WATER QUALITY STATUS REPORT ● REPORT NO. 63

BEDROCK CREEK
NEZPERCE/CLEARWATER COUNTIES, IDAHO
1985

Agricultural Non-point Source Pollution Abatement Program

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ABSTRACT

A water quality monitoring study was conducted on Bedrock Creek, a third order tributary to the Clearwater River in north-central Idaho. The objectives of the study were to: 1) assess water quality of the stream and its major tributary; 2) document the effects of storm runoff on water quality; 3) determine the suitability of the region for an Idaho Agricultural Nonpoint Source Pollution Abatement Project.

Water quality of Bedrock Creek is impacted by land management techniques used on the watershed. Sediment yield rates of 1.59 tons per acre were estimated for non-irrigated cropland, 0.06 tons per acre for rangeland, 0.30 tons per acre for pasture land and 0.25 tons per acre for forested land in the Clearwater Basin.

A total of 1800 tons of suspended sediment, 78 tons of inorganic nitrogen and 5 tons of total phosphorous were exported from the drainage during the study period. These figures are considered to underestimate, by a substantial amount, the average annual suspended sediment and nutrient loads because of the unusually mild spring and lack of heavy storm events. The most intense storm event that occured delivered 87 percent of the total phosphorus load and 34 percent of the inorganic nitrogen, for the whole study period.

Differences in solute concentrations between stations were noted. Station #1 at Cavendish had greater concentrations of suspended sediment, total phosphorus, and inorganic nitrogen than Station #2 at Louse Creek.

The two areas above the upper stations comprise 42 percent of the crop land. They contributed over half of all the nitrogen, a third of the suspended sediment and about a third of the phosphorus.

The conclusions are: 1) land use, primarily non-irrigated cropland, adversely impacts Bedrock Creek; 2) beneficial uses of the stream are impaired by water quality; 3) the impact of a successful Agricultural Non-point Source Pollution Abatement Program would be beneficial to water quality.

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INTRODUCTION

The Clearwater Soil & Water Conservation District (SWCD) signed a grant agreement with the Idaho Division of Environment (DOE) for a planning project on Bedrock Creek on January 21, 1985. That planning project was to assist in determining the suitability of the Bedrock Creek watershed for implementation of cost-shared Best Management Practices to reduce water pollution.

The Bedrock Creek project area encompasses 41,800 acres. Clearwater SWCD has responsibility for 19,000 acres, and the Nez Perce SWCD oversees the remaining 22,800 acres. Clearwater SWCD took the lead in the planning project because most of the critical acreages were in that district. The 16,300 acres of cultivated land in the headwaters are located on the rolling plateau ridgetops. The steeper land in the canyon is divided into 12,700 acres of pasture and rangeland and 12,800 acres of forest. Crops grown in the region include wheat, barley and peas. Some Best Management Practices such as conservation cropping, grassed waterways, and tile drains are in use. Population centers include the three small communities of Southwick, Cavendish, and Lenore (Figure1).

The two main tributaries of Bedrock Creek originate on the forested southwestern slopes of Teakean Butte at an elevation of 4140 feet. These second order streams flow westward for 9 and 10 miles until their confluence in the steep canyon. The mainstem of Bedrock Creek is the northern-most of the parallel drainages. The 9,500 acres in the upper sub-watershed are 67 percent under cultivation. The rest of the 7,000 acres of the watershed is steeply sloped and utilized for range and timber. Louse Creek flows ten miles westerly to its confluence with Bedrock Creek. The first five miles across the plateau drains 5600 acres, of which approximately 70 percent is dryland cropping, and 30 percent is range and timber. The last five miles (4,000 acres) drop into the canyon, and the surrounding lands are primarily used for range and timber.

The third major region in the project area includes the numerous first and second order streams that drain the plateau and flow due south into the Clearwater River. These spring fed streams drop 1,700 feet in their short 1-3 mile lengths. This area, dubbed the Clearwater corridor, contains approximately 15,700 acres total. Cropland utilizes

3,800 acres; the rest of the 11,900 acres are range, timber, and pasture. Participants in the planning process speculated that a considerable amount of nutrients and sediment were transported down these waterways from the plateau above.

STUDY OBJECTIVES

The objectives of the planning study were to: (1) determine water quality in various reaches and sub-watersheds; (2) determine baseline water quality; and (3) document the effects of storm event runoff on water quality in Bedrock Creek.

METHODS AND MATERIALS

Methods of sample collection, preservation and analysis followed Standard Methods (APHA,1985), or EPA guidelines (EPA, 1979). Water samples were drawn with a DH-48 sampler at 0.6 times the stream depth and collected in a churn splitter from which separate samples were drawn. Grab samples were taken from turbulent stream reaches to provide mixing of laminar flows during minimal discharge.

SAMPLING SITES

Station locations were chosen to divide the watershed and to quantify the contributions of sediment and nutrient loadings. Three monitoring stations were selected on Bedrock Creek and its tributary, Louse Creek, and one station was chosen on one of the 12 intermittent streams that cascade off the Teakean plateau (Table 1). The land uses for the acreages above the stations are provided on Table 2.

FREQUENCY

This study was designed to monitor water quality during a period of maximum influx of nutrients and suspended sediment. It has been shown that the majority of the loading of nutrients and sediment are delivered during a few peak runoff events. These peak events usually occur in the spring when warm southwesterly winds deliver driving rains to frozen unprotected soils causing sheet and rill erosion.

A schedule was established which provided flexibility to respond to storm events as they occurred. Intermediate data points were gathered every two weeks to provide information on water quality during "normal" spring flows. Two additional samples were taken in the late spring to characterize ambient conditions at low flows. Selected dates were chosen for the purpose of comparing different watersheds on the same date. These are noted as "Sets" in the data (Table 3).

PARAMETERS

Agricultural practices were suspected to contribute significantly to the sedimentation and nutrient loading of Bedrock Creek and subsequently to the Clearwater River. Some of the monitored parameters reflect the nutrients normally leached from fields. Others are indicators of water quality which may highlight changes in designated beneficial uses of a particular stream segment. A listing of the physical, chemical and bacterial parameters is provided in Table 4.

Amounts of solutes contributed during the sampling period were deduced by assuming that an individual sample was a "typical" sample for a period equidistant from the previous sample to the following sample date. Multiplying the daily load by the number of days results in total loads for the period (Table 5).

Discharge

The methods used to determine discharge in this study were as outlined by the U. S. Geological Survey (U.S.G.S.,1977). Instantaneous discharge at a given point was calculated from the cross-sectional area of the stream and the stream velocity.

Evidence of peak discharges was gathered by use of crest-gauges anchored in the stream bed. These devices were located at Station #1 at Cavendish and at the mouth of Bedrock Creek. Ground cork is deposited at the high water mark on a measured rod which is encased in a PVC perforated tube (Figure 2). Correlation of stream depths with discharge data provided estimates of peak discharges.

Direct measurements of velocity and area were not always possible. During extreme flows the "orange peel" method was used to determine velocity. This method involves timing a floating object over a known length of the stream. Measurements from the top of the water to bridge railings compared with previous bottom profile data allowed estimation of depths. Observations of peak flow conditions, crest gauge data, slope, and the bottom roughness lead to estimations of discharge.

pH

The pH of water refers to its hydrogen ion activity, or whether it is basic, neutral, or acidic. This is related to the amount of charged particles in solution. Many chemical reactions are affected by the pH. On-site pH measurement was conducted using 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. This number is dependent on the total concentration of the dissolved solids and salts in the water, and the temperature at which the measurement is made (APHA,1985). Conductivity and temperature measurements were determined with a Yellow Springs Instrument Co., Model 33, S-C-T meter.

