LIMNOLOGICAL INVESTIGATION OF SELECTED KOOTENAY MOUNTAIN LAKES

SUMMER 1980

BOB ANDERSON
JUDY PRYCE
IRENE WEST

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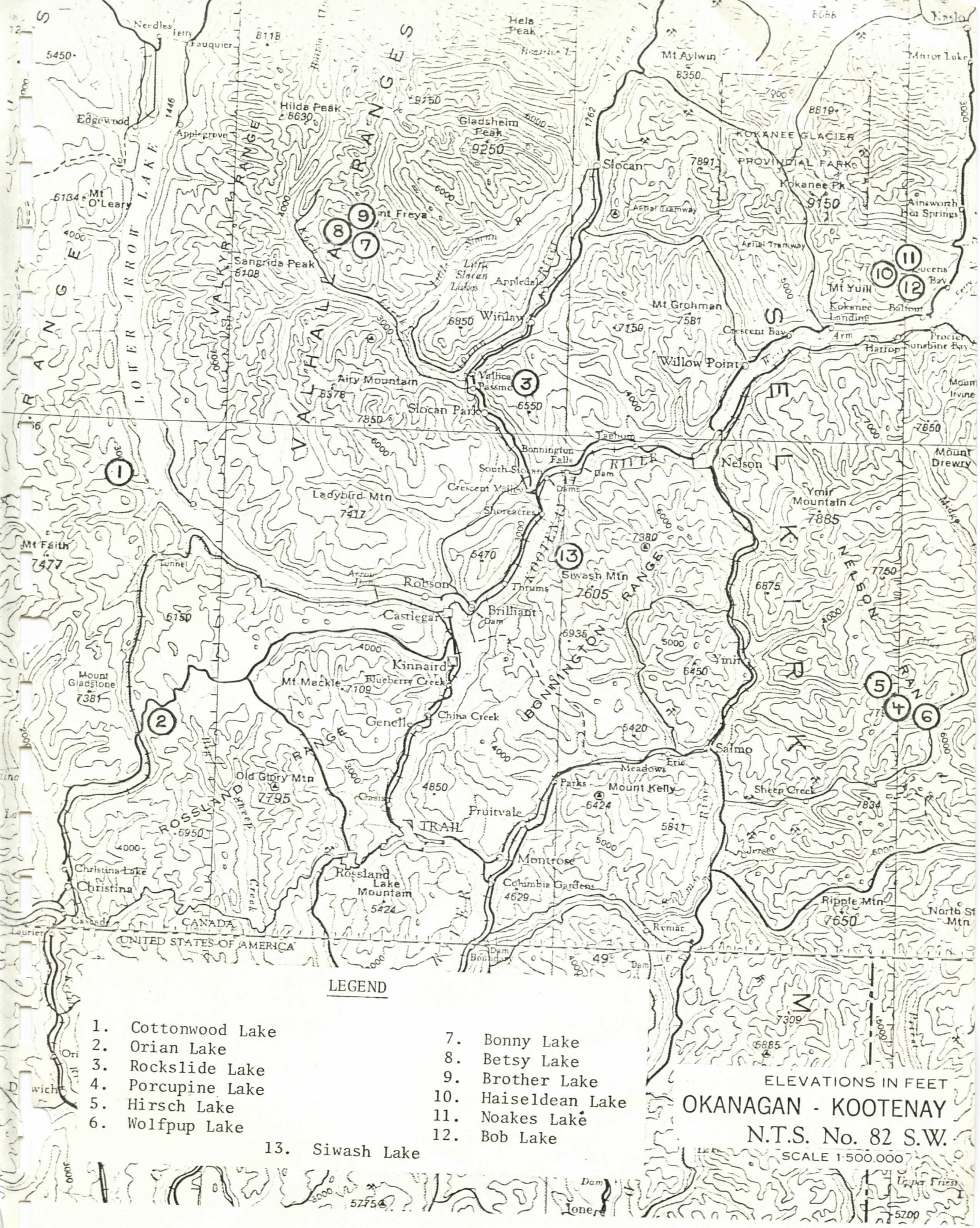


LEGEND

1. Cottonwood Lake
2. Orian Lake
3. Rockslide Lake
4. Porcupine Lake
5. Hirsch Lake
6. Wolfpup Lake
7. Bonny Lake
8. Betsy Lake
9. Brother Lake
10. Haiseldean Lake
11. Noakes Lake
12. Bob Lake
13. Siwash Lake

ELEVATIONS IN FEET

OKANAGAN - KOOTENAY

N.T.S. No. 82 S.W.

SCALE 1:500,000

PROJECT GOALS

This report contains basic limnological, biological, and geomorphological information obtained by studying selected Kootenay mountain lakes. This study continues the work done in the summers of 1977 and 1978, that was contained in the reports "Limnological Investigation of Selected Kootenay Alpine Lakes" and Limnology of Selected Kootenay Alpine Lakes."

The data collected on the lakes studied is significant in a number of ways. Some of these are:

A) From the base information gained-appraisal of the potentiality for fish stocking can be gained. The Fish and Wildlife Service has agreed to stock those lakes which warrant it on the basis of the finished report. The added attraction of a sporting fishery would do much in broadening the interest base of the lakes as a recreational resource.

B) Base data gained could be a starting point for future biologic/limnologic studies by Selkirk College Wildland Recreation students, Biology students or Fish and Wildlife Personnel. For example: changes in water quality due to pollution of Forestry practices; relationship between fish survival in mountain lakes and physical parameters outlined, etc.

C) Basic information about the mountain lakes could be used in teaching Limnology, Wildlife Biology and Ecology in Regional Post-Secondary Institutions.

PROJECT GOALS (cont'd)

D) Basic information would be of value to: any government resource agency or private company which may become concerned with Environmental impact, statements, or economic analyses of areas in multiple use/single use conflicts, and in adding to the present inventory of information available for larger lakes.

E) It would add to our total knowledge of our local resources and by its example stimulate more research activity directed at understanding our local environment.

F) Publication of the Access Route Descriptions and Hiking Time might better encourage more recreational use of these areas - and relieve pressure on overly crowded local parks.

INTRODUCTION

This project is a continuation of the work done by Lousie Richards and Anne Quaedvlieg in 1977 and Abram Davis and John MacDonald in 1978. Several changes have been made in this study as compared to the above. First, the research team was expanded to include three members. The extra member was a great asset to the project as general "paper work" for each of the lakes could be done with greater efficiency and speed thus more lakes could be studied. The three member team made work in the field easier and less time consuming (e.g. as one of us was doing the survey, the other two could be measuring streams; or as two are siting and doing depth soundings, the third is taking vegetation sites). The extra member also allowed equipment to be distributed over three packs making hiking easier. Communication in the larger lakes was also aided by the additional person. The major changes in the report itself deal with the vegetational and geomorphological aspects. The Fish and Wildlife Department suggested that less emphasis be placed on site vegetation so we decided that identifying and classifying the main types of flora were sufficient for the purposes of the report, thus the coverage in 1980 is not as extensive as that in 1978. Also, we felt that inclusion of the common names of plants would be useful for the average person. This year we were able to expand on the geomorphology because of the larger research team. A basic landform map accompanies each lake report. Overall, we tried to lay out the report in an easy-to-understand, scientific and factual way as much as possible.

The lakes were selected with the aim of the "Project Goals" (see page 3 .) in mind. Some lakes were selected to provide baseline data for spawning streams. We tried to find as many lakes as possible without fish to research their stocking potential although determining this aspect a priori was chancey (some "fish" lakes turned out to be "fishless" and vice versa). The lakes were also chosen for accessibility in relation to the time of year. Relatively low level lakes had to be chosen in May and June (e.g. Cottonwood and Orian Lakes) as the high level lakes were still icebound, some of the lakes that we originally planned to study were not done by the end of the year because of several reasons:

1. We ran out of time (Murray Lakes - located near Koch Creek).
2. We got lost ("Bulldog" Lake near Bulldog Mountain - good luck next year!).
3. The "lake" turned out to be an oversized mudpuddle that bears use to wash their paws (Johnianne Lake near Rockslide Lake).

This is the third year of attempting to reach Siwash Lake (which is now unofficially called Jinx Lake - a name well deserved!) and we can now consider it conquered. On the third try this year we finally made it. On the first try we were totally rained out. The second excursion ended when we tried the "more direct route" and after 8 1/2 hours of bushwhacking didn't even get close to an inflow/outflow stream, never mind the lake. Siwash Lake certainly earned its position as number 13 on our list!

We feel this project should continue in future years as it is valuable in assessing the potential of the beautiful West Kootenays. Residents of this area should be made aware of the vast unexplored majesty of their local mountains. The study was also a great learning experience for the authors: we gained experience in hiking, camping, scientific study, writing scientific reports and in general, more about our local area.

ACKNOWLEDGEMENTS

This project is funded by a grant from the Youth Employment Program of the B.C. Government.

There are many individuals and institutions without whose help this project would be impossible.

A million thanks to Doug McBride who secured funds, helped gain access to the lakes, explained methods of physical measurements and how the equipment worked, lent his vehicle for lake access, gave ideas, scheduled his holidays so as to be available for consultation whenever possible and in general served as the "daddy" of the project.

Thanks also go to:

- Peter Wood for flying us over and helping gain access to the lakes.
- Moira Alexander for helping in the lab and outlining the use of equipment.
- Walter Volovsek for helping gain access to the lakes and helping in the lab.
- Bob Shepherd for help in the Chemistry lab.
- Leslie Anderton for helping with the geomorphology.
- Roland Anderson for the use of his Land Rover.
- Ken Cazakoff for help in the Audio Visual Department.
- Joan Snyder for help with vegetation classification.
- Darkwoods Forests and Forester-in-charge H. Tschechne for permitting access to their property and use of their Porcupine Cabin.
- Lil Knowler for typing the final copy of the report (it was greatly appreciated).

The Castlegar and Trail Wildlife Associations both contributed to this project and without their help the project could not continue.

We'd also like to thank Selkirk College for use of their facilities especially the Department of Environmental Sciences. Thanks also go to the Department of Physical Sciences and the Department of Forest Technology.

COTTONWOOD LAKE

DATE STUDIED: May 29th and 30th, 1980.

I. LOCATION:

- 49° 28' N. 118° 12' W.
- Department of Mines and Technical Surveys Map: Renata 82E/8E, 1:50,000; Grid Reference 134801.
- Department of Lands and Forests Map: Grand Forks 82E/SE, 1:126,720.
- Aerial photographs #BC 4265-014, #BC 4265-013

II. ACCESS:

By Vehicle

To Syringa Provincial Park boat launch.

By Boat

To Renata Beach, on the north side of Renata Creek.

II. ACCESS:

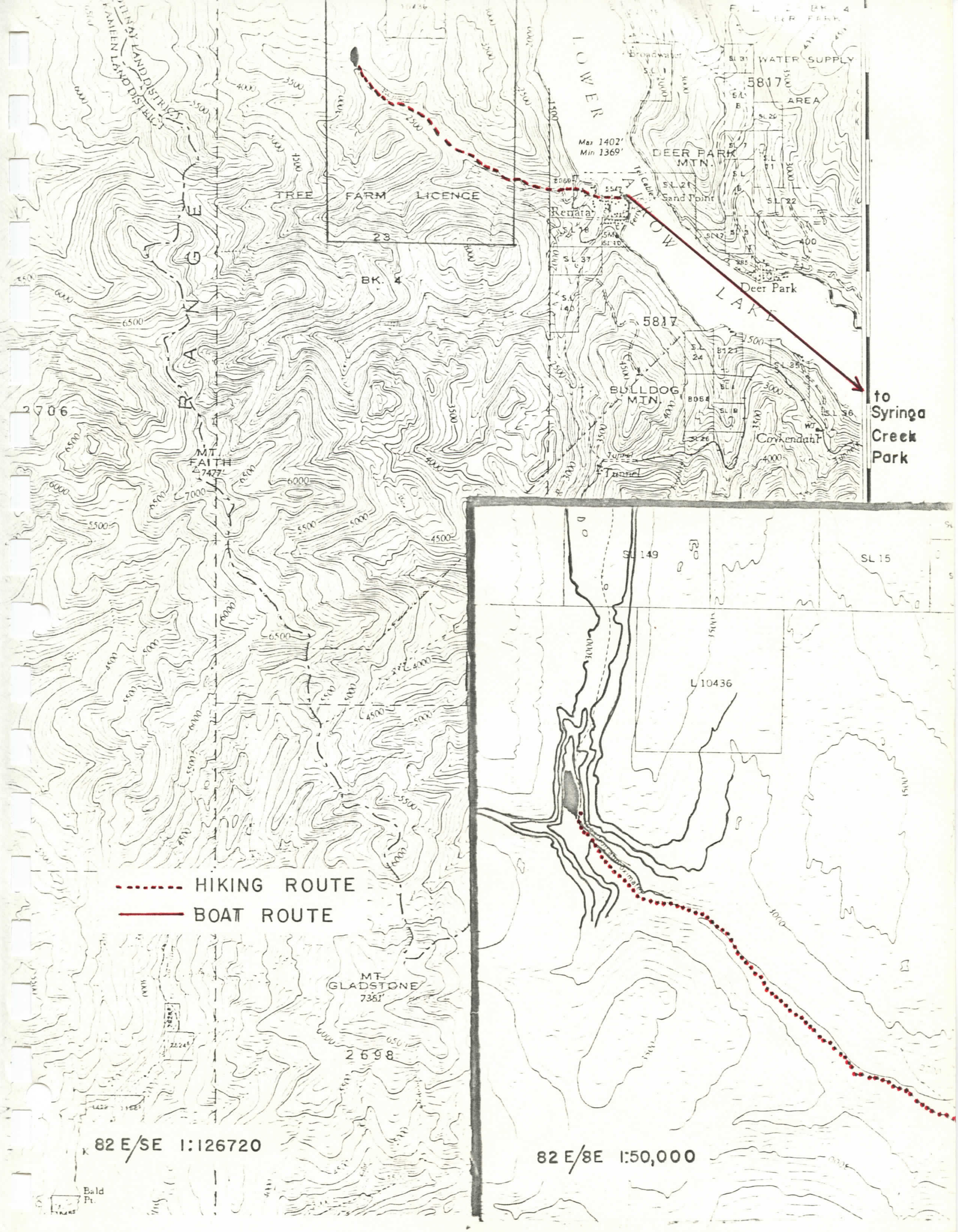
Hiking Route

There is a logging road from Renata Beach leading directly to Cottonwood Lake. Walk along the well-used road for approximately 8 kilometers (there are distance indicators nailed to trees along the way). When a fork in the road is reached, the right hand, less travelled route, is taken. Cottonwood Lake is approximately 200 meters from the fork. It took two hours to hike this route.

Alternate Routes

The lake can be reached solely by vehicle.

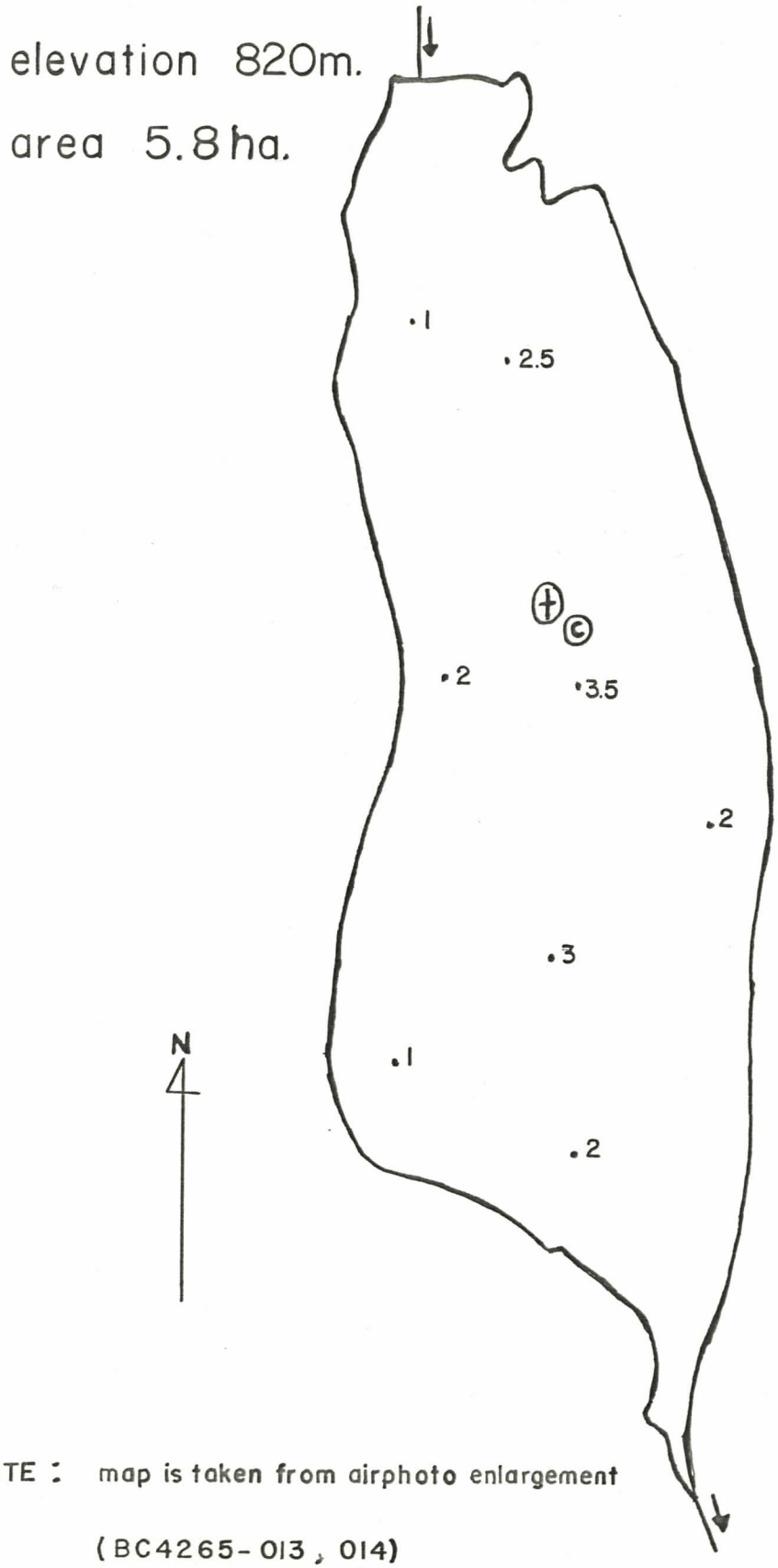
1) Drive to Edgewood, B.C. and take the logging road leading to Renata for approximately 64 kilometers to the 8 1/2 km. mark and the fork in the road. Take the left hand fork for 200 meters.



LOWER
ARROW
LAKE
TREE FARM LICENCE
23
BK. 4
Broadwater
WATER SUPPLY
5817
AREA
Max 1402'
Min 1369'
DEER PARK
MTN.
Sand Point
Renata
Deer Park
5817
BULLDOG
MTN.
Tunnel
to
Syringa
Creek
Park
RANGE
2706
MT.
FAITH
7477'
MT.
GLADSTONE
7351'
2698
HIKING ROUTE
BOAT ROUTE
82 E/SE 1:126720
Bald
Pt.
SL 149
SL 15
L 10436
82 E/8E 1:50,000

FIG. IA

COTTONWOOD LAKE



legend

inflow/outflow streams

depth soundings

temperature record

chemical record

NOTE : map is taken from airphoto enlargement

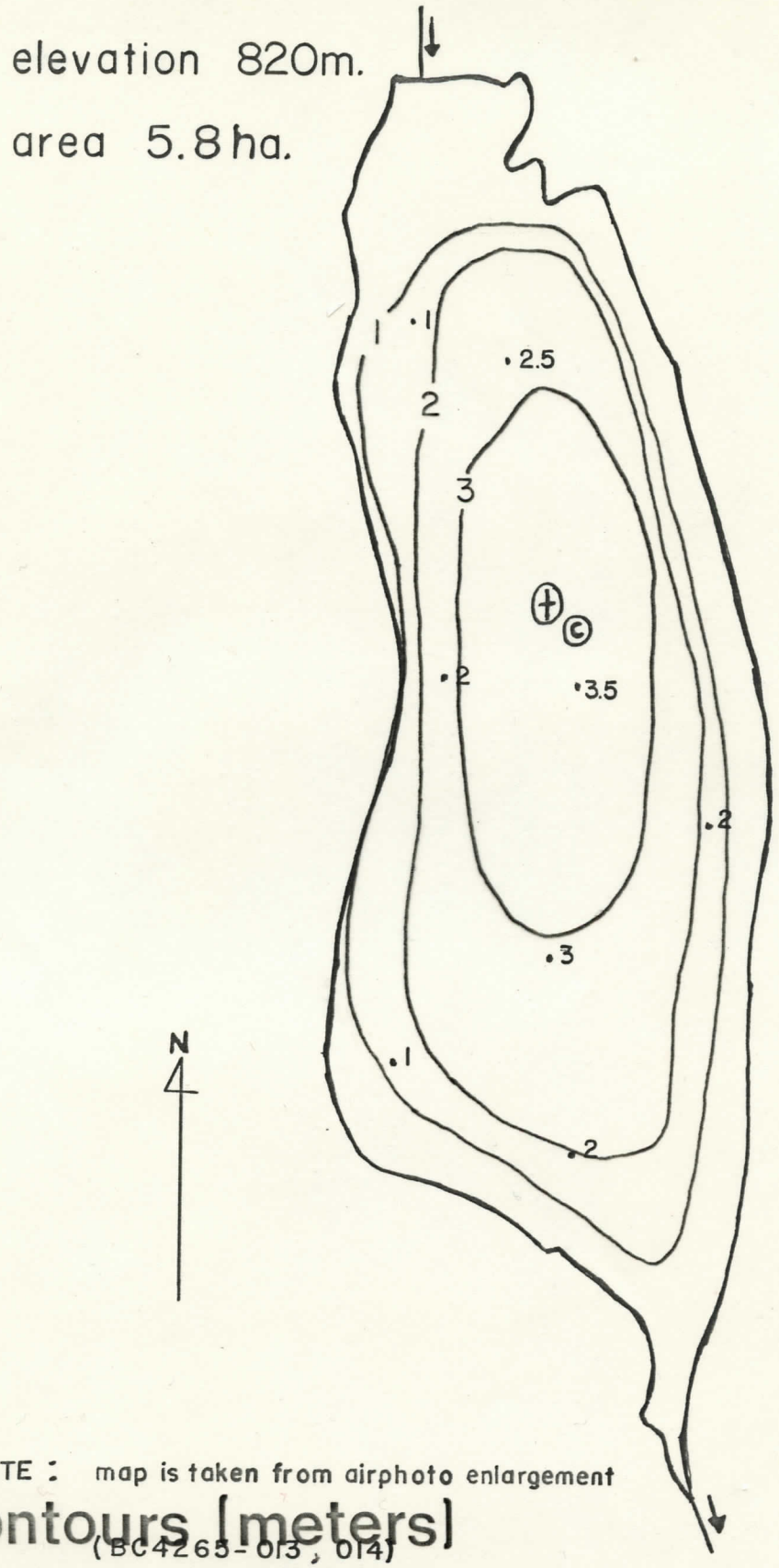
(BC4265-013, 014)

depth soundings are approximated

SCALE = 1:2600

FIG. IA

COTTONWOOD LAKE



legend

inflow/outflow streams

depth soundings

temperature record

chemical record

NOTE : map is taken from airphoto enlargement

contours [meters]

(BC4265-013, 014)

depth soundings are approximated

SCALE = 1: 2600

III. GENERAL DESCRIPTION:

Cottonwood Lake exists in a post-glacial V-shaped valley at an elevation of 2700 feet (820 meters). The lake was probably formed when an ancient landslide of talus blocked Cottonwood Creek. Numerous burned trees on either side of the lake, as well as a 5 cm. layer of ash under a 5 cm. layer of humus testified to a forest fire in the area approximately 60 years ago. Granodiorite is the primary rock type in the area (being derived from the Nelson Bathoeith). Joints in this igneous rock-type, due to pressure release and freeze/thaw action, explains the presence of talus slopes.

The lake is a medium-sized, shallow lake that is fed on the north end and drained on the south end by Cottonwood Creek (Cottonwood Creek runs into Renata Creek approximately 700 meters downstream). The lake was at high level. Low water level appeared to be approximately 35 cm. below the high water mark.

The lake shoreline did not have good access as it was densely overgrown with trees and shrubs. The north end was a swamp. There were many dead trees in the lake, especially the south end. As access was so difficult it was impossible to set up plane table stations, and a survey could not be done.

The only reasonably flat place that was suitable for camping was on the south end of the lake on the west side of Cottonwood Creek. There was an abundant supply of firewood available. A crude campsite was previously set up in this spot and may be used.

III. GENERAL DESCRIPTION: (cont'd)

The inflow stream and lake were well stocked with rainbow trout. The fish observed were up to 30 cm. in length. Some fry could be seen in the lake which indicated that there was successful spawning. One rainbow, measuring 26 cm. in length and weighing 170 grams was caught in the lake.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

Cottonwood Lake contained some submergent water plants (e.g. Potamogeton sp.) while algal growth appeared minimal.

Sites

Cottonwood Lake is located in the Interior Western Hemlock Biogeoclimatic Zone. The vegetation sites were chosen on the basis of moisture regime and differing vegetation. The site areas are illustrated in Figure 1C.

Site 1

Located at the south end of the lake, this area was slightly rolling but relatively flat with no measurable slope. The soil was approximately 10 cm. deep, with the profile as seen in Figure 1B. This was underlain by rock (granodiorite). The site was situated on an old rock slide, which dams the lake.

Exposure: North northeast

Moisture Regime: Slightly damp

Vegetation Classification: Western Hemlock-False Box-Moss Association for the IWH Biogeoclimatic Zone - wet subzone

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1 (cont'd)

Vegetation

Trees:

Larix occidentalis (Western Larch)

Thuja plicata (Western Red Cedar)

Tsuga heterophylla (Western Hemlock)

Taxus brevifolia (Western Yew) - rare

Pseudotsuga menziesii (Douglas Fir)

Alnus tenuifolia (Mountain Alder)

Acer glabrum var. douglasii (Douglas Maple)

Shrubs:

Pachistima myrsinites (False Box)

Rubus parviflorus (Thimbleberry)

Berberis repens (Creeping Mahonia) - rare

Vaccinium membranaceum (Black Mountain Huckleberry)

Amelanchier sp. (Saskatoon Berry)

Fragaria glauca (Blueleaf Strawberry)

Gaultheria hispidula (Snowberry)

Flowers:

Arnica cordifolia (Heart-leaf Arnica)

Castilleja sp. (Indian Paintbrush)

Rosa gymnocarpa (Dwarf Rose)

Clintonia uniflora (Queen's Cup)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1 (cont'd)

Vegetation

Lichens:

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

Mosses:

Polytrichum juniperinum

Site 2

This site was located on the east bank of the lake and was situated on a stabilized talus slope that was underlain by several meters of glacial till (as seen in the logging road cut). The slope varied from 38° to 32°, sited from the logging road down to the lake.

Exposure: West

Moisture Regime: Slightly damp to slightly dry

Vegetation Classification: Pachistima - Moss Association/dry transition of the IWHb Biogeoclimatic Zone*

Vegetation

Trees:

Pseudotsuga menziesii (Douglas Fir)

Acer glabrum var. douglasii (Douglas Maple)

Populus trichocarpa (Northern Black Cottonwood)

Alnus tenuifolia (Mountain Alder)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2 (cont'd)

Vegetation

Shrubs:

Rubus parviflorus (Thimbleberry)

Berberis repens (Creeping Mahonia)

Pachistima myrsinites (False Box)

Fragaria glauca (Blueleaf Strawberry)

Flowers:

Castilleja sp. (Indian Paintbrush - 2 sp.)

Epilobium angustifolium (Fireweed)

Penstemon fruticosis var. scouleri (Beard Tongue)

Moss: Polytrichum juniperinum

Site 3

This site was located at the north northwest end of the lake and covered two types of terrain:

1) active to stabilizing talus; and

2) swamp.

The talus slopes were beginning to be covered with lichen - the first sign of slope stabilization. The rock type here was primarily granodiorite.

Slope: 32°

Exposure: Southeast

Moisture Regime: Dry

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3 (cont'd)

The swamp occurred at the mouth of the inflow stream and had a cover of at least 50 cm. of humus. The ground here was flat with no measurable slope. The soil was completely waterlogged at a depth of 20 cm. The top 20 cm. was damp.

Exposure: Southeast

Moisture Regime: Wet

Vegetation Classification: Alluvial Normal Moss Association of the IWHa Biogeoclimatic Zone*

Vegetation

Trees:

Acer glabrum var. douglasii (Douglas Maple)

Pseudotsuga menziesii (Douglas Fir)

Shrubs:

Ribes lacustre (Swamp Gooseberry)

Lonicera involucrata (Black Twinberry)

Lonicera ciliosa (Orange Honeysuckle)

Amelanchier sp. (Saskatoon Berry)

Sium cicutaefolium (Water-parsnip)

Fragaria glauca (Blueleaf Strawberry)

Flowers:

Rosa gymnocarpa (Dwarf Rose)

Veratrum eschocholtzii (Indian Hellebore)

Viola glabella (Yellow Violet)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3 (cont'd)

Vegetation

Fern:

Woodsia sp.

Lichens:

Cladina sp.

Xanthoria sp.

Moss:

Polytrichum juniperinum

Grasses:

Unidentified

V. PHYSICAL AND CHEMICAL DATA:

Air temperature: 18.6°C at noon, May 30th

A) Lake

Test	Result
- Temperature	Surface 13.4°C Bottom 12.5°C
- Secchi Disc	Visible on lake bottom at 3.5 m.
	- weather conditions: sunny (May 30th, noon)
	- water conditions: slight ripple
- Bottom composition	Mud
- pH	7.5

Cottonwood Lake campsite on west side of Cottonwood Creek.

View of lake from northeast.

V. PHYSICAL AND CHEMICAL DATA:

A) Lake (cont'd)

Test	Result
- Total Alkalinity	19 ppm.
- Total Dissolved Solids	48 ppm.

NOTE: Nitrate/nitrite and Ortho Phosphate/Metaphosphate were in insignificant amounts.

B) Inflow Stream

Average width	-	1.3 meters
Average depth	-	16 cm.
Velocity	-	0.32 m/second
Volume of flow	-	66 liters/second
Bottom Composition	-	coarse sand and pea gravel 1 - 3 mm. in diameter
	-	occasional small cobbles up to 8 cm. in diameter

Comments: Slow running stream meanders and in last 100 meters splits into 2 to 4 streams. There are many large, deep pools.

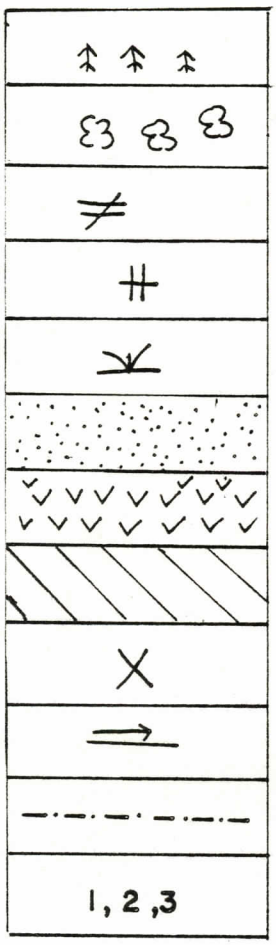
C) Outflow Stream

Average width	-	3.4 meters
Average depth	-	20 cm.
Velocity	-	0.51 m/second
Volume of Flow	-	350 liters/second
Bottom Composition	-	coarse sand and pea gravel, 1 - 3 mm. in diameter
	-	large cobbles up to 20 cm. in diameter (occasional)

* The vegetation within sites 2 and 3 could not be adequately classified within the associations given by the Forestry Handbook for British Columbia. The classification for sites 2 and 3 are developed from Utzig's Guide for Tree Species Selection in the Nelson Forest District.

FIG. IB

LEGEND



Soil Profile of SITE 1

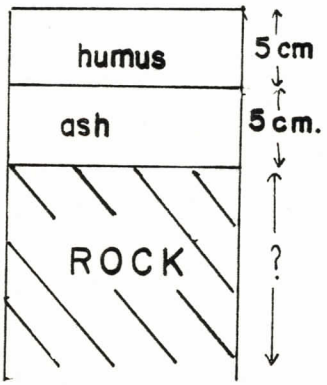
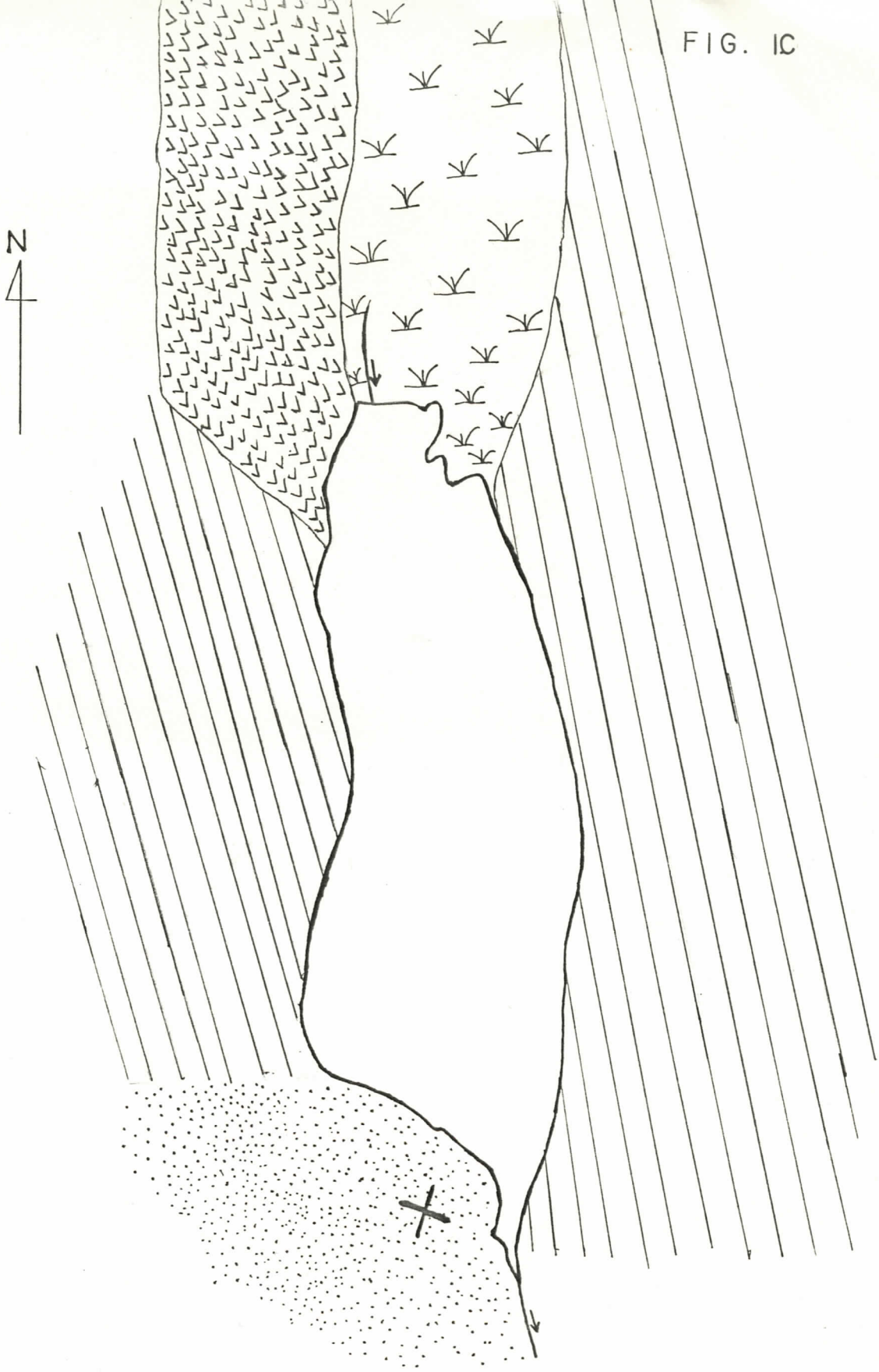


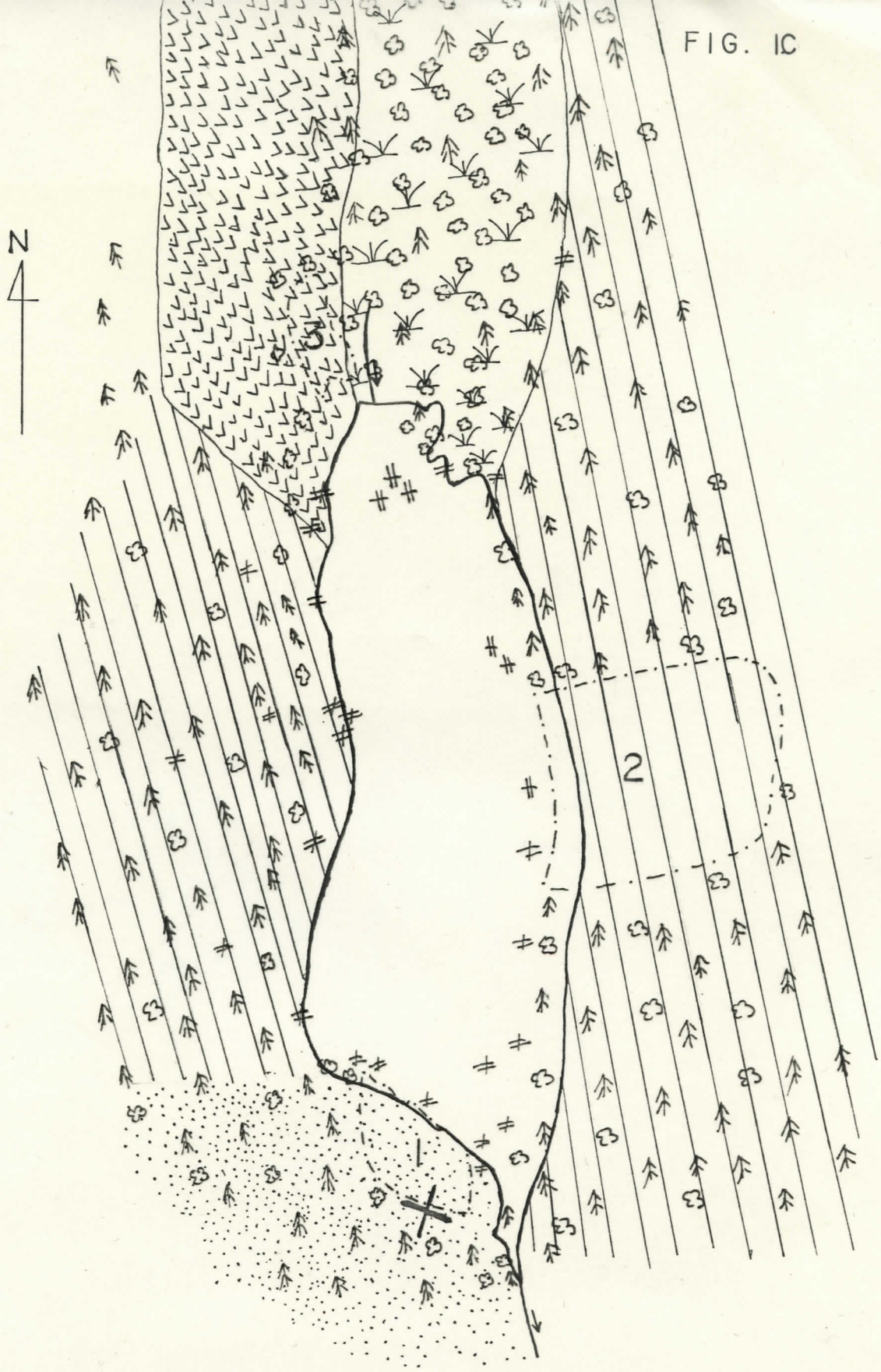
FIG. IC



COTTONWOOD LAKE - LANDFORMS

scale = 1:3500

FIG. IC



COTTONWOOD LAKE - LANDFORMS

VEGETATION

scale = 1:3500

ORIAN LAKE

DATE STUDIED: June 10th - 11th, 1980.

