

WATER QUALITY SUMMARY REPORT NO. 26

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**STREAM AND LAKE NUTRIENT LOADING  
FROM BURNED LOGGING SLASH  
Bonner and Kootenai Counties, Idaho  
1989-1990**

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**Idaho Department of Health and Welfare  
Division of Environmental Quality  
Water Quality Bureau  
1410 N. Hilton  
Boise, Idaho 83706-1253**

**1990**

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Prepared by  
Jack Skille

Coeur d'Alene Field Office  
2110 Ironwood Parkway, Suite 101  
Coeur d'Alene, ID 83814

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

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## BACKGROUND

In the summer of 1988, the Division of Environmental Quality conducted audits of forest practices throughout Idaho. One objective of these audits was to evaluate the effectiveness of forest Best Management Practices (BMPs) in protecting water quality and beneficial uses. On several timber sales, slash piles had been or were planned to be burned near streams, lakes or reservoirs.

Presently, the Idaho Forest Practices Rules and Regulations do not address burning distances from water, or burning within the stream protection zone (SPZ) [Forest Practices and Regulations, 1989]. Most forest practice BMPs are designed to reduce or prevent soil erosion and the subsequent pollution of streams and lakes by fine sediment.

The Washington State Forest Practices Rules and Regulations (1988) address slash disposal in riparian areas with the following rule:

### WAC 222-30-100 Slash Disposal.

#### (1) Slash Disposal Techniques:

- (a) Except in riparian management zones and on sites where the department determines that a particular method would cause unreasonable risk to public resources or unreasonably damage site productivity, any conventional method of slash disposal may be used, such as: Controlled broadcast burning; pile or windrow and burn; pile or windrow without burning; mechanical scatter and compaction; scarification; chip, mulch or lop and scatter; burying; and physical removal from the forest lands: Provided, That on land shown to have low productivity potential the landowner or operator shall obtain the department's approval as a slash disposal technique. In riparian management zones, slash disposal shall be by hand, unless approved by the department.
- (b) All slash burning requires a burning permit from the department which provides for compliance with the smoke management plan and reasonable care to prevent damage to riparian management zones, soil, residual timber, public resources and other property.

- (c) Location of slash piles. Except where burning will be completed before the next ordinary high-water season, slash shall not be piled or windrowed below the 50-year flood level of any Type 1, 2, 3 or 4 Water or in locations from which it could be expected to enter any stream, lake or pond.

The State of Oregon directly prohibits burning of slash in a riparian area under Rule 629-24-301:

- 6 (a). No land owner or operator shall burn in a riparian area along a Class I water.
- (b). When burning in riparian areas of influence, landowners and operators shall protect aquatic and wildlife habitat such as downed logs and snags.

These rules apply in all three (3) Forest Practice Regions of Oregon.

In 1988, members of the audit team suggested that the Division of Environmental Quality monitor the nutrient contributions from slash burning. As a follow-up to these concerns, the Idaho Department of Fish and Game requested that DEQ conduct monitoring of nutrient input to lakes and reservoirs from slash disposal (See Appendix A).

Research indicates that nutrient increases in runoff water due to logging or road building is not a significant problem. Studies by Fredriksen (1971 and 1973) in the Oregon Cascades indicate that road construction and logging have little effect on stream nutrient increases. Increases are usually in the form of organic nitrogen contained in the suspended sediment load.

Fredriksen also found that after broadcast slash burning (burning slash where it falls instead of piling), annual watershed nutrient losses increased from 1.6 lbs/acre nitrogen to 4.6 lbs/acre. Maximum in-stream concentrations were never more than 0.6 mg/l nitrate nitrogen ( $\text{NO}_3\text{-N}$ ) and 0.12 mg/l phosphate phosphorus ( $\text{PO}_4\text{-P}$ ) during the first and second years after burning.

Snyder, et.al. (1975) found no significant increase in stream nitrate nitrogen ( $\text{NO}_3$ ) concentrations below broadcast burned clearcuts in northern Idaho. They concluded that "soil is very effective in absorbing nutrients."