Suspended Sediment

Suspended sediment consists of all particles that are entrained in the water column from three inches above the stream bottom to the top of the water column (Clark, 1985). Suspended sediment samples were drawn from the midst of the composited grab samples.

Nitrogen

Three major interconvertible fractions of nitrogen were sampled during the length of the study. They were, total Kjeldahl nitrogen, ammonia, and the nitrite + nitrate combination. Samples were preserved with two ml. of concentrated sulfuric acid.

The method of determination for the total organic nitrogen concentrations is called the Total Kjeldahl Nitrogen (TKN) process.

This process does not distinguish between organic nitrogen and ammonia. An estimate of just the organic fraction may be made by subtracting the ammonia content.

Phosphorus

Three major forms of phosphorus were monitored during this study of Bedrock Creek. They were total phosphorus (T.P.), orthophosphate ($O'PO_4$), and hydrolyzable phosphorus (H.P.). The samples were drawn from the composited grab samples and were preserved with two ml of concentrated sulfuric acid.

Bacteria

Samples for bacterial analysis were collected in 250 ml Nalgene® bottles. They were refrigerated until submitted to the Central District Health Lab for analysis.

Trace Metals and Minerals

Trace elements were analyzed to detect the presence of potentially toxic substances. Some farm chemicals contain ions such as mercury, arsenic, and copper. One sample was drawn for analysis of trace metals and minerals. Samples were preserved with 10 ml of 1N nitric acid and submitted to the state laboratory for anaylsis. A list of the trace metals and minerals screened for is provided in Table 4.

Quality Assurance

Duplicate and spiked samples were collected from various stations and on different dates for several water quality monitoring studies. The data were pooled and results were compiled for estimates of precision and accuracy (Bauer, 1985).

RESULTS

Discharge

The "flashy" nature of the watershed made sampling difficult. Transitory peaks of flows and concentrations were evidenced by comparing data for April 11, 1985 at the mouth of Bedrock Creek taken in the morning and later in the evening. Additionally the flow data estimated for April 3, and actual flow taken April 4 after the peak passed also showed th rapid and dramatic changes which occur (Table 3).

The most significant runoff event that occurred during spring of 1985 on Bedrock Creek was on April 3. Flows at Cavendish and Louse Creek peaked at 75 cfs and 150 cfs respectively (Figure 3). An estimate of 470 cfs at the mouth was calculated using the Manning equation (Emmett, 1975). By June 24th, 1985 Louse Creek had stopped flowing.

Suspended Sediment

An estimated 1800 tons of suspended sediment was lost from the Bedrock Creek watershed by extrapolation of the loading data for 1985. Overall, 33 percent of the total suspended sediment load was recorded at the upper watersheds; Cavendish site averaged 21 percent and Louse Creek drainage averaged 12 percent of the total. From the data available it is estimated that 21 tons of suspended sediment were lost from the Sunnyside site. Average concentrations of suspended sediments at Louse Creek were about half the values seen at Cavendish and at the mouth (Table 3). Comparison of data collected from each station on the same date showed that concentrations of suspended sediment for Louse Creek were 50 to 75 percent less.

The four day period surrounding April 3rd contributed 87 percent of the total suspended sediment discharge for the sampling season. No other weighted average contributed more than 11 percent of the total suspended sediment load. The impact of this one event may be seen in all the nutrient and sediment data in Table 5.

Nitrogen

At the mouth of Bedrock Creek it was estimated that a total of 78 tons of inorganic nitrogen were lost from the study area. Most of the inorganic nitrogen was in the form of nitrite + nitrate. The ammonia fraction accounted for 5 tons, or 6 percent of the total. Therefore 73 tons of nitrite + nitrate account for the remainder. Overall, 37 percent of the total inorganic nitrogen which was lost came from Louse Creek, and only 18 percent came from Cavendish. Total Kjeldahl nitrogen samples from this study ranged from 0.27 to 1.94 mg/L, mean = 0.71 mg/L.

Average concentrations of ammonia differed for the various reaches. The concentrations at Cavendish were the greatest at 0.34 mg/L, Louse Creek averaged 0.14 mg/L,and at the mouth of Bedrock Creek it was 0.26 mg/L. Eighty-three percent of the total ammonia was delivered during the April 3 storm. At Cavendish, 94 percent of the 3300 pounds of ammonia was contributed by the one sample period. Louse Creek did not have the same spike for that period, and only 14 percent of the total load was attributed to that date. Indeed, the total load for Louse Creek was only 1,400 pounds for the whole study, or 15 percent of the total ammonia (Table 5).

Phosphorus

Ten thousand four hundred pounds of phosphorus were lost from the drainage. Cavendish yielded 1,300 pounds or 13 percent of the total. Louse Creek contributed 2,100 pounds, or 20 percent. The Sunnyside site lost 140 pounds of phosphorus for the same period of time (Table 5).

Sixty-nine percent (7200 pounds) of the total phosphorus was lost during a four day "window" around the peak storm event, April 3. Orthophosphate made up 12 percent of the total, while the hydrolyzable fraction accounted for 79 percent.

Percent composition for orthophosphate and hydrolyzable phosphorus varied on each individual sample date and at each station (Table 3). The hydrolyzable phosphorus made up the largest portion of phosphorus at 54, 65, and 70 percent respectively for the stations. This means that approximately 61 percent of the orthophosphate load from upper Bedrock Creek, 86 percent at Louse Creek, and 88 percent at the mouth was phosphate which was convertible to a bioavailable form. The mean percentage of the orthophosphate fraction varied from 7 percent at Cavendish and 21 percent at Louse Creek, to 17 percent at the mouth. Mean concentrations of total phosphorus were 0.19 mg/L for the Cavendish site, 0.16 mg/L for Louse Creek and 0.27 mg/L at the mouth. Sunnyside averaged 0.27 mg/L of total phosphorus.

Bacteria

The single day criterion for secondary contact recreation was exceeded on one sample set taken, May 30, 1985. Those violations were enumerated from the samples taken from both the Cavendish site and Louse Creek.

The fecal coliform to fecal streptococcus ratio averaged 1.6 at Cavendish, 1.7 at Louse Creek and 0.9 at the mouth. The ratio at Sunnyside averaged 0.5.

Total Metals

An analysis for total metals was conducted once at the mouth of Bedrock Creek, and once at Sunnyside. All of the analyses from the mouth of Bedrock Creek resulted in concentrations below the detectable limits. At Sunnyside, 10 µg/l of copper, 100 µg/l of manganese and 51 µg/l of zinc were found, all others were below detectable limits.

Quality Assurance

Precision estimates for suspended sediment, total phosphorus, total nitrite and nitrate, total Kjeldahl nitrogen and turbidity were good to excellent . Orthophosphate concentrations may very 17 percent in duplicate samples, while total hydrolyzable phosphorus, and total ammonia concentrations showed a wide variations of 70 and 90 percent respectively in sampling replicability. (Bauer, 1985).

Accuracy estimates for several agricultural surveys found suspended sediment, orthophosphate, total nitrate, and total Kjeldahl nitrogen were good at less than five percent. Total phosphorus concentrations were overestimated by 13 percent, and total ammonia 20 percent. Total hydrolyzable phosphorus was underestimated by 20 percent.

DISCUSSION

Discharge

Peak runoff events normally occur when chinook storms from the southwest rapidly melt the snowpack. The combination of low percent of forest cover, frozen soils that prevent percolation, steep slopes that allow little time for absorbtion, and the sudden onslaught of warm westerly winds with heavy rain, all contribute to the "flashy" nature of the watershed. This pattern is typical of the numerous drainages of the Palouse region.

