Technical Report

Winter Limnology Study of Violin Lake

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INTRDUCTION

The study of limnology is, in a broad sense, aquatic ecology. It concerns the interactions between aquatic organisms and their physical environment.

This report is a winter limnology study of Violin Lake prepared as a part of the requirements for Wildland Recreation Technology.

The objectives of this report are:
to record the Topographical and Bathymetric measurements that are important in determining the mass volume of water and the average water depth of Violin Lake; to record chemical qualities that concern the survival of fish species present in the lake; and to record present health of fish species in the lake.

SUMMARY

1. The shoreline development ratio for Violin Lake is 2.5.

2. Oxygen levels meet requirements for Brook Trout survival.

3. All chemical tests meet requirements for Brook Trout survival.

4. Air pollution from Cominco does not effect the limnology of the lake.

5. The deepest point of the lake is 12 meters.

6. The total volume of Violin Lake is 1,959,703.6 m^3.

7. The average depth of the lake is 2.4 meters.

8. The only fish species present in the lake is Eastern Brook Trout.

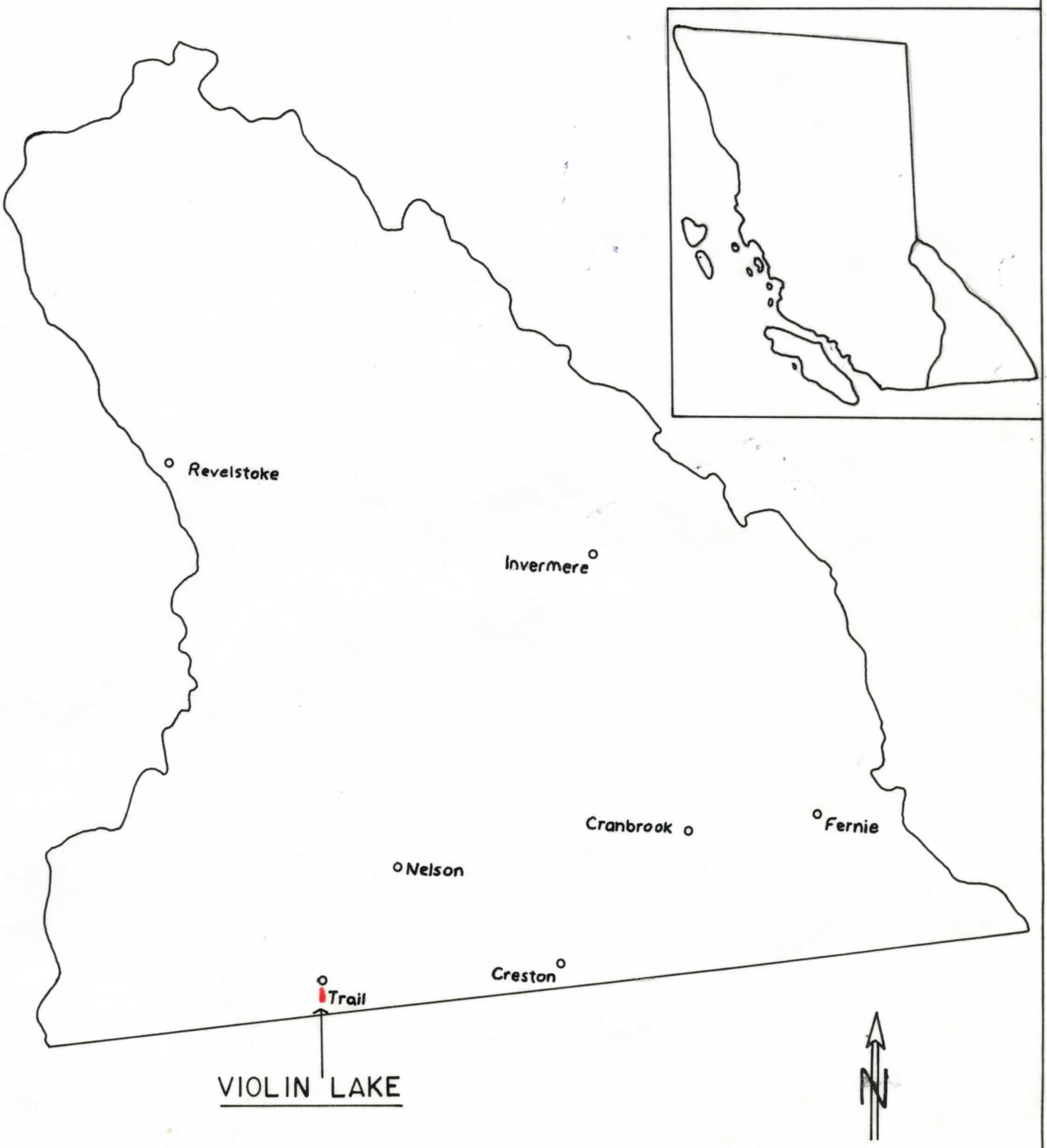
9. The average fork length in cm for Brook Trout is 15.9 cm

10. The average weight in grams for Brook Trout is 157.34 gms.

11. The average age for Brook Trout is 3.5 years.

LOCATION MAP

KOOTENAY REGION



Warfield
TRAIL
City Municipality
Talus Hill
Pump House
Arsenic Dump
Reservoir
Gas Pipeline (underground)
Radio
Underground Res
Lookout Mountain
Lake Mountain
Baldy Mountain
Violin Lake
Cambridge Cr
Ryan Cr
Cosino
Sheppard
Golf Course
Cemetery
Orchard
Abandoned
Gravel Pit
Sawmill
Motel
SL 40
SL 42
SL 43
SL 44
SL 45
SL 46
SL 148
SL 182
Tp 8A
F O R E S T
G R O U S E
R I D G E
N
1(b)

