WATER QUALITY STATUS REPORT NO. 101

CITIZEN'S VOLUNTEER MONITORING PROGRAM ANNUAL SUMMARY
North Idaho
1989

Idaho Department of Health and Welfare

Division of Environmental Quality

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Glossary of Limnological Terms

Aerobic - living or active only in the presence of molecular oxygen; with oxygen.

Algae - small aquatic plants lacking stems, roots and leaves; often filaments, single cells, or colonies of single cells.

Algal bloom - a high concentration of a specific algal species in a water body, usually caused by nutrient enrichment.

Alkalinity - the acid neutralizing capacity of water, expressed as milligrams per liter (mg/l) of $CaCO_3$.

Anaerobic - living or active in the absence of molecular oxygen; without oxygen.

Anoxic - a condition of no oxygen in the water.

Benthic zone - organisms living in and on the bottom sediments of lakes and streams.

Biomass - the weight of biological matter.

Biota - all plant and animal species occurring in a specified area.

Chlorophyll - a pigment molecule found in plant tissues.

Chlorophyll **a** - a type of chlorophyll found in algae and higher plants; necessary for plant photosynthesis; an indicator of of algal biomass.

Cultural eutrophication - an accelerated rate of lake aging induced by human sources of nutrients and sediment.

Decomposition - the transformation of organic molecules to inorganic molecules through biological and non-biological processes.

Dissolved oxygen - molecular oxygen dissolved in water and readily available to aquatic organisms.

Ecosystem - a system of interrelated organisms and their physical-chemical environment.

Epilimnion - the upper, circulating waters of a thermally stratified lake.

Euphotic zone - the depth to which light penetrates; the lighted zone of a waterbody.

Eutrophic - a well-nourished aquatic ecosystem.

Eutrophication - the process of physical, biological, and chemical changes associated with nutrient, organic matter, and silt enrichment of a lake or reservoir; the natural aging process of a waterbody.

Exchange rate - the proportion of lake volume exchanged per year (also known as flushing rate; reciprocal of hydraulic residence time).

Gram - the mass of a substance equivalent to .035 ounces.

Hardness - the sum of the calcium and magnesium concentrations in a water sample, expressed as $CaCO_3$ (mg/l); originally understood to be the capacity of water to precipitate soap.

Heavy metals - metals of high specific gravity, including cadmium, chromium, cobalt, copper, lead, and mercury; toxic to many organisms in low concentrations.

Hydraulic residence time - the amount of time required to completely replace the lake's current volume with an equal volume of "new" water.

Hypolimnion - the bottom waters of a thermally stratified lake.

Inorganic nitrogen - the sum of ammonia, nitrite, and nitrate nitrogen.

Kjeldahl nitrogen - a term representing the organic and ammonia components of total nitrogen.

Limnology - the study of inland waters.

Liter - the volume of a substance equivalent to 1.057 quarts.

Macrophytes - large aquatic plants.

Mesotrophic - a moderately nourished aquatic ecosystem; the middle range between oligotrophic and eutrophic.

Metalimnion - the layer of water between the epilimnion and the hypolimnion in a stratified lake; delimited as the zone with the maximum rate of temperature change; resistant to mixing.

Meter - a linear measurement equivalent to 3.281 feet.

Microgram - the mass of a substance equal to one-millionth of a gram (.000001 gram).

Microgram per liter (ug/l) - mass per unit volume, equivalent to milligram per cubicmeter (mg/m^3).

Milligram - the mass of a substance equal to one one-thousandandth of a gram (.001 gram)

Milligram per liter (mg/l) - mass per unit volume, roughly equivalent to parts per million (ppm).

Nitrogen - as essential nutrient for aquatic organisms, comprising 80% of the earth's atmosphere.

Nonpoint source - water pollution emanating from a spatially diffuse source.

Nutrient - a chemical element or compound that sustains life and promotes growth of organisms, such as phosphorus, nitrogen, carbon, oxygen, and others.

Nutrient budget - the amount of nutrient(s) flowing into and out of an aquatic ecosystem per unit time.

Oligotrophic - a poorly nourished aquatic ecosystem.

Organic matter - molecules manufactured by plants and animals and containing linked carbon atoms and elements such as hydrogen, oxygen, nitrogen, sulfur, and phosphorus.

Orthophosphate - a predominantly soluble form of biologically available, inorganic phosphorus.

Pelagic zone - the open area of a lake, from the littoral zone to the center of a lake.

Periphyton - a community of microscopic plants and animals associated with the surfaces of submersed objects.

pH - the intensity factor of acidity, measured on a scale between 1 and 14; a change of one pH unit represents a tenfold change in hydrogen concentration. The pH of most natural waters ranges between 4 and 9, with a value of 7 being neutral between acid and alkaline conditions.

Phosphorus - an essential nutrient for aquatic organisms; derived from weathered rock and human sources.

Photosynthesis - the process occurring in green plants in which light energy is used to convert inorganic compounds to carbohydrates; carbon dioxide is consumed and oxygen is released.

Plankton - a community of plants (phytoplankton) and animals (zooplankton), usually swimming or suspended in water, nonmotile or insufficiently motile to overcome transport by currents.

Point source - water pollution emanating from a single source.

Secchi disk transparency depth -a standardized measure of water transparency obtained by lowering a weighted circular plate, 20 centimeters in diameter into water until it is no longer visible.

Specific conductance - a measure of a water's capacity to conduct an electrical current; used as an estimate of the total concentration of dissolved ionic matter in the water.

Thermal stratification - a seasonal process where some lakes stratify into a warm, upper layer (the epilimnion), a cool, dense lower layer (the hypolimnion), and separated by a metalimnion; due to temperature- induced density differences.

Thermocline - a horizontal plane across a lake at the depth of the most rapid vertical change in temperature and density in a stratified lake.

Total nitrogen - the sum of kjeldahl, nitrite, and nitrate nitrogen in a water sample.

Total phosphorus - the sum of organic and inorganic phosphorus in a water sample.

Trophic state - characterizing the biological productivity of an aquatic ecosystem based on organism nutrition; the relative degree of eutrophication.

Turnover - a seasonal process of lake transition from thermal stratification to complete circulation (mixing); caused by temperature changes and wind energy.

Turbidity - an expression of the optical property of water that causes light to be scattered and absorbed, rather than transmitted in straight lines; influenced by suspended matter, such as clay, silt, plankton, and other microscopic organisms; expressed in terms of nepholemetric turbidity units (ntu) or Jackson turbidity units (jtu).

Watershed - a drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

INTRODUCTION

In 1987, the Idaho Division of Environmental Quality (IDEQ) developed an innovative statewide program to monitor the health of Idaho's lakes and rivers using lake and river association volunteers. The general purposes of this cooperative program are to:

1. Collect reliable water quality data in a cost-effective manner, using volunteer support;

2. Use water quality monitoring data to determine lake trophic status and long term water quality trends; and

3. Increase community awareness of water quality and water quality protection issues.

Currently, the north Idaho volunteer water quality monitoring program involves approximately 40 volunteers representing nine lakes and one river segment, including:

Lake/River	County	Surface Acres
Priest Lake	Bonner	24,000
Pend Oreille Lake	Bonner/Kootenai	80,640
Rose Lake	Kootenai	350
Hauser	Kootenai	625
Spirit Lake	Kootenai	1,400
Lower Twin Lake	Kootenai	400
Upper Twin Lake	Kootenai	490
Cocolalla Lake	Bonner	800
Hayden Lake	Kootenai	3,900
Spokane River	Kootenai	na

MONITORING APPROACH

The IDEQ approach to this partnership has been to develop monitoring strategies tailored to the level of interest, commitment, and financial resources of each volunteer group. Monitoring programs vary in complexity from obtaining relatively simple water clarity measurements (using a standardized "secchi " disk) to collecting water quality samples using Kemmerer sampling bottles, sampling probes, and dissolved oxygen kits.

For monitoring groups choosing to purchase water quality sampling equipment, water quality samples are taken at specific, open-water locations, usually the deepest point of a lake or river. These samples are stored and preserved in cubitainers and transported to the Idaho Bureau of Laboratories for nutrient and chlorophyll a (algal biomass) analyses. The nutrients quantified include total phosphorus, orthophosphorus, nitrite and nitrate nitrogen, total kjeldahl nitrogen, and total ammonia. Samples are collected at six week intervals, from April through October, and once through the ice in mid-February.

Additionally, volunteers obtain readings for maximum depth, secchi disk transparency depth (water clarity), and water quality profiles of dissolved oxygen and water temperature. The dissolved oxygen and temperature readings are taken at equal interval depths and indicate if the the water column is seasonally stratified into thermal layers or continually mixed.

QUALITY ASSURANCE

A major challenge for any citizen volunteer water quality monitoring program is convincing water quality managers that volunteers are collecting high quality, reproducible water quality data and information. In response to this need, a series quality assurance checks and balances were developed to quantify the quality of the data being generated and address other quality assurance concerns. These checks and balances include an annual volunteer water quality monitoring training session; an IDEQ field audit; replicate and duplicate sampling; and laboratory quality controls.

Training

The citizen volunteers begin each monitoring season by attending a water quality training session. This outdoor workshop provides the volunteers with an opportunity to learn how to properly use and calibrate their water quality sampling equipment. The IDEQ trains the volunteers to use the "cookbook approach" to ensure that water quality samples and information are being collected in a systematic, step by step manner. This is especially important because of the six-week time lag between water quality sampling dates and the tendency to inadvertently forget some of the water quality sampling details.

The training session is also designed to provide a forum for presenting the water quality sampling results from previous monitoring seasons and discussing water quality trends.

Field Audit

In addition to water quality sampling training, each volunteer group is required to schedule a field audit with the IDEQ staff during the monitoring season. The purpose of this IDEQ visit is to take a non-threatening look at their sampling procedures and to provide constructive comments for improving water quality sampling techniques.

The field audit includes an informal evaluation of the volunteers' organizational capabilities, their preparation and labeling procedures, paperwork, consistency, meter calibrating techniques, and their ability to preserve and transport water quality samples in a timely manner. Thus far, we have found volunteers conscientiously applying proper water quality sampling techniques and procedures.

Replicate Sampling

The volunteers are required to collect one set of replicate water quality samples (i.e. repeat the sampling procedure) on at least one occasion during the sampling season. These replicate samples enable IDEQ to estimate the level of sampling precision, or the amount of reproducibility among individual measurements of the same parameter (Bauer 1986). Although IDEQ has not defined acceptable levels of precision for volunteer monitoring parameters, most of the replicate sampling results indicate low levels of sample variability.

Duplicate Sampling

Duplicate sampling will be incorporated into the 1990 Lake Water Quality Assessment for estimating levels of volunteer monitoring accuracy. Accuracy refers to the agreement or disparity between quantities measured and the amount actually present (Bauer 1986). IDEQ staff will coordinate with the volunteers to collect this comparative water quality data.

Laboratory Quality Controls

Volunteers collect, preserve, and transport their water quality samples to the Idaho Bureau of Laboratories for the appropriate chemical and biological analyses. Analyses are conducted in accordance with Environmental Protection Agency and the American Public Health Association (APHA 1985) standards and are tested for estimates of analytical accuracy and laboratory precision.

Although no single element in a quality assurance program would be enough to validate the results of a volunteer water quality monitoring program, we feel that a combination of these several checks and balances is adequate to meet our program goals and objectives.

COMPLEMENTARY VOLUNTEER ACTIVITIES

In addition to collecting water quality data, volunteers also have an opportunity to provide regulatory agencies with comments and valuable background information through stream and shoreline surveys.

Streamwalk

Streamwalk was developed by the Environmental Protection Agency (1988) as an educational tool to increase community awareness about the relationship between lakes, streams, and their surrounding watersheds. The Streamwalk exercise is coordinated by the IDEQ field office staff and provides volunteers with a mechanism to evaluate stream corridor health in a standardized, qualitative format. The results of these surveys can be recorded in a data collection system and are comparable over time or on a regional basis.

Shoreline Surveys

Volunteers are encouraged to conduct informal surveys of lake and river shorelines to identify existing or potential sources of water pollution. Past surveys reveal that sensitive shorelines areas are especially susceptible to drainage pipes, yard waste burn piles, fire pits, dilapidated docks, poorly maintained boats, antiquated septic systems and other lake encroachments. Shoreline survey information can serve as a "red flag" for regulatory agencies (e.g. Idaho Department of Lands, Army Corps of Engineers, Idaho Department of Water Resources, Idaho Department of Fish and Game) and can be processed by IDEQ as a water quality complaint, if appropriate.

The following discussion is a brief summary of the results obtained during the 1989 CVMP sampling season. Sampling site maps, data compilations, graphical displays, and other supportive materials can be found in the appendices at the end of this text.

LOWER TWIN LAKE

Volunteers have been monitoring Lower Twin Lake since the summer of 1987. Water quality samples and water column profiles of temperature and dissolved oxygen are collected from a single lake location, approximately 17.6 meters (m) deep (see map in Appendix A).

Results from the 1989 field season indicate that productivity in Lower Twin Lake is primarily phosphorus-limited, especially during the summer months when nitrogen to phosphorus ratios exceed 15:1. Secchi disk transparency depths have remained consistent throughout the past four seasons, averaging between 4.5 m and 4.8 m. Chlorophyll levels, except during the fall of 1987, have been relatively low and have averaged less than 3 micrograms per liter (ug/l) for the past two seasons (Table 2).

Lower Twin Lake is considered to be an oligo-mesotrophic or mesotrophic aquatic system (Falter and Hallock 1987). However, there are some indications that cultural eutrophication might be causing some subtle, albeit important, water quality problems. The most obvious sign of change can be found in the lake hypolimnion, below 10 m depth. Between June and October, hypolimnetic waters are relatively devoid of oxygen (anoxic) and are therefore incapable of supporting fish and other aquatic organisms. Volunteers can attest that samples collected from 1 m off the bottom are typically bright yellow and replete with decomposing organic matter (see Kjeldahl nitrogen values in Table 1 and 2) during periods of thermal stratfication. Internal phosphorus loading from lake sediments also reaches a peak under anaerobic conditions.

Unfortunately, in-lake restoration techniques to improve Lower Twin Lake (e.g. hypolimnetic aeration) are relatively expensive. In the interim, however, Twin Lakes Improvement Association members have been diligently seeking to influence watershed management practices in the drainage and reduce external sources (watershed) of phosphorus flowing into the lake. They have been by participating in the Clean Lakes Coordinating Council lake management planning process, setting water quality goals, working with landowners (e.g. Inland Empire Paper Company and the Easterday Ranch) to implement best management practices (BMP's), and studying the feasibility a lakeshore sewer. These actions are important first steps in preserving the longterm health of this popular recreational lake.

Table 1 Lower Twin Lake CVMP Water Quality Data Summary for 1989

	Lower Twin	Lower Twin	Lower Twin	
Date	1989 CVMP Min	1989 CVMP Max	1989 CVMP Avg	
Deep sample depth (m)	17.5	18	17.7	
Secchi Depth (m)	3.5	5.1	4.5	
T. Ammonia as N mg/l (euphotic	0.016	0.041	.033	
T. Ammonia as N (deep)	0.016	0.691	.329	
T. N02+N03 as N (euphotic)	0.0005	0.005	.002	
T. N02+N03 as N (deep)	0.0005	0.042	.009	
T.Kjeldahl as N mg/l (euphotic)	0.0025	0.31	.195	
T. Kjeldahl as N (deep)	0.26	0.97	.586	
T. Phosphorus as P mg/l (euphot	0.011	0.013	.012	
T. Phosphorus as P (deep)	0.027	0.31	.178	
Ortho phosphate as P mg/l (euph	0.001	0.003	.002	
Ortho phosphate as P (deep)	0.012	0.26	.154	
Chlorophyll a (ug/l)	1.7	3.6	2.6	
Lower Twin Lake	Depth (m)	1989 Min	1989 Max	1989 Avg
Temperature Profile (C)	0	11.5	23.5	18.5
	2	11	22	18.0
	4	11	21	17.1
	6	8.5	19	14.7
	8	6.5	13	10.7
	10	6	9	7.7
	12	5.5	7.5	6.8
	14	5	7	6.3
	16	5	6.5	6.0
	18	5	6	5.9
		0		
Lower Twin Lake	Depth (m)	1989 Min	1989 Max	1989 Avg
Dissolved Oxygen Profile (mg/l)	0	8	11	9.4
	2	8	11	9.1
	4	8	10.8	9.0
	6	8.2	10.6	9.2
	8	4.8	9.4	7.1
	10	0.5	7.8	3.9
	12	0.2	7.6	3.3
	14	0.1	7.4	2.9
	16	0.001	7	2.3
	18	0	6.3	1.5

Table 2 Comparison of Average Annual CVMP Values for Lower Twin Lake

	Lower Twin	Lower Twin	Lower Twin
Date	1987 CVMP Avg	1988 CVMP Avg.	1989 CVMP Avg
Secchi Depth (m)	4.8	4.7	4.5
T. Ammonia as N mg/l (euphotic)	.110	.038	.033
T. Ammonia as N (deep)	.720	.298	.329
T. NO2+NO3 as N (euphotic)	.030	.012	.002
T. NO2+NO3 as N (deep)	.004	.013	.009
T.Kjeldahl as N mg/l (euphotic)	.380	.243	.195
T. Kjeldahl as N (deep)	1.090	.565	.586
T. Phosphorus as P mg/l (euphotic)	.017	.011	.012
T. Phosphorus as P (deep)	.313	.136	.178
Ortho phosphate as P mg/l (euphotic)	.004	.001	.002
Ortho phosphate as P (deep)	.223	.119	.154
Chlorophyll a (ug/l)	8.7	2.2	2.6

UPPER TWIN LAKE

Water quality data and water column profiles of Upper Twin Lake have been collected by volunteers with the Twin Lakes Improvement Association since 1987. Sampling results indicate that Upper Twin Lake should be characterized as a mesotrophic or a meso-oligotrophic aquatic ecosystem, based on values presented by Falter and Hallock (1987) in their comprehsive water quality assessment.

Upper Twin Lake is a relatively shallow lake, with a maximum depth of less than five meters (see Appendix B). This morphological feature prevents seasonal development of a thermocline layer (i.e. the lake is too shallow for thermal stratification) and allows for complete mixing of oxygenated water throughout the water column (Table 3). This important feature greatly reduces the potential for internal phosphorus loading from the lake sediments.

Estimates of water-column phosphorus and nitrogen showed a small amount of variability over time. Phosphorus concentrations ranged between 12 and 15 micrograms per liter, well below the threshold for algae bloom conditions. Chlorophyll a concentrations were also relatively low, averaging less than 2 ug/L (Table 4).

Members of the Twin Lakes Improvement Association have expressed concerns for increased lake shallowing. Although there are no longterm figures documenting changes in maximum depth, Upper Twin Lake can be viewed as a sedimentation basin for downstream portions of the drainage. Erosion and subsequent sedimentation from the cumulative impacts of forest roads, unvegetated slopes, streambank trampling and other soil disturbances can decrease lake depth and create ideal growing conditions for aquatic weeds.