A report in the Lower Granite Sedimentation Study cited an average annual discharge of 1 cubic foot per second (cfs) per square mile of watershed for the Clearwater Basin (USDA, 1986). The length of times over which a flow occurred were estimated by local SWCD members. An annual average discharge of approximately 40 cfs may be anticipated from the drainage as a whole, based upon the USDA study.

A "normal" year may produce flows on the upper drainages of approximately 15-20 cfs for about 30 days, and approximately 50-200 cfs for 8 days in the spring. The mouth of Bedrock Creek will have flows of approximately 100 cfs during moderate periods and may peak at 400-600 cfs.

On February 24, 1986 discharge measurements were taken by the NezPerce Tribal Fisheries department after a particularly intense thunderstorm. An estimate of 800 cfs was recorded. This would approach the discharge estimated for a ten-year frequency storm event (Thomas, 1973).

Periods of minimal discharges occur during the dry summer months and when the streams freeze solid during the winter. Both of the upper drainages dry up by late spring.

Suspended Sediment

Sediment is one of the main constituents of nonpoint pollution of streams. It is transported either suspended in the water column or along the bottom as bedload. Bedload sediment loads are approximately five percent of the suspended sediment loads (Jones and Sietz, 1980). Agricultural practices may have a significant impact on the amount of sediment that reaches a stream.

The contribution of sediments by the the two upper areas were not in proportion to the amount of cropland contained in the sub-drainages. The Cavendish site accounted for 21 percent of the total sediment load but contains 11 percent of the dryland agriculture while Louse Creek contributed only 11 percent of the sediment but contains 31 percent of the cropland.

The contribution and significance by a major storm event to the suspended sediment load can clearly be seen from this study (Figure 4). The suspended sediment concentrations increased as the surface runoff from eroding fields are added to the stream. The total load of 1800 tons for the spring of 1985 was eclipsed by the February 24,1986 storm. Data collected by the NezPerce Tribal Fisheries Agency on that day, indicated suspended sediment concentration of 1136 mg/L and the estimated discharge at 800 cfs. This yielded a single day load of 2454 tons. This shows that the data collected in 1985 was lacking the major storm events and the effect that such a storm could have had on the total loads.

The Soil Conservation Service report to the Corps of Engineers, (USDA, 1986), has estimated that 800,000 cubic yards of sediment must be removed annually from the confluence of the Snake River and Clearwater River. This is necessary to keep the ports open and to prevent flooding of Lewiston, Idaho and Clarkston, Washington. Most of this material in the immediate vicinity of the confluence appears to be sand. The finer clays and silts are carried further downriver where they may settle out behind the numerous impoundments on the Snake and Columbia rivers. The study estimated erosion rates of 1.59 tons per acre from non-irrigated cropland. An estimated 20,000 tons of sediment will reach the Clearwater River per year from sheet and rill erosion from the Bedrock Creek drainage, according to the Soil Conservation Service figure. Another 150 tons will be contributed by range, pasture, forest land and stream bank erosion (USDA, 1986). The total sediment load recorded from the mouth of Bedrock Creek during the 1985 study was approximately ten percent of what could be expected from a drainage that size in the Clearwater region.

Nitrogen

Nitrogen is an essential element for maximum potential plant growth. There are three major interconvertible fractions of nitrogen in soil and water: total organic nitrogen, ammonia (NH_3), and the nitrite and nitrate complex (NO_2 + NO_3).

The total organic fraction consists of a wide variety of organically bound nitrogen usually found in plant and animal tissue. It also includes the byproducts of those organic complexes and synthetic organic molecules e.g. pesticides and herbicides. This represents a reservoir of nitrogen that will be available for plant utilization once it has been broken down by oxidation and nitrifying bacteria. Nitrogen may be applied to cultivated fields as a fertilizer in the form of anhydrous ammonia and nitrate compounds.

Ammonia is converted by microbial action into nitrate, which is the more plant available form of nitrogen. This reaction is sensitive to several environmental factors such as temperature, moisture, aeration, pH, and the ratio between ammonia and nitrate.

Nitrate is soluble in water and, as such, may be leached readily from soils and carried into streams. When samples are analyzed for nitrates it is a common practice to analyze for both the nitrite and nitrate fraction. The reasoning for this is due to the interconvertibility of NO_2 and NO_3, and the difficulty in achieving steady state conditions between the two before analysis which is dependent upon pH and temperature (APHA, 1985).

The presence of excess nitrogen in aquatic systems may lead to accelerated eutrophication, and in extreme cases may be harmful to aquatic life. A concentration of total inorganic nitrogen (nitrite + nitrate and ammonia) of 0.3 mg/L is considered the maximum limit for preventing the development of biological nuisance and accelerated eutrophication of lakes and impoundments (Mackenthun 1973). Inorganic nitrogen criterion was exceeded on every sample taken, (mean = 5.5 mg/L).

The loss of inorganic nitrogen as nitrite + nitrate was related to the season. High concentrations in the early spring tapered off later in the study (Figure 5). This is consistent with the soluble characteristic of the ion which allows it to be leached from the soil. The elevated point at Station #1, sample set 6, may be due to the application of nitrogenous fertilizers or the oxidation of ammonia to the nitrite + nitrate complex during warm weather. The loading was directly related to the magnitude of the flow.

There was a difference in concentrations of nitrogen reported at the various stations. This indicates that land management techniques that affect inorganic nitrogen losses may be different for the drainages. There are several ways this is possible, including livestock grazing practices, and fertilizer application methodologies.

Natural waters exhibit a range of values of TKN from 0.05 to 2.0 mg/L (U.S.G.S., 1977). Samples from this study ranged from 0.27 to 1.94 mg/L, mean = 0.71 mg/L. No criteria have been set for excess TKN concentrations.

Phosphorus

Phosphorus (P) is a natural element essential to plant growth, and is considered to be a limiting factor to maximizing plant production. It may be applied as a supplement to fields to increase crop yields. The three major species of phosphorus that were monitored during the this study were total phosphorus, orthophosphate , and hydrolyzable phosphorus.

Total phosphorus refers to all the phosphorus present in the sample regardless of form. Organically bound phosphates, condensed phosphates, and orthophosphates are all included. Dissolved orthophosphate is the nutrient form of phosphate available for biological uptake. Hydrolyzable phosphorus consists of the fractions of other phosphates convertible to orthophosphate.

Phosphorus, in the phosphate form, is easily adsorbed onto soil particle surfaces. Therefore the erosion of the soil transports the phosphorus to the stream. The concurrent rise in suspended sediment concentration during storm events was correlated with an increase in total phosphorus concentrations.

A goal of 0.1 mg/L total phosphorus has been suggested by Mackenthun to prevent nuissance growth in flowing waters not discharging directly to lakes or impoundments (Mackenthun, 1973). Total phosphorus values exceeded the recommended criterion of 0.1 mg/L during the period of runoff between March and June at all sites. Values decreased to within limits during normal non-runoff flows.

Bacteria

Bacteria, if exposed to an optimum environment, grow at an exponential rate. Therefore several factors influence not only the growth rate, but ultimately the number of colonies observed. These factors include water temperature, presence of inhibitors and the availability of nutrients. For these reasons the numbers of colonies are only meant as gross indicators.

Monitoring for bacterial contamination is a standard water quality procedure to indicate potential contamination and possible presence of disease causing organisms. The ratio of fecal coliform to fecal streptococcus greater than 0.7 may indicate that the source of bacterial contamination was from warm-blooded animals.