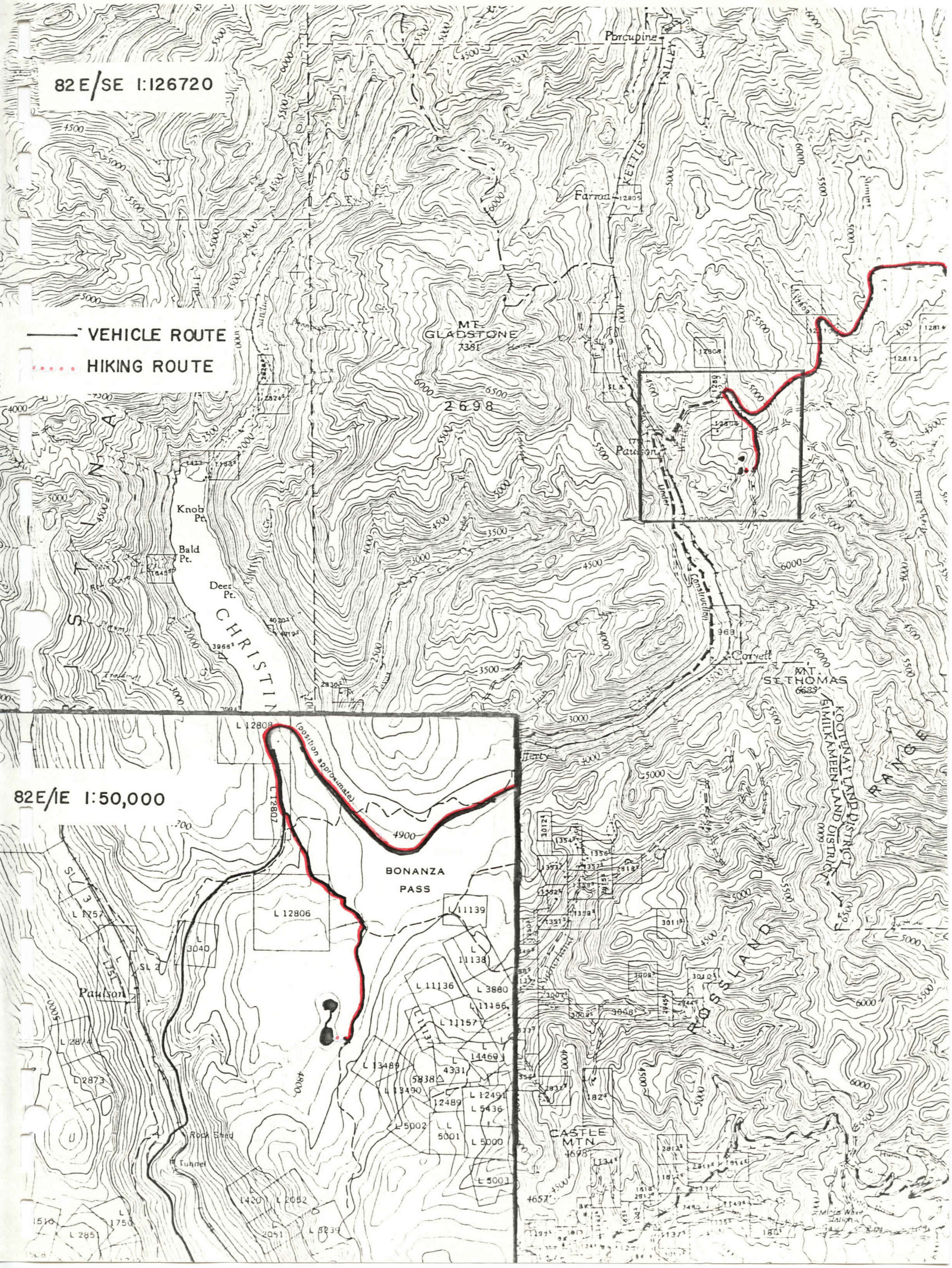
I. LOCATION:

- 49° 12' N., 118° 5' W.
- Department of Mines and Technical Surveys Map: Grand Forks, B.C. 82E/!E, 1:50,000; Grid Reference: 209502.
- Department of Lands and Forests Map: Grand Forks, B.C. 82E/SE, 1:126700
- Aerial photographs #BC 5343-004, #BC 5343-005

II. ACCESS:

By Vehicle

Drive up the Blueberry-Paulson Highway 39 km (distance from the Castlaird Plaza). Take the logging road on the left side of the highway and proceed as follows:



82 E/SE 1:126720
VEHICLE ROUTE
HIKING ROUTE
MT. GLADSTONE
7381
2698
Porcupine
KETTLE
Farron
Paulson
Coryell
MT. ST. THOMAS
KOOTENAY LAND DISTRICT
SIMILKAMEEN LAND DISTRICT
CHRISTINA
Knob Pt.
Bald Pt.
Deer Pt.
82 E/IE 1:50,000
(position approximate)
BONANZA PASS
L 12808
L 12807
L 12806
L 11139
L 11138
L 11136
L 3880
L 11156
L 11157
L 13489
L 13490
Paulson
CASTLE MTN.
Rock Shed
Tunnel

II. ACCESS:

By Vehicle (cont'd)

Distance (km)	Feature	Route
0.5	two-way fork	R
2.0	two-way fork	L
2.5	clearing beside the road with old collapsed buildings	

Hiking Route

Orian lake is approximately a 5 minute hike following an inflow stream from the clearing.

III. GENERAL DESCRIPTION:

Orian Lake is a relatively large beaver dammed lake at an elevation of 1450 meters. The entire shoreline of this lake is edged with dead trees. Dead, upright trees extend into the lake to a minimum distance of 10 meters and span the entire width of the middle of the lake. Because of these trees, air photos and maps depict this large lake as two small lakes.

Perhaps the most notable feature of Orian Lake is its numerous floating Sphagnum moss islands. These islands, ranging in length from 3 to 70 meters, are arranged in a circular pattern at both the north and south ends of the lake (see Figure 2b).

The lake is fed by 7 small inflow streams (one of which is beaver dammed) and is drained by Orian Creek which has also been dammed by beavers.

III. GENERAL DESCRIPTION: (cont'd)

The only area suitable for camping is located beside the logging road in the clearing (see "ACCESS"). The collapsed buildings provide abundant firewood.

No fish were present in the lake.

Before the dam was built across Orian Creek, the area was probably a swamp, being fed by the small inflow streams. There may have been a pond at the south end of the lake, as it is now the deepest part (see Figure2A). After the dam was built, the swamp flooded and killed all the trees in what is now the lake. At present, the dam is not as effective as it once was, thus the lake level has dropped approximately 1 meter (this can be observed by the white "high water mark" that extends all the way around the lake on the dead trees). Presently, the lake appears to have a high water mark approximately 70 cm. above measured levels.

The logging practices in the area have caused most of the inflow streams to become braided. Crushed gravel from the roads has been washed down and the inflow stream on the southeast corner of the lake has built up a small delta (see Figure 2C overlay).

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

Orian Lake contained some submergent aquatic plants (e.g. Potamogeton sp.). Nymphaea polysepalum (yellow Pond Lily) was found along the Sphagnum islands. Algal growth appeared minimal.

IV. VEGETATION AND GEOMORPHOLOGY: (cont'd)

Sites

Orian Lake is located in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. The site areas are illustrated in Figure 2C.

The shore of Orian Lake has virtually the same soil type all the way along, with only the moisture regime varying with the slope (also, in the wetter areas the humus layer is thicker). Thus the soil profile around the lake is uniform. It consists of approximately 60 cm. of humus underlain by at least 6 feet of glacial till. The presence of the till could explain the existence of the original swamp at the site that is now Orian Lake. Till is virtually impermeable and allows no seepage.

Site 1

Slope:	3°
Exposure:	West northwest
Moisture Regime:	Very damp
Vegetation Classification:	Equisetum Association of the ESSFw Biogeoclimatic Zone.*

Vegetation

Trees:

Pseudotsuga menziesii (Douglas Fir)

Tsuga heterophylla (Western Hemlock)

Thuja plicata (Western Red Cedar)

North end of lake. Note Sphagnum island beyond dead trees in foreground.

South end of lake.

IV. VEGETATION AND GEOMORPHOLOGY: (cont'd)

Sites (cont'd)

Vegetation

Shrubs:

Vaccinium myrtilloides (Canada Blueberry)

Ribes divaricatum (Wild Gooseberry)

Linnaea borealis (Twin-flower)

Vaccinium membranaceum (Black Mountain Huckleberry)

Lycopodium lucidulum (Club Moss)

Flowers:

Veratrum eschocholtzii (Indian Hellebore)

Calypso bulbosa (False Lady's Slipper) - rare

Trillium ovatum (Western Trillium)

Clintonia uniflora (Queen's Cup)

Viola glabella (Yellow Violet)

Equisetum arvense (Common Horsetail)

Thalictrum sp. (Meadow Rue)

Ferns: Woodsia sp.

Mosses:

Brachythecium sp.

Dicranum sp.

Liverworts:

Unidentified leafy liverwort

Lichens:

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

IV. VEGETATION AND GEOMORPHOLOGY: (cont'd)

Site 2

Slope: 15°

Exposure: East

Moisture Regime: Slightly damp

Vegetation Classification: Pachistima Association of the ESSFw Biogeoclimatic Zone.*

Vegetation

Trees:

Pseudotsuga menziesii (Douglas Fir)

Thuja plicata (Western Red Cedar)

Tsuga heterophylla (Western Hemlock)

Shrubs:

Pachistima myrsinites (False Box)

Vaccinium scoparium (Grouseberry)

Vaccinium caespitosum (Dwarf Huckleberry)

Mosses:

Polytrichum juniperinum

Pohlia wahlenbergii

Rhacomitrium aciculare

Lichens:

Alectoria sp. (Old Man's Beard)

Cladonia sp. (Trumpet Lichen)

IV. VEGETATION AND GEOMORPHOLOGY: (cont'd)

Site 3

Slope: 10°

Exposure: East southeast

Moisture Regime: Damp

Vegetation Classification: Pachistima Association of the ESSFw Biogeoclimatic Zone.*

Vegetation

Trees:

Pseudotsuga menziesii (Douglas Fir)

Thuja plicata (Western Red Cedar)

Tsuga heterophylla (Western Hemlock)

Shrubs:

Pachistima myrsinites (False Box)

Lonicera utahensis (Red Twinberry)

Linnaea borealis (Twin-flower)

Ribes divaricatum (Wild Gooseberry)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Flowers:

Clintonia uniflora (Queen's Cup)

Trollius laxus (Globe Flower)

Mosses:

Pohlia wahlenbergii

Lichens:

Alectoria sp. (Old Man's Beard)

Candelaria sp.

IV. VEGETATION AND GEOMORPHOLOGY: (cont'd)

Site 4

Sphagnum island vegetation

Slope: 0°

Moisture Regime: Permanently wet

Vegetation Classification: Sphagnum Association of the ESSFw Biogeoclimatic Zone.*

Vegetation

Trees:

Picea glauca ssp. engelmannii (Engelmann Spruce)

Flowers:

Viola palustris (Blue Swamp Violet)

Potentilla palustris (Marsh Cinquefoil)

Kalmia polifolia (Swamp Laurel)

Mosses:

Sphagnum sp.

Lichens:

Alectoria sp. (Old Man's Beard)

Sedges: Unidentified

NOTE: The following vegetation was also found in abundance approximately 100 meters from the lake:

Trees: Picea glauca ssp. engelmanii (Engelmann Spruce)

Picea glauca ssp. glauca (White Spruce)

Shrubs: Oplopanax horridus (Devil's Club)

* The association classifications for the sites were developed from Utzig's Guide For Tree Species Selection in the Nelson Forest District under the biogeoclimatic zone Engelmann spruce - subalpine Fir Zone (ESSFw).

FIG. 2A

ORIAN LAKE

ELEVATION 1450 m.

AREA 11.9 ha.

legend

inflow/outflow streams →

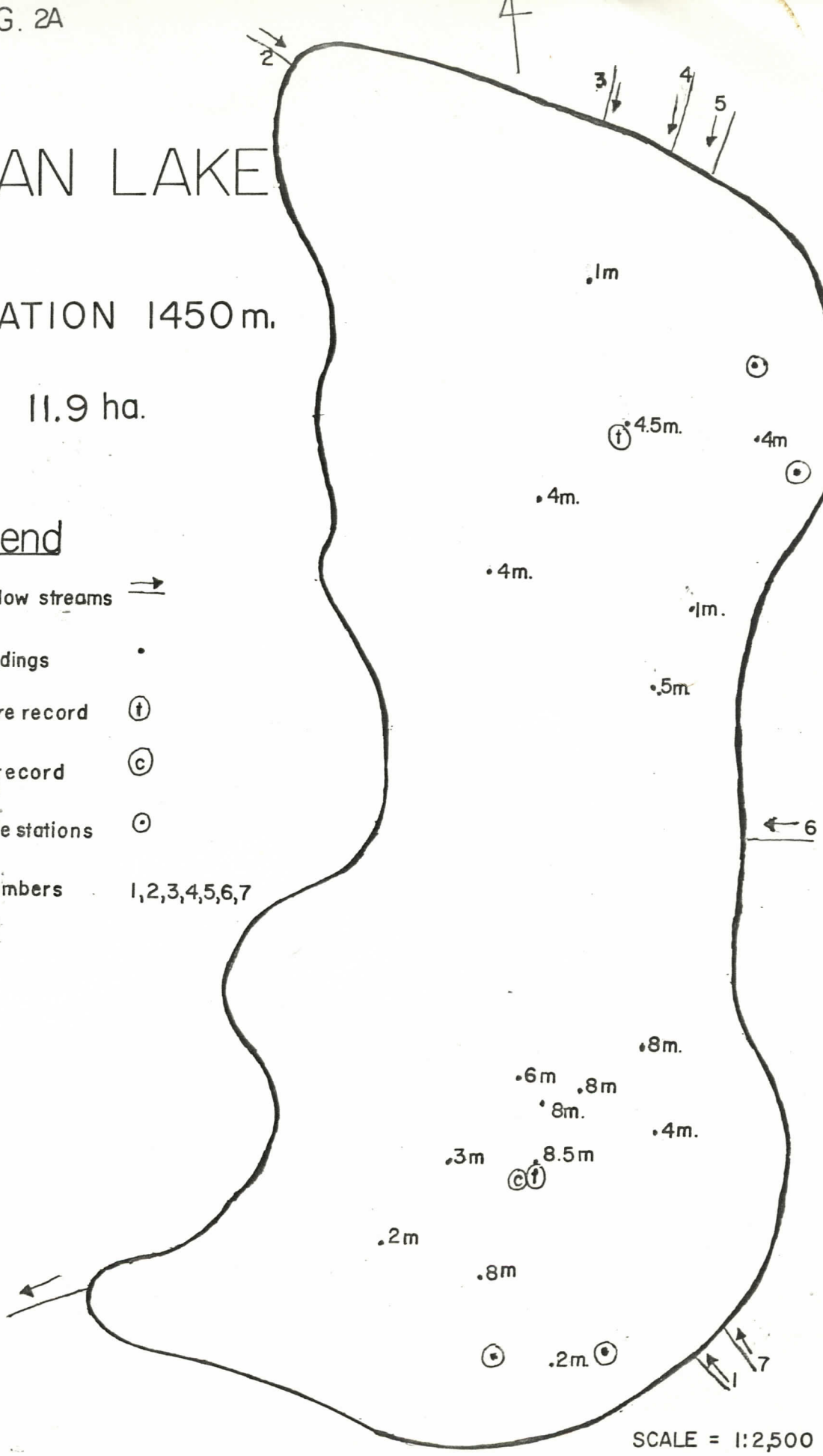
depth soundings •

temperature record (t)

chemical record (c)

plane table stations ⊙

stream numbers 1,2,3,4,5,6,7



SCALE = 1:2,500

PLANE TABLE SURVEY

FIG. 2A

ORIAN LAKE

ELEVATION 1450 m.

AREA 11.9 ha.

legend

inflow/outflow streams →

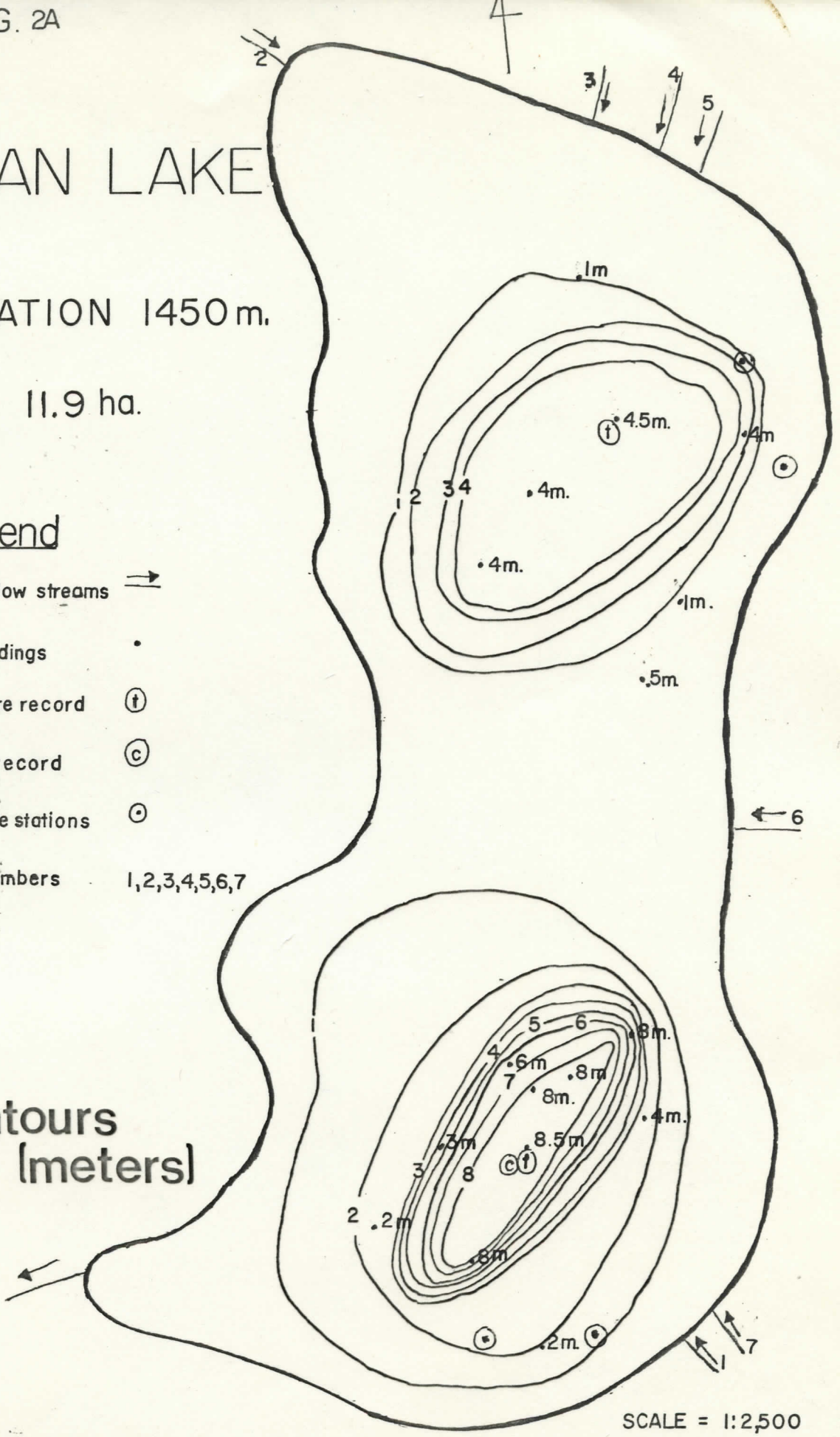
depth soundings •

temperature record (t)

chemical record (c)

plane table stations ⊙

stream numbers 1,2,3,4,5,6,7



contours (meters)

SCALE = 1:2,500

PLANE TABLE SURVEY

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test		Result
Temperature	i)	South end
		surface - 14.1°C
		bottom - 11.2°C
	ii)	North end
		surface - 14.7°C
		bottom - 12.6°C
Secchi Disc	-	Limit of visibility
	i)	South end - 3.7 m
		- weather conditions: sunny (June 10, noon)
		- water conditions: calm
	ii)	North end - 2.9 m
		- weather conditions: sunny (June 11, noon)
		- water conditions: slight ripple
Bottom Composition	-	Muck/Humus
pH	-	7.1
Total Alkalinity	-	17 ppm
Total Dissolved Solids	-	39 ppm

V. PHYSICAL AND CHEMICAL DATA: (cont'd)

B) Inflow Streams (Figure 1)

i) Inflow #1

Average width	-	85 cm
Average depth	-	2 cm
Velocity	-	0.40 meters/second
Volume of Flow	-	7 liters/second
Temperature	-	7.6°C
Bottom Composition	-	Particles ranging from sand up to small faceted cobbles 8 cm in length
	-	clean gravel

ii) Inflow #2

Average width	-	1.0 m
Average depth	-	6.4 cm
Velocity	-	0.19 meters/second
Volume of Flow	-	12 liters/second
Temperature	-	9.8°C
Bottom Composition	-	Humus with occasional large cobbles up to 20 cm in length

Comments: Beaver dammed, occasional pooling.

iii) Inflow #3

Average width	-	75 cm
Average depth	-	11.8 cm
Velocity	-	0.20 meters/second
Volume of Flow	-	18 liters/second
Temperature	-	9.8°C
Bottom Composition	-	Humus and particles ranging in size from sand up to small cobbles 10 cm in length

V. PHYSICAL AND CHEMICAL DATA:

B) Inflow Streams (cont'd)

iv) Inflow #4

This inflow appeared to originate from the same stream as Inflow #3. It had similar dimensions to Inflow #3, thus they were not measured.

v) Inflow #5

Average width	-	61 cm
Average depth	-	7 cm
Velocity	-	0.29 m/second
Volume of Flow	-	12 liters/second
Temperature	-	5°C
Bottom Composition	-	Humus and particles of sand ranging from sand up to small cobbles 10 cm. in length.

vi) Inflow #6

Average width	-	1 meter
Average depth	-	9 cm
Velocity	-	0.25 meters/second
Volume of Flow	-	22 liters/second
Temperature	-	5°C
Bottom Composition	-	Particles ranging in size from sand to occasional coarse gravel 2 cm. in length
	-	clean gravel
	-	occasional pooling
Comments:	-	This stream is the only one that appeared suitable for spawning, but was blocked by too many logs.

V. PHYSICAL AND CHEMICAL DATA:

B) Inflow Streams (cont'd)

vii) Inflow #7

This stream originated from the same source as inflow #1 and its dimensions were smaller, thus measurements were not taken.

None of the above streams studied are suitable for spawning. They all have unsuitable bottom composition, with the exception of streams # 1, 6 and 7. Streams number 1 and 7 are much to shallow for spawning and stream number 6 is blocked by logs.

C) Outflow Stream

Average width	-	2.8 meters
Average depth	-	15.3 cm
Velocity	-	0.71 meters/second
Volume	-	304 liters/second
Temperature	-	14.2°C
Bottom Composition	-	Particles ranging in size from pea gravel to small boulders 50 cm. in length
Comments:	-	Beaver damned.
	-	Many small pools

FIGURE 2B

LEGEND

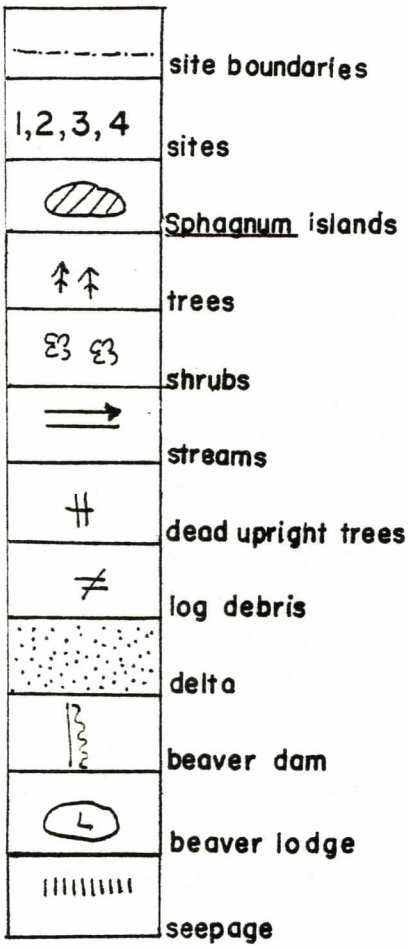
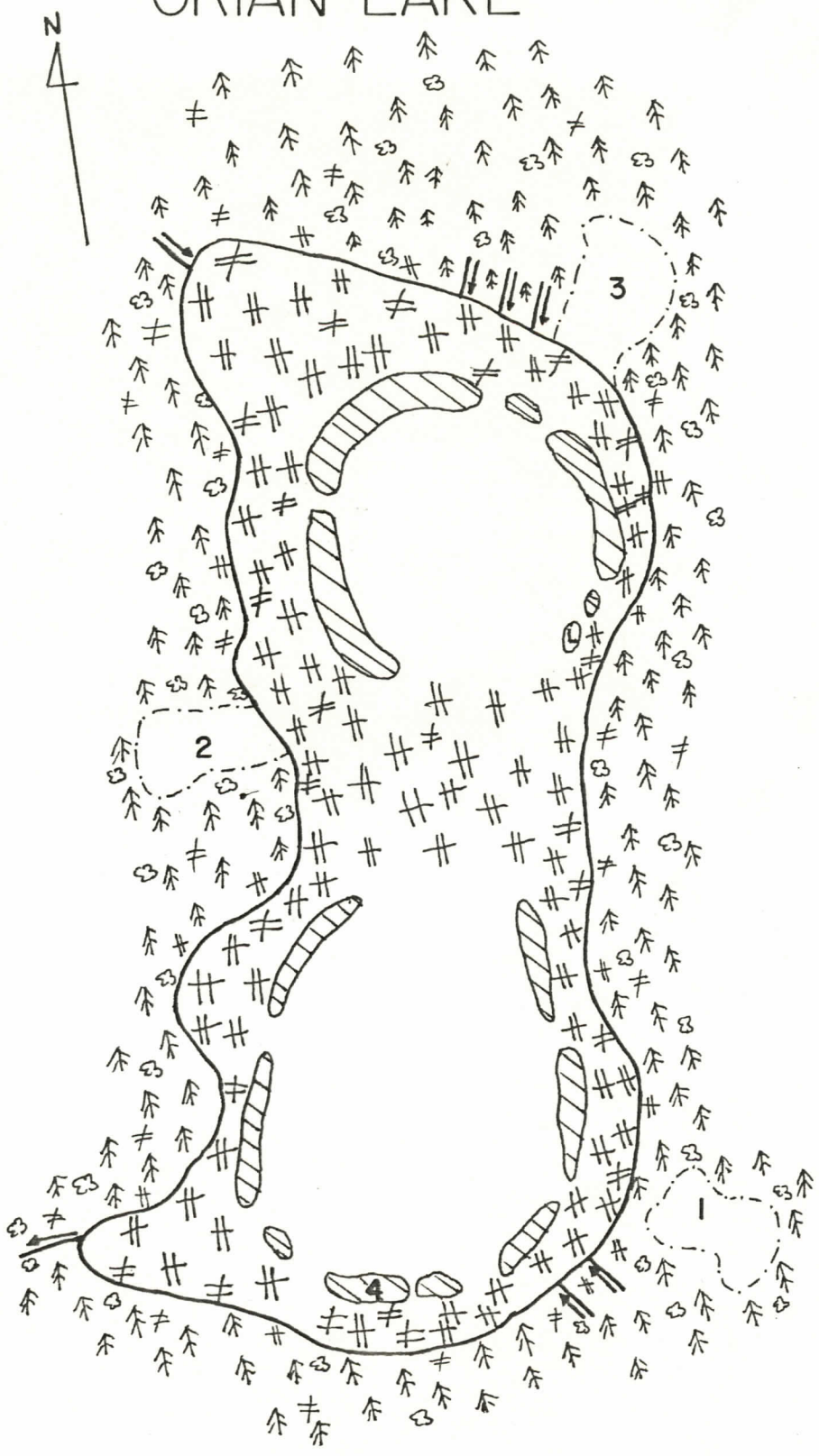


FIGURE 2C

ORIAN LAKE

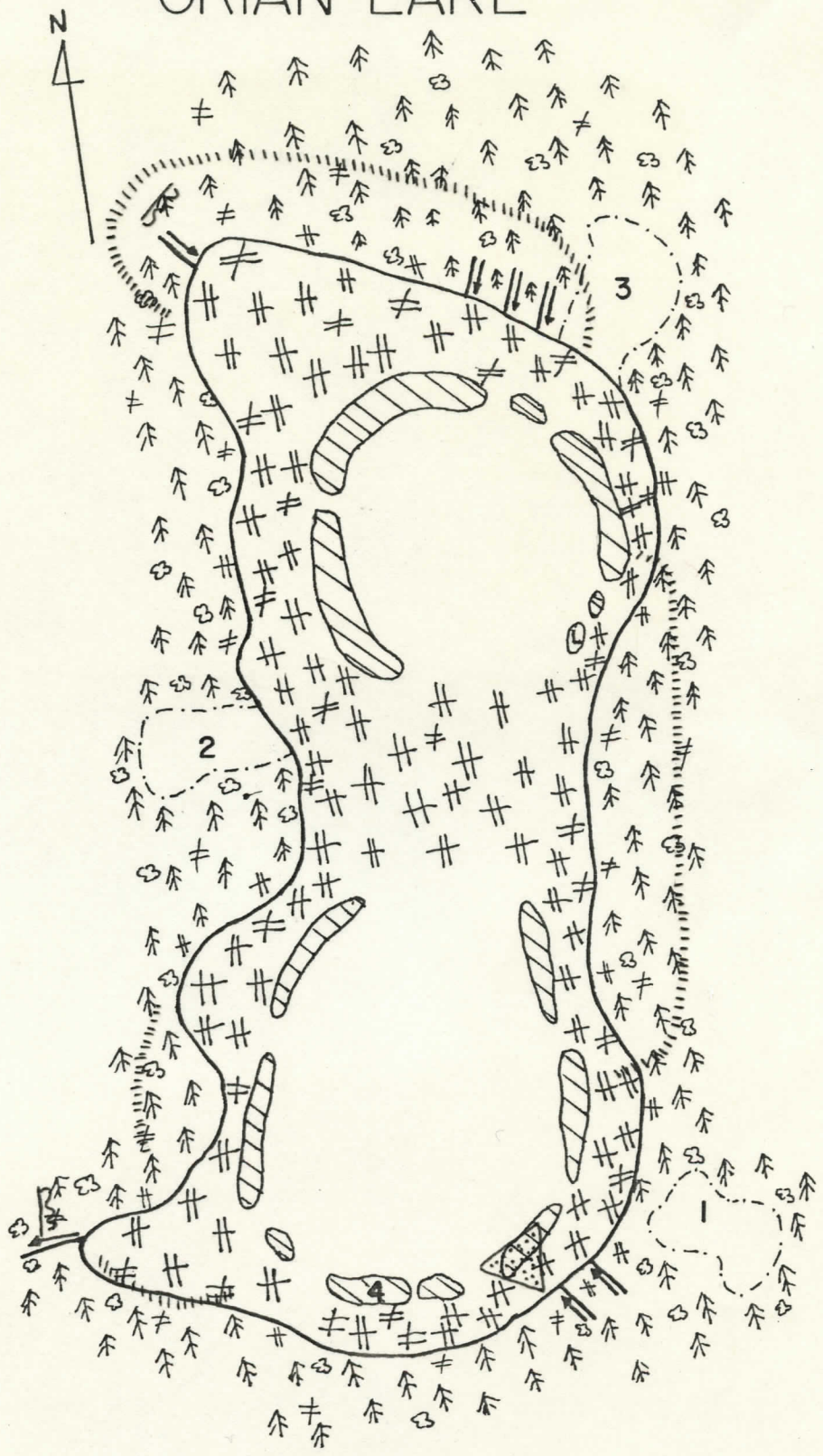


VEGETATION

scale = 1:3850

FIGURE 2C

ORIAN LAKE



VEGETATION

LANDFORMS

scale = 1:3850

ROCKSLIDE LAKE

DATED STUDIED: June 20th, 1980.

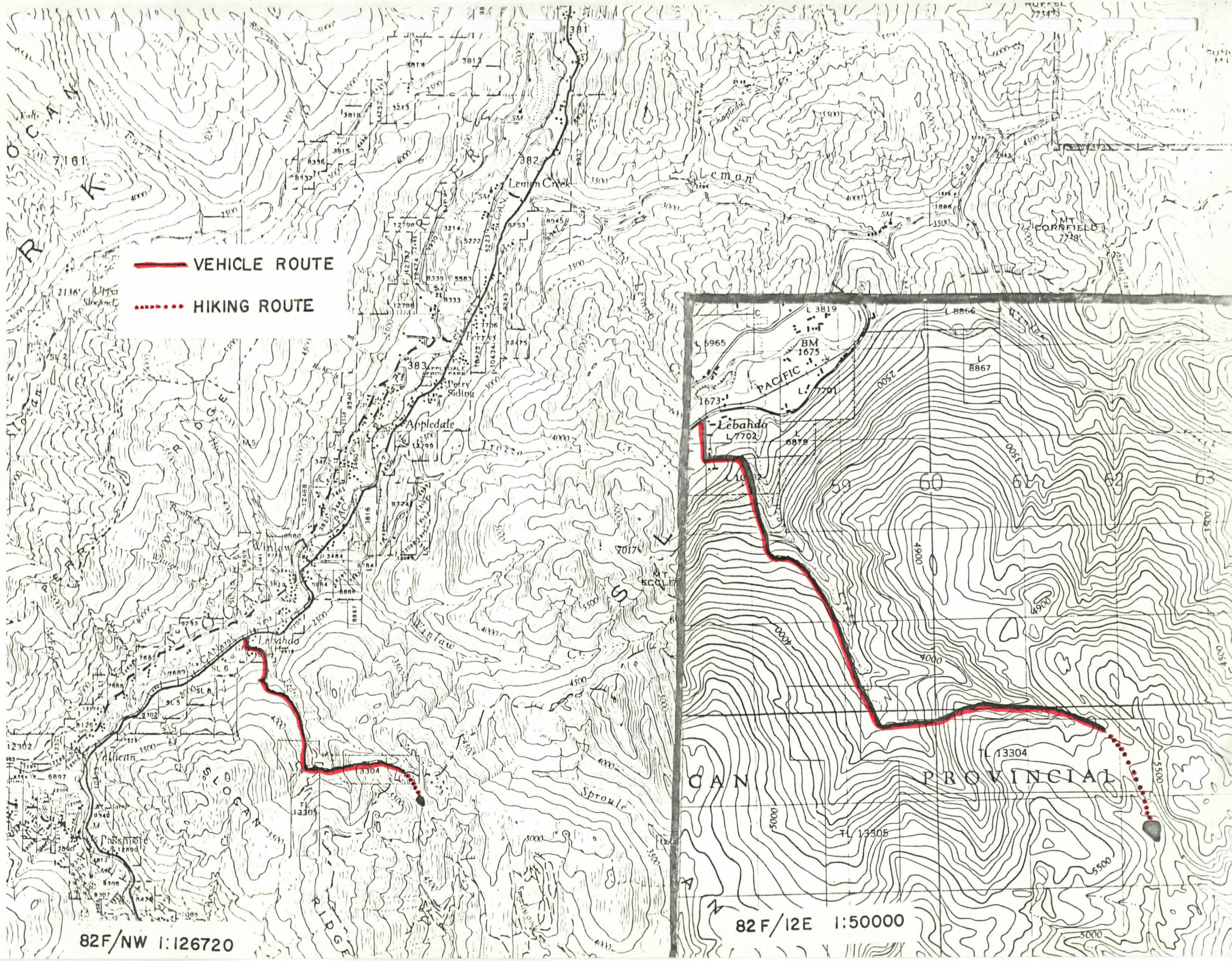
I. LOCATION:

- 49° 33'N. 117° 31'W.
- Department of Mines and Technical Surveys Map: Passmore, B.C. 82F/12E, 1:50,000; Grid Reference: 623888.
- Department of Lands, Forests and Water Resources Map: Slocan, B.C. 82F/NW, 1:126720.
- Aerial photographs: #BC 5352-173, #BC 5352-174.

II. ACCESS:

By Vehicle

Lake Highway #3A from Castlegar to the Playmor Junction. From there, drive 23.5 kilometers to Pedro Creek Junction make a right turn on a paved road, and then proceed as follows:


VEHICLE ROUTE
HIKING ROUTE
82F/NW 1:126720
82 F/12E 1:50000
Lemon Creek
Perry Siding
Appledale
Winlaw
Lebahdo
Passmore
Vallican
MT. CORNFIELD
Wintaw
Sproule
PACIFIC
PROVINCIAL

II. ACCESS:

By Vehicle (cont'd)

DISTANCE (km.)	FEATURE	ROUTE
0.3	sign: **Pedro** Creek Logging road use at own risk	L
6.8	fork in road	L
11.0	fork in road	R
11.3	start of path	L

Hiking Route

A well used path leads to the lake (following the inflow stream approximately half the way). The hike takes approximately 15 minutes.

III. GENERAL DESCRIPTION:

Rockslide Lake is a small relatively deep lake located at an elevation of 1550 meters. There were numerous trails to follow around the southerly exposed lake. The most notable feature of the lake was an active talus slope backed by a steep, mass-wasting escarpment on the east side.

The lake is fed by one small inflow stream and drained by Rockslide Creek. Only the inflow appears suitable for spawning. Eastern brook trout up to 25 centimeters in length were observed in the lake. One measuring 22 centimeters in length and weighing 80 grams was caught.

III. GENERAL DESCRIPTION: (cont'd)

There were no suitable camping areas in the immediate vicinity of the lake shore because the terrain was either too rocky or too damp. There were a few adequate campsites further inland on the west side of the lake. Firewood was in abundant supply. In addition,there were a few small rafts along the shore of the lake.

Due to spring thaw, the lake was at high water level during this study. Low water mark appeared to be approximately 30 centimeters from the measured level.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

Rockslide Lake contained some algal growth near the shoreline.

Sites

Rockslide Lake is located in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. The site areas are illustrated in the Figure 3C overlay.

The lake exists in a glacially carved U-shaped valley and is blocked by a small lateral moraine which is approximately 2 meters in height (see cross-profile in Figure 3B). The primary rock type of this area is granodiorite. The south and northwest ends of the lake surrounding the inflow and outflow streams were swampy. In general, the moisture regime was very damp, but this was due to spring thaw and the area probably dries out later in the summer.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

This site consists of two different moisture regimes: one dry and one damp. The dry area was the bottom of an active talus slope, thus the vegetation growth was sparse. The damp area, beside the talus slope, ranged from very damp at the edge of the lake to slightly damp a few meters higher.

Slope: 12° - 37°

Exposure: South and West

Moisture Regime: Moderately damp to very dry

Vegetation Classification: Pachistima Association for the ESSFw Biogeoclimatic Zone.*

Vegetation

Trees:

Picea glauca ssp. glauca (White Spruce)

Pseudotsuga menziesii (Douglas Fir)

Abies lasiocarpa (Alpine Fir)

Picea mariana (Black Spruce)

Shrubs:

Sorbus sitchensis (Sitka Mountain Ash)

Pachistima myrsinites (False Box)

Rubus idaeus (Red Raspberry)

Vaccinium membranaceum (Black Mountain Huckleberry)

Corylus sp. (Hazelnut)

Rhododendron albiflorum (White Rhododendron)

Lycopodium sp. (Club Moss)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

Vegetation (cont'd)

Flowers:

Saxifraga lyallii (Lyall's saxifrage)

Tiarella unifoliata (Foam Flower)

Daucus carota (Wild Carrot)

Viola palustris (Blue Swamp Violet)

Clintonia uniflora (Queen's Cup)

Veratrum eschocholtzii (Indian Hellebore)

Streptopus amplexifolius (Twisted Stalk)

Mosses:

Aulacomnium palustre

Lichens:

Alectoria sp. (Old Man's Beard)

Lecanora sp.

Grasses: Unidentified

Site 2

This area formed the foot of an inactive talus slope. Also, this site was situated at lake level, therefore seepage was present.

Slope: 0°

Exposure: Northwest

Moisture Regime: Wet

Vegetation Classification: Equisetum-Senecio Association for the ESSFw Biogeoclimatic Zone.*

View of the lake's namesake.

The only lake visited containing Eastern Brook trout.

IV. VEGETATION AND GEOMORPHOLOGY:

Vegetation

Trees:

Pseudotsuga menziesii (Douglas Fir)

Picea glauca ssp. glauca (White Spruce)

Abies grandis (Grand Fir)

Shrubs:

Corylus sp. (Hazelnut)

Vaccinium membranaceum (Black Mountain Huckleberry)

Equisetum arvense (Common Horsetail)

Rhododendron albiflorum (White Rhododendron)

Flowers:

Streptopus amplexifolius (Twisted Stalk)

Veratrum eschocholtzii (Indian Hellebore)

Daucus carota (Wild Carrot)

Actaea rubra (Baneberry)

Leptarrhena amplexifolia (Leptarrhena)

Trollius laxus (Globe Flower)

Moneses uniflora (Single Delight)

Viola glabella (Yellow Violet)

Senecio triangularis (Giant Ragwort)

Epilobium angustifolium (Fireweed)

Thalictrum sp. (Meadow Rue)

Epilobium luteum (Yellow Willow Herb)

IV. VEGETATION AND GEOMORPHOLOGY:

Vegetation (cont'd)

Ferns:

Woodsia sp.

Mosses:

Aulacomnium palustre

Calliergon giganteum

Lichens:

Alectoria sp. (Old Man's Beard)

Grasses: Unidentified

Site 3

Slope: 18°

Exposure: Southeast

Moisture Regime: Damp

Vegetation Classification: Equisetum Association for the ESSFw Biogeoclimatic Zone.*

Vegetation

Trees:

Pseudotsuga menziesii (Douglas Fir)

Tsuga heterophylla (Western Hemlock)

Shrubs:

Rhododendron albiflorum (White Rhododendron)

Vaccinium membranaceum (Black Mountain Huckleberry)

Sorbus sitchensis (Sitka Mountain Ash)

Equisetum arvense (Common Horsetail)

IV. VEGETATION AND GEOMORPHOLOGY:

Vegetation

Flowers:

Viola glabella (Yellow Violet)

Trollius laxus (Globe Flower)

Veratrum eschocholtzii (Indian Hellebore)

Streptopus amplexifolius (Twisted Stalk)

Clintonia uniflora (Queen's Cup)

Actaea rubra (Baneberry)

Ferns:

Woodsia sp.

