WATER QUALITY STATUS REPORT ● REPORT NO. 65

LAPWAI/MISSION CREEK
Lewis County, Idaho
1986

Agricultural Nonpoint Source
Pollution Abatement Program

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ABSTRACT

Lapwai Creek was identified in the Agricultural Nonpoint Source Pollution Abatement Program as a first priority stream segment for reduction of agriculture related pollutants. As part of the planning process a water quality study was conducted on the Mission/Lapwai drainage from February 25, 1985 to April 8, 1986. The objectives of the study were to: 1) determine baseline water quality in various reaches of Mission/Lapwai Creeks; 2) document the effects of storm event runoff on water quality in Mission/Lapwai Creeks..

Lapwai Creek is a tributary of the Clearwater River which it joins 11 miles east of Lewiston. There are 85,400 acres in the Mission/ Lapwai Creek project area. Mission Creek is the major tributary of Lapwai Creek and drains 44,900 acres. Current beneficial uses of these streams are as domestic and agricultural water supplies, for primary and secondary contact recreation, cold water biota, and anadromous fishery habitat. Winchester Lake, at the head of the Lapwai Creek drainage, is designated as a Special Resource Water.

Water quality in these streams is most severely impacted by two periods, runoff and low flows. Periods of minimal discharge, less than three cubic feet per second (cfs), normally occur from early May to the next January. Flash-flood events may occur at any time due to thunderstorms, but are most common during spring in response to snowmelt runoff and chinook winds and accompanying rains. Seventy-two percent of the flows at the U.S.G.S. gauging station on Lapwai Creek at Lapwai originate from the project area. The Lapwai Creek drainage above Mission Creek provided 34% of the discharge recorded at the U.S.G.S. gauging station contributed another 38% of the U.S.G.S. recorded discharge. The estimated peak discharge near Culdesac, in 1985, was over 300 cfs. A ten-year frequency flood event, on February 23,1986, peaked between 1100 and 1600 cfs. Mission Creek peaked between 600 and 900 cfs on the same day.

Most of the sediment load lost from the drainage was delivered during the storm events. Ninety-two percent of the 1400 tons of sediment from Lapwai Creek was lost during the April 2, 1985 storm.

Although it was unmeasured, we estimate that between 1800 and 7000 tons of suspended sediment were lost during the February 23,1986 storm. Each of the drainages contributed amounts of sediment in proportion to their relative surface areas.

The influx of nutrients were event related. At least 800 lbs. of ammonia; 52,000 lbs. of nitrite + nitrate; and 6000 lbs. of phosphorus were discharged from the Lapwai Creek drainage. Mission Creek exported 600 lbs. of ammonia; 24,000 lbs. of nitrite + nitrate; and 2600 lbs. of phosphorus.

The total sediment and nutrient loads reported herein are considered to be 10-20% of the loads annually lost from the Mission/ Lapwai drainage. Factors that minimized the recorded loads were: a 23% below normal precipitation; a 25% below normal discharge at the Lapwai U.S.G.S. station; and inadequate sampling data, particularly of peak flow events.

Acknowledgements

The contributions of the following individuals are gratefully acknowledged: the Lewis S.W.C.D. for guidance and interest in mitigating water quality pollution; Jim Graham, 'Biff' Burleigh and the personnel of the Lewis and NezPerce S.C.S. field offices for background on the Mission/Lapwai area; John Moeller and Steve Bauer for editorial review and technical assistance.

List of Tables and Figures

INTRODUCTION

The Lewis Soil & Water Conservation District (SWCD) signed an Idaho Agriculture Nonpoint Source Pollution Abatement planning grant agreement with the Idaho Division of Environment (DOE) in July of 1985. Lapwai Creek had been identified by the DOE and the 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 Lapwai Creek watershed for implementation of Best Management Practices (BMPs) to reduce water pollution caused by agricultural practices. Part of this planning process included a water quality monitoring study of Lapwai Creek.

Lapwai Creek originates at the base of Mason Butte, and flows north and west for 30 miles to its confluence with the Clearwater River, 11 miles east of Lewiston, Idaho (Figure 1). There are five major second and third order tributaries to Lapwai Creek; Tom Beall, Soldier's Canyon, Garden Gulch, Sweetwater Creek and Mission Creek. Mud Springs reservoir and Winchester Lake are located at the upper end of Lapwai Creek. Winchester Lake is showing the signs of rapid eutrophication associated with excessive nutrient loading. The source of nutrients is suspected to be from the land use practices in the watershed, and internal nutrient cycling within the lake (Moeller, 1986).

Current usages of Lapwai Creek are as a domestic and agricultural water supply, for primary and secondary contact recreation, cold water biota, and as an anadromous fishery habitat. Winchester Lake near the headwaters of the stream is designated as a Special Resource Water.

Approximately 245 square miles are contained in the Lapwai drainage. The topography is characterized by rolling plateaus and ridgetops, with slopes of three to seven percent, steep canyons with 70 percent slopes and "U" shaped valleys with slopes to 20 percent. Elevations range from 4300 feet at the foot of Mason Butte to 800 feet at the confluence of Lapwai Creek with the Clearwater River. Annual precipitation ranges from an average of 22 inches per year at Culdesac, to 28 inches per year at Mason Butte (S.C.S., 1985).

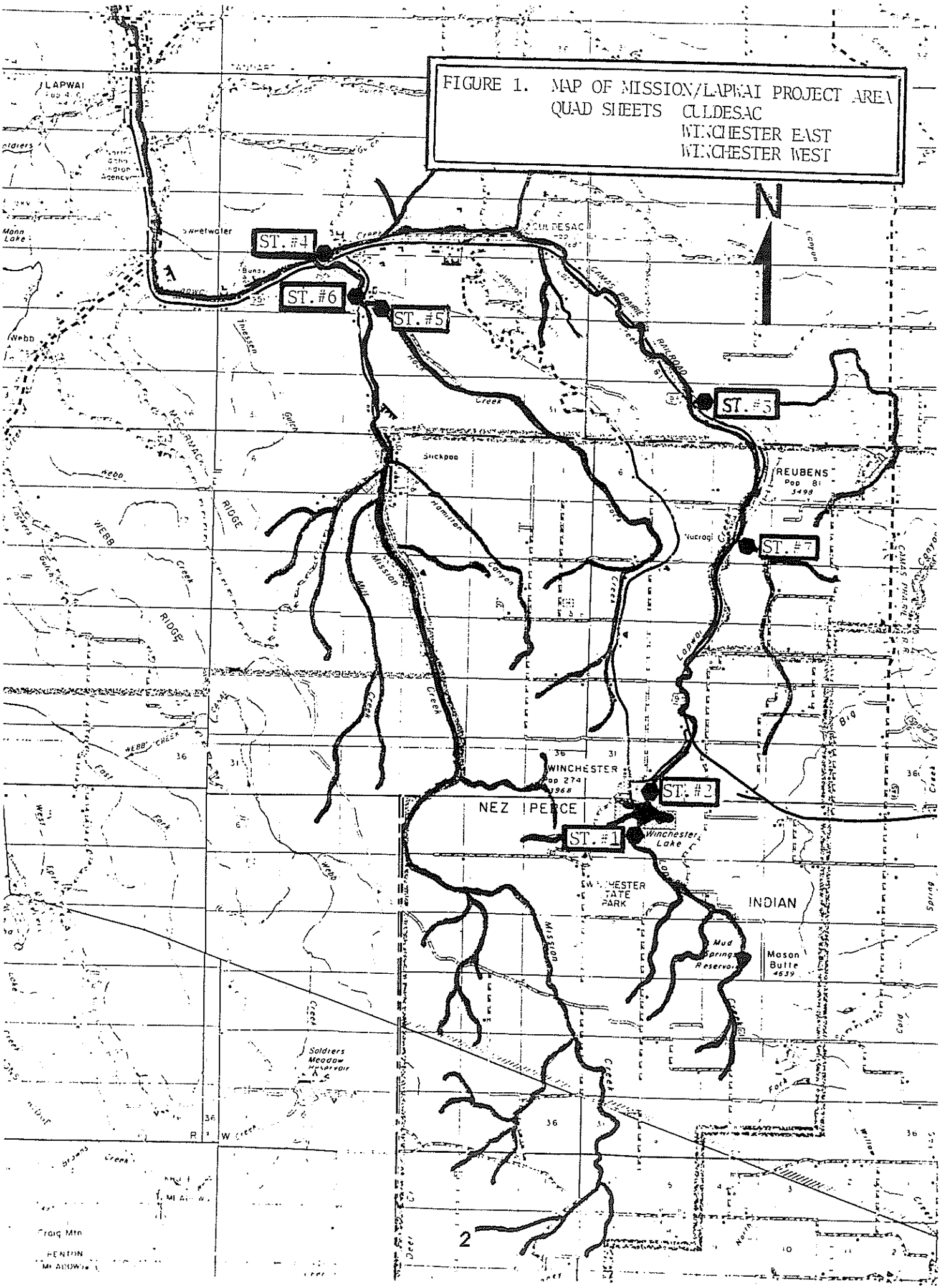


FIGURE 1. MAP OF MISSION/LAPWAI PROJECT AREA
QUAD SHEETS CULDESAC
WINCHESTER EAST
WINCHESTER WEST
N
ST. #1
ST. #2
ST. #3
ST. #4
ST. #5
ST. #6
ST. #7
LAPWAI
Sweetwater
CULDESAC
REUBENS
Pop 81
WINCHESTER
Pop 274
NEZ PERCE
INDIAN
Winchester Lake
Mason Butte
Mud Spring Reservoir
Soldiers Meadow Reservoir
Mann Lake
Webb
Stickpoo
Hamilton
Mission
Lapwai
Creek
RIDGE
WEBB
CANAL PRAIRIE
RAILROAD
2

The Mission/Lapwai project area encompasses the 85,400 acres of the headwaters of Lapwai Creek, downstream to and including the Mission Creek drainage. Eight hundred people live in the project area; most reside in the population centers of Winchester, Culdesac, and Reubens. Seventy operators manage the 35,000 acres of cropland; 12,000 acres of hay and pasture; 15,200 acres of grazable forest land; and 22,600 acres of timber and range in the project area (Table 1). All of the project area is within the NezPerce Indian Reservation but only 8,725 acres are owned by the Tribe.

Mission Creek is a tributary to Lapwai Creek, and drains approximately 70 square miles. The confluence is nine miles south of the mouth of Lapwai Creek. Rock Creek, Hamilton Canyon, and Mill Creek are the major tributaries of Mission Creek. Most of the agricultural lands are at the head of the drainage, on the ridgetops and the valley floor. Extensive logging of the canyon slopes was conducted in the late 1930's and again in the 1950's. A limestone quarry, opened in 1932, is operated intermittently by the NezPerce Indian Tribe.

Mission Creek was a major spawning area for anadromous fish and a traditional steelhead snag fishery for the NezPerce Tribe until about 25 years ago. The NezPerce Fisheries Resource Agency has included Mission Creek in its anadromous fisheries habitat improvement program.

Study Objectives

The objectives of the planning study were to : (1) determine baseline water quality in various reaches and sub-watersheds; (2) document the effects of storm event runoff on water quality in Lapwai 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 sub-samples were drawn. Grab samples were taken from turbulent stream reaches that provided mixing of potential laminar flows during minimal discharge.

Table 1. Land Use of Total Drainage Area, (Cumulative Acres)[Δ] Above Each Station.