Controversy also exists about livestock grazing practices on the western shore of Upper Twin Lake. The Kootenai-Shoshone Soil Conservation District is recommending improved grazing management to protect the lake and lake shoreline. The lower Fish Creek drainage might also be eligible for increased protection as a Stream Segment of Concern in Idaho's Antidegradation program.

Table 3 Upper Twin Lake CVMP Water Quality Data Summary for 1989

	Upper Twin	Upper Twin	Upper Twin	
Date	1989 CVMP Min	1989 CVMP Max	1989 CVMP Avg	
Secchi Depth (m)	3.5	4.4	3.85	
T. Ammonia as N mg/l (euphotic)	0.023	0.116	.054	
T. Ammonia as N (deep)				
T. NO2+NO3 as N mg/l (euphotic)	0.0005	0.01	.003	
T. NO2+NO3 as N (deep)				
T.Kjeldahl as N mg/l (euphotic)	0.0025	0.3	.211	
T. Kjeldahl as N (deep)				
T. Phosphorus as P mg/l (euphotic)	0.011	0.014	.012	
T. Phosphorus as P (deep)				
Ortho phosphate as P mg/l (euphotic)	0.001	0.003	0.002	
Ortho phosphate as P (deep)				
Upper Twin Lake	Depth (m)	1989 Min	1989 Max	1989 Avg
Temperature Profile (C)	0	12.5	24	18.7
	1	12.5	22	17.9
	2	12.5	22	17.5
	3	12.5	22	17.2
	4	12.5	22	17
	5	22	22	22
Upper Twin Lake	Depth (m)			
Dissolved Oxygen Profile (mg/l)	0	7.6	10.2	8.8
	1	7.9	10.2	8.9
	2	7.9	10.2	8.9
	3	7.9	10.2	8.7
	4	7.9	10.2	8.7
	5		8.8	8.9

Table 4 Comparison of Average Annual CVMP Values for Upper Twin Lake

	Upper Twin	Upper Twin Lake	Upper Twin
Date	1987 CVMP Avg	1988 CVMP Avg.	1989 CVMP Avg
Secchi Disk (m)	3.9	4.2	3.9
T. Ammonia as N mg/l (euphotic)	.040	.023	.054
T. Ammonia as N (deep)	.060	.015	
T. NO2+NO3 as N mg/l (euphotic)	.025	.009	.003
T. NO2+NO3 as N (deep)	.026	.002	
T.Kjeldahl as N mg/l (euphotic)	.350	.250	.211
T. Kjeldahl as N (deep)	.340	.240	
T. Phosphorus as P mg/l (euphotic)	.015	.013	.012
T. Phosphorus as P (deep)	.014	.012	
Ortho phosphate as P mg/l (euphotic)	.002	.001	.002
Ortho phosphate as P (deep)	.002	.001	
Chlorophyll a (ug/l)	2.3	2.5	1.9

COCOLALLA LAKE

Members of the Cocolalla Lake Association have been actively particpating in the volunteer water quality monitoring program for the past three years. In 1986, Cocolalla Lake was assessed by Falter and Good (1987) as a meso-eutrophic aquatic ecosystem, based on low water clarity values, hypolimnetic anoxia, and persistent algae bloom conditions. These characteristics indicate that Cocolalla Lake might have the poorest water quality of all north Idaho lakes.

Water quality sampling results from the 1989 field season confirm this meso-eutrophic classification. Secchi disk transparency depths ranged between .75 meters (m) and 2.5 m , averaging 1.4 m. Cocolalla Lake also had relatively high average concentrations of phosphorus (33 micrograms per liter) and chlorophyll a (17.6 micrograms per liter) (Table 5). On August 27, 1989 a phytoplankton sample indicated a blue-green algae bloom (see Appendix C).

Water column profiles of temperature and dissolved oxygen (Table 24) indicate that Cocolalla Lake develops a thermocline at eight to nine meters depth and stratifies into thermal layers during mid to late summer. This layering phenomenon leads to oxygen depletion in the hypolimnion and increased internal phosphorus loading from the lake sediments.

Cocolalla Lake volunteers were the first group to show an interest in the Environmental Protection Agency's Streamwalk program. Approximately eight volunteers and IDEQ staff evaluated three representative stream locations: the upper, middle, and lower reaches of the Fish Creek drainage (see Appendix C). The evaluation revealed a variety of stream health conditions; good conditions in the upper watershed and poor ratings for the lower segment. The Streamwalk team surmised that historical land uses (grazing, road building, and hydrologic modifications) have contributed to stream habitat and water quality changes.

Currently, a federal Clean Lakes Program Phase I Diagnostic and Feasibility Analysis is being conducted on Cocolalla Lake, including biweekly sampling on the lake and its five major tributary streams, an aquatic plant survey, a sediment release study, and a riparian evaluation of Fish and Cocolalla Creeks. The outcome of this research will be applied toward developing a longterm lake water quality management plan.

Table 5 Cocolalla Lake CVMP Water Quality Data Summary for 1989

	Cocolalla	Cocolalla	Cocolalla
Date	1989 CVMP Min.	1989 CVMP Max.	1989 CVMP Avg.
Deep sample depth (m)	10	11	10.2
Secchi Disk (m)	0.75	2.5	1.4
T. Ammonia as N mg/l (euphotic)	0.017	0.094	.047
T. Ammonia as N (deep)	0.018	0.628	.166
T. NO2+NO3 as N mg/l (euphotic)	0.0005	0.012	.004
T. NO2+NO3 as N (deep)	0.0005	0.015	.005
T.Kjeldahl as N mg/l (euphotic)	0.19	0.68	.527
T. Kjeldahl as N (deep)	0.15	0.87	.488
T. Phosphorus as P mg/l (euphotic)	0.018	0.057	.033
T. Phosphorus as P (deep)	0.026	0.26	.083
Ortho phosphate as P mg/l (euphotic)	0.0005	0.006	.003
Ortho phosphate as P (deep)	0.001	0.25	.052
Chlorophyll a (ug/l)	3.8	27	17.6
Cocolalla Lake Temperature Profile (C)	1989 Min	1989 Max	1989 Avg.
1	11.5	20.8	17.2
2	9.75	20.8	16.7
3	9.5	20.8	16.5
4	9.25	20.5	16.2
5	9	19	15.5
6	9	19	15.1
7	8.75	19	14.6
8	8.5	19	14.0
9	8.25	17.5	13.5
10	8.25	15.8	12.8
11	11.5	11.5	11.5
Cocolalla Lake Dissolved Oxygen Profile (mg/l)	1989 Min	1989 Max	1989 Avg.
1	6.7	11.8	9.0
2	6.7	11.8	9.1
3	6.7	12	9.1
4	6.7	12	9.0
5	6.4	11.2	8.2
6	5.5	10.8	7.8
7	4.1	10	7.3
8	3	8	6.3
9	2.7	6.6	4.4
10	0.7	6.6	3.1
11	3.1	3.1	3.1

Table 6 Comparison of Average Annual CVMP Values for Cocolalla Lake

Date	Cocolalla 1987 CVMP Average	Cocolalla 1988 CVMP Average	Cocolalla 1989 CVMP Average
Deep sample depth (m)		10.9	10.2
Secchi Disk (m)	1.8	1.65	1.4
T. Ammonia as N mg/l (euphotic)	.050	.026	.047
T. Ammonia as N (deep)	.310	.163	.166
T. NO2+NO3 as N mg/l (euphotic)	.010	.015	.004
T. NO2+NO3 as N (deep)	.020	.009	.005
T.Kjeldahl as N mg/l (euphotic)	.610	.676	.527
T. Kjeldahl as N (deep)	.810	.606	.488
T. Phosphorus as P mg/l (euphotic)	.028	.031	.033
T. Phosphorus as P (deep)	.100	.092	.083
Ortho phosphate as P mg/l (euphotic)	.005	.000	.003
Ortho phosphate as P (deep)	.017	.056	.052
Chlorophyll a (ug/l)	12.2	39.7	17.6

SPIRIT LAKE

Members of the Spirit Lake Property Owners Association have participated in the Citizen's Volunteer Monitoring Program since 1987. Prior to this water quality monitoring effort, limnologists with Eastern Washington University (Soltero and Hall 1985) characterized Spirit Lake as a mesotrophic, or moderately enriched aquatic ecosystem. This classification was based on lake trophic status (biological productivity), hypolimnetic anoxia and elevated concentrations of deep water nutrients.

Volunteer monitoring data collected from a single lake location at approximately 24 meters depth (see map in Appendix D) indicates that Spirit Lake exhibits thermal stratification between June and October. The lake thermocline, or zone of maximum change in water temperature and density, has been consistently located at approximately 12 meters depth. As the summer progresses, temperature and dissolved oxygen profiles (Table 26) show that the hypolimnion becomes relatively devoid of oxygen (anoxic) below 14 meters depth.

Associated with these seasonally anoxic conditions is an increase in phosphorus release from the lake sediments. This internal source of phosphorus loading is evident in the deep sampling results taken from 1 meter off the bottom. Table 7 indicates elevated levels of all nutrients, especially soluble, inorganic orthophosphate. There is almost a seven-fold difference between euphotic zone phosphorus and deep sample concentrations. Fortunately, most of this internal nutrient loading is dispersed throughout the lake during turnover (mixis) and is not available to aquatic plants during the growing season.

Secchi disk transparency depth measurements for Spirit Lake have remained remarkably consistent over the past few years, with only a slight decrease from an average of 5.1 meters in 1988 to an average of 4. 6 meters during 1989.

As is true for other thermally stratified north Idaho lakes, controlling the rate of oxygen depletion, internal phosphorus loading, and watershed sources of phosphorus will continue to be important needs for maintaining Spirit Lake water quality.

Table 7 Spirit Lake CVMP Water Quality Data Summary for 1989

Date	Spirit Lake 1989 CVMP Min	Spirit Lake 1989 CVMP Max	Spirit Lake 1989 CVMP Avg	
Deep sample depth (m)	18.7	26.2	23.3	
Secchi Disk (m)	3	5.7	4.6	
T. Ammonia as N mg/l (euphotic)	.014	.073	.034	
T. Ammonia as N mg/l (deep)	.026	.167	.088	
T. N02+N03 as N mg/l (euphotic)	.001	.050	.015	
T. N02+N03 as N mg/l (deep)	.001	.053	.022	
T.Kjeldahl as N mg/l (euphotic)	.080	.260	.188	
T. Kjeldahl as N mg/l (deep)	.110	.380	.256	
T. Phosphorus as P mg/l (euphotic)	.009	.012	.011	
T. Phosphorus as P mg/l (deep)	.013	.130	.072	
Ortho phosphate as P mg/l (euphotic)	.001	.002	.001	
Ortho phosphate as P mg/l (deep)	.004	.113	.048	
Chlorophyll a (ug/l)	1.6	7.0	3.1	
Spirit Lake Temperature Profile (C)	Depth (m)	1989 Min	1989 Max	1989 Avg
	2	9.5	21.0	16.5
	4	9.2	21.0	16.3
	6	8.2	19.2	14.4
	8	8.0	19.0	13.2
	10	6.0	13.5	10.1
	12	5.2	11.0	8.0
	14	5.0	7.2	6.1
	16	4.8	6.5	5.7
	18	4.5	6.0	5.5
	20	4.5	6.0	5.3
	22	4.7	6.0	5.4
	24	4.5	6.0	5.2
	26	4.5	6.0	5.2
Spirit Lake Dissolved Oxygen Profile (mg/l)	Depth (m)	1989 Min	1989 Max	1989 Avg
	2	8.3	14.6	10.6
	4	8.3	14.4	10.5
	6	8.3	14.6	11.2
	8	8.3	14.5	11.4
	10	8.2	13.2	11.6
	12	6.3	12.6	9.3
	14	.8	12.4	7.1
	16	.8	12.0	6.3
	18	.3	11.8	5.6
	20	.8	11.7	6.2
	22	.3	11.4	5.9
	24	.3	11.2	6.4
	26			

Table 8 Comparison of Average Annual CVMP Values for Spirit Lake

	Spirit Lake	Spirit Lake	Spirit Lake
Date	1987 CVMP Avg	1988 CVMP Avg	1989 CVMP Avg
Secchi Disk (m)	5.1	5.0	4.6
T. Ammonia as N mg/l (euphotic)	0.04	.046	.034
T. Ammonia as N mg/l (deep)	0.25	.165	.088
T. NO2+NO3 as N mg/l (euphotic)	0.03	.027	.015
T. NO2+NO3 as N mg/l (deep)	0.08	.022	.022
T.Kjeldahl as N mg/l (euphotic)	0.24	.231	.188
T. Kjeldahl as N mg/l (deep)	0.48	.647	.256
T. Phosphorus as P mg/l (euphotic)	0.014	.014	.011
T. Phosphorus as P mg/l (deep)	0.16	.112	.072
Ortho phosphate as P mg/l (euphotic)	0.002	.001	.001
Ortho phosphate as P mg/l (deep)	0.096	.060	.048
Chlorophyll a (ug/l)	4.2	1.6	3.1

HAYDEN LAKE

Save Hayden Lake, Inc. volunteers have participated in the volunteer monitoring program since its inception in 1987. Hayden Lake has two lake volunteer monitoring stations; one representing the deep (50 meters), pelagic waters of the lake and the other at the north end of the lake in a shallow, productive site (see map in Appendix E).

Researchers from Eastern Washington University (Soltero et al. 1985) conducted a water quality assessment on Hayden Lake in 1985 and characterized it as a phosphorus-limited, meso-oligotrophic aquatic ecosystem. This characterization is still valid based on the water quality sampling results for 1989 (Table 9) showing that Hayden Lake maintains high quality pelagic waters with little or no oxygen depletion in the hypolimnion during periods of thermal stratification. This phenomenon appears to be the exception, rather than the rule for most north Idaho lakes.

Table 10 indicates that Hayden Lake water quality testing results are consistent from year to year, with low levels of euphotic zone and deep water phosphorus, low concentrations of chlorophyll a, and secchi disk transparency depths averaging greater that 7 meters. Nitrogen to phosphorus ratios are generally greater than 15: 1 (Table 27), verifying a phosphorus limitation.

The shallow, productive site at the north end of the lake (sampling site # 282) exhibits more eutrophic qualities than the open water, including ideal growing conditions for aquatic plants, higher concentrations of chorophyll a (algae), and warmwater fish (see Table 29). This area is also subject to water level fluctuations, depending on the availability of water and the hydrologic year.

Hayden Lake continues to exhibit very high water quality, despite continued and increased influence from shoreline development, antiquated septic systems, and other land use activities accelerating the eutrophication process. As lake and watershed use increases, it will be important to monitor the water quality changes, especially dissolved oxygen concentrations in the hypolimnion.

Table 9 Hayden Lake Sampling Site 279 CVMP Water Quality Data Summary for 1989

	Hayden 279	Hayden 279	Hayden 279	
Date	1989 CVMP Min	1989 CVMP Max	1989 CVMP Avg	
Deep sample depth (m)	50	57	53.7	
Secchi Depth (m)	5.5	11.5	7.5	
T. Ammonia as N mg/l (euphotic)	.023	.049	.033	
T. Ammonia as N (deep)	.036	.046	.040	
T. N02+N03 as N mg/l (euphotic)	.001	.047	.017	
T. N02+N03 as N (deep)	.004	.036	.021	
T.Kjeldahl as N mg/l (euphotic)	.060	.150	.123	
T. Kjeldahl as N (deep)	.050	.170	.118	
T. Phosphorus as P mg/l (euphotic)	.004	.017	.009	
T. Phosphorus as P (deep)	.006	.008	.007	
Ortho phosphate as P mg/l (euphotic)	.001	.005	.003	
Ortho phosphate as P (deep)	.003	.005	.004	
Chlorophyll a ug/l	.8	1.4	1.1	
	Depth (m)	1989 Min	1989 Max	1989 Avg
Hayden Lake 279	1	12.5	21	17.8
Temperature Profile (C)	5	10	21	16.8
	10	7.1	19	13.0
	15	5.3	8	6.6
	20	4.9	5.5	5.1
	25	4.5	5	4.7
	30	4	4.9	4.5
	35	4	4.9	4.5
	40	4	4.8	4.4
	45	4	4.5	4.2
	50	4.5	5	4.8
	Depth (m)	1989 Min	1989 Max	1989 Avg
Hayden Lake 279	1	7.9	10.4	8.9
Dissolved Oxygen Profile (mg/l)	5	7.9	11.2	9.3
	10	8.75	12	10.7
	15	11.8	12.5	12.0
	20	10.1	11.4	10.8
	25	9	11.4	10.1
	30	9.25	11.2	10.0
	35	9.25	11.4	10.2
	40	9.5	11.6	10.3
	45	8.6	11.1	9.8
	50	8.6	11.2	9.8

Table 10 Comparison of Average Annual CVMP Values for Hayden Lake Sampling Site 279

Date	Hayden 279 1987 CVMP Avg	Hayden 279 1988 CVMP Avg	Hayden 279 1989 CVMP Avg
Secchi Depth (m)	11.3	9.5	7.5
T. Ammonia as N mg/l (euphotic)	.030	.024	.033
T. Ammonia as N (deep)	.040	.026	.040
T. NO2+NO3 as N mg/l (euphotic)	.014	.008	.017
T. NO2+NO3 as N (deep)	.072	.048	.021
T.Kjeldahl as N mg/l (euphotic)	.200	.176	.123
T. Kjeldahl as N (deep)	.170	.140	.118
T. Phosphorus as P mg/l (euphotic)	.009	.007	.009
T. Phosphorus as P (deep)	.016	.008	.007
Ortho phosphate as P mg/l (euphotic)	.002	.001	.003
Ortho phosphate as P (deep)	.004	.003	.004
Chlorophyll a ug/l	5.1	1.0	1.1

PRIEST LAKE

The Priest Lake Monitors have established two types of water quality monitoring programs at this 24,000 acre lake: 1) water quality sampling at 6 representative lake locations (Soldier Creek, Kalispell Creek, Hunt Creek, Pinto Point, Two Mouth Creek, and Beaver Creek); and 2) an extensive secchi disk transparency depth survey of 76 different lake locations (see Appendix F).

Average annual water quality sampling results for Priest Lake during 1988 and 1989 field seasons are provided in Table 11. Although these results indicate that there might be some differences between sites over time, Priest Lake exhibits very high water quality. The Hunt Creek site (III) had the highest concentrations of organic and inorganic nitrogen, possibly indicating increased watershed land use and tributary loading from Hunt Creek.

These results also indicate that average secchi disk transparency depths decreased for all sites from 11.2 meters in 1988 to 7.7 meters in 1989. Some of this variability might be explained by the fact that the 1989 values represent only 2 sampling trips, in July and August. The bi-weekly secchi disk survey, mentioned below, calculated a seasonal lakewide average of 8.9 meters, slightly below the 1988 values.