LOCATION

British Columbia Forest Service
Forest Inventory Division Map:
Rossland-Trail 82-F-4-b

1:15, 840 (Grid Reference 117°43' Latitude 49°02'30" Longitude); Trail 82F/sw 1: 125,000

Arerial Photos #BC 7640 #102,103

ACCESS

During winter the lake can only be reached with the use of a snowmobile or cross-country skis. A road located south east of Trail off highway 3B leading five miles to the lake is the only accessible route during the winter months.

DESCRIPTION OF LAKE

The lake surface elevation is approximately 3125 feet and when viewed from the air resembles the shape of a violin. There are two outflow streams which have been dammed by the City of Trail to prevent water from flowing out of the lake, Goodeve Creek to the south and Cambridge Creek to the north. The lake is fed by several small springs that are usually frozen during winter and difficult to detect. The lake bottom material

is composed of mud and gravel. The gravelled areas are suitable for spawning fish.

Small but numerous Brook Trout are found in the lake. Located near the north end of the lake there is a beaver lodge housing two beavers.

The lake is surrounded by dominant trees of Western Larch(Larix occidentalis) and Western Hemlock(Tsuga heterophylla); co-dominant trees of Engelmann Spruce (Picea engelmannii); and juvenile trees of Western Hemlock(Tsuga heterophylla). The lake is also partially surrounded by an overgrown road that encompasses approximately four sevenths.

VIOLIN LAKE LIMNOLOGICAL STUDY PROCEDURES

VEGETATION

Species lists of submergent, emergent and terrestrial plants were determined by walking the perimeter of the lake and recording vegetation observed. The book "Trees and Shrubs" was used in aiding myself to identify unknown plants.

PHYSICAL FEATURES

The physical characteristics were recorded by walking the perimeter of the lake and observing the features. The physical features were also recorded on photographs.

Depth sounding was accomplished by drilling holes through the ice 100 meters apart and measuring the depth at each hole using a rope with a weight on one end of it. The rope was marked in meters. The results were recorded and used in the development of a contour map.

Chemical Analysis

Chemical tests were taken at data stations I,II,III, and IV. Water samples were taken with the aide of a Van Dorne bottle. One sample from the surface and one sample from the bottom at station I was taken in site for CO_2, PO_4 and pH levels using a Selkirk College

Hach Kit. Surface and bottom samples were taken at stations II and III and taken to the West Kootenay Unit laboratory in Trail and tested for Pb(lead), NO_2 (nitric Oxide), PO_4(phosphate), SO_4(sulphate), Zn(zinc), and turbidity levels.

With the use of a battery powered oxygen temperature probe, oxygen and temperature readings were taken and recorded so an oxygen and temperature profile could be drawn up. The readings were taken at data station IV near the deepest section of the lake.

Total dissolved solids were measured from a surface sample taken back to the Selkirk College, dried and weighed in scales in the biology lab.

Wildlife Species List:

Wildlife using the lake and immediate area were determined by actual sightings, tracks and droppings found along the banks of the lake.

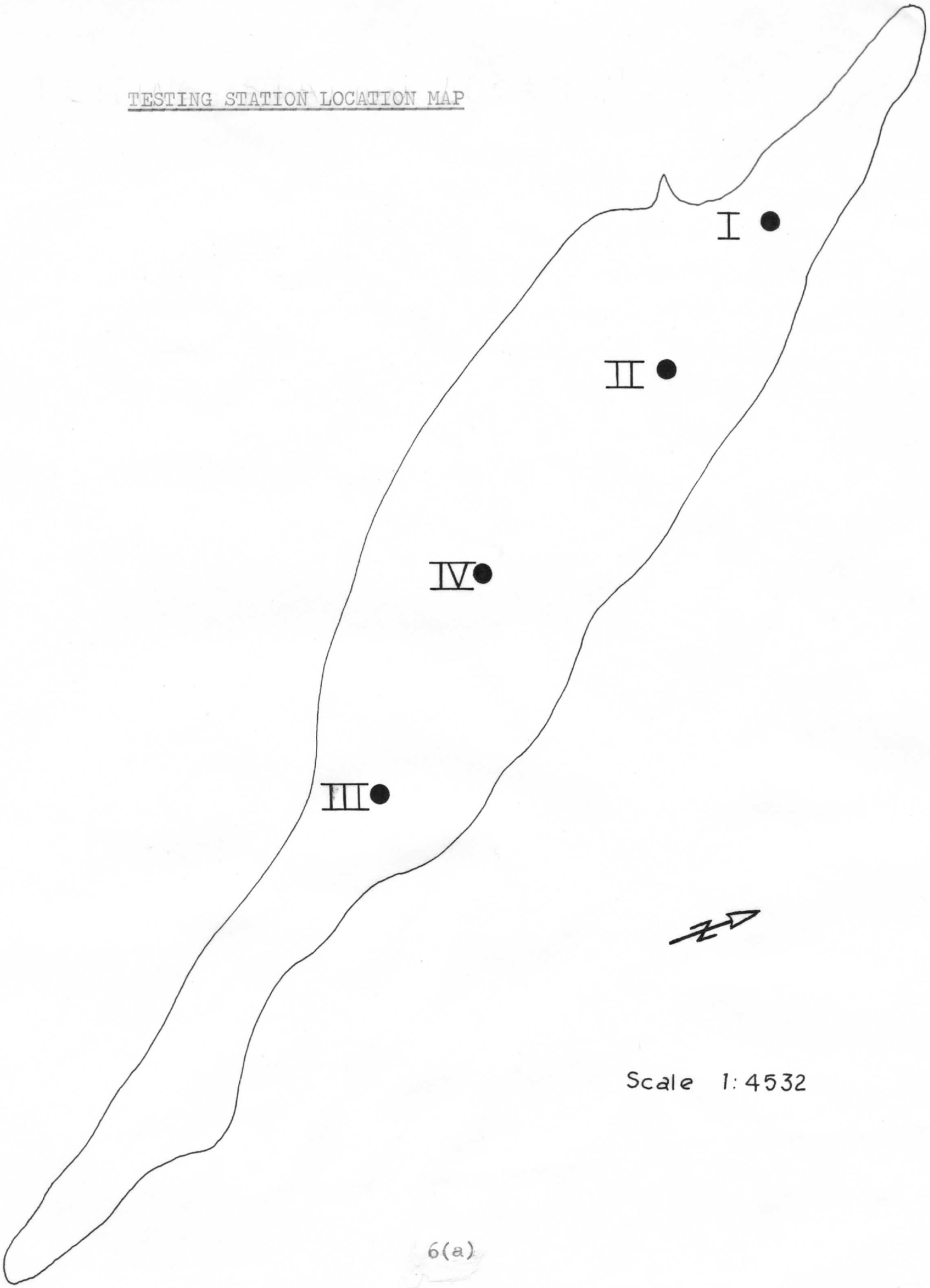
Fish Species List:

