3100'	2020312
S-7	Holes Creek near Fletcher Little Canyon Cr. Tributary	46°16'55"/ 116°22'50"	324.3/139.3/35.3 18.4/6.5	3380'	2020313
S-8	Long Hollow near mouth Little Canyon Cr. Tributary	46°16'48"/ 116°15'45"	324.3/139.3/35.3 18.4/1.4	3100'	2020142
S-9	Long Hollow Midway Little Canyon Cr. Tributary	46°13'25"/ 116°19'56"	324.3/139.3/35.3 18.4/12.4	3400'	2020315

Parameters

Agricultural practices contribute to the sediment and nutrient loading of Big Canyon Creek and subsequently to the Clearwater River. Sample parameters (Table 2) are indicators of water quality which may threaten the designated beneficial uses of the stream segment. Some of the sample parameters are nutrients typically leached from farm fields.

Total contribution of solute loads for a single day was determined by assuming that a grab sample was representative of a 24 hour period. Different subwatersheds or stations were compared to each other by using data collected only on the same day. Thus, contributions from subwatershed could be determined.

Discharge

The mid-point method to determine stream discharge was used in the study as described by the U. S. Geological Survey (U.S.G.S., 1977). The total instantaneous stream discharge is calculated from the cross-sectional area of the stream and the stream velocity.

Direct measurement of velocity and depth was made with a Marsh McBirney, Model 201, current meter and wading rod. During high flow a sounding reel, bridge board, and Model 201 meter were used to measure velocity and depth from bridges.

pH

The pH of water is a measure of its hydrogen ion concentration. Many chemical reactions are affected by the pH. On-site pH measurements were obtained with a Corning, Model #103, pH meter.

Conductivity and Temperature

Conductivity is a numerical expression of the ability of a water sample to carry an electrical current. It is dependent on the total concentrations of the total dissolved solids and salts in the water (APHA, 1985). Conductivity and temperature measurements were taken with a YSI, Model 33, SCT meter. Conductivity was corrected to 25 degrees centigrade.

Table 2. Sample parameters for Big Canyon Creek water quality study.

Parameter	Units	STORET*
Stream Discharge	cfs	00061
Water Temperature	°C	00010
pH	S.U.	00400
Conductivity	µmho/cm	00665
Suspended Sediment	mg/l	80154
Total phosphorus (TP)	mg/l	00665
Dissolved orthophosphate (DOP)	mg/l	00671
Total Kjeldahl nitrogen (TKN)	mg/l	00625
Nitrate + Nitrite (NO2+NO3)	mg/l	00630
Fecal coliform	#/100 ml	31616
Fecal streptococcus	#/100 ml	31679

Suspended Sediment

Suspended sediment concentrations are one of the primary indicators of nonpoint source pollution. Suspended sediment consists of soil particles that are entrained in the water column from three inches above the stream bottom to the top of the water column (USGS, 1985).

Nitrogen

Total organic nitrogen concentrations were determined by the Total Kjeldahl Nitrogen (TKN) process, which does not distinguish between organic and ammonia nitrogen compounds. The organic fraction may be estimated by subtracting the ammonia concentration from the TKN concentration. The inorganic nitrogen fraction includes the ammonia and nitrite + nitrate concentrations. All samples analyzed for the nitrogen fractions were preserved with 2 ml. of sulfuric acid and shipped on ice to the Idaho State Bureau of Laboratories for analysis.

Phosphorus

The major forms of phosphorus monitored during the study were total phosphorus (TP) and dissolved orthophosphate (DOP). Total phosphorus includes all the forms of phosphorus present in the sample. Orthophosphate is the dissolved fraction, and is the form most readily available for biological processes. Total phosphorus samples were preserved with 2 ml. of concentrated sulfuric acid. The samples analyzed for dissolved orthosphosphate were filtered on site through a 0.45 um prewashed membrane filter and sent on ice to the State laboratory in Boise for analysis.

Bacteria

Samples for bacterial analysis were collected in sterile, 250 mg. bottles. The samples were refrigerated until analysis by the North Central District Health Department Laboratory in Lewiston.