The biweekly secchi disk transparency depth survey for 76 Priest Lake locations is the most intensive water clarity survey in the north Idaho region. Table 12 provides a summary of a portion of this database, comparing 1989 results with the 3 year (1987 to 1989) average. Huckleberry Bay had the lowest average secchi disk transparency depths for both 1989 (6.7 meters) and the three year average (8.4 meters). Outlet Bay shows the highest water clarity with a three year average of 11.1 meters.

Priest Lake is probably one of the highest quality lakes in the northwestern United States. Maintaining that oligotrophic status is important to the residents of Priest Lake, as evidenced by the nature and scope of the Priest Lake Monitors' secchi disk survey.

Table 11 Average Values of Priest Lake CVMP Sampling Sites for 1988 and 1989

Priest Lake Data Summary							
CVMP 1988							
SITE	I	II	III	IV	V	VI	1988 Average For All Sites
SECCHI DEPTH (M)	11.0	11.4	11.1	11.4	11.3	11.0	11.2
TEMPERATURE (F)@ SECCHI DEPTH	68.0	62.0	66.0	62.0	60.0	64.0	63.7
TOTAL AMMONIA AS N (MG/L)	.027	.010	.007	.006	.006	.002	.010
TOTAL NO2+NO3 AS N (MG/L)	.015	.030	.005	.008	.005	.007	.012
TOTAL KJELDAHL NITROGEN AS N(MG/L)	.077	.097	.120	.107	.097	.063	.093
TOTAL PHOSPHORUS AS P (MG/L)	.003	.003	.002	.003	.004	.003	.003
CVMP 1989							
SITE	I	II	III	IV	V	VI	1989 Average For All Sites
SECCHI DEPTH (M)	8.3	7.8	7.3	7.8	7.8	7.2	7.7
TEMPERATURE (F)@ Secchi Depth	64.0	62.0	67.0	65.0	65.0	65.5	64.8
TOTAL AMMONIA AS N (MG/L)	0.026	0.019	0.049	0.021	0.008	0.016	0.023
TOTAL NO2+NO3 AS N (MG/L)	0.003	0.007	0.015	0.005	0.003	0.003	0.006
TOTAL KJELDAHL NITROGEN AS N(MG/L)	0.080	0.060	0.090	0.070	0.090	0.070	0.077
TOTAL PHOSPHORUS AS P (MG/L)	0.004	0.005	0.005	0.004	0.005	0.004	0.004

Table 12 1989 Average Secchi Disk Transparency Depths for Priest Lake

	1989 Average Secchi Depths	1987 - 1989 Average Secchi Depths
SITE 13 A (Mosquito Bay)	9.0	9.2
SITE 14 A (Tango Creek)	8.3	8.6
SITE 12 A (Two Mouth Creek)	9.6	9.9
SITE 11 C (Huckleberry Bay)	6.7	8.4
SITE 15 A (Copper Bay)	9.6	9.5
SITE 16 B (Reeder Creek)	7.9	9.5
SITE 10 A (Cape Horn)		8.6
SITE 9 A (Indian Creek Bay)	9.3	10.2
SITE 17 A (Indian Rock)	9.6	10.8
SITE 18 A (Kalispell Island)	9.2	10.0
SITE 7 A (Hunt Creek)	10.9	11.0
SITE 19 C (Baritoe Island)	8.2	9.8
SITE 6 A (Fenton Creek)	8.2	9.4
SITE 5 A (4 mile Island)	10.6	10.8
SITE 4 A (Outlet Bay)		11.1
SITE 2 A (Soldier Creek)	8.5	9.1
SITE 3 A (Mid-lake, Soldier to Outlet)	9.7	9.9
SITE 1 A (Coolin Bay)	7.0	8.5
* in meters	1989 Lakewide Average = 8.9	3 Year Lakewide Average = 9.7

SPOKANE RIVER

Members of the Spokane River Association collect water quality samples for the Coeur d'Alene Lake to the Post Falls Dam stretch of the Spokane River from three representative mid-river sites: the Cedars Restaurant, located at the mouth of the river; Harbor Island; and the Post Falls Bridge (see Appendix G).

The Cedars site represents baseline water quality as it flows out of Lake Coeur d'Alene. Sampling results shown in Table 13 reveal that the river is relatively well-mixed at this location and contains low levels of phosphorus, nitrogen, and chlorophyll a. Dissolved oxygen is generally above 8 milligrams per liter (mg/L) and water temperature is uniform from top to bottom. Average values for all parameters were similar for both 1988 and 1989.

The Harbor Island site is three miles downsteam from Coeur d'Alene Lake and has an average depth of 6.9 meters. Average dissolved oxygen and temperature values were similar to the upstream location and were not indicative of thermal stratification. The levels of organic and inorganic nitrogen and phosphorus increased significantly during 1988 and 1989 in response to inputs from point source (e.g. Coeur d'Alene Wastewater Treatment Plant) and nonpoint source (e.g. septics, stormwater, mill waste) pollution. Chorophyll a values remained low and bacteria counts met Idaho Water Quality Standards for primary and secondary contact recreation. A single measure of zinc concentration proved to be relatively low under aerobic conditions.

The Post Falls Bridge samples are collected upstream from the Post Falls Dam at a site which is 7.8 meters deep. Water temperature values and dissolved oxygen measurements for this site indicate that the water column is mixed from top to bottom and there is no evidence of oxygen depletion or thermal stratification. Nitrogen and phosphorus concentrations were either very similar or slightly reduced compared to the Harbor Island site, indicating that there might be some nutrient attenuation as water moves downstream during the growing season.

An interstate committee of regulatory agency representatives and point source dischargers from both Idaho and Washington meet on a regular basis to implement provisions of the Spokane River Phosphorus Management Agreeement. The Spokane River Association also addresses these issues and is actively seeking to minimize recreational and point source impacts to river.

Table 13 Average Values of Spokane River CVMP Sampling Sites for 1988 and 1989

SPOKANE RIVER CVMP CEDARS SITE	1988 Averages	1989 Averages
MAXIMUM DEPTH (M)	2.6	2.6
SECCHI DEPTH (M)	2.6	2.5
TEMPERATURE (C)@ 1M DEPTH	17.7	16.0
TEMPERATURE (C)@ 1M OFF BOTTOM	17.5	16.5
DISSOLVED OXYGEN (MG/L)@ 1M	8.2	8.8
DISSOLVED OXYGEN (MG/L)@ 1M OFF BOTTOM	7.7	8.5
TOTAL AMMONIA (MG/L)	.019	.044
TOTAL NO2+NO3 (MG/L)	.015	.012
TOTAL KJELDAHL (MG/L)	.106	.126
TOTAL PHOSPHORUS (MG/L)	.009	.010
ORTHOPHOSPHORUS (MG/L)	.002	.002
SPECIFIC CONDUCTANCE (UMHOS)	50.6	
CHLOROPHYLL a (UG/L)	1.1	2.0
ZINC (UG/L)	84.8	40.0

SPOKANE RIVER CVMP HARBOR ISLAND SITE	1988 Averages	1989 Averages
MAXIMUM DEPTH (M)	5.8	6.9
SECCHI DEPTH (M)	3.7	4.4
TEMPERATURE (C)@ 1M DEPTH	17.6	18.0
TEMPERATURE (C)@ 1M OFF BOTTOM	17.7	18.0
DISSOLVED OXYGEN (MG/L)@ 1M	8.3	8.0
DISSOLVED OXYGEN (MG/L)@ 1M OFF BOTTOM	8.8	8.7
TOTAL AMMONIA (MG/L)	.033	.084
TOTAL NO2+NO3 (MG/L)	.023	.014
TOTAL KJELDAHL (MG/L)	.146	.099
TOTAL PHOSPHORUS (MG/L)	.023	.019
ORTHOPHOSPHORUS (MG/L)	.012	.008
SPECIFIC CONDUCTANCE (UMHOS)	51.9	
CHLOROPHYLL a (UG/L)	2.0	1.8
ZINC	67.5	40.0
FECAL COLIFORM (#/100 ML)	10.0	28.5

SPOKANE RIVER CVMP POST FALLS BRIDGE	1988 Averages	1989 Averages
MAXIMUM DEPTH (M)	8.6	7.8
SECCHI DEPTH (M)	4.0	4.1
TEMPERATURE (C)@ 1M DEPTH	18.0	18.2
TEMPERATURE (C)@ 1M OFF BOTTOM	17.9	18.2
DISSOLVED OXYGEN (MG/L)@ 1M	8.8	7.6
DISSOLVED OXYGEN (MG/L)@ 1M OFF BOTTOM	8.5	7.8
TOTAL AMMONIA (MG/L)	.024	.027
TOTAL NO2+NO3 (MG/L)	.020	.005
TOTAL KJELDAHL (MG/L)	.144	.113
TOTAL PHOSPHORUS (MG/L)	.022	.017
ORTHOPHOSPHORUS (MG/L)	.011	.005
SPECIFIC CONDUCTANCE (UMHOS)	45.1	
CHLOROPHYLL a (UG/L)	2.4	3.3
ZINC (UG/L)	82.0	

PEND OREILLE LAKE

A secchi disk transparency depth survey was implemented on Pend Oreille Lake in 1989 to provide the public with an opportunity to participate in a two year, interstate (Montana, Idaho, Washington) water quality investigation of the Clark Fork/Pend Oreille Basin. This study was mandated by Section 525 of the 1987 federal Clean Water Act and Amendments. Volunteers were recruited from throughout the watershed by the Clark Fork Coalition to take weekly water transparency readings at 14 different nearshore locations (see Appendix H).

The lakewide average for secchi disk transparency depth was 5.4 meters (see Table 14), ranging from a low of 3.2 meters at Bottle Bay to maximum of 7.5 meters at the Lakeview site. The Bottle Bay value, however, might have been more of a of maximum depth reading, rather than a water clarity measurement. Figure 1 illustrates that average secchi disk transparency depth values were generally greater in the southern end of the lake. Preliminary indications are that reduced water clarity might be correlated to the amount of sediment flowing into the lake from the Clark Fork River, especially during high flow conditions.

Another benefit of the Pend Oreille Lake secchi disk survey is that it complements water quality research being conducted by by limnologists from University of Idaho and the United States Geological Survey. The volunteers expect to continue their secchi disk survey beyond the life of the project and want to incorporate nearshore water quality sampling into their monitoring program.

Table 14 Average Secchi Disk Transparency Depths for Pend Oreille Lake during 1989

Location	1989 Averages	Notes
Springy Point	4.1	n=10
Chuck's Slough	4.3	n=8
Murphy Bay	4.4	n=8
Bottle Bay*	3.2	n=11
Pack River Bay	4.8	n=8
Trestle Creek	5.2	n=8
Ellisport Bay	4.7	n=5
Camp Bay	5.6	n=7
Glengary Bay	5.9	n=11
Garfield Bay	5.9	n=6
Talache	5.9	n=2
Lakeview	7.5	n=17
Scenic Bay	6.6	n=13
Idlewilde Bay	7.4	n=13
Lakewide Average	5.4	
*Artificially low due to shallow lake depth		

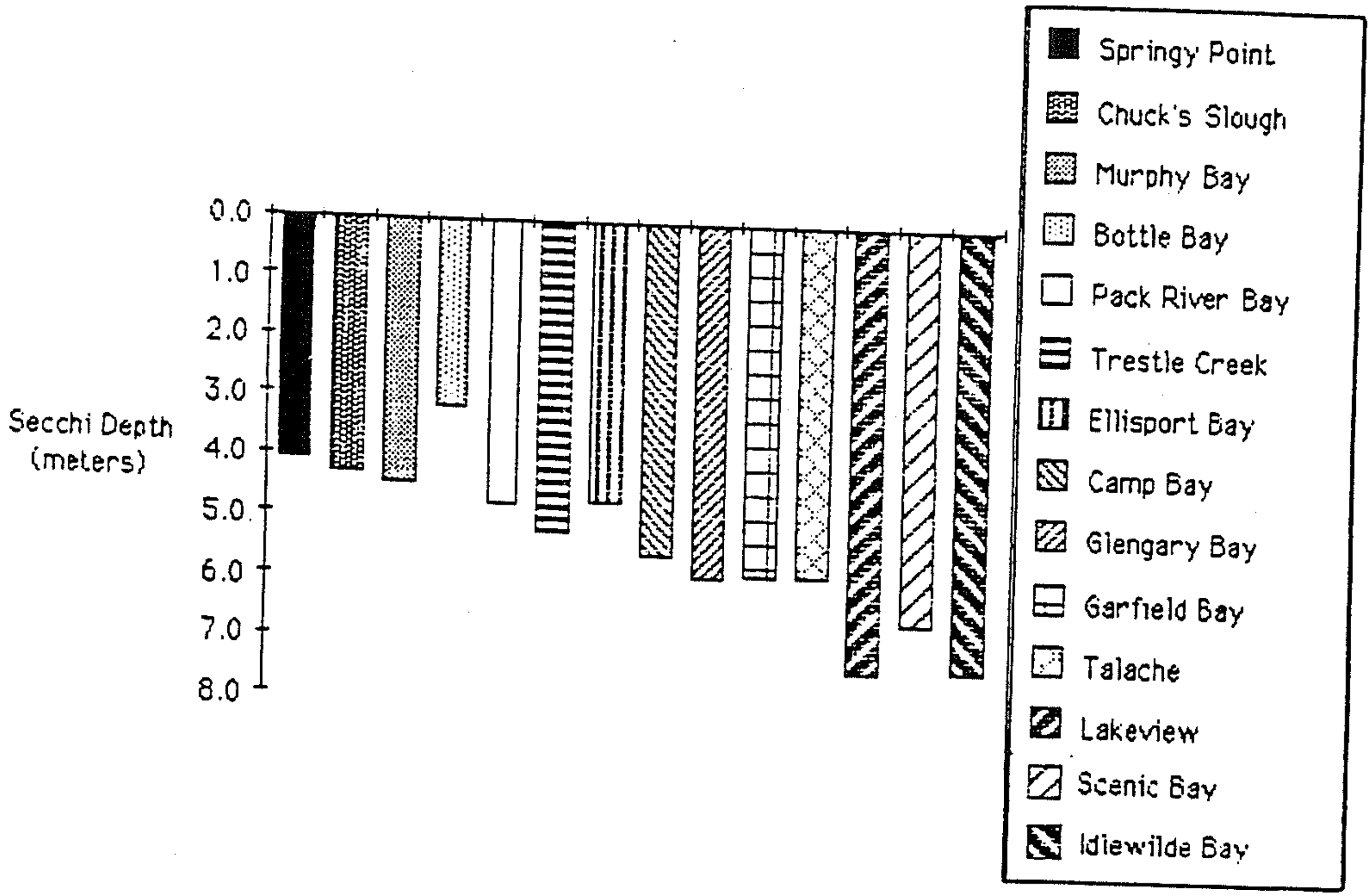

Figure 1 1989 Average Secchi Disk Transparency Depths for Pend Oreille Lake

HAUSER LAKE

Members of the Hauser Lake Watershed Coalition began participating in the volunteer water quality trend monitoring program during the 1989 field season after completing a two year federal Clean Lakes Program Phase I Diagnostic and Feasibility Analyses (Entranco 1990). One of the water quality management planning recommendations from this baseline assessment was to continue longterm water quality trend monitoring.

During the Phase I study, researchers with Entranco Engineers (1990) characterized Hauser Lake as a phosphorus-limited, mesotrophic aquatic ecosystem based on results they obtained for secchi disk transparency depth, total phosphorus, and chlorophyll a.

Volunteers collected water quality samples from the same open water location as the water quality study (see Appendix I. Average secchi disk transparency depth readings were 3.0 meters; total phosphorus concentrations averaged 19 micrograms per liter (ug/L); and chlorophyll a concentrations averaged 6.3 ug/L (Table 15). These values compare well with the 3.9 meter average secchi depth, the 17 ug/L total phosphorus, and 4.8 ug/L chorophyll a values obtained during the Phase I investigation. Nitrogen to phosphorus ratios in Table 34 (greater than 20:1) clearly indicate that Hauser Lake is phosphorus-limited during the growing season.

Entranco Engineers (1990) also determined that Hauser Lake stratifies into thermal layers between mid-June and October and exhibits hypolimnetic anoxia below 1 milligram per liter (mg/L) dissolved oxygen by late June. The volunteers confirmed this phenomenon by collecting deep water dissolved oxgyen samples averaging 3.0 mg/L. Low levels of dissolved oxygen in the hypolimnion contribute to the lake's internal, sediment phosphorus release load (Entranco 1990).

The Hauser Lake Watershed Coalition will continue their follow-up monitoring and determine if the one year baseline assessment accurately portrayed lake conditions. In the interim, the Clean Lakes Coordinating Council lake management process will refine water quality management goals and coordinate watershed planning.

Table 15 Hauser Lake CYMP Water Quality Data for 1989

Date	Hauser Lake 1989 CYMP Min	Hauser Lake 1989 CYMP Max	Hauser Lake 1989 CYMP Avg
Deep sample depth (m)	10	11.5	10.9
Secchi Depth (m)	1.6	4	3.02
T. Ammonia as N mg/l (euphotic)	0.017	.038	.028
T. Ammonia as N (deep)	0.022	.393	.175
T. NO2+NO3 as N mg/l (euphotic)	0.0005	.005	.003
T. NO2+NO3 as N (deep)	0.0005	.045	.013
T.Kjeldahl as N mg/l (euphotic)	0.4	.610	.488
T. Kjeldahl as N (deep)	0.35	.900	.618
T. Phosphorus as P mg/l (euphotic)	0.014	.024	.019
T. Phosphorus as P (deep)	0.023	.290	.140
Ortho phosphate as P mg/l (euphotic)	0.0005	.002	.001
Ortho phosphate as P (deep)	0.006	.185	.103
Chlorophyll a (ug/l)	1.9	16.0	6.3
Temperature (C) (euphotic)	13	21.5	17.6
Temperature (C) (deep)	8	11.0	9.8
Dissolved Oxygen mg/l (euphotic)	8	13.0	10.5
Dissolved Oxygen mg/l (deep)	0.4	9.0	3.0

ROSE LAKE

Volunteers with the Rose Lake Improvement Association intitiated a water quality monitoring program on Rose Lake during the 1989 field season. Prior to this effort, relatively little was known about the water quality of Rose Lake, except for occasional complaints about algae bloom conditions.

Historically, Rose Lake was periodically influenced by flows from the Coeur d"Alene River. As such, there was some initial concern about the amount of mining-related metals and sediment in the lake. However, it was determined that Rose Lake is presently isolated from the river and receives most of its flow from the Rose Creek watershed and groundwater sources.