Several Brook Trout were obtained using a baited line for study purpose. These fish were measured for length and weight with a tape measure and a fish scale. Scale samples were taken from each fish, placed under a microscope and the ages were determined.

Topographical and Bathymetric Measurements

Topographical and Bathymetric Measurements were calculated from the contour map. (see page 12a) The measurements taken of the lake were: surface area; maximum length; maximum effective length; maximum width; and shoreline length. These measurements were used to determine total water volume and average depth of Violin Lake.

TESTING STATION LOCATION MAP



Scale 1:4532

RELEVANCE OF DATA

Vegetation:

Vegetation cover along streams provide shade for fish, bank stability through root systems and a place for insects to live and breed in which indirectly provides a source of food for fish when the insects fall into the water. These reasons indicate that the taller the vegetation, the greater the value.

Aquatic plants are good to fisheries in many ways such as production of oxygen, hiding places for aquatic insects and fish, and in some cases supply herbivorous fish with a food source.

Measurement of Temperature

Temerature is a vital and impotant part of habitat. Temperature change is very crucial when involving egg and alevin survival. Temperature has a definite effect on the carrying capacity of dissolved oxygen in water. But its relationship to flora and fauna production is more important.

Measurement of Oxygen

For cold water biota, it is preferred that dissolved oxygen concentrate be at or near saturation. This is especially important in spawning areas where dissolved oxygen levels must not be lower than 7mg/1 at any time.

For good growth and general health of fish and their associated biota, dissolved oxygen concentrations should not be below 6mg/1.

Measurement of Carbon Dioxide.

The presence of CO_2 in a fish's bloodstream tells the fish when to breath in oxygen. It is recommended that the CO_2 concentrations should not exceed 25mg/1. CO_2 is also a major element in the photosynthesis process for plant growth, which in turn supply hiding places for small fish and other aquatic life.

Measurements of Phosphates:

Phosphorus is one of the major nutrients important in a biological system. Regarding productivity of a lake, it is most likely the main control. For their nutrition, plants require inorganic phosphate, typically called orthophosphate ions. The total phosphorous concentration of most uncontaminated surface waters are between 10-50ppm.

Measurement of pH:

Fish habitat requires pH or by hydrogen-ions concentrations fall within the range of 6.5 to 8.5. No highly dissociated materials should be added in quantities large enough to raise pH above 9.0 or to lower pH below 6.0.

Measurement of Total Dissolved Solids.

Dissolved materials that are relatively innocous should not be increased by more than 1/3 of the natural concentration that is characteristic of the subject water. In no instance should the concentration of dissolved solids exceed 1500 ppm.

Measurement of Turbidity:

Turbidity affects light penetration in water which in turn has pronounced effect on the growth of aquatic plants. Turbidity also affects many species of fish classed as sight feeders. In addition, suspended materials absorb solar heat, causing temperature increase of the water. A high daily change in the water temperature will affect all life in the water and produce a high mortality of fish and hatching eggs. Turbidity reduces the enjoyment of fishing and may limit fishing success.

Spring Sources:

Springs producing more than 100 gallons per minute should be noted and water temperature taken. This

information is relevant for potential water sources that can be used for potential spawning habitat if no natural areas exist.

Shore Development Ratio:

Where s is the length of the shoreline and A is the area or acreage of the lake, the term shoreline development refers to the ratio of actual length of shoreline of a lake to the length of the circumference of a circle, the area of which is equal to that of the lake. This figure is expressible as an index figure to denote degree of regularity or irregularity. In general the higher this index figure is for shore developement the greater the biological productively of the body of water.