Quality Assurance

Duplicate samples were collected from station S-2 on eight different dates to estimate precision. The method used to estimate the average relative range for precision followed Bauer (1986).

RESULTS AND DISCUSSION

Discharge

The Big Canyon Creek drainage is subject to annual discharge extremes. USGS, 1973 recorded a maximum discharge of 8360 cubic feet per second (cfs) on January 29, 1965. Recent investigations (BLM, 1989) of dewatered mainstem reaches in the Big Canyon Creek drainage indicate that channel erosion from the 1965 event may have disturbed the streambed "seal." Now stream flow escapes through the channel bottom in several reaches (Figure 1) and flows subterranean during the summer low flow period. Loss of stream flow has been observed in channelized and overgrazed reaches of other streams of basalt parent materials (Mann, 1989; Bohn 1987). These findings emphasize the need for riparian management that maintains channel stability to help prevent channel scour and the resulting loss of stream flow. Minimum recorded stream flow is 4.1 cfs (IDF&G, 1980) measured during an instream flow study which recommended minimum stream flows of 25 cfs for April, May, June, and 2 cfs during the remainder of the year for steelhead spawning and rearing.

During the two year study period we measured stream flows at the mouth of Big Canyon Creek, S-1, ranging from 5.2 to 225.0 cfs. Our measured maximum flow of 225.0 cfs on March 7, 1987 is only 12% of the two year discharge reoccurrence interval and 7% of the ten year interval of 1827 and 3034 cfs, respectively (USGS 1980).

Several factors contributed to the small amount of stream flow originating from the watershed. Primarily, precipitation was 78 and 67 percent of normal for both winter periods (October through April) in 1986-87 and 1987-88 respectively (Table 3). The spring snowmelt occurred in February and March of both 1986 and 1987 from rain on snow events. The snowmelt period lasted about a month to six weeks. These relatively slow melt conditions did not produce an extreme peak in the hydrograph. Also, a large portion of the precipitation that fell infiltrated into the ground due to low soil moisture conditions.

Suspended Sediment

Suspended sediment (SS) discharge of Big Canyon Creek at the mouth, S-1, ranged from 0.056 to 6.97 tons per day for corresponding stream flows of 5.2 and 225.0 cfs.

TABLE 3: MONTHLY PRECIPITATION (INCHES) AND PRECIPITATION FOR OCTOBER THROUGH APRIL FOR BIG CANYON CREEK (DATA RECORDED AT NEZ PERCE, IDAHO)

MONTHLY PRECIPITATION

PERIOD	MONTH												ANNUAL PRECIP.	% OF NORMAL
	J	F	M	A	M	J	J	A	S	O	N	D		
1911-87	1.97	1.41	1.76	1.73	2.82	2.34	0.92	1.29	1.40	1.88	1.93	1.88	21.83	-
1986	2.10	2.83	1.74	1.98	1.91	0.84	1.77	1.07	3.02	1.88	2.83	0.59	22.56	103
1987	0.72	0.81	2.01	0.96	1.97	2.56	1.92	0.59	0.30	0.00	0.65	1.07	13.56	62
1988	1.36	0.86	2.17	2.29	3.53	1.75	0.68	0.23	1.52	0.37	2.32	0.57	17.65	81

PERCENT OF NORMAL PRECIPITATION FOR OCTOBER THROUGH APRIL

PERIOD		ANNUAL PRECIP.	% OF NORMAL
1921-87		12.56	-
1986-87	(DATA FROM ABOVE TABLE)	9.80	78
1987-88		8.40	67

Highest instream SS concentrations were measured in the headwater tributaries which are influenced primarly by dryland agriculture. For example SS discharge at S-7, Holes Creek a Little Canyon Creek tributary, was 56.2 tons/day for a corresponding streamflow of 22.0 cfs on 2-9-88. Another Little Canyon Creek tributary, Long Hollow Creek at S-8, discharged 49.9 tons/day SS at 7.9 cfs on 2-9-88. However, downstream SS loading measured at S-2 on the same day was 24.8 tons/day at a flow of 64.7 cfs. Other sampling showed a similar trend of higher headwater concentrations with lower concentrations measured near the mouth of the Big Canyon Creek. This trend is not typical since usually concentration of constituents increase as water flows downstream (USGS 1985). Several possibilities may explain the observation. For example, sediment concentrations may have been diluted by tributary and/or groundwater inflow. Perhaps sediment pulses were missed during sampling, or most likely insufficent stream flow may not have allowed sediment to route completely through the system. However, water quality data and observation both indicate that upper Big and Little Canyon Creeks are discharging sediment produced by agricultural activities.

