WATER QUALITY STATUS REPORT ● REPORT NO. 78

LOWER BLACKFOOT RIVER
Bingham County, Idaho
1987

Prepared by
Blaine Drewes

Pocatello Field Office
150 North Third Avenue
Pocatello, Idaho 83201

Department of Health & Welfare
Division of Environment
Boise, Idaho

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TABLE OF CONTENTS

LIST OF TABLES and FIGURES

TABLES

FIGURES

ABSTRACT

The lower Blackfoot River was identified in the Agricultural Nonpoint Source Pollution Abatement Program as a second priority stream segment for the reduction of agriculture related pollutants. From November 19, 1986 to July 6, 1987 a water quality study was conducted on the lower Blackfoot River and its drainage. This survey had two chief objectives. One was to observe the effects that each tributary has on the Blackfoot River. The other was to determine the sources of water quality degradation in the tributaries.

Three sampling stations were located on the Blackfoot River and another 7 on its tributaries to determine the amount of pollutants which may affect the water quality of the Blackfoot River. An additional three sites were chosen to determine the amount of mass wasting which occurs along the lower section of the Blackfoot River.

The dry winter and cool, dry spring played an important part in the study. Much of the water which makes up a normal runoff was retained in the soil, and that which ran off flowed slowly without much erosive potential. Flows in the tributaries were much less than normal. The low flows experienced below the Little Indian and Just Canals in the Blackfoot River caused a minimum of streambank erosion at our mass wasting sites.

Although the tributaries had levels of suspended sediment, nitrates+ nitrites, total phosphorus, dissolved ortho-phosphates, and bacteria which exceeded regulations and recommendations, the pollutants were diluted to below standards on all but one occasion in the Blackfoot River (March 2).

Due to the mass wasting in the tributaries, the cattle impact, and the farming, all of which occurred simultaneously, it was impossible to determine what amount of stream pollution was due to any one factor.

The near drought conditions in southeastern Idaho made it impossible to determine the normal impact of agricultural pollution on the Blackfoot River or its tributaries.

INTRODUCTION

The lower Blackfoot River drainage contains the area starting upstream at the Trail Creek bridge in southeast Bingham County continuing northwest for 16 miles to the bridge at "Reid Valley" (Figures 1 and 2). The major tributaries of the lower Blackfoot River are Wolverine, Cedar, and Miner Creeks. Jones Creek, site of sampling station 5, is a tributary of Wolverine Creek. The Blackfoot River is a major tributary of the Snake River, entering 4 miles south of the town of Blackfoot. The Blackfoot River (USB 350) has been identified as a second priority stream segment in the Nonpoint Source Pollution Abatement Plan.

The current designated uses of the Blackfoot River are as an agricultural water supply, cold water biota, salmonid spawning, and primary and secondary contact recreation.

The Blackfoot River watershed contains approximately 48,000 acres. Of this amount 36,500 acres are private land, most of which are used for range (Table 1).

Table 1: Land Ownership and Use (Acres)

Federal	9,120
State	8,640
Private	30,240
Dry Cropland	6,700
Irrigated Cropland	2,400
Range	21,140

All upper portions of the tributaries are used for range except for a small portion off Jones Creek which is in a wheat-fallow rotation. The lower section of Cedar Creek is in a wheat-fallow rotation although 700 acres went into conservation reserve program (CRP) in 1987. The lower portion of Wolverine Creek is in a wheat-fallow rotation with some potato-grain crops which are irrigated.

The watershed extends 16 miles northwest from Trail Creek, and is 14 miles wide at its widest point. The watershed averages 11 miles in width along its length. The study area includes only the land on the east and north sides of the Blackfoot River as the south and west sides are contained on the Fort Hall Indian Reservation. Elevations range from 7,550 feet in the mountains to 4,500 feet at the "Reid Valley" bridge.

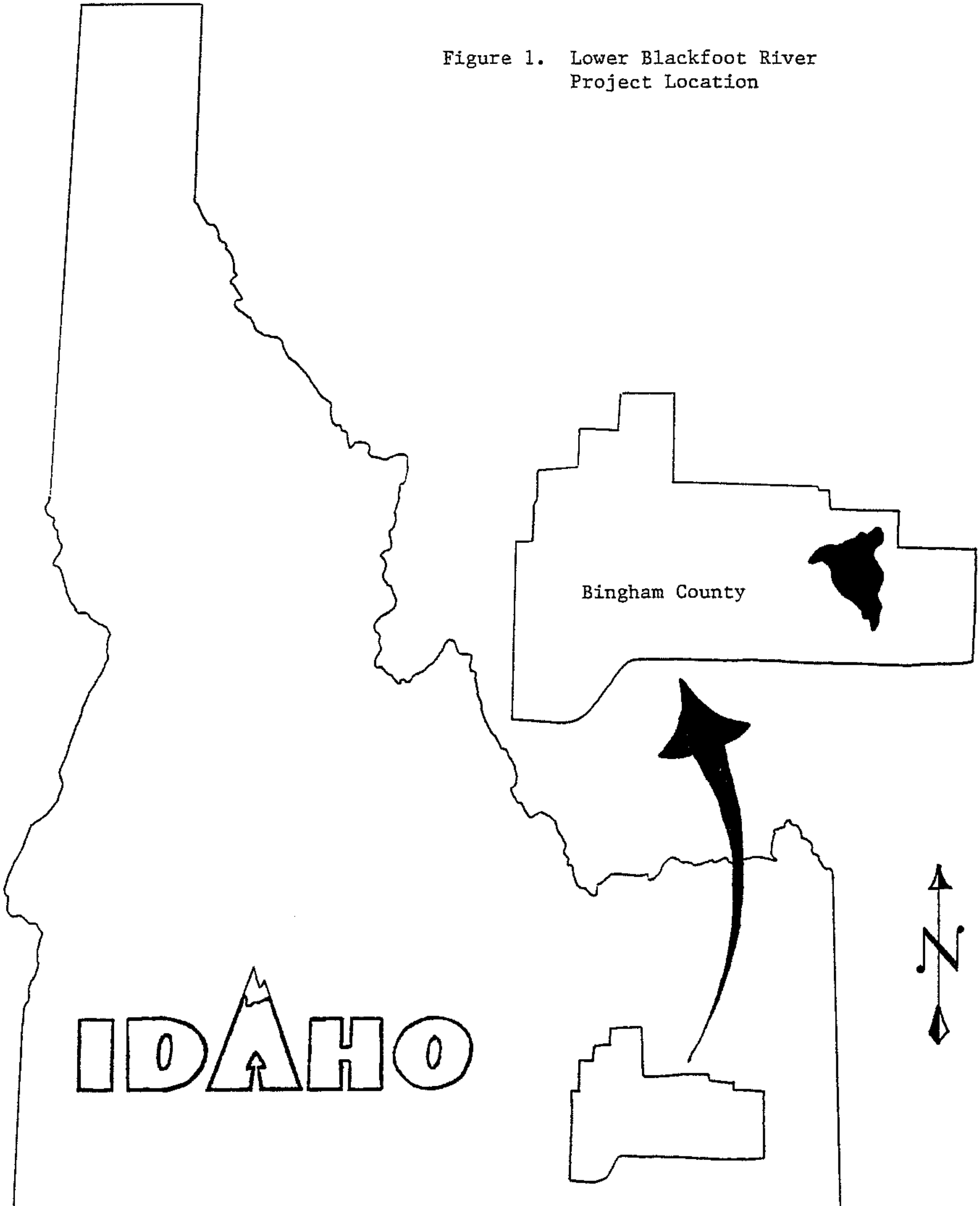
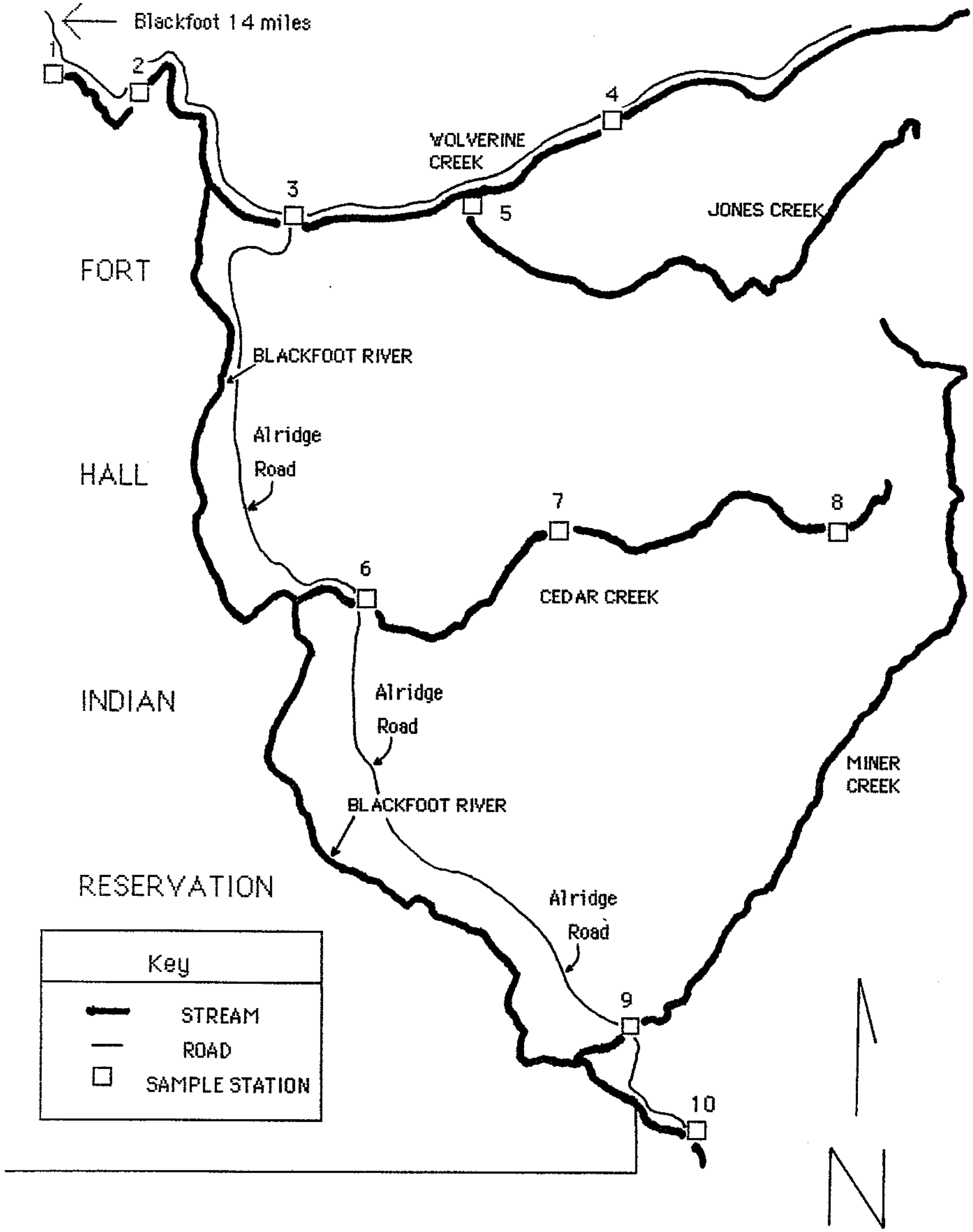