Lake Surface Elevation:

Elevation is critical in estimating the number of snow -and-ice free periods which influences the amount of biological activity in the lake.

Topographical and Bathymetric Measurements:

These measurements are important for determining the volume of water present in the lake. The volume of water in the lake will vary through the four seasons of a year but may change drastically over a period of ten to twenty years. By recording the volume of water in the lake each year and plotting the information on a graph it is possible

to know if the lake is dieing out and being taken over by biological succession. It is also possible to know if the lake is stable or increasing in volume. This information is important for Violin Lake because it supplies water to approximately one quarter of Trail.

LIMNOLOGICAL SURVEY RESULTS

Due to the difficult access to the lakr during winter months, only two sets of data could be gathered. This information is presented in chart form. Beside Violin Lake survey data are Brook Trout habitat requirement data for comparison purpose.

Figure 1 1982 Temperature and Oxygen Gradient Results For Violin Lake

Depth/m	Temperature/C°		Oxygen/ppm	
	Jan.	Feb.	Jan.	Feb.
0	1	1	11	9
1	1	1	10.8	8.3
2	1	1.5	9.2	8.0
3	1.5	1.5	9.0	8.0
4	2	2	8.1	7.8
5	2	2	8.0	7.8
6	2.5	2.5	8.1	5.9
7	3	2.5	8.1	4.5
8	3	3	6.0	3.8
9	3.5	3	4.5	2.7
10	4	3	2.9	1.5
11	4	3.5	2	1
12	4	3.5	2	1

Shore Development Ratio= 2.5

This represents below an average productive littoral zone.

Figure 2 Data Chart For Violin Lake 1982

		Jan. 16	Feb. 21	Brook Trout Requirements
O_2	Surface	11ppm.	9 ppm.	4 ppm. min.
	Bottom	2 ppm.	1 ppm.	4 ppm. min.
CO_2	Surface	6 ppm.	8ppm.	10 ppm. max.
	Bottom	9 ppm.	11.5 ppm.	10 ppm. max.
Temperature	Surface	1 °C	1 °C	23 °C max.
	Bottom	4 °C	3.5 °C	23 °C max.
pH	Surface	8.1 ppm.	8.0 ppm.	6.5 min.
	Bottom	9.2	8.9	8.5 min.

Figure 3 Data Chart For Violin Lake 1982

		Jan. 16	Feb. 21	Brook Trout Requirements
PO_4	Surface	.026 ppm.	.022 ppm.	.03-.15 ppm.
	Bottom	.082 ppm.	.075 ppm.	.03-.15 ppm.
Turbidity		3.3 ppm.	3.3 ppm.	No Restrictions
TDS		123 ppm.	120 ppm.	1500 ppm. max.
Colour		light brown to clear	light brown to clear	No Restrictions