St.	STORET	Station Description	Dryland Ag.	Hay/ Pasture	Grazable Forest	Forest/ Range	Other	Total
1	2020246	Lapwai Ck. above Win. Lake	------	------	------	-----	----	4700
2	2020115	Winchester Lake Outlet	3100	900	3500	0	340	7840
3	2020247	Lapwai Ck. midway to Mission Ck.	------	------	------	-----	----	28900
4	2020113	Lapwai Ck. below Culdesac	20300	2700	5800	11100	600	40500
5	2020248	Rock Ck. 1/2 mi. from mouth	4500	2000	1600	2500	0	10600
6	2020249	Mission Ck. 1.4 mi. from mouth	14700	9300	9400	11500	0	44900
7	2020250	Tributary to Lapwai Ck. at Nucrag	------	-----	-----	-----	----	3800
Total Project Area			**35000**	**12000**	**15200**	**2260**	**600**	**85400**

Δ Includes Acreages From Previous Stations

* Courtesy of Lewis Soil Conservation Service

--- Data Unavailable

Sample Sites

Upper Lapwai Creek and Mission Creek are suspected of contributing significantly to the sediment and nutrient loads of the Clearwater River. Seven water quality monitoring sites were chosen to evaluate the contribution by specific subdrainages to Lapwai Creek (Figure 1).

a) Station #1 is located above Winchester Lake.

b) Station #2 is below the dam. Samples drawn there characterized Winchester Lake and the wastewater discharged from the town of Winchester.

c) Station #7, at Nucrag, is a tributary which originates along the ridge east of Lapwai Creek, and joins Lapwai Creek three and a half miles north of Winchester.

d) Station #3 is half way down the Culdesac canyon. Water samples taken there include the influent from a sub-watershed from the Reubens area. There are approximately 10 square miles in the Reubens drainage, accounting for 40% of the area above St.#3 not including the watersheds above St.#7 and St.#2.

e) Station #4, the last site on Lapwai Creek, is below the town of Culdesac, just above the confluence of Mission and Lapwai Creeks.

f) Station #5 is at the mouth of Rock Creek, a major tributary to Mission Creek, was sampled early in the study, but was discontinued as a monitoring site in 1986 because of its limited contributions to the suspended sediment loading of Mission Creek.

g) Station # 6 is on Mission Creek about 200 yards below the Rock Creek confluence, approximately 1.4 miles from Lapwai Creek.

Sample Frequency

This study was designed to monitor water quality during spring and storm runoff events when the maximum influx of nutrients and suspended sediment typically occurs. These peak events usually occur in the spring when chinook winds deliver driving rains which melt the snowpack.

A sample schedule was established that provided flexibility to respond to storm events as they occurred. Intermediate data were gathered approximately 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. Thirteen sample sets were taken.

Parameters

Agricultural practices may contribute substantially to the sedimentation and nutrient loading of Lapwai Creek and subsequently to the Clearwater River. Some of the sample parameters provide an indication of nutrients typically leached from farm fields. Other parameters are general indicators of water quality which highlight changes in designated beneficial uses of a particular stream segment (Table 2).

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

Discharge

The methods used to determine discharge in this study were as outlined by the U.S. Geological Survey (U.S.G.S., 1977). Provisional discharge data of the U.S.G.S. gauge station # 1334250, at Lapwai, Idaho was provided by the Sandpoint, Idaho U.S.G.S. Field Office (U.S.G.S. 1986). Instantaneous discharge at a given point was calculated from the cross-sectional area of the stream and the stream velocity.

Table 2. Sample Parameters for Lapwai/Mission Creek Water Quality Study

Parameter	unit	STORET #
Stream Discharge	CFS	00061
Crest Gauge	ft.	None
Water Temperature	°C	00010
pH	S.U.	00400
Turbidity	NTU	00076
Specific Conductivity	µmhos/cm	00665
Suspended Sediments	mg/L	80154
Total Phosphorus as P (T.P.)	mg/L	00665
Total Hydrolyzable Phosphorous as P (T.H.P.)	mg/L	00669
Orthophosphate as P ($O'PO_4$)	mg/L	70507
Total Kjeldahl Nitrogen as N (TKN)	mg/L	00625
Total Nitrite + Nitrate as N (NO_2+NO_3)	mg/L	00630
Total Ammonia as N (NH_3)	mg/L	00610
Fecal Coliform	#/100 ml	31616
Fecal Streptococcus	#/100 ml	31679

Evidence of peak discharges was gathered by use of crest gauges anchored in the stream bed (Figure 2). Crest gauges were used at stations #1 (above Winchester Lake), #5 (on Rock Creek), #7 (at Nucrag) to provide details on peak discharges that would have been missed otherwise.

Direct measurement of velocity was made with a Marsh McBirney, Model 201, current meter whenever possible. During high flow the "orange peel" method was used. 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 and crest gauge readings allowed estimation of depths.

A regression equation for peak discharges of ten year frequency was adopted from Thomas (1973). The Manning equation was also used to determine the peak discharges of storm events (U.S.G.S., 1977).

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

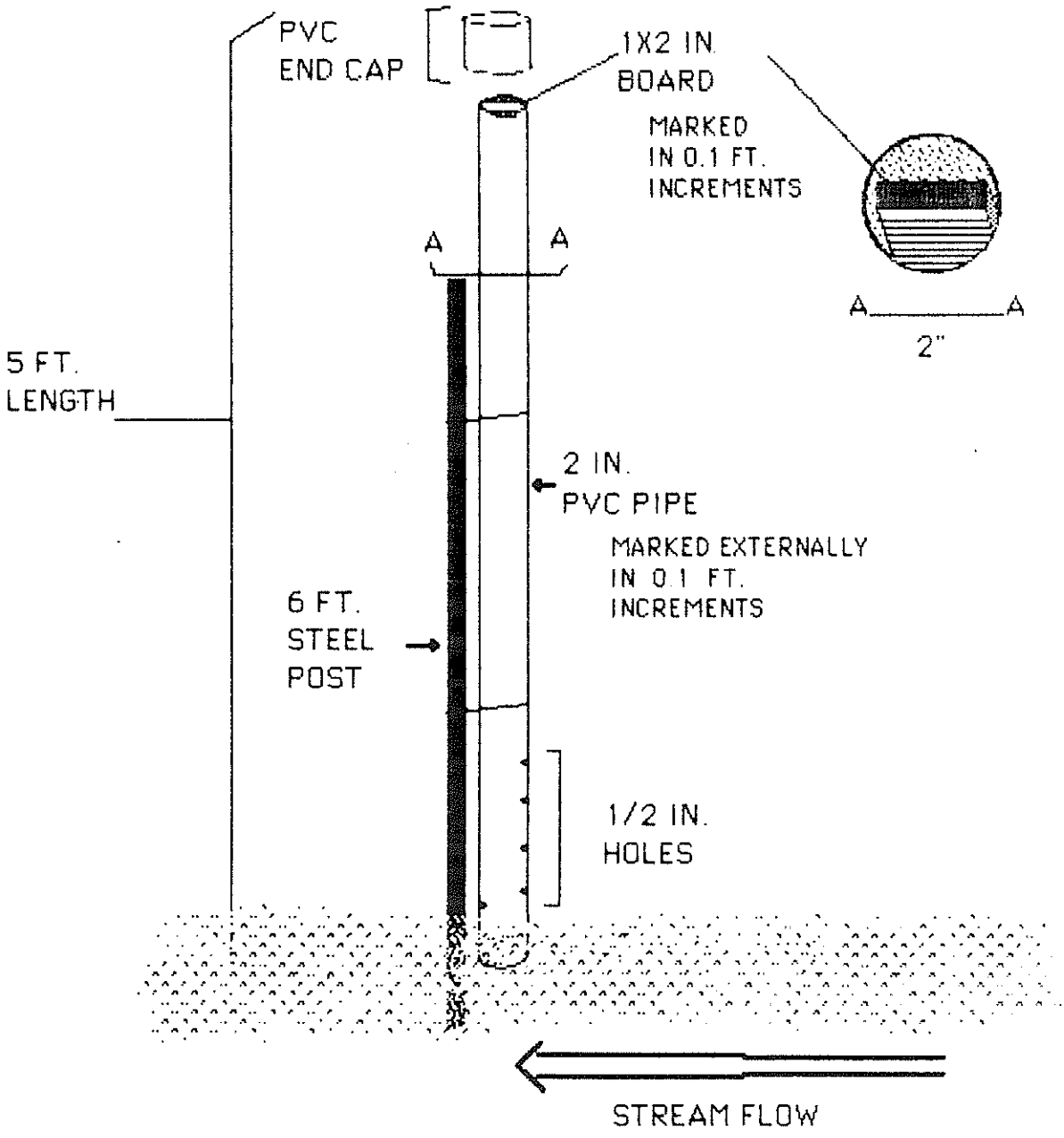
Conductivity is a numerical expression of the ability of a water sample to carry an electrical current. It is dependent on the total concentrations of the total dissolved solids and salts in the water (APHA, 1985). Conductivity and temperature measurements were taken with a YSI, Model 33, S-C-T meter.

Suspended Sediment

Suspended sediment concentrations are one of the prime 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 (Clark, 1985).

FIGURE 2. STREAM CREST GAUGE

NOTE: GROUND CORK IS PLACED IN THE GAUGE AS THE WATER RECEDES THE CORK ADHERES TO THE MEASURING ROD.



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 laboratory for analysis.

Phosphorus

The three major forms of phosphorus that were monitored during this study were total phosphorus (T.P.), dissolved orthophosphate ($O'PO_4$), and hydrolyzable phosphorus (T.H.P.). Total phosphorus includes all the forms of phosphorus present in the sample. Total hydrolyzable phosphorus includes the phosphorus easily hydrolyzed to the dissolved state; sources include organically bound phosphorus and some fertilizers . Orthophosphate is the dissolved fraction, and is the form most readily available for plant uptake.

Total and hydrolyzable phosphorus samples were preserved with 2 ml of concentrated sulfuric acid. The samples to be analyzed for dissolved orthophosphate were filtered on site through a 0.45 µm pre-washed membrane filter and sent on ice to the Boise laboratory for analysis.

Bacteria

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

Quality Assurance

This project served as part of a series of quality assurance checks by the DOE on precision and accuracy of sampling procedures. Duplicate and spiked samples were collected from various stations and on different dates. Samples collected by SCS personnel, under DOE

supervision, were considered as duplicate samples. The data on accuracy were pooled for several projects and results were compiled (Bauer, 1985). The methods used to estimate the average relative range for precision followed the methods outlined by Bauer.