These studies indicate that broadcast slash burning is not a significant source of nutrients to lakes and streams. However, it is not known what effect concentrated burning of slash piles and landing site debris near a lake or reservoir may have on nutrient loading.

In April 1988, the Division of Environmental Quality and the Idaho Department of Lands conducted preliminary slash/nutrient sampling near Spring Creek in northern Idaho. A large landing slash pile had been burned near a small stream during the previous fall. Water samples were collected in the stream below the slash pile and in a similar size stream (control) where no slash was burned. Both streams were tributaries to Lake Pend Oreille.

Results of the Spring Creek pilot monitoring suggested that slash burning may significantly increase nutrients in runoff water. Inorganic nitrogen ( $\text{NO}_2 + \text{NO}_3$ ) was approximately 2.5 times higher in the "slash burn" tributary and total phosphorus was 2 times higher (Table 1). These results indicate that slash burning may increase nutrient loads carried by nearby streams.

Eutrophication of streams is generally not a concern in Idaho. However, eutrophication of lakes is becoming a major issue, especially in north Idaho. The Spring Creek results indicated that slash burning near tributary streams may contribute to lake eutrophication. Therefore, more intensive studies were initiated and are described in this report.

Table 1. Nutrient Concentrations (mg/l) in a Small Stream Below Burned Slash and in a Control Stream, April 29, 1988 (Skille & Clark).

	<u>Burned Slash Stream</u>	<u>Control Stream</u>
Inorganic nitrogen ( $\text{NO}_2 + \text{NO}_3$ )	0.073	0.029
Organic nitrogen (Kjeldahl - N)	0.06	0.09
Total phosphorus (P)	0.015	0.007
Turbidity (NTU)	0.29	0.25

Nitrate ( $\text{NO}_3$ ) is the nitrogen form of greatest concern for water quality because it is the most mobile (soluble) essential plant nutrient in soil and has a potential for causing eutrophication of streams and lake systems (Tiedeman, 1981).

Phosphate ( $\text{PO}_4$ ) is an anion that is not as mobile as nitrate nitrogen because it is easily absorbed with metal oxides. However, if it reaches a lake (usually on soil particles) it also can provide for accelerated development of algae and thus eutrophication (Tiedeman, 1981).