Figure 4 OXYGEN AND DEPTH GRAPH OF VIOLIN LAKE FOR JAN. 16, 1982

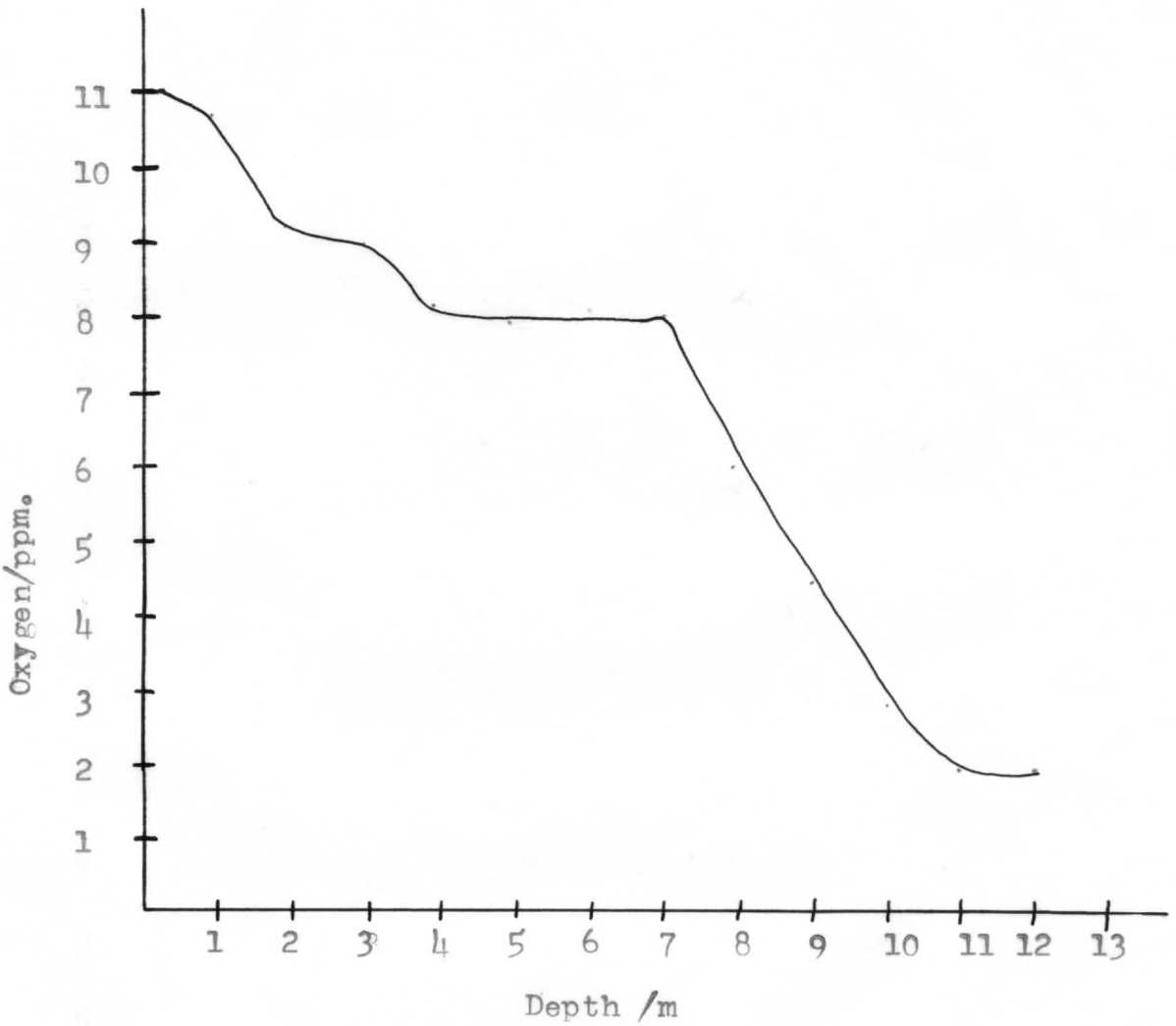


Figure 5 TEMPERATURE AND DEPTH GRAPH OF VIOLIN LAKE FOR JAN. 16, 1982