RESULTS

Discharge

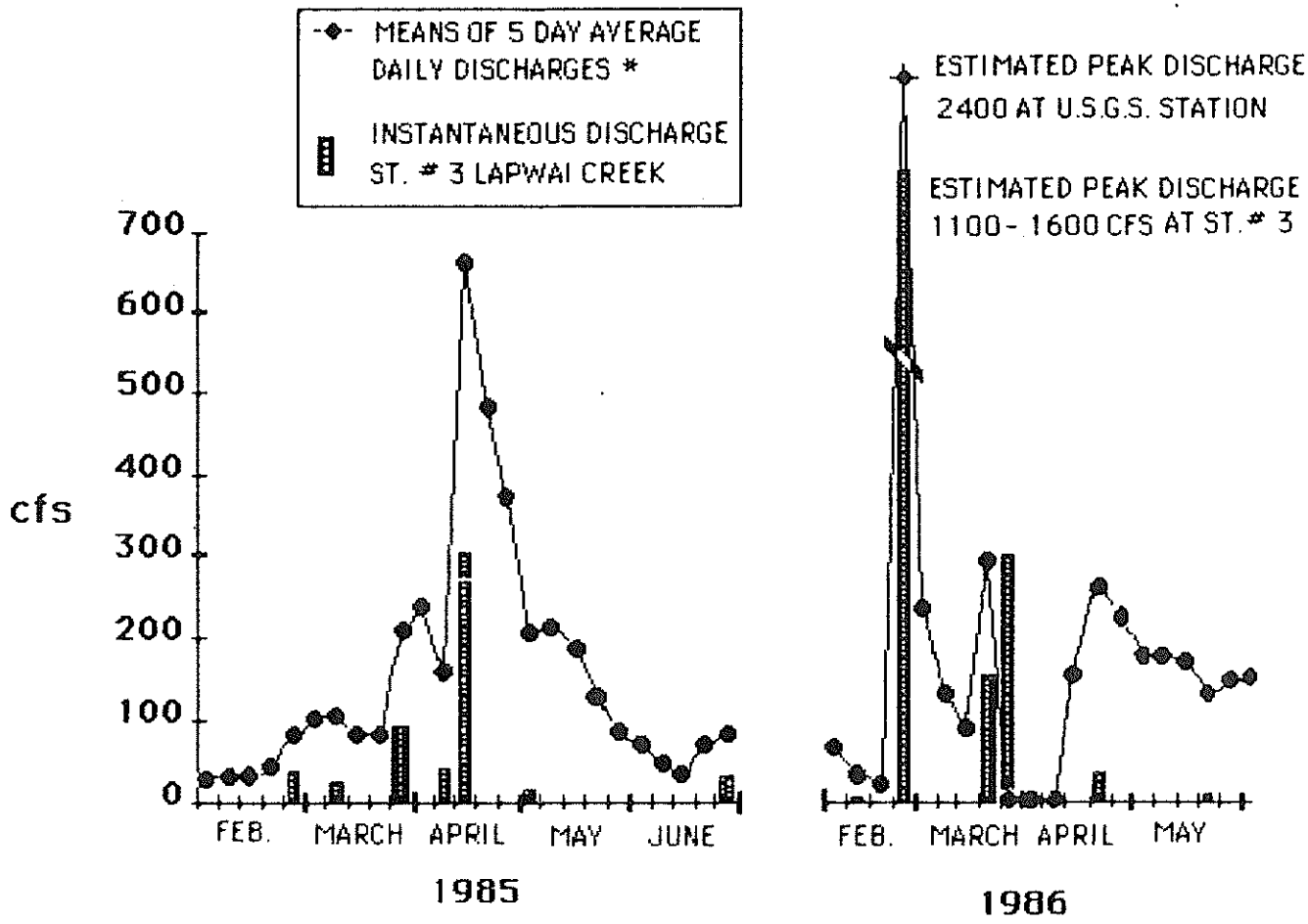
The Mission and Lapwai Creek drainages are subject to extremes in discharge throughout the year. Minimal discharges of less than 1 to 3 cubic feet per second (cfs) are released and/or leak from the Winchester Lake dam and outlet throughout the summer. Spring runoff increases the release from the impoundment to approximately 100 cfs for several weeks. The base flows are augmented by intense, short duration, flash floods caused by thunderstorms or chinook snowmelts.

Average discharge recorded at the Lapwai U.S.G.S. station for the last eleven years is 91.3 cfs. The previous ten-year peak recorded discharge was 2,200 cfs on December 1, 1975. An estimated 2,400 cfs was discharged on February 23, 1986 at the gauging station. The peak estimated discharge, for the period of record at this site, was 4,350 cfs in January, 1965 (U.S.G.S., 1986).

The 1985 spring runoff was typical in its timing as it started in mid-March and continued until mid-April The U.S.G.S. gauging station at Lapwai recorded the peak discharge of 1,100 cfs on April 3, 1985. The peak estimated discharge at St. #4, below Culdesac, was 300 cfs on April 2, 1985. The U.S.G.S. gauge records indicate there were five periods of elevated discharges lasting from five days to three weeks each (Figure 3).

The 1986 runoff started in late January and early February with seven pulses, each lasting five days to two weeks. A ten-year frequency flood event was initiated by 1.5 inches of rain which fell on snow at Winchester. This resulted in an estimated peak discharge of 1,100 to 1,600 cfs at St.#3, on February 23, 1986.

FIGURE 3. HYDROGRAPH OF 1985, AND 1986 SPRING DISCHARGE ON LAPWAI CREEK



* FROM U.S.G.S. PROVISIONAL DISCHARGE DATA U.S.G.S. GAUGING STATION LAPWAI, IDAHO #13342450.

Suspended Sediment

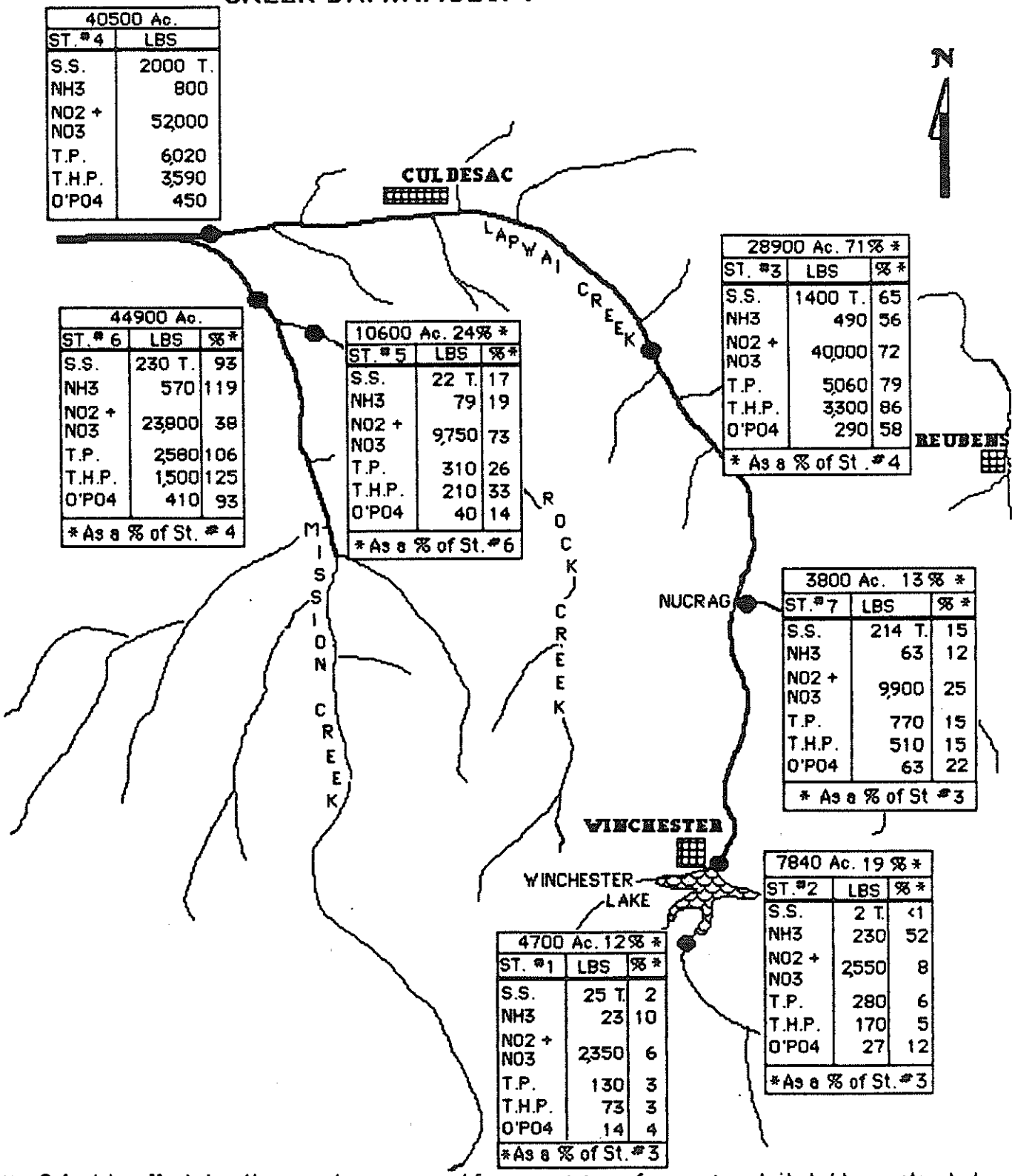
Concentrations of suspended sediment in Lapwai Creek ranged from less than 2 to 1,619 mg/L, the mean being 88 mg/L, (Appendix A1-7). The Mission Creek and Rock Creek drainage had a mean concentration of 30 mg/L, with a range of less than 2 to 125 mg/L. Comparison of the same sample dates did show a wide variability in concentrations at different stations. Mean concentrations of suspended sediment in Rock Creek were 31% of those in Mission Creek, with a range of 12 - 57%. Winchester Lake, at the head of the Lapwai drainage, acted as a settling pond, reducing the concentrations of sediment in the discharge from the upper watershed by an average of 83%. Sediment concentration at St.#3, half way down Lapwai Creek, averaged 44% more than St. #4 below Culdesac, (range 32 - 367%). Suspended sediment concentrations in Mission Creek averaged 42% higher than those in Lapwai Creek.

The total suspended sediment load delivered to Winchester Lake on the dates sampled was 25 tons (Appendix B1-7). Only 4 tons were exported from the lake on the same days, which accounted for less than one percent of the total 1,400 tons recorded at St. #3 (Figure 4). The Nucrag drainage (St. #7), provided 15% of the daily loads exported or about 210 tons of suspended sediment. By the time the stream reached the midpoint, at St. #3, another 1,200 tons were present in the water column. Below Culdesac, at St. #4 ,the total amount was reduced by 35%. The Mission Creek drainage yielded a total of 230 tons of suspended sediment for the days monitored. Rock Creek, the major tributary to Mission Creek, contributed 22 tons or 17% of the comparative day's totals of the Mission Creek total. The sampling dates of April 2, 1985 and February 25, 1986 were after heavy storms that provided 32% and 34%, respectively, of the entire loads of Mission and Lapwai Creeks over the course of this entire study.

Nitrogen

At least 800 lbs. of ammonia were exported from St.#4, while Mission Creek transported an estimated 570 lbs. of ammonia during the study (Figure 4). Ammonia yields from both the Mission and Lapwai drainages on the same sampling days were within.two percent of each other. The outfall of Winchester Lake, St.#2, exhibited the greatest

FIGURE 4. CONTRIBUTION OF WATERSHEDS TO THE SOLUTE LOADS OF THE MISSION AND UPPER LAPWAI CREEK DRAINAGES. ¥



¥ Only data collected on the same days were used for computation of percent contributed by a watershed.

T. Suspended sediment loads reported in tons

average ammonia concentrations, 0.311 mg/L (range 0.063 - 0.844 mg/L), and provided 49% of the total ammonia load recorded from Lapwai Creek at St #4. The contribution to the total load by the other individual drainages averaged 10% from above Winchester Lake, and 12% from Nucrag. Station #4 below Culdesac had 39% more ammonia present than St. #3 above it. Rock Creek provided a disproportionate amount (67%) of the ammonia load to Mission Creek.

Concentrations of nitrite + nitrate ranged from 0.41 mg/L at Mission Creek to 20.4 mg/L at Nucrag. The mean concentrations of nitrite + nitrate for the study were the greatest at St. #7, 8.02 mg/L. The outlet of Winchester Lake had the lowest mean of 2.2 mg/L. The Mission Creek drainage had a mean of 2.4 mg/L.

The most complete record available, St#3, indicates that 41,000 lbs. of inorganic nitrogen were exported (Appendix B3). St#3 averaged 72% of the load exhibited at St.#4, six miles downstream. Thirty-nine percent of the inorganic nitrogen load contributed to Winchester Lake from St.#1 remained in the lake. On Mission Creek, 91% of the daily totals of inorganic nitrogen came from Rock Creek. The total load of inorganic nitrogen in Mission Creek was 24,400 lbs.

The organic nitrogen content was within the range of values exhibited by natural waters except on March 18, 1985 and April 2, 1985 when St #7 showed concentrations of 2.17 mg/L and 3.03 mg/L respectively. St.#3 also exceeded the natural range with a concentration of 4.48 mg/L on April 2, 1985 (Appendix A3, A7). Mission Creek had the lowest mean concentration of 0.68 mg/L, while the Nucrag drainage averaged 1.01mg/L, (Table 3).