Figure 1. Lower Blackfoot River Project Location

FIGURE 2. SAMPLING STATIONS IN THE BLACKFOOT RIVER WATERSHED



The climate is semi-arid with cool, moist winters and warm, dry summers. Annual precipitation is 9 inches in the lowlands, increasing with elevation. Snowpacks average 31 inches in the foothills, also increasing with elevation. The frost free growing season lasts about 102 days, from the end of May to mid-September. For a 50 year period of record, the mean low temperature in January is 13°F and the mean high is 32°F. The mean low in July is 53°F and the mean high is 89°F.

Topography of the area is generally characteristic of eastern Idaho with rolling hills and steep mountainous terrain. Cropland slopes range from 0% to 30 %. Dry cropland rotations are grain-fallow. Irrigated land rotations include potato-grain, alfalfa, and pasture. Irrigation systems include high pressure center pivots, wheel lines, and flood irrigation.

The soils in the Blackfoot River study area are highly erodable. The main soil types in the watershed are:

Wolverine sand, 0-30% slope. Elevation about 4,500 ft. This soil is used for range animals. Surface runoff is slow and the erosion potential is slight.

Sasser sandy alluvium, 0-8% slope. Elevation about 4,500 ft. Irrigated hay, pasture, and small grain are grown on this soil. Runoff is slight and erosion is moderate.

Stan fine sandy loam 0-4% slope. Elevation from 4,500 to 5,500 ft. Irrigated crops are grown on this soil. Runoff is medium and erosion is moderate.

Newdale silt loam, 0-20% slope. Elevation 4,700 to 6,000 ft. This soil is used for dryland grain, hay, and for range. Erosion and runoff potential is severe.

Newdale silt loam, 20-60% slope. This soil is the same as the Newdale 0-20%, except it is used only for range.

Swanner loam, 0-30% slope. Elevation 4,500 to 6,500 ft. This rangeland has a medium runoff and moderate erosion potential.

Tetonia silt loam, 12 to 60% slope. Elevation 5,500 to 6,200 ft. The runoff rate is high and the erosion potential is severe on this rangeland.

Wahtigup-Ricrest-Hymas Association stony loams, 10 to 80 % slopes. These soils are found on the mountain slopes and ridges between 4,500 and 7,000 ft. in elevation. All of these soils are used for range and have a rapid runoff and high erosion rating.

Sheege extremely stony loam, 0-60% slope. This rangeland is found on mountain slopes between 6,500 and 7,000 ft. The runoff and erosion ratings are both moderate.

Pavohroo loam, 30 to 60 % slope. This highly erosive soil is located on mountain ridges and sides from 6,000 to 8,000 ft. in elevation. It is used for woodland and range (North Bingham SCD).

The water regime is heavily dependant upon the irrigation season. Water is released for irrigation during the summer from the Blackfoot Reservoir located on the upper Blackfoot River. The first major turnouts are the Just Canal and the Little Indian Ditch located 15 miles east of Blackfoot. The turnouts are located between our stations 1 and 2. During the irrigation season, these diversions reduce the river flow dramatically. Flows in the Blackfoot River are usually low in the fall and winter as water is stored in the reservoir.

The purpose of the study was to determine if erosion from agricultural lands adversely affected the water quality of the Blackfoot River. Mass wasting was also looked at as a possible source of pollution in the Blackfoot River.

MATERIALS AND METHODS

Methods of sample collection, preservation, and analysis followed Standard Methods (APHA, 1985), and the National Handbook of Recommended Methods for Water Data Aquisition (USGS, 1977). All samples, except bacterial, were collected using a Bel-Art Products churn splitter from which seperate samples were drawn. Samples were collected from the center of the stream or from an area of complete mixing. Bacterial samples were dipped directly into the sample containers.

SAMPLE STATIONS

Ten sampling stations were designated on the Blackfoot River and the main tributaries (Figure 2). These locations were chosen to allow differentation of the sources of pollutants entering the streams. The sample sites, STORET numbers, and reasons for their placement are given below.

Station 1. Blackfoot River at Reid Bridge. STORET #2080146. This station was located on the low end of the study area. The data gathered here represented the total impact of pollution from the study area. Further, the stretch of river from station 1 to station 2 has had streambank erosion problems which could be detected by subtracting the concentration of pollutants at station 2 from the concentration of pollutants at station 1.

Station 2. Blackfoot River at the USGS gauge station. STORET #2080147. Data collected at this station is indicative of the impact the tributaries contribute to the Blackfoot River. Since this station is located above any major mass wasting problems on the Blackfoot River, it was used to help determine streambank erosion on the lower reach.

Station 3. Wolverine Road at Alridge Road. STORET #2080148. This station was located close to the mouth of Wolverine Creek and indicated the total pollution load received from the Wolverine Creek drainage.

Station 4. Wolverine Creek at HH A-frame home. STORET # 2080149. This station served to collect baseline information for Wolverine Creek.

Station 5. Jones Creek at Mouth. STORET #2080150. Jones Creek appeared to have a major impact on Wolverine Creek. The station was placed here to determine the severity of that impact.

Station 6. Cedar Creek at Alridge Road. STORET #2080151. This station was located close to the mouth of Cedar Creek and indicated the total pollution load received from the Cedar Creek drainage.

Station 7. Cedar Creek at the Grazing Association gate. STORET# 2080152. A large stretch of mass wasting was located just below this station, and range cattle were located above it. This station served as a baseline data station for the mass wasting on Cedar Creek, and a data collection station for the impact of the range cattle above it.