Waters designated as usable for secondary contact recreation, i.e. wading and fishing, are not to exceed fecal coliform colonies greater than 800/100 ml at any time or a geometric mean of 200/100 ml based on 5 samples/30 days (IDHW/DOE, 1985). This criterion was exceeded on May 30, 1985 at all four stations. Warm weather for optimum growth, and increased cattle grazing on pastureland may account for the increased counts

Bacteria are not considered to be a major water quality problem on Bedrock Creek. By inference, cattle do not pose a problem by bacterial contamination. However, they may contribute to the ammonia load and to the sedimentation load by their accessibility to the stream, and the resultant riparian degradation caused by grazing.

Trace Metals and Minerals

Concentrations of the detected trace metals and minerals were below suggested water quality criteria and do not pose a threat to aquatic life (APHA, 1985).

Quality Assurance

Precision is a measure of mutual agreement (or measure of the dispersion) among individual analysis of the same property. It is expressed by a relative range or coefficient of variation. A narrow range indicates precise data. Sources of error may occur at any time from sample collection to analysis and may include sampling techniques, contamination and interference, or inherent analytical errors. Precision estimates from duplicate samples gathered in March 1985 are presented in Table 6.

Accuracy is a measure of agreement between the measured value and the absolute value expressed as percent recovery. The absolute value is determined from a sample "spiked" with a known quantity of a given parameter. The ratio of the two values is then expressed as a percentage. The optimum is to have an average percent recovery of 100% with a narrow confidence interval expressed as a plus or minus percentage figure (Table 7).

Monitoring of Bedrock Creek often occured under less than favorable conditions, i.e. extreme flows, and/or adverse weather conditions. Adherence to standard techniques and procedures reduced precision errors. The techniques used for monitoring total phosphorus concentrations were consistant but tended to overestimate by 13 percent. Accuracy of total hydrolyzable phosphorus and total ammonia were under and overestimated by 20 percent respectively. This reflects in the precision estimates where duplicate samples of these two parameters may vary in concentrations 70 and 90 percent respectively.

CONCLUSIONS

An increased emphasis is being placed on the anadromous fishery in the Clearwater River drainage by the NezPerce Indian Nation, sportsmen, land managers, tourism bureaus, and environmental groups. The economic dependency on this resource is substantial. Past abuses and further degradation of water quality by nonpoint pollution in the Clearwater River drainage must be offset.

1. Sampling was conducted during an atypical year with fewer than normal storm events, therefore loading rates computed from data collected in 1985 are lower than the norm.

2. There is a significant suspended sediment problem in the watershed that affects water quality of Bedrock Creek and it's receiving waters, the Clearwater River.

3. Most of the sediment loss occured during peak runoff events. The increased suspended sediment concentrations contributed to the increased loss of total phosphorus.

4. There are considerable differences in sediment and nutrient concentrations between the two upper stations. Cavendish had concentrations of suspended sediment greater than Louse Creek on most comparable dates. The difference in solute concentrations may indicate different land uses or farming techniques on the separate drainages.

5. Existing beneficial uses of Bedrock Creek, as defined by Idaho Water Quality Standards are agricultural water supply and secondary contact recreation. Utilization by cold water biota and as a salmonid spawning habitat are limited by current water quality, i.e. extremes in flows, elevated temperatures, and pH. Agricultural nonpoint source pollution contributes to the limitations imposed by the water quality.

RECOMMENDATIONS

1. Water quality of Bedrock Creek would probably benefit from a State Agriculture Implementation program. A successful campaign should also enhance potential fish habitat, reduce soil erosion, and decrease the sediment delivery rate.

2. The Clearwater SWCD should submit an implementation plan which specifically addresses reduction of sediment reaching Bedrock Creek. A reduction of suspended sediment concentrations should concurrently reduce phosphorus loading in the stream. The plan should also present methods to reduce nutrient losses, specifically inorganic nitrogen, in the early spring.

3. Based upon this water quality survey, Best Management Practices should be targeted to specific drainages.

4. Inclusion of Bedrock Creek into the Idaho Water Quality Standards will provide a means for protecting future designated beneficial uses of the stream. The designated uses should include agricultural water supply, cold water biota, salmonid spawning, and secondary contact recreation.

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Table 1.

Station Descriptions
Bedrock Creek Project

Station #	Description	Latitude/Longitude	River Mile	Elevation	STORET #
1	Bedrock Cr. @ Cavendish	46°33'30"/116°26'00"	324.30/139.30/26.30/ 10.90	2,930'	2020265
2	Louse Cr. @ U B Camp	46°32'15"/116°26'30"	324.30/139.30/26.30/ 6.80/5.70	2,845'	2020266
3	Bedrock Cr. nr Mouth	46°31'10"/116°35'10"	324.30/139.30/26.30/ .50	915'	2020267
4	Sunnyside ¼ mi E of Sunnyside Cemetary	46°30'15"/116°28'45"	324.30/139.30/32.30/ 1.0	1,600'	2020269

Table 2. Land Use In Bedrock Creek Project Area, Acres.*

Stn#	STORET#	Drainage Area	Crop	Range	Timber	Hay/ Pasture	Total
1	2020265	Above Cavendish	1,355	0	800	30	2,185
2	2020266	Above. Louse Cr	3,929	0	1,100	596	5,625
3	2020267	Bedrook Cr. at Mouth	12,477	3,936	8,322	1,391	26,136
4	2020269	Above Sunnyside	----	----	----	----	≠ 600
	Clearwater Corridor		3,790	4,811	4,487	2,584	15,672
	Project Total		16,267	8,747	12,819	3,975	41,808

* From Clearwater SCS

Table 3a. WATER QUALITY DATA ON BEDROCK CREEK FOR THE SPRING OF 1985.

STATION # 1, Bedrock Creek at Cavendish

SET	DATE	T °C	FLOW CFS	COND. @25°C µmhos/cm	pH S.U.	TURB. NTU	S.S. mg/L	TKN mg/L	NH3 mg/L	NO2+ NO3 mg/L	T.P. mg/L	H'PO4 mg/L	O'PO4 mg/L	F.STREP #/100 ml	F.COLI #/100 ml
	AVERAGE	7.4	12.9	117.2	*6.6	51.7	81.7	0.79	0.340	6.64	0.19	0.083	0.026	*18	*54
	MAXIMUM	13.8	73.9	142.6	7.0	200.0	405.0	1.94	1.930	12.40	0.65	0.380	0.059	1531	1562
	MINIMUM	2.0	0.1	82.6	6.0	6.9	4.9	0.34	0.032	2.03	0.04	<0.01	0.007	4	8
1	02/20/85	2.0	1.7	142.6	7.0	6.9	4.9	0.34	0.032	10.3	0.04	0.022	0.010	5	27
2	03/07/85	5.1	3.4	137.0	AAA	17.0	24.0	0.47	0.086	12.4	0.06	<0.01	0.020	4	8
3	03/25/85	7.0	13.1	135.6	6.6	38.0	60.0	0.79	0.066	7.0	0.14	0.032	0.030	10	10
4	04/03/85	5.6	73.9	82.6	6.0	200.0	405.0	1.94	1.930	5.3	0.65	0.380	0.007	AAA	AAA
5	04/11/85	8.2	4.8	88.3	6.7	40.0	20.0	0.66	0.113	4.0	0.13	0.120	0.035	40	60
	04/19/85	6.8	4.3	131.8	6.3	45.0	83.0	AAA	AAA	AAA	AAA	AAA	AAA	AAA	AAA
6	05/30/85	10.8	2.0	115.2	6.8	57.0	46.7	0.90	0.044	5.5	0.21	0.030	0.059	1531	1562
7	06/24/85	13.8	0.1	104.3	6.5	10.0	9.8	0.43	0.115	2.03	0.09	<0.01	0.024	160	120

AAA Data Unreported
* Logarithmic Mean
◊ Estimated Discharge

Table 3b. WATER QUALITY DATA ON BEDROCK CREEK FOR THE SPRING OF 1985.