Phosphorus

Total phosphorus concentrations ranged from 2.39 mg/L at St.#3 to 0.10 mg/L at Rock Creek (Appendix A1-7). St.#7, at Nucrag, had the greatest mean concentrations of 0.4 mg/L. Rock Creek had the lowest mean concentration of 0.16 mg/L. Total phosphorus concentrations exceeded the recommended criterion, for waters not discharging directly into impoundments, of 0.1 mg/L, for each sample at all stations. Each drainage showed different proportions of phosphorus species (Table 4).

Table 3. Organic and Inorganic Nitrogen Concentrations (mg/L)

		Organic Nitrogen (TKN - NH3)		Inorganic Nitrogen (NO2 +NO3 and NH3)	
St.#	n	Mean	Range	Mean	Range
1	7	0.81	0.13 - 1.83	4.47	0.64 - 8.48
2	7	1.00	0.75 - 1.42	2.53	2.02 - 3.46
3	11	1.12	0.35 - 4.48	5.69	0.95 ->11.1
4	8	0.56	0.16 - 1.20	4.87	1.04 - 8.54
5	8	0.57	0.15 - 0.88	4.94	1.11 - 8.53
6	12	0.68	0.34 - 1.09	2.52	0.46 - 4.77
7	11	1.18	0.31 - 3.10	7.88	1.57 ->20.4

n = Number of samples
> = Does not include ammonia concentration

Table 4. Proportion of Phosphorus Species in Total Phosphorus (%)

	STATION						
	1	2	3	4	5	6	7
Hydrolyzable Phosphorus	70	52	79	59	44	82	63
Dissolved Orthophosphate	18	45	20	45	30	28	17

≠ 100% Because of inter-convertibility of species and analytical errors.

The load of total phosphorus, as recorded at St.#3, exceeded 5,000 lbs. This station was sampled the most and therefore was used to determine the contribution of solutes from the other drainages (Figure 4). Only six percent of the total phosphorus load was contributed by Lapwai Creek above Winchester Lake, another 15% came from Nucrag, while 79% of the total estimated load was present by St.#3 downstream. Rock Creek contributed 26% of the load of Mission Creek.

Eighty-six percent of the total hydrolyzable phosphorus was present at St.#3, but only 15% and 5% were donated by Nucrag and Winchester, respectively. Major contributors to the orthophosphate loads were provided by Nucrag (22%) and the area between St#3 and #4 (42%).

Bacteria

Waters designated as usable for primary contact recreation are not to exceed fecal coliform colonies greater than 500/100 ml at any time or a geometric mean of 50/100 ml based on five samples/30 days (IDHW-DOE, 1985). The single day criterion was exceeded on one sample date, March 11, 1986, at Mission Creek.

Fecal streptococcus to fecal coliform ratios greater than 0.7 may be indicative of fecal contamination by warm-blooded animal . The geometic mean of the ratios on Mission Creek was 1.4, and on Rock Creek 0.6. On Lapwai Creek, the ratios were: 0.8 at St.#1; 1.3 at St. #2; 0.3 at St.#7; 0.6 at St.#3; and 0.9 at St.#4.

Quality Assurance

Percent recovery, or accuracy, for suspended sediment, dissolved orthophosphate, total nitrate, and total Kjeldahl nitrogen were within 5% of the true value (Table 5). Methods used to determine hydrolyzable phosphorus tended to underestimate concentrations by 20%. Total phosphorus was overestimated by 12% and total ammonia overestimated by 20%.

Precision is expressed by the average relative range (Table 6). Values of total phosphorus concentrations were very precise with a relative range of 0.0%. Total nitrite + nitrate, and total Kjeldahl

Table 5. Accuracy Estimates of Monitored Parameters*

STORET#	Parameter	n	Average % Recovery	95% CI
80154	Suspended Sediment	13	95.4	1.2
00665	Total Phosphorus as P	13	112.8	2.9
70507	Orthophosphate as P	13	99.0	6.3
00669	Total Hydrolyzable Phosphorus as P	13	80.0	4.5
00620	Total Nitrate as N	13	103.9	3.8
00610	Total Ammonia as N	13	120.1	11.8
00625	Total Kjeldahl Nitrogen as N	13	104.0	9.0

* From Bauer (1985)
n = Number of samples
CI = Confidence Interval

Table 6. Precision Estimates of Monitored Parameters

STORET #	Parameter	n	Average Relative Range (%)
80154	Suspended Sediment	10	34
00665	Total Phosphorus as P	10	0.0
70507	Orthophosphate as P	10	15
00669	Total Hydrolyzable Phosphorus as P	10	79
00630	Total Nitrite + Nitrate as N	11	10
00610	Total Ammonia as N	9	58
00625	Total Kjeldahl Nitrogen as N	11	10
00076	Turbidity	6	3.2

n = Number of samples

nitrogen as N, values were within 10%. Dissolved orthophosphate as P concentrations showed 15% variability, suspended sediment 34%. Total ammonia as N and total hydrolyzable phosphorus as P concentrations had a wide range of variability at 58%, and 79%, respectively.

DISCUSSION

Discharge

The erratic nature of flows in the Lapwai Creek drainage made systematic monitoring difficult. The crest and staff gauges were installed in an attempt to gather information on peak discharge. Data collected from these could only be compared since the last major event due to the movement of bedload material around the base of the gauges.

Peak runoff events in Lapwai Creek normally occur when chinook rains from the southwest rapidly melt the snowpack. The combination of minimal forest cover, frozen soils that prevent percolation, steep slopes that allow little time for absorption, and the sudden onslaught of warm west winds with heavy rain, all contribute to the "flashy" nature of the watershed by reducing the hydraulic storage capacity. This pattern is typical in the numerous drainages of the Palouse region.

Localized thunderstorms make the contributions of flows by specific subwatersheds variable. Winchester Lake mitigates the effects of fluctuating discharges from the watershed above it. The impact that the Nucrag drainage and the drainage to the north have on the discharges is reflected by the increase in discharge recorded at St.#3. Nucrag averaged 19% (range 10-60%) of the flow from the 13% of the land above St.#3. The 6,500 acres in the drainage to the north is similar in terrain and land use to the Nucrag drainage and comprises 22% of the watershed above St.#3. Given these parameters it is estimated that this drainage would provide at least 33% of the discharges recorded at St.#3. Discharges from Rock Creek contributed between 8% and 62% of the flows recorded at Mission Creek during spring flows. The impoundments located at the head of Rock Creek are too small to mitigate storm events. In late spring, Rock Creek, Nucrag, and the Reubens drainages dry up completely.

The peak flood event during the study occured on February 23, 1986. An inch and a half of precipitation fell in 24 hours at Winchester (N.O.A.A. 1986). The resultant flash-flood scoured the channel and cut into the road embankments. U.S.G.S. personnel estimated the discharge at the Lapwai gauge to be 2,400 cfs. The evidence left by the flood on the banks at St.#3 indicated that between 1,100 and 1,600 cfs roared through the canyon which typically carries only 300-500 cfs during peak events. Mission Creek peaked between 600 and 900 cfs, which would be equivalent to a ten-year flood event.

Periods of minimum flows usually occur from early May to January. Discharges may drop to as low as 1 cfs in late July and slowly rise to 20-30 cfs with the advent of the fall rains. Occasional thunderstorms will augment these low flows with brief flash-floods lasting 1 to 3 days.

The records of discharge from the U.S.G.S. gauging station at Lapwai are incomplete. Sudden fluctuations in water levels, freezing, or instrument failure have disrupted the flow record. Two such blanks are evident in the provisional data from the U.S.G.S. The first was a one day disruption the last of November,1985; the other was from February 22, to March 6, 1986 following the ten-year flood event (U.S.G.S. 1986). Flow estimations were calculated from field observations and the Manning equation.

Suspended Sediment

Most of the soil loss in the Mission/Lapwai drainage occurs during the spring runoffs and thunderstorms (Appendix B1-7). The April 2, 1986 storm accounted for 90% of the total sediment load recorded during the study. Estimates of the February 23, 1986 storm are between 1,800 - 7,000 tons of sediment exported.

The concentrations of suspended sediment in a sample may be affected by several factors. These include: variability in sampling techniques; source of discharge, since snowmelt may suspend less soil particles than rainwater; stream velocity, which allows more settling time or resuspension of particles; timing of sample collection, since more sediment is carried before the peak than after; and the lack of data from peak events. Any of these factors may explain the observed decrease of suspended sediment concentrations between St. #3 and St. #4.

The data collected from St. #3, midway down Lapwai Creek, was used as a reference point for comparing the watersheds because of the completeness of the data. An interesting trend may be seen by examining the data. Winchester Lake, Mud Springs, and several small stock watering ponds on Rock Creek, act as settling basins by reducing the sediment load in the runoff from these areas. Less than one percent of the daily suspended sediment load was present below Winchester Lake. Nucrag added only a proportion equal to its relative size. The land area between St.#2 and #3 is 43% of the upper Lapwai drainage, but contributed 65% of the sediment load.

A comparison of flows and sediment loading was made between Mission and Lapwai drainages. Mission Creek is a slightly larger drainage but provided less sediment. Rock Creek contributed less sediment for its size because of the settling basins at the head of the drainage. This reduction is reflected in the Mission Creek data.

All of the suspended sediment does not originate from land surfaces. An estimated 5% comes from erosion of the stream banks (U.S.D.A. 1980). This is dependent upon the morphology and stability of the stream channel. A stream reach and channel stability survey completed on Mission Creek concluded that the channel is in fair condition with an index number of 90. A range of 77-114 is considered to be fair, and indicates that the section is not able to withstand sudden fluctuations in discharge without scouring of the channel and sloughing of the banks (S.C.S., 1985). Most of the stream bed below Winchester Lake was straightened and channelized when the road was placed down Culdesac canyon. There are sections of the stream banks that are unprotected by vegetation or riprap that are likely to contribute more sediment than the more protected areas.

Bedload is the particulate and substrate material contained in the bottom three inches of the water column (Clark, 1985). Size of the material is governed by the geology and morphology of the streambed, and in the Lapwai area may be as large as two feet in diameter. Studies have shown that 6-10% of the total sediment load is moved as bedload, and 40% of the bedload is delivered to the Clearwater River in one year (U.S.G.S., 1980). These figures yield estimates of at least 84-140 tons of bedload being moved for the days monitored at St #3. This is considered to be a conservative estimate because of the

intense velocities of the stream during the peak floods. Most of the bedload is moved during these times. A graphic illustration was the rechannelization evident after the February 23, 1986 storm. Bedload deposits occluded one 4.5 foot culvert, partially buried another and reopened a third. An estimate of 200-300 tons of material were redeposited at this one site.