Nitrogen

Cultural addition of nitrogen may enrich aquatic communities by increasing primary production. In most cases undesirable conditions result. Organic enrichment of surface waters and the threat to public health from nitrogen increases are well known (Wetzel, 1983; USGS, 1985). Our data indicate that agricultural practices in the Big Canyon Creek watershed have increased surface water concentrations of nitrogen.

Table 4 displays the range and mean of nitrogen species for the study period. Long Hollow Creek, S-8, had the highest mean concentration of ammonia, 0.379 mg/l. The highest mean concentration, 5.912 mg/l, of nitrite, nitrate was measured at the mouth of Big Canyon Creek, S-1. Mean total Kjeldahl nitrogen was highest at S-5, Big Canyon Creek near Craig Junction.

Bacteria

Fecal coliform (FC) and fecal streptococcus (FS) bacteria are used as indicators of bacterial water pollution because of their presence in the intestinal tract of warm blooded animals. Although these bacteria are not

TABLE 4: RANGE AND MEAN OF NITROGEN SPECIES (MG/L) FOR BIG CANYON CREEK STATIONS DURING 1987 AND 1988
(n varies see APPENDIX A)

STATION		NH3	NO2+NO3	TKN
S-1 Big Canyon Cr. at mouth	RANGE	0.019-0.530	0.150-16.800	0.18-0.60
	MEAN	0.114	5.912	0.42
S-2 Big Canyon Cr. below Little Canyon Cr.	RANGE	0.017-0.125	0.249-16.200	0.28-102
	MEAN	0.046	5.629	0.48
S-3 Big Canyon Cr. above Little Canyon Cr.	RANGE	0.015-0.045	0.361-15.200	0.03-0.56
	MEAN	0.029	4.648	0.35
S-5 Big Canyon Cr. near Craig Junction	RANGE	0.030-0.180	0.377-6.520	0.78-26.80
	MEAN	0.073	2.583	4.59
S-6 Colds Springs Cr. at mouth (BC Cr. Trib.)	RANGE	0.023-0.223	0.38-12.00	0.64-8.31
	MEAN	0.100	2.660	2.48
S-7 Holes Creek (LC Cr. Trib.)	RANGE	0.019-0.288	0.448-10.500	0.30-1.76
	MEAN	0..75	3.426	0.98

TABLE 4: CONTINUED

STATION		NH3	NO2+NO3	TKN
S-8 Long Hollow Cr. (LC Cr. Trib.)	RANGE	0.052-0.754	0.117-20.400	0.29-4.17
	MEAN	0.379	5.262	1.75
S-9 Long Hollow Cr. (LC Cr. Trib.)	RANGE	0.029-0.122	0.055-19.000	0.69-2.16
	MEAN	0.052	4.238	1.22

ordinarily considered disease causing organisms, other pathogens associated with them in the intestine may cause illness. The ratio of fecal coliform to fecal streptococcus greater than 0.7 is generally accepted as an indicator of fecal contamination from livestock.

Table 5 displays bacteriological data for the Big Canyon Creek watershed during the study period. At stations S-6 through S-9, located in the upper watershed, maximum fecal streptococcus counts and FC:FS ratios indicate livestock sources of bacterial pollution. All sample points exceeded State water quality standards for primary and secondary contact recreation except S-3 and S-6.