Pteridium aquilinum pubescens (Bracken Fern)

Mosses:

Polytrichum juniperinum

Sphagnum sp.

Lichens:

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

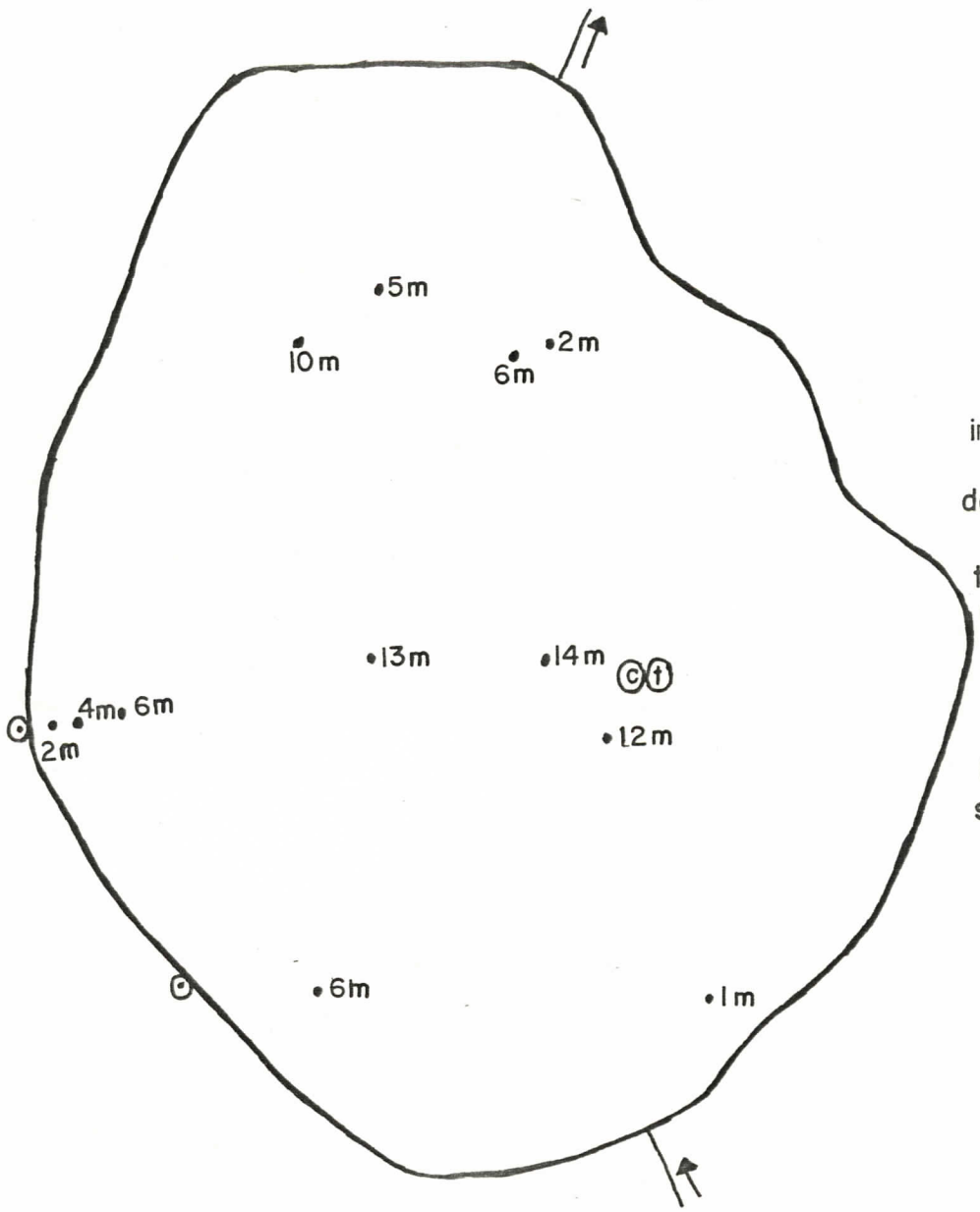
* The association classifications for the sites were developed from Utzig's Guide for Tree Species Selection in the Nelson Forest District under the biogeoclimatic zone Engelmann Spruce-Subalpine Fir Zone (ESSFw).

FIG. 3A

ROCKSLIDE LAKE

AREA 2.1 ha.

ELEVATION 1550 m.



PLANE TABLE SURVEY

scale = 1:1250

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test	Result
Temperature	Top - 13.0°C
	Bottom - 12.0°C
Secchi Disc	- Limit of Visibility
	- June 20th, noon
	- weather conditions: high overcast
	- water conditions: ripples
	8.0 meters
Bottom Composition	- Rocks, sand and mud
pH	- 7.2
Total Alkalinity	- 17 ppm
Total Dissolved Solids	- 24 ppm

B) Inflow Stream

Average width	- 1.0 meters
Average depth	- 5 cm
Velocity	- 0.29 meters/second
Volume of Flow	- 14 liters/second
Temperature	- 7.8°C
Bottom Composition	- Particles ranging in size from coarse sand to small cobbles 10 cm in length
Comments:	- Pooling
	- Stream is much bigger at mouth
	- Suitable for spawning

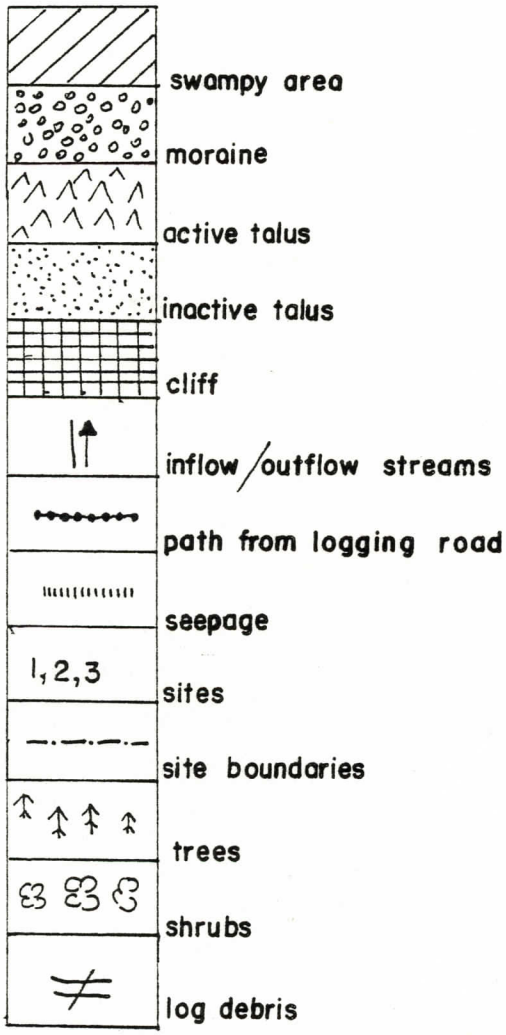
V. PHYSICAL AND CHEMICAL DATA:

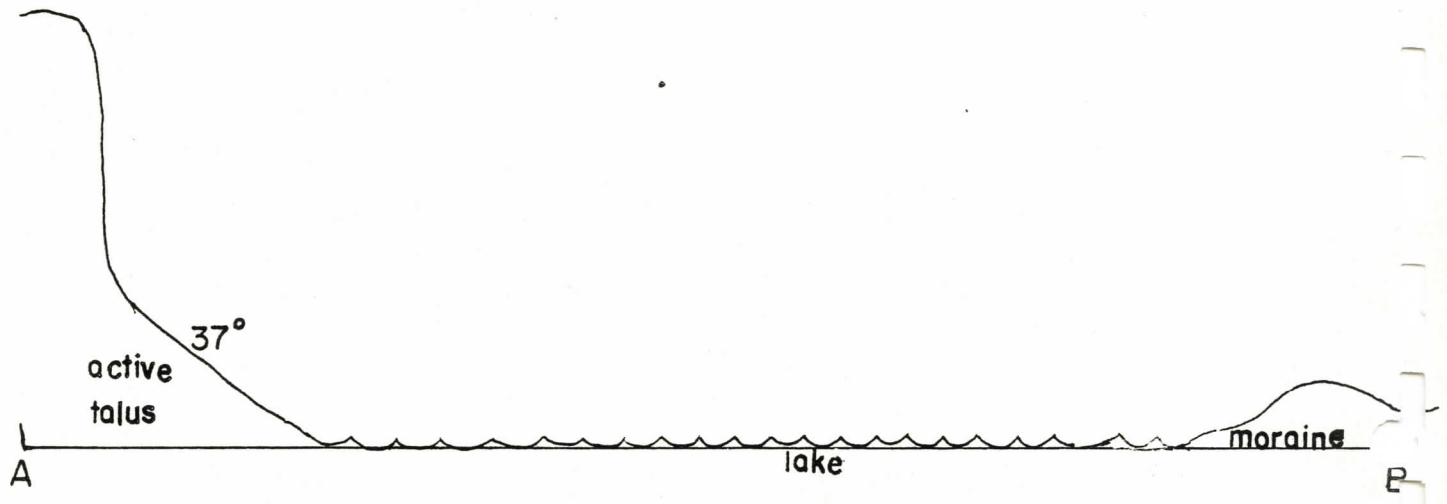
C) Outflow Stream

Average width	-	1.3 meters
Average depth	-	31 cm.
Velocity	-	0.27 meters/second
Volume of Flow	-	109 liters/second
Temperature	-	14.2°C
Bottom Composition	-	Dead branches, twigs, bark and grass
Comments:	-	Position of data record: 10 meters from shore
	-	Stream meandered and was braided

LEGEND

FIG. 3B





CROSS-PROFILE OF FIG. 2b. not to scale

FIG. 3C

ROCKSLIDE LAKE

LANDFORMS

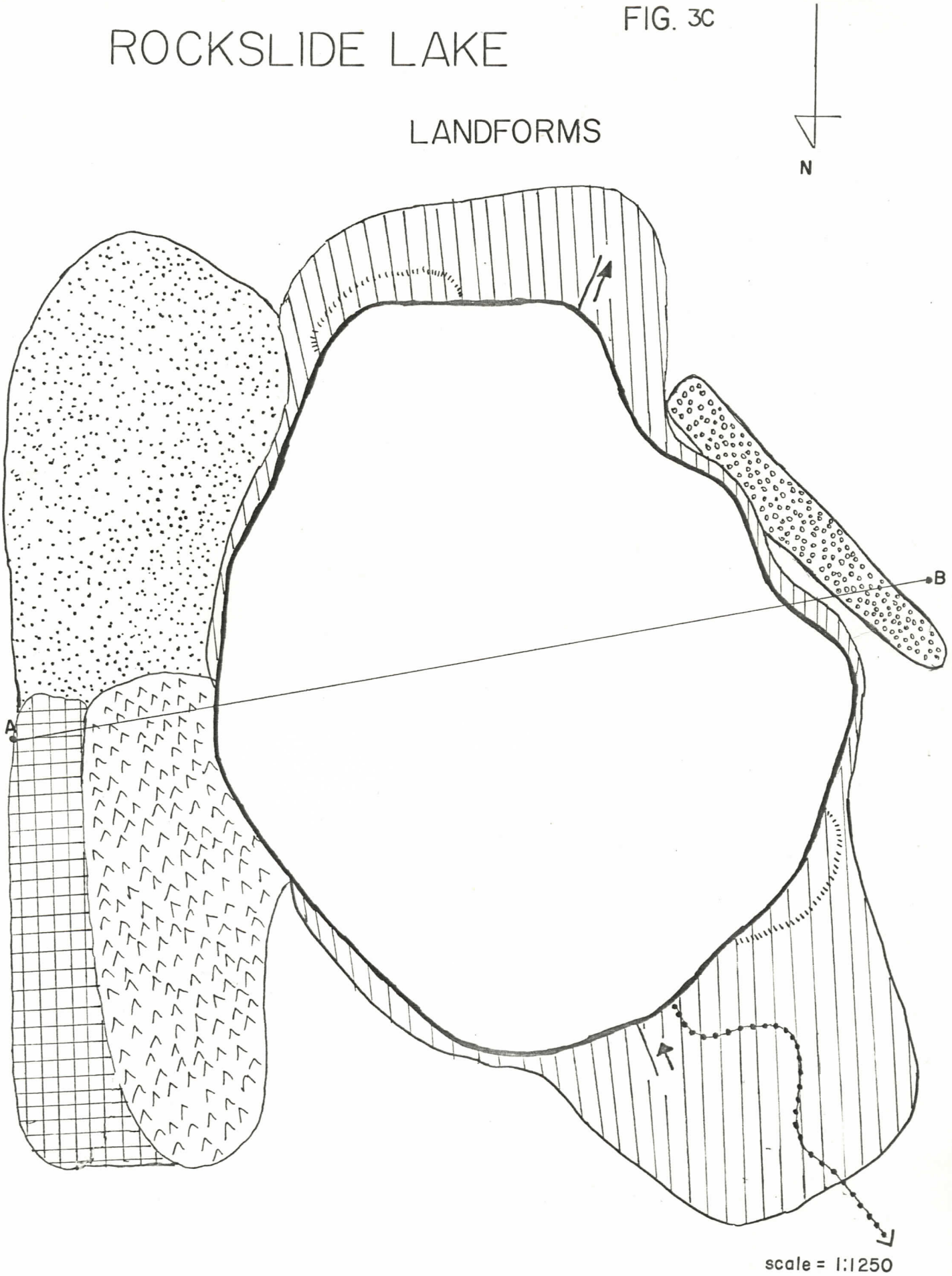
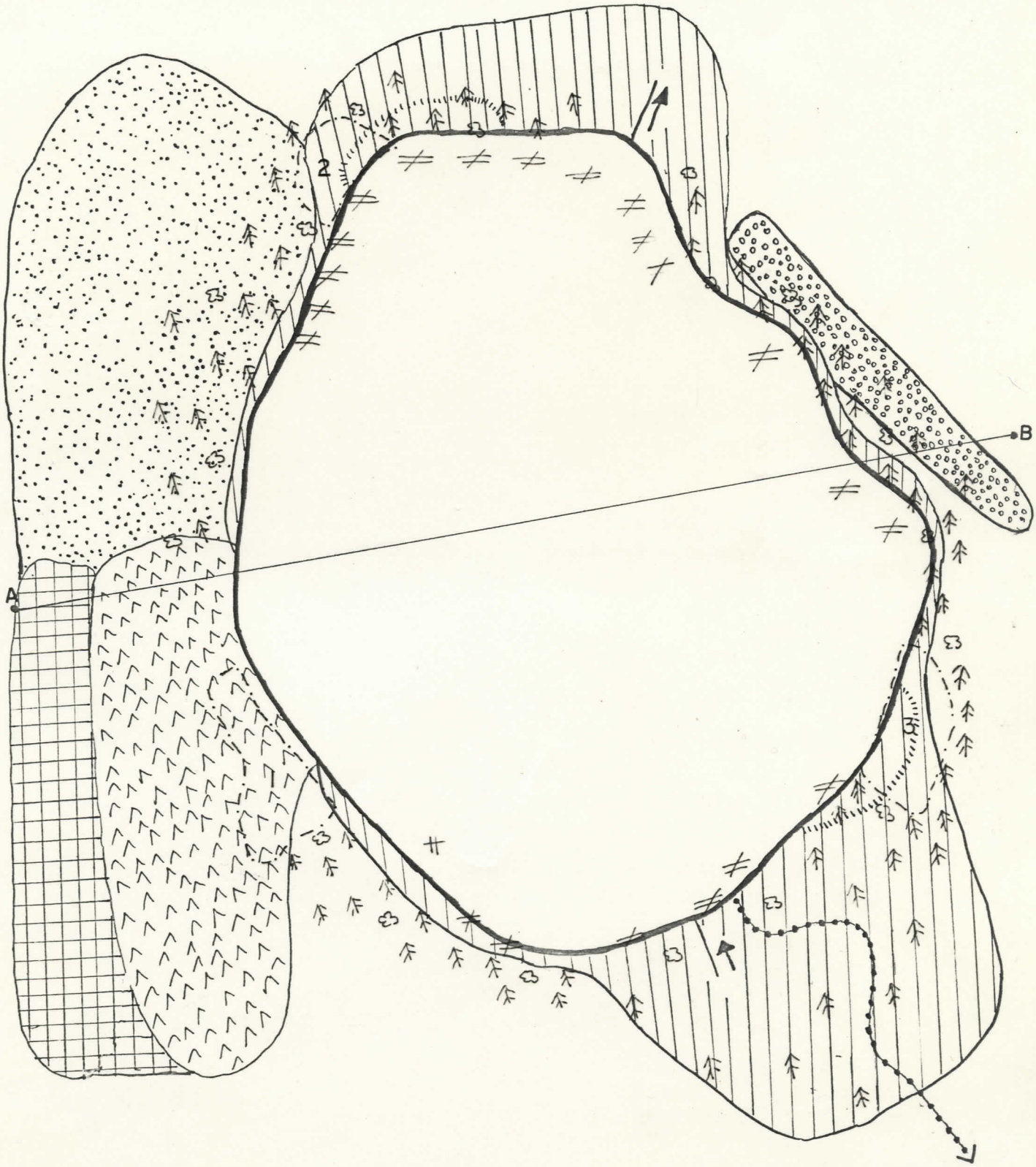


FIG. 3C

ROCKSLIDE LAKE

LANDFORMS



VEGETATION

PORCUPINE LAKE

DATE STUDIED: July 3rd, 1980

I. LOCATION:

- 49° 15.5' N., 117° 1.5' W.
- Department of Mines and Technical Surveys Map: Nelson, B.C.; 82F/6E; 1:50,000; Grid Reference 981562
- Department of Lands and Forests Map: Trail, B.C.; 82F/SW; 1:126720
- Aerial photographs #BC 5348-125, #BC 5348-126

II. ACCESS:

By Vehicle

Starting from the Salmo Forestry Station, proceed towards Ymir as follows:

DISTANCE (km)		FEATURE	ROUTE
10.4	-	Beginning of Porcupine Creek logging road	R
10.5	-	Railway crossing	
10.55	-	Bridge	
10.9	-	Fork in road	L
11.8	-	Bridge	
13.5	-	Fork in road	L
16.5	-	Fork in road	R
19.7	-	Fork in road	L
21.5	-	Fork in road	L
22.0	-	Fork in road	R
22.1	-	Fork in road	L
22.6	-	Fork in road	R
23.3	-	Fork in road	L
25.4	-	Fork in road	L
25.5	-	Fork in road (stay on main road)	R
27.3	-	Lake	

NOTE:

Part of the access to Porcupine Lake is on private property (permission to utilize roadways and area must be obtained from Darkwoods Forest Industries, Nelson, B.C.).

82F/SW 1:126720
82F/6E 1:50000
VEHICLE ROUTE
MT. ELISE
BALDY MTN
MT. DUNDEE
RANGE
JUBILEE MTN
Ymir
Porto Rico
Hall
KEYSTONE MTN
Boulder Mill
HEWLETT PK
SALMO
RENO
NEVADA MTN
IRON MTN
Burnt Flat

III. GENERAL DESCRIPTION:

Porcupine Lake is a large, relatively shallow, moraine-dammed lake located at an elevation of 1860 meters. Moraine is found extending the whole perimeter of the lake, excepting the east side, which is a talus slope.

The westerly exposed lake was excellent for fishing as it was filled with small rainbow trout. The average size of the fish was approximately 20 centimeters long and 90 grams in weight, although a few larger fish were observed in inflow #1.

The lake was fed by two large inflow streams (which were filled with spawning rainbow trout at the time of study) and a small meltwater stream on the southeast edge. It was drained by Porcupine Creek on the north shore.

The north end of the lake had several suitable campsites and firewood was plentiful.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

Minimal algal growth was observed along the shoreline.

Sites

Porcupine Lake is located in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. The site areas are illustrated in Figure 4D .

Porcupine Lake is situated on the border of the Laib Formation and the Quartzite Range Formation, giving a great variety of rock types to the area. The major rocks

IV. VEGETATION AND GEOMORPHOLOGY:

Sites (cont'd)

observed were phyllite, dolomite, schist, and white, pinkish and green quartzite. The east talus slope was primarily comprised of phyllite and the back wall consisted of a synclinal peak. The area was upthrusted and contains some spectacular vertical layers on the west side of the lake. The lake is dammed by a low moraine on the north and northwest edges.

Site 1

This site was located on a large phyllite talus slope on the east edge of the lake. The vegetation is very sparse as the talus is still active.

Slope: 36°

Exposure: West

Moisture Regime: Dry

Vegetation Classification: Lichen Association/dry transition of the ESSFw Biogeoclimatic Zone*

Vegetation

Trees:

Pinus albicaulis (Whitebark Pine)

Larix occidentalis (Western Larch)

Picea glauca ssp. glauca (White Spruce)

Tsuga heterophylla (Western Hemlock)

Pseudotsuga menziesii (Douglas Fir)

Abies amabilis (Balsam Fir)

IV. VEGETATION AND GEOMORPHOLOGY:

Vegetation

Site 1 (cont'd)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Mosses:

Pohlia nutans

Lichens:

Lecanora sp.

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

Site 2

This site was situated on the southeast edge of the lake by a small meltwater channel. The moisture regime varied from very damp to slightly damp. The flora was low-lying.

Slope: 10°

Exposure: Northwest

Moisture Regime: Very damp to slightly damp

Vegetation Classification: *Menziesia-Tiarella* Association of the ESSFw Biogeoclimatic Zone*

Vegetation

Trees:

Picea glauca ssp. glauca (White Spruce)

Abies amabilis (Balsam Fir)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2 (cont'd)

Vegetation

Shrubs:

Menziesia ferruginea (False Azalea)

Rhododendron albiflorum (White Rhododendron)

Vaccinium membranaceum (Black Mountain Huckleberry)

Ribes lacustre (Swamp Gooseberry)

Flowers:

Montia sibirica (Siberian Miner's Lettuce)

Streptopus amplexifolius (Twisted Stalk)

Smilacina amplexicaulis (False Solomon's Seal)

Trollius laxus (Globe Flower)

Tiarella unifoliata (Foam Flower)

Daucus carota (Wild Carrot)

Viola glabella (Yellow Violet)

Senecio triangularis (Giant Ragwort)

Pedicularis bracteosa (Wood Betony)

Epilobium angustifolium (Fireweed)

Pedicularis groenlandica (Elephant Head)

Veratrum eschocholtzii (Indian Hellebore)

Equisetum arvense (Common Horsetail)

Oenanthe sarmentosa (Water Parsley)

Xerophyllum tenax (Bear Grass)

Mitella breweri (Feathery Mitrewort)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2 (cont'd)

Vegetation

Ferns:

Woodsia sp.

Mosses:

Pohlia wahlenbergii

Polytrichum juniperinum

Lichens:

Alectoria sp. (Old Man's Beard)

Liverwort:

Unidentified

Grasses:

Unidentified

Site 3

This site was located on the west side of the lake on a lateral moraine that partially dams the lake. White Rhododendron was the major shrub, making the undergrowth quite dense.

Slope: 17°

Exposure: South

Moisture Regime: Slightly Damp

Vegetation Classification: Menziesia-Tiarella Association of the ESSFw Biogeoclimatic Zone*

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3 (cont'd)

Vegetation

Trees:

Pseudotsuga menziesii (Douglas Fir)

Picea glauca ssp. glauca (White Spruce)

Picea glauca ssp. engelmannii (Engelmann Spruce)

Abies amabilis (Balsam Fir)

Alnus tenuifolia (Mountain Alder)

Shrubs:

Rhododendron albiflorum (White Rhododendron)

Vaccinium membranaceum (Black Mountain Huckleberry)

Menziesia ferruginea (False Azalea)

Sorbus scopulina (Western Mountain Ash)

Phyllodoce empetriformis (Red Heather)

Flowers:

Leptarrhena amplexifolia (Leptarrhena)

Streptopus amplexifolius (Twisted Stalk)

Smilacina amplexicaulis (False Solomon's Seal)

Tiarella unifoliata (Foam Flower)

Trollius laxus (Globe Flower)

Daucus carota (Wild Carrot)

Ranunculus eschscholtzii (Snow Buttercup)

Veratrum eschocholtzii (Indian Hellebore)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

Vegetation

Flowers: (cont'd)

Viola glabella (Yellow Violet)

Equisetum arvense (Common Horsetail)

Oenanthe sarmentosa (Water Parsley)

Xerophyllum tenax (Bear Grass)

Lichens:

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

* The association classifications for the sites were developed from Utzig's Guide For Tree Species Selection in the Nelson Forest District under the biogeoclimatic zone Engelmann Spruce-Subalpine Fir Zone (ESSFw).

FIG. 4B

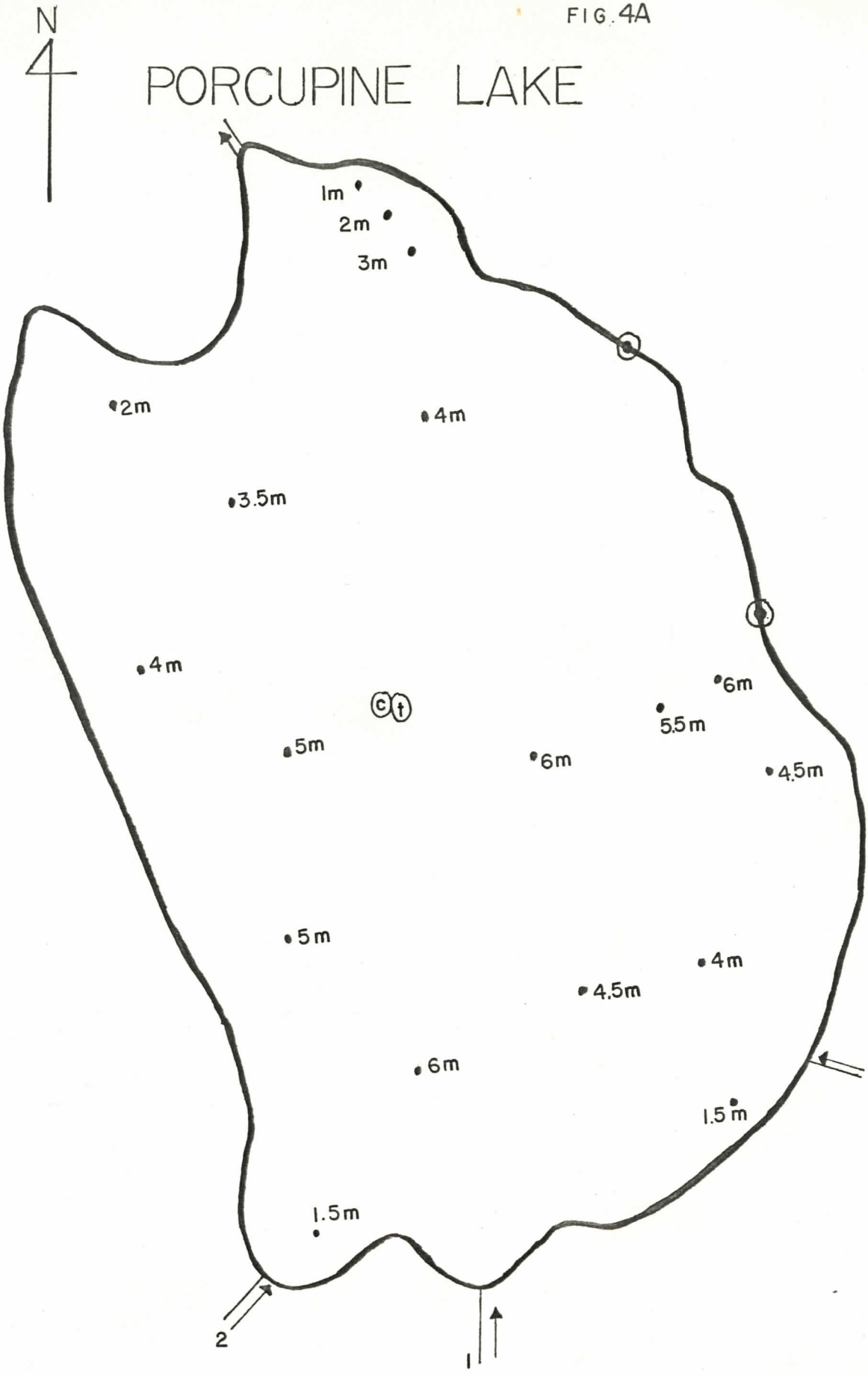
area 7.8 ha.

elevation 1860 m.

LEGEND

1, 2	stream numbers
⟹	inflow/outflow streams
⊙	plane table stations
•	depth soundings
Ⓒ	chemical record
Ⓣ	temperature record

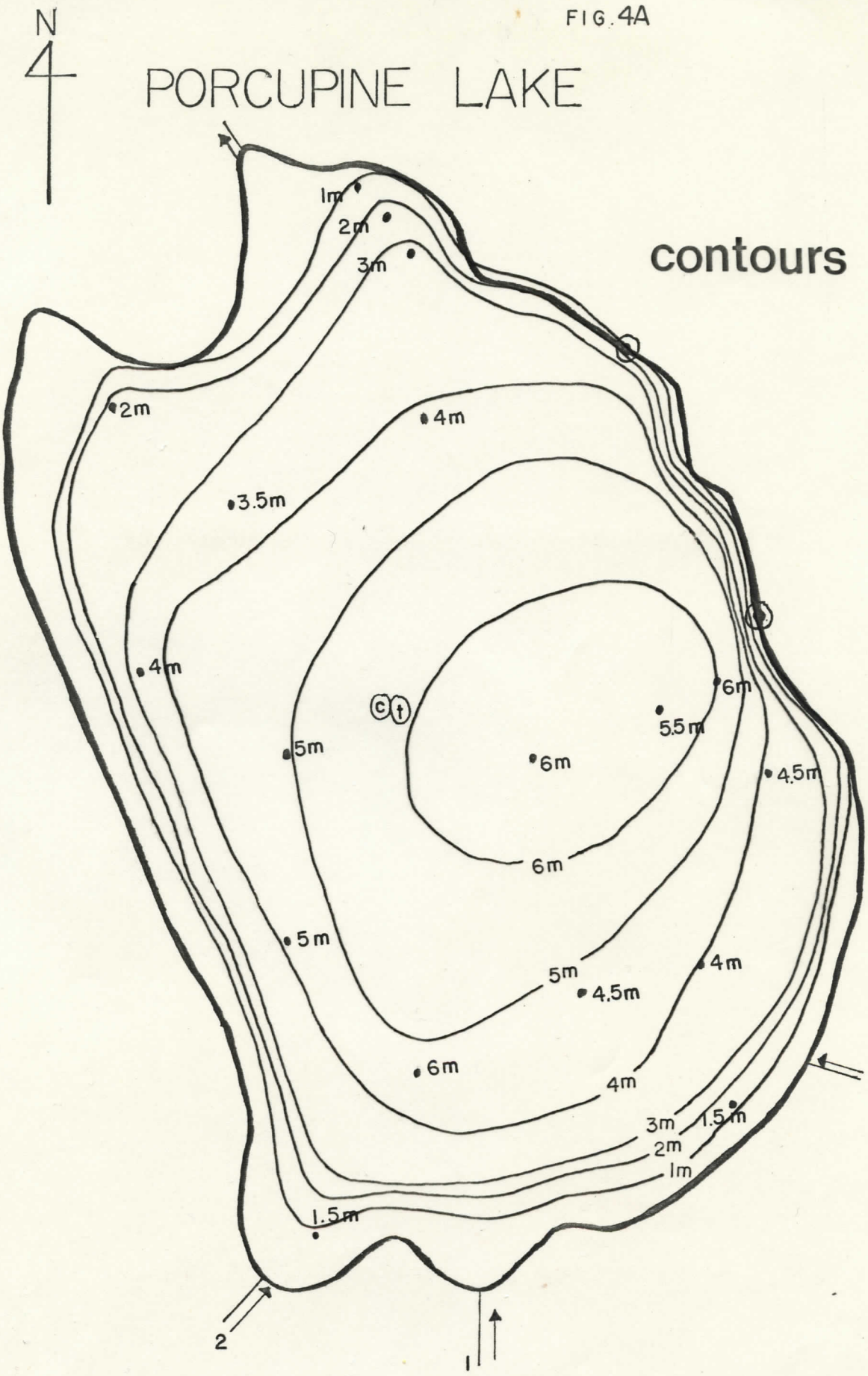
FIG. 4A



PLANE TABLE SURVEY

scale = 1:2000

FIG. 4A



PLANE TABLE SURVEY

scale = 1:2000

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test	Result
Temperature	- Surface - 11.9°C
	- Bottom - 11.4°C
Secchi Disc	- Limit of visibility - visible on lake bottom at a depth of 6 meters
	- Weather conditions - overcast
	- Water conditions - ripples (July 3rd, 2:00 p.m.)
Bottom Composition	- Rocks, muck
pH	- 7.0
Total Alkalinity	- 6 ppm
Total Dissolved Solids	- 11 ppm
Lake Level	- At high water mark

B) Inflow Streams

i) Inflow #1

Average width	- 3.8 meters
Average depth	- 31 centimeters
Velocity	- 0.83 meters/second
Volume of Flow	- 981 liters/second
Temperature	- 10.9°C
Bottom Composition	- Mud and particles ranging in size from pea gravel to large boulders 100 cm. in length
	- Moss was growing on some submerged rocks

V. PHYSICAL AND CHEMICAL DATA:

B) Inflow Streams

i) Inflow #1 (cont'd)

Comments:	- Braids into two streams fish up to 20 cm. were observed

ii) Inflow #2

Average width	- 2.0 meters
Average depth	- 10 centimeters
Velocity	- 0.50 meters/second
Volume of Flow	- 100 liters/second
Temperature	- 13.5°C
Bottom Composition	- Mud and particles ranging in size from sand to medium boulders 60 cm. in length
Comments:	- Braided - Many fish up to 25 cm. were observed - A couple of fish were approximately 50 cm. in length

C) Outflow Stream

Average width	- 4.1 meters
Average depth	- 28 centimeters
Velocity	- 1.11 meters/second
Volume of Flow	- 1274 liters/second
Temperature	- 12.0°C

V. PHYSICAL AND CHEMICAL DATA:

C) Outflow Stream (cont'd)

Bottom Composition - Particles ranging in size from small cobbles (6 cm.) up to large boulders 100 cm. in length

Comments: - Smaller particles were probably washed further downstream

- Many pools

NOTE: The lake was revisited on July 21st, 1980 and several changes were noted. Lake level had dropped approximately 30 cm. from first measured level and Equisetum hyemale grew in the water on the north edge of the lake. Water temperatures also differed: top temperature was 16.5°C. and bottom temperature was 15.0°C.

A deceptively shallow lake - 6 M.!

View from the south illustrating log debris near inflow streams.

FIG. 4C

LEGEND

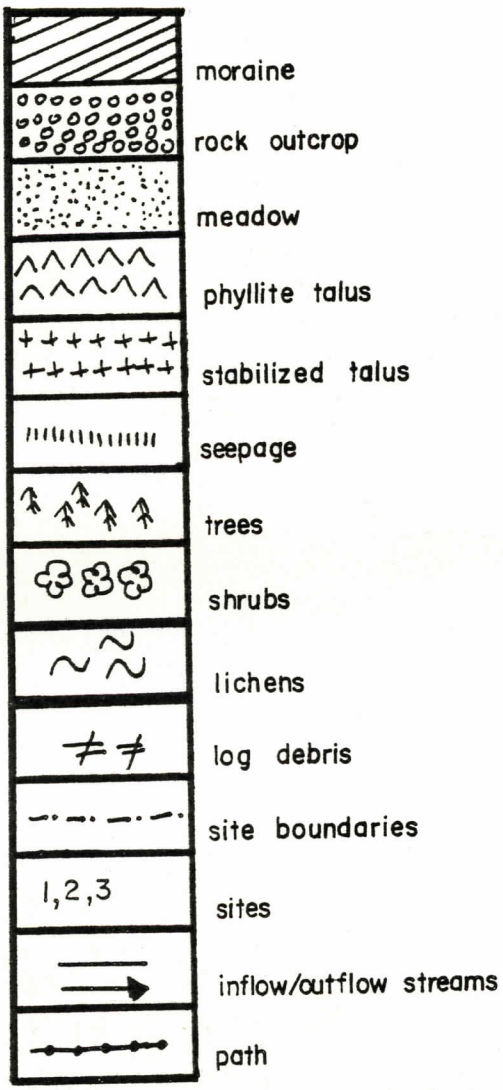
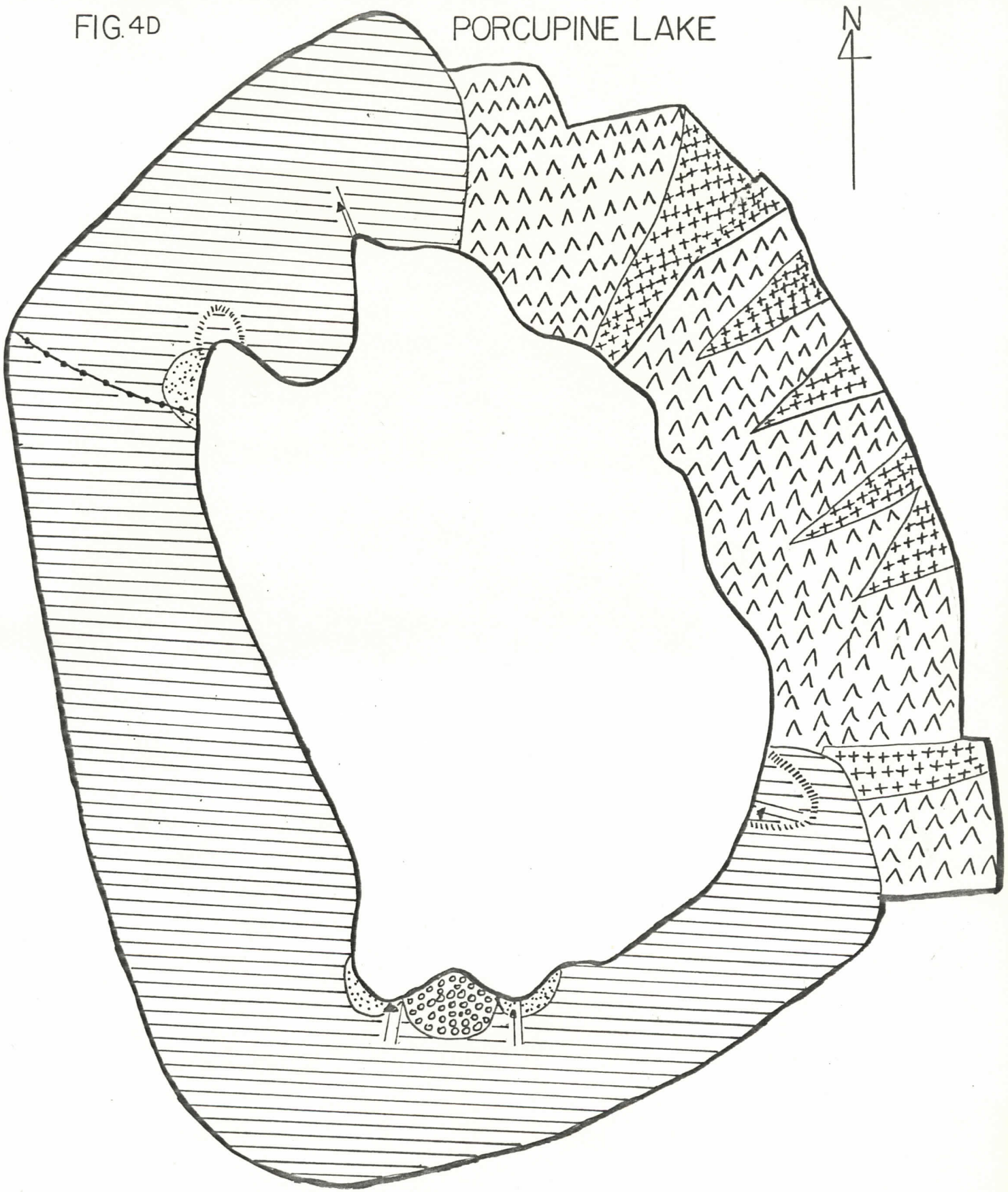