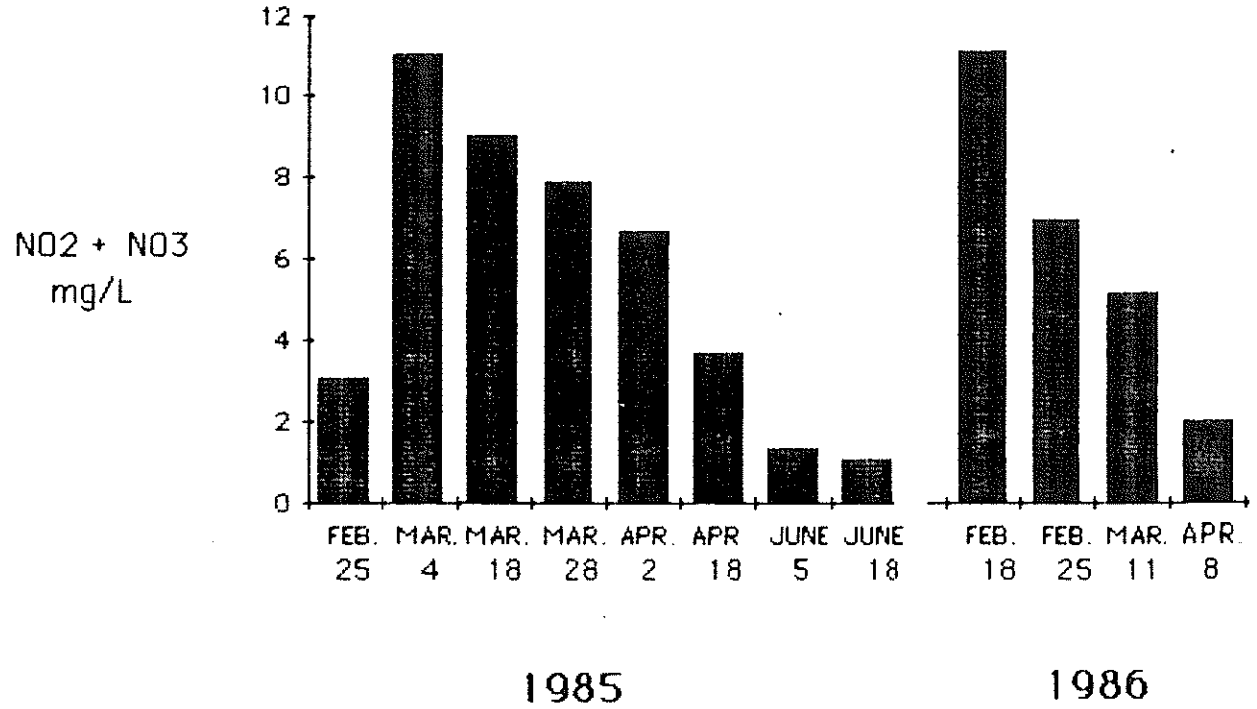
Nitrogen

Sources of nitrogen in surface waters include nitrogen fixing algae, decomposing plant material, animal wastes, nitrogenous fertilizers, and domestic wastewater disposal. The form that the inorganic nitrogen takes is dependent upon the pH, temperature, and oxygen content in the water. The reduction of nitrogen to ammonia occurs under anaerobic conditions and is accelerated with a pH greater than 8.0 and/or increased temperatures. Aerobic conditions will convert ammonia to nitrite and then nitrate.

Winchester Lake is rapidly eutrophying because of excess nutrient loading. The additional nitrogen and phosphorus added to the system are being recycled in the lake by the biomass. The oxygen demand, placed upon the lake by the biomass, and thermal stratification then lead to anoxic conditions which are conducive to the ammonification process (Moeller, 1986). The anaerobic conditions which exist at the bottom of Winchester Lake convert the available nitrogen into ammonia, contributing greatly to the 52 tons exported from the lake. There are unknown quantities of nutrients contributed by the treated municipal wastewater of Winchester that is discharged over land between the dam and St. #2. This may also contribute to the elevated nutrient loads at St.#2. Aeration converts some of the ammonia to nitrite and nitrate during its eight mile trek to Station #3.

Concentrations of the nitrite + nitrate complex showed a downward seasonal trend, with higher concentrations in the early spring (Figure 5). This is consistent with the water soluble characteristics of the complex, and the ease with which it is leached from the soil. Unusually high concentrations of the nitrite + nitrate complex were evident at St. #7 early in the spring.

FIGURE 5. NITRITE + NITRATE CONCENTRATIONS AT LAPWAI CREEK, ST.#3



The concentrations decreased as spring runoff receded, indicating suface origin of the complex. The criterion of 10 mg/L of nitrate, set for drinking water, was exceeded six times at St. #7, at Nucrag. No samples from the other stations exceeded the criterion (Appendix A1-7).

Inorganic nitrogen concentrations were very high at the Nucrag site, St. #7. Twenty-five percent of the total nitrite + nitrate complex load of St.#3 came from this drainage. Fertilizers are the most likely source of the inorganic nitrogen, as there are few domestic dwellings and only low density pasturing on the adjacent riparian areas. Rock Creek also shows an unusually high contribution of inorganic nitrogen to Mission Creek. The mean concentration of nitrite + nitrate on Rock Creek was twice that of Mission Creek.

Phosphorus

Phosphorus is an essential element to plant growth, and, if not present in sufficient quantities, is a limiting factor to maximum plant production. Sources of phosphorus are natural deposits, fertilizers, animal wastes, domestic wastewater, and decomposing organic material. An instream goal of 0.1 mg/L total phosphorus has been suggested to prevent nuisance growth in flowing waters not discharging directly to lakes or impoundments (Mackenthun, 1973). This criterion was exceeded on each sample date at all stations.

Analysis for total phosphorus includes all the phosphorus present in the sample regardless of form. Included are organically bound phosphates, condensed phosphates, and orthophosphates. Dissolved orthophosphate refers to a water soluble form of phosphate available for biological uptake. Hydrolyzable phosphorus is the fraction of phosphorus convertible to orthophosphate.

The differences in proportions of the various phosphorus components may be related to the concentrations of suspended sediment. A source of hydrolyzable phosphorus is organic particles. If a sample has less suspended particles, less hydrolyzable phosphorus

will be present, therefore dissolved orthophosphate will then make up a larger proportion of the total phosphorus. An explanation for the increase in orthophosphate concentrations during periods of low flows could be that the deposits of orthophosphates, stored in the perched groundwater, are diluted by the runoff.

Phosphorus concentrations and loading are typically event related (Appendix B1-7).. The phosphorus ion has an affinity for the positively charged soil particles, particularly the clays. The erosion of the soil then transports the phosphorus to the stream. Therefore an increase in suspended sediment concentrations was associated with increased total phosphorus concentrations (Figure 6).

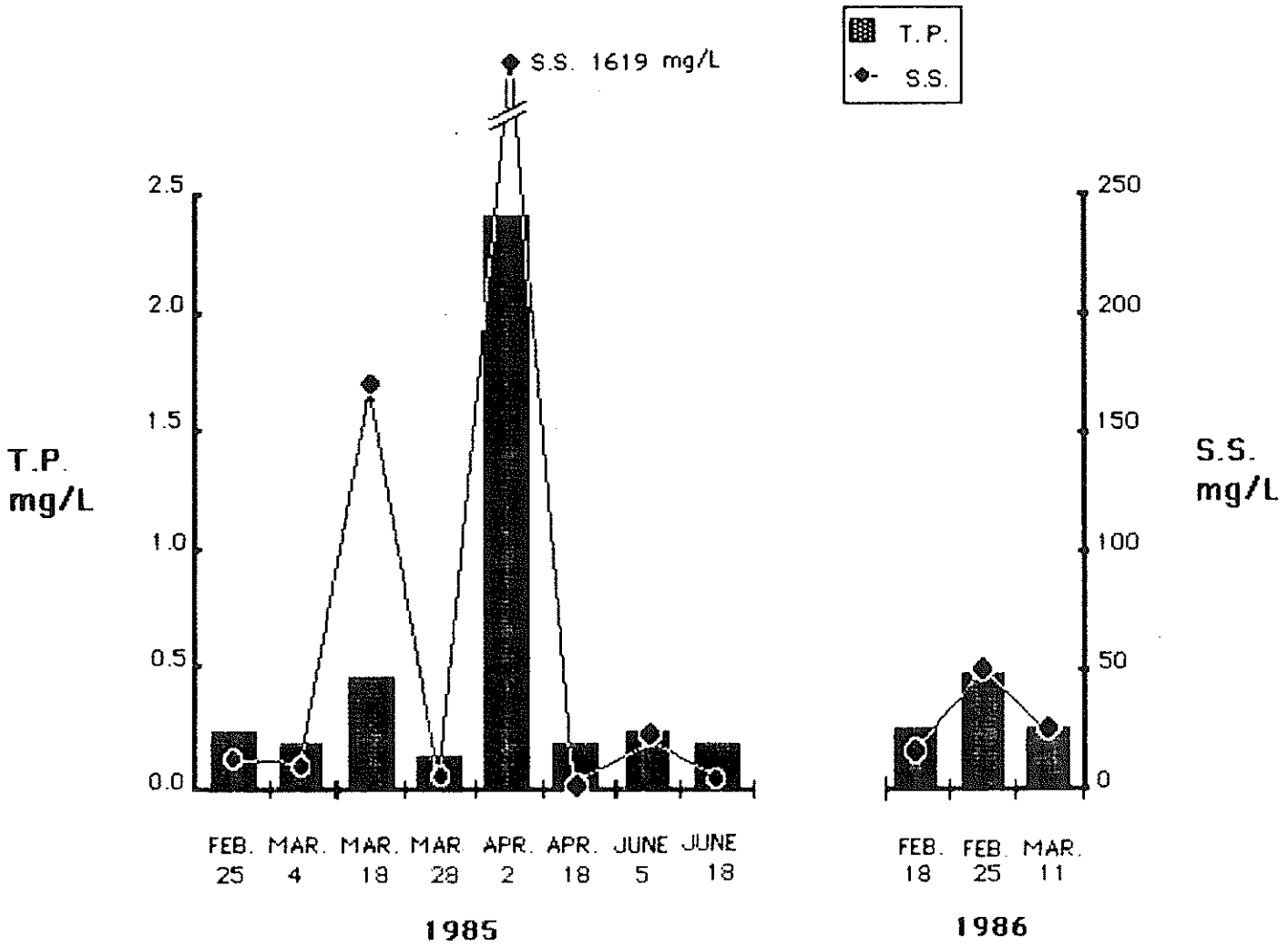
Each watershed contributed a proportion of the phosphorus load in approximate relationship to its size (Figure 4). The exception was a disproportionate increase at St. #3, which possibly originated from the Reubens area.

Mean concentrations of total phosphorus increased between the upper St.#2, and St.#3 (midway to Culdesac) but decreased at St.#4 below Culdesac (Appendix A1-7). This followed the trend established by the suspended sediment concentrations. St.#7 (at Nucrag) had the greatest concentrations of total phosphorus on all sampling dates, except on April 2, 1985 when St.#3 was the greatest. This was due to the high suspended sediment concentration (1619 mg/L) present in the April 2nd sample at St.#3.

Total Kjeldahl nitrogen and hydrolyzable phosphorus are both byproducts of organic matter decomposition. The elevated levels of these two constituents indicates that the source of the elevated mean concentration exhibited at St.#7 may be organic debris.

The eutrophication of Winchester Lake has been partly attributed to the phosphorus loads present. The phosphorus is recycled internally by the biomass and is entrained in the sediments in the bottom of the lake. Total phosphorus concentrations should not exceed 0.025 mg/L within a lake or reservoir (Mackenthun, 1973). Mean total phosphorus concentration in the euphotic zone of Winchester Lake was 0.14 mg/L, and in the waters directly overlying the sediments it was 0.33 mg/L (Moeller, 1986).

FIGURE 6. SUSPENDED SEDIMENT AND TOTAL PHOSPHORUS CONCENTRATIONS AT ST.#3



Bacteria

Monitoring for bacterial contamination has been a standard water quality procedure to indicate potential contamination and possible presence of other disease-causing organisms. Two factors that may elevate the number of colonies present in samples are heavy runoff from areas where livestock are contained and warm water temperatures that will accelerate the growth rate of bacteria. Both factors probably affected the observed counts.

Ratios of fecal coliform/fecal streptococcus indicate that fecal contamination from cattle is the most likely source of bacteria. In general, ratios greater than 0.7 were exceeded only during periods of runoff at most stations, indicating that runoff from pastures and feedlots are probably the source.

Mission Creek showed the most consistent colony counts of bacteria, and may exceed Idaho Water Quality Standards for primary contact recreation throughout the year. Lapwai Creek showed occasional periods of high bacterial contamination and may exceed the criterion for short periods of time. Geometric means of the ratios exceeded 0.7 above Winchester Lake, and at the last station below Culdesac.