Station 8. Cedar Creek at the Grazing Association Cabin. STORET# 2080153. This was the baseline information collection station for Cedar Creek.

Station 9. Miner Creek at Mouth. STORET #2080154. Pollution impacts of the Miner Creek drainage were monitored here.

Station 10. Blackfoot River at Trail Creek. STORET * 2080155. This was the uppermost station in the study area, and was the baseline information station for the Blackfoot River.

This study was designed to monitor water quality during spring and storm runoff events when the maximum influx of nutrients and suspended sediment was expected. It has been shown that the greatest amounts of pollutants are delivered at these times. Therefore, the sample schedule was established with the flexibility to respond to storm events. Data was also gathered twice monthly from mid-February to early July to provide information on water quality during spring thaw. In addition, one sample set was taken during November to characterize ambient conditions at low flow.

The determination of total solutes contributed during a one day period was based on the assumption that an individual sample was representative of the whole day.

PARAMETERS

Parameters which were sampled are shown below.

Parameter	Units	STORET No.
Flow	cfs	00061
Suspended Sediment	mg/l	00530
Nutrients		
Total Ammonia (NH_3)	mg/l	00610
Total Nitrate+ Nitrite (NO_2+NO_3)	mg/l	00630
Total Kjeldahl Nitrogen (TKN)	mg/l	00625
Total Phosphorus (TP)	mg/l	00665
Total Ortho-Phosphate (To-p)	mg/l	70507
Dissolved o-Phosphate (Do-p)	mg/l	00671
Bacteria		
Fecal Coliform	colonies/100ml	31616
Fecal Streptococcus	colonies/100ml	31679

Flow

Direct measurement of stream velocity was made with a Marsh McBirney Model 201 flow meter. Cross sections of the creeks were made by measuring the stream width to the nearest tenth of a foot, and measuring the water depth to the nearest tenth of a foot. Velocities were measured each foot at 0.6 depth. Determination of these two factors was not always possible. High flows in the Blackfoot River prohibited use of the flow meter. The flows were estimated at these sampling stations using the "orange peel" method. This method involves timing a floating object over a known length of the river. Depth measurements were made as above. Flows for station 2 were obtained from the USGS, which maintaines a gauge station at that site.

Suspended sediment

Suspended sediment is one of the prime indicators of non-point agricultural pollution. Used in a low runoff area with high mass wasting, it can also be used to determine the relative effects of stream erosion. Suspended sediment consists of soil particles that are entrained in the water column from three inches above stream bottom to the top of the column (Clark, 1985).

Three sites were established to estimate the amount of soil lost from a segment of the Blackfoot River due to streambank erosion (Figures 3 - 6). Stakes were placed on March 9 with streambank height and distances to steaks recorded. The sites were checked for erosion on August 28. The difference between the two measurements was the soil loss.

Nitrogen

Nitrogen is a primary plant nutrient and is applied in various forms to agricultural lands. This study tested for the four most common nitrogen compounds; Nitrate, Nitrite, Ammonia, and Total Kjeldahl Nitrogen. Because of the rapid interchangeability of nitrate and nitrite, these compounds were analyzed together as nitrate+nitrite.

The concentration of organic nitrogen was determined by the Total Kjeldahl Nitrogen (TKN) method. Organic nitrogen is the nitrogen "locked" in detritus, waste, and complex nitrogen compounds. The TKN process does not distinguish between organic and ammonia nitrogen. An estimate of the amount of organic nitrogen can be made by subtracting the ammonia concentration from the TKN concentration.