The first set of water quality samples and baseline information on Rose Lake reveal that it has a maximum depth of 6.5 meters (Table 16). This relatively shallow depth precludes development of thermal stratification, as indicated by the uniform water temperature and dissolved oxygen measurements from the water column (Table 35).
The secchi disk transparency depth of Rose Lake varied between 1.5 meters and and 3.5 meters during the sampling season. These values seem to correlate well with chorophyll a concentrations, 13 micrograms per liter (ug/L) and 7.4 ug/L respectively, as good indicators of lake trophic status.

Total phosphorus concentrations ranged between 25 and 45 ug/L, with an average value of 36 ug/L. These concentrations are relatively high and might indicate excessive nonpoint phosphorus pollution from a variety of watershed sources. Submersed aquatic plants can also make a significant contribution to the lake's internal phosphorus cycle, however, the density and areal extent of these weeds are unknown.

During the 1990 field season, it is expected that the Rose Lake volunteers will have an opportunity to collect samples for metals analyses and determine if past lake sediment deposition is adversely affecting lake water quality.

Table 16 Rose Lake CVMP Water Quality Data for 1989

Date	Rose Lake 1989 CVMP Min	Rose Lake 1989 CVMP Max	Rose Lake 1989 CVMP Avg
Deep sample depth (m)	5	6.5	5.4
Secchi Depth (m)	1.5	3.5	2.3
T. Ammonia as N mg/l (euphotic)	0.054	0.162	.112
T. Ammonia as N (deep)	0.037	0.371	.151
T. NO2+NO3 as N mg/l (euphotic)	0.0005	0.025	.013
T. NO2+NO3 as N (deep)	0.0005	0.015	.004
T.Kjeldahl as N mg/l (euphotic)	0.52	0.69	.603
T. Kjeldahl as N (deep)	0.49	1.13	.683
T. Phosphorus as P mg/l (euphotic)	0.025	0.045	.036
T. Phosphorus as P (deep)	0.024	1.3	[illegible]
Ortho phosphate as P mg/l (euphotic)	0.001	0.011	.007
Ortho phosphate as P (deep)	0.0005	0.047	.015
Chlorophyll a (ug/l)	2.2	13	5.7
Temperature (C) (euphotic)	14	22	19.3
Temperature (C) (deep)	14	22	17.8
Dissolved Oxygen mg/l (euphotic)	7	9	7.8
Dissolved Oxygen mg/l (deep)	4	9	7

REGIONAL COMPARISONS

A comparative look at north Idaho lakes indicates that there are a wide variety of lake and watershed conditions represented in the north Idaho region. The following discussion attempts to pull some of these variables together and develop some conclusions about the relative status of our lakes. Table 18 is provided as a reference of representative values for different lake classfications.

Secchi disk transparency depth is usually a good indicator of lake trophic condition because it integrates a range of variables into one standardized measurement. Figure 2 shows the average secchi disk transparency depths for north Idaho lakes during 1989. Priest Lake has the best water clarity in the region, followed by Hayden Lake and Pend Oreille Lake. These lakes are relatively large and deep and therefore have greater capacity to absorb nutrients and pollutants without showing undesirable water quality changes. Cocolalla Lake, however, shows the poorest average annual water clarity and is less capable of absorbing increased nutrient loads without impairing beneficial uses.

Table 17 lists average annual concentrations of nutrients and chlorophyll a for north Idaho Lakes. Although it is difficult to develop any firm conclusions about these values and the status of our lakes (without an exception or lack of explanation) it is possible to form general opinions about some of these variables. Since most of our lakes are phosphorus limited during the growing season, it is important to look at their average annual epilimnetic phosphorus concentrations. The lakes with the best water clarity, such as Priest Lake and Hayden Lake, typically have the lowest phosphorus concentrations (less than 10 micrograms per liter (ug/L). Lakes with average annual phosphorus concentrations greater than 30 ug/L, such as Cocolalla Lake and Rose Lake, can usually be classified as meso-eutrophic or eutrophic and are capable of supporting nuisance algae blooms. Cocolalla Lake had the highest annual average chlorophyll a concentration, more than double the value of any other lake.

Another important consideration in lake water quality management is the presence or absence of thermal stratification. Figure 3 illustrates the relative importance that oxygen depletion and sediment release of soluble inorganic phosphorus have on the nutrient budget of a thermally stratified lake. Most notably, concentrations of phosphorus can be 10 to 20 times higher in the hypolimnion than in the euphotic zone. Lower Twin Lake, Hauser Lake, Spirit Lake , and Cocolalla Lake each have oxygen depletion problems which are accelerating the eutrophication process. Fortunately, most of this phosphorus is not available to nuisance aquatic plants during most of the growing season.

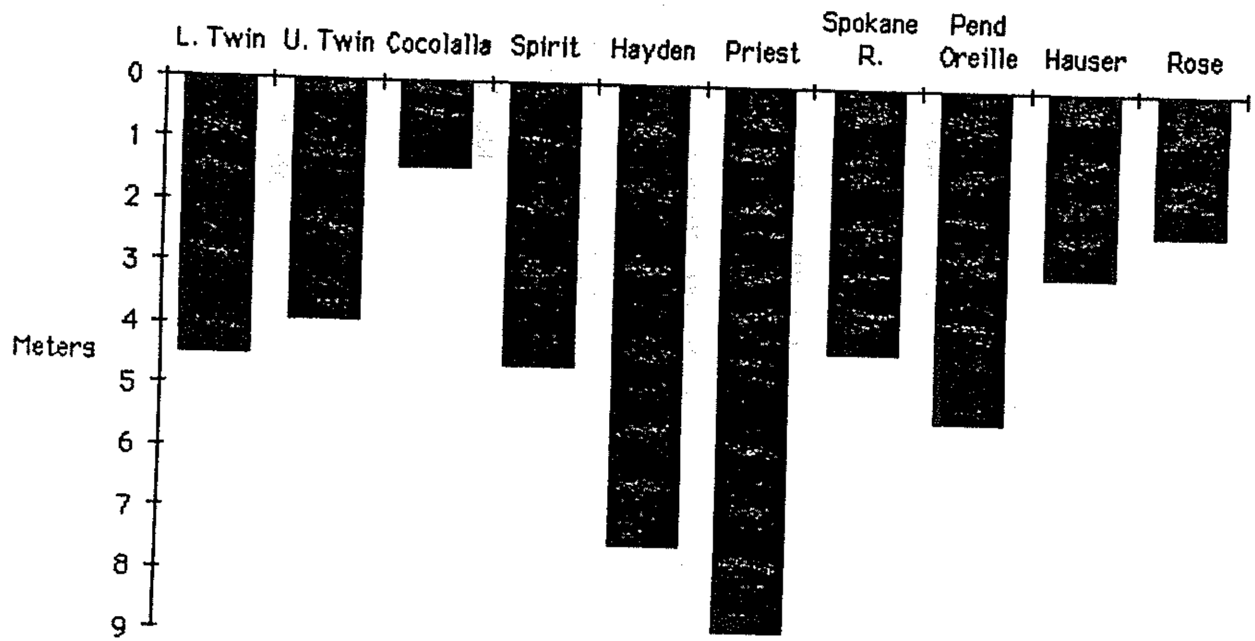

Figure 2 1989 Average Secchi Disk Transparency Depths for North Idaho Lakes and the Spokane River

Table 17 1989 Summary of Average Water Quality Values for North Idaho Lakes

Lake	L. Twin	U. Twin	Cocolalla	Spirit	Hayden	Priest	Hauser	Rose
Secchi Disk (m)	4.5	3.85	1.4	4.6	7.5	7.7	3	2.3
T. Ammonia as N mg/l (euphotic)	0.033	0.054	0.047	0.034	0.033	0.023	0.028	0.112
T. Ammonia as N (deep)	0.329		0.166	0.088	0.04		0.175	0.151
T. NO2+NO3 as N mg/l (euphotic)	0.002	0.003	0.004	0.015	0.017	0.006	0.003	0.013
T. NO2+NO3 as N (deep)	0.009		0.005	0.022	0.021		0.013	0.004
T.Kjeldahl as N mg/l (euphotic)	0.195	0.211	0.527	0.188	0.123	0.077	0.488	0.603
T. Kjeldahl as N (deep)	0.586		0.488	0.256	0.118		0.618	0.683
T. Phosphorus as P mg/l (euphotic)	0.012	0.012	0.033	0.011	0.009	0.004	0.019	0.036
T. Phosphorus as P (deep)	0.178		0.083	0.072	0.007		0.14	0.032
Ortho phosphate as P mg/l (euphotic)	0.002	0.002	0.003	0.001	0.003		0.001	0.007
Ortho phosphate as P (deep)	0.154		0.052	0.048	0.004		0.103	0.015
Chlorophyll a (ug/l)	2.6	1.9	17.6	3.1	1.1		6.3	5.7

EPILIMNION

	T. Phosphorus	T. Nitrogen	Chl a	Secchi (meters)
L. Twin	12	35	2.6	4.5
U. Twin	12	57	1.9	3.9
Cocolalla	33	51	17.6	1.4
Spirit	11	49	3.1	4.6
Hayden	9	50	1.1	7.5
Priest	4	29	-	7.7
Hauser	19	31	6.3	3.0
Rose	36	125	5.7	2.3

---------------------------THERMOCLINE---------------------------

HYPOLIMNION

	T. Phosphorus	T. Nitrogen
L. Twin	178	338
Cocolalla	83	171
Spirit	72	110
Hayden	7	25
Hauser	140	188
Rose	32	155

Figure 3 1989 Averages of Select Water Quality Parameters for North Idaho Lakes (in micrograms per liter)

Table 18 Representative Values of Chlorophyll a, Secchi Transparency Depth, and Total Phosphorus for Lake Classifications.

Classification	Chlorophyll a (mg/m^3)	Secchi Depth (m)	Total Phosphorus (ug/l)
From Jones and Lee (1982)			
Oligotrophic	<2.0	>4.6	<7.9
Oligo-mesotrophic	2.1-2.9	4.5-3.8	8-11
Mesotrophic	3.0-6.9	3.7-2.4	12-27
Meso-Eutrophic	7.0-9.9	2.3-1.8	28-39
Eutrophic	>10	<1.7	>40
From OECD (1982)			
Oligotrophic	0.3-4.5	5.4-28.3	3.0-17.7
Mesotrophic	3.0-11	1.5-8.1	10.9-95.6
Eutrophic	2.7-38	0.8-7.0	16.2-386

CONCLUSIONS

Water quality can vary over time, depending on trends, seasonal cycles, daily cycles, hydrological changes (streamflow, lake level), natural variability, and measurement error. The challenge for the future of volunteer monitoring will be to use this water quality trend information to determine the degree to which water quality in lakes is responding to changes (land use and pollutant discharge) in their watersheds.

Ideally, a statistically valid water quality trend monitoring should include fifty monthly observations at the same site(s) (Reckhow 1990); we now have three years of water quality trend monitoring data (i.e. 20 observations) and some data from previous water quality assessments. Trend analyses will likely require another two years of quality-assured, volunteer water quality monitoring data.

This water quality information and its associated educational value would not be possible without the dedicated support of these volunteer water quality monitors. Volunteers serve as the eyes and ears for monitoring the health or our watersheds and preventing water quality problems.

ACKNOWLEDGMENTS

The volunteers in this water quality monitoring program performed an admirable job of collecting samples and delivering them to the laboratory in a timely manner. The staff at the Coeur d'Alene office of the Idaho Bureau of Laboratories should also be commended for their professionalism and high quality analytical work.

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APPENDIX A

LOWER TWIN LAKE

Table 19 Lower Twin Lake CVMP Water Quality Datafor 1989

Investigator	CVMP	CVMP (dupe)	CVMP	CVMP	CVMP	CVMP
Date	5/2/89	5/2/89	6/13/89	7/18/89	8/29/89	10/9/89
Deep sample depth (m)	18	18	18	17.5	17.5	17.5
Secchi Depth (m)	3.5	3.5	4.7	5	4	5.1
T. Ammonia as N mg/l (euphotic)	0.016	0.025	0.041	0.034	0.04	0.023
T. Ammonia as N (deep)	0.016	0.018	0.337	0.092	0.509	0.691
T. NO2+NO3 as N (euphotic)	0.0005	0.0005	0.0005	0.005	0.003	0.0005
T. NO2+NO3 as N (deep)	0.0005	0.0005	0.042	0.002	0.0005	0.0005
T.Kjeldahl as N mg/l (euphotic)	0.22	0.19	0.0025	0.18	0.31	0.29
T. Kjeldahl as N (deep)	0.26	0.38	0.39	0.33	0.86	0.97
T. Phosphorus as P mg/l (euphotic)	0.015	0.013	0.013	0.011	0.012	0.011
T. Phosphorus as P (deep)	0.027	0.028	0.18	0.1	0.27	0.31
Ortho phosphate as P mg/l (euphotic)	0.002	0.001	0.002	0.001	0.003	0.002
Ortho phosphate as P (deep)	0.014	0.012	0.16	0.11	0.23	0.26
Chlorophyll a (ug/l)	3.6	3.6	3	1.7	2	2.9
N : P (euphotic)	14.7:1	14.7:1	3.9:1	16.8:1	26.0:1	26.4:1

Table 20 Lower Twin Lake CVMP Temperature and Dissolved Oxygen Profiles for 1989

Lower Twin Lake	Depth (m)	5/2/89	6/13/89	6/25/89	7/18/89	8/29/89	10/9/89
Temperature Profile (C)	0	11.5	21	21	23.5	20	14
	2	11	21	21	22	19.5	13.5
	4	11	19	19	21	19	13.5
	6	8.5	15	15	17	19	13.5
	8	6.5	10	11	10	13	13.5
	10	6	7	7	8	9	9
	12	5.5	7	7	7	7.5	7
	14	5	6	6	6.5	7	7
	16	5		6	6	6.5	6.5
	18	5		6	6	6	6.5
Lower Twin Lake	Depth (m)	5/2/89	6/13/89	6/25/89	7/18/89	8/29/89	10/9/89
Dissolved Oxygen Profile (mg/l)	0	11	9.6	9.9	8	9.5	8.4
	2	11	8.2	9.9	8	9.4	8.3
	4	10.8	8.2	9	8	9.4	8.3
	6	9.6	8.6	10.6	8.9	9.3	8.2
	8	8.4	9.4	6.4	4.8	5.4	8.1
	10	7.8	6.4	4.8	2.6	1.5	0.5
	12	7.6	5.2	4.4	2	0.2	0.3
	14	7.4	4.6	3.4	1.4	0.1	0.25
	16	7	4.4	2.2	0.2	0.001	0.25
	18	6.3		1	0	0.001	0.25

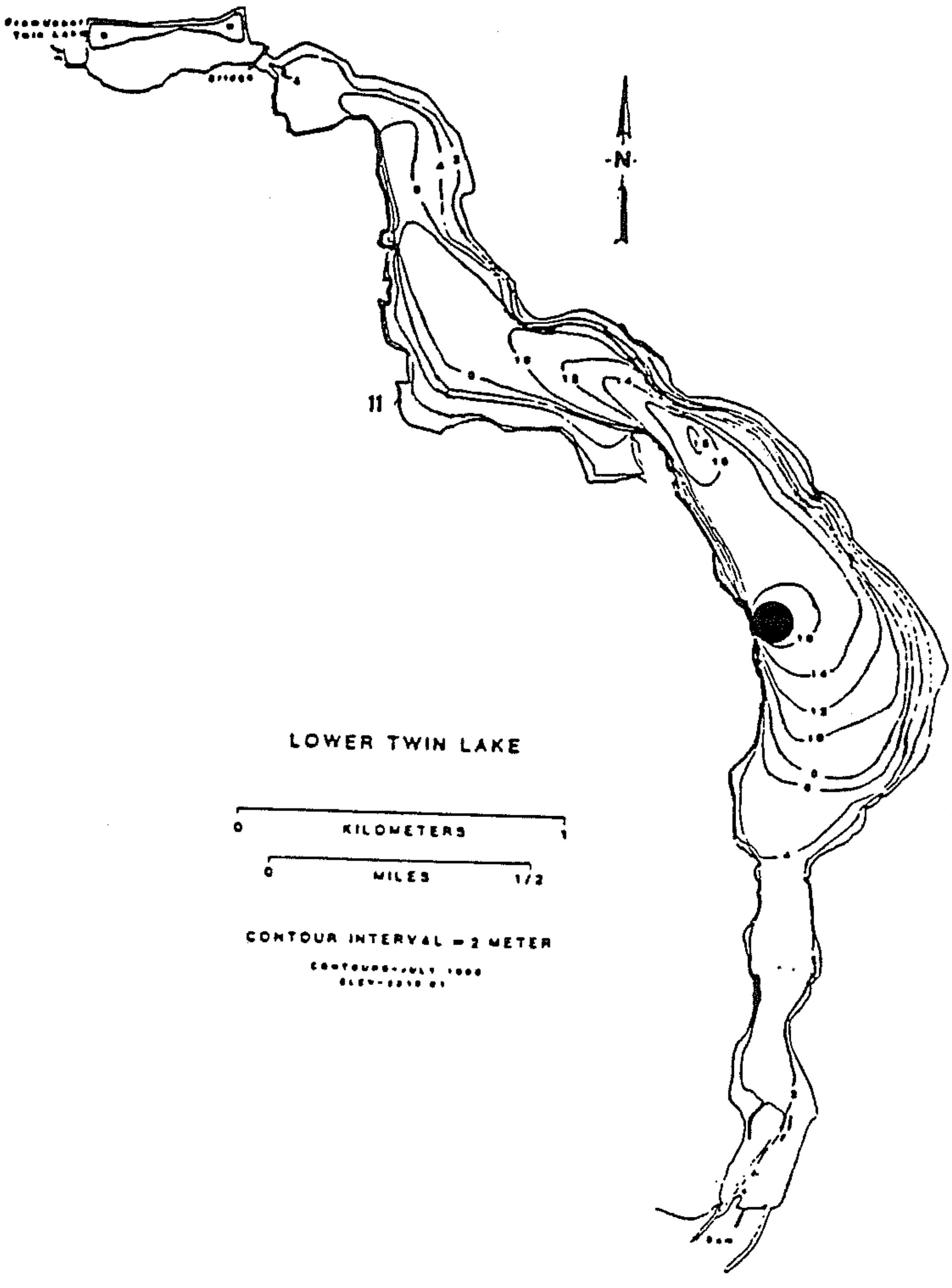


Figure 4 CVMP Water Quality Sampling Site Location for Lower Twin Lake, Idaho

APPENDIX B

UPPER TWIN LAKE

Table 21 Upper Twin Lake CVMP Water Quality Data for 1989

Investigator	CVMP (+dupe)	CVMP	CVMP	CVMP	CVMP
Date	5/2/89	6/13/89	7/18/89	8/29/89	10/10/89
Deep sample depth (m)					
Secchi Depth (m)	3.5		3.5	4	4.4
T. Ammonia as N mg/l (euphotic)	.016 (.020)	0.034	0.042	0.116	0.023
T. Ammonia as N (deep)					
T. NO2+NO3 as N mg/l (euphotic)	.0005 (.0005)	0.0005	0.0005	0.01	0.002
T. NO2+NO3 as N (deep)					
T.Kjeldahl as N mg/l (euphotic)	.16 (.22)	0.0025	0.27	0.27	0.3
T. Kjeldahl as N (deep)					
T. Phosphorus as P mg/l (euphotic)	.012 (.012)	0.011	0.014	0.013	0.011
T. Phosphorus as P (deep)					
Ortho phosphate as P mg/l (euphotic)	.001 (.002)	0.002	0.001	0.003	0.002
Ortho phosphate as P (deep)					
Chlorophyll a (ug/l)	1.2 (1.9)	1.4	1.6	2	2.7
N : P (euphotic)	13.4:1	4.6:1	19.4:1	21.5:1	27.5:1