FIG. 4D

PORCUPINE LAKE

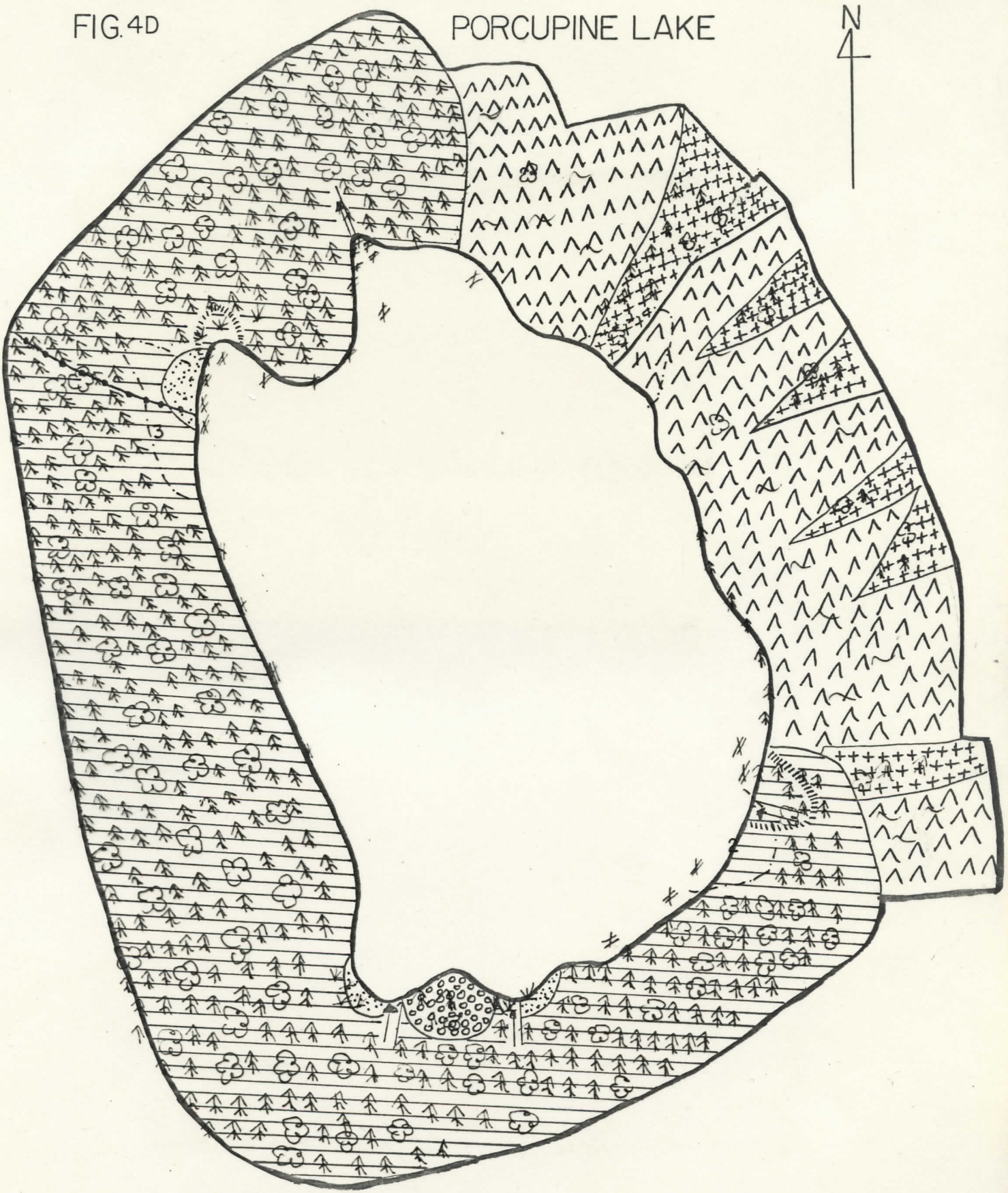


LANDFORMS

scale = 1:2600

FIG. 4D

PORCUPINE LAKE



LANDFORMS

VEGETATION

scale = 1:2600

HIRSCH LAKE

DATE STUDIED: July 2nd, 1980

I. LOCATION:

- 49° 15.5' N., 117° 1.5' W.
- Department of Lands and Forests Map, Trail, B.C., 82F/SW, 1:126720
- 82F/6E 1:50,000
- Aerial photographs: #BC 5348-125, #BC 5348-126

II. ACCESS:

By Vehicle

Starting from the Salmo Forestry Station proceed towards Ymir as follows:

DISTANCE (km)	FEATURE	ROUTE
10.4	- Beginning of Porcupine Creek logging road	R
10.5	- Railway crossing	
10.55	- Bridge	
10.9	- Fork in road	L
11.8	- Bridge	
13.5	- Fork in road	L
16.5	- Fork in road	R
19.7	- Fork in road	L
21.5	- Fork in road	L
22.0	- Fork in road	R
22.1	- Fork in road	L
22.6	- Fork in road	R
23.3	- Fork in road	L
25.4	- Fork in road	L
25.5	- Fork in road	L
26.8	- Fork in road	R
27.0	- Fork in road	R
28.1	- Fork in road	R
28.4	- Fork in road	R
28.6	- Fork - turn off main road	R
29.4	- Fork - road is rough (4 wheel drive)	R
30.5	- End of road	

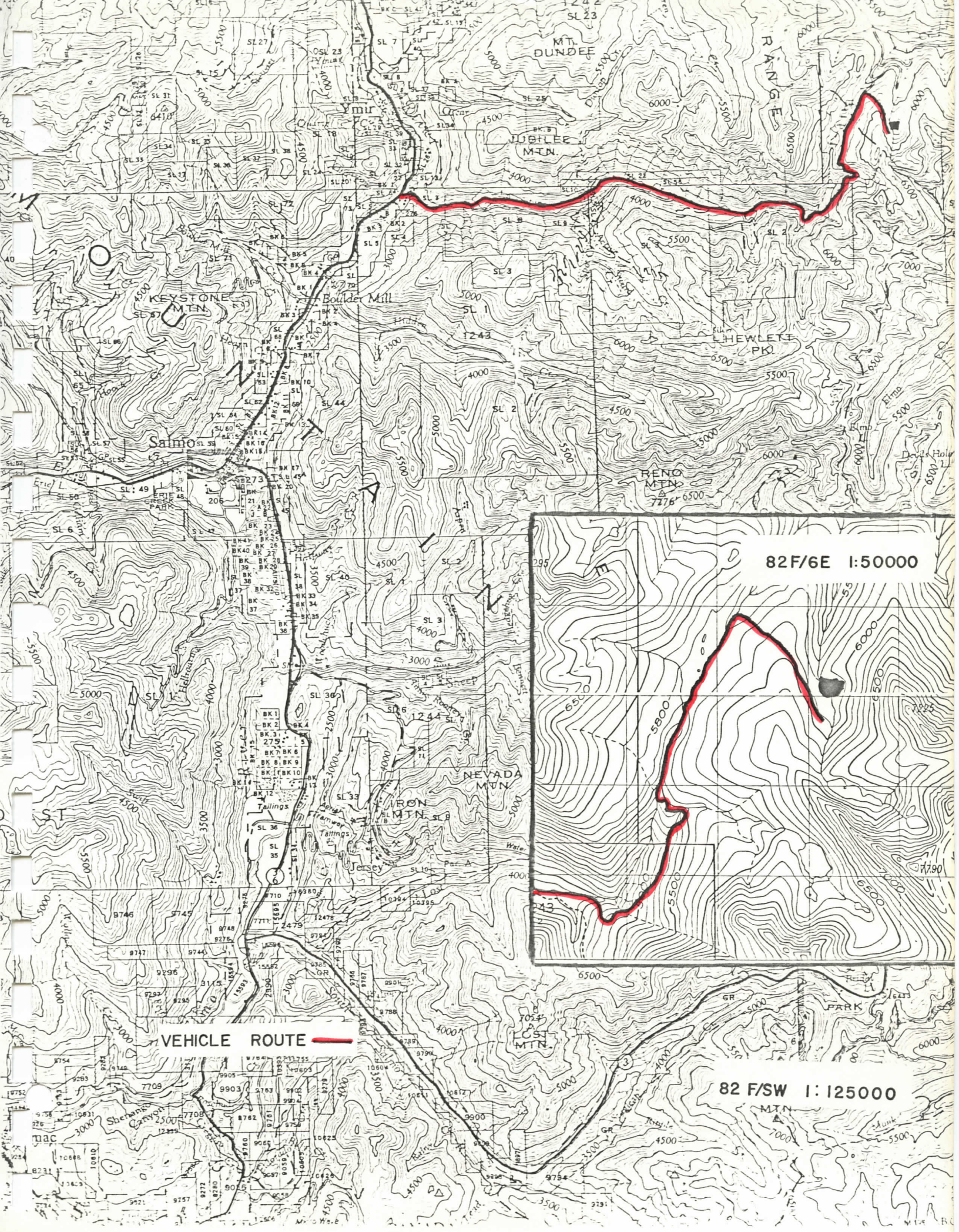
II. ACCESS:

NOTE:

Part of the access to Hirsch Lake is on private property (permission to utilize roadways and area must be obtained from Darkwoods Forest Industries, Nelson, B.C.).

Hiking Route

It is a 5 minute walk down to the lake.


82F/6E 1:50000
VEHICLE ROUTE
82 F/SW 1: 125000
MT. DUNDEE
JUBILEE MTN.
KEYSTONE MTN.
Boulder Mill
LHEWLETT PK.
RENO MTN.
Ymir
Saimo
NEVADA MTN.
IRON MTN.
Jersey
LOST MTN.
PARK
RANGE

III. GENERAL DESCRIPTION:

Hirsch Lake is a small moraine-dammed lake located at an elevation of 1730 meters. At the time of this report, this westerly exposed lake appeared to be approximately 15 centimeters below high water level. As sedges extended into the water around much of the lakeshore, the low water level was estimated to be approximately 40 centimeters below the measured level.

The lake is fed on the south end by two large inflow streams (which are both suitable for spawning) and also by a small melt-water channel on the north end. It is drained by Hirsch Creek on the north end.

Rainbow trout, up to 18 centimeters in length were sampled. Trout up to 20 centimeters long were observed in the outflow stream.

There are no suitable campsites in the immediate vicinity of the lake as it was either too steep or too wet. Camp could be set up on or near the end of the logging road by the two large inflow streams. Firewood is abundant.

The area north of the moraine (on the north end of the lake) and the area south of the logging road (on the south end of the lake) were both logged. Logging activity caused the inflow streams (2 and 3) to braid extensively. Streams 2 and 3 (see figure 1) probably both originate from Wolf Creek above the logged area.

Grassy meadows border the southern end of the lake.

The study of Hirsch and Porcupine Lakes was facilitated by the use of the Darkwoods Forest Industries cabin at Porcupine summit. From left to right: Irene, Bob and Judy.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

Minimal algal growth was noted along the shoreline.

Sites

Hirsch Lake is located in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. The site areas are illustrated in the Figure 5C.

The lake is situated in the Quartzite Range Formation, making the major rock type of this area white, green and pinkish quartzite. The fact that this sturdy rock type does not weather readily could explain the low TDS reading (see section V). The lake exists in a glacially carved U-shaped valley that has had renewed downcutting. The lake is blocked by a large, terminal moraine that is 8 to 10 meters in height.

Site 1

This site was located on the east southeast edge of the lake on slightly rolling, moderately moist ground. The soil had a thick humus layer (approximately 30 cm. thick). The area was well vegetated but not dense.

Slope:	Average 6°
Exposure:	West Northwest
Moisture Regime:	Moderately damp
Vegetation Classification:	Menziesia-Tiarella Association for the ESSFw Biogeoclimatic Zone*

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1 (cont'd)

Vegetation

Trees:

Pinus albicaulis (Whitebark Pine)

Picea glauca ssp. glauca (White Spruce)

Picea glauca ssp. engelmannii (Engelmann Spruce)

Tsuga heterophylla (Western Hemlock)

Abies amabilis (Balsam Fir)

Shrubs:

Vaccinium occidentale (Bog Bilberry)

Phyllodoce empetriformis (Red Heather)

Rubus pedatus (Trailing Rubus)

Sorbus scopulina (Western Mountain Ash)

Vaccinium membranaceum (Black Mountain Huckleberry)

Menziesia ferruginea (False Azalea)

Rhododendron albiflorum (White Rhododendron)

Flowers:

Kalmia polifolia (Swamp Laurel)

Tiarella unifoliata (Foam Flower)

Clintonia uniflora (Queen's Cup)

Daucus carota (Wild Carrot)

Erigeron aureus (Golden Fleabane)

Pedicularis sp. (Wood Betony)

Arnica latifolia (Broad-leaf Arnica)

Arnica cordifolia (Heart-leaf Arnica)

Veratrum eschocholtzii (Indian Hellebore)

Xerophyllum tenax (Bear-grass)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1 (cont'd)

Ferns:

Woodsia sp.

Mosses:

Fontinalis antipyretica

Polytrichum juniperinum

Lichens:

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

Site 2

This site was located in a flat, marshy area on the southeast end of the lake. Since the lake was almost at high water mark, this area might be drier as the lake level drops.

Slope: 1° - 2°

Exposure: Northwest

Moisture Regime: Wet

Vegetation Classification: Equisetum Association for the ESSFw Biogeoclimatic Zone*

Vegetation

Trees:

Abies amabilis (Balsam Fir)

Picea glauca ssp. glauca (White Spruce)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2

Vegetation (cont'd)

Shrubs:

Vaccinium membranaceum (Black Mountain Huckleberry)

Menziesia ferruginea (False Azalea)

Rhododendron albiflorum (White Rhododendron)

Flowers:

Tiarella unifoliata (Foam Flower)

Daucus carota (Wild Carrot)

Kalmia polifolia (Swamp Laurel)

Leptarrhena amplexifolia (Leptarrhena)

Streptopus amplexifolius (Twisted Stalk)

Hieracium gracile (Slender Hawkweed)

Viola palustris (Blue Swamp Violet)

Pedicularis groenlandica (Elephant Head)

Equisetum hyemale (Scouring Rush)

Equisetum arvense (Common Horsetail)

Mosses:

Pohlia wahlenbergii

Polytrichum commune

Sphagnum sp.

Lichens:

Cladonia pyxidata

Alectoria sp. (Old Man's Beard)

Grasses: Unidentified

Sedges: Unidentified

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

This site was located on the northwest end of the lake by a small inflow stream at the edge of the terminal moraine.

Slope: 3°

Exposure: Southeast

Moistrue Regime: Very damp at edge of lake to slightly damp a few meters higher

Vegetation Classification: Menziesia-Tiarella Association for the ESSFw Biogeoclimatic Zone*

Vegetation

Trees:

Pseudotsuga menziesii (Douglas Fir)

Picea glauca ssp. glauca (White Spruce)

Shrubs:

Rhododendron albiflorum (White Rhododendron)

Menziesia ferruginea (False Azalea)

Vaccinium membranaceum (Black Mountain Huckleberry)

Lonicera involucrata (Black Twinberry)

Flowers:

Oenanthe sarmentosa (Water Parsley)

Tiarella unifoliata (Foam Flower)

Arnica sp. (Arnica)

Pedicularis sp. (Wood Betony)

Daucus carota (Wild Carrot)

Veratrum eschocholtzii (Indian Hellebore)

Streptopus amplexifolius (Twisted Stalk)

Leptarrhena amplexifolia (Leptarrhena)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

Flowers: (cont'd)

Pedicularis groenlandica (Elephant Head)

Montia sibirica (Siberian Miner's Lettuce)

Trollius laxus (Globe Flower)

Viola glabella (Yellow Violet)

Potentilla diversifolia (Mountain Meadow Cinquefoil)

Senecio triangularis (Giant Ragwort)

Mertensia ciliata (Mountain Bluebell)

Equisetum arvense (Common Horsetail)

Equisetum hyemale (Scouring Rush)

Mosses:

Pohlia wahlenbergii

Lichen:

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (old Man's Beard)

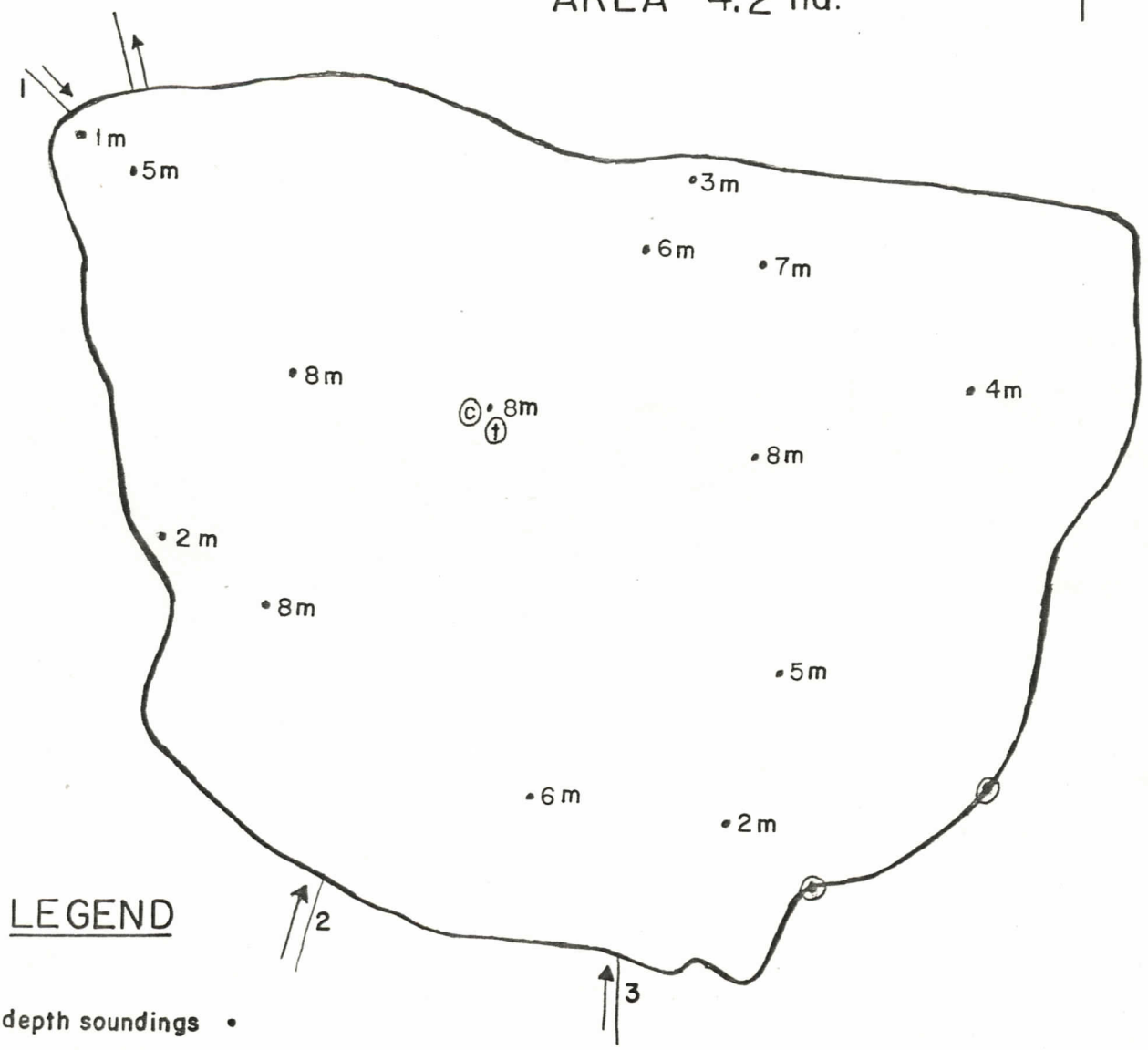
* The association classifications for the sites were developed from Utzig's Guide For Tree Species Selection in the Nelson Forest District under the biogeoclimatic zone Engelmann Spruce-Subalpine Fir Zone (ESSFw).

FIG. 5A

HIRSCH LAKE

ELEVATION 1730 m.

AREA 4.2 ha.



LEGEND

depth soundings •

inflow/outflow streams →

plane table stations ⊙

temperature record (t)

chemical record (c)

stream numbers 1, 2, 3

scale = 1:1700

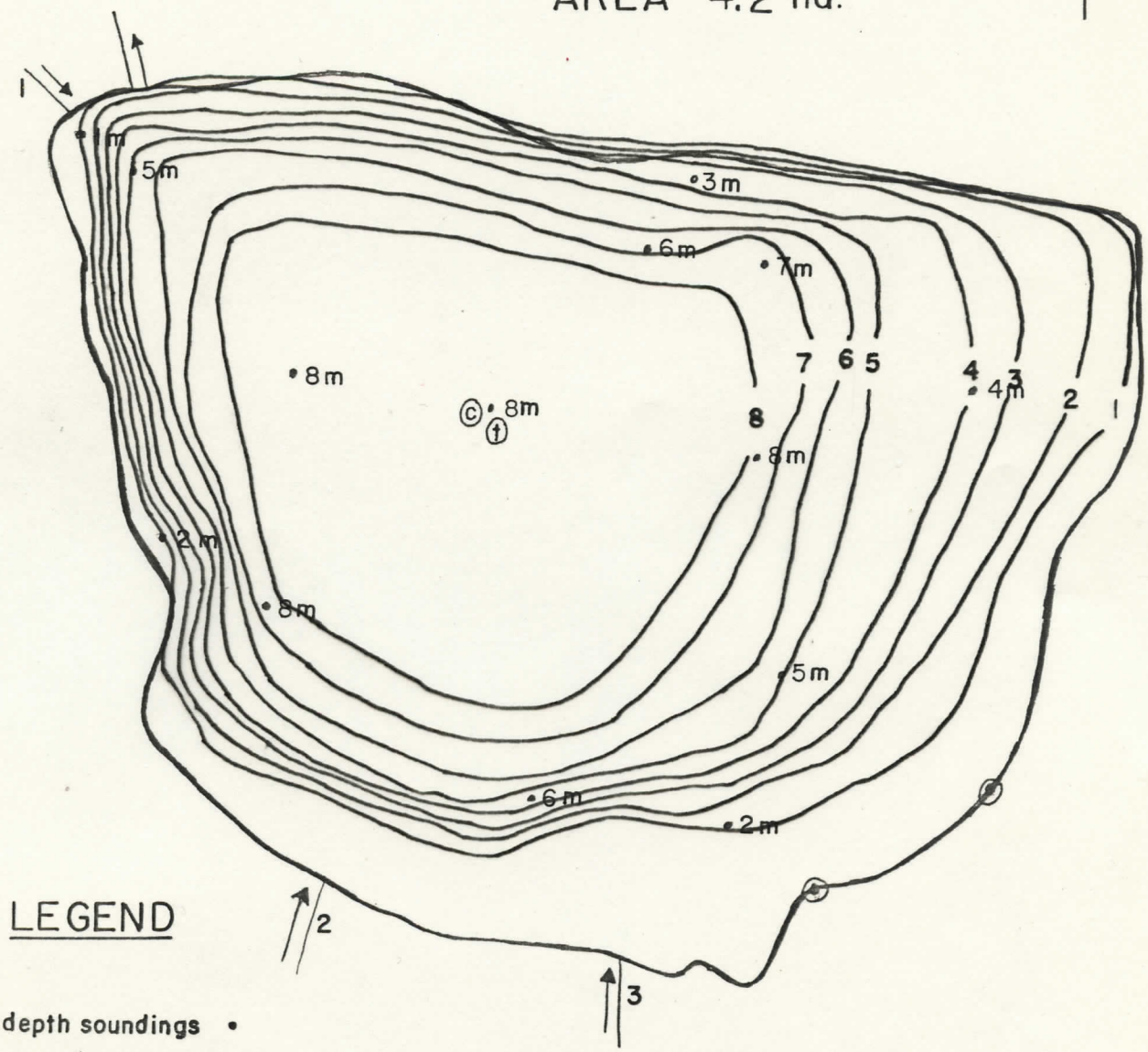
PLANE TABLE SURVEY

FIG. 5A

HIRSCH LAKE

ELEVATION 1730 m.

AREA 4.2 ha.



LEGEND

depth soundings •

inflow/outflow streams →

plane table stations ⊙

temperature record (t)

chemical record (c)

stream numbers 1, 2, 3

contours (meters)

scale = 1:1700

PLANE TABLE SURVEY

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test	Result
Temperature	- surface - 12.3°C
	- bottom - 11.7°C
Secchi Disc	- Limit of visibility - visible on lake bottom at a depth of 8 meters
	- weather conditions - overcast
	- water conditions - slight ripple (July 2nd, 1:00 p.m.)
Bottom Composition	- Muck/humus
pH	- 6.7
Total Alkalinity	- 5 ppm
Total Dissolved Solids	- 16 ppm

B) Inflow Streams

i) Inflow #1

Average width	- 1.0 meters
Average depth	- 10 centimeters
Velocity	- 0.17 meters/second
Volume of Flow	- 17 liters/second
Temperature	- 4.8°C
Bottom Composition	- Mud and particles ranging in size from sand to very coarse gravel 4 cm. in length
Comments:	- Braided

V. PHYSICAL AND CHEMICAL DATA:

B) Inflow Streams (cont'd)

ii) Inflow #2

Average width	-	1.9 meters
Average depth	-	18 centimeters
Velocity	-	0.71 meters/second
Volume of Flow	-	243 liters/second
Temperature	-	11.9°C
Bottom Composition	-	Mud and particles ranging in size from sand to small boulders 30 cm. in length
	-	Occasional medium boulders 50 cm. in length
Comments:	-	Braids into two main streams

iii) Inflow #3

Average width	-	2.4 meters
Average depth	-	18 centimeters
Velocity	-	0.56 meters/second
Volume of Flow	-	242 liters/second
Temperature	-	11.6°C
Bottom Composition	-	Mud and particles ranging in size from sand to small boulders 30 cm. in length
	-	Occasional medium boulders 50 cm. in length
Comments:	-	Braided
	-	Fed mainly by same stream as Inflow #2 and also fed by a smaller stream

V. PHYSICAL AND CHEMICAL DATA:

C) Outflow Stream

Average width	-	3.2 meters
Average depth	-	20 centimeters
Velocity	-	1.20 meters/second
Volume of Flow	-	788 liters/second
Temperature	-	13.0° C
Bottom Composition	-	Moss and particles ranging in size from very coarse sand to medium boulders 60 cm. in length
Comments:	-	Some pooling
	-	Fish up to 20 cm. were observed

FIG. 5B

LEGEND

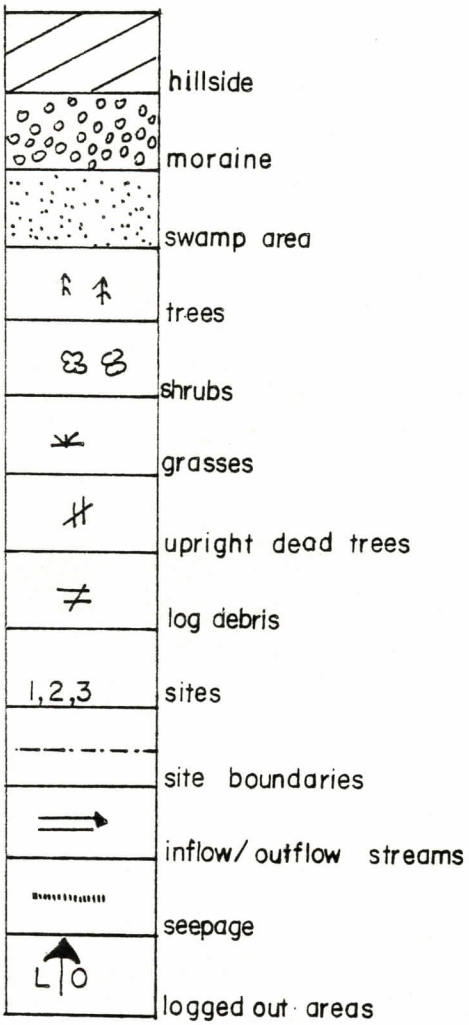
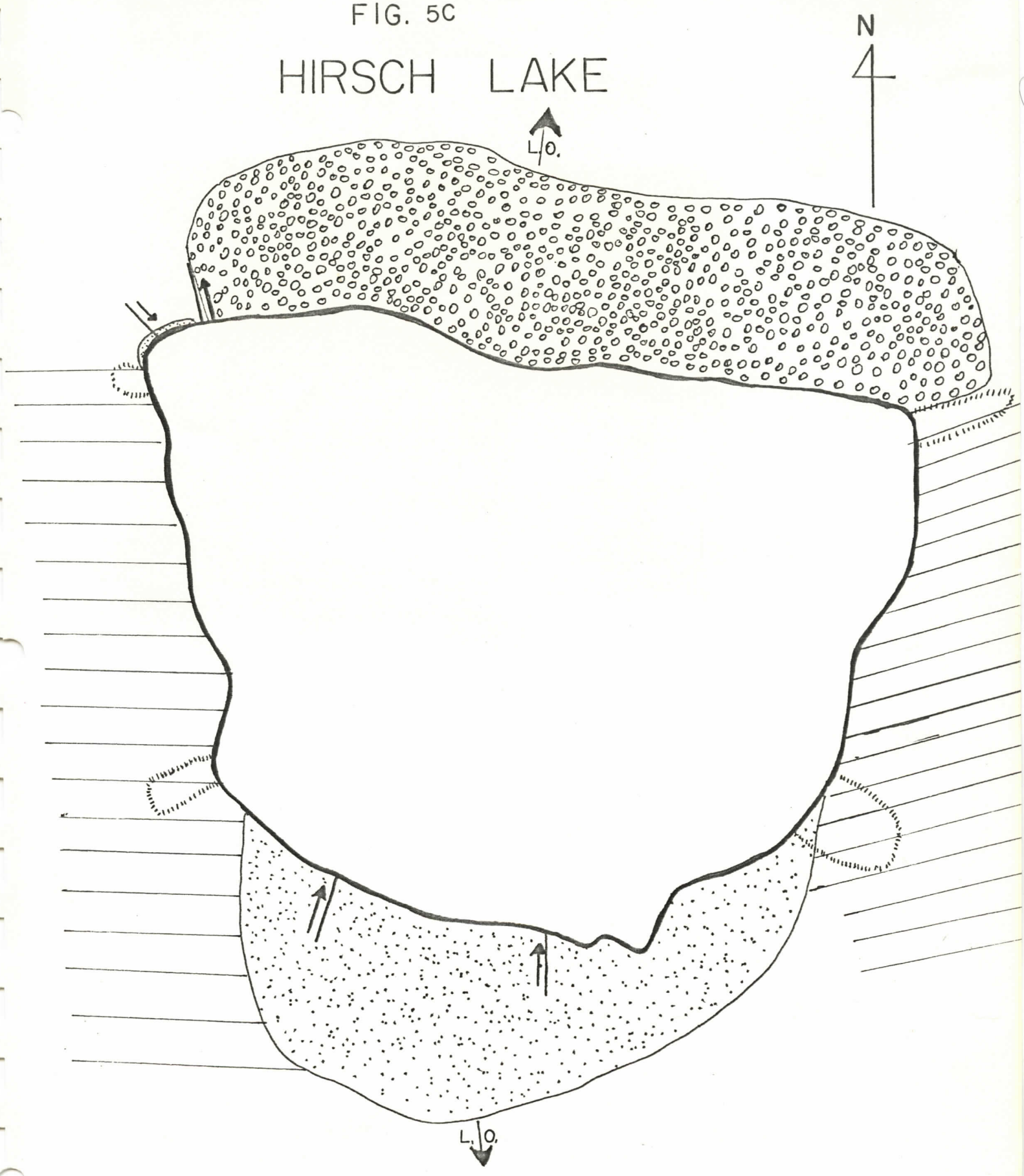


FIG. 5C

HIRSCH LAKE

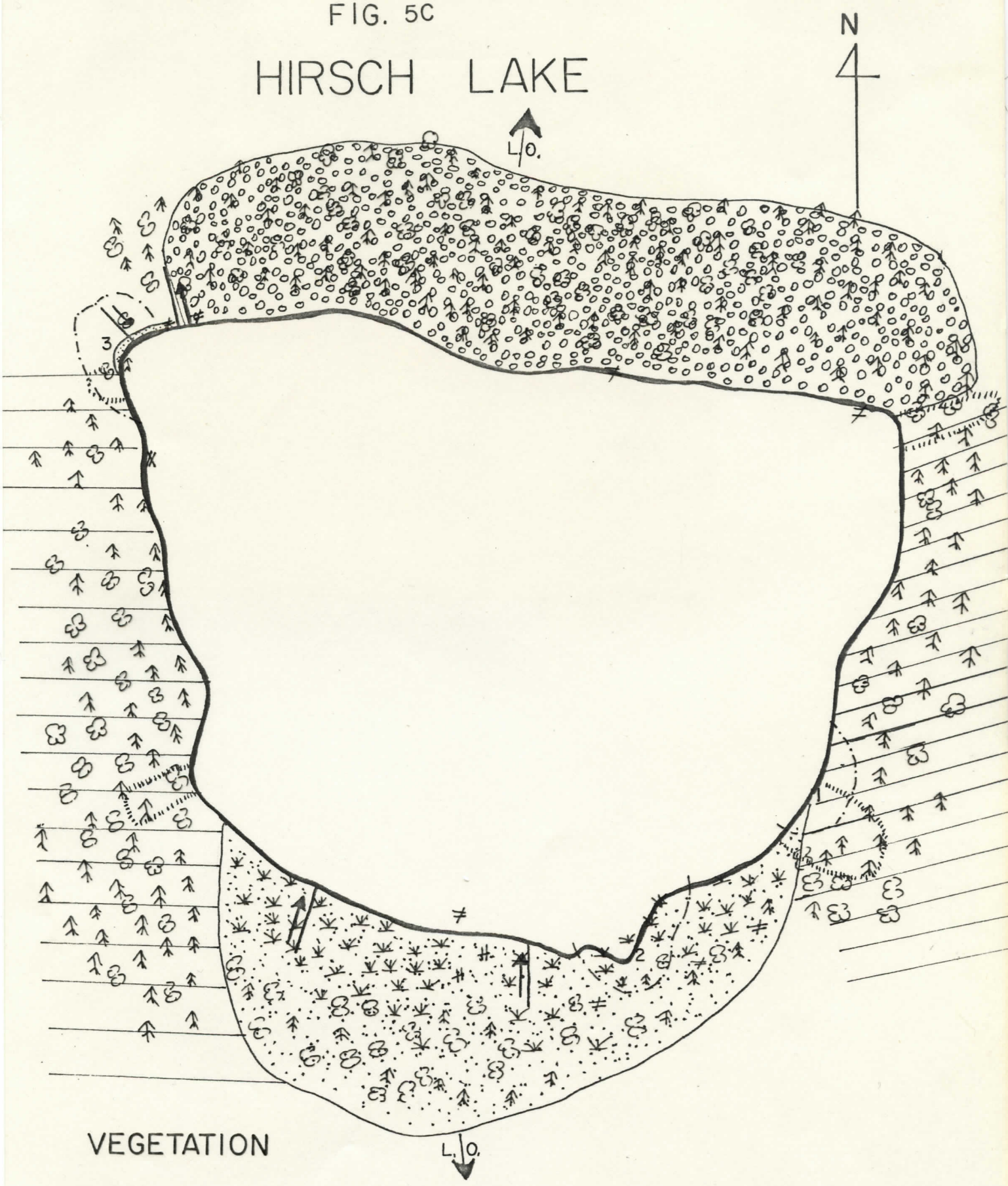


LANDFORMS

scale = 1:1700

FIG. 5C

HIRSCH LAKE



VEGETATION

LANDFORMS

scale = 1:1700

WOLFPUP LAKE

DATED STUDIED: August 11th, 1980

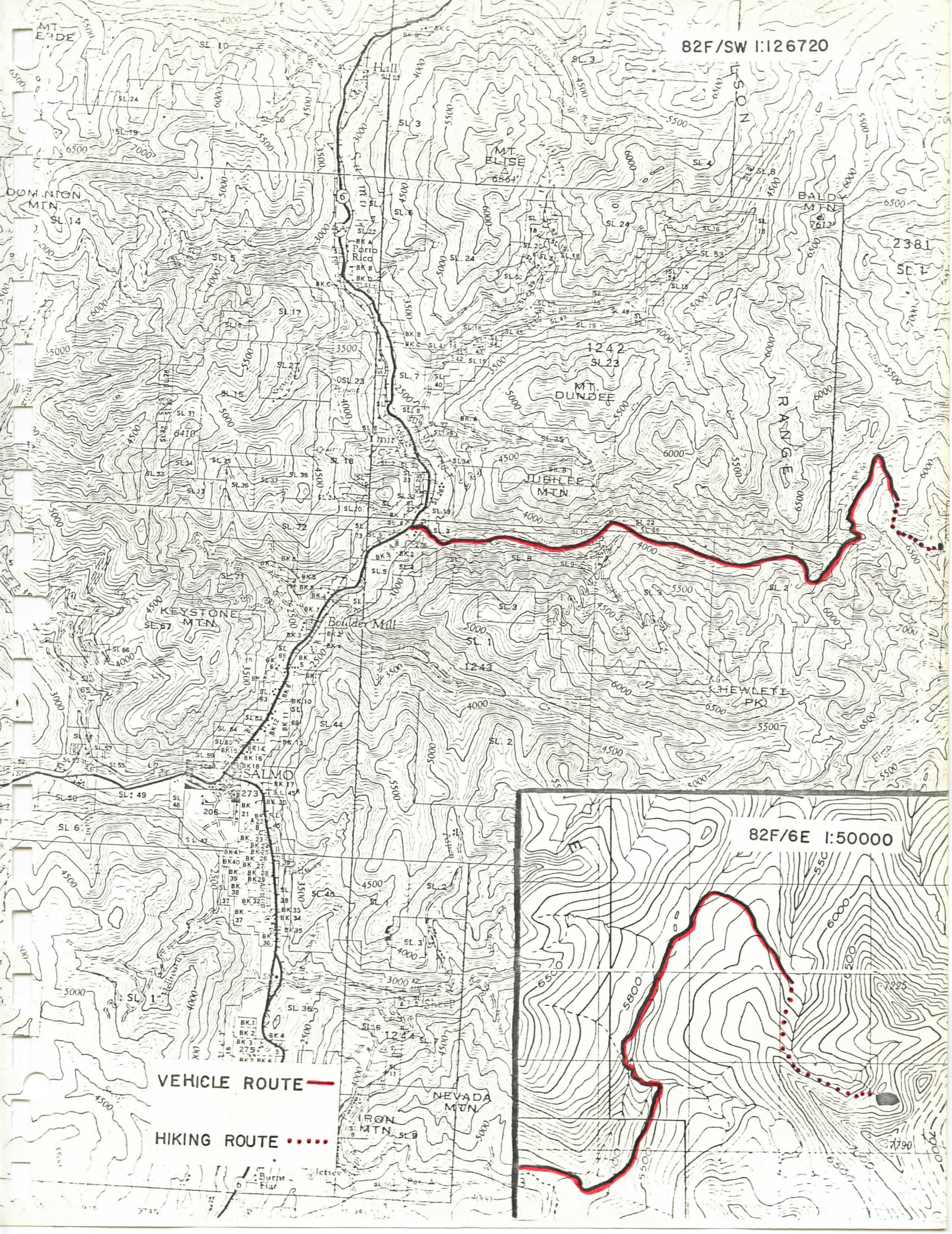
I. LOCATION:

- 49° 16' N., 117° 0.5' W.
- Department of Mines and Technical Surveys Map: Nelson, B.C. 82F/6E, 1:50,000; Grid Reference 992566.
- Department of Lands and Forests Map: Trail, B.C. 82F/SW, 1:126720.
- Aerial photographs #BC 5348-125, #BC 5348-126.

II. ACCESS:

By Vehicle

See "ACCESS" to Hirsch Lake. NOTE: part of the access to Wolfpup Lake is on private property (permission to utilize roadways and area must be obtained from Darkwoods Forest Industries, Nelson, B.C.).



82F/SW 1:126720
82F/6E 1:50000
VEHICLE ROUTE
HIKING ROUTE
MT. ELISE
BALDY MTN
DOMINION MTN
MT. DUNDEE
JUBILEE MTN
KEYSTONE MTN
HEWLETT PK
NEVADA MTN
IRON MTN
SALMO
Porto Rico
Hall
Boulder Mill
RANGE

II. ACCESS: (cont'd)

Hiking Route

Proceed up the road on the left up through the logged area. Where the road terminates, follow Wolf Creek up to Wolf Lake and walk along the shore, then angle up the talus slope towards the draw located at the far end of the lake. Climb through the draw and follow the stream over the next ridge to Wolfpup Lake. Total hiking time is 1 1/2 hours.

III. GENERAL DESCRIPTION:

Wolfpup Lake is a small, easterly exposed tarn located at an elevation of 2080 meters. It is fed by several seasonal inflow streams located around the cirque basin, the largest being located on the southwest shore. The lake is drained on the northwest end by Wolfpup Creek which flows into Wolf Lake approximately 600 meters below. This creek runs underneath a talus slope during the latter part of its course. None of the streams are suitable for spawning.

The best camping area is located in a grassy meadow above the northeast shore. Firewood is in good supply.

Wolfpup Lake appeared to be approximately 80 cm below the high water level. No fish were present in the lake.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

No vegetation was observed in the lake.

Sites

Wolfpup Lake is located in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. The sites are illustrated in Figure 6C.

IV. VEGETATION AND GEOMORPHOLOGY:

Sites (cont'd)

Wolfpup Lake is an ideally formed tarn in a deep cirque basin on the border of the Laib and Quartzite Range Formations. The headwall is located on the southwest edge of the lake while the cirque lip extends over the north end. Large talus slopes of phyllite and pinkish, greenish and white quartize stretched over 75% of the lake from the southwest to the north edges. The outflow stream drained through a joint in a large phyllite outcropping and there were three small waterfalls and pools within 200 meters of the lake.

Site 1

This site was located on the north edge of the lake near one of the plane table stations. It was situated on stabilized talus and although the flora was abundant there was little variety.

Slope: 25°

Exposure: Southwest

Moisture Regime: Dry

Vegetation Classification: Moss Association for the ESAF Biogeoclimatic Zone*

Vegetation

Trees:

Pinus flexilus (Limber Pine)

Larix lyallii (Alpine Larch)

Abies lasiocarpa (Alpine Fir)

IV. VEGETATION AND GEOMORPHOLOGY:

Vegetation

Site 1 (cont'd)

Flowers:

Anemone occidentalis (Western Anemone)

Erythronium montanum (Avalanche Lily)

Heuchera glabella (Alumroot)

Penstemon davidsonii var. menziesii (Menzies Penstemon)

Mosses:

Polytrichum juniperinum

Abietinella abietina

Lichens:

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

Sedges:

Unidentified

Site 2

This site was located on the west bank of the outflow stream. Soil development was very poor, ranging from 0 to 5 cm in depth. Vegetation was sporadic.