FIGURE 3. MASS WASTING SITES

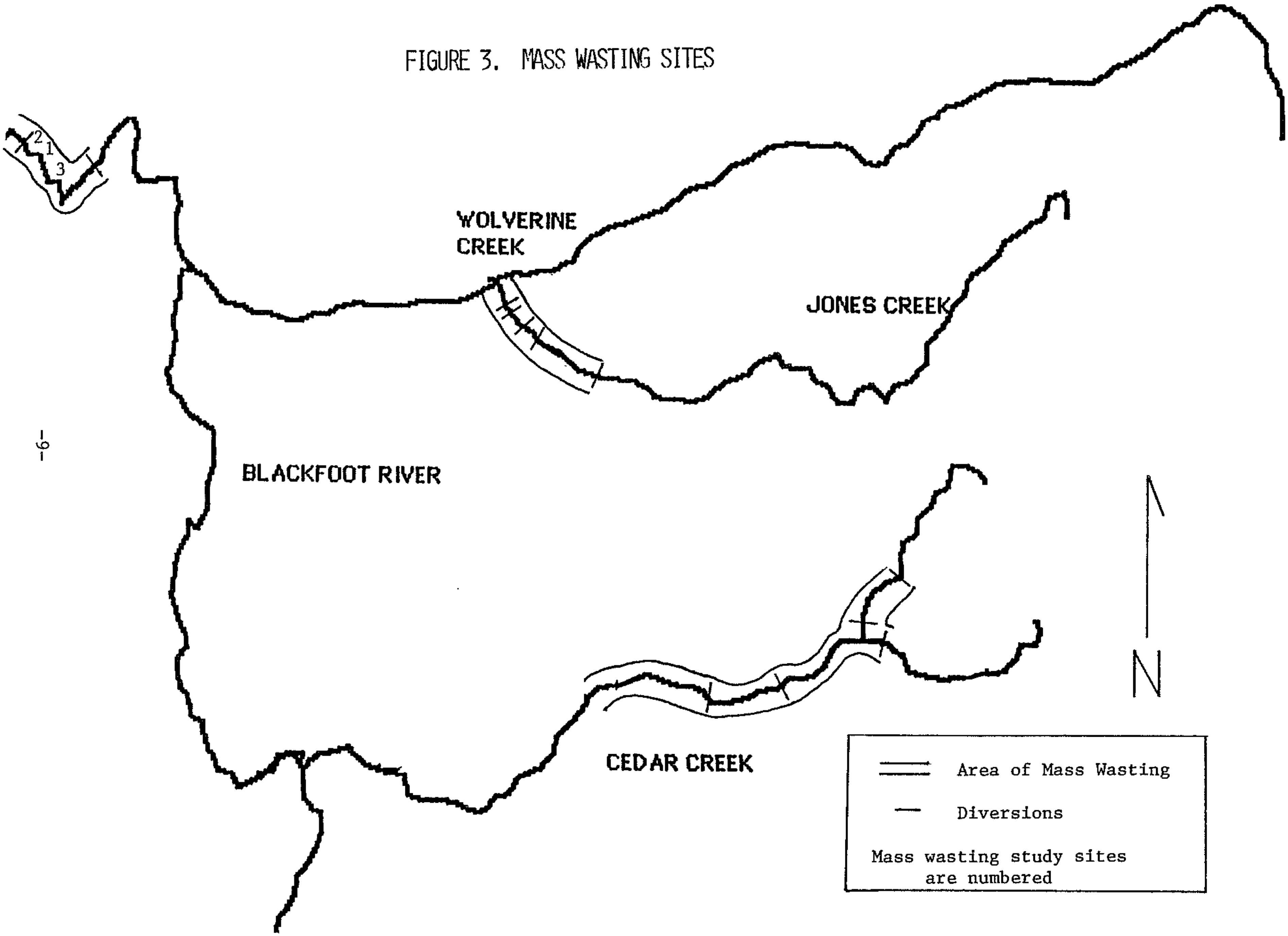


Figure 4. Streambank Erosion Site #1

Observed Erosion

Station	Cu. Yards	Tons
#1	0.00	0.00
#2	0.00	0.00
#3	0.00	0.00
#4	0.00	0.00

1.2 Tons=1 Cu. Yard

Refer to text for explanation

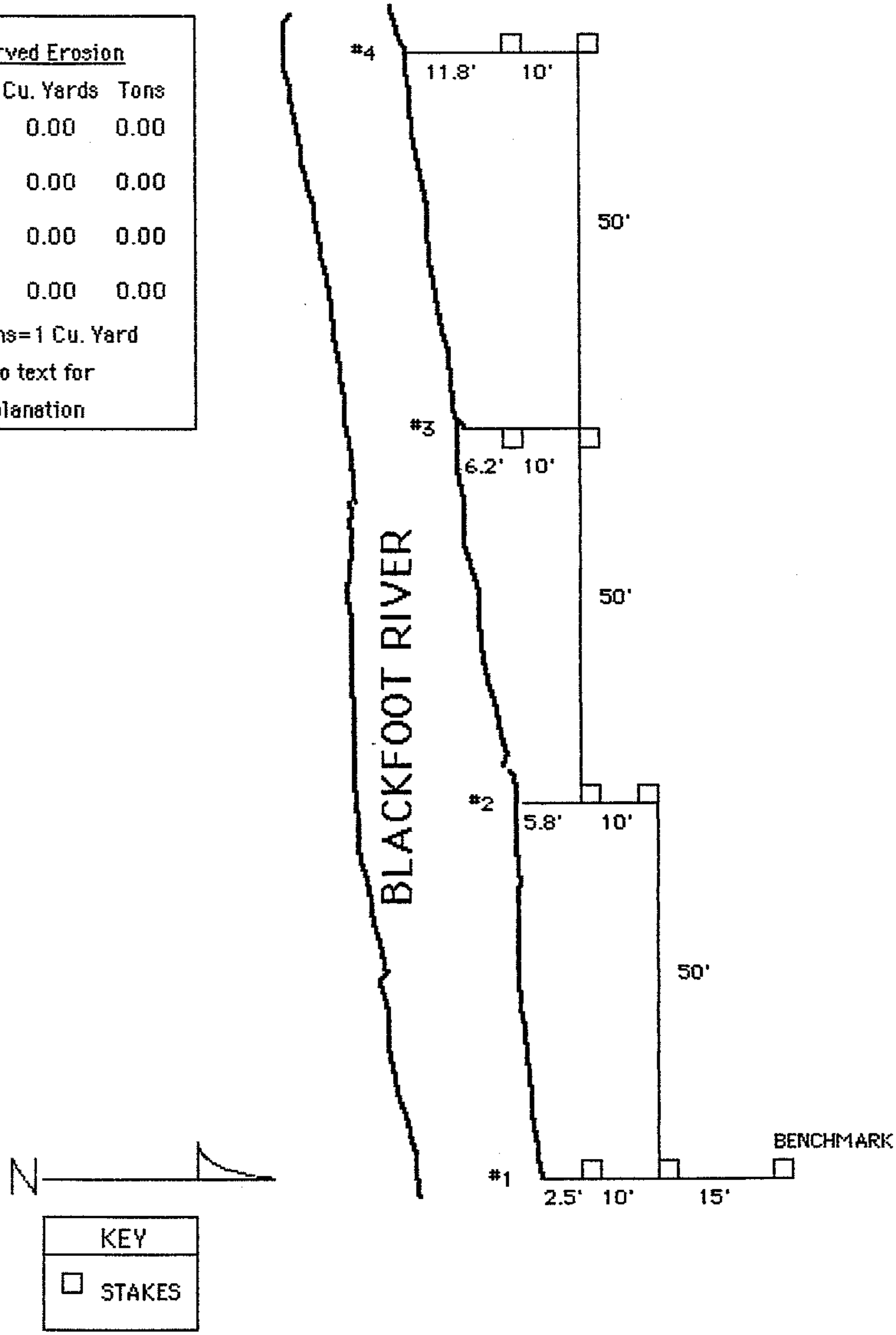


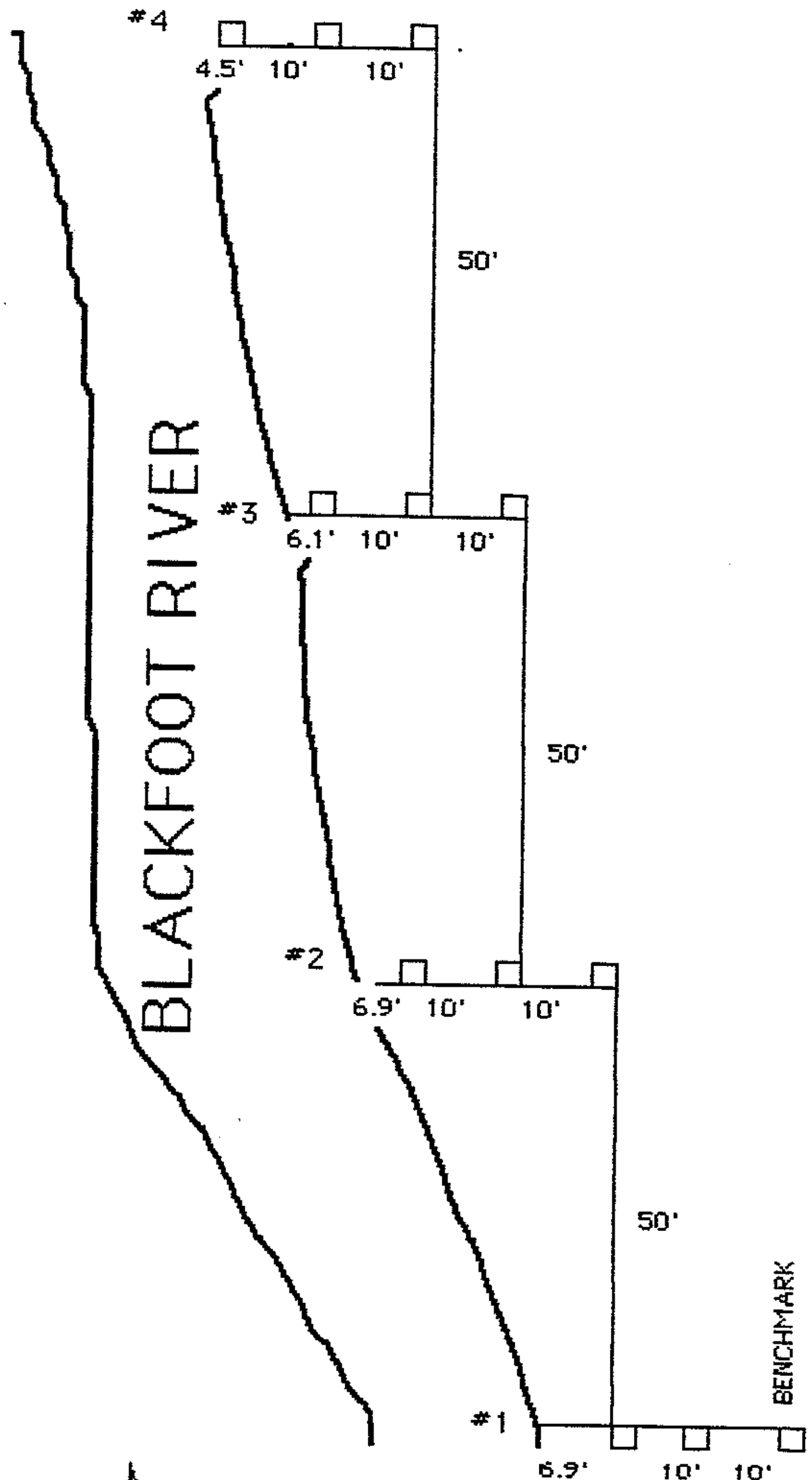
Figure 5. Streambank Erosion Site #2

Observed Erosion

Station	Cu. Yards	Tons
#1	0.00	0.00
#2	0.00	0.00
#3	0.00	0.00
#4	0.00	0.00

1.2 Tons = 1 Cu. Yard

Refer to text for explanation



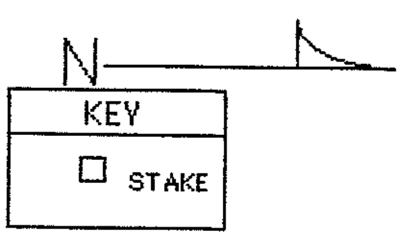


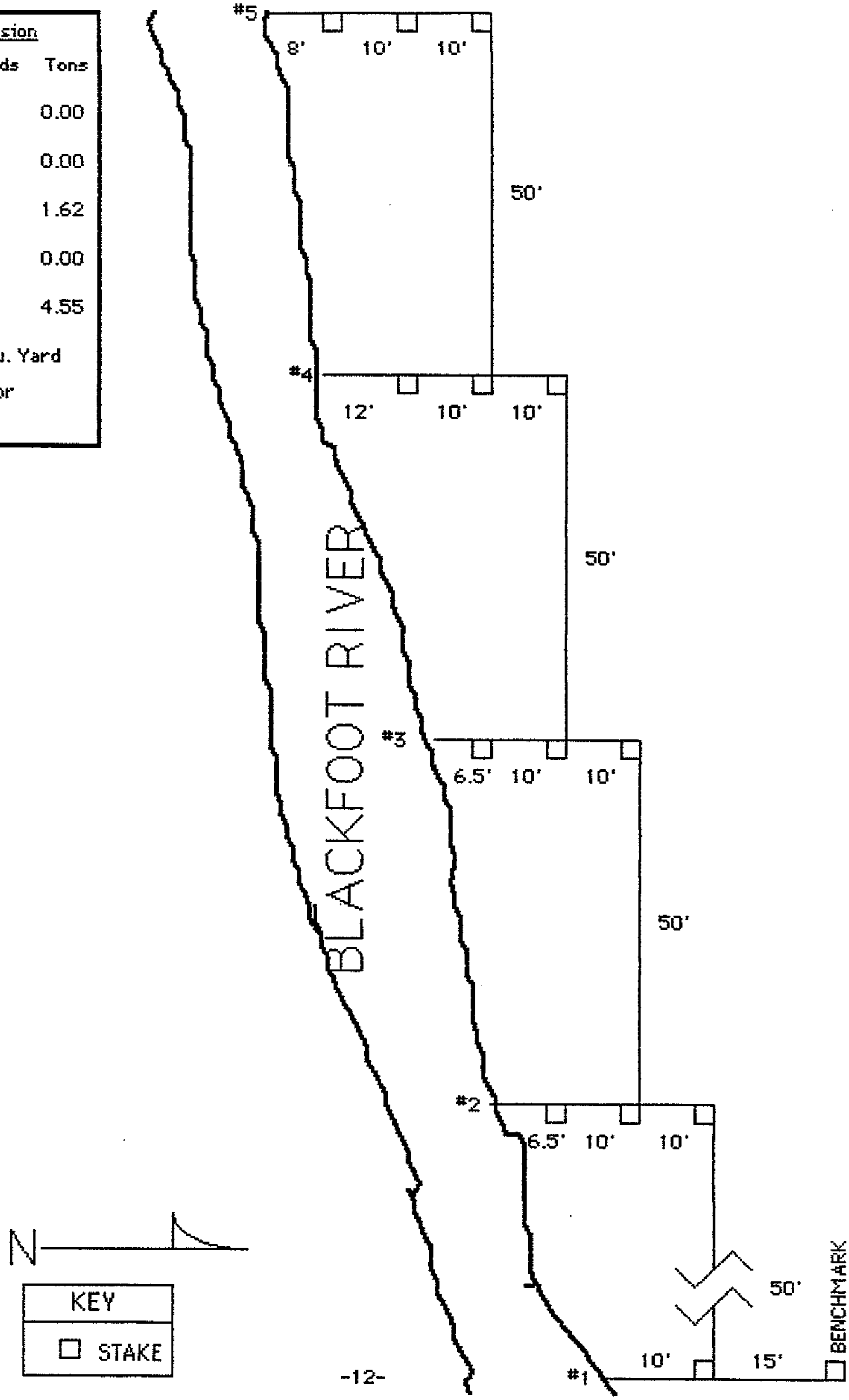
Figure 6. Streambank Erosion Site #3

Observed Erosion

Station	Cu. Yards	Tons
#1	0.00	0.00
#2	0.00	0.00
#3	1.35	1.62
#4	0.00	0.00
#5	3.79	4.55

1.2 Tons = 1 Cu. Yard

Refer to text for explanation



Phosphorus

Three major forms of phosphorus were monitored during the study. These were total phosphorus, dissolved ortho-phosphate, and total ortho-phosphate. Total ortho-phosphate was analyzed on November 19, 1986 and June 2 and 15, 1987 when problems of contamination of the dissolved ortho-phosphate samples occurred.

Total phosphorus includes all forms of phosphorus present. Total ortho-phosphate and dissolved ortho-phosphate are those portions which are dissolved in water and ready for plant uptake. Dissolved ortho-phosphate was filtered on site through a 0.45μm filter. Total ortho-phosphate is filtered at the laboratory. Bauer (1987) states that comparison of total ortho-phosphate and dissolved ortho-phosphate concentrations shows an increase in the amount of ortho-phosphate when it is filtered in the laboratory. This he attributes to the soil bound phosphorus becomming hydrolized in transit.

Bacteria

Two bacterial parameters were sampled during this study. The first, fecal coliform, is found in the intestines of warm blooded animals and is used as an indicator of fecal contamination of the water. Streptococcus, the second, indicates wastes of livestock origin. Both bacteria types are reported in terms of numbers per 100 ml of sample. A ratio of the fecal coliform to streptococcus colonies can be used to determine the source of the contamination (Clark 1985b, 1986).

QUALITY ASSURANCE

Duplicate samples were collected each sampling date from Wolverine Creek at Alridge Road to measure precision. Chemical samples were divided with the churn splitter. Average relative ranges were calculated according to Bauer (1986).

Spiked field samples were used to determine accuracy. Laboratory supplied spikes were added to 900ml of sample water. Spiked samples were analyzed for suspended sediment, nitrate+nitrite, TKN, ammonia, total phosphorus, and dissolved o-phosphate. A different sampling site was selected for spiking each sampling run. Percent recovery is determined by subtracting the values of the unspiked samples from the spiked samples and comparing this figure with the known amount in the spike.

RESULTS AND DISCUSSION

FLOW