Phosphorus

Phosphorus is usually the limiting factor of primary production in aquatic systems. Phosphorus enrichment of streams and lakes from cultural activities can produce changes in plankton populations and macrophyte communities. For example, undesirable increases in numbers and change in community structure may increase the eutrophication rate of natural waters. Recommended total phosphorus concentration for streams is 0.1 mg/l and for streams that feed lakes the recommended standard is 0.05 mg/l (US EPA, 1973). Mean total phosphorus (TP) concentration exceeded the recommended standard of 0.1 mg/l at all Big Canyon Creek stations. Mean TP concentrations ranged from 0.18 to 1.69 mg/l with S-5 having the highest mean concentration of any station. Although TP concentrations were higher at the agricultural influenced water quality monitoring stations (S-5, S-6, S-7, S-8, S-9), mean concentration measured at the mouth (S-1) was much lower than the upper stations, 0.21 mg/l (Table 6).

Dissolved orthophosphate (DOP) is the form of phosphorus which is most available for biological processes (Wetzel 1983). Mean DOP concentrations ranged from 0.115 to 0.463 mg/l with S-8 having the highest mean DOP concentration. DOP concentrations generally decreased downstream with the highest mean concentration, 0.463 mg/l, recorded in the headwaters at S-8.

pH, Conductivity,and Temperature

We measured one pH value, 9.5 S.U., on 6-16-87 at the mouth of Big Canyon Creek, S-1, that exceeded the EPA (1986) criteria range of 6.5-9.0 for freshwater aquatic life. Mean pH at this station, S-1, was 7.8.

TABLE 5: BACTERIOLOGICAL DATA (COLONIES/100ML) FOR BIG CANYON CREEK STUDY DURING 1987 AND 1988

STATION	n	FECAL COLIFORM MINIMUM	FECAL COLIFORM MAXIMUM	GEOMETRIC MEAN	FECAL STREPTOCOCCUS MINIMUM	FECAL STREPTOCOCCUS MAXIMUM	GEOMETRIC MEAN	RATIO FC:FS
S-1	6	1	1410	21	2	960	37	0.58
S-2	7	4	890	39	4	600	50	0.78
S-3	7	1	390	7	2	980	29	0.24
S-5	5	14	1100	106	39	1200	181	0.59
S-6	6	12	600	90	10	6000	154	0.58
S-7	6	30	1000	148	10	6000	276	0.54
S-8	6	12	1310	89	12	6500	289	0.31
S-9	5	<1	1200	10	6	5800	130	0.08

TABLE 6 : RANGE AND MEAN OF TOTAL PHOSPHOROUS AND DISSOLVED ORTHOPHOSPHATE CONCENTRATIONS (MG/L)
FOR BIG CANYON CREEK DURING 1987 AND 1988
(n varies see APPENDIX A)

STATION		TOTAL PHOSPHOROUS	DISSOLVED ORTHOPHOSPHATE
S-1 Big Canyon Cr. at mouth	RANGE	0.12-0.42	0.093-0.219
	MEAN	0.21	0.126
S-2 Big Canyon Cr. below Little Canyon Cr.	RANGE	0.12-0.89	0.070-0.240
	MEAN	0.24	0.129
S-3 Big Canyon Cr. above Little Canyon Cr.	RANGE	0.14-0.31	0.090-0.216
	MEAN	0.18	0.115
S-5 Big Canyon Cr. near Craig Junction	RANGE	0.19-9.78	0.063-0.375
	MEAN	1.69	0.165
S-6 Cold Springs Cr. at mouth (BC Cr. Trib.)	RANGE	0.18-3.39	0.069-0.299
	MEAN	0.94	0.166
S-7 Holes Creek (LC Cr. Trib.)	RANGE	0.10-2.40	0.081-0.407
	MEAN	0.58	0.187

TABLE 6: CONTINUED

STATION		TOTAL PHOSPHOROUS	DISSOLVED ORTHOPHOSPHATE
S-8 Long Hollow Cr. (LC Cr. Trib.)	RANGE	0.25-4.15	0.122-0.664
	MEAN	0.96	0.463
S-9 Long Hollow Cr. (LC Cr. Trib.)	RANGE	0.06-0.91	0.121-0.289
	MEAN	0.39	0.251

Mean conductivity of Big Canyon Creek, S-1, was 168 µhmos/cm. Highest measured water temperature, 22.0° C, was recorded at the mouth of Big Canyon Creek, S-1, on 6/16/87.