Table 22 Upper Twin Lake CVMP Temperature and Dissolved Oxygen Profiles for 1989

Upper Twin Lake Temperature Profile (C)	Depth (m)	5/2/89	6/25/89	7/18/89	8/29/89	10/9/89
	0	12.5	21	24	21	15
	1	12.5	21	22	20	14
	2	12.5	20	22	19	14
	3	12.5	19	22	19	13.5
	4	12.5	18	22	19	13.5
	5			22		

Upper Twin Lake Dissolved Oxygen Profile (mg/l)	Depth (m)	5/2/89	6/25/89	7/18/89	8/29/89	10/9/89
	0	10.2	9.8	8	7.6	8.5
	1	10.2	9.8	8.2	7.9	8.5
	2	10.2	9.8	8.2	7.9	8.5
	3	10.2	9	8.1	7.9	8.3
	4	10.2	9	8.1	7.9	8.3
	5			8.8		

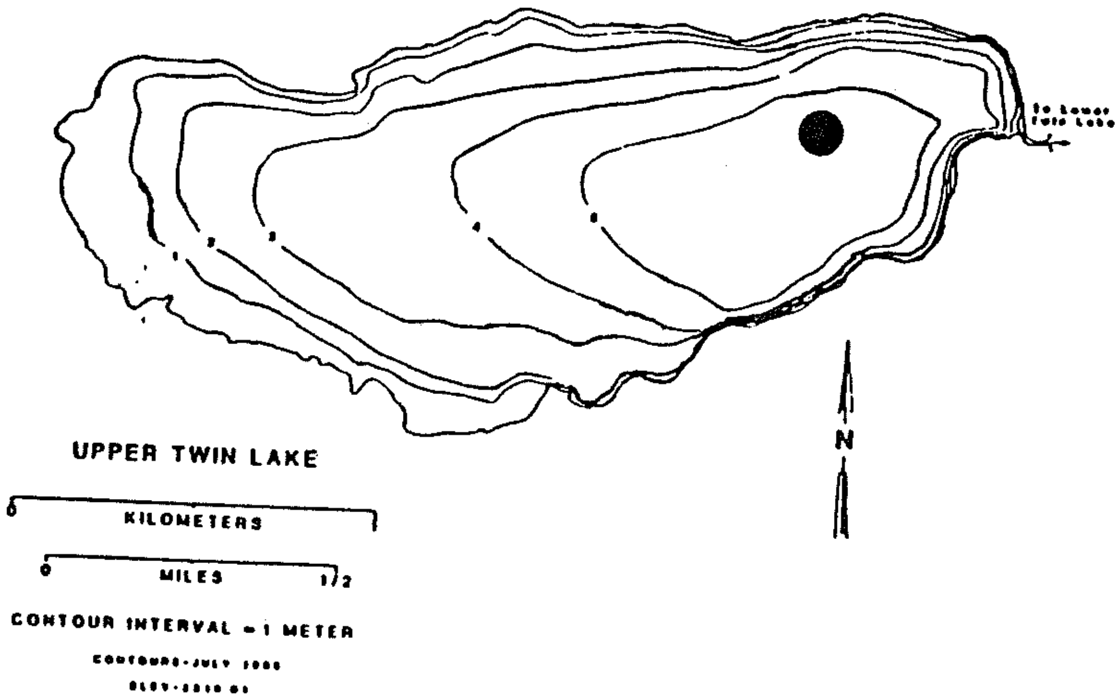


Figure 5 CVMP Water Quality Sampling Site Location for Upper Twin Lake, Idaho

APPENDIX C

COCOLALLA LAKE

Table 23 Cocolalla Lake CVMP Water Quality Data for 1989

Investigator	CVMP	CVMP	CVMP	CVMP	CVMP	CVMP (Dupe)
Date	4/30/89	6/11/89	7/18/89	8/28/89	10/11/89	10/11/89
Deep sample depth (m)	10	11	10	10	10	10
Secchi Depth (m)	1	2.5	1	0.75	1.5	1.5
T. Ammonia as N mg/l (euphotic)	0.017	0.027	0.026	0.026	0.094	0.091
T. Ammonia as N (deep)	0.018	0.056	0.069	0.628	0.098	0.126
T. NO2+NO3 as N mg/l (euphotic)	0.0005	0.003	0.012	0.0005	0.001	0.004
T. NO2+NO3 as N (deep)	0.0005	0.0005	0.002	0.0005	0.015	0.012
T.Kjeldahl as N mg/l (euphotic)	0.38	0.19	0.64	0.68	0.65	0.62
T. Kjeldahl as N (deep)	0.38	0.15	0.35	0.87	0.58	0.6
T. Phosphorus as P mg/l (euphotic)	0.022	0.018	0.03	0.025	0.043	0.057
T. Phosphorus as P (deep)	0.026	0.057	0.063	0.26	0.046	0.048
Ortho phosphate as P mg/l (euphotic)	0.002	0.002	0.001	0.0005	0.004	0.006
Ortho phosphate as P (deep)	0.005	0.044	0.001	0.25	0.004	0.005
Chlorophyll a (ug/l)	11.9	3.8	18	27	22	23
N : P (euphotic)	17.5:1	10.7:1	21.7:1	27.2:1	12.9:1	10.9:1

Table 24 Cocolalla Lake CVMP Temperature and Dissolved Oxygen Profiles for 1989

Cocolalla Lake Temperature Profile (C)	Depth (m)	4/31/89	6/11/89	7/17/89	8/28/89	10/11/89
	1	11.5	20	20.8	19.8	14
	2	9.75	19.5	20.8	19.5	14
	3	9.5	19	20.8	19	14
	4	9.25	18	20.5	19	14
	5	9	16.5	19	19	14
	6	9	15.5	18.2	19	14
	7	8.75	14	17	19	14
	8	8.5	12.5	16	19	14
	9	8.25	12	15.8	17.5	14
	10	8.25	11.5	14.5	15.8	14
	11		11.5			

Cocolalla Lake Dissolved Oxygen Profile (mg/l)	Depth (m)		6/11/89	7/17/89	8/28/89	10/11/89
	1		11.8	9	8.3	6.7
	2		11.8	9	8.7	6.7
	3		12	9	8.8	6.7
	4		12	8.9	8.3	6.7
	5		11.2	6.4	8.3	6.7
	6		10.8	5.5	8.2	6.7
	7		10	4.1	8.1	6.8
	8		7.4	3	8	6.6
	9		5.2	2.7	3.2	6.6
	10		3.5	1.5	0.7	6.6
	11		3.1			

HWH-0314

IDAHO DEPARTMENT OF HEALTH AND WELFARE

MISCELLANEOUS EXAMINATION

Patient Name or Sample Identification	Lab. #	
Cocolalla Algae Bloom	Sex	Age

Test Requested	Type & Source of Sample		
Identification			
Submitted by	**Date**	**Received by**	**Date**
DEQ	8/29/89		8/29/89

RESULTS

Many organisms present including Nodularia sp., Anabaena sp., Fragilaria sp., Microcystis, various centric diatoms, Dinobryon in very low concentrations

PHONED	Time	Date	Callers Initials

Report to:	Date/Microbiologist
DEQ	8/31/89
Street Address 2110 Ironwood Parkway	**cc:**
City, State, Zip Coeur d'Alene, ID 83814	

LABORATORIES

☐ Boise ☒ Coeur d'Alene ☐ Idaho Falls ☐ Lewiston ☐ Pocatello ☐ Twin Falls

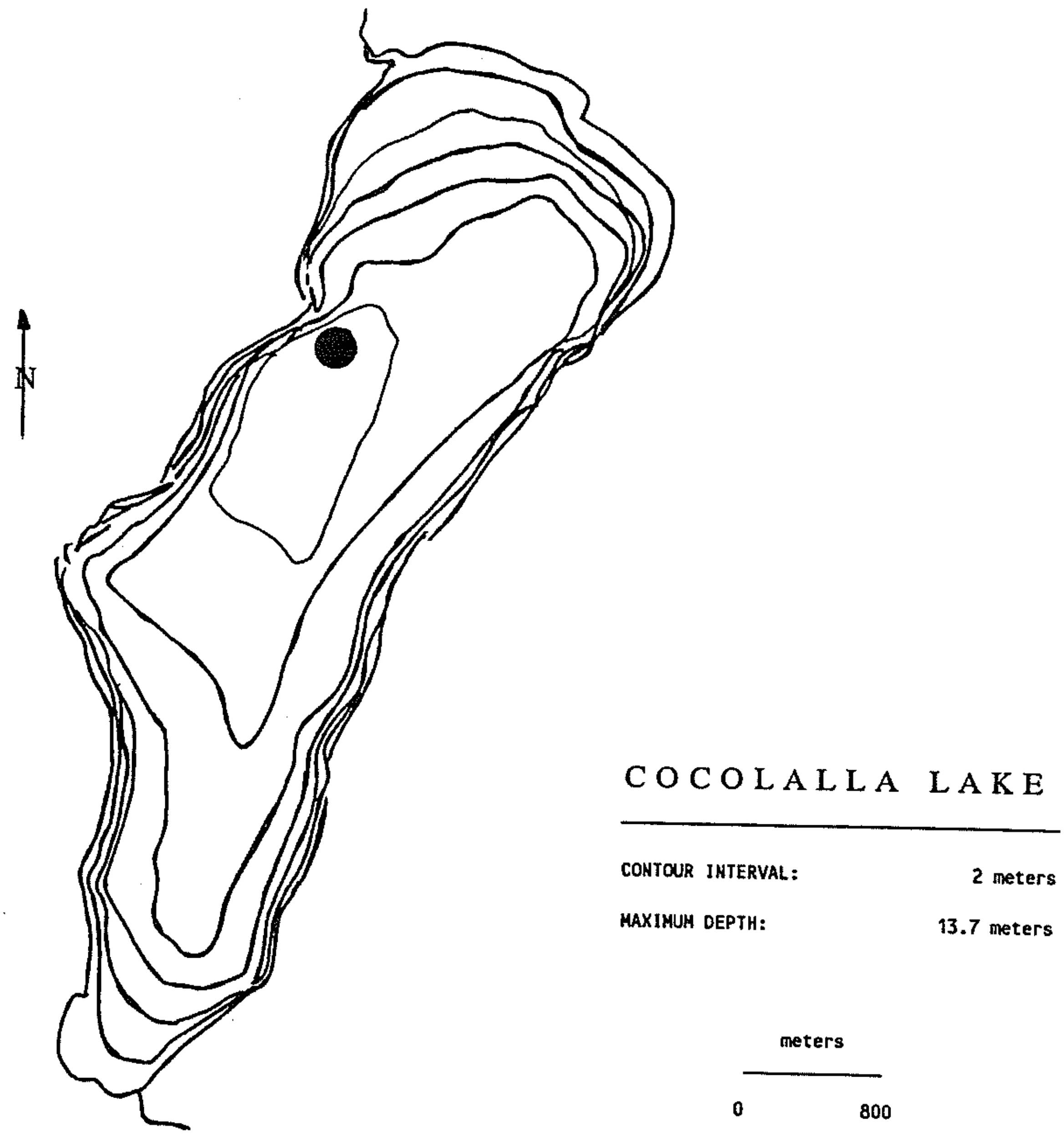


Figure 6 CVMP Water Quality Sampling Site Location for Cocolalla Lake, Idaho

Stream Walk on Fish Creek October 15, 1989

Section A

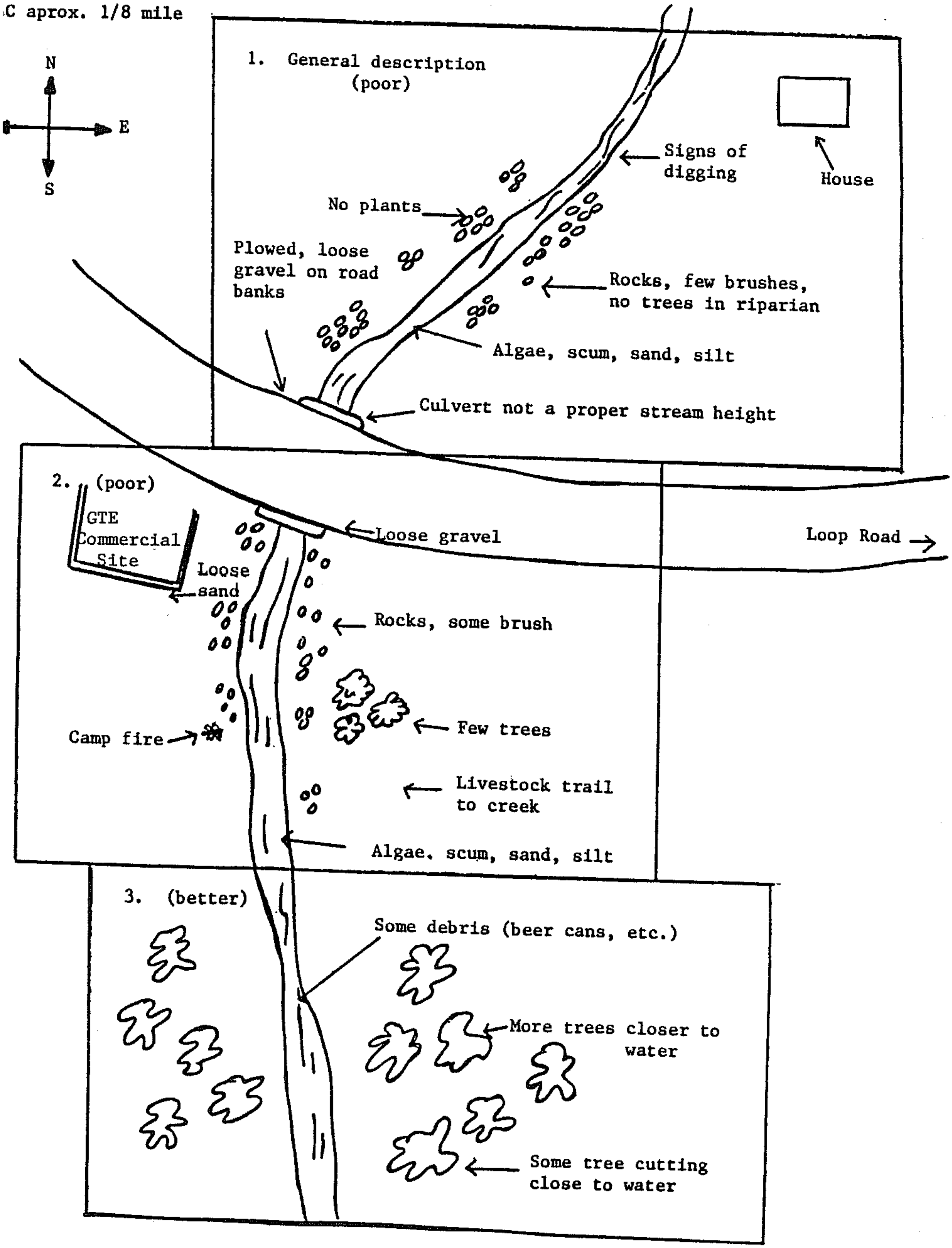
Noted large segment of clear cutting approximate age of cut 3 years
Trees cut in streamside zone
Streamside vegetation of shrubs and small trees degraded
Stream cover about 25%
Stream width about one to two feet
Bedrock

Section B

Streamside vegetation of shrubs, moss, large and small trees
Stream cover about 75 to 100%
Presence of logs common in stream
Stream width of three to four feet
Bedrock
Clarity of water-excellent
Small fish noted

Section C

Streamside vegetation-none or little
Width of riparian zone nonexistent at zone 3
Streamside cover nonexistent in zones 1 and 2
Stream width of two to four feet
Bedrock with algae in all three zones and foam in zone 2
Noted two beer cans and paper bag in zone 3
Livestock grazing trail in zone 3
New construction site twenty feet uphill from zone 1 with potential for stream pollution during wet seasons
Old campfire and manure pile on north side of stream in zone 1
Culvert placed too high for fish access in zone 1


C aprox. 1/8 mile
N
E
S
1. General description (poor)
Signs of digging
House
No plants
Plowed, loose gravel on road banks
Rocks, few brushes, no trees in riparian
Algae, scum, sand, silt
Culvert not a proper stream height
2. (poor)
GTE Commercial Site
Loose gravel
Loop Road
Loose sand
Rocks, some brush
Camp fire
Few trees
Livestock trail to creek
Algae, scum, sand, silt
3. (better)
Some debris (beer cans, etc.)
More trees closer to water
Some tree cutting close to water

APPENDIX D

SPIRIT LAKE

Table 25 Spirit Lake CVMP Water Quality Data for 1989

Investigator	CVMP	CVMP	CVMP	CVMP	CVMP
Date	5/1/89	6/12/89	7/16/89	8/28/89	10/10/89
Deep sample depth (m)	26.2	25	21.3	25.2	18.7
Secchi Disk (m)	3	5.7	5.1	4.2	5
T. Ammonia as N mg/l (euphotic)	0.016	0.024	0.014	0.041	0.073
T. Ammonia as N mg/l (deep)	0.026	0.046	0.077	0.123	0.167
T. NO2+NO3 as N mg/l (euphotic)	0.0005	0.0005	0.02	0.003	0.05
T. NO2+NO3 as N mg/l (deep)	0.0005	0.004	0.032	0.053	0.022
T.Kjeldahl as N mg/l (euphotic)	0.19	0.08	0.18	0.26	0.23
T. Kjeldahl as N mg/l (deep)	0.17	0.11	0.27	0.38	0.35
T. Phosphorus as P mg/l (euphotic)	0.012	0.012	0.01	0.009	0.01
T. Phosphorus as P mg/l (deep)	0.013	0.03	0.059	0.13	0.129
Ortho phosphate as P mg/l (euphotic)	0.001	0.002	0.0005	0.0005	0.0005
Ortho phosphate as P mg/l (deep)	0.004	0.018	0.038	0.113	0.065
Chlorophyll a (ug/l)	7	2.4	1.6	2.3	2
N : P (euphotic)	15.9:1	6.8:1	20.0:1	29.2:1	25.0:1