STATION # 2, Louse Creek

SET	DATE	T °C	FLOW CFS	COND. @25°C µmhos/cm	pH S.U.	TURB. NTU	S.S. mg/L	TKN mg/L	NH3 mg/L	NO2+ NO3 mg/L	T.P. mg/L	H'PO4 mg/L	O'PO4 mg/L	F.STREP #/100 ml	F.COLI #/100 ml
	AVERAGE	6.03	37.0	118.8	*6.5	57.0	42.5	0.74	0.143	5.14	0.16	0.088	0.036	*72	*60
	MAXIMUM	10.5	154.6	200.5	6.8	126.0	108.0	1.17	0.416	9.0	0.29	0.200	0.095	2490	2616
	MINIMUM	0.0	9.0	74.7	6.0	13.0	4.3	0.41	0.540	1.3	.03	<0.01	0.011	8	6
2	03/07/85	0.0	10.5	185.6	AAA	13.0	4.3	0.41	0.066	9.0	0.03	<0.01	0.011	8	6
3	03/25/85	4.5	15.1	200.5	6.6	24.0	18.0	0.54	0.054	7.4	0.07	<0.01	0.019	20	20
4	04/03/85	6.8	154.6	88.9	6.0	102.0	108.0	1.00	0.058	6.0	0.29	0.200	0.006	500	AAA
5	04/11/85	7.4	23.7	78.3	6.6	44.0	12.2	0.59	0.123	2.0	0.13	0.110	0.051	10	40
	04/19/85	7.0	9.0	85.3	6.5	33.0	19.0	AAA	AAA	AAA	AAA	AAA	AAA	AAA	AAA
6	05/30/85	10.5	9.6	74.7	6.8	126.0	93.3	1.17	0.416	1.3	0.26	0.130	0.095	2490	2616

AAA Data Unreported
* Logarithmic Mean
◊ Estimated Discharge

Table 3c. WATER QUALITY DATA ON BEDROCK CREEK FOR THE SPRING OF 1985.

STATION # 3, Bedrock Creek at Mouth

SET	DATE	T °C	FLOW CFS	COND. @25°C µmhos/cm	pH S.U.	TURB. NTU	S.S. mg/L	TKN mg/L	NH3 mg/L	NO2+ NO3 mg/L	T.P. mg/L	H'PO4 mg/L	O'PO4 mg/L	F.STREP #/100	F.COLI #/100
	AVERAGE	10.1	78.9	151.8	*7.5	41.7	77.7	0.62	0.255	3.980	0.27	0.179	0.071	*17	*9
	MAXIMUM	19.0	◊470	315.5	8.4	270.0	691.0	1.92	1.730	8.200	1.61	1.270	0.190	280	30
	MINIMUM	3.0	2.6	101.1	6.8	2.1	2.8	0.27	0.016	0.421	0.07	<0.01	0.020	7	3
1	02/20/85	3.0	12.2	132.8	7.0	10.0	4.8	0.34	0.016	4.4	0.09	0.039	0.052	15	4
2	03/07/85	4.8	34.2	231.1	AAA	12.0	7.5	0.41	0.086	8.2	0.07	<0.01	0.020	7	3
3	03/25/85	5.0	133.4	315.5	7.2	40.0	40.0	1.22	0.036	6.6	0.20	0.096	0.036	10	30
4	04/03/85	7.2	◊470	106.0	6.8	270.0	691.0	1.92	1.730	6.0	1.61	1.270	0.190	10	AAA
5A	04/11/85	9.8	41.8	101.4	7.3	28.0	2.8	0.39	0.172	3.4	0.12	0.090	0.050	20	20
5B	04/11/85	12.0	47.4	101.1	7.3	29.0	2.8	0.40	0.061	3.5	0.12	0.090	0.055	10	10
	04/19/85	9.6	24.3	130.3	7.6	14.0	3.0	AAA	AAA	AAA	AAA	AAA	AAA	AAA	AAA
	04/30/85	15.8	15.8	118.8	8.4	7.0	2.8	0.32	0.089	2.3	0.08	0.022	0.038	9	8
6	05/30/85	14.8	7.3	131.6	8.0	5.3	13.3	0.27	0.049	1.0	0.09	0.010	0.093	280	10
7	06/24/85	19.0	2.6	149.0	8.0	2.1	9.1	0.38	0.057	0.421	0.10	<0.01	0.107	20	10

AAA Data Unreported
* Logarithmic Mean
◊ Estimated Discharge

Table 3d. WATER QUALITY DATA ON BEDROCK CREEK FOR THE SPRING OF 1985.

STATION # 4, Sunnyside Creek

SET	DATE	T °C	FLOW CFS	COND. @25°C µmhos/cm	pH S.U.	TURB. NTU	S.S. mg/L	TKN mg/L	NH3 mg/L	NO2+ NO3 mg/L	T.P. mg/L	H'PO4 mg/L	O'PO4 mg/L	F.STREP #/100 ml	F.COLI #/100 ml
	AVERAGE	10.8	0.8	104.3	*7.4	49.6	75.8	0.70	0.079	2.98	0.27	0.126	0.099	*61	*64
	MAXIMUM	13.4	2.8	145.9	7.7	108.0	153.0	1.29	0.170	5.50	0.44	0.210	0.156	1601	980
	MINIMUM	9.0	0.2	97.5	6.8	9.8	30.0	0.32	0.044	1.02	0.17	0.040	0.027	1	<1
3	03/20/85	9.0	2.8	AAA	7.2	108.0	153.0	1.10	0.044	4.3	0.44	0.208	0.148	1	<1
4	04/03/85	9.0	1.1	126.7	7.5	63.0	72.0	0.73	0.070	4.7	0.25	0.210	0.027	100	AAA
5	04/16/85	12.2	0.3	127.0	6.8	18.0	35.0	0.39	0.053	1.3	0.17	0.073	0.067	18	14
	04/30/85	13.4	0.2	128.4	7.7	18.0	43.0	0.42	0.088	1.1	0.19	0.065	0.065	40	24
6	05/30/85	10.2	0.2	97.6	7.6	81.0	122.0	1.29	0.051	5.5	0.40	0.160	0.156	1601	980
7	06/24/85	11.4	0.1	145.8	7.7	9.8	30.0	0.32	0.170	1.02	0.21	0.04	0.132	450	50

AAA Data Unreported
* Logarithmic Mean
◊ Estimated Discharge

Table 4. Bedrock Creek Project Water Quality Parameters

STORET #	PARAMETER	UNIT
Field Measurements		
00061	Flow	CFS
00010	Water Temperature	°C
00094	Conductivity	µmhos/cm
00400	pH	S.U.
Laboratory Analyses		
00076	Turbidity	NTU
80154	Suspended Sediment (S.S.)	mg/L
00625	Total Kjeldahl Nitrogen as N (TKN)	mg/L
00610	Total Ammonia as N (NH_3)	mg/L
00630	Total Nitrite+Nitrate as N (NO_2 + NO_3)	mg/L
00665	Total Phosphorus as P (T.P.)	mg/L
00669	Total Hydrolyzable Phosphorus as P (H.P.)	mg/L
00671	Dissolved Orthophosphate as P (O'PO_4)	mg/L
31679	Fecal Streptococcus	#/100 ml
31616	Fecal Coliform	#/100 ml
Trace Metals		
01002	Arsenic, total	µg/L
01027	Cadmium, total	µg/L
01034	Chromium, total	µg/L
01042	Copper, total	µg/L
01051	Lead, total	µg/L
01055	Manganese, total	µg/L
71900	Mercury, total	µg/L
01067	Nickel, total	µg/L
01077	Silver, total	µg/L
01092	Zinc, total	µg/L
Minerals		
00900	Hardness as $CaCO_3$	mg/L
00410	Total Alkalinity as $CaCO_3$	mg/L
00951	Fluoride	mg/L
00945	Sulphate as SO_4	mg/L