Quality Assurance

Duplicate samples were collected eight times from S-2 for the chemical parameters. Suspended sediment and nitrite plus nitrate average relative range of precision was estimated to be 17.9 and 2.8 percent respectively (Appendix-B).

CONCLUSIONS

1) Designated beneficial uses for Big Canyon Creek, as defined by Idaho water quality standards, are adversely affected by pollutants from nonpoint sources in the watershed. Primary pollutants are suspended sediment, ammonia, nitrite and nitrate, total Kjeldahl nitrogen, total phosphorus, fecal coliform, and fecal streptococcus bacteria.

2) The majority of sediment and nutrient transport occurs during the spring snowmelt period.

3) Livestock are the likely source of bacterial contamination.

4) Agricultural practices affecting stations S-5, S-6, S-7, S-8, and S-9 have increased nitrogen and phosphorus concentrations.

5) The headwaters are the primary contributors of water pollutants to the watershed.

6) Little Canyon Creek is more impacted from nonpoint sediment sources than Big Canyon Creek as sediment discharge and substrate quality data indicate.

7) Water quality sampling conducted during a normal precipitation year may have resulted in higher sediment routing and nutrient discharge.

RECOMMENDATIONS

1) An agricultural nonpoint source pollution abatement program targeted to implement Best Management Practices should mitigate some of the impacts of agriculture on water quality on Big Canyon Creek.

2) An implementation plan submitted by the NezPerce SWCD should emphasize the following:

   1) Reduction of soil erosion from critical acreages.

   2) Reduction of the excessive phosphorus and nitrogen loads from dryland agriculture and livestock.

   3) Mitigation of bacterial sources close to the streams of Big Canyon Creek.

   4) Stabilization of eroded banks.

   5) Enhancement of upland riparian areas.

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APPENDIX A-DATA

STATION	DATE	TEMP. °C	FLOW CFS	COND. µhmos @25°C	pH S.U.	NH3 mg/l	NO2+ NO3 mg/l	TKN mg/l	TOTAL P mg/l	D.ORTHO P mg/l	S.S. mg/l	S.S. ton/day
S-1												
	2/3/87	4.0	98.3	166	7.4	-	3.565	0.54	0.27	0.157	9	2.389
	2/10/87	4.0	110.0	181	7.2	-	7.370	0.26	0.25	-	8	2.376
	3/5/87	2.0	205.0	132	7.2	0.033	9.010	0.56	0.17	0.098	10	5.535
	3/7/87	8.0	225.0	138	7.6	0.098	16.800	0.60	0.18	0.093	6	3.645
	6/16/87	22.0	14.8	180	9.5	0.530	0.423	0.34	0.17	0.110	3	0.120
	8/24/87	18.0	5.2	198	8.7	0.039	0.150	0.43	0.15	0.219	4	0.056
	2/9/88	4.0	56.1	250	6.9	0.039	1.300	0.18	0.41	0.102	46	6.968
	2/17/88	4.0	73.2	130	7.7	0.019	8.860	0.41	0.12	0.108	2	0.395
	2/23/88	6.0	48.4	135	8.1	0.043	5.730	0.48	0.19	0.121	2	0.261

** denotes average of duplicate samples
- denotes parameter not measured
D. means dissolved
S.S. means suspended sediment

BC

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-2		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/3/87	4.0	95.9	177	7.5	-	3.630	0.42	0.26	0.187	8	2.071
**	2/10/87	4.0	107.5	180	7.4	-	7.320	0.34	0.15	-	5	1.451
**	3/5/87	3.0	198	128	7.3	0.023	9.540	0.52	0.15	0.070	6	3.208
**	3/7/87	7.0	224	132	7.6	0.022	16.200	0.56	0.17	0.081	5	3.024
**	6/16/87	19.0	13.7	180	9.1	0.125	0.573	0.28	0.16	0.135	4	0.148
**	8/24/87	16.5	5.5	196	7.9	0.029	0.249	0.29	0.16	0.240	4	0.059
**	2/9/88	3.0	64.7	210	6.9	0.051	1.270	1.02	0.89	0.133	142	24.806
**	2/17/88	4.0	63.9	130	7.7	0.017	7.355	0.50	0.12	0.098	2	0.345
**	2/23/88	5.5	48.5	130	8.1	0.050	5.800	0.38	0.16	0.123	2	0.262
**	3/27/88	7.0	95.7	125	8.4	0.063	4.350	0.49	0.19	0.101	7	1.809