Table 26 Spirit Lake CYMP Temperature and Dissolved Oxygen Profiles for 1989

Spirit Lake Temperature Profile (C)	Depth (m)	5/1/89	6/12/89	7/16/89	8/28/89	10/10/89
	2	9.5	18.8	21	19.4	13.8
	4	9.2	18.2	21	19.4	13.8
	6	8.2	12	19	19.2	13.8
	8	8	9.8	15.5	19	13.7
	10	6	8	10	13	13.5
	12	5.2	6.2	8.8	8.8	11
	14	5	5.5	7	7.2	6
	16	4.8	5.2	6	6.5	6
	18	4.5	5.2	6	6	6
	20	4.5	5.2	5.5	6	
	22	4.7	5.2	5.5	6	
	24	4.5	5.2		6	
	26	4.5	5.2		6	

Spirit Lake Dissolved Oxygen Profile (mg/l)	Depth (m)	5/1/89	6/12/89	7/16/89	8/28/89	10/10/89
	2	14.6	12.2	9.1	8.7	8.3
	4	14.4	12.2	9.2	8.6	8.3
	6	14.6	14.2	10.4	8.5	8.3
	8	14.5	13.8	11.9	8.6	8.3
	10	13.2	13	11.4	12	8.2
	12	12.6	10.8	10	6.8	6.3
	14	12.4	9.5	7.8	5	0.8
	16	12	9.2	6	3.4	0.8
	18	11.8	8.8	5.1	2.1	0.3
	20	11.7	8.5	3.6	0.8	
	22	11.4	8.4	3.3	0.3	
	24	11.2	7.8		0.3	

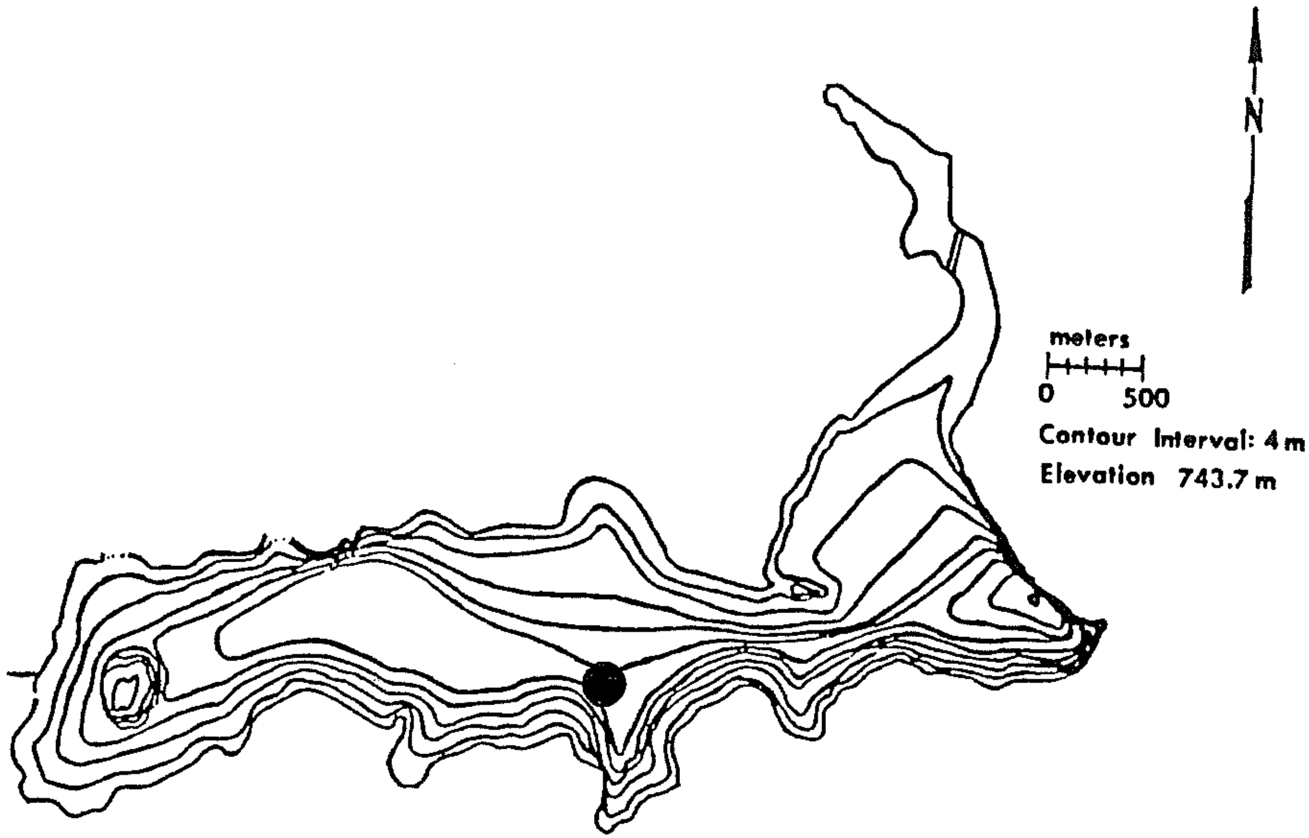


Figure 7 CVMP Water Quality Sampling Site Location for Spirit Lake, Idaho

APPENDIX E

HAYDEN LAKE

Table 27 Hayden Lake Sampling Site 279 CVMP Water Quality Data for 1989

Investigator	CVMP	CVMP	CVMP	CVMP	CVMP
Date	5/15/89	6/13/89	7/17/89	8/29/89	10/10/89
Deep sample depth (m)	57	56	50.5	55	50
Secchi Depth (m)	6	5.5	11.5	8.5	6.2
T. Ammonia as N mg/l (euphotic)	0.034	0.023	.013 (dupe .024)	0.024	0.049
T. Ammonia as N (deep)	0.036	0.043	.017 (dupe .018)	0.036	0.046
T. NO2+NO3 as N mg/l (euphotic)	0.004	0.0005	.006 (dupe .004)	0.047	0.018
T. NO2+NO3 as N (deep)	0.015	0.028	.022 (dupe .003)	0.004	0.036
T.Kjeldahl as N mg/l (euphotic)	0.14	0.06	.17 (dupe .14)	0.14	0.15
T. Kjeldahl as N (deep)	0.15	0.05	.11 (dupe .11)	0.17	0.1
T. Phosphorus as P mg/l (euphotic)	0.006	0.007	.009 (dupe .008)	0.017	0.004
T. Phosphorus as P (deep)	0.006	0.007	.005 (dupe .005)	0.006	0.008
Ortho phosphate as P mg/l (euphotic)	0.005	0.001	.001 (dupe .001)	0.002	0.002
Ortho phosphate as P (deep)	0.004	0.003	.001 (dupe .002)	0.005	0.003
Chlorophyll a ug/l	1.4	0.9	1	0.8	1.3
N : P (euphotic)	24.0:1	8.6:1	19.5:1	11.0:1	42.0:1

Table 28 Hayden Lake Sampling Site 279 CVMP Temperature and Dissolved Oxygen Profiles for 1989

Hayden Lake 279 Temperature Profile (C)	Depth (m)	5/15/89	7/17/89	8/28/89
	1	12.5	21	19.75
	5	10	21	19.5
	10	7.1	13	19
	15	5.3	6.5	8
	20	5	4.9	5.5
	25	4.7	4.5	5
	30	4.7	4	4.9
	35	4.5	4	4.9
	40	4.5	4	4.8
	45	4.5	4	4
	50	4.5	5	
Hayden Lake 279 Dissolved Oxygen Profile (mg/l)	Depth (m)	5/15/89	7/17/89	8/28/89
	1	10.4	7.9	8.5
	5	11.2	7.9	8.75
	10	12	11.4	8.75
	15	11.8	11.8	12.5
	20	11.4	10.1	10.75
	25	11.4	10	9
	30	11.2	9.6	9.25
	35	11.4	9.8	9.25
	40	11.6	9.7	9.5
	45	11.1	9.6	8.6
	50	11.2	8.6	9.5

Table 29 Hayden Lake Sampling Site 282 CVMP Water Quality Data for 1989

Investigator	CVMP	CVMP	CVMP (dupe)	CVMP	CVMP
Date	5/15/89	6/13/89	7/17/89	8/29/89	10/10/89
Deep sample depth (m)	1	1	1	1	1
Secchi Depth (m)	1	1	1	1	1
T. Ammonia as N mg/l (euphotic)	0.024	0.027	.013 (.019)	0.1	0.03
T. Ammonia as N mg/l (deep)					
T. NO2+NO3 as N mg/l (euphotic)	0.002	0.0005	.008 (.013)	0.02	0.003
T. NO2+NO3 as N mg/l (deep)					
T. Kjeldahl as N mg/l (euphotic)	0.12	0.07	.22 (.23)	0.35	0.26
T. Kjeldahl as N mg/l (deep)					
T. Phosphorus as P mg/l (euphotic)	0.014	0.01	.011 (.010)	0.019	0.016
T. Phosphorus as P mg/l (deep)					
Ortho phosphate as P mg/l (euphotic)	0.008	0.002	.002 (.002)	0.003	0.003
Ortho phosphate as P mg/l (deep)					
Temperature (C)	14	22	22	19.5	14
Dissolved Oxygen (mg/l)	9.5	12	8.2	10	10.5
Chlorophyll a (ug/l)	1.4	0.9	3.2 (3.4)	7.5	7.2
N : P	8.7:1	7.1:1	20.7:1	19.5:1	16.4:1

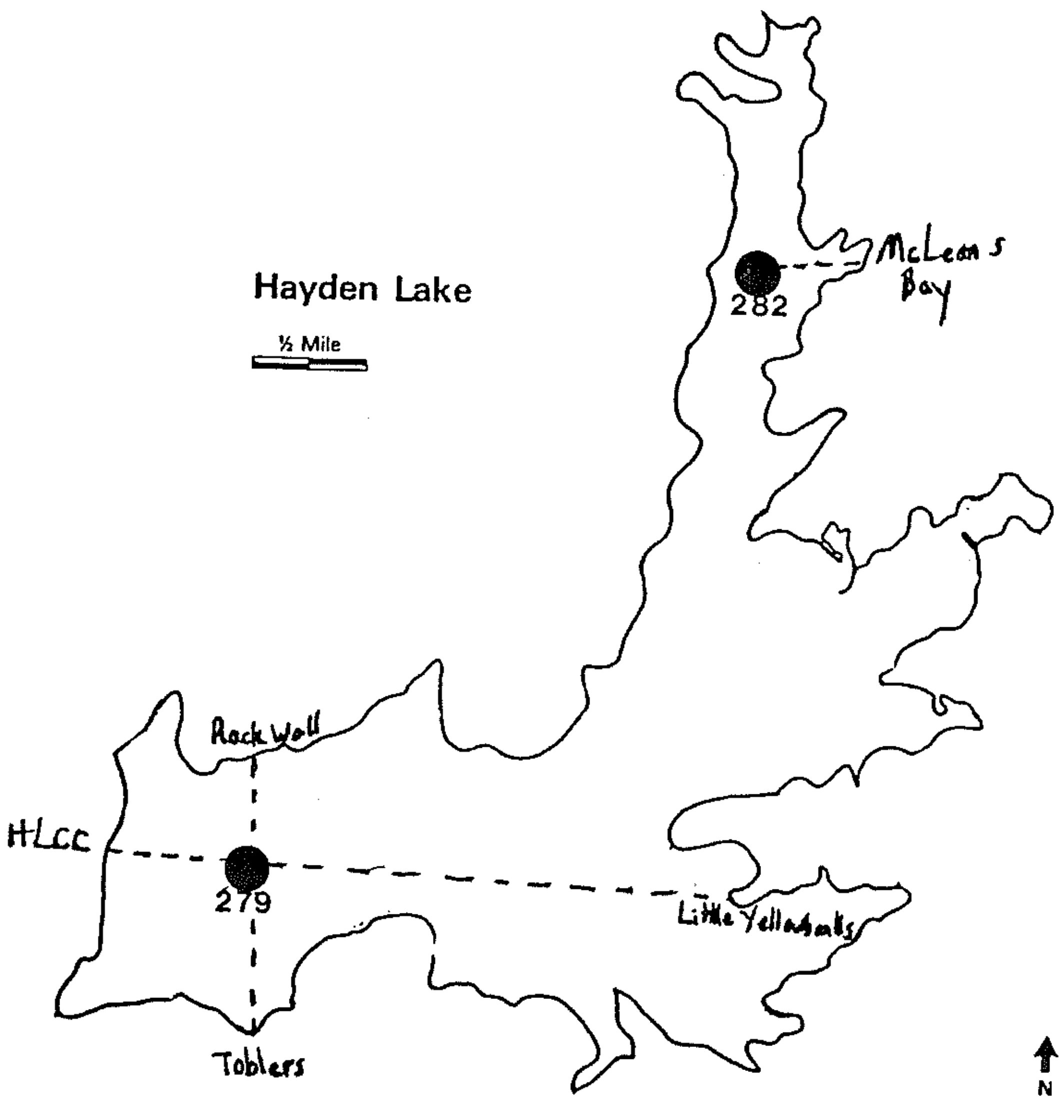


Figure 8 CVMP Water Quality Sampling Site Locations or Hayden Lake, Idaho

APPENDIX F

PRIEST LAKE

Table 30 Priest Lake CVMP Water Quality Data for 1989

Priest Lake				
CVMP 1989				
Coolin Bay (Site I)				
DATE	7/17/89	8/28/89	1989 Average	1988-1989 Average
SECCHI DEPTH (M)	7.4	9.1	8.3	9.9
TEMPERATURE (F)@ Secchi Depth	62	66	64.0	65.3
TOTAL AMMONIA AS N (MG/L)	0.016	0.035	.026	.027
TOTAL NO2+NO3 AS N (MG/L)	0.006	0.0005	.003	.011
TOTAL KJELDAHL NITROGEN AS N(MG/L)	0.08	0.08	.080	.078
TOTAL PHOSPHORUS AS P (MG/L)	0.005	0.003	.004	.004
N : P	17.2:1	26.8:1		
Priest Lake				
CVMP 1989				
Kalispell Creek (Site II)				
DATE	7/17/89	8/28/89	1989 Average	1988-1989 Average
SECCHI DEPTH (M)	7.4	8.2	7.8	10.0
TEMPERATURE (F)@ Secchi Depth	58	66	62.0	62.0
TOTAL AMMONIA AS N (MG/L)	0.013	0.024	.019	.014
TOTAL NO2+NO3 AS N (MG/L)	0.011	0.003	.007	.021
TOTAL KJELDAHL NITROGEN AS N(MG/L)	0.05	0.07	.060	.082
TOTAL PHOSPHORUS AS P (MG/L)	0.004	0.005	.005	.004
N : P	15.3:1	14.6:1		

Table 30 Priest Lake CVMP Water Quality Data for 1989

Priest Lake				
CVMP 1989				
Hunt Creek (Site III)				
DATE	7/17/90	8/28/89	1989 Average	1988-1989 Average
SECCHI DEPTH (M)	7.2	7.3	7.3	9.5
TEMPERATURE (F)@ Secchi Depth	68	66	67.0	66.7
TOTAL AMMONIA AS N (MG/L)	0.008	0.089	.049	.024
TOTAL NO2+NO3 AS N (MG/L)	0.003	0.026	.015	.009
TOTAL KJELDAHL NITROGEN AS N(MG/L)	0.07	0.11	.090	.108
TOTAL PHOSPHORUS AS P (MG/L)	0.004	0.006	.005	.003
N : P	18.3:1	22.7:1		
Priest Lake				
CVMP 1989				
Indian Creek (Site IV)				
DATE	7/17/89	8/28/89	1989 Average	1988-1989 Average
SECCHI DEPTH (M)	7.4	8.2	7.8	10.0
TEMPERATURE (F)@ Secchi Depth	66	64	65.0	64.0
TOTAL AMMONIA AS N (MG/L)	0.007	0.034	.021	.012
TOTAL NO2+NO3 AS N (MG/L)	0.002	0.008	.005	.007
TOTAL KJELDAHL NITROGEN AS N(MG/L)	0.06	0.08	.070	.092
TOTAL PHOSPHORUS AS P (MG/L)	0.004	0.004	.004	.003
N : P	15.5:1	22:01		

Table 30 Priest Lake CVMP Water Quality Data for 1989

Priest Lake					
CVMP 1989					
Huckleberry Bay (Site V)					
DATE	7/17/89	28-Aug-89	1989 Average	1988-1989 Average	
SECCHI DEPTH (M)	7.4	8.2	7.8	9.9	
TEMPERATURE (F)@ Secchi Depth	66	64	65.0	63.3	
TOTAL AMMONIA AS N (MG/L)	0.005	0.011	.008	.007	
TOTAL NO2+NO3 AS N (MG/L)	0.006	0.0005	.003	.004	
TOTAL KJELDAHL NITROGEN AS N(MG/L)	0.07	0.11	.090	.094	
TOTAL PHOSPHORUS AS P (MG/L)	0.005	0.005	.005	.004	
N : P	15.2:1	22.1:1			
Priest Lake					
CVMP 1989					
Mosquito Bay (Site VI)					
DATE	7/17/89	8/28/89	1989 Average	1988-1989 Average	
SECCHI DEPTH (M)	7	7.3	7.2	9.5	
TEMPERATURE (F)@ Secchi Depth	66	65	65.5	65.0	
TOTAL AMMONIA AS N (MG/L)	0.01	0.021	.016	.008	
TOTAL NO2+NO3 AS N (MG/L)	0.005	0.0005	.003	.005	
TOTAL KJELDAHL NITROGEN AS N(MG/L)	0.06	0.08	.070	.066	
TOTAL PHOSPHORUS AS P (MG/L)	0.004	0.004	.004	.003	
N : P	16.3:1	20.1:1			

Table 31 Priest Lake Secchi Disk Transparency Depths

	May 27 - June 10, 1989	June 13 - 23, 1989	June 24 - 30, 1989	July 2 - 10, 1989
SITE 13 A (Mosquito Bay)		6.3	6	7.2
SITE14 A (Tango Creek)			4.7	
SITE 12 A (Two Mouth Creek)				7.2
SITE 11 C (Huckleberry Bay)			5.2	
SITE 15 A (Copper Bay)				
SITE 16 B (Reeder Creek)		5.3	5.3	7.9
SITE 10 A (Cape Horn)	no readings during 1989			
SITE 9 A (Indian Creek Bay)			6.1	7.2
SITE 17 A (Indian Rock)				7.5
SITE 18 A (Kalispell Island)		6.1	7.9	
SITE 7 A (Hunt Creek)				
SITE 19 C (Baritoe Island)			7	
SITE 6 A (Fenton Creek)			6.3	7.2
SITE 5 A (4 mile Island)				8.4
SITE 4 A (Outlet Bay)	no readings during 1989			
SITE 2 A (Soldier Creek)		6.9		
SITE 3 A (Mid-lake, Soldier to Outlet)	9.3	9.3	8.4	
SITE 1 A (Coolin Bay)	7.4		7.2	
* in meters				