CONCLUSIONS

1. Designated beneficial uses, as defined by Idaho Water Quality Standards, are adversely affected by the influx of solutes from nonpoint sources. Primary contaminants are suspended sediment, total phosphorus, nitrite + nitrate, ammonia, and fecal coliforms.

2. The majority of the sediment and nutrient influxes are the products of rainstorm events and snowmelt. A reduced hydraulic storage capacity makes this stream susceptible to flash floods.

3. Winchester Lake, Mud Springs and small impoundments on Rock Creek are effective settling basins. Considerable amounts of sediment are trapped behind these impoundments.

4. The phosphorus and nitrogen loads entering Winchester Lake have been identified as leading causes of the eutrophication of the lake.

5. Excess ammonia from Winchester Lake is due to the anoxic conditions, created by eutrophication, converting available nitrogen to ammonia.

6. The presence of settling basins near the headwaters of Rock Creek drainage reduced the sediment load and may have increased the nitrate + nitrite concentrations from the drainage. This had an impact on the nutrient loads of Mission Creek.

7. The drainage designated as 'Nucrag' contributed to Lapwai Creek disproportionate loads of nitrite + nitrates and orthophosphates compared to its relative size. The greatest concentrations of total phosphorus and inorganic nitrogen were recorded at this station.

8. Cattle are the likely source of bacterial contamination above Winchester Lake, below St.#3, and in the Mission Creek drainage.

9. The rechanneling of the stream beds has had some negative impacts on bank stability. Straightening of the channel has resulted in increased velocity, reduced the pool/riffle ratio necessary for prime anadromous fishery habitat, and increased the erosive action on banks.

10. Flash floods result in movement of massive amounts of bedload material.

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 Mission and Lapwai Creeks.

2. An implementation plan submitted by the Lewis S.W.C.D. should emphasize:

   A) Reduction of soil erosion from all critical acreages, in particular the areas around Reubens and above Winchester Lake.

   B) Reduction of the excessive phosphorus and nitrogen loads from the drainages that are contributing to the eutrophication of Winchester Lake;

   C) Reduction of the excess nitrite + nitrate loading from Nucrag and Rock Creek drainages;

   D) Mitigation of bacterial sources close to the streams on Mission Creek;

   E) Stabilization of all denuded banks;

   F) Enhancement of all riparian areas.

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APPENDIX A 1. MISSION/LAPWAI CREEK DATA

STORET # 2020246
STATION #1, at the Winchester Lake inlet

SITE	DATE	FLOW CFS	T °C	COND @ 25 °C	pH S.U.	NH3 mg/L	NO2+NO3 mg/L	TKN mg/L	TOTAL P mg/L	HYDRO p mg/L	ORTHO PO4 mg/L	S.S. mg/L	TURB. NTU	FECAL STREP. #/.1L	FECAL COLI. #/.1L
3	03/18/85	4.1	6.2	129	7.3	0.042	3.21	0.98	0.26	0.13	0.023	38.4	32	34	18
4	03/28/85	8.9	2.5	172	7.4	0.032	7.14	0.86	0.13	AAA	0.008	23.0	17	5	13
5	04/02/85	40.7	9.6	429	6.8	0.086	8.39	1.92	0.51	0.284	0.046	215.6	99	120	80
7	04/18/85	4.4	11.1	137	7.4	0.077	0.91	0.81	0.18	0.11	0.039	15.0	26	80	<10
9	06/18/85	0.4	17.1	172	7.6	0.061	0.614	0.58	0.14	0.06	0.068	12.0	17	169	175
12	V03/11/86	AAA	AAA	AAA	AAA	0.152	2.08	0.78	0.2	AAAAA	AAAAA	10	AAA	AAA	AAA
12	03/11/86	6.1	5.0	116	7.1	0.033	1.87	0.80	0.2	0.105	0.058	8	AAA	10	100
12	*03/11/86	6.1	5.0	116	7.1	0.092	1.98	0.79	0.2	0.105	0.058	9	AAA	10	100
13	04/08/86	1.2	8.0	124	7.2	0.539	1.11	0.67	0.1	0.110	0.030	68	AAA	24	4
	SUMMARY OF DATA														
	AVERAGE	9.4	8.5	183	£7.3	0.133	3.34	0.94	0.2	0.14	0.035	54	38	£35	£28
	MINIMUM	0.4	2.5	116	6.8	0.032	0.614	0.58	0.1	0.06	0.008	9	17	5	<10
	MAXIMUM	40.7	17.1	429	7.6	0.539	8.39	1.92	0.51	0.284	0.068	215.6	99	169	175

AAA UNREPORTED VALUES
◇ ESTIMATED DISCHARGE
✓ QUALITY CHECK SAMPLE
£ LOGARITHMIC MEAN
V DATA COLLECTED BY SCS PERSONNEL
* MEAN FOR ALL DATA COLLECTED ON THAT DATE
< MEAN CALCULATED WITH "LESS THAN" VALUE

APPENDIX A 2. MISSION/LAPWAI CREEK DATA

STORET # 2020115
STATION #2, at the Winchester Lake outfall

SITE	DATE	FLOW CFS	T °C	COND @ 25 °C	pH S.U.	NH3 mg/L	NO2+NO3 mg/L	TKN mg/L	TOTAL P mg/L	HYDRO p mg/L	ORTHO PO4 mg/L	S.S. mg/L	TURB. NTU	FECAL STREP. #/.1L	FECAL COLI. #/.1L
4	03/28/85	3.4	2.0	126	7.2	0.100	2.11	0.95	0.16	0.150	0.009	7.2	12	4	2
5	04/02/85	114	2.2	126	7.0	0.282	1.74	1.03	0.19	0.16	0.016	7.3	10	<10	<10
7	04/18/85	1.0	7.4	163	7.0	0.063	3.40	1.47	0.53	0.30	0.234	14.0	23	7	2
9	06/18/85	1.1	13.1	183	7.0	0.844	2.19	1.90	0.67	0.06	0.480	13.0	12	1	10
10	02/18/86	8.8	2.0	126	6.8	AAA	0.986	1.43	0.30	AAAAA	0.130	12	AAA	3	28
11	02/25/86	◇100	1.5	103	7.3	0.072	2.40	0.82	0.20	0.105	AAAAA	4	AAA	AAA	AAA
12	V03/11/86	AAA	AAA	AAA	AAA	0.368	2.49	1.52	0.4	AAAAA	AAAAA	18	AAA	AAA	AAA
12	03/11/86	2.6	4.6	163	7.0	0.316	2.03	1.44	0.4	0.314	0.152	18	AAA	<10	<10
12	*03/11/86	2.6	4.6	163	7.0	0.342	2.26	1.48	0.4	0.314	0.152	18	AAA	<10	<10
13	04/08/86	3.1	9.4	120	7.2	0.477	2.65	1.53	0.5	0.376	0.234	32	AAA	1	<1
	SUMMARY OF DATA														
	AVERAGE	32.2	5.7	141	£7.1	0.311	2.22	1.31	0.4	0.21	0.179	14	14	£3	£3
	MINIMUM	1.0	1.5	103	6.8	0.063	0.986	0.82	0.16	0.06	0.009	4	10	<10	<10
	MAXIMUM	114	13.1	183	7.3	0.844	3.40	1.90	0.67	0.376	0.480	32	23	7	28

AAA UNREPORTED VALUES
◇ ESTIMATED DISCHARGE
✓ QUALITY CHECK SAMPLE
£ LOGARITHMIC MEAN

V DATA COLLECTED BY SCS PERSONNEL
* MEAN FOR ALL DATA COLLECTED ON THAT DATE
< MEAN CALCULATED WITH "LESS THAN" VALUE

APPENDIX A 3. MISSION/LAPWAI CREEK DATA

STORET # 2020247
STATION #3, at Lapwai Creek midway to Culdesac

SITE	DATE	FLOW CFS	T °C	COND @ 25 °C	pH S.U.	NH3 mg/L	NO2+NO3 mg/L	TKN mg/L	TOTAL P mg/L	HYDRO p mg/L	ORTHO PO4 mg/L	S.S. mg/L	TURB. NTU	FECAL STREP. #/.1L	FECAL COLI. #/.1L
1	02/25/85	15.9	3.0	142	7.5	0.054	3.03	0.55	0.21	0.113	0.093	19.0	27	56	15
2	03/04/85	22.1	3.0	291	8.2	0.072	11.00	0.67	0.19	0.073	0.071	8.5	17	39	35
2	✓03/04/85	AAA	AAA	AAA	AAA	0.023	7.26	0.61	0.17	<0.01	0.074	8.0	16	22	30
2	*03/04/85	22.1	3.0	291	8.2	0.048	9.13	0.64	0.18	0.037	0.072	8.2	17	26	32
3	03/18/85	◊90	2.5	172	7.2	0.055	9.03	1.71	0.46	0.250	0.070	201.0	66	31	81
4	03/28/85	39.8	5.0	167	7.8	0.040	7.88	0.62	0.13	0.120	0.024	5.2	17	2	2
5	04/02/85	◊300	7.0	132	7.3	0.140	6.68	4.62	2.39	1.63	0.050	1619	380	80	150
7	04/18/85	12.9	9.0	151	7.9	0.174	3.64	0.55	0.18	0.105	0.089	<2.0	16	79	3
8	06/05/85	◊30	14.1	126	7.9	0.055	1.34	0.75	0.23	0.06	0.143	22.0	30	AAA	AAA
9	06/18/85	3.0	22.1	142	8.7	0.072	1.02	0.49	0.19	0.05	0.114	3.2	6	39	36
10	02/18/86	152	0.5	161	6.9	AAA	11.1	1.41	0.20	AAAAA	0.123	14	AAA	103	126
11	02/25/86	◊300	4.8	116	7.1	0.112	6.93	1.14	0.40	0.274	AAAAA	50	AAA	144	80
12	V03/11/86	AAA	AAA	AAA	AAA	0.048	5.39	0.75	0.2	AAAAA	AAAAA	4	AAA	AAA	AAA
12	03/11/86	31.5	6.5	165	7.4	0.033	4.92	0.58	0.2	0.173	0.108	40	AAA	<10	<10
12	*03/11/86	31.5	6.5	165	7.4	0.040	5.10	0.66	0.2	0.173	0.108	22	AAA	<10	<10
13	04/08/86	7.0	10.1	103	8.0	0.108	2.46	0.46	0.2	0.144	0.098	AAA	AAA	20	<1
	SUMMARY OF DATA														
	AVERAGE		7.8	143	£7.6	0.082	5.6	1.20	0.4	0.317	0.080	179	86	£31	£15
	MINIMUM	3.0	0.5	103	7.1	0.040	1.02	0.46	0.1	0.04	0.024	<2.0	6	<10	<1
	MAXIMUM	◊300	22.1	291	8.7	0.174	11.1	4.62	2.39	1.63	0.123	1619	380	144	150