MICA CREEK TRIBUTARY

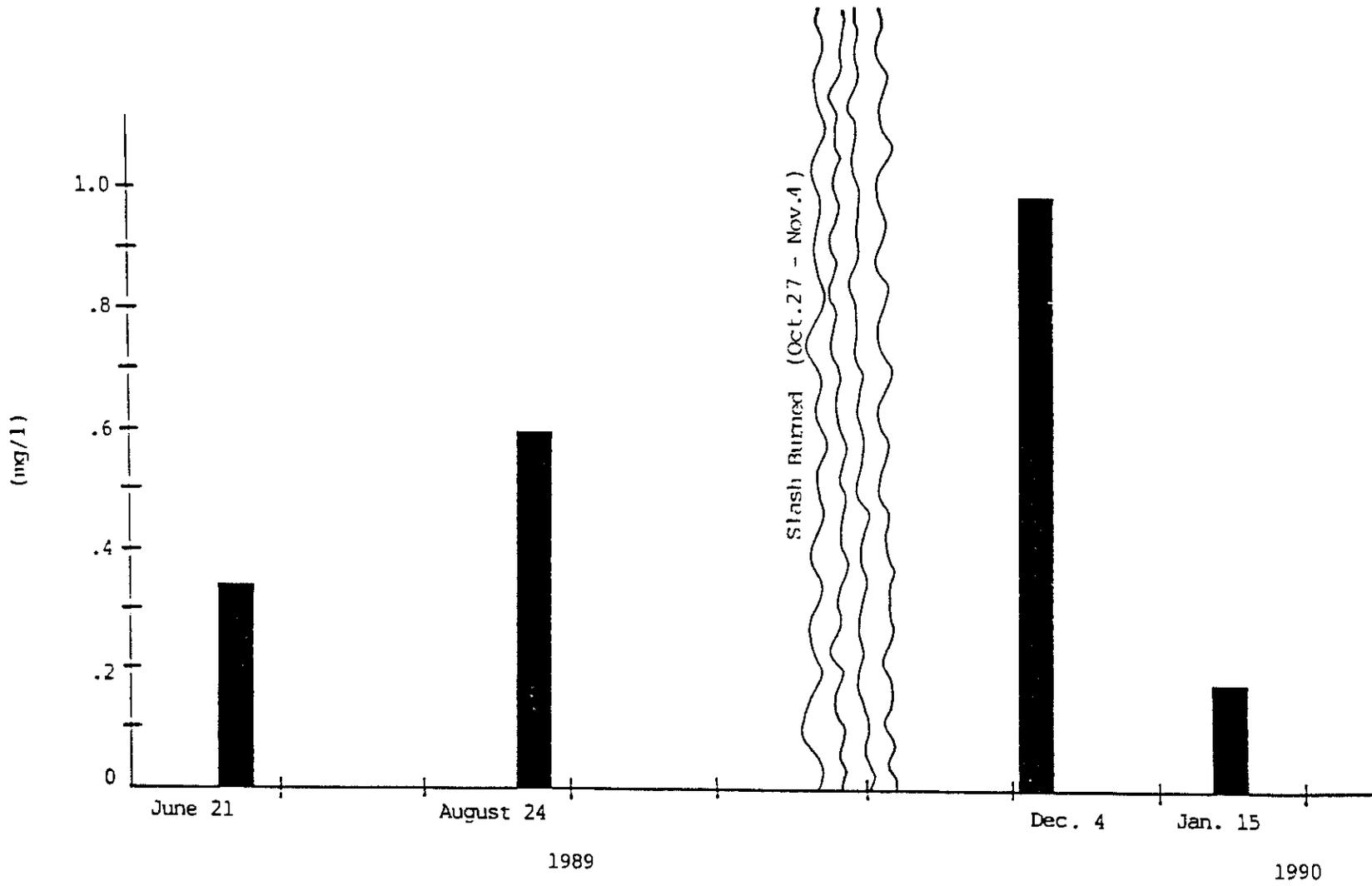


Figure 1. Nitrogen Concentrations ( $\text{NO}_2 + \text{NO}_3 + \text{Kjeldahl N}$ ) in the Mica Creek Tributary During Rain and Snowmelt Events (1989-90).

Total phosphorus concentrations followed trends similar to nitrogen at the Mica Creek site. Phosphorus concentrations were the highest (.430 mg/l) during the first stream flow after slash burning (Figure 2).

### Fish Creek Tributary

The Fish Creek tributary is a Class I stream which flows all year. During the study trout were observed in the stream. The slash was burned from October 23 to approximately November 1, 1989.

The first samples taken on October 24, the day after the slash burning started, had the highest concentrations of both phosphorus (.058 mg/l) and nitrogen (.341 mg/l) [Figures 3 and 4]. After heavy December rains and snow melt, the January 15, 1990 phosphorus concentrations had dropped to .020 mg/l and nitrogen had dropped to .151 mg/l.

The Fish Creek tributary in this study can be compared to a Twin Lake tributary located 2 1/2 miles east of the Fish Creek tributary which has no recent road work, harvest or slash burning. Both watersheds have similar soils, forest cover and drainage size. Total nitrogen concentrations in the comparison watershed averaged .095 and .087 mg/l in 1988 and 1989, respectively. All Fish Creek tributary samples in this study had higher total nitrogen concentrations than in the comparison watershed.

Insight into the significance of nutrient levels in the Fish Creek tributary can be seen by comparing them to nutrient levels in Upper Twin Lake (Bellatty, 1989). The highest total nitrogen concentrations in the stream after slash burning were .341 mg/l. Lake concentrations for 1988 (n = 6) averaged .256 mg/l. The highest stream total phosphate concentration was .058 mg/l after slash burning. This is about four (4) times higher than the 1988 average lake total phosphorus concentration of .014 mg/l (n = 6). Algal production in Upper Twin Lake is "phosphorus limited" during most of the year (Bellatty, 1989). This means that inflow of phosphorus can stimulate plant growth in the lake.