Flows in the Blackfoot River are directly influenced by the Blackfoot Reservoir releases. Water is stored during the winter and spring months resulting in lower flows in the Blackfoot River. During the summer months, this water is released for irrigation purposes, increasing the river flow greatly. In 1987, the flow increased rapidly between April 13 and May 4 due to irrigation releases from the Blackfoot Reservoir. Discharges recorded by the USGS at station 2 showed an increase from 224 cfs to 666 cfs during this time.

Discharges from the tributaries were lower than normal due to the extremely dry winter and slow spring melt. The highest flow recorded on the tributaries was 20.9 cfs at Wolverine Creek at Alridge Road (Tables 3-12). The mean flows for the tributaries at the lowest stations were: Wolverine Creek 11.7cfs; Jones Creek 1.6 cfs; Cedar Creek 2.8 cfs; Miner Creek 4.2 cfs.

One storm event occurred on May 16 causing considerable damage. A thunderstorm moved through the lower part of the study area affecting sampling stations 2 and 3. Although samples and rainfall amounts were not taken during the storm, the damage was apparent. The land surrounding the USGS gauge was severely eroded by the storm. The access road to the gauge station was completely blocked by debris and rock up to 3' in diameter, and was rutted to bedrock with some of the ruts 6' deep and 3' wide.

The main flow of water came from a watershed of about 200 acres which was planted in potatoes and grain. Sediment flowed down the watershed into the landowners yard burying it in 4' of soil. The sediment then filled in a 2' deep stock pond and cascaded into the Blackfoot River valley. The stream channel at the cascade dug into the bedrock pushing rock into the river. This stream channel eroded down 6' and averaged 20' wide for over 100' loosing an estimated 530 tons of soil to the river. USGS gauge records for that date showed a high of 9.10 ft. at 1500 hrs., and 7.45 ft. (1040 cfs) 3 hours earlier. USGS conversion tables end at 8.50 ft. with a flow of 2120 cfs so it is not possible to know the actual flow.

The station on Wolverine Creek at Alridge Road (Station 3) was also impacted by this storm. The 5' flow gauge installed by the IDHW-DOE was topped and damaged by the flow in Wolverine Creek. Water flowed over the road depositing 4 inches of silt on the road. Estimated flow at this station, assuming a velosity of 7 ft./sec., was greater than 200 cfs.

SUSPENDED SEDIMENT

There were three major contributors of suspended sediment to the tributaries; agricultural runoff, range and fenced cattle, and mass wasting in the streams. It was not possible to determine the relative impacts of each of these contributers, because these practices occurred simultaniously in each watershed.

Recorded suspended sediment concentrations were highest during the March spring runoff, although samples taken after the storm event showed an increase in the sediment load at the lower Blackfoot River and lower Wolverine Creek stations.

Using the formula: (mg/l)*(0.0027)*(cfs)

where mg/l is the concentration in milligrams per liter and cfs is the flow in cubic feet per second, it is possible to determine the loading in tons/day (Table 2).