AAA UNREPORTED VALUES
◊ ESTIMATED DISCHARGE
✓ QUALITY CHECK SAMPLE
£ LOGARITHMIC MEAN

V DATA COLLECTED BY SCS PERSONNEL
* MEAN FOR ALL DATA COLLECTED ON THAT DATE
< MEAN CALCULATED WITH "LESS THAN" VALUE

APPENDIX A 4. MISSION/LAPWAI CREEK DATA

STORET # 2020113
STATION #4, at Lapwai Creek below Culdesac

SITE	DATE	FLOW CFS	T °C	COND @ 25 °C	pH S.U.	NH3 mg/L	NO2+NO3 mg/L	TKN mg/L	TOTAL P mg/L	HYDRO p mg/L	ORTHO PO4 mg/L	S.S. mg/L	TURB. NTU	FECAL STREP. #/.1L	FECAL COLI. #/.1L
1	02/25/85	36.4	5.7	190	7.5	0.105	3.29	0.66	0.22	0.113	0.10	20.3	27	37	10
2	03/04/85	32.1	4.8	290	8.0	0.031	6.23	0.43	0.14	<0.01	0.091	8.5	14	30	15
2	✓03/04/85	AAA	AAA	AAA	AAA	0.103	6.49	0.54	0.17	0.06	0.065	7.8	15	AAA	AAA
2	*03/04/85	32.1	4.8	290	8.0	0.067	6.36	0.48	0.16	0.035	0.078	8.2	14	30	15
3	03/18/85	130.0	6.5	204	7.3	0.068	8.47	1.27	0.32	0.131	0.072	82.0	44	73	181
4	03/28/85	62.3	7.0	184	7.5	0.020	6.42	0.55	0.15	0.125	0.031	10.0	16	40	17
7	04/18/85	33.7	9.0	176	7.6	0.098	3.73	0.60	0.17	0.102	0.078	6.2	12	65	40
9	06/18/85	5.1	20.	173	7.8	0.054	0.993	0.48	0.18	0.04	0.098	2.6	3	55	110
12	V03/11/86	AAA	AAA	AAA	AAA	0.048	5.54	0.63	0.2	0.158	0.118	<2	AAA	AAA	AAA
12	03/11/86	51.3	8.3	171	7.8	0.048	5.55	0.69	0.2	0.179	0.133	2.0	AAA	20	110
12	✓03/11/86	AAA	AAA	AAA	AAA	0.048	5.91	0.64	0.2	AAAAA	AAAAA	4.0	AAA	AAA	AAA
12	*03/11/86	51.3	8.3	171	7.8	0.048	5.67	0.65	0.2	0.168	0.126	2.7	AAA	20	110
13	04/08/86	11.9	12.1	160	7.7	0.137	3.50	0.30	0.2	0.151	0.103	6	AAA	63	36
13	✓04/08/86	AAA	AAA	AAA	AAA	0.142	3.21	0.30	0.2	0.147	0.116	6	AAA	AAA	AAA
13	*04/08/86	11.9	12.1	160	7.7	0.140	3.36	0.30	0.2	0.149	0.110	6	AAA	63	36
	SUMMARY OF DATA														
	AVERAGE	46.4	9.9	180	£7.6	0.075	4.79	0.64	0.2	0.118	0.09	17	71	£47	£47
	MINIMUM	5.1	4.8	160	7.3	0.020	0.993	0.30	0.15	0.04	0.031	2.6	3	20	10
	MAXIMUM	130	20.1	290	8.0	0.140	8.47	1.27	0.32	0.168	0.126	82.0	44	73	181

AAA UNREPORTED VALUES
◇ ESTIMATED DISCHARGE
✓ QUALITY CHECK SAMPLE
£ LOGARITHMIC MEAN

V DATA COLLECTED BY SCS PERSONNEL
* MEAN FOR ALL DATA COLLECTED ON THAT DATE
< MEAN CALCULATED WITH "LESS THAN" VALUE

APPENDIX A 5. MISSION/LAPWAI CREEK DATA

STORET # 2020248
STATION #5, at Rock Creek near the Mouth

SITE	DATE	FLOW CFS	T °C	COND @ 25 °C	pH S.U.	NH3 mg/L	NO2+NO3 mg/L	TKN mg/L	TOTAL P mg/L	HYDRO p mg/L	ORTHO PO4 mg/L	S.S. mg/L	TURB. NTU	FECAL STREP. #/.1L	FECAL COLI. #/.1L
1	02/25/85	4.0	4.1	125	7.9	0.088	2.24	0.58	0.20	0.10	0.059	19.6	21	340	49
2	03/04/85	4.6	6.6	106	8.0	0.041	3.69	0.19	0.11	<0.01	0.046	4.6	12	9	14
3	03/18/85	29.1	5.1	124	7.3	0.029	8.48	0.72	0.16	0.018	0.034	17.8	19	64	68
4	03/26/85	26.0	4.6	155	7.5	0.064	6.34	0.64	0.10	0.008	0.023	7.6	9	50	30
5	04/02/85	131.0	3.2	111	7.1	0.070	8.45	0.95	0.31	0.26	0.02	54.0	44	60	20
6	04/09/85	32.8	11.1	114	7.3	0.048	5.29	0.56	0.15	0.12	0.039	10.2	26	299	85
7	04/18/85	6.5	8.8	120	7.7	0.038	3.59	0.37	0.11	0.032	0.078	<2.0	10	42	73
8	06/05/85	AAA	14.1	123	7.9	AAA	AAAAA	AAA	AAAA	AAAAA	AAAAA	AAA	AAA	AAA	AAA
9	06/18/85	2.4	13.1	143	7.9	0.054	1.06	0.49	0.12	0.01	0.078	5.4	4	69	57
	SUMMARY OF DATA														
	AVERAGE	26.3	8.0	125	£7.6	0.057	4.89	0.62	0.16	0.071	0.048	15	18	£78	£45
	MINIMUM	2.4	3.2	106	7.1	0.029	1.06	0.37	0.10	<0.01	0.02	<2.0	4	9	20
	MAXIMUM	131	13.1	155	8.0	0.088	8.48	0.95	0.31	0.26	0.078	54.0	44	340	85

AAA UNREPORTED VALUES
◇ ESTIMATED DISCHARGE
✓ QUALITY CHECK SAMPLE
£ LOGARITHMIC MEAN
V DATA COLLECTED BY SCS PERSONNEL
* MEAN FOR ALL DATA COLLECTED ON THAT DATE
< MEAN CALCULATED WITH "LESS THAN" VALUE

APPENDIX A 6. MISSION/LAPWAI CREEK DATA

STORET # 2020249
STATION #6, at Mission Creek,1.4 Miles from the Mouth

SITE	DATE	FLOW CFS	T °C	CONDD @ 25 °C	pH S.U.	NH3 mg/L	NO2+NO3 mg/L	TKN mg/L	TOTAL P mg/L	HYDRO p mg/L	ORTHO PO4 mg/L	S.S. mg/L	TURB. NTU	FECAL STREP. #/.1L	FECAL COLI. #/.1L
1	02/25/85	40.8	40.1	149	8.2	0.049	2.18	0.91	0.31	0.22	0.072	65.6	34	270	320
2	03/04/85	29.5	2.2	187	8.2	0.119	3.28	0.42	0.18	<0.01	0.073	20.6	21	130	310
2	✓03/04/85	AAA	AAA	AAA	AAA	0.038	3.15	0.40	0.18	0.039	0.063	19.1	21	AAA	AAA
2	*03/04/85	29.5	2.2	187	8.2	0.078	3.22	0.41	0.18	0.024	0.068	19.8	21	AAA	AAA
3	03/18/85	58.4	6.2	122	7.5	0.026	4.04	0.89	0.24	0.106	0.016	50.4	32	45	216
4	03/26/85	104	4.8	168	7.5	0.088	4.68	0.97	0.23	0.096	0.040	58.0	26	310	320
5	04/02/85	212	4.6	116	7.2	0.060	4.41	1.15	0.37	0.22	0.056	125.0	72	300	320
6	04/09/85	227	11.1	91	7.3	0.162	2.59	0.70	0.28	0.17	0.107	30.8	56	23	55
7	04/18/85	78	9.0	91	7.6	0.129	0.71	0.71	0.24	0.12	0.082	16.0	44	51	86
8	06/05/85	◇30	15.1	115	7.7	0.096	0.509	0.63	0.16	0.05	0.085	29.0	29	AAA	AAA
9	06/18/85	12.5	16.1	155	8.3	0.050	0.410	0.48	0.13	AAAAA	0.026	9.4	15	77	88
10	02/18/86	◇130	0.5	114	7.1	AAA	4.26	1.18	0.30	AAAAA	0.077	26	AAA	62	7
11	02/25/86	480	6.0	93	7.7	0.044	2.39	0.91	0.40	0.286	AAAAA	60	AAA	36	88
12	V03/11/86	AAA	AAA	AAA	AAA	0.040	1.86	0.59	0.2	AAAAA	AAAAA	32	AAA	AAA	AAA
12	03/11/86	112	7.1	146	7.6	0.032	1.77	0.58	0.2	0.156	0.089	32	AAA	120	620
12	*03/11/86	112	7.1	146	7.6	0.036	1.82	0.58	0.2	0.156	0.089	32	AAA	120	620
13	04/08/86	21.9	14.1	119	8.6	0.091	0.687	0.44	0.1	0.108	0.055	6	AAA	55	58
	SUMMARY OF DATA														
	AVERAGE	126.9	13.1	124	£7.7	0.074	2.45	0.75	0.2	0.198	0.056	41	39	£89	£12
	MINIMUM	12.5	0.5	91	7.1	0.026	0.41	0.41	0.1	0.024	0.016	6	15	23	7
	MAXIMUM	480	40.1	187	8.6	0.162	4.68	1.18	0.40	0.286	0.089	125.0	72	300	620

AAA UNREPORTED VALUES
◇ ESTIMATED DISCHARGE
✓ QUALITY CHECK SAMPLE
£ LOGARITHMIC MEAN
V DATA COLLECTED BY SCS PERSONNEL
* MEAN FOR ALL DATA COLLECTED ON THAT DATE
< MEAN CALCULATED WITH "LESS THAN" VALUE

APPENDIX A 7. MISSION/LAPWAI CREEK DATA

STORET # 2020250
STATION #7,at Nucrag

SI EI TI	DATE	FLOW CFS	T °C	COND @ 25 °C	pH S.U.	NH3 mg/L	NO2+ NO3 mg/L	TKN mg/L	TOTAL P mg/L	HYDRO p mg/L	ORTHO PO4 mg/L	S.S. mg/L	TURB. NTU	FECAL STREP. #/.1L	FECAL COLI. #/.1L
1	02/25/85	1.9	2.0	144	7.5	0.448	2.88	0.75	0.27	0.168	0.104	20	31	590	21
2	03/04/85	2.7	1.0	262	8.0	0.044	11.10	0.63	0.19	0.023	0.100	10.9	13	92	11
3	03/18/85	14.7	0.5	172	7.4	0.042	10.6	2.21	0.82	0.495	0.057	599	140	26	38
4	03/28/85	5.5	2.0	181	7.6	0.022	10.60	0.67	0.18	0.185	0.012	16	23	6	6
5	04/02/85	84.6	9.0	133	7.2	0.070	10.2	3.11	1.27	0.89	0.061	805	280	180	40
7	04/18/85	1.5	7.2	185	7.9	0.079	4.88	0.57	0.21	0.099	0.121	9	17	4	<1
8	06/05/85	◇5	1.0	173	7.7	0.238	1.33	1.12	0.38	0.04	0.264	33	60	460	280
9	06/18/85	0.3	23.1	158	7.7	0.064	1.75	0.47	0.23	0.03	0.159	11	13	41	3
10	02/18/86	14.8	0.5	291	6.9	AAA	20.4	1.31	0.30	AAAAA	0.183	48	AAA	22	130
11	02/25/86	33.0	5.8	142	7.4	0.060	11.6	1.24	0.40	0.278	AAAAA	26	AAA	32	10
12	V03/11/86	AAA	AAA	AAA	AAA	0.025	7.50	0.75	0.2	AAAAA	AAAAA	2	AAA	AAA	AAA
12	03/11/86	3.3	5.1	190	7.5	0.028	7.13	0.93	0.2	0.199	0.126	4	AAA	<10	<10
12	*03/11/86	3.3	5.1	190	7.5	0.026	7.32	0.84	0.2	0.199	0.126	3	AAA	<10	<10
13	04/08/86	0.4	7.0	150	8.0	0.046	3.52	0.36	0.2	0.161	0.111	8	AAA	1	2
	SUMMARY OF DATA														
	AVERAGE	16.1	6.9	162	£7.6	0.104	8.02	1.11	0.4	0.314	0.083	132	95	£31	£14
	MINIMUM	0.3	0.5	133	6.9	0.022	1.33	0.36	0.18	0.023	0.012	2	13	<10	<1
	MAXIMUM	84.6	23.1	291	8.0	0.448	20.4	10.6	2.21	0.89	0.264	805	280	590	280