Table 5. WEIGHTED NUTRIENT AVERAGE FOR BEDROCK CREEK IN LBS/PERIOD

DATE	PERIOD	S.S.	TKN	NH_3	NO_2+NO_3	T.P.	H'PO_4	O'PO_4
At Cavendish								
3/07	18	7,900	160	29	4,100	20	3	7
3/25	14	59,000	780	66	6,900	140	32	29
4/03	4	645,000	3,100	3,100	8,400	1,000	600	11
4/11	30	16,000	510	90	3,100	100	93	27
5/30	37	19,000	360	18	2,200	80	11	22
		747,000	4,900	3,300	24,700	1,300	740	96
At Louse Creek								
3/07	18	4,400	420	67	9,200	31	11	11
3/25	14	21,000	620	62	400	80	11	21
4/03	4	360,000	3,300	190	2[illegible],000	970	670	20
4/11	30	47,000	2,300	470	7,600	500	420	200
5/30	37	3,500	2,200	580	9,400	500	250	180
		440,000	8,800	1,370	57,000	2,080	1,360	430
At Mouth of Bedrock Creek								
3/07	18	25,000	1,400	290	27,000	230	32	66
3/25	14	400,000	12,000	360	66,000	2,000	970	360
4/03	1*	1,800,000	4,900	4,400	15,000	4,100	3,200	480
4/04	3	1,300,000	3,700	3,300	12,000	3,100	2,500	370
4/11	30	20,000	2,900	800	25,000	860	650	380
5/30	37	19,000	390	70	1,400	130	15	140
		3,600,000	35,000	9,200	146,000	10,400	7,400	1,800
At Sunnyside Creek								
3/20	14	32,000	230	10	910	92	43	3
4/03	13	5,600	56	5	360	20	16	3
4/16	13	740	8	1	3	4	1	1
4/30	22	1,000	10	2	22	4	2	2
5/30	27	2,900	38	1	160	12	5	5
6/24	26	420	4	3	30	3	3	3
		43,000	350	22	1,480	140	70	17

* One day total

Table 6. Precision Estimates of Monitored Parameters *

STORET	Parameter	N	Average Relative Range
80154	Suspended Sediment	6	4.4
00665	Total Phosphorus	6	6.6
70507	Orthophosphate	6	16.6
00669	Total Hydrolyzable Phosphorus	6	70.2
00630	Total Nitrite & Nitrate	6	9.7
00610	Total Ammonia	6	89.7
00625	Total Kjeldahl Nitrogen	6	8.5
00076	Turbidity	6	3.2

* Pooled from several agricultural water quality surveys conducted by the Lewiston D.O.E. Field Office (Bauer, 1985)

N = number of samples

Table 7. Accuracy Estimates of Monitored Parameters *

STORET*	Parameter	N	Average % Recovery	95% CI
80154	Suspended Sediment	13	95.4	± 1.2
00665	Total Phosphorus	13	112.8	± 2.9
70507	Orthophosphate	13	3.0	± 6.3
00669	Total Hydrolyzable Phosphorus	13	80.0	± 4.5
00620	Total Nitrate	13	103.9	± 3.8
00610	Total Ammonia	13	120.1	±11.8
00625	Total Kjeldahl Nitrogen	13	104.0	± 9.0

* Pooled from several agricultural water quality surveys conducted by the Lewiston DOE Field Office.

N = Number of samples

Table 8. Summary of Precipitation Data for the Spring of 1985 at the Dworshak National Fish Hatchery.*

	Recorded (in)	Normal (in)	% of Normal
January	0.50	3.03	16
February	1.60	2.65	60
March	1.59	2.99	53
April	2.42	2.08	116
May	3.15	2.25	140
June	1.27	1.97	64
Total	10.53	14.97	70