Turbidity appears to be related to flow at both the Mica Creek and Fish Creek sites (Table 2). High stream flows result in high turbidity. The Mica Creek site had the highest nutrient concentrations and the highest turbidity, indicating that nutrients may be tied to particles.

MICA CREEK TRIBUTARY

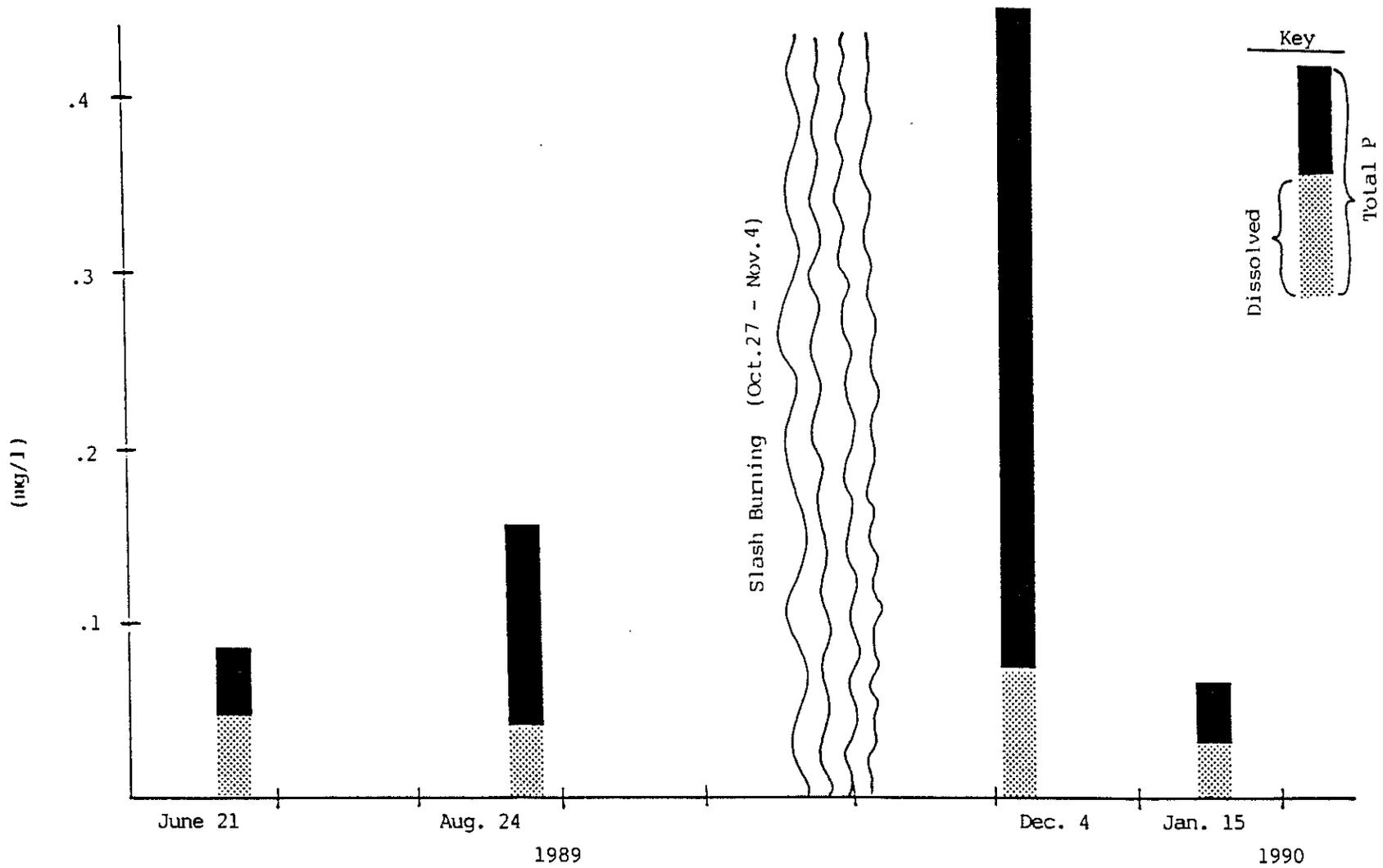


Figure 2. Total and Dissolved Phosphorus Concentrations in the Mica Creek Tributary During Rain and Snowmelt Events (1989-90).