Slope: 0° - 5°

Exposure: Northwest

Moisture Regime: Dry

Vegetation Classification: Alpine Fir-Black Huckleberry Association for the ESAF Bio-geoclimatic Zone*

An ideal tarn - almost perfectly circular.

View of Wolf lake (see 1977 report) from access route to Wolf pup Lake.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2 (cont'd)

Vegetation

Trees:

Larix lyallii (Alpine Larch)

Abies lasiocarpa (Alpine Fir)

Shrubs:

Phyllodoce empetriformis (Red Heather)

Phyllodoce glanduliflora (Yellow Heather)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Flowers:

Erigeron strigosus (Daisy Fleabane)

Erigeron aureus (Golden Fleabane)

Erythronium montanum (Avalanche Lily)

Penstemon davidsonii var. menziesii (Menzies Penstemon)

Veratrum eschocholtzii (Indian Hellebore)

Mosses:

Ceratodon purpureus

Pohlia nutans

Lichens:

Alectoria sp. (Old Man's Beard)

Lecanora sp.

Grasses:

Unidentified

Sedges:

Unidentified

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

This slope was situated on the north edge of the lake on the rock lip. Soil development reached 15 cm right on the lake edge.

Slope: 30°

Exposure: East

Moisture Regime: Dry

Vegetation Classification: Engelmann Spruce-Alpine Fir-Black Huckleberry Association for the ESAF Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Picea glauca ssp. engelmannii (Engelmann Spruce)

Shrubs:

Phyllodoce empetriformis (Red Heather)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Flowers:

Leptarrhena amplexifolia (Leptarrhena)

Valeriana sitchensis (Mountain Valerian)

Parnassia kotzebuei (Alpine Parnassus)

Anemone occidentalis (Western Anemone)

Erigeron aureus (Golden Fleabane)

Erythronium montanum (Avalanche Lily)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

Vegetation

Flowers: (cont'd)

Myosotis sylvatica var. alpestris (Mountain Forget-Me-Not)

Penstemon davidsonii var. menziesii (Menzies Penstemon)

Epilobium angustifolium (Firewood)

Ferns:

Cryptogramma crispa (Parsley Fern)

Cystopteris fragilis (Fragile Fern)

Gymnocarpium sp. (Oak-Fern)

Dryopteris sp.

Mosses:

Polytrichum juniperinum

Abietinella abietina

Lichens:

Physcia sp.

Lecanora sp.

Grasses:

Unidentified

Sedges:

Unidentified

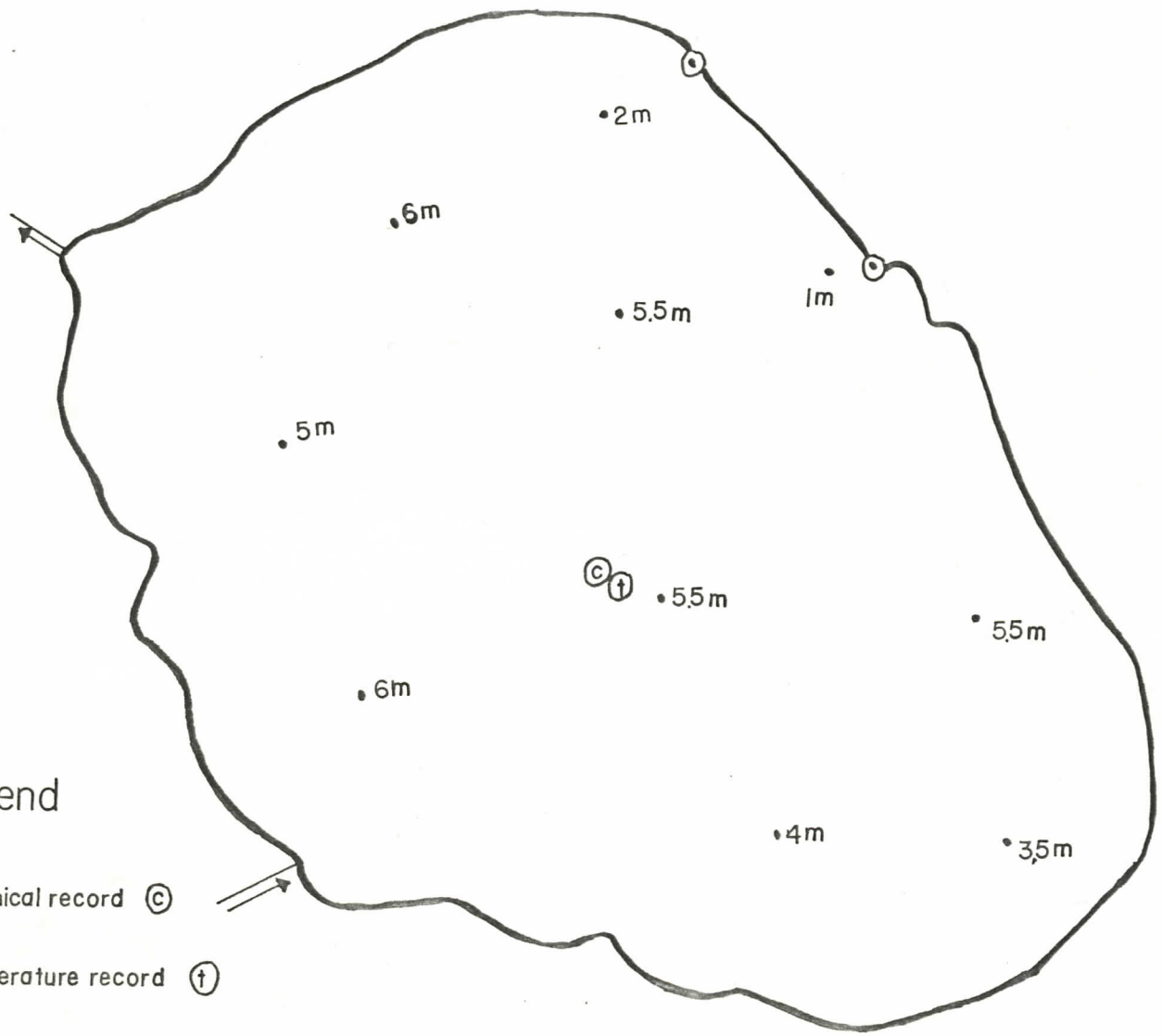
* The associations for the sites were classified within the associations given by the Forestry Handbook for British Columbia under the biogeoclimatic Zone Engelmann Spruce-Alpine Fir Zone (ESAF).

fig. 6A

WOLFPUP LAKE

AREA 2.4 ha.

ELEVATION 2080 m.



plane table survey

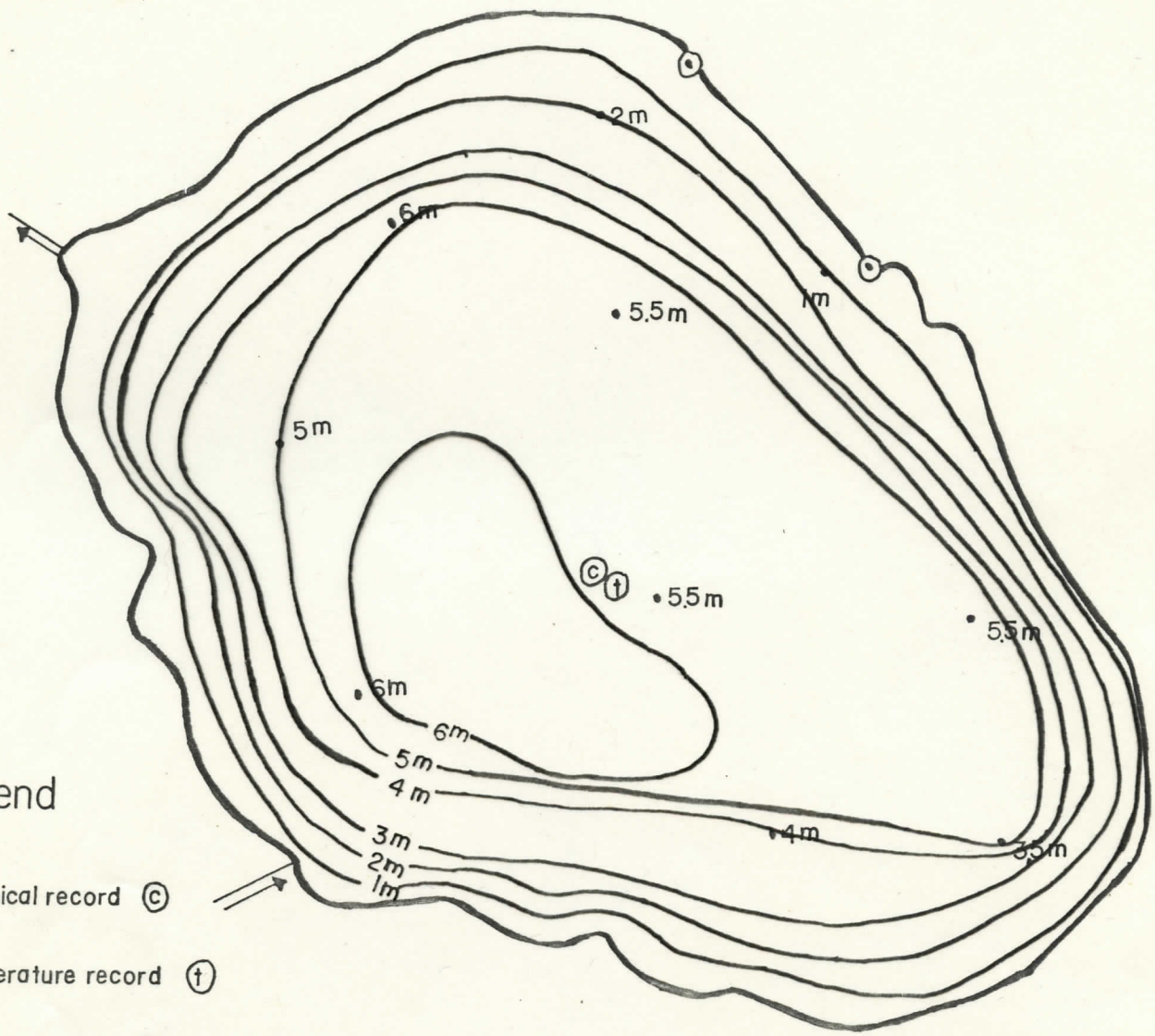
scale = 1 : 1250

fig. 6A

WOLFPUP LAKE

AREA 2.4 ha.

ELEVATION 2080 m.



plane table survey

scale = 1: 1250

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test	Result
Temperature	- Surface - 13.6°C
	- Bottom - 13.4°C
Secchi Disc	- Limit of visibility
	- Visible on lake bottom at a depth of 6 meters
	- Weather conditions - overcast (August 11, 1:30 p.m.)
	- Water conditions - slight ripple
Bottom Composition	- Rocks, muck
pH	- 6.5
Total Alkalinity	- 4 ppm
Total Dissolved Solids	- 3 ppm

B) Inflows

Wolfpup Lake is fed primarily by a relatively small inflow located on the southwest shore of the lake. This stream could not be measured because the terrain was too steep and the stream flowed over a rock face. Meltwater seepage, which occurred around the lake, also fed the lake.

C) Outflow

Average width	- 0.3 meters
Average depth	- 8 centimeters
Velocity	- 1.0 meters/second
Volume of flow	- 24 liters/second
Temperature	- 13.8 C
Bottom composition	- Solid phyllite and some moss

V. PHYSICAL AND CHEMICAL DATA:

C) Outflow

Comments:

- stream flows through a joint in the rock
- some large pools
- several waterfalls

fig. 6B

legend

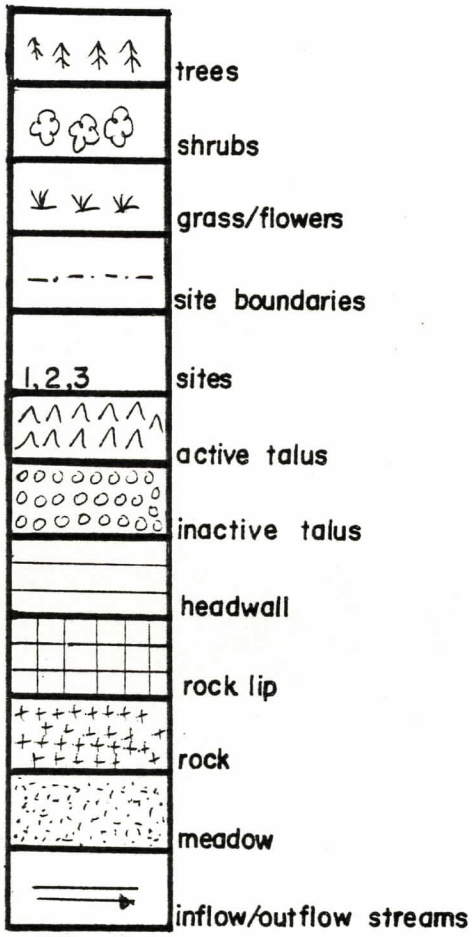
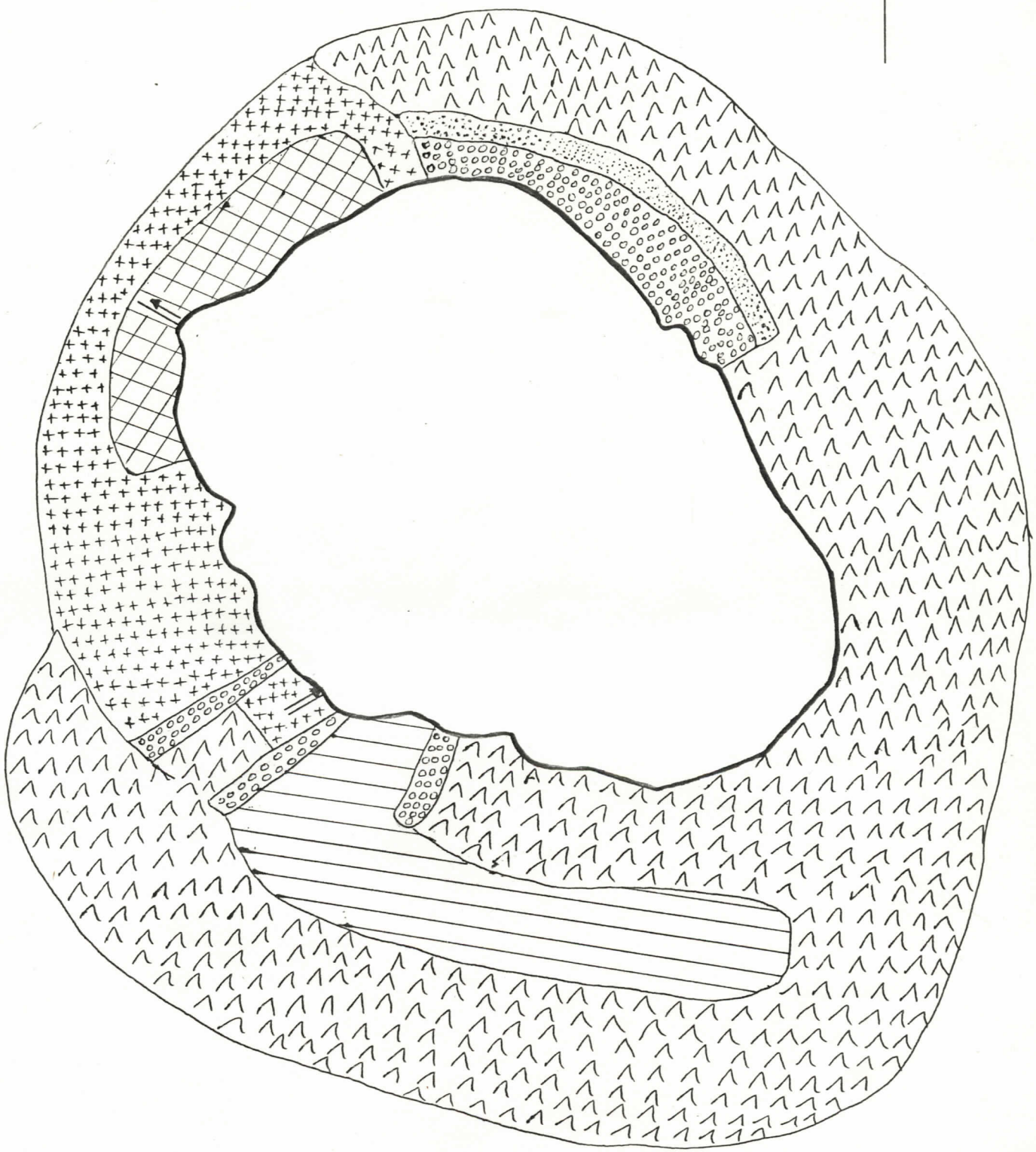


FIG. 6C

WOLFPUP LAKE

N



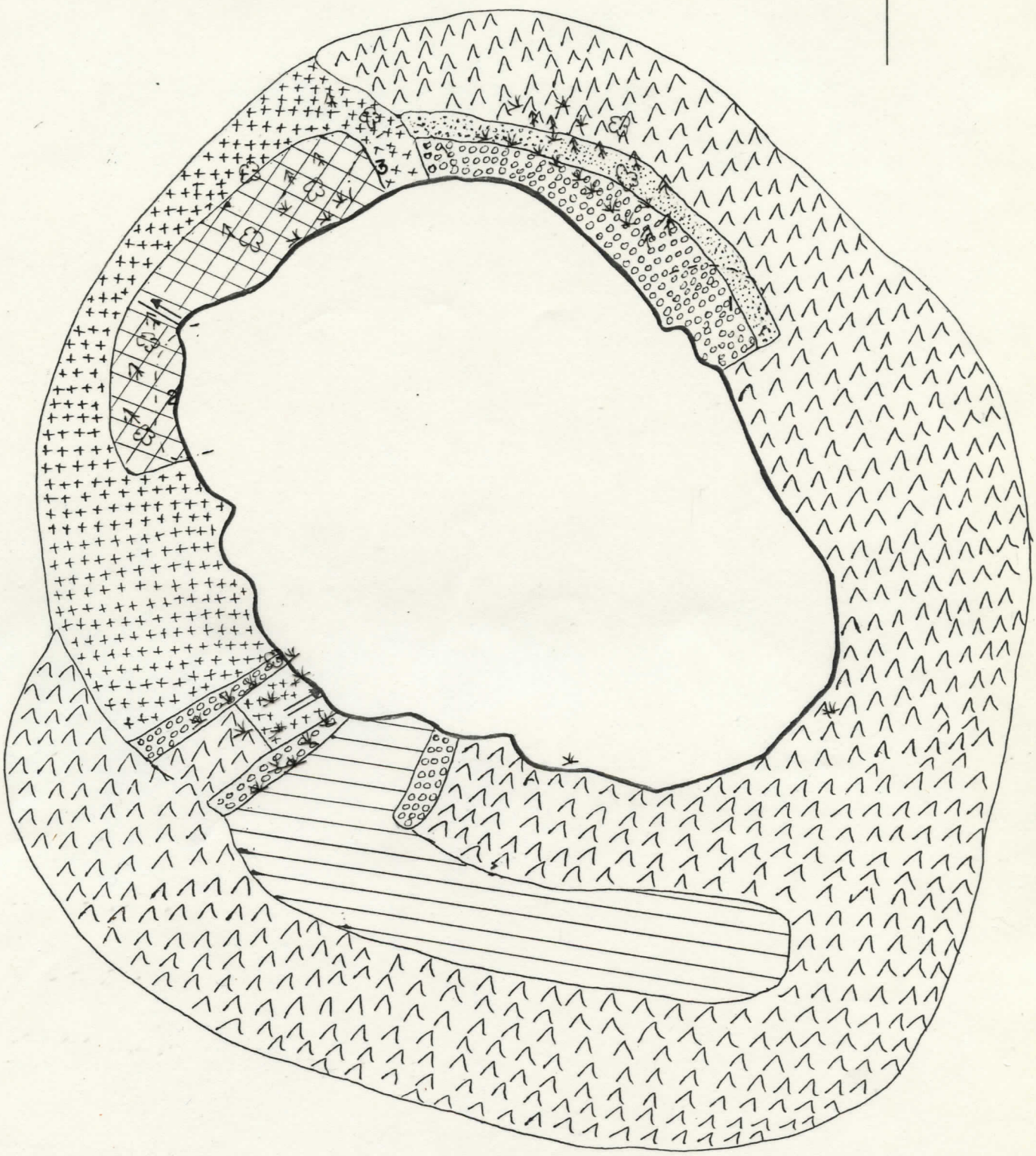
LANDFORMS

scale= 1:1700

FIG. 6C

WOLFPUP LAKE

N



LANDFORMS

VEGETATION

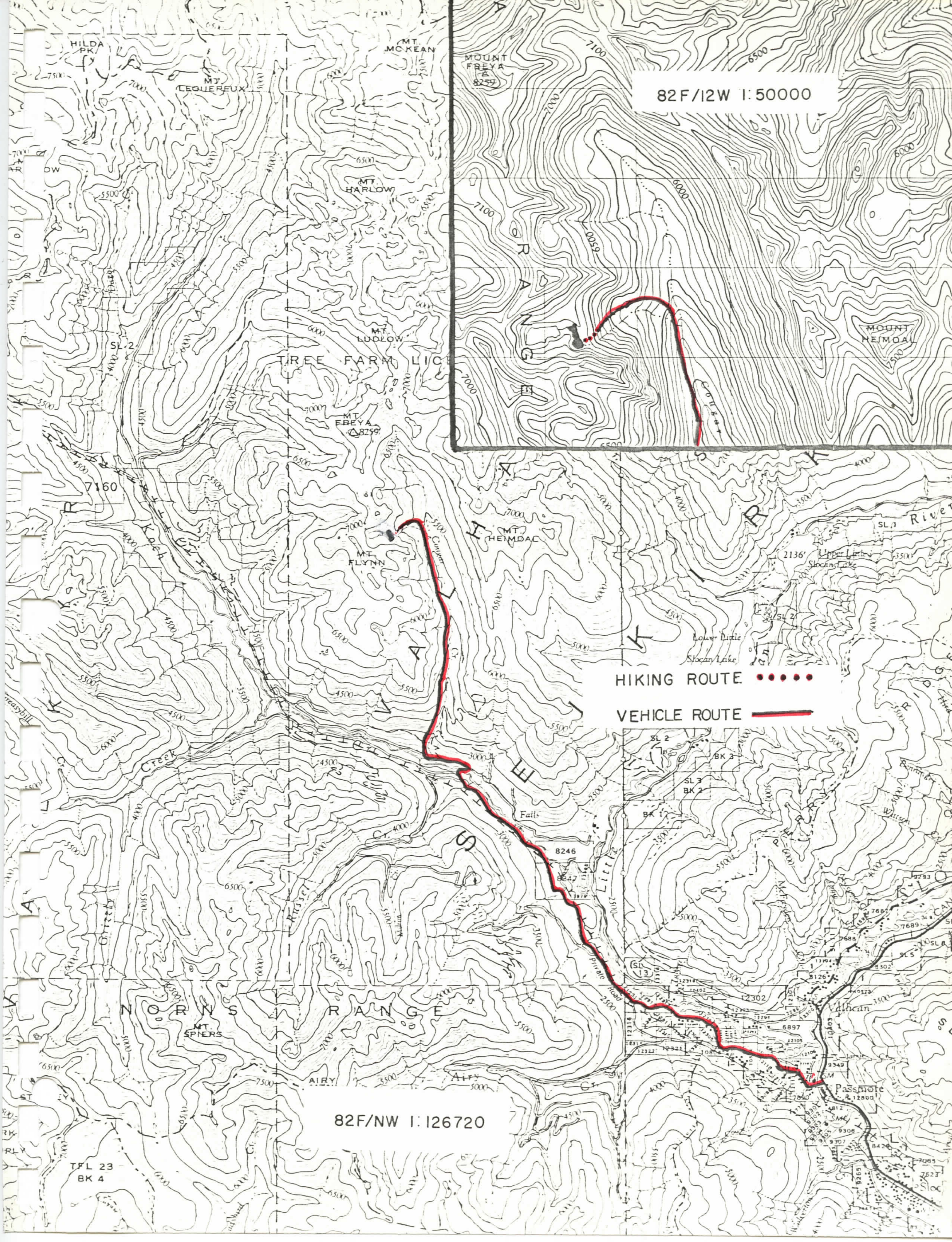
scale= 1:1700

BONNY LAKE

DATE STUDIED: July 10th, 1980

I. LOCATION:

- 49° 41' N., 117° 49' W.
- Department of Mines and Technical Surveys Map: Passmore, B.C., 82F/12W, 1:50,000; Grid Reference 413032
- Department of Lands, Forests and Water Resources Map: Slocan, B.C., 82F/NW, 1:126720
- Aerial photographs #BC 5352-017, #BC 5352-018


82F/12W 1:50000
MOUNT FREYA 8257
MOUNT HEIMDAL
HIKING ROUTE
VEHICLE ROUTE
82F/NW 1:126720
HILDA PK.
MT. LEQUEREUX
MT. MC KEAN
MT. HARLOW
MT. LUDLOW
TREE FARM LIC
MT. FREYA 8259
MT. FLYNN
MT. HEIMDAL
NORNS RANGE
MT. SPIERS
TFL 23 BK 4
Passmore
Vallican

II. ACCESS:

By Vehicle

Drive to the Playmore Junction (junction of Highway 6 and Highway 3A) and turn onto Highway 6. Proceed as follows:

DISTANCE (km)		FEATURE	ROUTE
16	-	Passmore Junction (Little Slocan Road, paved)	L
16.3	-	Bridge	
19.1	-	Beginning of dirt road	
19.8	-	Fork in road	L
20.5	-	Fork in road	L
21.2	-	Airy Mountain Road turn-off	R
22.4	-	Bridge (Airy Creek)	
28.2	-	Bridge (Boulder Creek)	
29.8	-	Russel Creek Road to left	R
30.1	-	Bridge (Koch Creek)	
30.6	-	Koch Creek Road turn-off	R
34.4	-	Cougar Creek Road turn-off	R
36.2	-	Fork in road	R
38.6	-	Bridge (Cougar Creek)	

II. ACCESS:

By Vehicle (cont'd)

DISTANCE (km)		FEATURE	ROUTE
39.6	-	Fork in road	L
40.9	-	Fork in road	R
42.8	-	Fork in road	L
44.5	-	Fork in road	L
45.3	-	End of road	

Hiking Route

Follow skid trails approximately half way up lowest ridge, then keep climbing straight up to the top. Hiking time is approximately one hour.

III. GENERAL DESCRIPTION:

Bonny Lake is a small, picturesque lake located at an elevation of 2000 meters. The southeasterly exposed lake is situated in a small cirque basin. The glacier that originally filled the basin converged with the Betsy Lake glacier, running in a northerly direction. The combined glaciers then ran into the larger Cougar Creek glacier that filled the valley to a height of almost 2000 meters. The northerly flow of Bonny cirque glacier gouged the rock, leaving the elongated shape seen today as Bonny Lake.

The lake is fed by several small meltwater streams coming down from the southern headwall and two larger inflows, one of which is Betsy Creek. Bonny Creek drains the lake on the south east edge.

III. GENERAL DESCRIPTION: (cont'd)

A notable feature of Bonny Lake is the two small, sparsely vegetated islands located near the north- and southwestern shores.

The best camping area was located on the moraine between Bonny Lake and Betsy Lake. The terrain there was dry and flat, and firewood was in good supply. There were several good camping areas on the east shore as well.

No fish were present in the lake.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

No vegetation was observed in Bonny Lake.

Sites

Bonny Lake is located in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. The site areas are illustrated in Figure 7C .

Bonny Lake is a small tarn. The south end of the lake comprises the major part of the cirque. A large rock lip, approximately 7 meters in height, extends over the entire east side of the lake. The outflow stream has managed to cut through the lip and has created a miniature gorge. The south and southwest ends consist of a steep headwall. There are two islands that were large pieces of rock which had broken loose from the headwall or adjoining ridge and had fallen into the lake. The major rock type is granite of the Valhalla Plutonic Zone. Also, there are many large quartz crystals in the area.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

This site was on the northeast end of the lake, at the base of a cliff. Vegetation grew in the cracks in the rocks in a thin (7 cm.) soil.

Slope: 39°

Exposure: West

Moisture Regime: Slightly damp

Vegetation Classification: Engelmann Spruce-Alpine Fir-Black Huckleberry Association of the ESAF Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Pinus flexilus (Limber Pine)

Picea glauca ssp. engelmannii (Engelmann Spruce)

Shrubs:

Rhododendron albiflorum (White Rhododendron)

Vaccinium membranaceum (Black Mountain Huckleberry)

Phyllodoce empetriformis (Red Heather)

Sorbus scopulina (Western Mountain Ash)

Flowers:

Phacelia hastata leucophylla (White-Leaved Phacelia)

Leptarrhena amplexifolia (Leptarrhena)

Viola glabella (Yellow Violet)

Mitella trifida (Three-Toothed Mitrewort)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

Vegetation (cont'd)

Mosses:

Dicranum fuscescens

Aulacomnium palustre

Lichens:

Parmeliopsis sp.

Cladonia sp. (Trumpet Lichen)

Peltigera sp.

Lecanora sp.

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

Site 2

This site was on the northwest edge of the lake on a small, terminal moraine where camp was set up. The soil here was better developed (20 - 25 cm.) but the flora was mainly low-lying.

Slope: 1°

Exposure: Southeast

Moisture Regime: Damp

Vegetation Classification: Engelmann Spruce-Alpine Fir-Black Huckleberry Association of the ESAF Biogeoclimatic Zone*

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2 (cont'd)

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Picea glauca ssp. engelmannii (Engelmann Spruce)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Gaultheria humifusa (Mountain Teaberry)

Phyllodoce glanduliflora (Yellow Heather)

Flowers:

Phacelia hastata leucophylla (White-Leaved Phacelia)

Anemone occidentalis (Western Anemone)

Penstemon sp. (Penstemon)

Mitella trifida (Three-Toothed Mitrewort)

Mosses:

Dicranum fuscescens

Hookeria lucens

Aulacomnium palustre

Lichens:

Parmeliopsis sp.

Alectoria sp. (Old Man's Beard)

Cladonia sp. (Trumpet Lichen)

Lecanora sp.

Grasses:

Unidentified

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

This site was located on the east edge of the lake, near the outflow stream. The soil depth was variable, from 10 cm. to bare rock.

Slope: 2°

Exposure: South

Moisture Regime: Slightly damp

Vegetation Classification: Engelmann Spruce-Alpine Fir-Black Huckleberry Association of the ESAF Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Pinus flexilus (Limber Pine)

Picea glauca ssp. engelmannii (Engelmann Spruce)

Shrubs:

Rhododendron albiflorum (White Rhododendron)

Vaccinium membranaceum (Black Mountain Huckleberry)

Phyllodoce empetriformis (Red Heather)

Phyllodoce glanduliflora (Yellow Heather)

Vaccinium Vitis-idaea (Mountain Bilberry)

Flowers:

Phacelia hastata leucophylla (White-Leaved Phacelia)

Mosses:

Pohlia nutans

Polytrichum juniperinum

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3 (cont'd)

Lichens:

Parmeliopsis sp.

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

Lecanora sp.

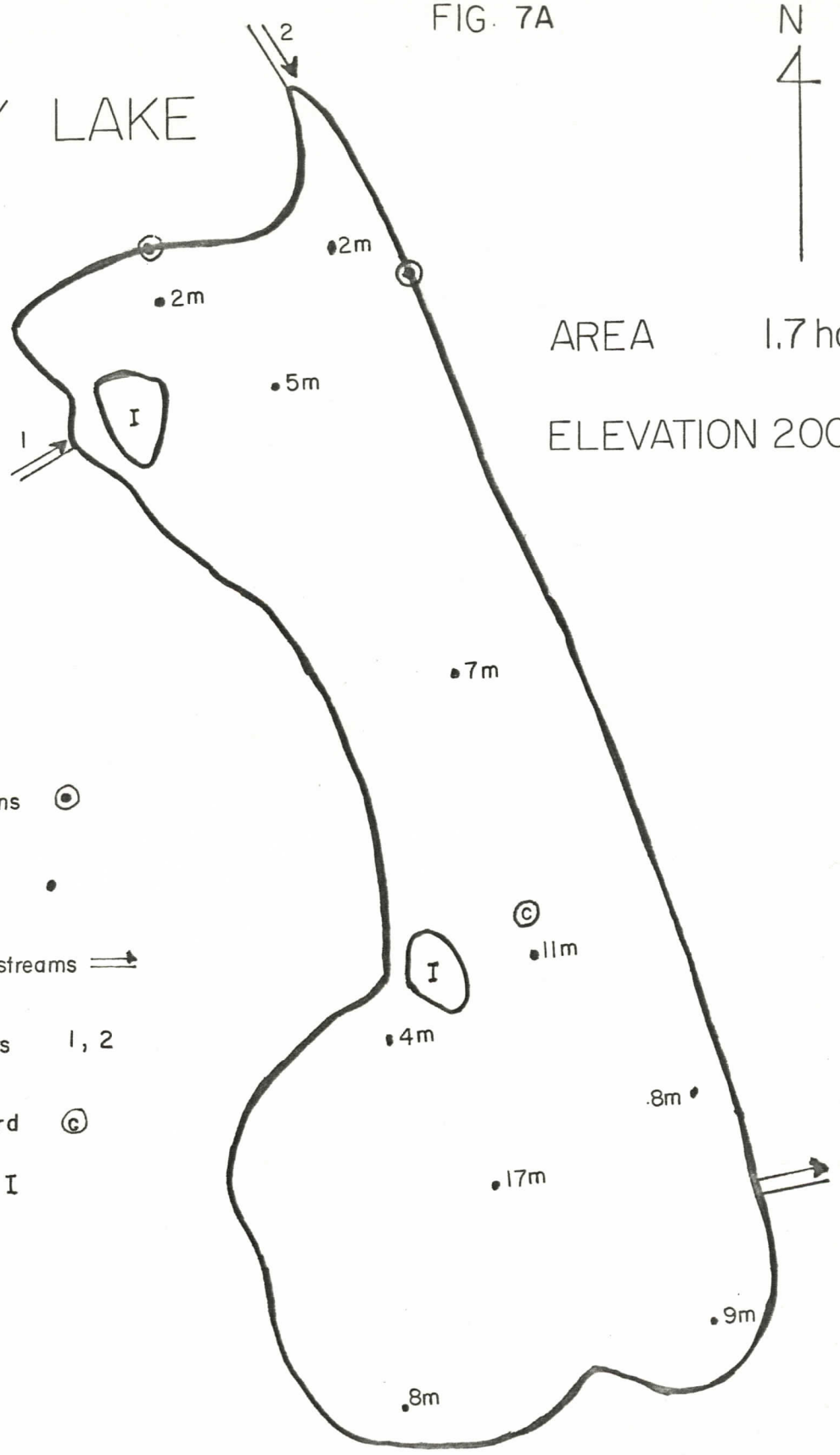
Grasses:

Unidentified

* The associations for the sites were classified within the associations given by the Forestry Handbook for British Columbia under the biogeoclimatic zone Engelmann Spruce-Alpine Fir Zone (ESAF).

FIG. 7A

BONNY LAKE



legend

plane table stations ⊙

depth soundings •

inflow/outflow streams ⟹

stream numbers 1, 2

chemical record Ⓒ

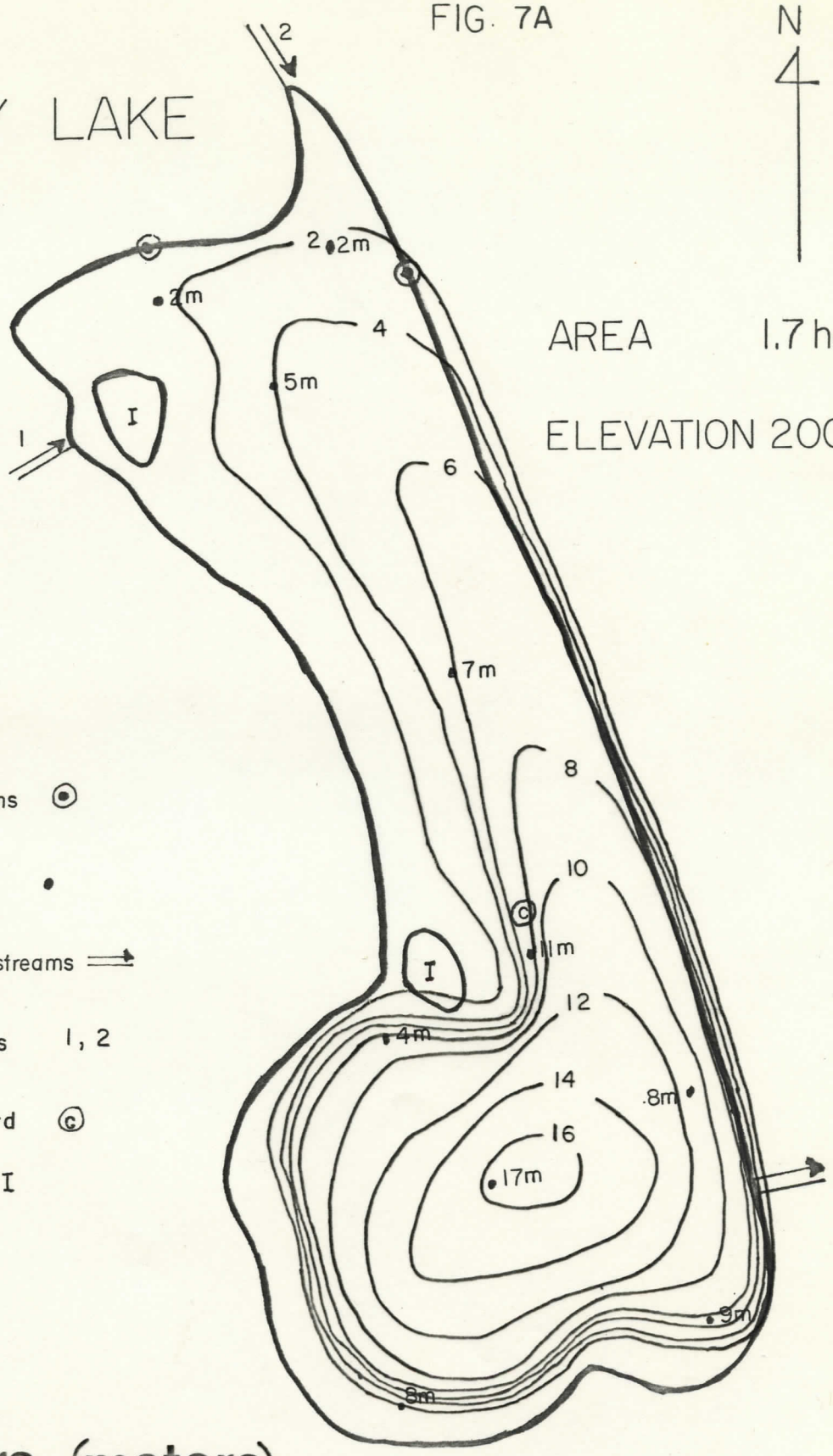
island I

PLANE TABLE SURVEY

scale = 1:1250

FIG. 7A

BONNY LAKE



AREA 1.7 ha.