AAA UNREPORTED VALUES
◇ ESTIMATED DISCHARGE
✓ QUALITY CHECK SAMPLE
£ LOGARITHMIC MEAN

V DATA COLLECTED BY SCS PERSONNEL
* MEAN FOR ALL DATA COLLECTED ON THAT DATE
< MEAN CALCULATED WITH "LESS THAN" VALUE

APPENDIX B 1. MISSION/LAPWAI CREEK NUTRIENT LOADS

STATION #1,at the Winchester Lake inlet

SET	DATE	FLOW CFS	S.S. LOAD TONS/DAY	NH3 LOAD LBS/DAY	NO2 + NO3 LOAD LBS/DAY	INORGANIC N LOAD LBS/DAY	T.P. LOAD LBS/DAY	T.H.P. LOAD LBS/DAY	O'PO4 LOAD LBS/DAY
3	03/18/85	4.1	0.4	<1	71	71	6	3	<1
4	03/28/85	8.9	0.6	2	342	344	6	~~AAA~~	<1
5	04/02/85	40.7	23.7	19	1840	1859	110	62	10
7	04/18/85	4.4	0.2	2	22	24	4	3	<1
9	06/18/85	0.4	<0.1	<1	1	1	<1	<1	<1
12	*03/11/86	6.1	0.2	3	65	68	7	4	2
13	04/08/86	1.2	0.2	3	7	10	<1	<1	<1
SUMMARY OF DATA									
	TOTAL		25.3	29	2346	2375	133	73	16
	MINIMUM	0.4	<0.1	<1	1	1	<1	<1	<1
	MAXIMUM	40.7	23.7	19	1840	1859	110	62	10

* MEAN FOR ALL DATA COLLECTED ON THAT DATE N = 2

◊ ESTIMATED DISCHARGE

~~AAA~~ UNREPORTED DATA

APPENDIX B 2. MISSION/LAPWAI CREEK NUTRIENT LOADS

STATION #2,at the Winchester Lake outfall

SET	DATE	FLOW CFS	S.S. LOAD TONS/DAY	NH3 LOAD LBS/DAY	NO2 + NO3 LOAD LBS/DAY	INORGANIC N LOAD LBS/DAY	T.P. LOAD LBS/DAY	T.H.P. LOAD LBS/DAY	O'PO4 LOAD LBS/DAY
4	03/28/85	3.4	<0.1	2	39	41	3	3	<1
5	04/02/85	114	2.2	170	1070	1240	117	98	10
7	04/18/85	1.0	<0.1	<1	18	19	3	2	1
9	06/18/85	1.1	<0.1	5	13	18	4	1	3
10	02/18/86	8.8	0.3	AAA	47	47	14	AAA	6
11	02/25/86	◊100	1.1	39	1290	1329	120	57	AAA
12	*03/11/86	2.6	0.1	5	32	37	6	4	2
13	04/08/86	3.1	0.3	8	44	52	8	6	4
SUMMARY OF DATA									
	TOTAL		4.3	230	2553	2783	275	171	27
	MINIMUM	1.0	<0.1	<1	13	18	3	1	<1
	MAXIMUM	114	4	170	1290	1329	120	98	10

* MEAN FOR ALL DATA COLLECTED ON THAT DATE N = 2
◊ ESTIMATED DISCHARGE
AAA UNREPORTED DATA

APPENDIX B 3. MISSION/LAPWAI CREEK NUTRIENT LOADS

STATION #3,at Lapwai Creek midway to Culdesac

SET	DATE	FLOW CFS	S.S. LOAD TONS/DAY	NH3 LOAD LBS/DAY	NO2 + NO3 LOAD LBS/DAY	INORGANIC N LOAD LBS/DAY	T.P. LOAD LBS/DAY	T.H.P. LOAD LBS/DAY	O'PO4 LOAD LBS/DAY
1	02/25/85	15.9	0.8	5	260	265	18	10	8
2	*03/04/85	22.1	0.5	6	1090	1100	21	5	9
3	03/18/85	◇90	48.8	27	4380	4400	223	121	34
4	03/28/85	39.8	0.6	9	1690	1700	28	26	5
5	04/02/85	◇300	1300	226	10800	11026	3860	2640	80
7	04/18/85	12.9	<0.1	12	253	265	12	7	6
8	06/05/85	◇30	3.6	9	220	230	37	10	23
9	06/18/85	3.0	<0.1	1	16	17	3	<1	2
10	02/18/86	152	5.7	AAA	9094	9094	164	AAA	101
11	02/25/86	◇300	40	181	11200	11381	650	440	AAA
12	*03/11/86	31.5	1.9	7	866	873	34	29	18
13	04/08/86	7.0	AAA	4	93	97	8	5	4

SUMMARY OF DATA

	TOTAL		1400	487	40000	40400	5060	3300	290
	MINIMUM	3.0	<0.1	1	16	17	3	<1	2
	MAXIMUM	◇300	1300	226	11200	11381	3860	2640	101

* MEAN FOR ALL DATA COLLECTED ON THAT DATE N = 2
◇ ESTIMATED DISCHARGE
AAA UNREPORTED DATA

APPENDIX B 4. MISSION/LAPWAI CREEK NUTRIENT LOADS

STATION #4,at Lapwai Creek below Culdesac

SET	DATE	FLOW CFS	S.S. LOAD TONS/DAY	NH3 LOAD LBS/DAY	NO2 + NO3 LOAD LBS/DAY	INORGANIC N LOAD LBS/DAY	T.P. LOAD LBS/DAY	T.H.P. LOAD LBS/DAY	O'PO4 LOAD LBS/DAY
1	02/25/85	36.4	2.0	21	645	666	43	22	20
2	*03/04/85	32.1	0.7	8	758	766	19	4	9
3	03/18/85	130.0	28.8	48	5930	5978	224	92	50
4	03/28/85	62.3	1.7	7	2160	2167	50	42	10
7	04/18/85	33.7	0.6	18	678	696	31	18	14
9	06/18/85	5.1	<0.1	2	27	28	5	1	3
12	*03/11/86	51.3	0.4	13	1570	1583	55	46	35
13	*04/08/86	11.9	0.2	9	216	225	13	10	7
SUMMARY OF DATA									
	TOTAL		34.4	126	11984	12108	440	235	148
	MINIMUM	5.1	<0.1	2	27	28	5	1	3
	MAXIMUM	130	28.8	48	5930	5978	224	92	50

* MEAN FOR ALL DATA COLLECTED ON THAT DATE
◊ ESTIMATED DISCHARGE
AAA UNREPORTED DATA

APPENDIX B 5. MISSION/LAPWAI CREEK NUTRIENT LOADS

STATION #5,at Rock Creek near the Mouth

SET	DATE	FLOW CFS	S.S. LOAD TONS/DAY	NH3 LOAD LBS/DAY	NO2 + NO3 LOAD LBS/DAY	INORGANIC N LOAD LBS/DAY	T.P. LOAD LBS/DAY	T.H.P. LOAD LBS/DAY	O'PO4 LOAD LBS/DAY
1	02/25/85	4.0	0.2	2	48	50	4	2	1
2	03/04/85	4.6	<0.1	5	440	445	13	1	6
3	03/18/85	29.1	1.4	4	1330	1334	25	3	5
4	03/26/85	26.0	0.5	9	888	897	14	1	3
5	04/02/85	131.0	19.1	49	5970	6020	219	184	14
6	04/09/85	32.8	0.9	8	935	943	27	21	7
7	04/18/85	6.5	<0.1	1	126	127	4	1	3
9	06/18/85	2.4	<0.1	<1	14	14	2	<1	1
SUMMARY OF DATA									
	TOTAL		22.1	79	9751	9830	308	214	40
	MINIMUM	2.4	<0.1	<1	14	14	2	<1	1
	MAXIMUM	131	19.1	49.4	5970	6020	219	184	14

* MEAN FOR ALL DATA COLLECTED ON THAT DATE

◊ ESTIMATED DISCHARGE

~~AAA~~ UNREPORTED DATA

APPENDIX B 6. MISSION/LAPWAI CREEK NUTRIENT LOADS

STATION #6,at Mission Creek,1.4 Miles from the Mouth

SET	DATE	FLOW CFS	S.S. LOAD TONS/DAY	NH3 LOAD LBS/DAY	NO2 + NO3 LOAD LBS/DAY	INORGANIC N LOAD LBS/DAY	T.P. LOAD LBS/DAY	T.H.P. LOAD LBS/DAY	O'PO4 LOAD LBS/DAY
1	02/25/85	40.8	7.2	11	480	490	68	48	16
2	*03/04/85	29.5	1.6	12	510	522	29	4	11
3	03/18/85	58.4	7.9	8.2	1270	1280	76	33	5
4	03/26/85	104	16.3	49	2620	2670	130	54	22
5	04/02/85	212	71.6	69	5040	5110	423	251	64
6	04/09/85	227	18.9	200	3170	3370	343	208	130
7	04/18/85	78	3.4	54	300	354	101	50	34
8	06/05/85	◇30	2.3	16	82	98	26	8	14
9	06/18/85	12.5	0.3	3	28	31	9	AAA	2
10	02/18/86	◇130	9.1	AAA	2980	2980	210	AAA	54
11	02/25/86	480	77.8	114	6180	6290	1030	740	AAA
12	*03/11/86	112	9.7	22	1100	1120	121	94	54
13	04/08/86	21.9	0.4	11	81	92	12	13	6
SUMMARY OF DATA									
	TOTAL		226.5	570	23840	21430	2578	1503	412
	MINIMUM	12.5	0.3	3	28	31	9	4	2
	MAXIMUM	480	77.8	200	6180	6290	1030	740	130

* MEAN FOR ALL DATA COLLECTED ON THAT DATE
◇ ESTIMATED DISCHARGE
AAA UNREPORTED DATA

APPENDIX B 7. MISSION/LAPWAI CREEK NUTRIENT LOADS

STATION #7,at Nucrag

SET	DATE	FLOW CFS	S.S. LOAD TONS/DAY	NH3 LOAD LBS/DAY	NO2 + NO3 LOAD LBS/DAY	INORGANIC N LOAD LBS/DAY	T.P. LOAD LBS/DAY	T.H.P. LOAD LBS/DAY	O'PO4 LOAD LBS/DAY
1	02/25/85	1.9	0.1	5	30	35	3	2	1
2	03/04/85	2.7	<0.1	<1	160	160	3	<1	2
3	03/18/85	14.7	24	3	840	843	65	39	4
4	03/28/85	5.5	0.2	<1	310	310	5	6	<1
5	04/02/85	84.6	184	32	4650	4680	580	406	28
7	04/18/85	1.5	<0.1	<1	39	39	2	<1	1
8	06/05/85	◊5	.4	6	36	42	10	1	7
9	06/18/85	0.3	<0.1	<1	3	4	<1	<1	<1
10	02/18/86	14.8	1.9	AAA	1630	1630	24	AAA	15
11	02/25/86	33.0	2.2	11	2060	2070	71	49	AAA
12	*03/11/86	3.3	<0.1	<1	130	130	4	4	2
13	04/08/86	0.4	<0.1	<1	8	8	<1	<1	<1
SUMMARY OF DATA									
	TOTAL		213.3	63	9900	9960	770	510	63
	MINIMUM	0.3	<0.1	<1	3	4	<1	<1	<1
	MAXIMUM	84.6	184	32	4650	4680	580	406	28

* MEAN FOR ALL DATA COLLECTED ON THAT DATE
◊ ESTIMATED DISCHARGE
AAA UNREPORTED DATA