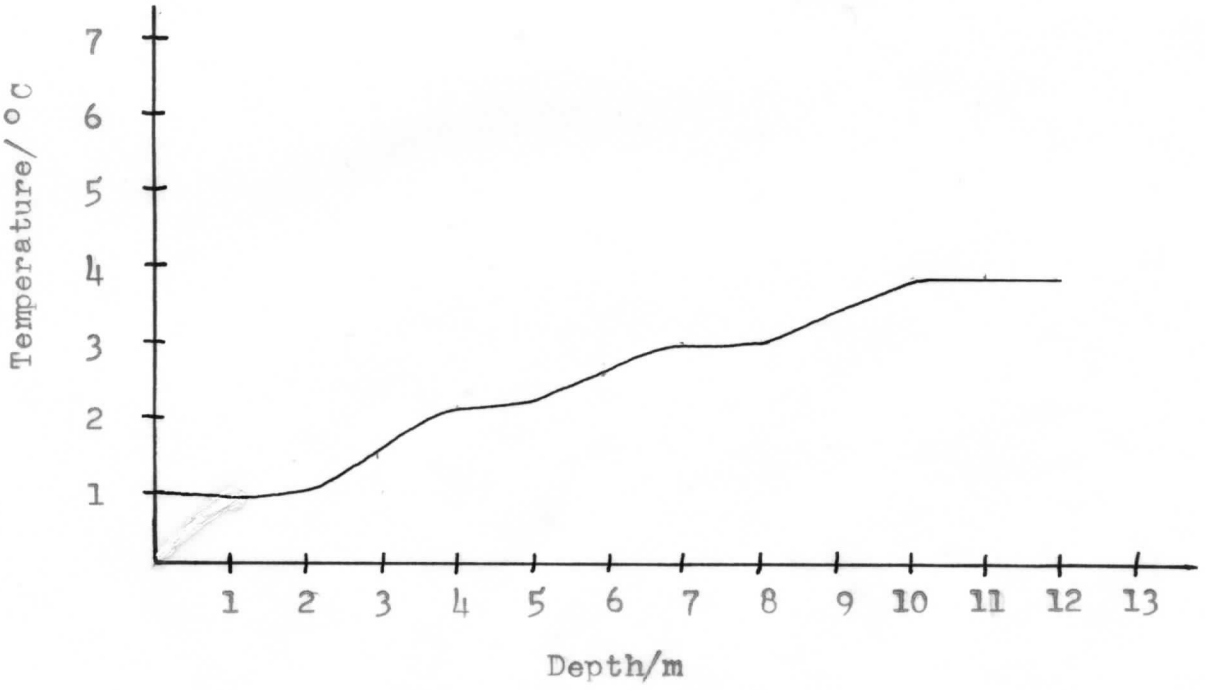


Figure 6 OXYGEN AND DEPTH GRAPH OF VIOLIN LAKE FOR FEB. 21, 1982

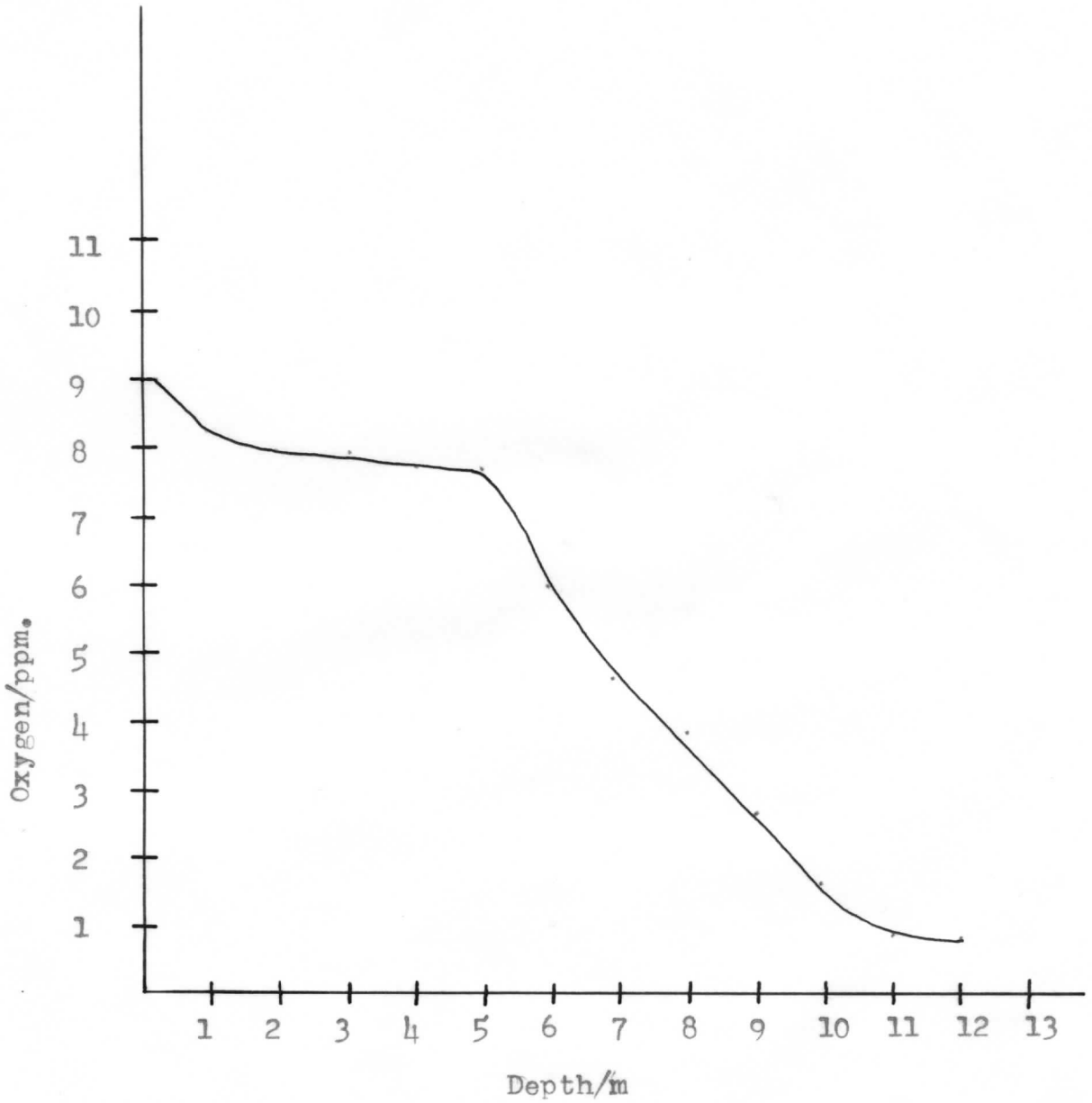
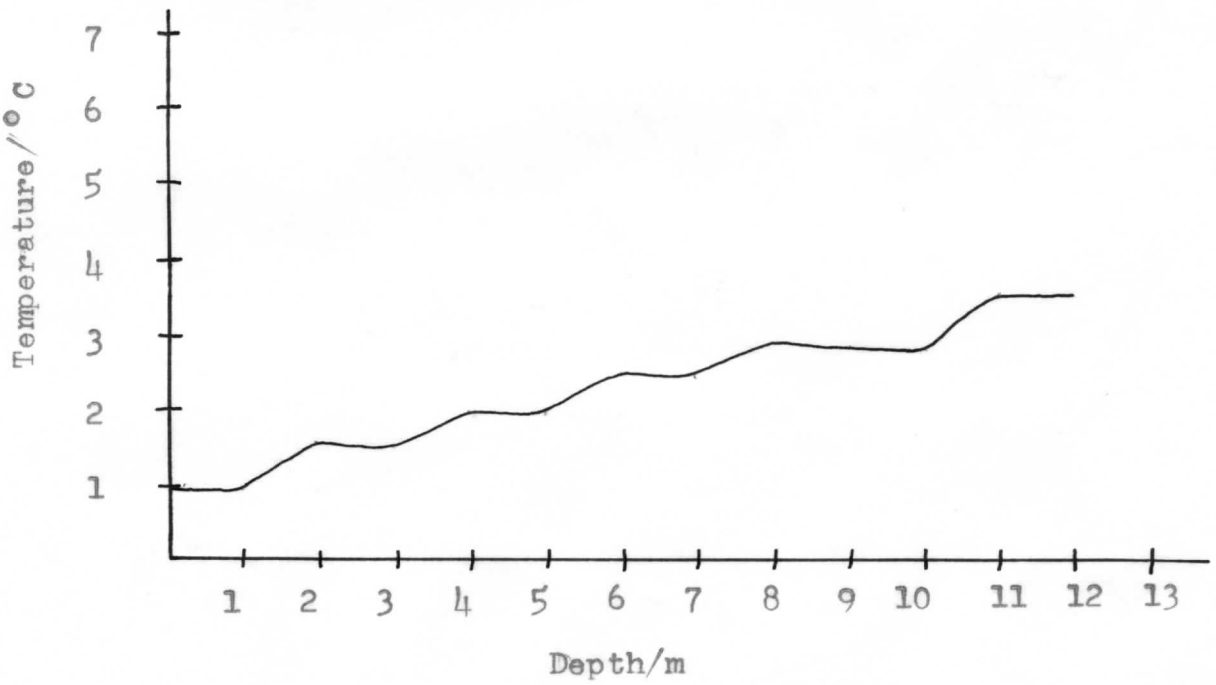