BC

STATION S-3	DATE	TEMP. °C	FLOW CFS	COND. µhmos @25°C	pH S.U.	NH3 mg/l	NO2+ NO3 mg/l	TKN mg/l	TOTAL P mg/l	D.ORTHO P mg/l	S.S. mg/l	S.S. ton/day
**	2/3/87	4.0	43.8	158	7.7	-	3.985	0.45	0.22	0.090	8	0.946
	2/10/87	4.0	53.4	134	7.8	-	4.600	0.03	0.15	-	4	0.577
	3/5/87	6.0	128	120	7.4	0.023	8.130	0.51	0.15	0.092	10	3.456
	3/7/87	7.0	154	114	7.7	0.024	15.200	0.56	0.16	0.090	6	2.495
	6/16/87	19.5	8.6	156	9.1	0.044	1.220	0.26	0.15	0.104	2	0.046
	8/24/87	15.5	3.0	171	7.8	0.026	0.361	0.27	0.15	0.216	6	0.049
	2/9/88	0.5	10.0	200	6.9	0.039	1.280	0.09	0.31	0.098	2	0.054
	2/17/88	4.0	35.7	110	7.8	0.015	1.360	0.39	0.20	0.104	4	0.386
	2/23/88	6.0	33.5	120	8.2	0.015	6.590	0.41	0.14	0.128	4	0.362
	3/27/88	6.5	79.8	115	8.4	0.045	4.350	0.51	0.20	0.112	12	2.586

BC

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-5		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/2/87	1.0	3.6	414	7	-	1.180	1.33	0.53	0.191	46	0.447
	2/10/87	11.0	-	63	-	-	3.000	1.26	0.42	-	142	
	3/6/87	-	-	-	-	0.054	6.520	2.52	0.68	-	420	
	5/1/87	-	-	-	-	0.180	0.377	26.80	9.78	-	7960	
	2/9/88	1.0	6.3	80	7	0.096	2.540	1.89	1.42	0.376	272	4.627
	2/17/88	1.0	0.8	90	6.9	0.042	3.380	0.78	0.19	0.063	18	0.039
	2/23/88	1.0	0.5	110	7.5	0.033	2.510	0.98	0.20	0.090	16	0.022
	3/27/88	2.0	3.5	60	7.8	0.030	1.160	1.18	0.31	0.106	94	0.888

BC

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-6		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/2/87	1.0	4.4	359	7.2	-	2.41	1.79	0.59	0.114	262	3.113
	2/10/87	1.0	0.1	210	-	-	4.23	3.70	1.29	-	648	0.175
	3/6/87	-	-	-	-	0.134	12.00	4.50	1.20	-	984	
	5/1/87	-	-	-	-	0.136	0.76	8.31	3.39	-	2070	
	8/24/87	6.0	0.1	298	8.0	0.223	0.59	0.65	0.13	0.144	16	0.004
	2/9/88	1.0	18.2	230	6.8	0.130	1.70	2.04	1.25	0.299	288	14.152
	2/17/88	1.0	2.5	125	7.2	0.028	1.11	0.64	0.20	0.247	10	0.068
	2/23/88	1.0	1.0	125	7.5	0.023	0.77	0.71	0.18	0.121	16	0.043
	3/27/88	2.5	2.6	120	8.2	0.029	0.38	1.03	0.25	0.069	54	0.379