*DNFH, Personal Communication Diane Praest

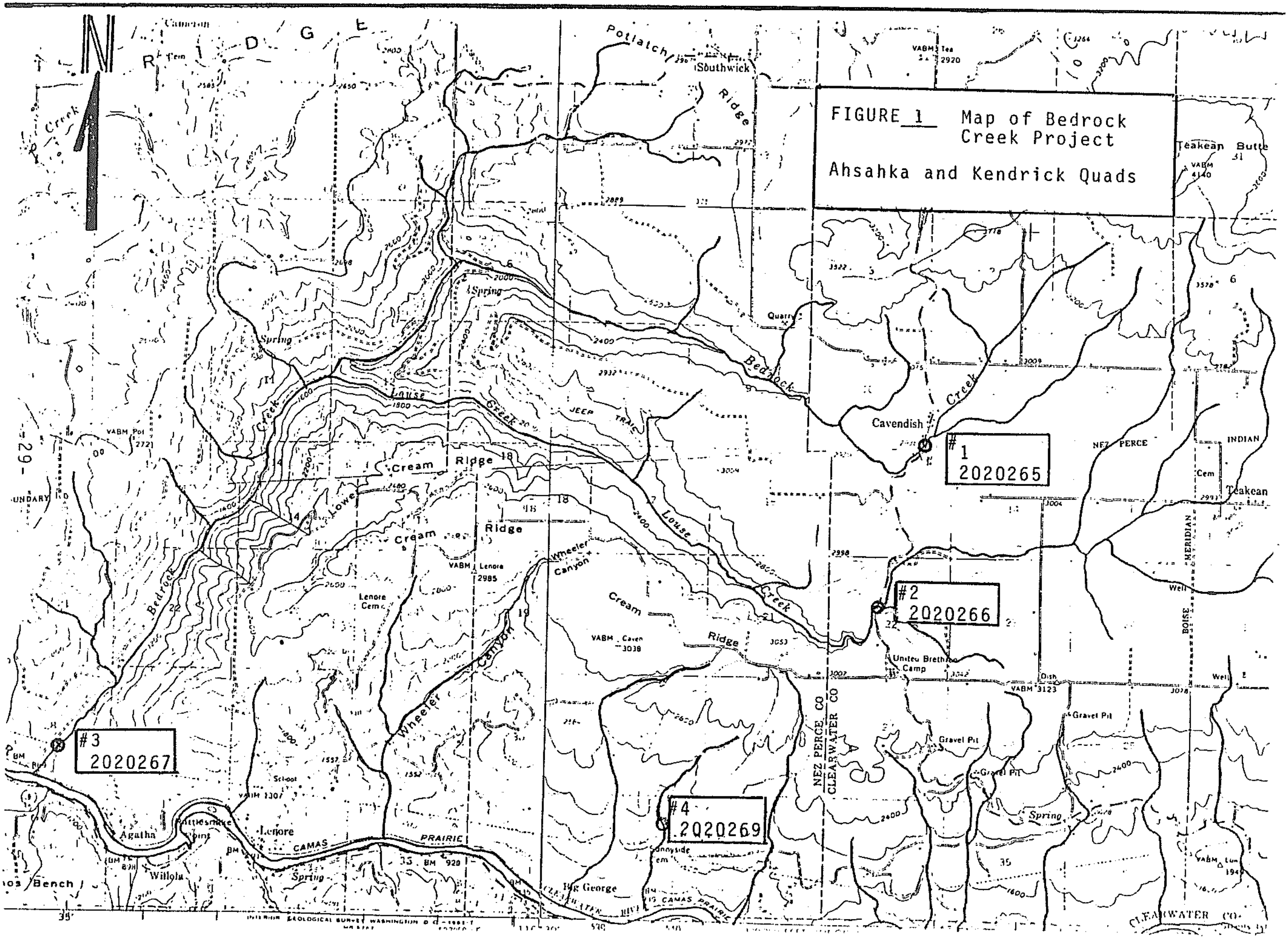

FIGURE 1 Map of Bedrock Creek Project

Ahsahka and Kendrick Quads

FIGURE 2. STREAM CREST GAUGE

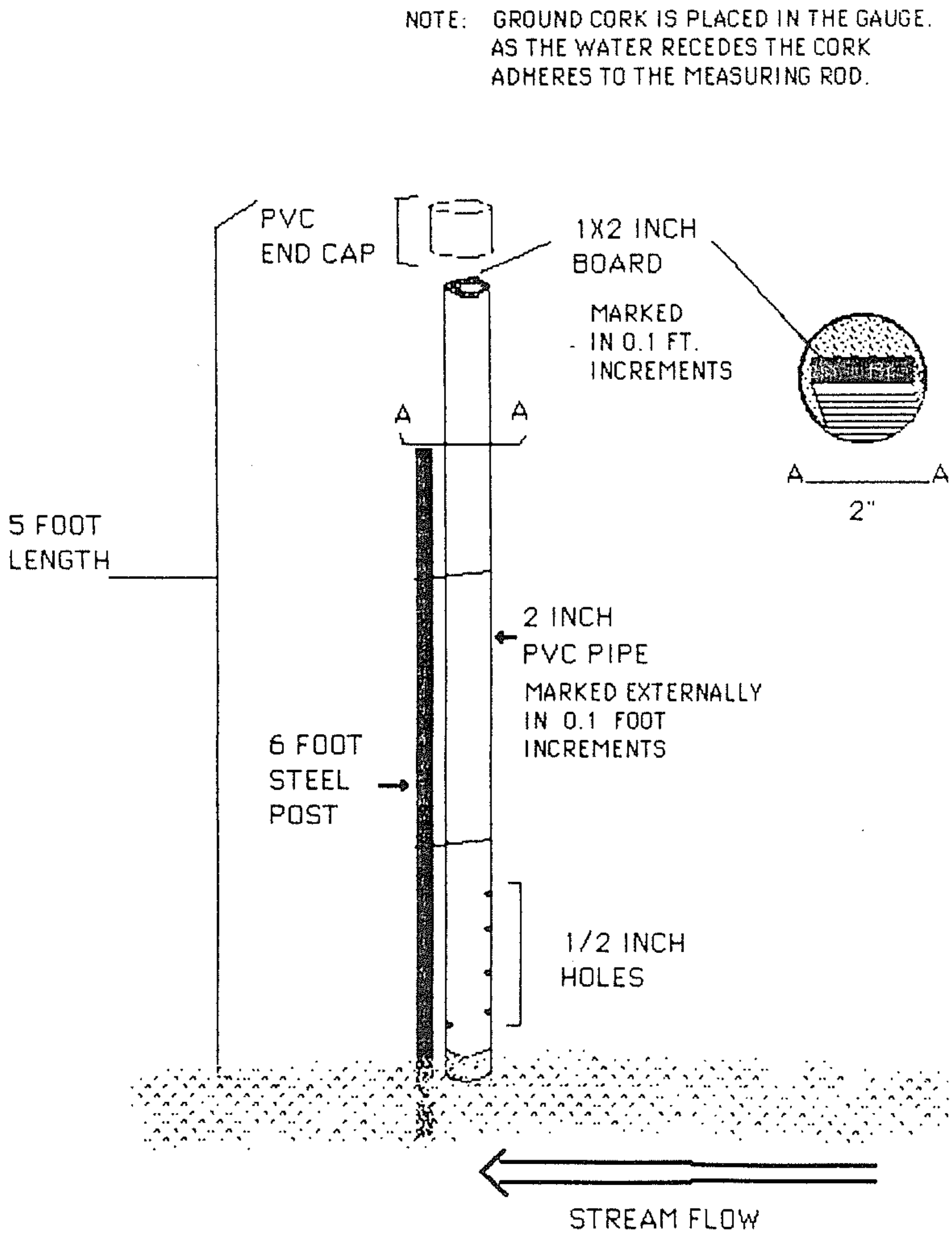

Figure 3. Discharge Data on Bedrock Creek for Selected Sample Dates in the Spring of 1985.

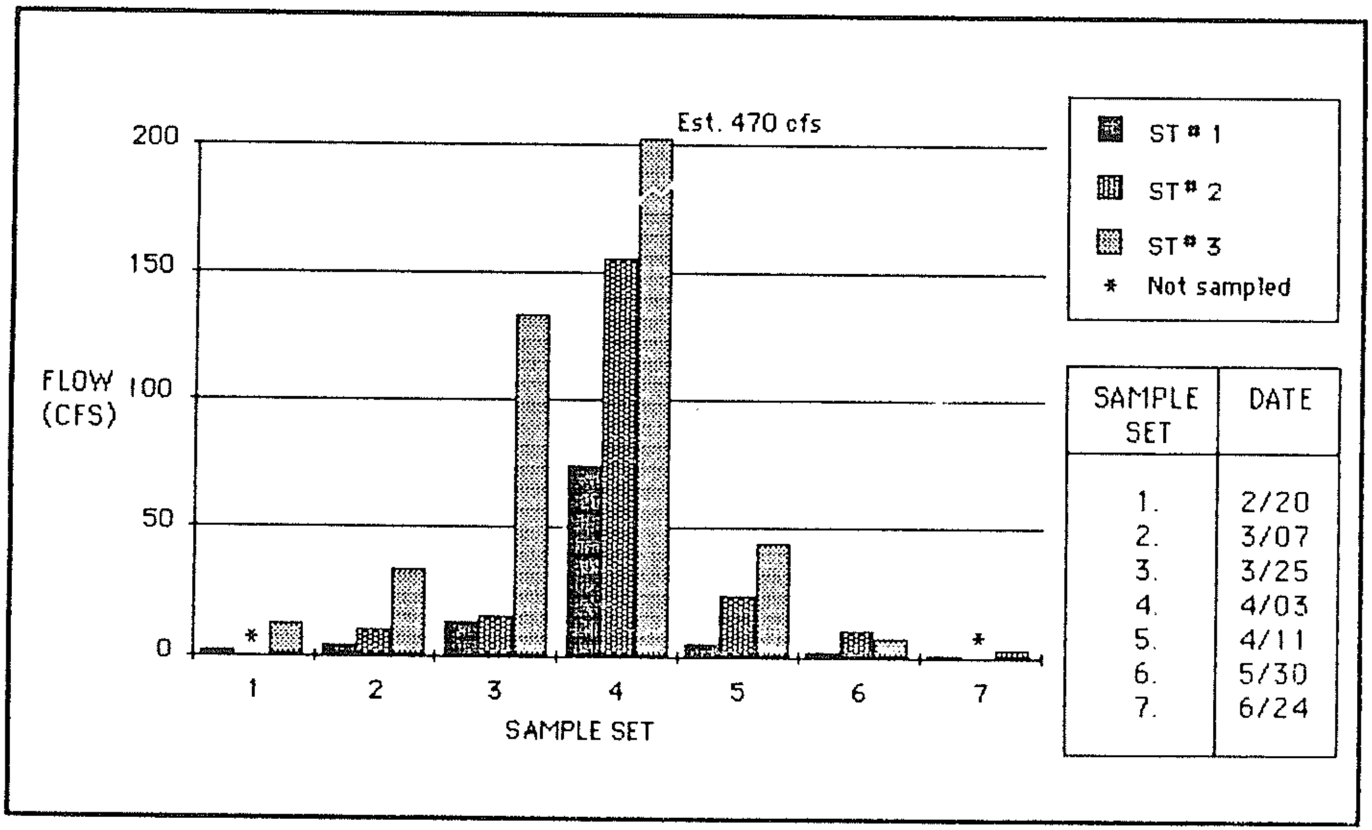

Figure 4. Suspended Sediment Concentrations in Response to Discharge at the Mouth of Bedrock Creek.