The data show Cedar Creek contributed the greatest amount of suspended sediment to the Blackfoot River with an average of 60.8 tons/day. This data is skewed by the high reading on March 2. Although there are large areas where mass wasting is occurring (Figure 3), the farmland in the lower stream reaches was in the fallow phase of a grain-fallow rotation, and probably contributed the greatest amount of sediment to Cedar Creek. Much of this land was placed into the conservation reserve program (CRP) in 1987, but had not been seeded as of March 2. With this land in CRP, most of the sediment and related pollutants are expected to come from mass wasting and the impacts of range cattle.

The Wolverine-Jones Creek drainage contributed the second largest amount of sediment to the Blackfoot River with an average of 6.3 tons/day. Of this amount, 63% was contributed by Jones Creek. Farmland in the Jones Creek drainage is steep (up to 20% slope) and is used in a grain-fallow rotation. There are large areas of mass wasting on Jones Creek (Figure 3), and the lower reaches are used as pasture. It is not known how much sediment is yielded by each source.

Table 2. Suspended Sediment Loading (Tons/ day) for the Tributaries

Date	STATION NUMBER 3	4	5	6	7	8	9
March 2	12.9	<0.1	6.5	540			
March 16	9.1	<0.1	12.0	1.3	0.9	<0.1	<0.1
March 30	7.3	0.3	0.2	3.1	3.9		<0.1
April 13	9.0	0.3	4.0	1.1	0.3		<0.1
May 4	1.5	0.7	3.7	0.3	0.4		0.2
May 19	9.9	0.3	8.3	0.1	0.4		0.4
June 2	3.9	0.2	0.5	<0.1	0.1		1.6
June 15	2.7	<0.1	0.1	0.3	0.1	0.2	0.1
July 6	<0.1	<0.1	<0.1	0.2	0.1		<0.1
Total	56.3	2.1	35.4	545	6.2	0.2	2.7
Mean	6.3	0.2	3.9	60.8	0.8	0.1	0.3

Sediment sources on Wolverine Creek include irrigation runoff, dryland farms, pasture, and one small (20 animal units) feedlot. There is very little mass wasting along this creek. The average daily sediment load at the mouth of Wolverine Creek was 6.3 tons/day of which 2.3 tons/day was not added by Jones Creek. 2.1 tons/day was added between the upper Wolverine Creek station and the lower Wolverine Creek station as a direct result of the sediment sources mentioned. The amount contributed from above the HH-A frame house was most likely due to natural erosion.

All other Blackfoot River tributary station data showed a sediment loading of less than 1 ton/day.

Mass Wasting

Three areas in the lower Blackfoot River study area show signs of severe mass wasting: the Blackfoot River between the USGS gauge station and Reid Bridge, Jones Creek, and Cedar Creek. Most of the mass wasting problems observed are man caused.

The lower Blackfoot River had severe streambank erosion problems along its entire length (Figure 3). The upper half of this stretch was modified in the early 1900's by an addition of a diversion dam (pers. comm. Wallace Reid). The addition of the dam modified the water current and slope causing the river to erode its banks (Binns, 1986). In 1985, this dam washed out increasing the water velocity, again causing modification of the stream flow. The diversion dam was rebuilt April 1987.

Natural streambank erosion is also occurring in the lower Blackfoot River as sediment is deposited on the inside curve of a stream meander. This deposition causes the river to exert more force on the outside of the meander resulting in increased streambank erosion (pers. comm. Shelby Brownfield).

Three streambank erosion measuring stations were situated on the lower streach of the Blackfoot River between stations 1 and 2 (Figures 4,5,and 6). The stations were established on March 9, 1987, and checked for erosion on August 29,1987. Using the assumption that a cubic yard of soil weighs 1.2 tons, a loading of 6.17 tons was recorded.

Cedar and Jones Creeks are both in the process of downdigging their streambottoms. Both streams have been diverted 5 or more times each, to provide larger areas of farmable lands or to save existing roads.

These streams will continue to downcut until a hard substrate is exposed. There were no erosion measuring sites located on these streams.

NUTRIENTS

Nitrogen

Nitrogen, one of the two nutrients tested for in this study, is an essential element in healthy plant growth. The most common use is as fertilizer. There are three major interconvertible types of nitrogen found in soil and water: organic nitrogen, ammonia (NH_3), and the nitrate and nitrite complex (NO_2 + NO_3). Nitrate nitrogen is soluable in water making it very mobile in damp soils. The concentration of nitrate+ nitrite nitrogen in stream water usually shows an inverse relationship with flow at a given sample site (Mackenthun, 1973).

Nitrates, nitrites, and ammonia are considered inorganic nitrogen compounds. A concentration of total inorganic nitrogen of 0.3 mg/l is considered the limit for the prevention of nuisance aquatic vegetation (Mackenthun, 1973). These recommendations were exceeded in 18 of the 89 samples taken. Seven of these exceedances occurred on the lower Blackfoot River (stations 1 and 2) during the low flow period of late fall and early spring, with no occurrances during high summer flows. All but one of the concentrations above 0.3 mg/l recorded at Jones Creek at Mouth were diluted by the larger flow of Wolverine Creek to below recommended limits. Cedar Creek at Alridge Road exceeded recommendations 5 times, but with the low flows and concentrations at this station the impact on the Blackfoot River was minimal.

Ammonia usually converts to nitrates and nitrites under natural conditions. Because of this, anhydrous (without water) ammonia is used as a fertilizer. Other sources of ammonia include animal wastes. Ammonia is the result of the natural breakdown of complex nitrogen based compounds under anaerobic conditions. Ammonia is toxic to many aquatic organisms in high concentrations. Ammonia standards were not exceeded at any time at any station (Idaho Water Quality Standards, 1987).

Natural waters exhibit TKN values between 0.05 and 2.0 mg/l (USGS, 1977). Seven of the 89 samples taken showed concentrations of TKN over 2.0 mg/l. These samples all came from areas where range cattle were kept and may indicate the washing of manure into the streams. There is no criteria set for excess TKN concentrations.

Phosphorus

Phosphorus is another of the primary plant nutrients, and is usually the limiting factor for healthy plant growth in eastern Idaho. The most common use of phosphorus is as a fertilizer, although some pest control sprays are phosphorus based. Most phosphorus is tightly bound to the soil particle with only a small amount (ortho-phosphate) dissolving in water. When high erosion occurs on farms, the bound phosphorus particles are washed away with the soil. It is not uncommon to note the increase in total phosphorus concentrations when the suspended sediment concentrations increase (Figure 7).

Total phosphorus concentrations exceeded the recommended criteria of 0.1 mg/l (Mackenthun,1973) 64% of the time (n=89). The lower tributary stations exceeded the recommendations on 24 of 31 occasions. On March 2, Wolverine Creek and Cedar Creek together contributed 0.492 tons of phosphorus to the Blackfoot River. These loading rates decreased through the summer as the flows decreased.

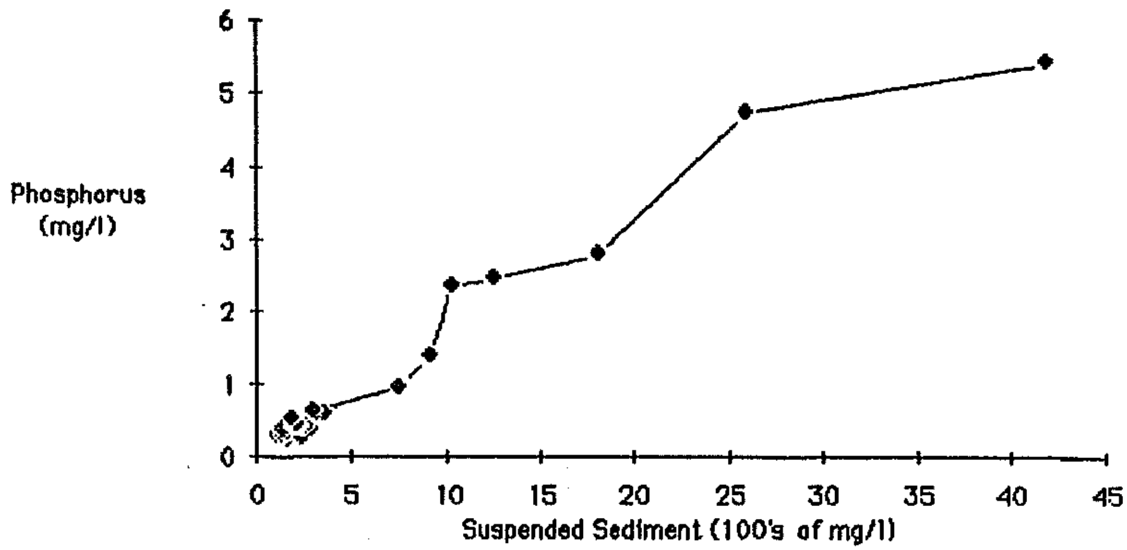
Dissolved ortho-phosphate concentrations followed the pattern shown for total phosphorus. The 0.025 mg/l recommendation (Mackenthun, 1973) was exceeded by 27 of 79 of the samples tested.