ELEVATION 2000m.

legend

plane table stations ⊙

depth soundings •

inflow/outflow streams ⟹

stream numbers 1, 2

chemical record Ⓒ

island I

contours (meters)

PLANE TABLE SURVEY

scale = 1:1250

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test	Result
Temperature	- Top 10.0° C
	- Bottom - 9.7° C
Secchi Disc	- Limit of visibility - 8.7 m.
	- Weather conditions: foggy, rainy (July 10th, noon)
	- Water conditions: ripples
Bottom Composition	- Rocks, silt, clay
pH	- 6.9
Total Alkalinity	- 4 ppm
Total Dissolved Solids	- 11 ppm
Lake Level	- 7 centimeters below high water level
	- 3 centimeters above low water level

B) Inflow Streams

i) Inflow #1 (Betsy Creek)

Average width	- 4.5 meters
Average depth	- 22 centimeters
Velocity	- 0.47 meters/second
Volume of Flow	- 465 liters/second
Temperature	- 9.8°C
Bottom Composition	- Particles ranging in size from silt to mammoth boulders
Comment:	- Stream runs through talus
	- Stream is approximately 50 m. long

V. PHYSICAL AND CHEMICAL DATA:

B) Inflow Streams (cont'd)

ii) Inflow #2

Average width	-	1.4 meters
Average depth	-	14 centimeters
Velocity	-	0.013 meters/second
Volume of Flow	-	3 liters/second
Temperature	-	9.7°C
Bottom Composition	-	Particles ranging in size from silt to small cobbles 10 cm. in length
Comments:	-	Meanders through grassy meadow
	-	Originates under talus approximately 70 m. from lakeshore

C) Outflow Stream

Average width	-	1.2 meters
Average depth	-	19 centimeters
Velocity	-	0.56 meters/second
Volume of Flow	-	128 liters/second
Temperature	-	11.1°C
Bottom Composition	-	Moss and particles ranging in size from small boulders 40 cm. in length to mammoth boulders
Comments:	-	Flows through a rock cut
	-	Flows under talus in places
	-	Many small waterfalls

FIG. 7B

legend

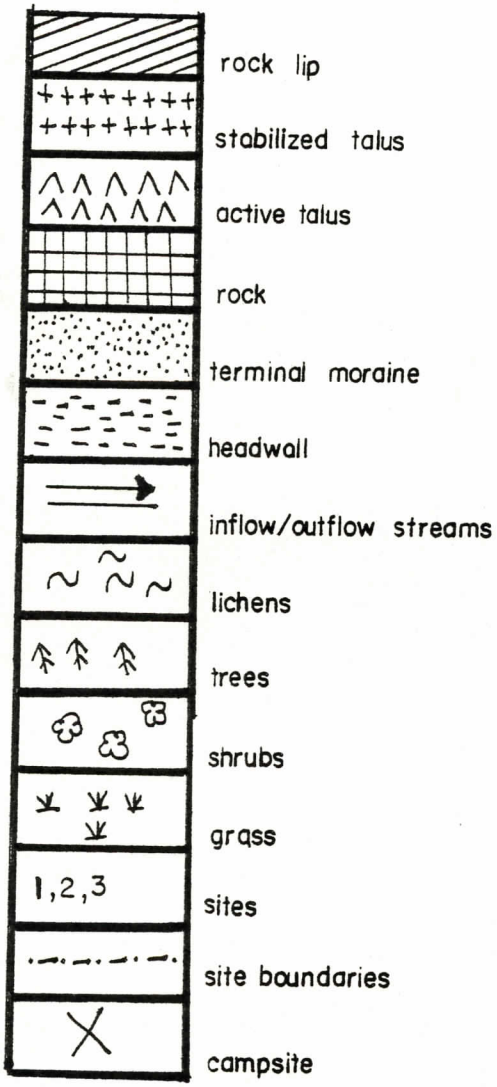
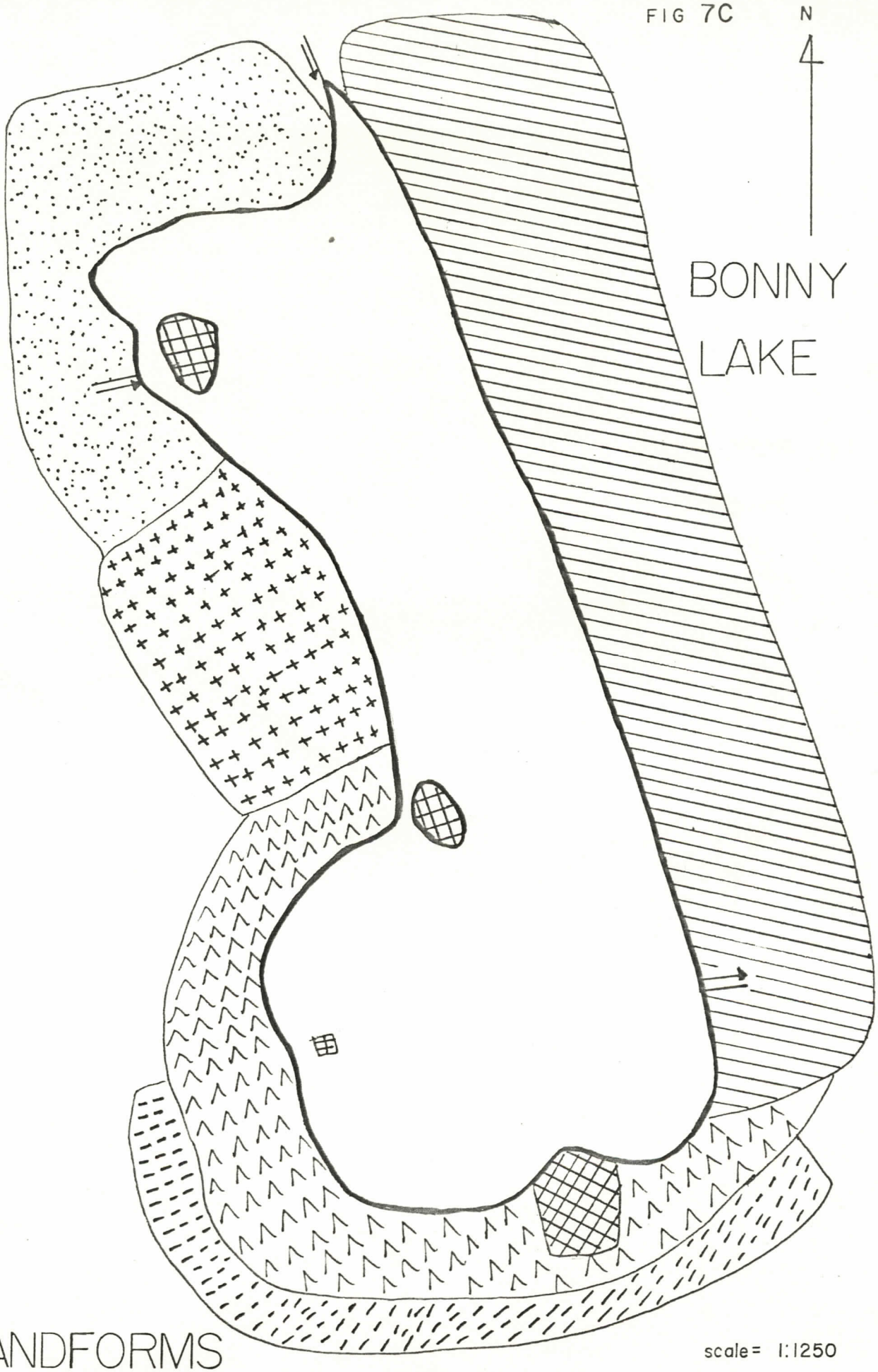


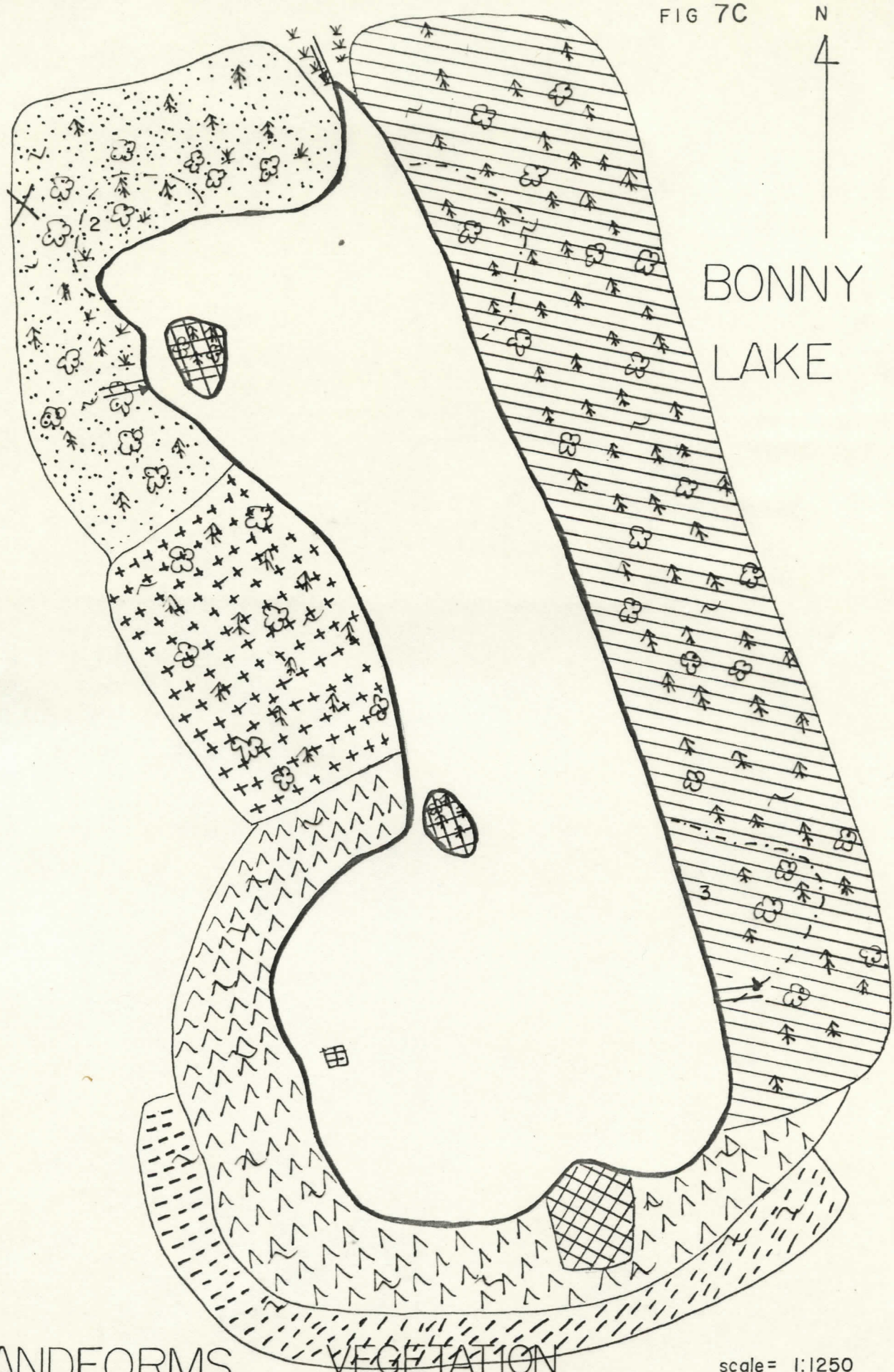
FIG 7C



LANDFORMS

scale = 1:1250

FIG 7C



LANDFORMS VEGETATION

scale = 1:1250

BETSY LAKE

DATE STUDIED: July 8th, 1980

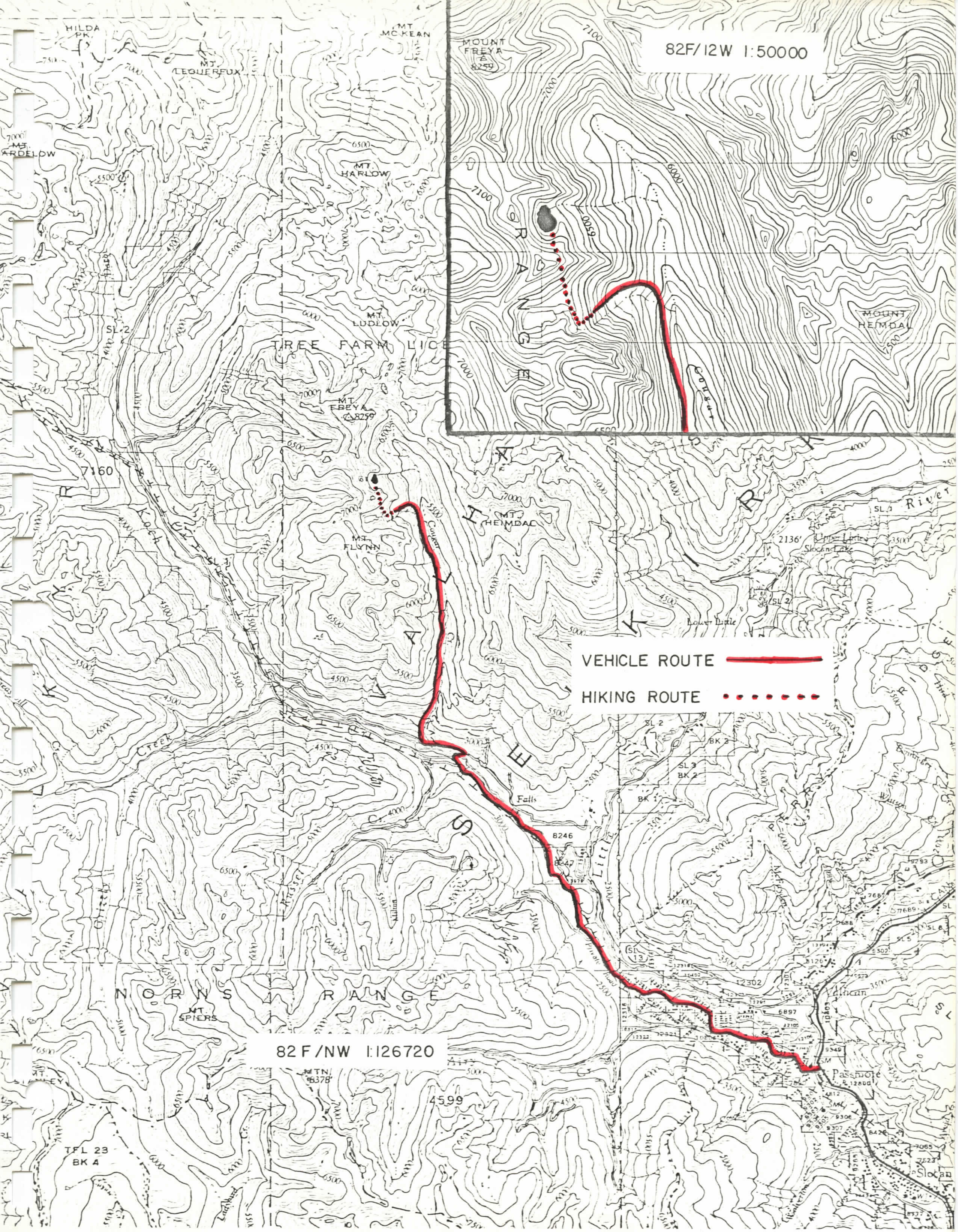
I. LOCATION:

- 49° 41' N., 117° 49' W.
- Department of Mines and Technical Surveys Map: Passmore, B.C., 82F/12W, 1:50,000; grid reference 410032.
- Department of Lands, Forests and Water Resources Map: Slocan, B.C., 82F/NW, 1:126720.
- Aerial photographs #BC 5352-017, #BC 5352-018.

II. ACCESS:

Travel to Bonny Lake as seen in "Access" on page .

Betsy is located approximately 50 meters from the Northwest shore of Bonny Lake.



82F/12W 1:50000
MOUNT FREYA 8259
MOUNT HEIMDAL
RANGE
VEHICLE ROUTE
HIKING ROUTE
HILDA PK.
MT. MCKEAN
MT. LEQUERFEUX
MT. HARLOW
MT. LUDLOW
TREE FARM LICE
MT. FREYA 8259
MT. HEIMDAL
MT. FLYNN
NORNS RANGE
MT. SPIERS
82 F/NW 1:126720
TFL 23 BK 4
Passmore
Vallican
Slocan

III. GENERAL DESCRIPTION:

Betsy Lake is a fairly large, deep lake located in a cirque basin at an elevation of 2000 meters.

The cirque glacier that originally filled Betsy Lake basin converged with Bonny Glacier at the north end of what is now Bonny Lake. As the ice melted back, the glacier left a small terminal moraine that now blocks Betsy Lake on the Northeast end.

Many small meltwater streams feed this easterly exposed lake. Betsy Creek drains the lake on the east end and flows approximately 50 meters until it flows into Bonny Lake. The lake was at high water level. Low water mark appeared to be approximately 30 centimeters below measured level.

The best camping area was located between Betsy Lake and Bonny Lake on the moraine. Firewood was in good supply.

No fish were present in the lake.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

Leuvenia sp. was identified as one of the algae observed growing along the edge of Betsy Lake.

Sites

Betsy Lake is located in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. The site areas are illustrated in Figure 8C.

IV. VEGETATION AND GEOMORPHOLOGY:

Sites (cont'd)

Betsy Lake is a tarn in an extended cirque basin. Instead of being blocked by a rock lip, it is dammed on the east end by a small terminal moraine of only a meter or two in height. The west edge of the lake consists of a steep headwall, while cliffs comprise the main part of the north side. The south side is not as steep but there are several large rock outcroppings. Several boulders, that have fallen from the ridge, are located in the east end of the lake. The cirque scouring action was intense as indicated by the measured depth of the lake, which was 27 meters. Granite and quartz crystals make up the major rock types derived from the Valhalla Plutonic Zone.

Site 1

This site was on the west end of Betsy Lake on a stabilized talus slope at the base of the headwall. Soil development was sporadic.

Slope:	32°
Exposure:	Southeast
Moisture Regime:	Dry
Vegetation Classification:	Lichen Association of the ESSFe Biogeoclimatic Zone*

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1 (cont'd)

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Pinus flexilus (Limber Pine)

Tsuga heterophylla (Western Hemlock)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Vaccinium scoparium (Grouseberry)

Vaccinium Vitis-idaea (Mountain Bilberry)

Flowers:

Phacelia hastata leucophylla (White-Leaved Phacelia)

Viola adunca (Blue Violet)

Veronica serpyllifolia (Thyme-Leaved Speedwell)

Sibbaldia procumbens (Sibbaldia)

Mosses:

Pohlia wahlenbergii

Polytrichum juniperinum

Lichens:

Lecanora sp.

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

View from outflow stream. Ridge in background rises to Mt. Flynn on the left.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2

This site was located on the south end of the lake on a large rock outcrop. The soil was approximately 10 cm. deep on rock base with a 4 cm. Ae horizon (gray, leached) over a 6 cm. Ah horizon (darker, more acidic).

Slope: 18°

Exposure: West

Moisture Regime: Well drained, slightly damp to dry

Vegetation Classification: Engelmann Spruce-Alpine Fir-Black Huckleberry Association of the ESAF Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Picea glauca ssp. engelmannii (Engelmann Spruce)

Pinus flexilus (Limber Pine)

Shrubs:

Phyllodoce empetriformis (Red Heather)

Cassiope mertensiana (White Moss Heather)

Rhododendron albiflorum (White Rhododendron)

Vaccinium membranaceum (Black Mountain Huckleberry)

Vaccinium scoparium (Grouseberry)

Vaccinium caespitosum (Dwarf Huckleberry)

Flowers:

Leptarrhena amplexifolia (Leptarrhena)

Sibbaldia procumbens (Sibbaldia)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2

Vegetation (cont'd)

Mosses:

Polytrichum juniperinum

Dicranum fuscescens

Pohlia wahlenbergii

Lichens:

Parmeliopsis sp.

Leprocaulon sp.

Cladonia sp. (Trumpet Lichen)

Lecanora sp.

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

Site 3

This site was located on the northeast edge of Betsy Lake on the moraine. The soil was relatively well developed (20 - 25 cm. in depth).

Slope: 1° - 5°

Exposure: Southwest

Moisture Regime: Dry

Vegetation Classification: Engelmann Spruce-Alpine Fir-Black Huckleberry Association of the ESAF Biogeoclimatic Zone*

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3 (cont'd)

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Tsuga heterophylla (Western Hemlock)

Pinus flexilus (Limber Pine)

Picea glauca ssp. engelmannii (Engelmann Spruce)

Pinus albicaulis (Whitebark Pine)

Abies amabilis (Balsam Fir) rare

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Rhododendron albiflorum (White Rhododendron)

Vaccinium membranaceum (Black Mountain Huckleberry)

Mosses:

Dicranum fuscescens

Lichens:

Parmeliopsis sp.

Alectoria sp. (Old Man's Beard)

Lecanora sp.

Grasses:

Unidentified

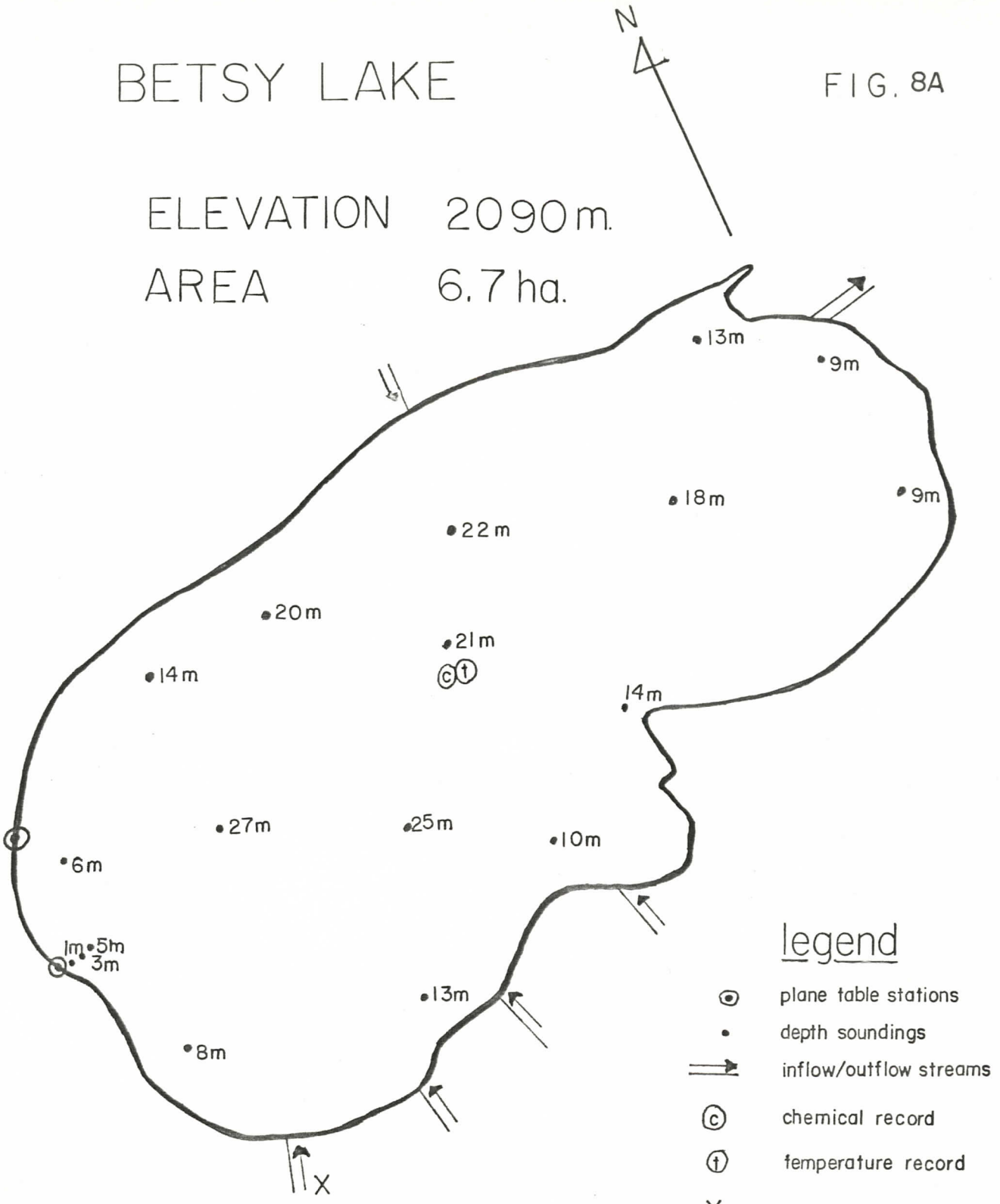
* The association classification for site 1 was developed from Utzig's Guide For Tree Species Selection in the Nelson Forest District under the biogeoclimatic zone Engelmann Spruce-Subalpine Fir Zone (ESSFe). The associations for sites 2 and 3 were classified within the associations given by the Forestry Handbook for British Columbia under the biogeoclimatic zone Engelmann Spruce Alpine Fir Zone (ESAF).

BETSY LAKE

FIG. 8A

ELEVATION 2090m.

AREA 6.7 ha.



PLANE TABLE SURVEY

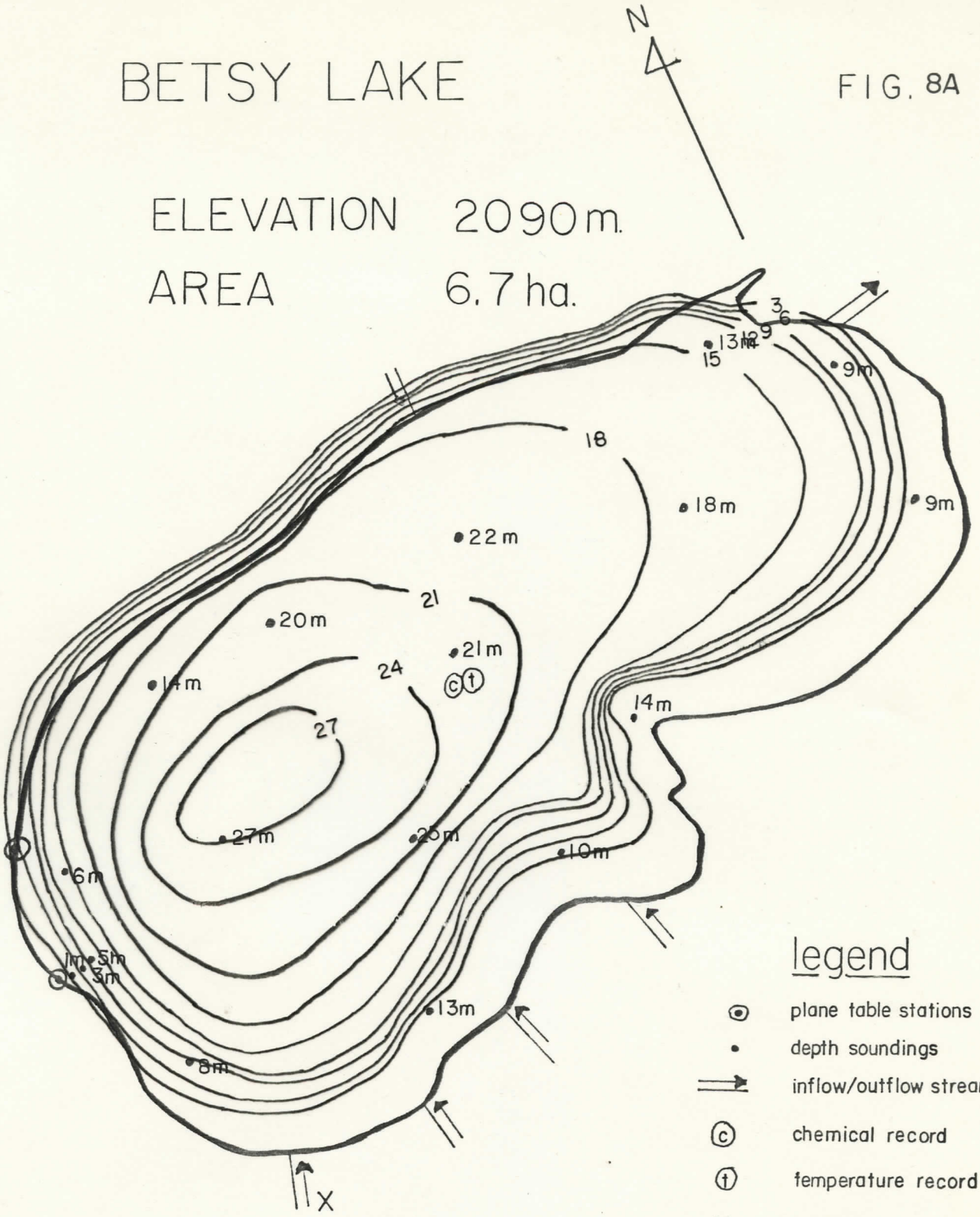
scale = 1:2000

BETSY LAKE

FIG. 8A

ELEVATION 2090 m.

AREA 6.7 ha.



contours (meters)

PLANE TABLE SURVEY

scale = 1:2000

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test		Result
Temperature	-	Top - 9.6° C
		Bottom - 9.2° C
Secchi Disc	-	Limit of Visibility - 9.2 meters
	-	Weather conditions - cloudy, windy (July 8th 5:00 p.m.)
	-	Water conditions - ripples
Bottom Composition	-	Rocks, silt
pH	-	6.8
Total Alkalinity	-	5 ppm
Total Dissolved Solids	-	9 ppm

B) Inflow Streams

There were several inflow streams running into Betsy Lake that originated from the many snow patches situated around the basin. The largest stream was measured, and had a 0.8°C temperature and width of approximately 3 meters. Any other measurements of this stream and the others were impossible as they flowed under talus. Stream velocity, depth and volume were all increased at warmer times of the day due to greater snowmelt.

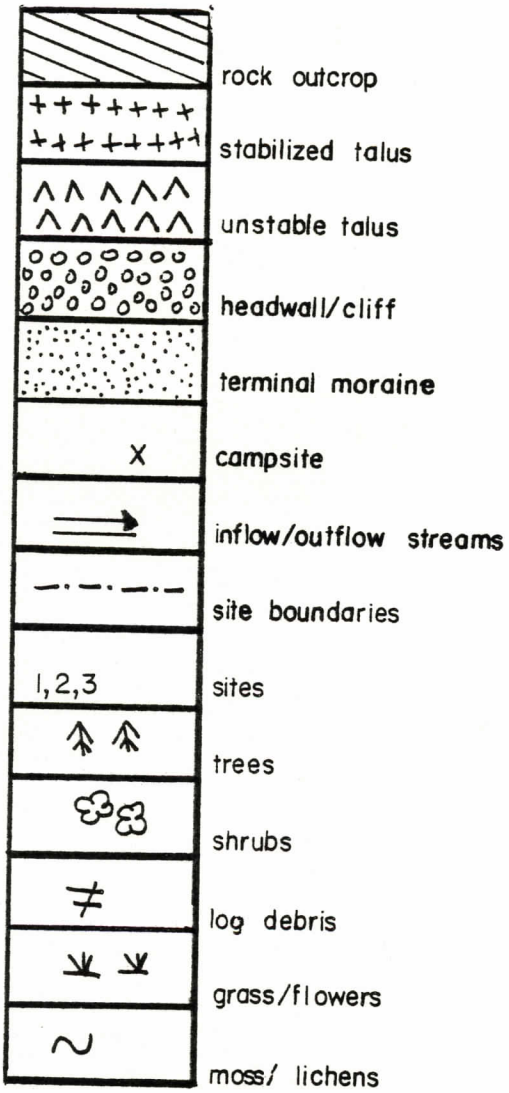
V. PHYSICAL AND CHEMICAL DATA:

C) Outflow Stream

Average width	-	4.5 meters
Average depth	-	22 centimeters
Velocity	-	0.47 meters/second
Volume of Flow	-	465 litres/second
Temperature	-	9.8°C
Bottom Composition	-	particles ranging in size from silt to mammoth boulders
Comments:	-	stream flows through talus
	-	stream is approximately 50 m. long

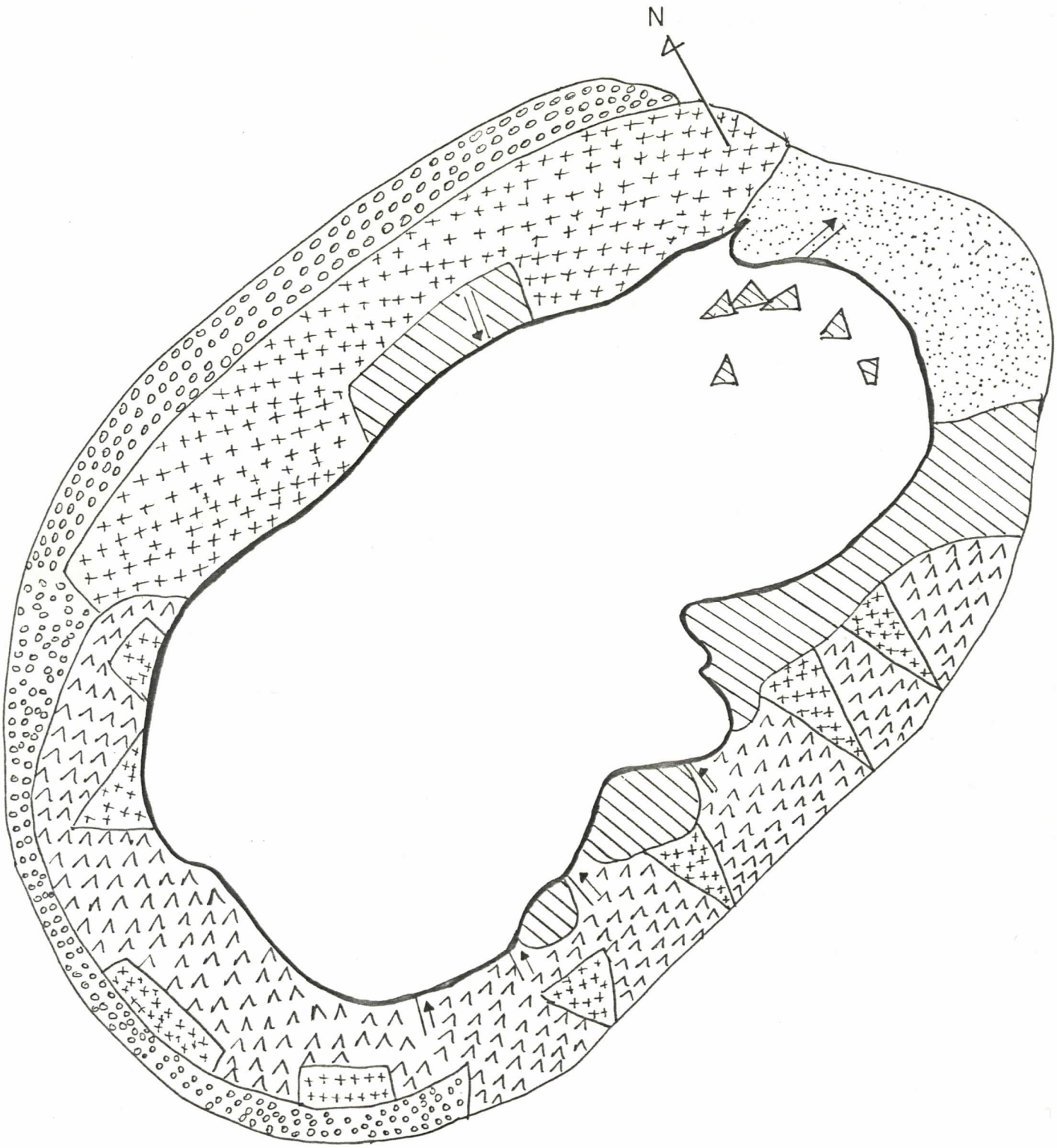
FIG. 8B

legend



BETSY LAKE

FIG. 8C

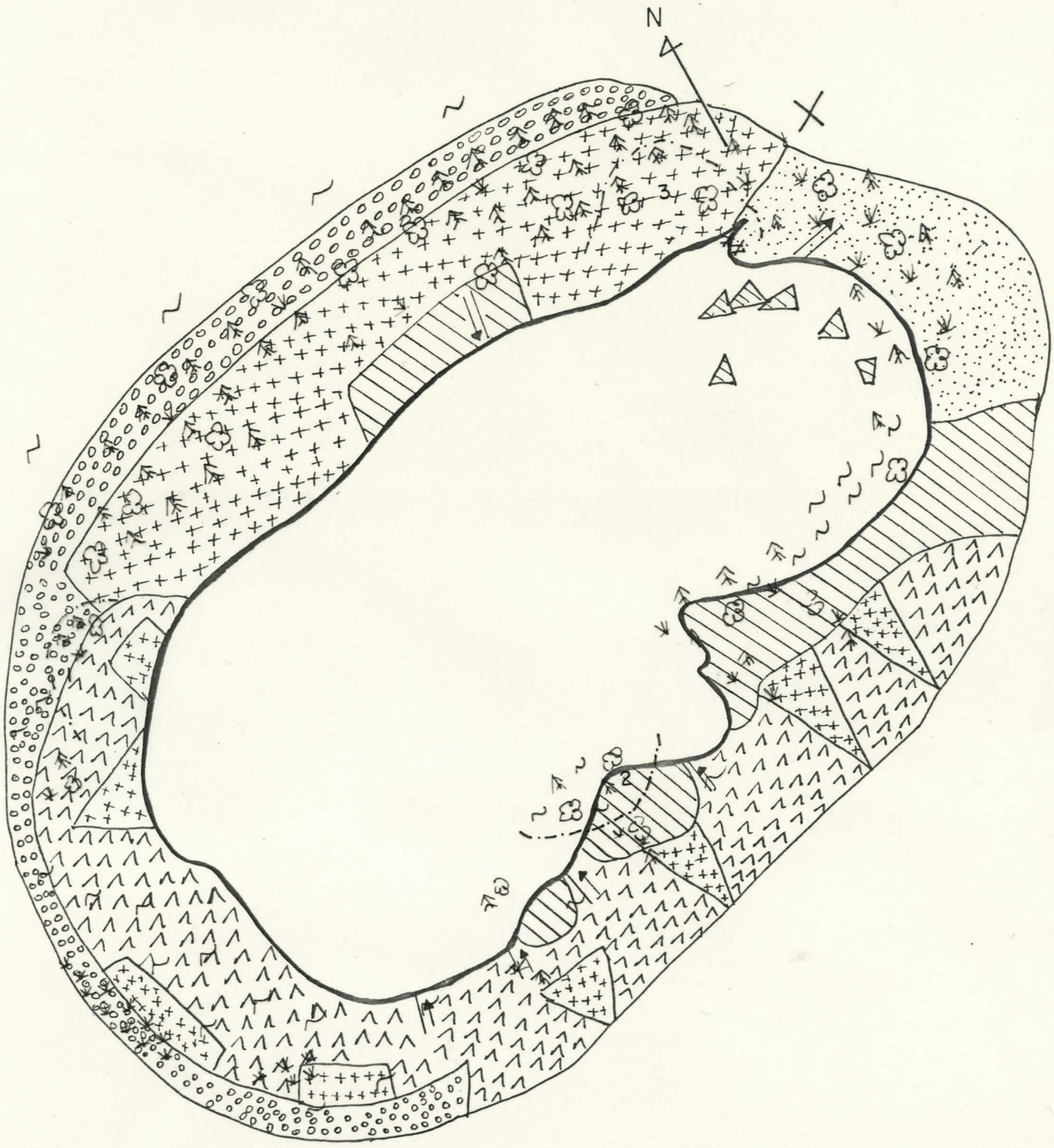


scale = 1:2400

LANDFORMS

BETSY LAKE

FIG. 8C



scale = 1:2400

LANDFORMS VEGETATION

BROTHER LAKE

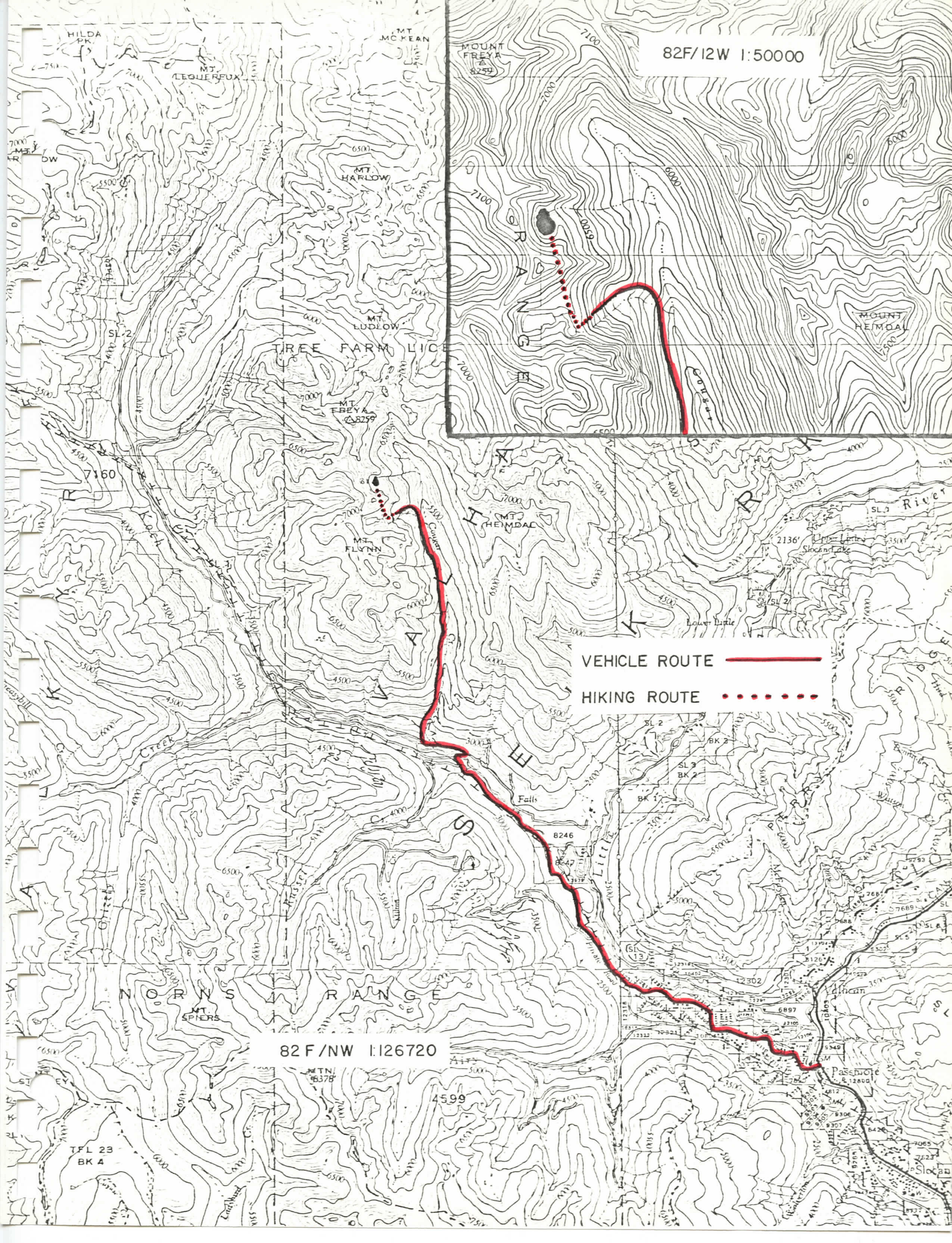
DATE STUDIED: July 9th, 1980

I. LOCATION:

- 49° 41.5' N., 117° 49' W.
- Department of Mines and Technical Surveys Map: Passmore, B.C., 1:50,000, 82F/12W; Grid Reference 410045
- Department of Lands, Forests and Water Resources Map: Slocan, B.C., 82F/NW, 1:126720
- Aerial photographs #BC 5352-017, #BC 5352-018

II. ACCESS:

Travel to Bonny Lake as seen in "ACCESS" on page . Follow the meandering inflow stream on Bonny Lake's north shore and continue up to the top of the high ridge following an avalanche trail. Brother Lake can be seen from the ridge. Walk straight down to the lake. Hiking time to the top of the ridge is approximately 45 minutes and it takes another 20 minutes to get down to the lake.