Table 31 Priest Lake Secchi Disk Transparency Depths

	July 12 - 18, 1989	July 22 - 31, 1989	August 3 - 18, 1989
SITE 13 A (Mosquito Bay)	7.5	9	9
SITE14 A (Tango Creek)		7.9	7.9
SITE 12 A (Two Mouth Creek)			10.3
SITE 11 C (Huckleberry Bay)			8.1
SITE 15 A (Copper Bay)		9.9	10.2
SITE 16 B (Reeder Creek)			9.8
SITE 10 A (Cape Horn)			
SITE 9 A (Indian Creek Bay)		10.9	10.9
SITE 17 A (Indian Rock)		11.2	
SITE 18 A (Kalispell Island)	9.7	9.7	10.3
SITE 7 A (Hunt Creek)	10.2	10.9	
SITE 19 C (Baritoe Island)	8.4		9.4
SITE 6 A (Fenton Creek)	9		8.4
SITE 5 A (4 mile Island)		10	12.1
SITE 4 A (Outlet Bay)			
SITE 2 A (Soldier Creek)	8.1		9.6
SITE 3 A (Mid-lake, Soldier to Outlet)	9.1	9.3	9.7
SITE 1 A (Coolin Bay)	7.1		7.2
* in meters			

Table 31 Priest Lake Secchi Disk Transparency Depths

	August 20 - September 3, 1989	September 5 - 12, 1989	September 16 - 24, 1989
SITE 13 A (Mosquito Bay)	10	10.6	10.6
SITE14 A (Tango Creek)	7.9		10.6
SITE 12 A (Two Mouth Creek)	11.2		
SITE 11 C (Huckleberry Bay)			
SITE 15 A (Copper Bay)	8.8	9.1	10.3
SITE 16 B (Reeder Creek)	9.7	9.1	
SITE 10 A (Cape Horn)			
SITE 9 A (Indian Creek Bay)		10	10.6
SITE 17 A (Indian Rock)		10	
SITE 18 A (Kalispell Island)			
SITE 7 A (Hunt Creek)	12.1	10.3	
SITE 19 C (Baritoe Island)	7.8		
SITE 6 A (Fenton Creek)	10		
SITE 5 A (4 mile Island)	11		11.5
SITE 4 A (Outlet Bay)			
SITE 2 A (Soldier Creek)	9.3		
SITE 3 A (Mid-lake, Soldier to Outlet)	9.1		11.2
SITE 1 A (Coolin Bay)	6.5		6.8
* in meters			

Table 31 Priest Lake Secchi Disk Transparency Depths

	September 27 - October 1, 1989	October 8 - 15, 1989
SITE 13 A (Mosquito Bay)	10.9	11.5
SITE 14 A (Tango Creek)	10.5	
SITE 12 A (Two Mouth Creek)		
SITE 11 C (Huckleberry Bay)		
SITE 15 A (Copper Bay)		9.1
SITE 16 B (Reeder Creek)		
SITE 10 A (Cape Horn)		
SITE 9 A (Indian Creek Bay)	7.9	10.6
SITE 17 A (Indian Rock)		
SITE 18 A (Kalispell Island)	11.2	
SITE 7 A (Hunt Creek)	10.9	
SITE 19 C (Baritoe Island)		
SITE 6 A (Fenton Creek)		
SITE 5 A (4 mile Island)		
SITE 4 A (Outlet Bay)		
SITE 2 A (Soldier Creek)		
SITE 3 A (Mid-lake, Soldier to Outlet)	11.5	
SITE 1 A (Coolin Bay)	6.9	7.2
* in meters		

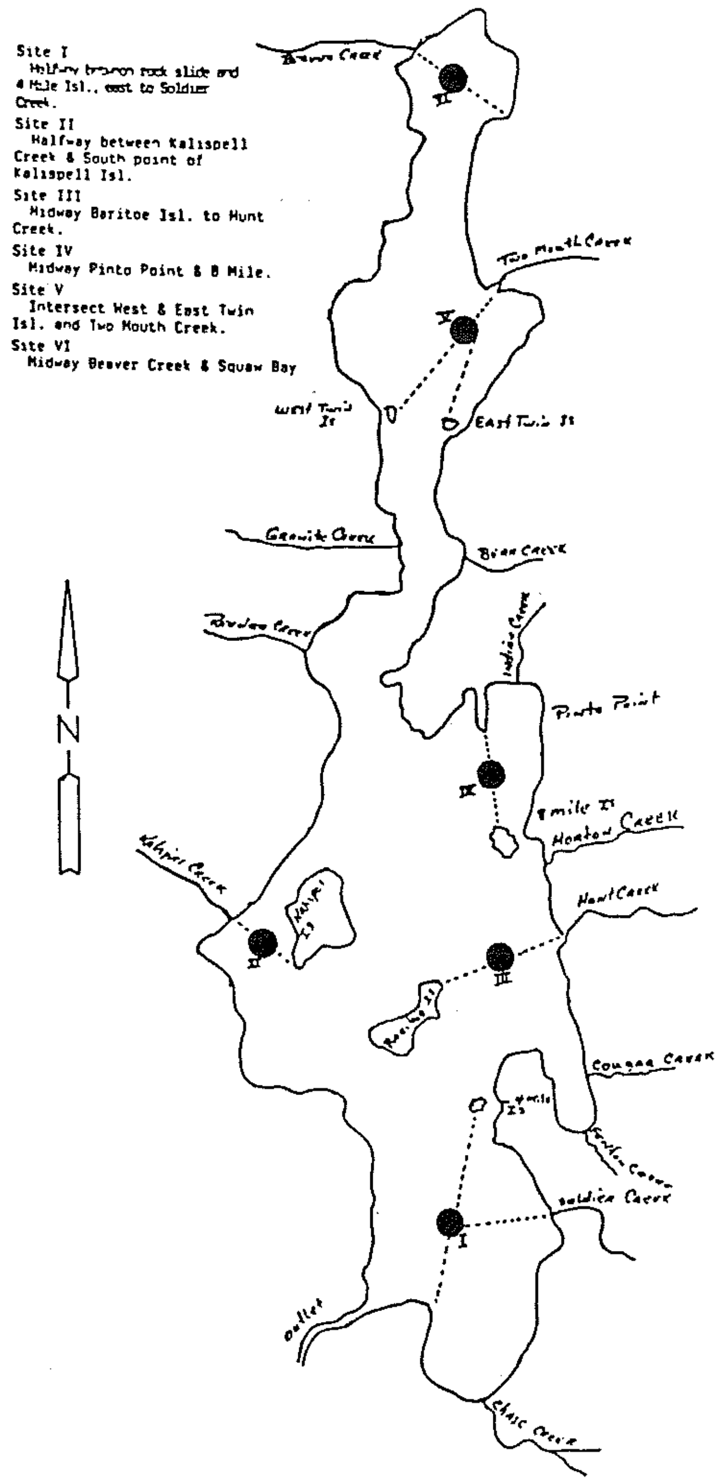


Figure 9 CYMP Water Quality Sampling Site Locations for Priest Lake, Idaho

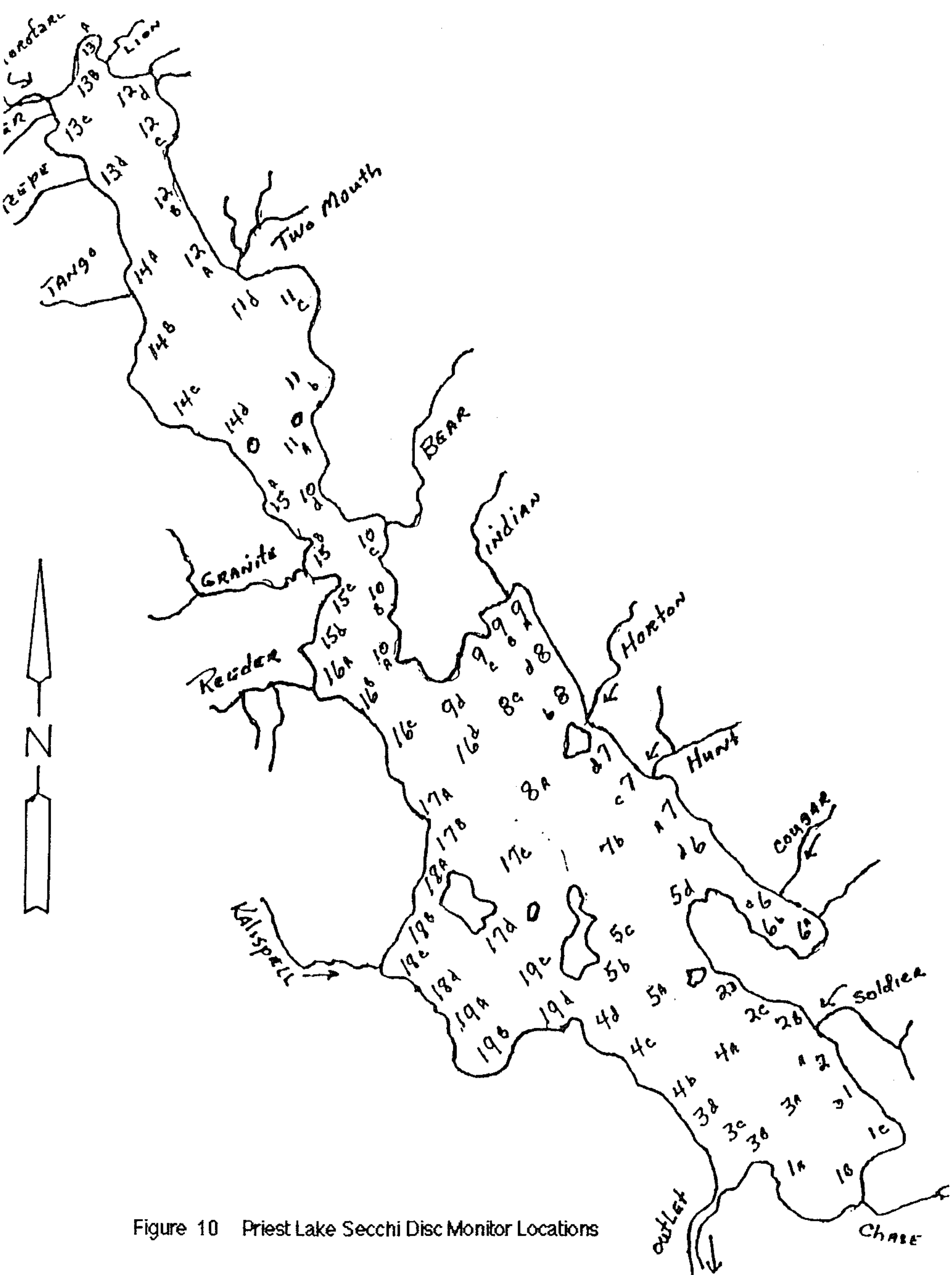


Figure 10 Priest Lake Secchi Disc Monitor Locations

APPENDIX G

SPOKANE RIVER

Table 32 Spokane River 1989 CVMP Water Quality Data

SPOKANE RIVER						
CVMP 1989						
CEDARS SITE						
DATE	5/2/89	6/13/89	7/18/89	8/28/89	9/11/89	10/10/89
TIME	1015	1030	0940	0830	0830	0930
MAXIMUM DEPTH (M)	3.0	2.8	2.8	2.6	2.6	2.2
SECCHI DEPTH (M)	2.0	2.8	2.8	2.6	2.6	2.2
TEMPERATURE (C)@ 1M DEPTH	8.0	19.0	20.0	19.0	15.0	15.0
TEMPERATURE (C)@ 1M OFF BOTTOM	8.0	19.0	20.0	19.0		
DISSOLVED OXYGEN (MG/L)@ 1M	8.0	9.0	8.0	9.0	9.0	10.0
DISSOLVED OXYGEN (MG/L)@ 1M OFF BOTTOM	8.0	9.0	8.0	9.0		
TOTAL AMMONIA (MG/L)	.020	.071	.020	.018	.042	.093
TOTAL NO2+NO3 (MG/L)	.005	.022	.002	.001	.001	.042
TOTAL KJELDAHL (MG/L)	.180	.025	.140	.120	.110	.180
TOTAL PHOSPHORUS (MG/L)	.013	.013	.008	.007	.008	.008
ORTHOPHOSPHORUS (MG/L)	.001	.003	.002	.001	.003	.003
SPECIFIC CONDUCTANCE (UMHOS)						
CHLOROPHYLL a (UG/L)	4.4	1.3	.6	2.0	2.0	1.8
ZINC (UG/L)					40	
N : P	14.2:1	3.6:1	17.8:1	17.3:1	13.9:1	27.8:1

Table 32 Spokane River 1989 CVMP Water Quality Data

SPOKANE RIVER						
CVMP 1989						
HARBOR ISLAND						
DATE	5/2/89	6/13/89	7/18/89	8/28/89	9/11/89	10/10/89
TIME	no samples	1105	1045	910	910	1000
MAXIMUM DEPTH (M)	high flow	6	8.8	8.5	5.75	5.25
SECCHI DEPTH (M)		4.5	3.3	5.75	4	4.5
TEMPERATURE (C)@ 1M DEPTH		19	21.0	19	16	15
TEMPERATURE (C)@ 1M OFF BOTTOM		19	21.0	19	16	15
DISSOLVED OXYGEN (MG/L)@ 1M		7	7.0	9	9	8
DISSOLVED OXYGEN (MG/L)@ 1M OFF BOTTOM		11	7.5	7	9	9
TOTAL AMMONIA (MG/L)		0.035	.043	0.054 (dupe .020)	.070	.187
TOTAL NO2+NO3 (MG/L)		0.011	.004	0.050 (dupe .006)	.007	.033
TOTAL KJELDAHL (MG/L)		0.025	.150	0.220 (dupe .190)	.090	.130
TOTAL PHOSPHORUS (MG/L)		0.016	.019	0.030 (dupe .022)	.021	.020
ORTHOPHOSPHORUS (MG/L)		0.002	.011	0.006 (dupe .004)	.007	.010
SPECIFIC CONDUCTANCE (UMHOS)						
CHLOROPHYLL a (UG/L)		1.2	1.2	3.0 (dupe 3.0)	3	1.8
ZINC					40	
FECAL COLIFORM (#/100 ML)					9	48
N : P		2.3:1	8.1:1	9.0:1 (dupe 8.9:1)	4.6:1	8.2:1

Table 32 Spokane River 1989 CVMP Water Quality Data

SPOKANE RIVER						
CVMP 1989						
POST FALLS BRIDGE						
DATE	5/2/89	6/13/89	7/18/90	8/28/90	9/11/89	10/10/89
TIME	no samples	1150	1140	1000	1000	1100
MAXIMUM DEPTH (M)	high flow	8.3	5.8	8.5	8.8	7.8
SECCHI DEPTH (M)		3.3	3.5	5.75	3.25	4.5
TEMPERATURE (C)@ 1M DEPTH		19.0	21.0	19	17	15
TEMPERATURE (C)@ 1M OFF BOTTOM		19.0	21.0	19	17	15
DISSOLVED OXYGEN (MG/L)@ 1M		7.0	5.0	9	9	8
DISSOLVED OXYGEN (MG/L)@ 1M OFF BOTTOM		7.0	8.0	7	9	8
TOTAL AMMONIA (MG/L)		.037	.021	0.02	0.034	0.021
TOTAL NO2+NO3 (MG/L)		.004	.005	0.011	0.0005	0.005
TOTAL KJELDAHL (MG/L)		.025	.150	0.18	0.09	0.12
TOTAL PHOSPHORUS (MG/L)		.015	.018	0.015	0.024	0.014
ORTHOPHOSPHORUS (MG/L)		.003	.009	0.001	0.007	0.007
SPECIFIC CONDUCTANCE (UMHOS)						
CHLOROPHYLL a (UG/L)		2.4	1.7	4	6	2.6
ZINC (UG/L)					40	
N : P		1.9:1	8.6:1	12.7:1	3.8:1	8.9:1

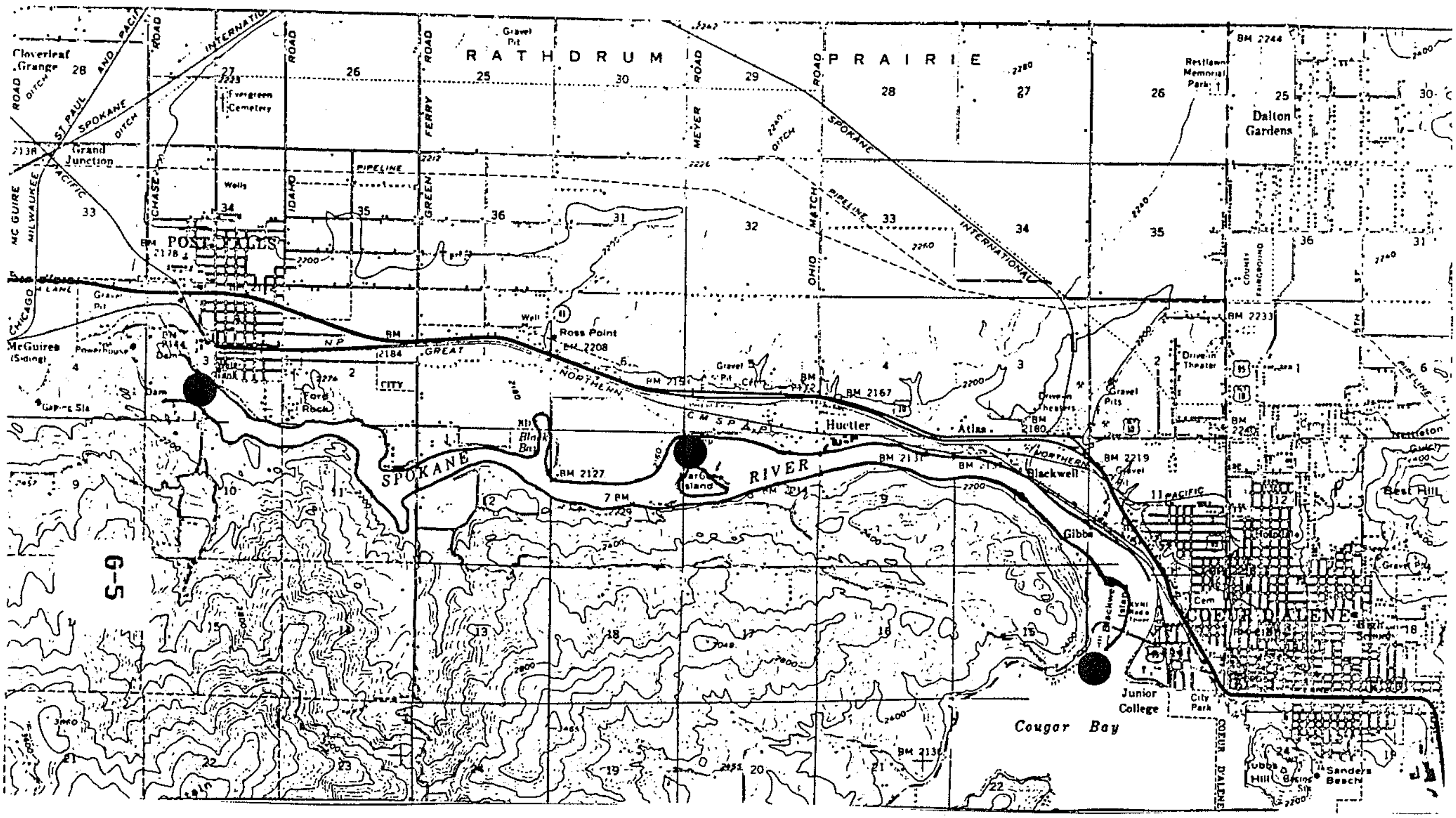


Figure 11 CVMP Water Quality Sampling Site Locations for the Spokane River, Idaho