BACTERIA

This segment of the Blackfoot River (USB 350) is protected for primary contact recreation (Idaho Water Quality Standards, 1985). Under the bacterial standards the fecal bacteria count shall not exceed 500/100ml at any one time; nor shall the geometric mean exceed 50/100ml based on a minimum of 5 samples taken over a 30 day period. Since there was a maximum of three samples taken at any station during one month, the only standard which may be applicable is the 500/100ml one time standard.

Fecal coliform standards were exceeded in 9 of the 90 samples taken (Table 3). All of the violations were in areas where range cattle were located and under conditions of low flow. The fecal coliform-streptococcus ratios (Table 4) show the influence of livestock. 25 of the 90 samples indicate a mixed livestock-human influence and 4 of the 90 indicate human influences.

Figure 7. Suspended Sediment and Total Phosphorus for All Stations



One value set- 23,860 mg/l suspended sediment and 14.2 mg/l phosphorus- has been deleted from the figure for clarity.

Table 3. Fecal Coliform/Streptococcus Counts (colonies per 100ml)

	Station #									
Date	1	2	3	4	5	6	7	8	9	10
11-19-86	20	<10	IA	30	90	<10	IA	IA	120	IA
	110	10	-	10	50	50	-	-	70	-
2-17-87	<10	<10	<10	<10	<10	<10	IA	IA	IA	IA
	30	10	20	40	10	10	-	-	-	-
3-2-87	10	<10	<10	300	<10	60	IA	IA	IA	IA
	40	<10	<10	7100	780	4500	-	-	-	-
3-16-87	<10	<10	<10	40	40	30	<10	<10	10	IA
	10	30	<10	40	220	210	<10	<10	20	-
3-30-87	<10	<10	<10	<10	<10	290	<10	IA	<10	<10
	<10	<10	<10	10	30	70	30	-	<10	10
4-13-87	10	<10	<10	10	<10	20	<10	IA	20	<10
	<10	<10	10	10	20	20	<10	-	10	<10
5-4-87	60	<10	250	<10	160	330	*3200*	IA	<10	<10
	40	20	70	60	200	60	110	-	30	<10
5-19-87	40	50	350	40	*800*	200	*1400*	IA	390	IA
	820	280	1900	90	3000	1200	680	-	270	-
6-2-87	20	<10	50	170	470	110	*540*	IA	*9600*	10
	20	40	40	500	550	290	470	-	610	10
6-15-87	110	40	30	210	*610*	290	*1300*	470	90	440
	250	130	60	2000	2200	240	750	1700	140	20
7-6-87	200	<10	200	130	*2100*	160	*490*	IA	160	10
	60	30	350	610	25000	420	880	-	210	10

IA= Station Inaccessible. Italicized numbers exceed State Coliform Standards

Table 4. Fecal Coliform/ Streptococcus Ratios

Date	Station # 1	2	3	4	5	6	7	8	9	10
11-19-86	0.18	NA	IA	3.00	1.80	NA	IA	IA	1.17	IA
2-17-87	NA	NA	NA	NA	NA	NA	IA	IA	IA	IA
3-2-87	4.00	NA	NA	0.04	NA	0.01	IA	IA	IA	IA
3-16-87	NA	NA	NA	1.00	0.18	0.14	NA	NA	0.50	IA
3-30-87	NA	NA	NA	NA	NA	4.14	NA	IA	2.00	NA
4-13-87	NA	NA	NA	1.00	NA	1.00	NA	IA	2.00	NA
5-4-87	1.50	NA	3.57	NA	0.80	*5.50*	*29.1*	IA	NA	NA
5-19-87	0.05	0.18	0.18	0.44	0.27	0.17	2.06	IA	1.44	IA
6-2-87	1.00	NA	1.25	0.34	0.85	0.38	1.15	IA	*15.7*	1.00
6-15-87	0.44	0.31	0.50	0.11	0.28	1.21	1.73	0.28	0.64	*22.0*
7-6-78	3.33	NA	0.57	0.21	0.08	0.38	0.56	IA	0.76	1.00

Plain values indicate strictly livestock influence (ratio 0.00 to 0.79).

Underlined values indicate mixed human/livestock influences (0.80 to 4.19).

Italicized values indicate human influences (4.2 and greater).

NA= Ratio not applicable due to low coliform or strep plate counts.

IA= Sample site not accessable.

QUALITY ASSURANCE

Please refer to Table 5 for the precision of split samples and the average percent range, and to Table 6 for the accuracy (% recovery) and the confidence intervals on spiked samples. Precision was good for all parameters except ammonia (28.3%) and ortho-phosphate (29.5%).

There were not enough accuracy samples taken during the study to get a true assessment of the accuracy. The accuracy samples from the Canyon Creek study were added to the Blackfoot River study samples to increase the data base. Even then, the preferred number of 10 samples was not achieved. The Canyon Creek samples were taken in the same manner as the Blackfoot River samples, and they were analyzed at the same time. The accuracy of nitrate (103.8 $\pm$ 12.0) and ammonia (105.6 $\pm$ 11.1) were excellent, the TKN (109.4 $\pm$ 8.8) and total phosphorus (104.0 $\pm$ 3.5) were good, but the suspended sediment (81.0 $\pm$ 14.8) and dissolved ortho-phosphate (63.3 $\pm$ 18.5) were poor.

CONCLUSIONS and RECOMMENDATIONS

Drought-like winter conditions and a cooler than normal spring melt severly limited the scope of the study. There were no spring rains to accelerate the snow melt, and much of the runoff was adsorbed by the soil.

This study had two objectives: First, to determine the agricultural pollution impacts on the Blackfoot River. Second, to determine if stream erosion impacts the Blackfoot River.

The tributaries of the Blackfoot River had high amounts of suspended sediments, nitrates and nitrites, TKN, total phosphorus, ortho-phosphate, and bacteria, but, because of the low precipitation, the impacts on the Blackfoot River were minimal.

Although the streambank erosion monitoring sites were located in an area with high potential for mass wasting, the low winter precipitation combined with irrigation turnouts upstream caused extremely low flows and little erosion.

It is recommended the North Bingham Soil Concervation District receive a planning grant when the precipitation levels are more normal. This would allow the SCD to receive funds to help alleviate the problems created by livestock, mass wasting, and farming.

Table 5. Precision of Split Samples of Wolverine Creek at Alridge Road

PARAMETER	N	RANGE (%)
Suspended Sediment	7	3.7
Nitrate + Nitrite	9	7.0
Ammonia	9	28.3
Total Kjeldahl Nitrogen	9	7.7
Total Phosphorus	8	8.8
Dissolved Ortho-phosphate	6	29.5

Table 6. Accuracy (average % recovery) and the 95% confidence interval for the Blackfoot River and Tributaries

PARAMETER	N	AVE. % RECOVERY	95% CI
Suspended Sediment	7	81.0	± 14.8
Nitrate	9	103.8	±12.0
Ammonia	7	105.6	±11.1
Total Kjeldahl Nitrogen	7	109.4	±8.8
Total Phosphorus	9	104.0	±3.5
Dissolved ortho-phosphate	6	63.3	±18.5

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APPENDIX

Discharge (cfs), Suspended Sediments(mg/l), and Nutrients (mg/l) for the Blackfoot River at Reid Bridge (Station 1)

Date	Discharge	Suspended Sediment	NO_2 + NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
11-19-86		42	0.240	0.027	0.38	0.1	0.002
2-17-87	225		0.553	0.025	0.15	<0.05	0.025
3-2-87	118	198	0.334	0.119	1.52	0.39	0.061
3-16-87	336	72	0.275	0.053	0.56	0.18	0.038
3-30-87	350	32	0.124	0.032	0.46	0.19	0.057
4-13-87	275	14	0.014	0.018	0.40	0.09	0.019
5-4-87	375	150	0.156	0.055	0.95	0.30	0.039
5-19-87	275	298	0.212	0.054	0.98	0.60	
6-2-87	560	24	0.005	0.014	0.39	<0.05	0.008
6-15-87	300	142	0.041	0.053	0.73	0.24	0.006
7-6-87	300	54	0.041	0.040	0.54	0.11	<0.005

Underlined O-Phosphate is Total Ortho- Phosphate; not field filtered.