Figure 7 TEMPERATURE AND DEPTH GRAPH OF VIOLIN LAKE FOR FEB. 21, 1982

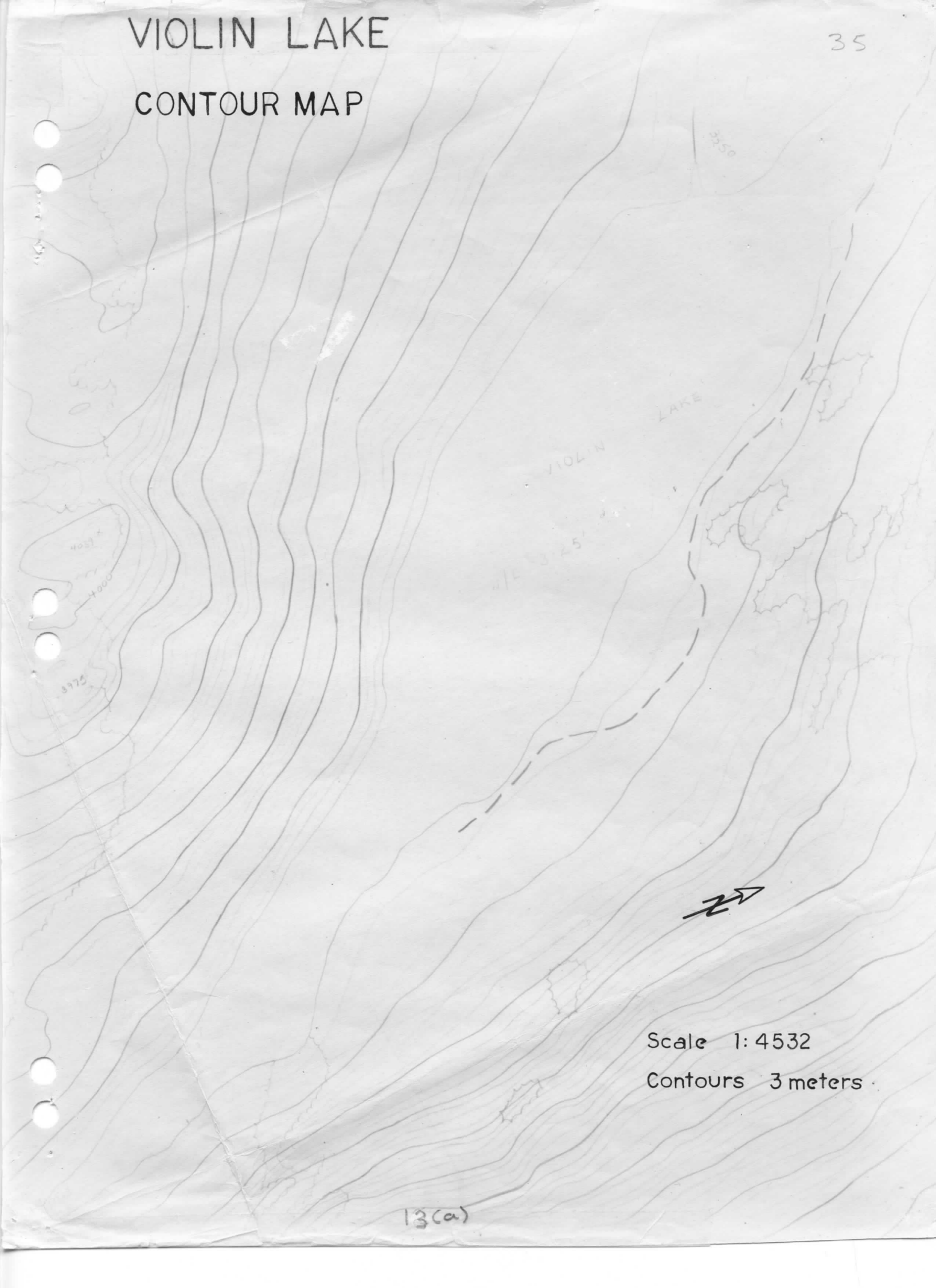


CHEMICAL TESTS DONE BY THE WEST KOOTENAY HEALTH UNIT

The levels of lead, nitric oxide, phosphate, sulfate, and zinc were so low that the actual amounts in parts per million are not worth mentioning in this report.

VIOLIN LAKE

CONTOUR MAP



Scale 1: 4532

Contours 3 meters

VIOLIN LAKE

CONTOUR MAP

Scale 1: 4532

Contours 3 meters

13(a)

Topographical and Bathymetric Measurements

	Surface Area of Frustrums	Volume of Frustrums
Lake	816647.66 m^2	
		1243729.8 m^3
3m	425967.45 m^2	
		557377.15 m^3
6m	130663.62 m^2	
		144604.04 m^3
9m	13560.7 m^2	
		13992.65 m^3
12m	314.16 m^2	

Total Volume 1,959,703.6 m^3

Surface Area of Lake

81.66 hectares

Maximum Length

1550 meters

Maximum Effective Length
(maximum unobstucted length)

1550 meters

Maximum Width
(maximum distance on lake surface perpendicular to maximum length)

249.26 meters

Shoreline Length

3340.1 meters

Average Depth 2.4 meters

Vegetation:

Because of the time of year that the study was carried out, submergent and emergent vegetation were difficult to observe.