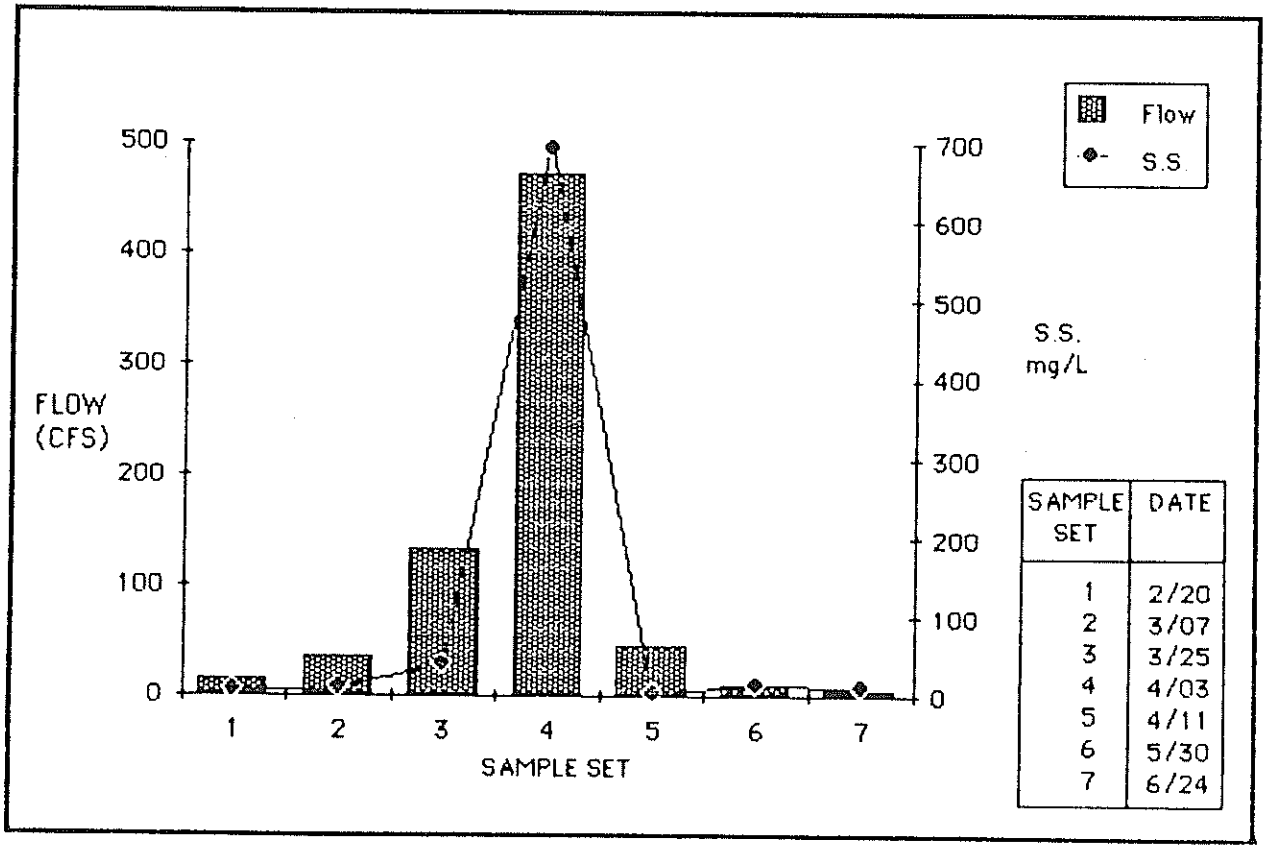

Figure 5. Nitrite + Nitrate Concentrations of Bedrock Creek for the Spring of 1985.

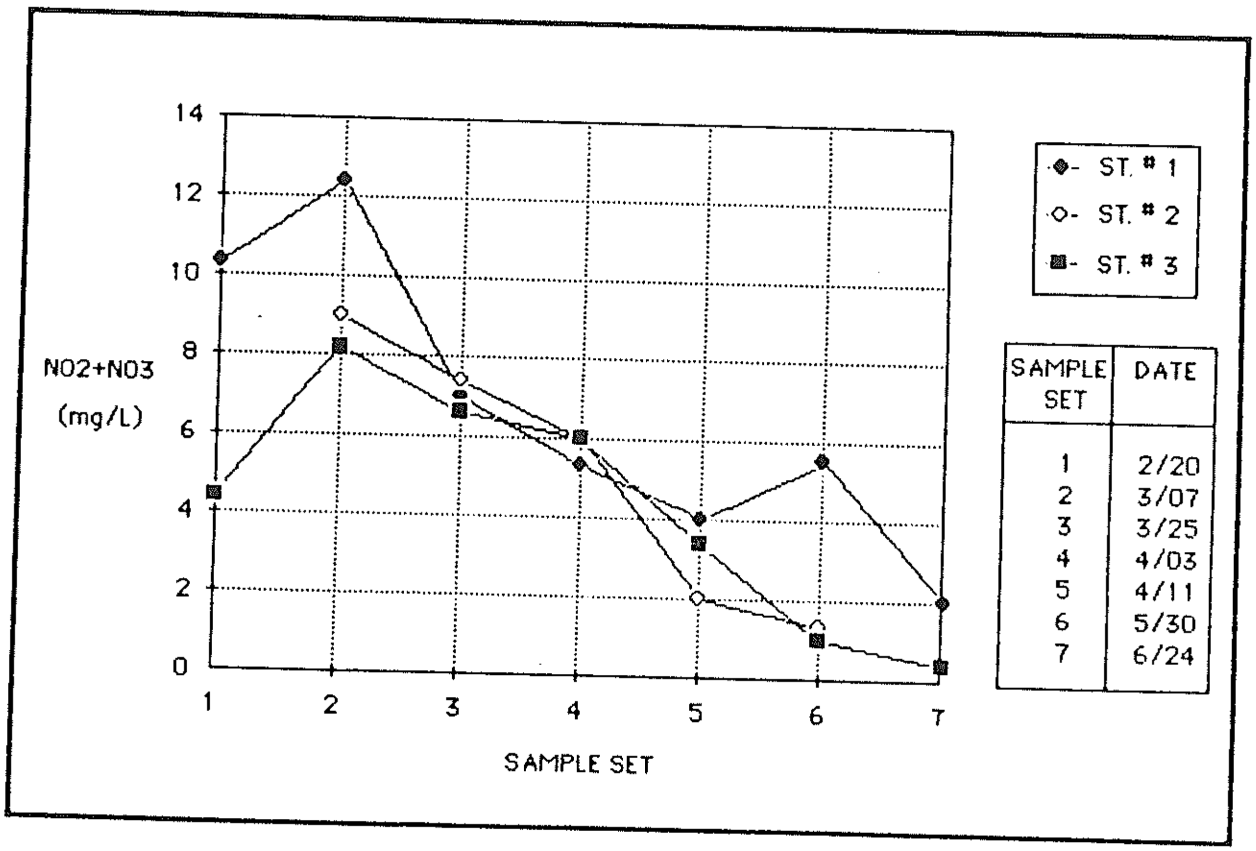

Figure 6. Total Phosphorus Concentrations in Response to Suspended Sediment Concentrations at the Mouth of Bedrock Creek.