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Blackfoot River at USGS Gauge Station (Station 2)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
11-19-86	344	12	0.342	0.041	0.38	<0.1	0.002
2-17-87	122		0.498	0.084	0.34	0.09	0.018
3-2-87	317	188	0.328	0.111	1.78	0.52	0.023
3-16-87	400	58	0.267	0.052	0.58	0.16	0.031
3-30-87	365	40	0.173	0.041	0.48	0.09	0.018
4-13-87	224	16	0.023	0.023	0.49	0.09	0.008
5-4-87	666	98	0.130	0.057	0.93	0.21	0.034
5-19-87	868	114	0.195	0.043	0.68	0.27	
6-2-87	713	20	0.010	0.018	0.44	0.06	0.008
6-15-87	918	34	0.037	0.038	0.42	0.07	0.008
7-6-87	968	16	0.042	0.073	0.49	0.08	0.008

Underlined O-Phosphate is Total Ortho- Phosphate; not field filtered.

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Wolverine Creek at Alridge Road (Station 3)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
11-19-86		10	0.153	0.014	0.08	<0.1	0.005
2-17-87	7.8		0.245	0.058	0.34	0.17	0.014
3-2-87	19.2	4,195	0.194	0.088	5.44	3.47	0.012
3-16-87	13.5	252	0.151	0.023	0.51	0.38	0.003
3-30-87	9.6	283	0.130	0.026	0.38	0.35	0.010
4-13-87	20.9	159	0.091	0.024	0.47	0.32	0.005
5-4-87	10.6	52	0.075	0.059	0.31	0.19	0.027
5-19-87	15.1	244	0.136	0.033	0.55	0.25	
6-2-87	16.3	90	0.066	0.017	0.33	0.16	0.009
6-15-87	6.3	159	0.119	0.064	0.37	0.21	0.017
7-6-87	0.3	2	0.055	0.107	0.15	<0.05	<0.005

Underlined O-Phosphate is Total Ortho- Phosphate; not field filtered.

Discharge (cfs), Suspended Sediment (mg/1), and Nutrients (mg/1) for Wolverine Creek at HH A Frame Home (Station 4)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
2-17-87	7.0		0.140	0.151	0.13	<0.05	0.008
3-2-87	11.5	4	0.193	0.024	0.73	0.98	0.008
3-16-87	9.1	2	0.132	0.019	0.07	<0.05	0.003
3-30-87	10.2	10	0.133	0.036	0.10	0.04	<0.002
4-13-87	18.8	6	0.128	0.017	0.11	<0.05	0.003
5-4-87	19.1	14	0.038	0.034	0.15	<0.05	<0.001
5-19-87	5.3	18	0.119	0.014	0.17	0.05	
6-2-87	6.9	10	0.088	0.014	0.09	<0.05	<0.003
6-15-87	6.1	2	0.040	0.076	0.05	<0.05	0.007
7-6-87	6.2	<2	0.018	0.052	0.10	<0.05	<0.005

Underlined O-Phosphate is Total Ortho- Phosphate; not field filtered.

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Jones Creek at Mouth (Station 5)

Date	Discharge	Suspended Sediment	NO_2 + NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
11-19-86		22	0.251	0.014	0.65	0.41	0.038
2-17-87	2.9		0.494	0.547	0.51	0.37	0.041
3-2-87	2.6	920	0.468	0.075	2.16	1.37	0.100
3-16-87	1.7	2,608	0.398	0.801	6.41	4.77	0.031
3-30-87	0.4	218	2.37	0.032	0.63	0.40	0.024
4-13-87	1.2	1,260	0.362	0.034	2.95	2.48	0.041
5-4-87	3.8	358	0.167	0.019	0.92	0.59	0.026
5-19-87	1.7	1,810	0.229	0.040	2.44	2.80	
6-2-87	0.9	218	0.128	0.027	0.96	0.43	0.025
6-15-87	0.6	54	0.093	0.035	0.38	0.11	0.003
7-6-87	0.7	12	0.029	0.077	0.42	0.10	<0.005

Underlined O-Phosphate is Total Ortho- Phosphate; not field filtered.

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Cedar Creek at Alridge Road (Station 6)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
11-19-86		62	0.342	0.034	0.33	0.15	<u>0.038</u>
2-17-87	2.8		0.108	0.062	0.30	0.08	0.035
3-2-87	8.3	23,860	0.403	0.205	20.1	14.2	
3-16-87	2.1	224	0.288	0.074	0.80	0.39	0.022
3-30-87	1.5	756	0.509	0.041	1.49	0.95	0.050
4-13-87	4.2	98	0.218	0.034	0.53	0.21	0.033
5-4-87	2.6	48		0.058	0.45	0.13	0.020
5-19-87	0.6	42	0.188	0.034	0.66	0.24	
6-2-87	1.2	52	0.170	0.041	0.42	0.14	<u>0.034</u>
6-15-87	2.4	52	0.240	0.059	0.50	0.13	<u>0.031</u>
7-6-87	2.4	28	0.268	0.110	0.48	0.12	0.011

<u>Underlined</u> O-Phosphate is Total Ortho- Phosphate; not field filtered.

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Cedar Creek at Cattlemens Association Gate (Station 7)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
3-16-87	1.9	182	0.084	0.012	0.54	0.35	0.016
3-30-87	1.4	1,036	0.089	0.045	2.55	2.39	0.014
4-13-87	1.4	90	0.059	0.025	0.53	0.20	0.022
5-4-87	1.3	106	0.003	0.034	0.78	0.23	0.004
5-19-87	1.1	150	0.011	0.018	1.11	0.36	
6-2-87	0.9	38	0.018	0.083	0.47	0.11	<u>0.025</u>
6-15-87	1.2	30	0.008	0.041	0.44	0.10	<u>0.024</u>
7-6-87	0.8	38	0.009	0.061	0.57	0.13	0.011

<u>Underlined</u> O-Phosphate is Total Ortho- Phosphate; not field filtered.

Discharge (cfs), Suspended Sediment (mg/1), and Nutrients (mg/1) for Cedar Creek at Cattlemens Association Cabin (Station 8)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
3-16-87	0.9	66	0.146	0.017	0.44	0.20	0.027
6-15-87	0.6	94	0.035	0.038	0.70	0.18	<u>0.034</u>

<u>Underlined</u> O-Phosphate is Total Ortho- Phosphate; not field filtered.

Discharge (cfs), Suspended Sediment (mg/l), and Nutrients (mg/l) for Miner Creek at Mouth (Station 9)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
11-19-87		110	0.036	0.020	0.42	0.20	0.044
3-16-87	0.2	46	0.036	0.017	0.45	0.14	0.037
3-30-87	2.6	80	0.062	0.020	0.39	0.17	0.024
4-13-87	1.5	14	0.026	0.022	0.29	0.07	
5-4-87	2.4	34	0.024	0.011	0.44	0.09	0.028
5-19-87	3.0	48	0.112	0.045	0.49	0.16	
6-2-87	1.9	320	0.020	0.076	1.54	0.58	<u>0.057</u>
6-15-87	4.2	12	0.021	0.035	0.28	0.08	<u>0.034</u>
7-6-87	3.4	<2	0.007	0.042	0.21	0.06	0.023

<u>Underlined</u> O-Phosphate is Total Ortho- Phosphate; not field filtered.

Discharge (cfs), Suspended Sediment (mg/1), and Nutrients (mg/1) for Blackfoot River at Trail Creek (Station 10)

Date	Discharge	Suspended Sediment	NO_2+ NO_3-N	NH_3-N	TKN	TP-P	O-Phos.
3-30-87	240	24	0.207	0.076	0.46	0.09	0.019
4-13-87	225	8	0.034	0.034	0.73	0.12	0.025
5-4-87	425	72	0.026	0.089	0.73	0.15	0.027
6-2-87	425	22	0.025	0.028	0.51	0.06	<u>0.011</u>
6-15-87	325	20	0.014	0.051	0.66	0.05	<u><0.001</u>
7-6-87	350	14	0.012	0.045	0.48	0.08	0.012

<u>Underlined</u> O-Phosphate is Total Ortho- Phosphate; not field filtered.