82F/12W 1:50000
MOUNT FREYA
MOUNT HEIMDAL
VEHICLE ROUTE
HIKING ROUTE
TREE FARM LICE
MT. HARLOW
MT. LUDLOW
MT. FREYA
MT. HEIMDAL
MT. FLYNN
HILDA PK.
MT. MCKEAN
MT. LEQUEREUX
NORNS RANGE
MT. SPIERS
82 F/NW 1:126720
Falls
Passmore
TFL 23 BK 4

III. GENERAL DESCRIPTION:

Brother Lake is a medium sized, relatively deep tarn located at an elevation of 2090 meters.

This southerly exposed lake is fed by numerous small meltwater streams and drained on the northeast end by Brother Creek.

The eastern side of the lake was dry and sparsely wooded thus containing several good camping areas. Firewood was abundant.

No fish were present in Brother Lake. Brother Creek appeared to have very limited spawning potential as it flowed under talus 40 meters from the lake.

The lake appeared to be 5 centimeters below high water mark and 10 centimeters above low water level.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

Algal growth was observed along the shoreline of Brother Lake (*Leuvenia sp.* was identified).

Sites

Brother Lake is situated in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. The site areas are illustrated in Figure . Brother Lake is a tarn which is geologically situated in the Valhalla Plutonic Zone. The major rock type is granite. The entire west side of the lake is the cirque headwall consisting of talus, glacially striated cliffs, and extremely sparse flora. The rock lip is on the east side of the lake. An adequate soil, in which trees and shrubs have taken root, has developed on the lip. No sites were established on the west side of the

IV. VEGETATION AND GEOMORPHOLOGY:

Sites (cont'd)

lake, as it was mainly cliffs and talus slopes, but the vegetation was basically mosses and lichens. Since there was moss and grass growing over it, all the talus around the lake has stabilized to some degree (see Figure 9C).

Site 1

This site was on the south edge of the lake at the bottom of a talus slope. It consisted of rolling ground covered in grass. The soil averaged 3 cm. deep.

Slope: 12°

Exposure: North

Moisture Regime: Slightly damp

Vegetation Classification: Lichen Association of the ESSFe Biogeoclimatic Zone*

Vegetation

Shrubs:

Phyllodoce empetriformis (Red Heather)

Cassiope mertensiana (White Moss Heather)

Flowers:

Phacelia hastata leucophylla (White-Leaved Phacelia)

Leptarrhena amplexifolia (Leptarrhena)

Ranunculus eschscholtzii (Snow Buttercup)

Mosses:

Oliogotrichum aligerum

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

Vegetation (cont'd)

Lichens:

Parmeliopsis sp.

Cladonia sp. (Trumpet Lichen)

Leprocaulon sp.

Lecanora sp.

Liverwort:

Unidentified

Grasses:

Unidentified

Site 2

This site was situated on the east side of the lake on the rock lip. Soil depth varied from at least 15 cm. to 0 cm. (bare rock).

Slope: 11°

Exposure: South

Moisture Regime: Dry

Vegetation Classification: Engelmann Spruce-Alpine Fir-Black Huckleberry Association of the ESAF Biogeoclimatic Zone*

Vegetation

Trees:

Picea glauca ssp. engelmannii (Engelmann Spruce) - sparse

Abies lasiocarpa (Alpine Fir)

Pinus flexilus (Limber Pine)

A rubber raft in a 10°C lake is cold even in July!

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2

Vegetation (cont'd)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Sambucus racemosa var. melanocarpa (Black-Berry Elder)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Flowers:

Phacelia hastata leucophylla (White-Leaved Phacelia)

Sibbaldia procumbens (Sibbaldia)

Mosses:

Oligotrichum aligerum

Lichens:

Parmeliopsis sp.

Alectoria sp. (Old Man's Beard)

Lecanora sp.

Grasses:

Unidentified

Site 3

This site was situated on the north end of the lake in a meadow. The soil was at least 10 cm. deep. Parts of the site consisted of talus that was overgrown with flora.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

Vegetation

Flowers: (cont'd)

Senecio triangularis (Giant Ragwort)

Erigeron aureus (Golden Fleabane)

Viola adunca (Blue Violet)

Veratrum eschocholtzii (Indian Hellebore)

Oxyria digyna (Mountain Sorrel)

Mitella trifida (Three-Toothed Mitrewort)

Valeriana capitata (Valerian)

Mosses:

Dicranella heteromalla

Aulacomnium palustre

Lichens:

Parmeliopsis sp.

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

Lecanora sp.

Grasses:

Unidentified

* The association classifications for sites 1 and 3 were developed from Utzig's Guide For Tree Species Selection in the Nelson Forest District under the biogeoclimatic zone Engelmann Spruce-Subalpine Fir Zone (ESSFe). The association for site 2 was classified within the association given by the Forestry Handbook for British Columbia under the biogeoclimatic zone Engelmann Spruce-Alpine Fir Zone (ESAF).

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3 (cont'd)

Slope: 3°

Exposure: Southwest

Moisture Regime: Slightly damp to damp by the inflow

Vegetation Classification: Vaccinium scoparium Association of the ESSFe Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Shrubs:

Phyllodoce empetriformis (Red Heather)

Cassiope mertensiana (White Moss Heather)

Rhododendron albiflorum (White Rhododendron)

Vaccinium membranaceum (Black Mountain Huckleberry)

Vaccinium scoparium (Grouseberry)

Flowers:

Montia sibirica (Siberian Miner's Lettuce)

Leptarrhena amplexifolia (Leptarrhena)

Phacelia hastata leucophylla (White-Leaved Phacelia)

Anemone occidentalis (Western Anemone)

Valeriana sitchensis (Mountain Valerian)

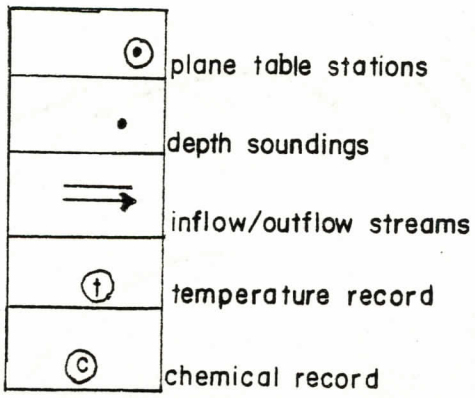
Moneses uniflora (Single Delight)

Castilleja sp. (Indian Paintbrush)

Ranunculus eschscholtzii (Snow Buttercup)

FIG. 9B

legend

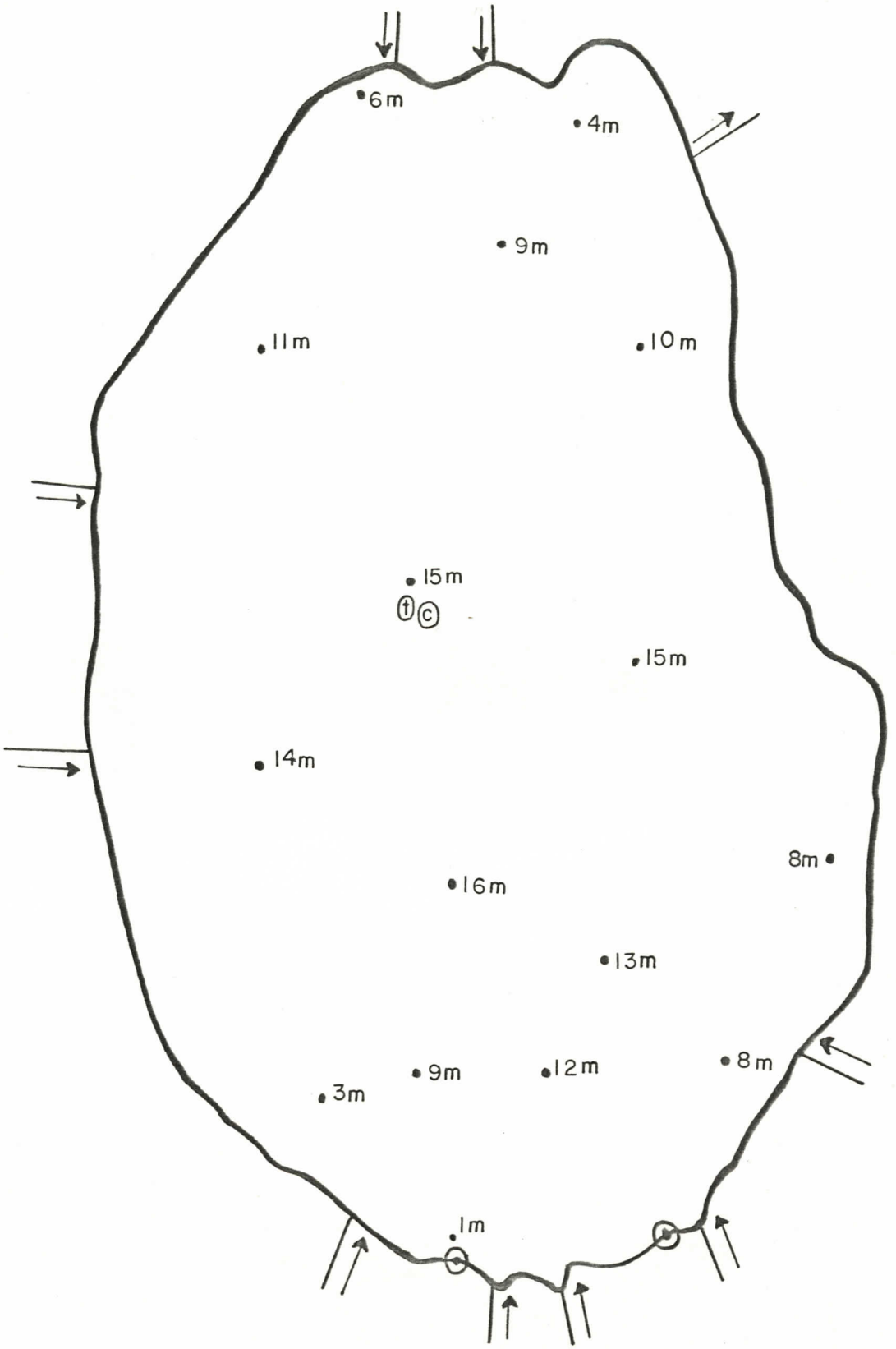


CONTOURS ARE IN METERS

ELEVATION	2000 m.
AREA	5.2 ha.

FIG. 9A

BROTHER LAKE

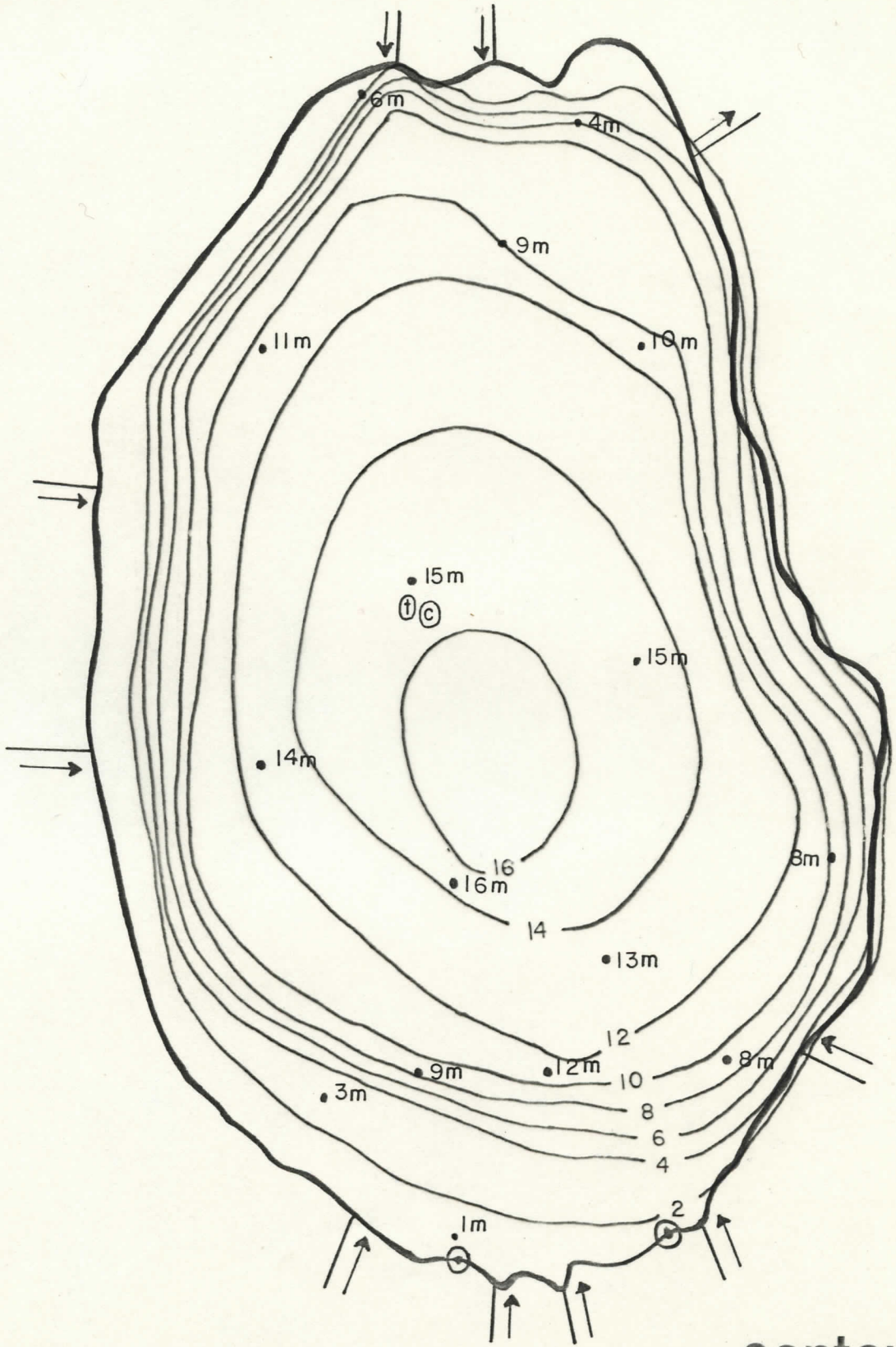


PLANE TABLE SURVEY

scale = 1:1700

FIG. 9A

BROTHER LAKE



contours

PLANE TABLE SURVEY

scale = 1:1700

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Temperature	-	Top - 9.9°C
	-	Bottom - 9.6°C
Secchi Disc	-	Limit of Visibility - 10.0 meters
	-	Weather conditions - sunny (July 9th, 1:00 p.m.)
	-	Water conditions - slight ripple
Bottom Composition	-	Rocks, silt
pH	-	6.9
Total Alkalinity	-	8 ppm
Total Dissolved Solids	-	6 ppm

B) Inflow Streams

Approximately ten small unmeasureable streams fed Brother Lake. Most of these seasonal runoff streams flowed underneath talus, originating from snow patches along the basin. A few streams braided over grassy meadows close to shore. The stream temperatures ranged from near 0°celsius to approximately 6°C. Stream velocity, depth and volume were all increased at warmer times of the day due to greater snowmelt. Stream bed particles ranged in size from sand to mammoth boulders.

V. PHYSICAL AND CHEMICAL DATA:

C) Outflow Stream

Average width	- 1.2 meters
Average depth	- 19 centimeters
Velocity	- 0.83 meters/second
Volume of Flow	- 189 liters/second
Temperature	- 10.8°C
Bottom Composition	- Moss and particles ranging in size from silt to mammoth boulders
	- particles less than 5 cm. in length were occasional
Comments:	- Stream flows under talus 40 m from lake
	- braided waterfalls 10 m from lake

FIG. 9C

legend

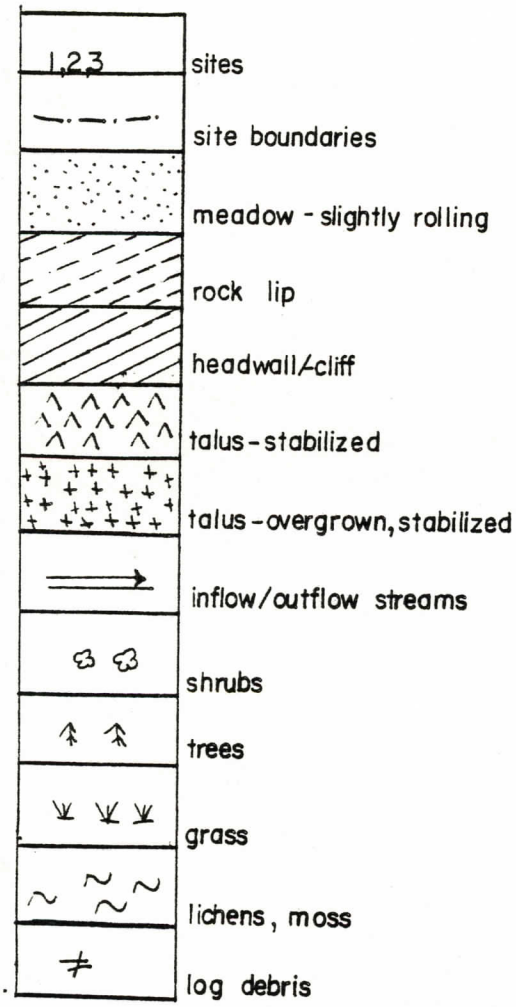
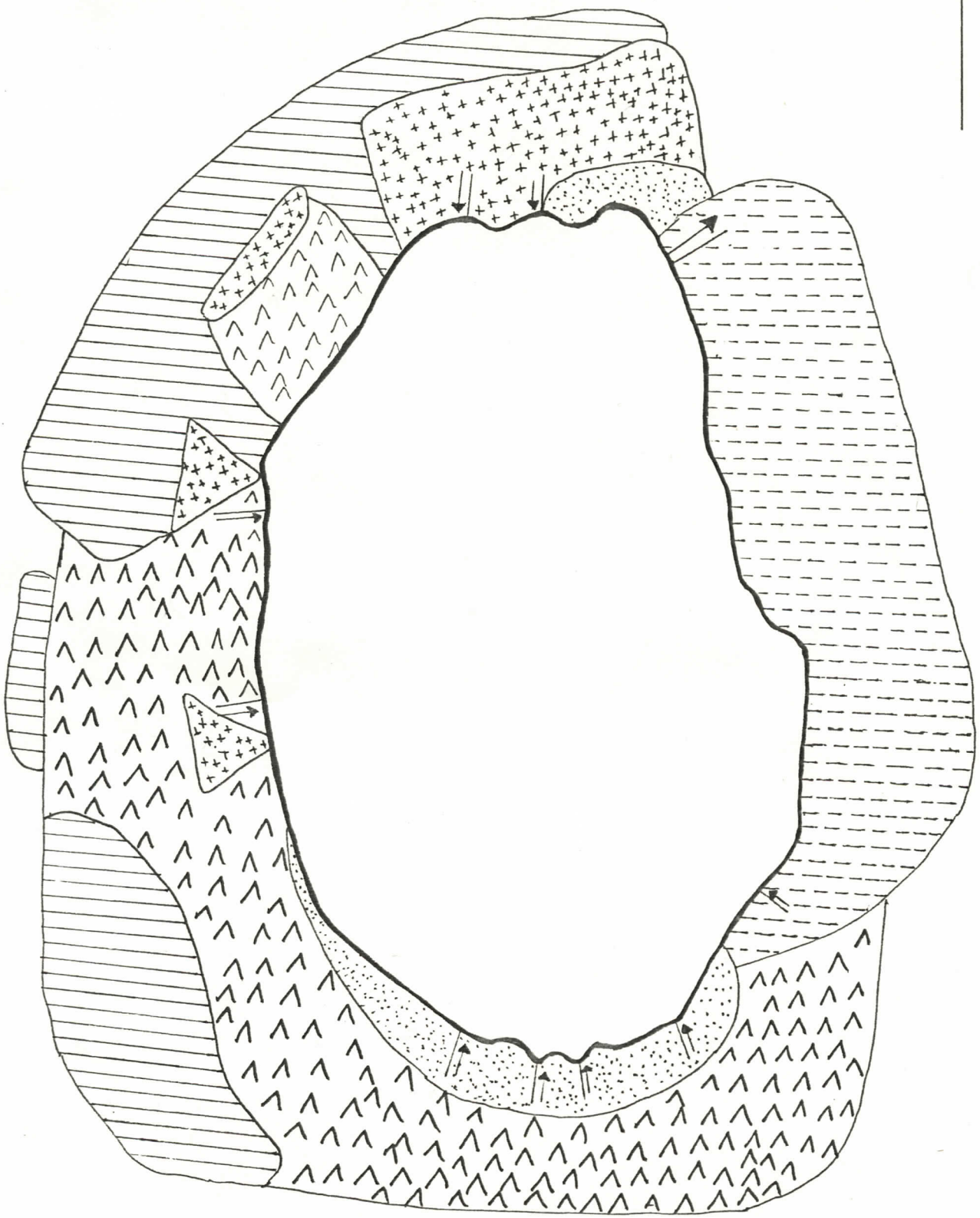


FIG. 9D

BROTHER LAKE

N

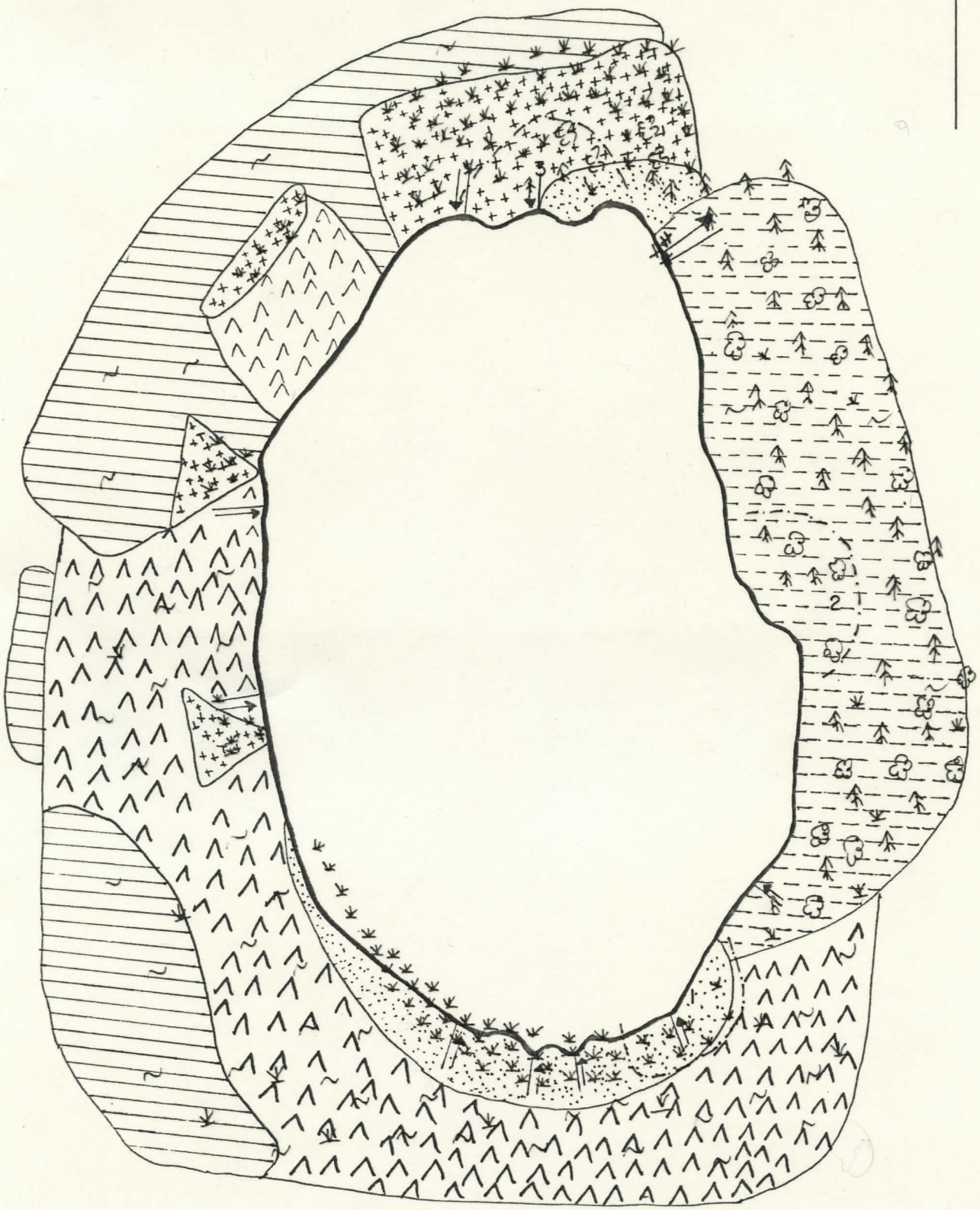


LANDFORMS

scale = 1 : 2000

FIG. 9D

BROTHER LAKE



VEGETATION

LANDFORMS

scale = 1 : 2000

HAISELDEAN LAKE

DATE STUDIED: July 28th, 1980

I. LOCATION:

- 49°40.5' N, 117° 2' W.
- Department of Mines and Technical Surveys Map: Kokanee Peak, Kootenay District, B.C. 82F/11E, 1:50,000. Grid Reference 973023
- Department of Lands, Forests and Water Resources Map: Slocan, B.C., 82F/NW, 1:126,720
- Aerial photographs #BC 5348-045, #BC 5348-046

II. ACCESS:

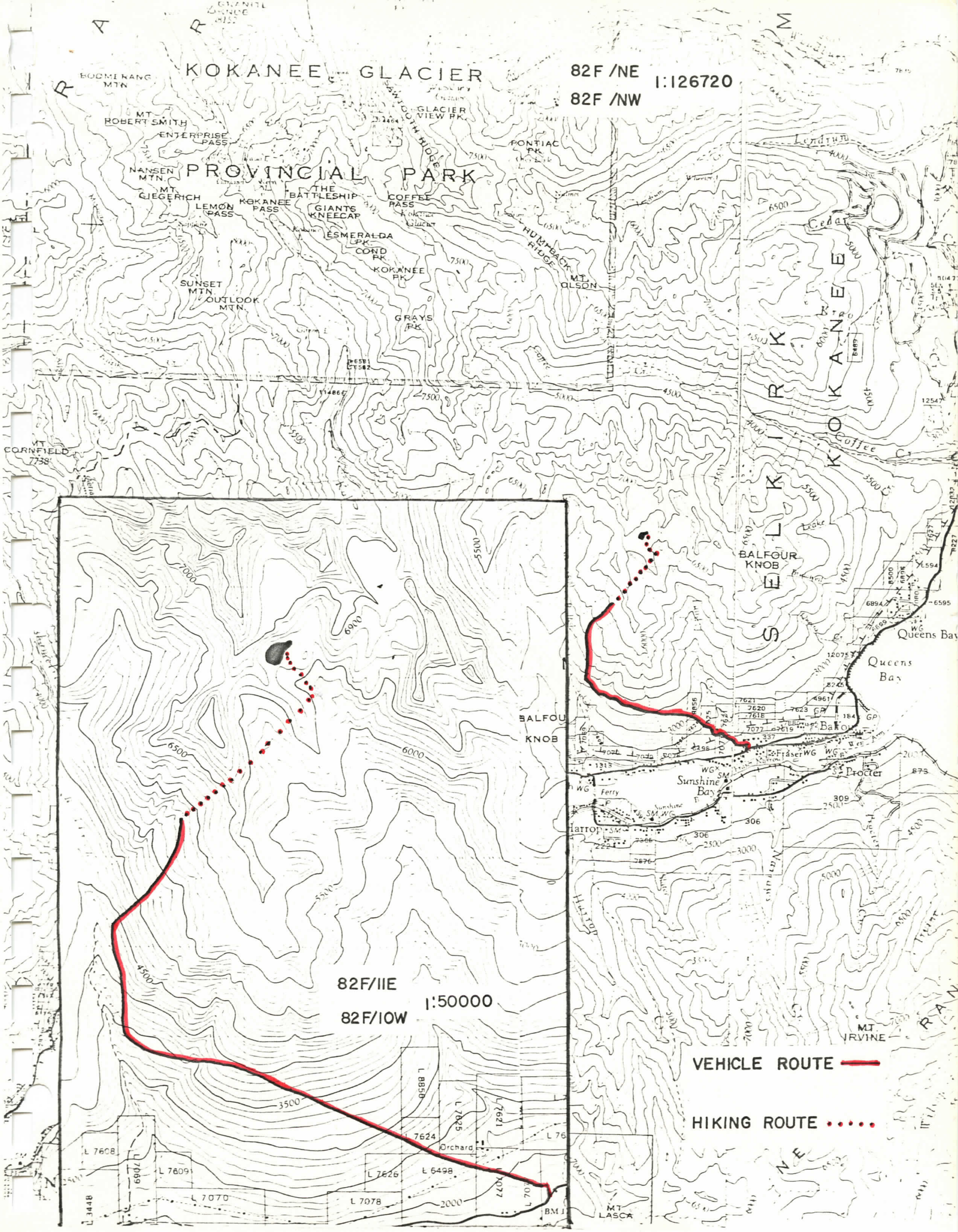
By Vehicle

Proceed towards the Balfour Ferry from Sandspit Provincial Campground (25 km from Nelson, B.C.) as follows:

DISTANCE (km)		FEATURE	ROUTE
8.9	-	Noakes Road turnoff	L
9.0	-	Fork in road	L
9.5	-	Fork in road	L
9.7	-	Bridge	
10.0	-	Fork in road	L
12.7	-	Fork in road	L
13.8	-	Fork in road	R
14.5	-	Fork in road	L
19.3	-	Fork in road	R
19.5	-	Fork in road	L
22.7	-	End of road	

Hiking Route

From the end of the road, face directly up the slope and head up at approximately a 30° angle to the left of this bearing. As the crest of the ridge is approached a saddle will become visible. Climb up to this saddle and a slough will be seen below. Cross the ridge to your left over to Haiseldean Lake. Total hiking time is approximately 2 hours.



KOKANEE GLACIER
PROVINCIAL PARK
82F /NE
82F /NW
1:126720
BOOMERANG MTN
MT. ROBERT SMITH
ENTERPRISE PASS
SAWTOOTH RIDGE
GLACIER VIEW PK.
PONTIAC PK.
NANSEN MTN.
MT. GIEGERICH
LEMON PASS
KOKANEE PASS
THE BATTLESHIP
GIANTS KNEECAP
COFFEE PASS
ESMERALDA PK.
COND PK.
KOKANEE PK.
HUMPBACK RIDGE
MT. OLSON
SUNSET MTN.
OUTLOOK MTN.
GRAYS PK.
MT. CORNFIELD 7738
BALFOUR KNOB
SELKIRK
KOKANEE
Queens Bay
Balfour
Procter
Sunshine Bay
Harrop
Ferry
MT. IRVINE
MT. LASCA
82F/11E
82F/10W
1:50000
Orchard
VEHICLE ROUTE
HIKING ROUTE

III. GENERAL DESCRIPTION:

Haiseldean Lake is a small, relatively deep, moraine-dammed lake located at an elevation of 2000 meters.

This southeasterly exposed lake is fed on the north end by two inflow streams. The largest inflow was a fine spawning stream and fish up to 25 cm were observed in it. Haiseldean Lake is drained on the south end by Haiseldean Creek which is a tributary of Laird Creek. Laird Creek ultimately flows into the west arm of Kootenay Lake.

Rainbow trout up to 28 cm in length and weighing 200 grams were caught in the lake.

The west side of the lake afforded many excellent camping areas. Firewood was plentiful.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

Minimal algal growth was observed around the edge of the lake.

Sites

Haiseldean Lake is located in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. The sites are illustrated in Figure 10C. This lake is situated in the Nelson Plutonic Zone with the primary rock type being porphyritic granite. The lake is blocked by a terminal moraine on the south and east sides. The inflow streams on the north end have built up small deltas that are now open meadows. The west side is dominated by a rock face that has talus beneath it.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

This site was situated on the south shore of the lake, on the border between the moraine and a rock ridge. The soil was relatively well developed and well drained.

Slope: 18°

Exposure: East

Moisture Regime: Moderately Dry

Vegetation Classification: Valeriana-Arnica Association of the ESSFn Biogeoclimatic Zone*

Vegetation

Trees:

Larix lyallii (Alpine Larch)

Abies lasiocarpa (Alpine Fir)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Vaccinium membranaceum (Black Mountain Huckleberry)

Flowers:

Leptarrhena amplexifolia (Leptarrhena)

Habenaria obtusata (One-Leaved Rein-Orchid)

Tiarella unifoliata (Foam Flower)

Antennaria sp. (White Pussytoes)

Valeriana sitchensis (Mountain Valerian)

Daucus carota (Wild Carrot)

Haplopappus lyallii (Lyall's Goldenweed)

Pedicularis bracteosa (Wood Betony)

Pedicularis racemosa (Sickletop Lousewort)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

Vegetation

Flowers:

Arnica latifolia (Broad-Leaf Arnica)

Arnica cordifolia (Heart-Leaf Arnica)

Arnica fulgens (Thin-Leaf Arnica)

Veronica alpina (Veronica)

Myosotis sylvatica var. alpestris (Mountain Forget-Me-Not)

Veratrum eschocholtzii (Indian Hellebore)

Mosses:

Ceratodon purpureus

Lichens:

Alectoria sp. (Old Man's Beard)

Lecanora sp.

Grasses:

Unidentified

Sedges:

Unidentified

Site 2

This site was located on the east shore of the lake on the low moraine in a meadow. The soil was very acidic and dry. The flora here was mainly low-lying; trees were sparse.

Slope: 4°

Exposure: West

Moisture Regime: Dry

Vegetation Classification: Arnica Association of the ESSFn Biogeoclimatic Zone*

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2 (cont'd)

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Larix lyallii (Alpine Larch)

Pinus flexilus (Limber Pine)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Phyllodoce glanduliflora (Yellow Heather)

Vaccinium membranaceum (Black Mountain Huckleberry)

Flowers:

Kalmia polifolia microphylla (Alpine Swamp Laurel)

Leptarrhena amplexifolia (Leptarrhena)

Tiarella unifoliata (Foam Flower)

Antennaria sp. (White Pussytoes)

Arnica cordifolia (Heart-Leaf Arnica)

Arnica latifolia (Broad-Leaf Arnica)

Myosotis sylvatica var. alpestris (Mountain Forget-Me-Not)

Veratrum eschocholtzii (Indian Hellebore)

Mosses:

Rhytidiadelphus triquetrus

Pohlia nutans

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2

Vegetation (cont'd)

Lichens:

Alectoria sp. (Old Man's Beard)

Lecanora sp.

Grasses:

Unidentified

Sedges:

Unidentifed

Site 3

This site was located on the north end of the lake in a meadow on the delta. The soil was very damp and contained a large amount of humus.

Slope: 4°

Exposure: South

Moisture Regime: Very Damp

Vegetation Classification: *Equisetum* Association of the ESSFn Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Pinus flexilus (Limber Pine)

Larix lyallii (Alpine Larch)

The three species of heather in the foreground typify the Englemann Spruce - Alpine Fir bio-geoclimatic zone.

Haiseldean campsite with view of steep northwest wall.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

Vegetation (cont'd)

Shrubs:

Phyllodoce empetriformis (Red Heather)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Flowers:

Leptarrhena amplexifolia (Leptarrhena)

Habenaria obtusata (One-Leaved Rein-Orchid)

Antennaria sp. (White Pussytoes)

Trollius laxus (Globe Flower)

Anemone occidentalis (Western Anemone)

Daucus carota (Wild Carrot)

Oxyria digyna (Mountain Sorrel)

Haplopappus lyallii (Lyall's Goldenweed)

Erythronium grandiflorum (Snow Lily)

Pedicularis racemosa (Sickletop Lousewort)

Fritillaria pudica (Yellow Bell)

Arnica latifolia (Borad-Leaf Arnica)

Arnica cordifolia (Heart-Leaf Arnica)

Castilleja sp. (Indian Paintbrush) - 2 species

Myosotis sylvatica var. alpestris (Mountain Forget-Me-Not)

Erigeron peregrinus (Mountain Daisy)

Viola palustris (Blue Swamp Violet)

Veratrum eschocholtzii (Indian Hellebore)

Equisetum arvense (Common Horsetail)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

Vegetation (cont'd)

Mosses:

Aulacomnium palustre

Pohlia nutans

Lichens:

Lecanora sp.

Grasses:

Unidentified

Sedges:

Unidentified

* The association classifications for the sites were developed from Utzig's Guide For Tree Species Selection In the Nelson Forest District under the biogeoclimatic Zone Engelmann Spruce-Subalpine Fir Zone (ESSFn).

NOTE:

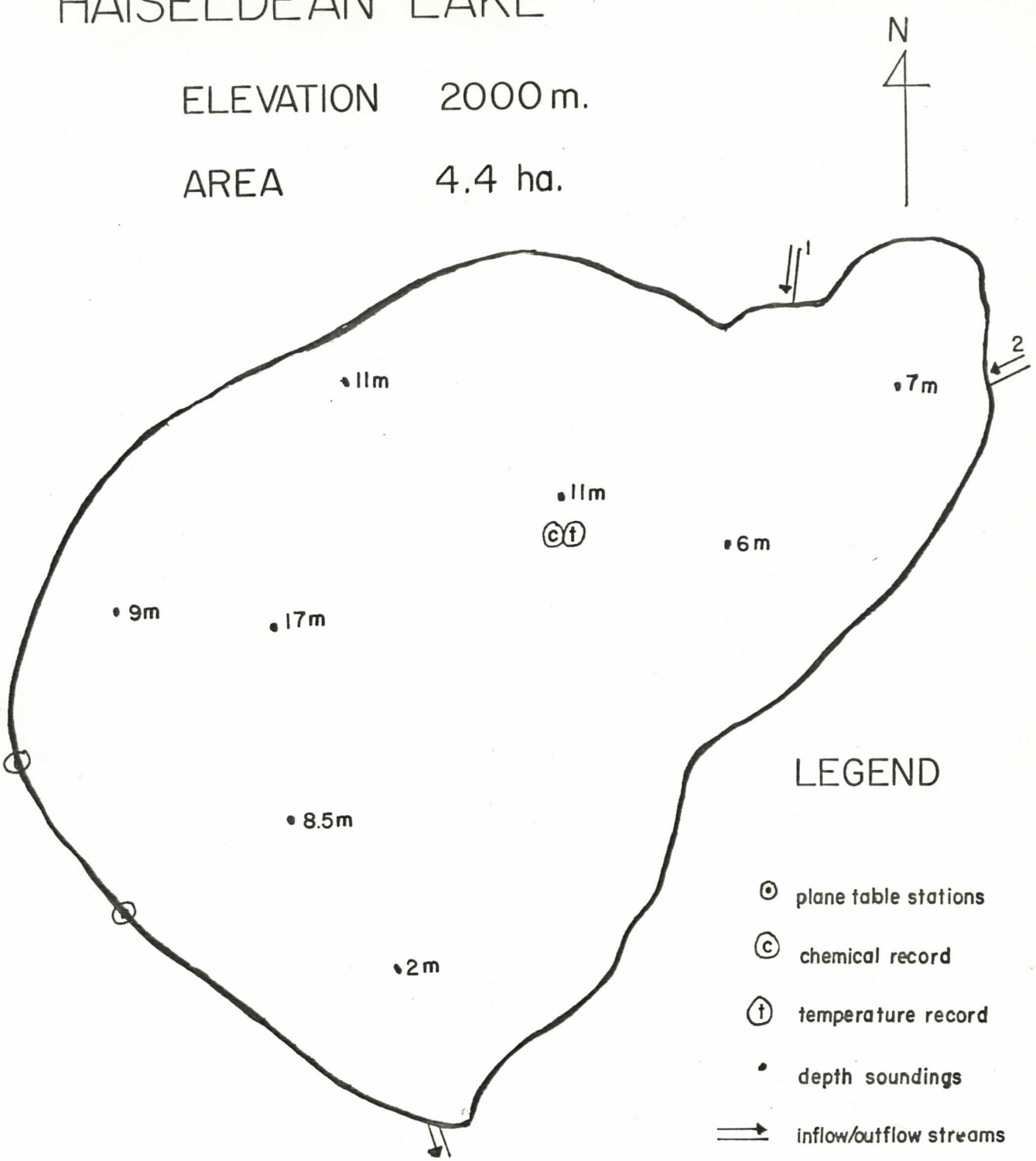
Although Engelmann Spruce was not present in any of the sites, it was observed in the general vicinity of the lake.

FIG. 10A

HAISELDEAN LAKE

ELEVATION 2000 m.

AREA 4.4 ha.