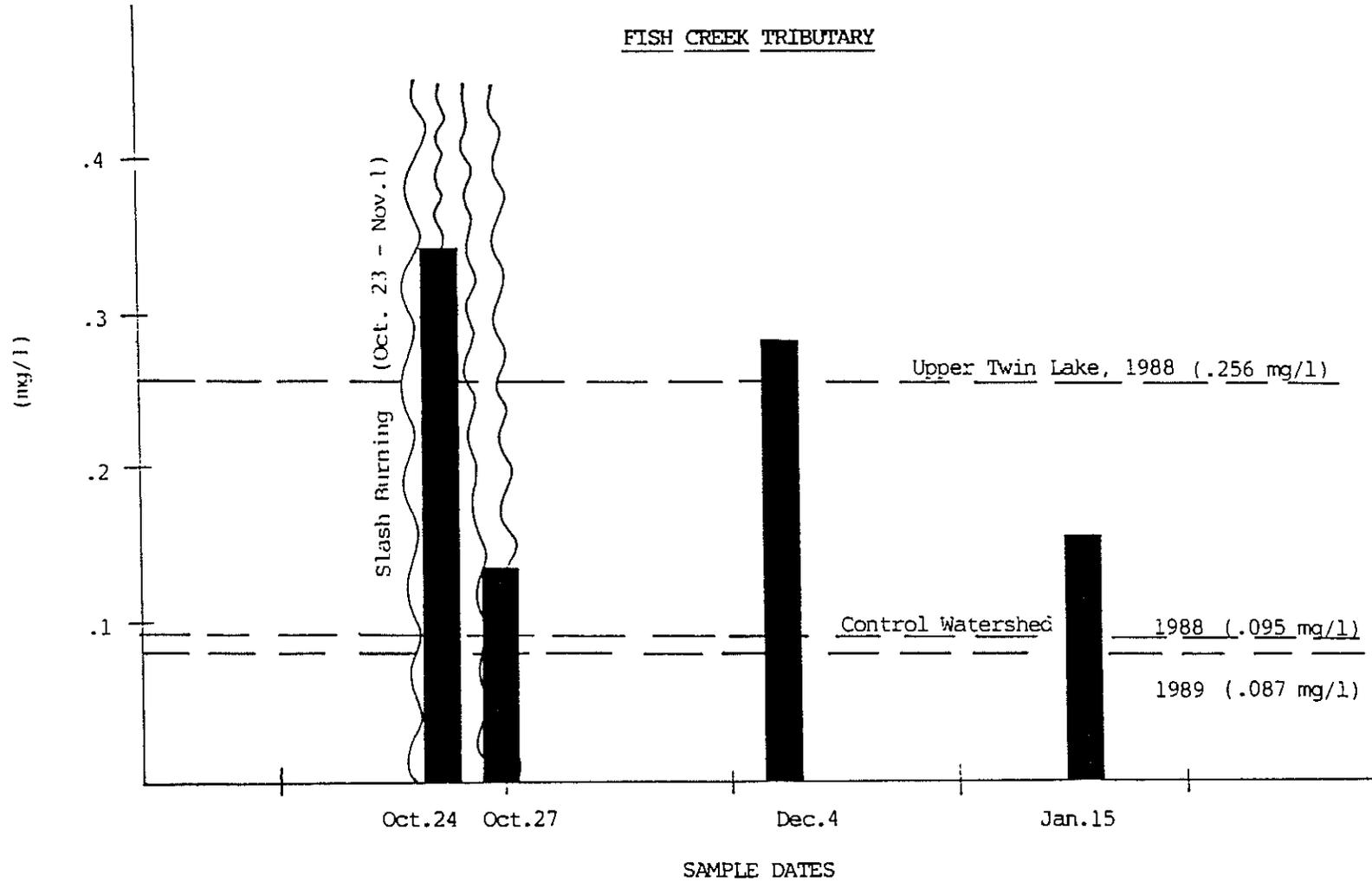


Figure 3. Nitrogen Concentrations ( $\text{NO}_2 + \text{NO}_3 + \text{KJeldahl N}$ ) in the Fish Creek Tributary during Rain and Snowmelt Events (1989-90).