The terrestrial vegetation immediately around the lake was mainly coniferous forest with some patches of deciduous forest. The biogeoclimatic zone was Interior Western Hemlock. This was evident because the most dominant tree species was Tsuga heterophylla. The ground vegetation present was characteristic of the biogeoclimatic zone. Co-dominant tree species were Picea engelmannii glauca and Thuja plicata.

Vegetation Species Lists:

Terrestrial:

COMMON NAME	LATIN NAME
Western Hemlock	Tsuga heterophylla
Western Red Cedar	Thuja plicata
Western Larch	Larix occidentalis
White Pine	Pinus monticola
Lodgepole Pine	Pinus contorta
Douglas Fir	Pseudotsuga menziesii
Englemann Spruce	Picea englemannii
False Box	Pachistima myrsinites
Princess Pine	Chinaphita umbellata
Bracken Fern	Pteridium aquifolium pubescens

WILDLIFE SPECIES LIST

COMMON NAME	LATIN NAME
Black Bear	Ursus americanus
Cougar	Felis concolor
Mule and White-tail Deer	Odocoileus virginianus
Western Red Squirrel	Tamiasciurus hudsonicus
Beaver	Castor canadensis

FISH SPECIES

Eastern Brook Trout
(member of Char Family)

BROOK TROUT

Lengths and Weights

Number	Fork Length in cm	Weight in grams	Age	Comments
1	23	289.17	4+	Healthy
2	11.7	93.56	3+	Thin and Unhealthy
3	15.8	141.75	4+	Large Head and Thin Body
4	17.1	175.77	4+	Healthy
5	13.4	113.40	3+	Healthy
6	14.2	130.41	3+	Large Head and Thin Body

Equipment Used

Field Notebook

Silva Compass

50 meter Chain

Hach Kits

PO_4 Model PO-20 po 20A ortho & meta (Poly) phosphate

NO_3 Model NI-10 Nitrate-Nitrite

pH Tape

Van Dorne Bottle

6 Inch Ice Ogger

Oxygen Temperature Probe-Model 54

Drafting Equipment

Metric Scale

Beaker and Filter Paper

Fishing Rod

Microscope

Analysis of Data(refer to figures)

Oxygen:

Brook Trout require a minimum of 4ppm of oxygen in the water to survive. From seven meters to the bottom of the lake the oxygen levels measured on January 21 were not at acceptable quantities for Brook Trout. These levels of oxygen can be expected at this time of year because of ice forming on the lake's surface causing a barrier to the replenishment of dissolved oxygen in the lake, and bacteria and fish consuming substantial quantities of oxygen that can not be replaced by living plants as quickly as the oxygen is being used. Because the mean depth of the lake is 2.4 meters, only approximately 1/6 of the lake's volume is below 4ppm of oxygen.(Fig. 2)

Carbon Dioxide:

The carbon dioxide level in February exceeded the maximum tolerance levels of 10ppm for Brook Trout. However the level of carbon dioxide was acceptable in the sample taken from the surface. Therefore, this poses no serious problems for fish survival in Violin Lake.(Fig. 2)

Ortho Phosphate:

Normal acceptable concentrations of Phosphate

according to Fish and Wildlife standards are .03-.15ppm. The Phosphate levels taken in January and February did not reach high levels for Brook Trout. The small amounts of Phosphate found indicates a poorly productive ecosystem in the lake.(Fig. 3)

ph:

Fish can not tolerate a too acidic or alkaline habitat. The closer it is to 7pH (neutral) the better the habitat is. Tests done in January and February revealed a slightly alkaline body of water but did not follow the requirements for Brook Trout.(Fig. 2)

Temperature:

Temperatures during winter may drop to as low as 2 degrees C. without having a harmful effect to fish.

The temperatures that were recorded in January and February are stable and pose no threat to survival of fish in a lake of this size. The lower the temperature the less oxygen a fish or other users of the lake require because their metabolism becomes very slow moving.(Fig. 2)

Turbidity:

The high degree of turbidity indicates that a large biomass of phyto plankton and zooplankton exist in the lake. This is beneficial for fish productivity.

CONCLUSIONS

The water level in Violin Lake does not change from year to year and the lake shows no signs of drying from natural ecological succession. This is a direct result of the dams placed on the two outflow streams.

Oxygen levels in the lake are low during the winter freeze over but are enough to meet the needs of most aquatic life forms found in small fresh water lakes.

The smelter known as Cominco is located approximately eight kilometers, as the crow flies, away from Violin Lake and does not at the present effect or threaten the natural limnology of the lake.

Violin Lake is well stocked with Brook Trout that are abundant but relatively small in size. The competition is great in the lake because of the over population and for that reason the fish do not have a high growth rate at any time in their life. This situation is very common in small lakes throughout British Columbia that have not been touched by Fish and Wildlife, Forest Service or any other enhancing agency.

RECOMMENDATIONS

I. The lake be monitored for any type of pollution that could be caused by air pollution from Cominco.

II. The daily limit of eight fish per angler be raised to ten for a period of one year. If no changes occur then the lake is to be stocked with two thousand one pound Brook Trout from the Hatchery in Wardner B.C. and the lake be closed to angling for a period of two full years.

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