BC

STATION S-7	DATE	TEMP. °C	FLOW CFS	COND. µhmos @25°C	pH S.U.	NH3 mg/l	NO2+ NO3 mg/l	TKN mg/l	TOTAL P mg/l	D.ORTHO P mg/l	S.S. mg/l	S.S. ton/day
**	2/2/87	1.0	6.7	323	7.2	-	2.740	1.24	0.39	0.158	46	0.832
	2/10/87	11.0	3.5	108	-	-	7.030	0.79	0.27	-	36	0.340
	3/6/87	-	-	-	-	0.029	10.500	1.73	0.39	-	136	
	8/24/87	5.5	0.1	230	7.8	0.028	0.448	0.30	0.12	0.140	16	0.004
	2/9/88	1.0	22.0	280	7.0	0.288	2.680	1.76	2.40	0.407	948	56.249
	2/17/88	1.0	2.3	165	7.4	0.023	2.190	0.56	0.72	0.253	10	0.062
	2/23/88	1.0	1.2	175	8.0	0.019	1.290	0.48	0.10	0.082	10	0.032
	3/27/88	3.0	4.4	190	8.0	0.061	0.528	0.97	0.23	0.081	6	0.071

BC

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-8		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
	2/2/87	1.0	26.9	136	7.2	-	2.520	2.57	1.08	0.442	160	11.621
**	2/10/87	10.0	3.0	127	-	-	11.400	1.18	0.45	-	56	0.454
	3/6/87	-	-	-	-	0.154	20.400	1.60	0.28	-	32	
	8/24/87	3.0	0.1	330	7.1	0.052	0.117	0.29	0.12	0.122	4	0.001
	2/9/88	1.0	7.9	300	6.9	0.754	2.900	4.17	4.15	0.508	2340	49.912
	2/17/88	0.5	2.0	200	7.4	0.650	1.970	1.76	0.25	0.562	8	0.043
	2/23/88	2.0	2.7	220	8.0	0.579	1.650	1.46	0.79	0.664	8	0.058
	2/27/88	6.0	1.4	225	8.5	0.083	1.140	0.96	0.59	0.478	2	0.008

BC

STATION	DATE	TEMP.	FLOW	COND. µhmos	pH	NH3	NO2+ NO3	TKN	TOTAL P	D.ORTHO P	S.S.	S.S.
S-9		°C	CFS	@25°C	S.U.	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	ton/day
**	2/2/87	1.0	19.5	122	7.1	-	2.555	2.16	0.91	0.504	115	6.055
	2/10/87	10.0	8.0	127	-	-	5.330	0.87	0.37	-	50	1.080
	3/6/88	-	-	-	-	0.033	19.000	1.98	0.40	-	142	
	2/9/88	1.0	1.1	210	6.9	0.122	1.120	1.30	0.61	0.289	22	0.065
	2/17/88	1.0	2.3	195	7.6	0.029	1.090	0.76	0.06	0.190	2	0.012
	2/23/88	1.5	2.6	200	8.1	0.035	0.513	0.69	0.21	0.152	4	0.028
	3/27/88	6.0	2.0	230	8.5	0.041	0.055	0.76	0.15	0.121	2	0.011

Appendix B

Summary of Duplicate Samples for Suspended Sediment Collected at Big Canyon Creek, S-2, for Estimate of Precision

Number	x1	x2	Mean	Range	Relative Range %
1	4	6	5	2	40.0
2	4	8	6	2	33.3
3	6	4	5	2	40.0
4	4	4	4	0	0
5	140	142	141	2	1.42
6	2	2	2	0	0
7	2	2	2	0	0
8	8	6	7	2	28.6
					Σ 143.3
n=8					**mean 17.9**

Summary of Duplicate Samples for Nitrite plus Nitrate Collected at Big Canyon Creek, S-2, for Estimate of Precision

Number	x1	x2	Mean	Range	Relative Range %
1	7.13	7.33	7.23	0.20	2.76
2	9.92	9.16	9.54	0.76	7.97
3	16.40	16.00	16.20	0.40	2.47
4	0.250	0.247	0.249	0.003	1.20
5	1.27	1.26	1.27	0.01	0.79
6	7.41	7.30	7.36	0.11	1.49
7	5.82	5.78	5.80	0.04	0.69
8	4.46	4.24	4.35	0.22	5.06
				Σ	22.43
n=8				**mean**	**2.80**