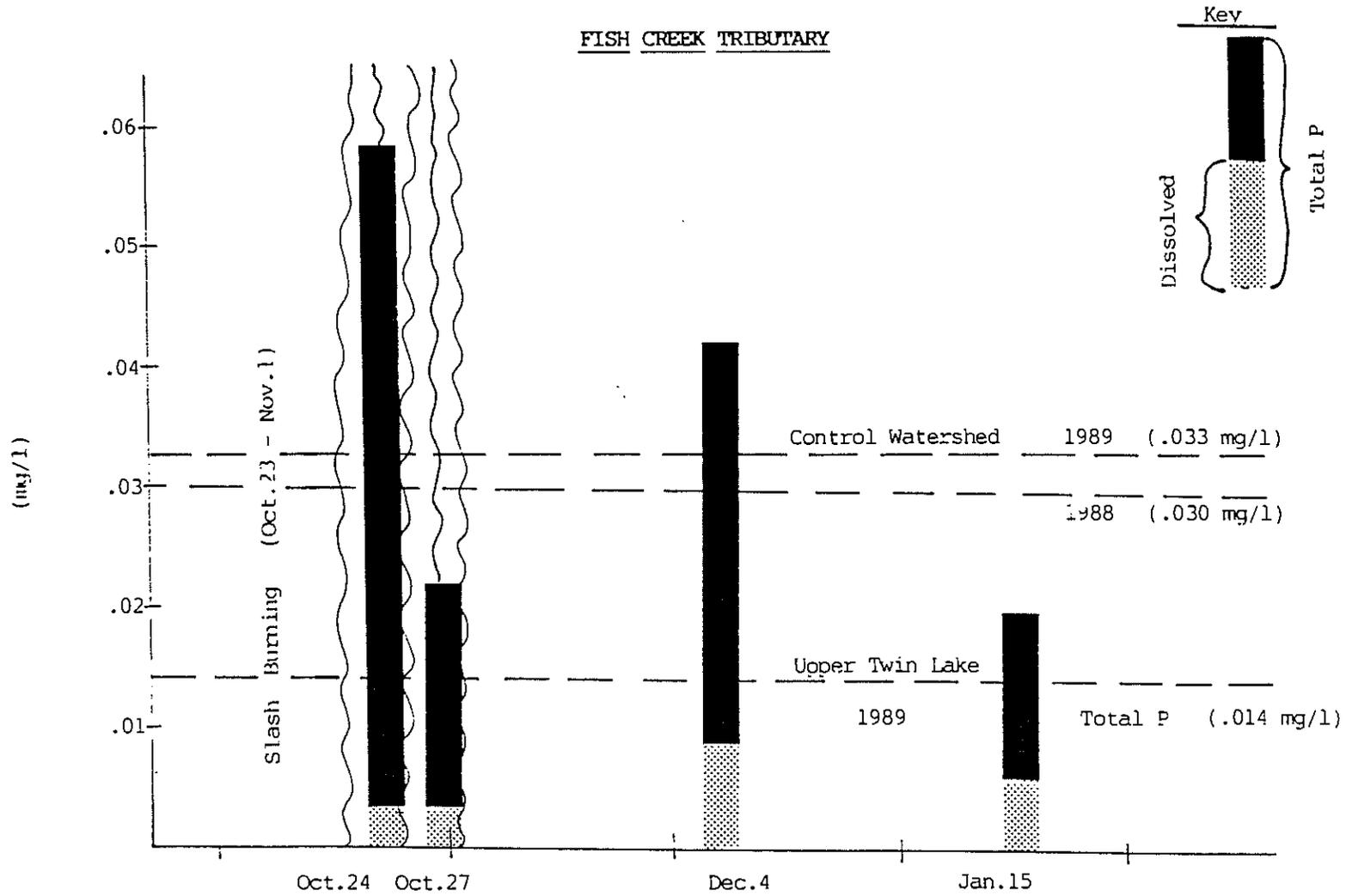


Figure 4. Total and Dissolved Phosphorus Concentrations in the Fish Creek Tributary During Rain and Snowmelt Events (1989-90).

Table 2. Water Quality Parameters at Three Sampling Sites (1989-90).

MICA CREEK TRIBUTARY

<u>Date</u>	<u>Flow (l/sec)</u>	<u>NO<sub>2</sub>+NO<sub>3</sub> Kjeldahl N (mg/l)</u>	<u>Total Phosphorus (mg/l)</u>	<u>Dissolved Phosphorus (mg/l)</u>	<u>Turbidity (NTU)</u>	<u>Comments</u>
6-21-89	1*	.341	.090	.049	---	Summer rain
8-24-89	1*	.601	.151	.042	1.4	Late summer rain
10-24-89	0					Slash not burned
10-27-89	0					Raining - burning
11- 3-89	0					Raining - burning
12 4-89	12	1.020	.430	.071	3.0	Melting snow and rain
1-15-90	1.7	.191	.063	.036	1.6	Rain on snow (rained previous 2 weeks)

FISH CREEK TRIBUTARY

10-24-89	1	.341	.058	.003	.75	First heavy rain--slash partially burned
10-27-89	1	.131	.022	.003	.68	Road ditch cleaned--slash burning No rain
12- 4-89	8	.281	.042	.009	3.10	Raining and melting snow
1-15-90	20	.151	.020	.006	2.40	Rained heavily last 2 weeks Raining and snowmelt

FREEMAN LAKE

10-11-89	0					No rain--slash not burned
10-27-89	0					Slash burning--no rain
12- 4-89	1	1.675	.240	.053	8.2	Slash still smoldering
1-15-90	0					Raining and snowmelt

## Freeman Lake Site

The Freeman Lake site was visited four (4) times during the study; twice before and twice after slash burning. The flume was installed October 11, 1989 in a dry draw between the slash pile (landing) and the lake. The only flow occurred December 4, 1989 after two weeks of heavy rain and snowmelt. That flow contained 1.675 mg/l nitrogen, the highest at any site during the study. The total phosphorus concentration was .24 mg/l (Table 2).