APPENDIX H

PEND OREILLE LAKE

Table 33 1989 Pend Oreille Lake Secchi Disk Transparency Depths

	5/20- 5/29	5/31-6/5	6/7-6/14	6/17-6/23	6/24-7/2	7/3-7/12	7/14-7/23	7/24-7/29	8/4-8/10
Location									
Springy Point	1.7	2.5	3.5	3.5	3	4	4.75	6	7
Chuck's Slough			2.5		2.6	3	5	5.5	
Murphy Bay			3		3.2	3.3	5	5.5	
Bottle Bay	2.7	2.5	2.8	3.8	3.2	2.6	3	3.6	3.5
Pack River Bay		3	3	3	3	5	6.5	6	8.5
Trestle Creek		4	5.25	3	5	4	5.5	6	
Ellisport Bay	3.75		3.75		4	4.75			
Camp Bay		4	3.75	3.25	4.75	5.5	8.25		9.5
Glengary Bay	3.75	4	3.25	3.6	4.25	5.5	7.5		9.25
Garfield Bay			4	3.25	3.5		7	7	10.5
Talache					4.5			7.25	
Lakeview	5.3	5.2	4	4	5.3	4.5	6.5	7.5	8
Scenic Bay	4	5.3	4.25	4.5	4	4.5	6	6.5	10
Idlewilde Bay	5.7	5.75	4	5	5	4	6.75	8	11

	8/12-8/21	8/23-9/12	9/15-9/23	9/27/89	10/4/89	10/10/89	10/18/89	10/25/89
Location								
Springy Point	5							
Chuck's Slough	5	5.5	5					
Murphy Bay	5	5.5	5					
Bottle Bay	3.8	3.25						
Pack River Bay								
Trestle Creek	9							
Ellisport Bay			7.25					
Camp Bay								
Glengary Bay	9.75	7.5	6.75					
Garfield Bay								
Talache								
Lakeview	8	10.25	10.3	12	10.75	8.5	9	8
Scenic Bay	8.25	10	9	10				
Idlewilde Bay	10.5	10	9.5	11				

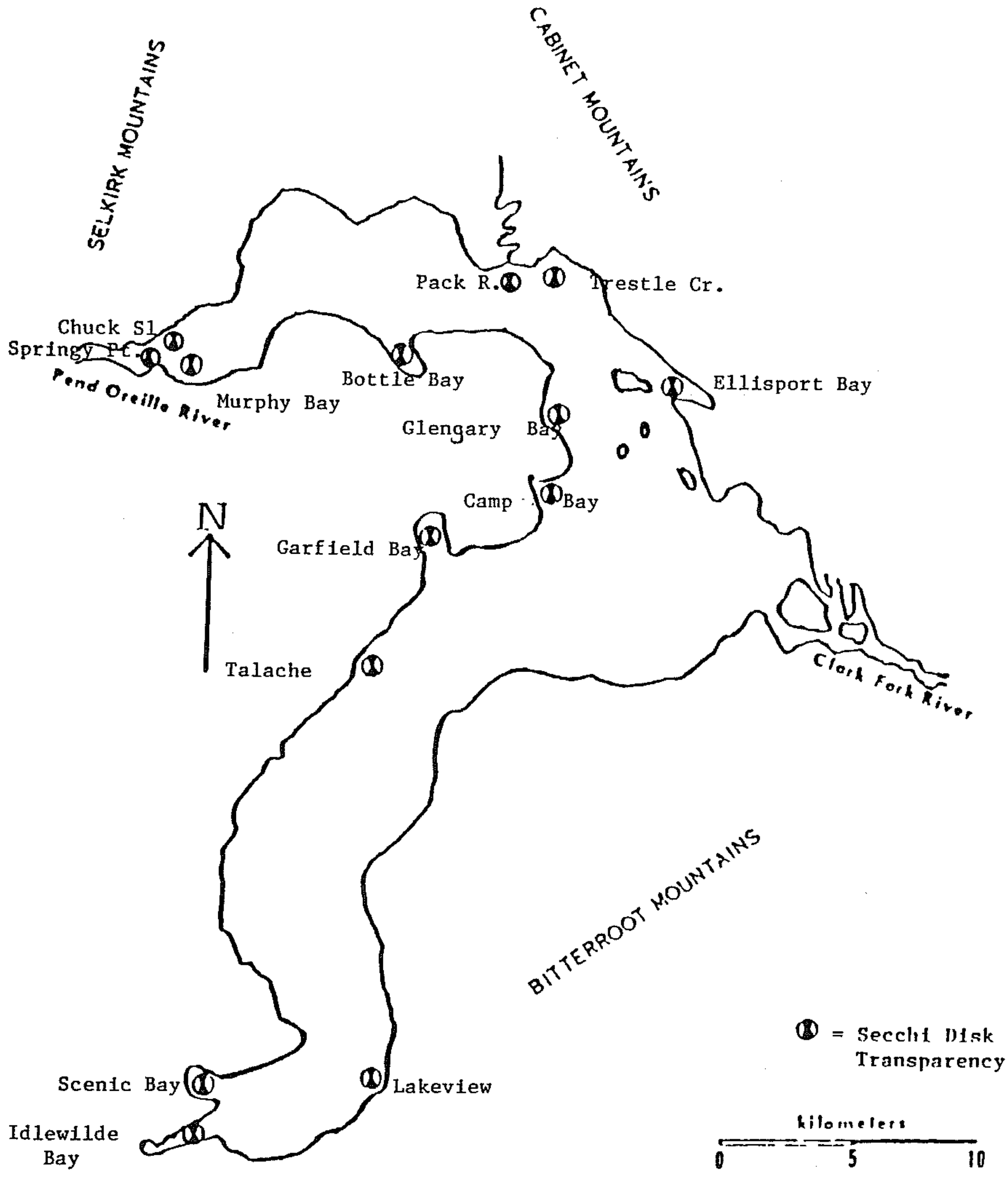


Figure 12 Volunteer Water Quality Monitoring Sites for Pend Oreille Lake, Idaho

APPENDIX I

HAUSER LAKE

Table 34 Hauser Lake CVMP Water Quality Data for 1989

Investigator	CVMP	CVMP	CVMP	CVMP	CVMP (+ dupe)
Date	5/2/89	6/11/89	7/18/89	8/27/89	10/10/89
Deep sample depth (m)	11.5	11	11	10	11
Secchi Depth (m)	1.6	3	4	3	3.5
T. Ammonia as N mg/l (euphotic)	0.017	0.036	0.02	0.038	.016 (.026)
T. Ammonia as N (deep)	0.022	0.1	0.186	0.393	1.27 (1.24)
T. NO2+NO3 as N mg/l (euphotic)	0.0005	0.0005	0.005	0.004	.003 (.003)
T. NO2+NO3 as N (deep)	0.0452	0.006	0.0005	0.0005	.0005 (.0005)
T.Kjeldahl as N mg/l (euphotic)	0.5	0.4	0.44	0.61	0.47 (.43)
T. Kjeldahl as N (deep)	0.47	0.35	0.75	0.9	2.03 (1.99)
T. Phosphorus as P mg/l (euphotic)	0.019	0.02	0.014	0.024	.019 (.016)
T. Phosphorus as P (deep)	0.023	0.076	0.17	0.29	.64 (.62)
Ortho phosphate as P mg/l (euphotic)	0.002	0.002	0.001	0.0005	.004 (.003)
Ortho phosphate as P (deep)	0.006	0.062	0.16	0.185	.54 (.56)
Chlorophyll a (ug/l)	3.7	1.9	3.7	16	5.9 (6.7)
Temperature (C) (euphotic)	13	19.5	21.5	19	15
Temperature (C) (deep)	8	10	10	11	10
Dissolved Oxygen mg/l (euphotic)	13	10	11		8
Dissolved Oxygen mg/l (deep)	9	2	3.2	0.4	0.4
N : P (euphotic)	26.3:1	20:01	31.8:1	25.6:1	24.9:1

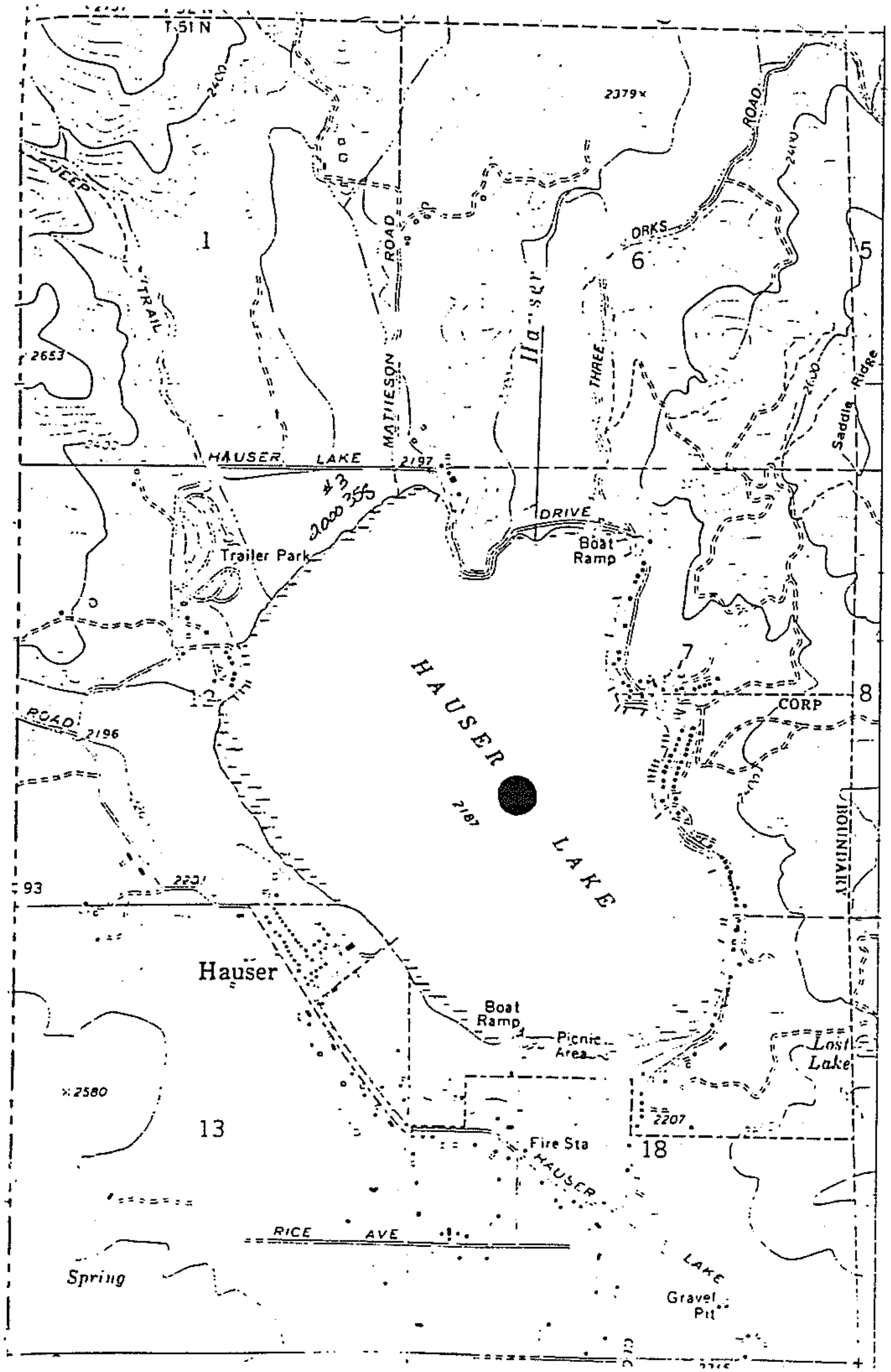


Figure 13 CVMP Water Quality Sampling Site Location for Hauser Lake, Idaho

APPENDIX J

ROSE LAKE

Table 35 Rose Lake CYMP Water Quality Data for 1989

Investigator	CYMP	CYMP (+dupe)	CYMP	CYMP	CYMP
Date	5/1/89	6/12/89	7/17/89	8/28/89	10/10/89
Deep sample depth (m)	5.5	5	6.5	5	5
Secchi Depth (m)	3	3.5	2	1.5	1.5
T. Ammonia as N mg/l (euphotic)	0.162	.043 (.043)	0.157	0.054	0.075
T. Ammonia as N (deep)	0.155	.207 (.202)	0.371	0.037	0.041
T. NO2+NO3 as N mg/l (euphotic)	0.019	.039 (.038)	0.025	0.0005	0.009
T. NO2+NO3 as N (deep)	0.015	.043 (.044)	0.0005	0.0005	0.001
T.Kjeldahl as N mg/l (euphotic)	0.69	.43 (.59)	0.68	0.52	0.52
T. Kjeldahl as N (deep)	0.55	.51 (.64)	1.13	0.56	0.49
T. Phosphorus as P mg/l (euphotic)	0.025	.022 (.026)	0.045		0.037
T. Phosphorus as P (deep)	0.024	.025 (.025)	1.3	0.051	0.036
Ortho phosphate as P mg/l (euphotic)	0.003	.022 (.026)	0.011	0.001	0.011
Ortho phosphate as P (deep)	0.001	.001 (.002)	0.047	0.0005	0.011
Chlorophyll a (ug/l)	4	7.4 (9.9)	2.2	13	3.7
Temperature (C) (euphotic)		22	22	19	14
Temperature (C) (deep)	14	20	22	19	14
Dissolved Oxygen mg/l (euphotic)		7	7	9	8
Dissolved Oxygen mg/l (deep)	9	5	4	8	9
N : P (euphotic)	28.4:1	21.3:1	15.7:1		14.3:1

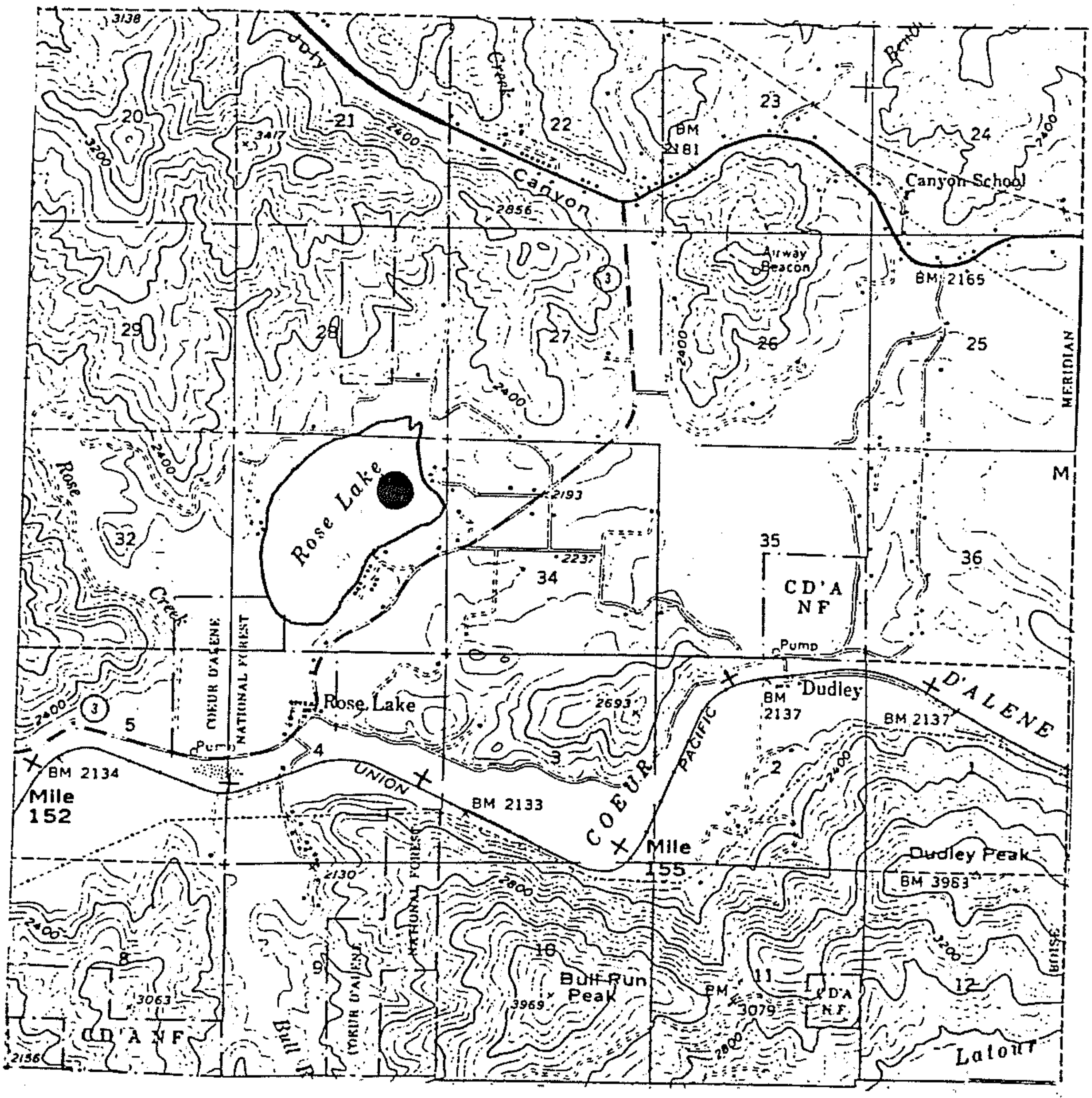


Figure 14 CVMP Water Quality Sampling Site Location for Rose Lake, Idaho

APPENDIX K

VOLUNTEER WATER QUALITY MONITORING DATA NOTES

Volunteer Water Quality Monitoring Data Notes

Less than values (<) assumed to be 1/2 of detection limit value.
NO2-N and NO3-N detection limit=.001
Kjeldahl N detection limit=.05
NH3-N detection limit=.001
Ortho PO4 and PO4 detection limit=.002
CVMP euphotic sample at secchi depth, not vertically integrated.