## SUMMARY AND CONCLUSIONS

This type of short term monitoring has some limitations since background conditions were not established. Sample sites were chosen only after it was known that slash was piled in a stream protection zone. This often precluded choosing sites where above/below or before/after controls could be used. Fall slash burning required fall sampling when many streams were not flowing. Because sampling was limited to rain events, sample numbers are low.

There are general conclusions that can be made about slash burning in the SPZ and the potential for increasing stream and lake nutrients:

- The first fall rains percolated into the dry soil and carried much of the burned slash nutrients. Later fall rains carried nutrients to live streams. This timing of burning tended to buffer the effect of nutrient contributions from slash burning.
- The first stream flows after slash burning had the highest nitrogen and phosphorus concentrations.
- Phosphorus and nitrogen concentrations returned to pre-burning levels after heavy winter rains.
- Nutrient concentrations associated with slash burning were approximately twice the concentrations before slash burning or after heavy winter rains.
- Phosphate concentrations in the Fish Creek tributary were four times higher than average Upper Twin Lake concentrations. With these phosphate concentrations entering the lake, the potential exists for stimulation of lake production (eutrophication).

A limited amount of slash burning in the lake watershed may not in itself contribute significant nutrients. However, slash burning in the stream/lake protection zone is part of a cumulative problem

along with lawn fertilization, agriculture runoff, cattle grazing, sewage systems, etc. If a lake is phosphate or nitrogen limited, any addition of these nutrients could result in nuisance algal blooms, increased weed growth and excessive periphyton production.

This monitoring project, as part of the feedback loop concept, points out a need for Idaho's Forest Practices Rules and Regulations to address slash burning in lake watershed stream protection zones. Possible rule changes are:

- Piling and burning of slash within the SPZ should be discouraged. The potential hazard of slash should be evaluated on a site-specific basis. If slash does not present a fire hazard, the slash should not be treated. This may require changes to the slash compliance rules as well as training of fire wardens and operators.
- In lake watersheds, piling and burning of slash should not be conducted within the stream protection zones. (Modify Rule 3.F.iii.)
- No burning of slash should be allowed within 75 feet (or more) of lake or pond shorelines. (Modify Rule 3.H.iii.)

## REFERENCES

- Bellatty, J.M. 1989. Annual Summary North Idaho 1988 Citizen's Volunteer Monitoring Program. Idaho Division of Environmental Quality Water Quality Status Report #86. 75 pp.
- Brown, G.W. 1985. Forestry and Water Quality. Oregon State University Book Stores, Corvallis, OR. 2nd Ed. 142 pp.
- Fredriksen, R.L. 1971. Comparative chemical quality-natural and disturbed streams following logging and slash burning, in Symposium on Forest Land and the Stream Environment. Oregon State University, Corvallis, OR. J.T. Krygier and J.D. Hall (Eds.)
- Fredriksen, R.L., D.G. Moore, and L.A. Norris. 1973. The impact of timber harvest, fertilization and herbicide treatment on streamwater quality in western Oregon and Washington, in Forest Soils and Forest Land Management. Proc. 4th Nor. Am. Forest Soils Conf. Laval University Press, Quebec, Canada. pp. 283-313.
- Rules and Regulations Pertaining to the Idaho Forest Practices Act, Title 38, Chapter 13, Idaho Code. February 1989. 32 pp.
- Snyder, G.G., H.F. Haupt, and G.H. Bett, Jr. 1975. Clearcutting and Burning Slash Alter Quality of Stream Water in Northern Idaho. USDA Forest Service Paper INT-168. 34 pp.
- Tiedeman, A.R. 1981. Stream chemistry, nutrient economy and site productivity consequences of wildland management and wildfire. pp. 183-202, in D.M. Baumgartner (Ed), Interior West Watershed Management. Washington State Coop. Ext., Pullman, WA. 228 pp.

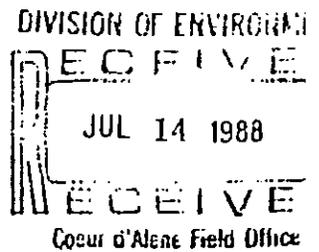
**APPENDIX A**

Idaho Department of Fish and Game Letter  
to the Idaho Division of Environmental Quality  
Requesting a Study (July 12, 1988).



IDAHO FISH & GAME

REGION 2  
1540 Warner Avenue  
Lewiston, ID 83501  
(208) 743-6502



July 12, 1988

Mr. Mark Von Lindern  
Division of Environment  
1118 F Street - P.O. Drawer B  
Lewiston, ID 83501

Dear Mark:

We participated in the FPA audit team review when the group toured the IDL timber sale adjacent to Moose Creek Reservoir. There was considerable slash piled above the reservoir that is scheduled for burning this fall. The team discussed some possible problems that may be associated with the slash burning. Nutrients released after the burn may get into the lake.

Presently Moose Creek Reservoir supports a substantial nutrient budget and is not in need of more phosphorus or nitrogen loading. We are requesting that DOE conduct some monitoring of the nutrient contribution after the slash is burned. If there is a significant problem additional BMPs may be necessary to address the problem.

We will gladly assist if needed.

Sincerely,

*Bert Bowler*  
for  
Jerry Thiessen  
Regional Supervisor

JT/BB/lkc

c Tulloch, DOE, Coeur d'Alene  
Reid, IDFG, Boise

Cecil D. Andrus / Governor  
Jerry M. Conley / Director