PLANE TABLE SURVEY

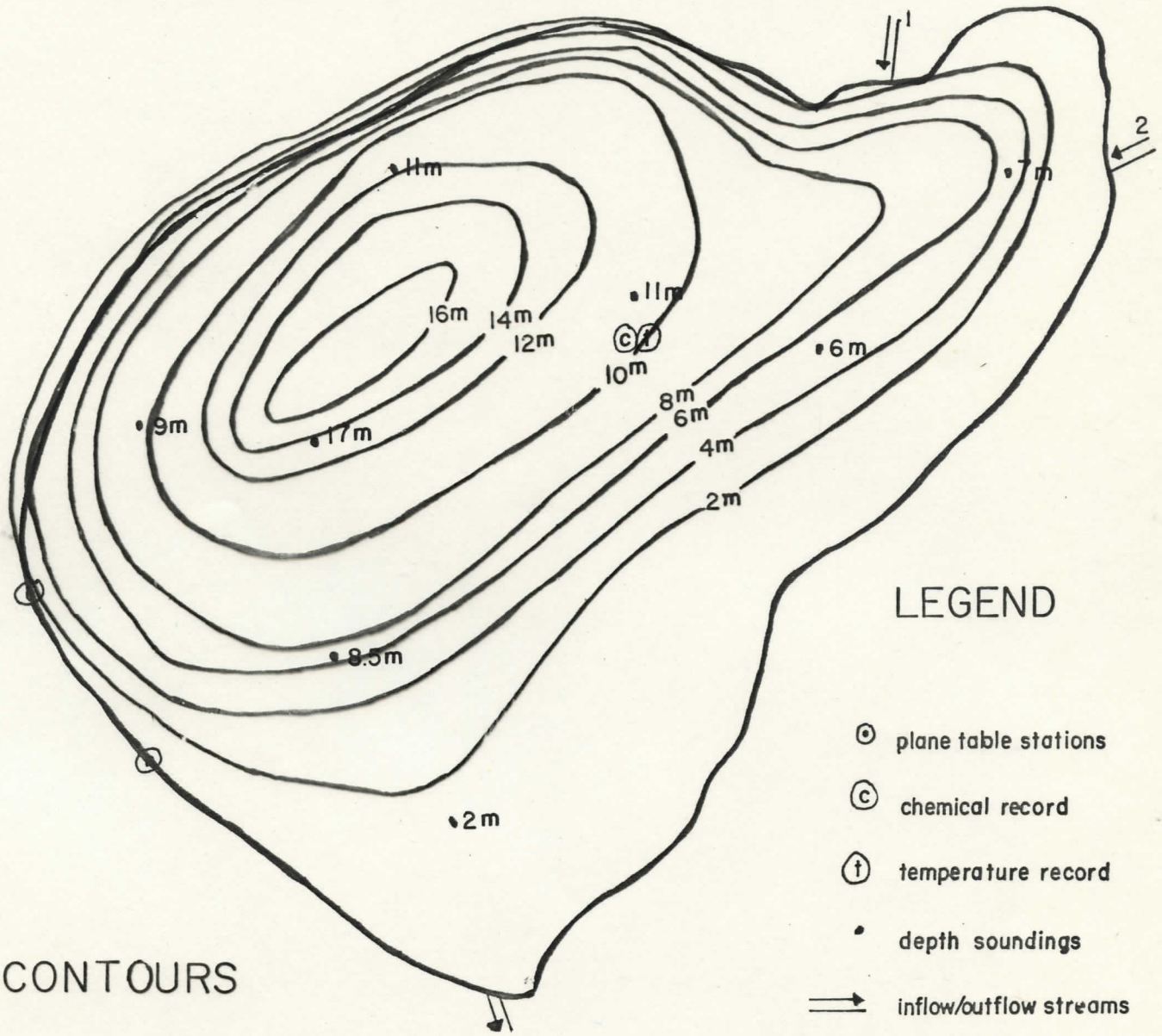
scale= 1:1700

FIG. 10A

HAISELDEAN LAKE

ELEVATION 2000 m.

AREA 4.4 ha.



CONTOURS

LEGEND

- ⊙ plane table stations
- Ⓒ chemical record
- Ⓣ temperature record
- • depth soundings
- ⟹ inflow/outflow streams
- 1,2 stream numbers

PLANE TABLE SURVEY

scale= 1:1700

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test		Result
Temperature	-	Top - 15.8°C
	-	Bottom - 15.0°C
Secchi Disc	-	Limit of visibility - 11.8 meters
	-	Weather conditions - clear sky (July 28th, 7:00 p.m.)
	-	Water conditions - ripples
Bottom Composition	-	Rocks, muck, clay
pH	-	6.9
Total Alkalinity	-	6 ppm
Total Dissolved Solids	-	5 ppm
Lake Level	-	Approximately 80 cm below high water mark

B) Inflows

i) Inflow #1

Average width	-	1.0 meters
Average depth	-	39 centimeters
Velocity	-	0.38 meters/second
Volume of Flow	-	148 liters/second
Temperature	-	11.2°C
Bottom Composition	-	Particles ranging in size from coarse sand to small cobbles 10 cm in length
	-	occasional particles up to small boulders 40 cm in length

V. PHYSICAL AND CHEMICAL DATA:

B) Inflows

i) Inflow #1 (cont'd)

Comments:
- braided
- small waterfall 20 m from lake shore
- large deep pools 10 m from lake
- some humus located around edge of pools
- fish up to 25 cm observed in stream

ii) Inflow #2

Average width - 0.9 meters

Average depth - 9 centimeters

Velocity - 0.18 meters/second

Volume of Flow - 15 liters/second

Temperature - 11.1°C

Bottom Composition
- Particles ranging in size from sand to small cobbles 6 cm in length
- occasional particles up to small boulders 40 cm in length

Comments:
- stream begins to meander and widen 30 m from lake shore as it flows through meadow

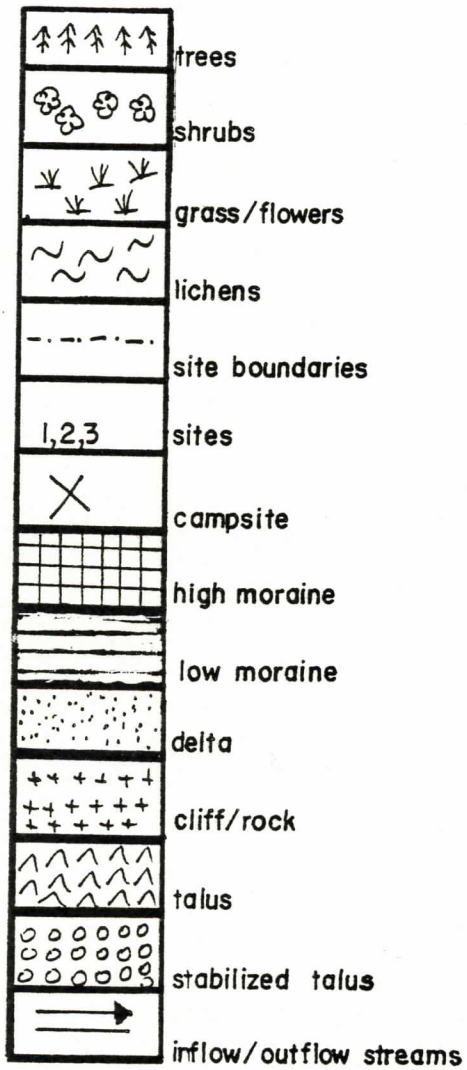
V. PHYSICAL AND CHEMICAL DATA:

C) Outflow

Average width	-	3.7 meters
Average depth	-	17 centimeters
Velocity	-	0.43 meters/second
Volume of Flow	-	270 liters/second
Temperature	-	16.2°C
Bottom Composition	-	moss and particles ranging in size from very coarse sand to medium boulders 60 cm in length
	-	occasional particles up to mammoth boulders 4 m in length
Comments:	-	creek is at low water level, high water level is approximately 10 cm higher

fig. 10B

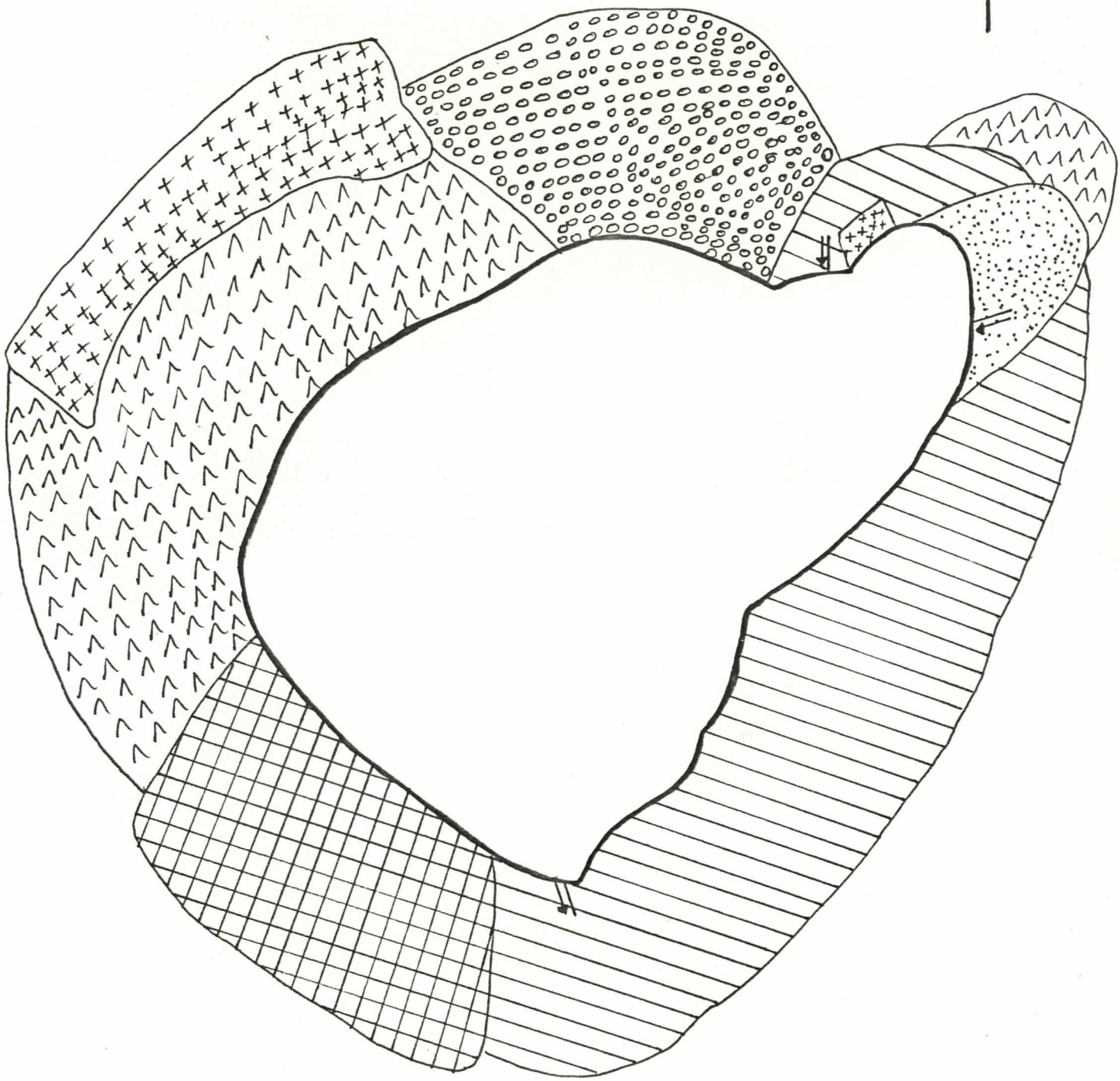
LEGEND



HAISELDEAN LAKE

FIG. 10C

N

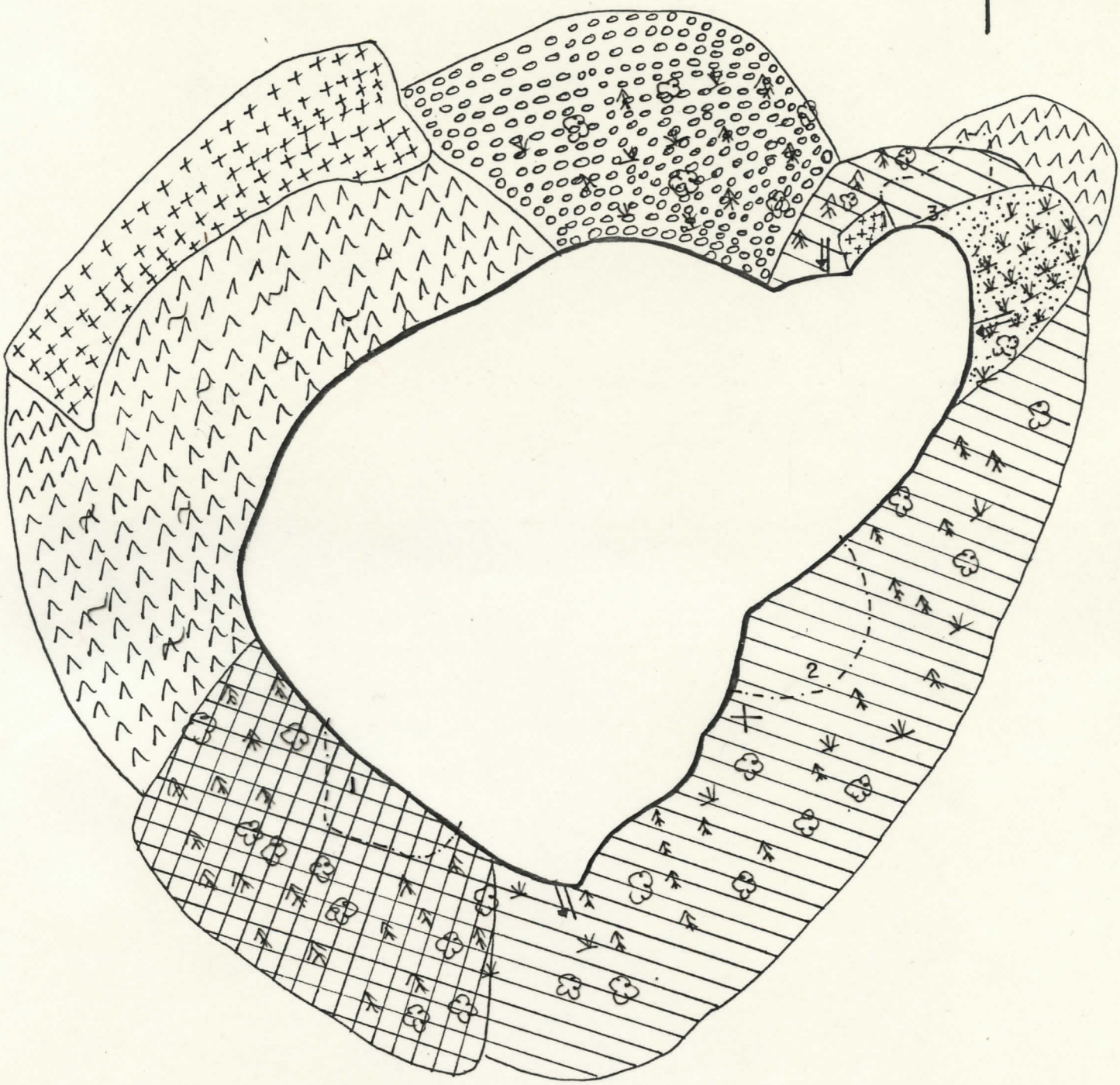


LANDFORMS

scale = 1:2300

HAISELDEAN LAKE

FIG. 10C



VEGETATION

LANDFORMS

scale = 1:2300

NOAKES LAKE

DATED STUDIED: July 29th, 1980

I. LOCATION:

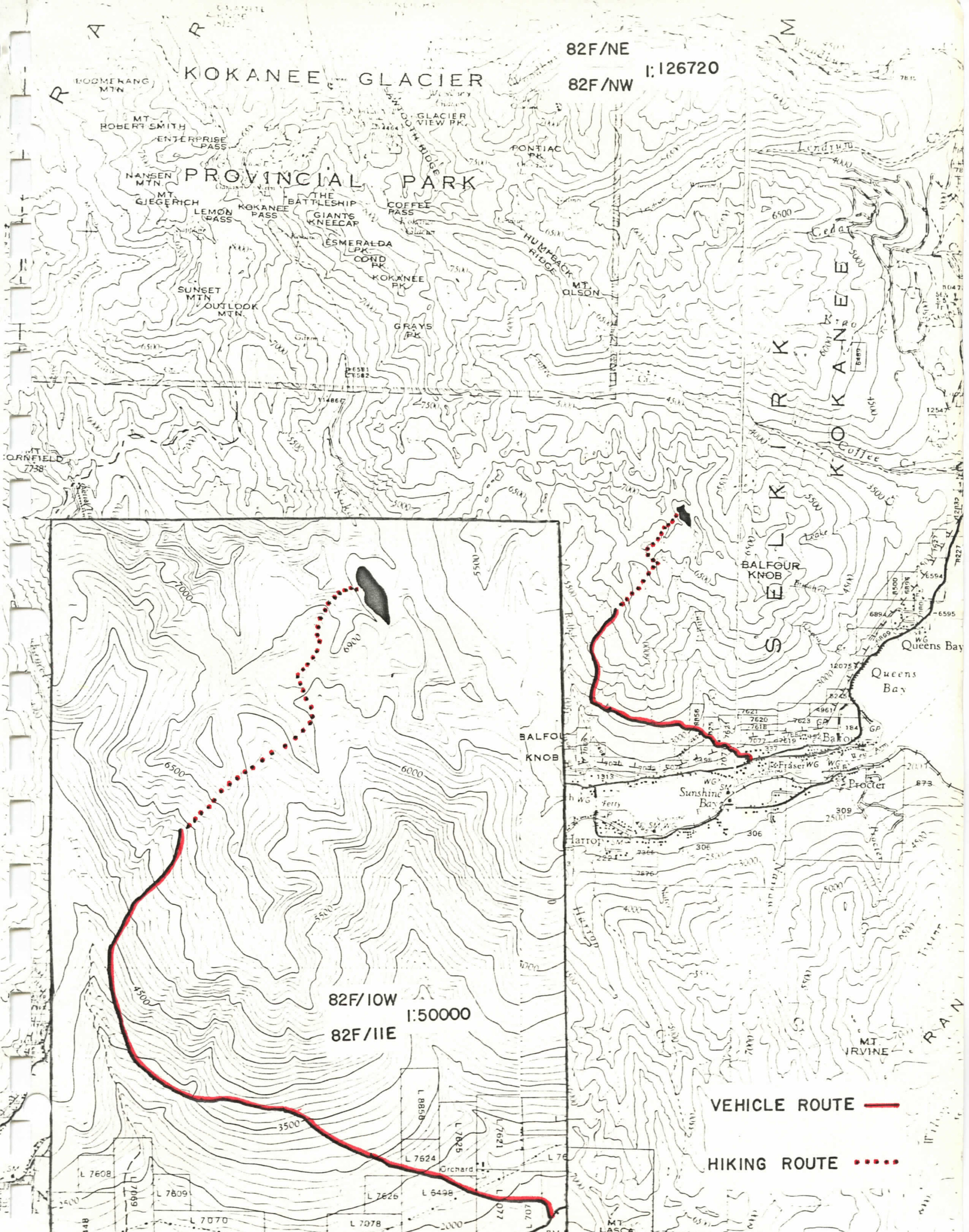
- 49° 41' N., 117° 1.5' W.
- Department of Mines and Technical Surveys Map: Kokanee Peak, Kootenay District, B.C., 82F/11E, 1:50,000. Grid Reference 985031
- Department of Lands, Forests and Water Resources Map: Slocan, B.C., 82F/NW, 1:126,720
- Aerial photographs #BC 5348-045, #BC 5348-046

IV. ACCESS:

See "ACCESS" to Haiseldean Lake

Hiking Route

From the north end of Haiseldean Lake proceed up the ridge directly ahead, keeping well to the left. Stay to the left and descend to Noakes Lake. Total hiking time is 45 minutes.


82F/NE
82F/NW
1:126720
KOKANEE GLACIER
PROVINCIAL PARK
BOOMERANG MTN
MT. ROBERT SMITH
ENTERPRISE PASS
NANSEN MTN.
MT. GIEGERICH
LEMON PASS
KOKANEE PASS
THE BATTLESHIP
GIANTS KNEECAP
COFFEE PASS
GLACIER VIEW PK.
SAWTOOTH RIDGE
PONTIAC PK.
ESMERALDA PK.
COND PK.
KOKANEE PK.
HUMPBACK RIDGE
MT. OLSON
SUNSET MTN
OUTLOOK MTN.
GRAYS PK.
MT. CORNFIELD
7738'
SELKIRK
KOKANEE
BALFOUR KNOB
Queens Bay
Balfour
Sunshine Bay
Procter
Harrop
MT. IRVINE
MT. LASCA
BALFOUR KNOB
82F/10W
82F/11E
1:50000
L 8858
L 7625
L 7621
L 7624
L 7608
L 7809
L 7626
L 6498
L 7070
L 7078
Orchard
VEHICLE ROUTE
HIKING ROUTE

III. GENERAL DESCRIPTION:

Noakes Lake is a large, deep, southeasterly exposed lake located at an elevation of 2100 meters.

At the time of study, Noakes Lake was fed by one small inflow on the north end. There were several seasonal streams on both the east and west edges of the lake that had dried up. The lake is drained by Noakes Creek which flows for approximately 300 meters before feeding Bob Lake.

The best camping area was located on the south west end of the lake, near the outflow stream. Firewood is plentiful.

No fish were observed in the lake.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

No aquatic vegetation was observed in this lake.

Sites

Noakes Lake is located in the Engelmann Spruce-Alpine Fir Biogeoclimatic Zone. Although no Engelmann Spruce was present in any of the sites, it was observed in the general vicinity of the lake. The sites are illustrated in Figure 11C. Noakes Lake is an elongated tarn with the headwall located on the western edge. The headwall and the adjoining ridges have been subjected to mass-wasting. This process has progressed to the point where it has formed a col on the north end of the lake. The lake is blocked by a rock lip on the eastern edge of the lake and a moraine on the southern edge. The lake is located in the Nelson Plutonic Zone and the primary rock type is porphyritic granite.

Looking toward northwestern col (notch in background) from outflow stream.

A short walk to the col pictured above yields a spectacular mountain view.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

This site was located on the south end of the lake near the outflow stream on the moraine. The soil ranged from very dry to wet near the stream. The soil was shallow.

Slope: 2°

Exposure: Southeast

Moisture Regime: Dry to wet near the stream

Vegetation Classification: Arnica Association for the ESSFn Biogeoclimatic Zone*

Vegetation

Trees:

Larix lyallii (Alpine Larch)

Abies lasiocarpa (Alpine Fir)

Shrubs:

Vaccinium caespitosum (Dwarf Huckleberry)

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Phyllodoce glanduliflora (Yellow Heather)

Vaccinium vitis-idaea (Mountain Bilberry)

Loiseleuria procumbens (Trailing Azalea)

Flowers:

Leptarrhena amplexifolia (Leptarrhena)

Habenaria obtusata (One-Leaved Rein-Orchid)

Tiarella unifoliata (Foam Flower)

Antennaria sp. (White Pussytoes)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

Vegetation

Flowers: (cont'd)

Anemone occidentalis (Western Anemone)

Daucus carota (Wild Carrot)

Haplopappus lyallii (Lyall's Goldenweed)

Erigeron aureus (Golden Fleabane)

Erythronium grandiflorum (Snow Lily)

Arnica latifolia (Broad-Leaf Arnica)

Heuchera glabella (Alumroot)

Veronica americana (American Brooklime)

Veronica alpina (Veronica)

Veratrum eschocholtzii (Indian Hellebore)

Ligusticum canbyi (Canby's Lovage)

Mosses:

Sphagnum sp.

Grasses:

Unidentified

Sedges:

Unidentified

Site 2

This site was situated on the eastern shore, on the rock lip. The soil only had a depth of 0 - 15 cm and was underlain by rock.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2 (cont'd)

Slope: 10°

Exposure: South

Moisture Regime: Dry

Vegetation Classification: Arnica Association for the ESSFn Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Larix lyallii (Alpine Larch)

Pinus flexilus (Limber Pine)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Phyllodoce glanduliflora (Yellow Heather)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Sorbus scopulina (Western Mountain Ash)

Flowers:

Antennaria sp. (White Pussytoes)

Erythronium montanum (Avalanche Lily)

Arnica latifolia (Board-Leaf Arnica)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2

Vegetation (cont'd)

Mosses:

Barbula cylindrica

Lichens:

Lecanora sp.

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

Site 3

This site was located on stabilized talus on the north end of the lake beneath the col. Again, soil development was not good and the ground was very dry.

Slope: 15°

Exposure: South

Moisture Regime: Dry

Vegetation Classification: Alpine Fir-Black Huckleberry Association for the ESAF Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Pinus flexilus (Limber Pine)

Larix lyallii (Alpine Larch)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

Vegetation

Shrubs: (cont'd)

Phyllodoce glanduliflora (Yellow Heather)

Vaccinium scoparium (Grouseberry)

Vaccinium membranaceum (Black Mountain Huckleberry)

Flowers:

Antennaria sp. (White Pussytoes)

Anemone occidentalis (Western Anemone)

Daucus carota (Wild Carrot)

Erigeron aureus (Golden Fleabane)

Mosses:

Pohlia nutans

Polytrichum juniperinum

Lichens:

Lecanora sp.

Alectoria sp. (Old Man's Beard)

Physcia sp.

Grasses:

Unidentified

Sedges:

Unidentified

IV. VEGETATION AND GEOMORPHOLOGY:

Site 4

This site was located on the southwest shore of the lake on the moraine. Vegetation was meadow-like with only a few stunted trees. Soil development was relatively good.

Slope: 1° - 4°

Exposure: South and North

Moisture Regime: Dry

Vegetation Classification: Arnica Association for the ESSFn Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Larix lyallii (Alpine Larch)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Phyllodoce glanduliflora (Yellow Heather)

Flowers:

Antennaria sp. (White Pussytoes)

Trollius laxus (Globe Flower)

Anemone occidentalis (Western Anemone)

Castilleja sp. (Indian Paintbrush) 2 species

Ranunculus eschscholtzii (Snow Buttercup)

Erigeron aureus (Golden Fleabane)

Haplopappus lyallii (Lyall's Goldenweed)

Erythronium montanum (Avalanche Lily)

Arnica cordifolia (Heart-Leaf Arnica)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 4

Vegetation

Flowers: (cont'd)

Myosotis sylvatica var. alpestris (Mountain Forget-Me-Not)

Viola adunca (Blue Violet)

Veratrum eschocholtzii (Indian Hellebore)

Ferns:

Polypodium vulgare (Licorice Fern)

Mosses:

Pohlia nutans

Lichens:

Lecanora sp.

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

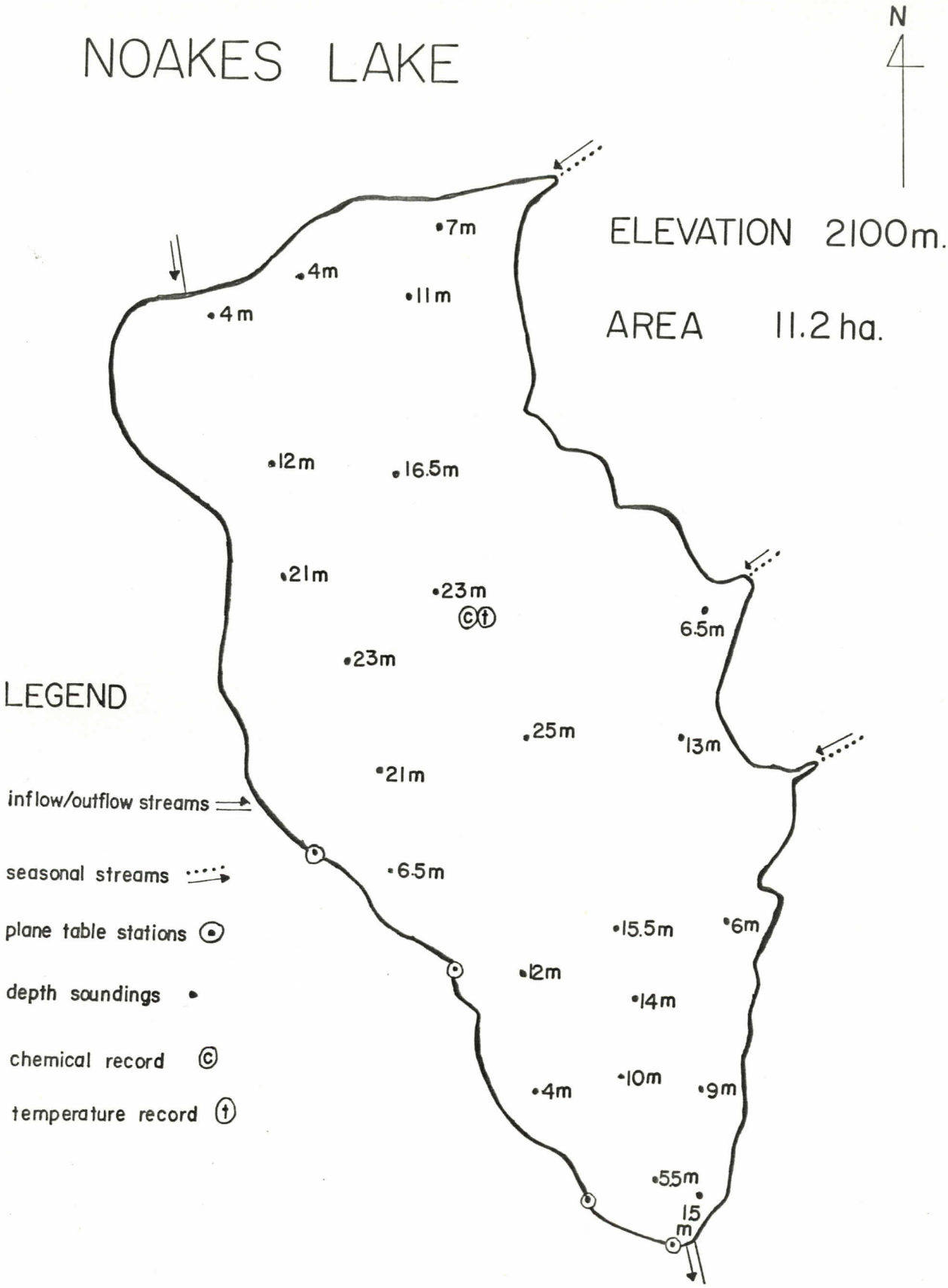
Sedges:

Unidentified

* The association classifications for sites 1, 2, and 4 were developed from Utzig's *Guide for Tree Species Selection in the Nelson Forest District* under the biogeoclimatic Zone Engelmann Spruce-Subalpine Fir Zone (ESSFn). The association for site 3 was classified within the association given by the *Forestry Handbook for British Columbia* under the biogeoclimatic Zone Engelmann Spruce-Alpine Fir (ESAF).

FIG. IIA

NOAKES LAKE

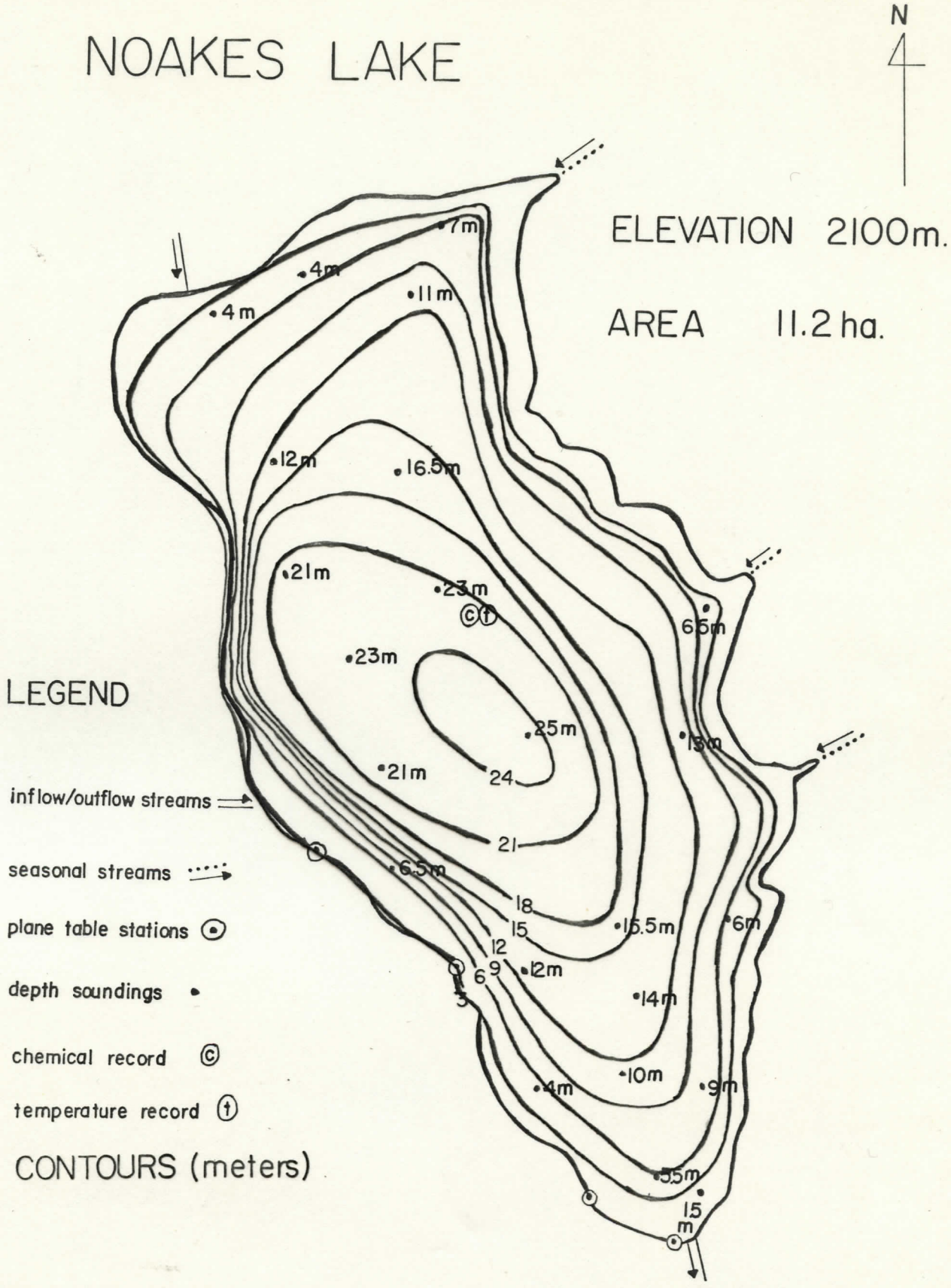


PLANE TABLE SURVEY

scale= 1: 3200

FIG. IIA

NOAKES LAKE



PLANE TABLE SURVEY

scale= 1: 3200

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test	Result
Temperature	- Surface - 13.9°C
	- Bottom - 13.4°C
Secchi Disc	- Limit of visibility - 14.8 meters
	- Weather conditions - clear sky (July 29th, 3:00 p.m.)
	- Water conditions - ripples
Bottom Composition	- Rocks, muck
pH	- 6.9
Total Alkalinity	- 4 ppm
Total Dissolved Solids	- 2 ppm
Lake Level	- 10 cm below high water mark

B) Inflow

Average width	- 0.8 meters
Average depth	- 5 centimeters
Velocity	- 0.25 meters/second
Volume of Flow	- 10 liters/second
Temperature	- 15.4°C
Bottom Composition	- Moss and particles ranging in size from fine gravel to small cobbles 10 cm in length
	- Occasional particles up to very large boulders 2 m in length

V. PHYSICAL AND CHEMICAL DATA:

C) Outflow

Average width	-	1.6 meters
Average depth	-	12 centimeters
Velocity	-	0.20 meters/second
Volume of Flow	-	38 liters/second
Temperature	-	12.8°C
Bottom Composition	-	Paricles ranging in size from sand to small cobbles 10 cm in length
	-	Occasional large moss covered boulders 1 m in length
Comments:	-	Stream at low water level

NOTE:

Noakes Creek gradually decreases in width from 15 m at its source to 1 m at its mouth. Rocks abound in this stream. Since there was little free flowing water it was not possible to determine the velocity or the width of the upper part of the creek. For this reason the data for Noakes Creek was obtained approximately 10 m from Bob Lake.

FIG. II B

legend

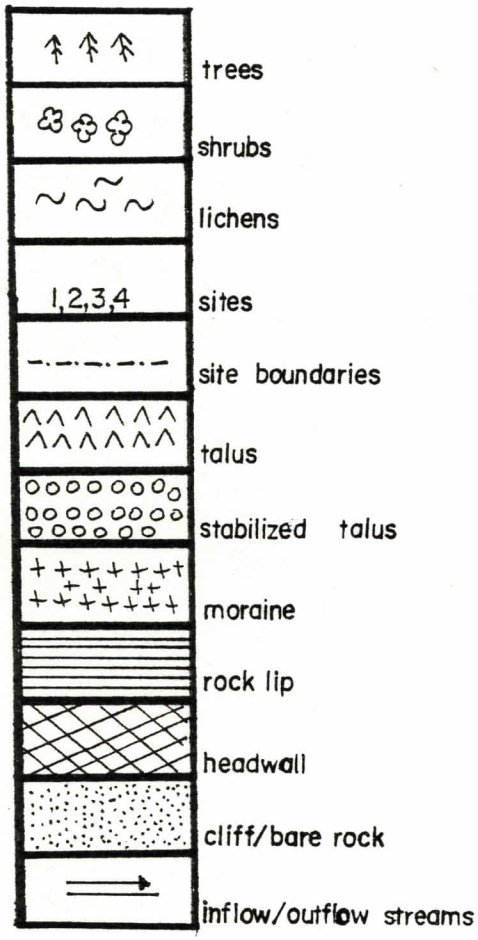
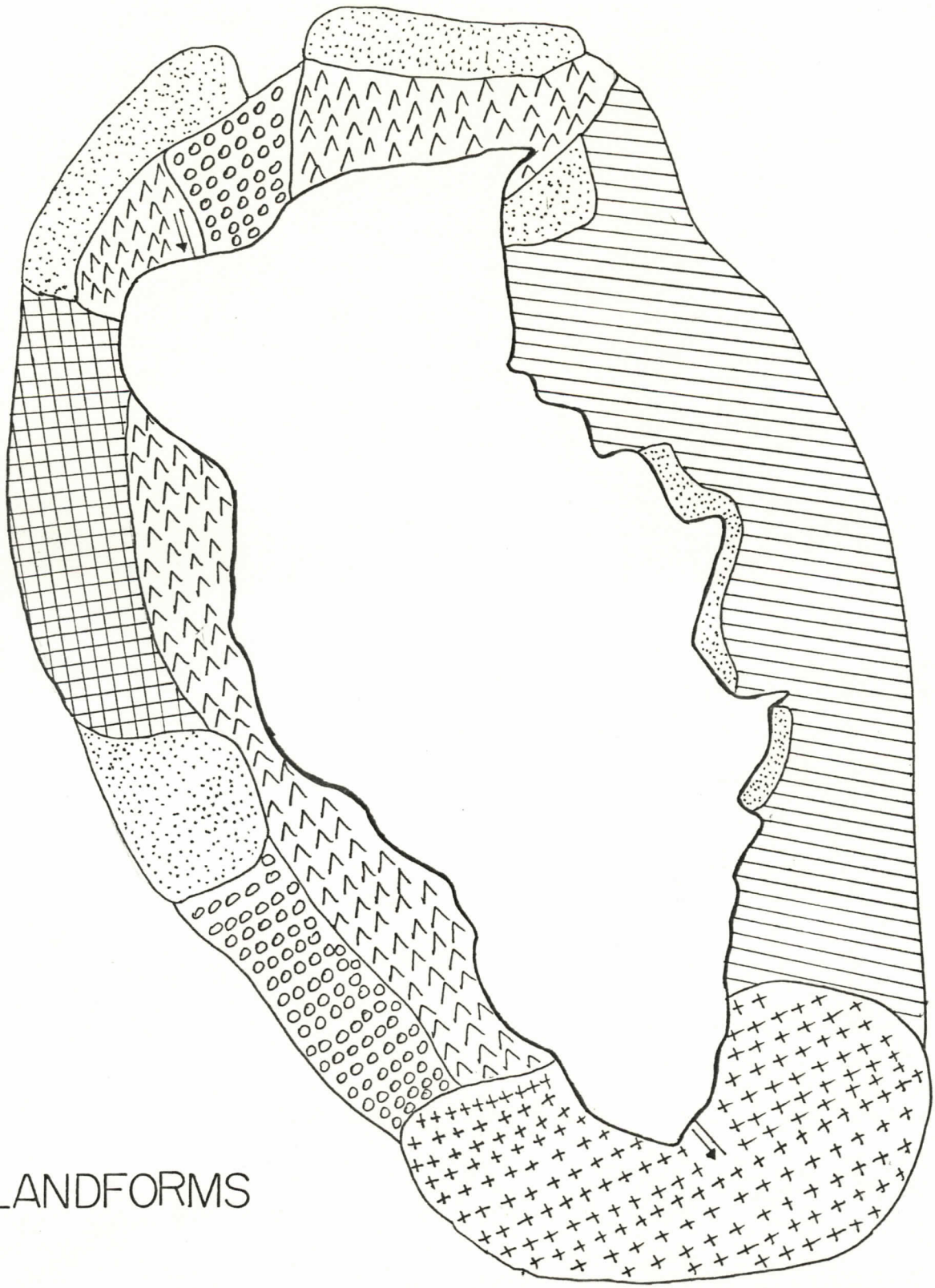


FIG IIC

NOAKES LAKE



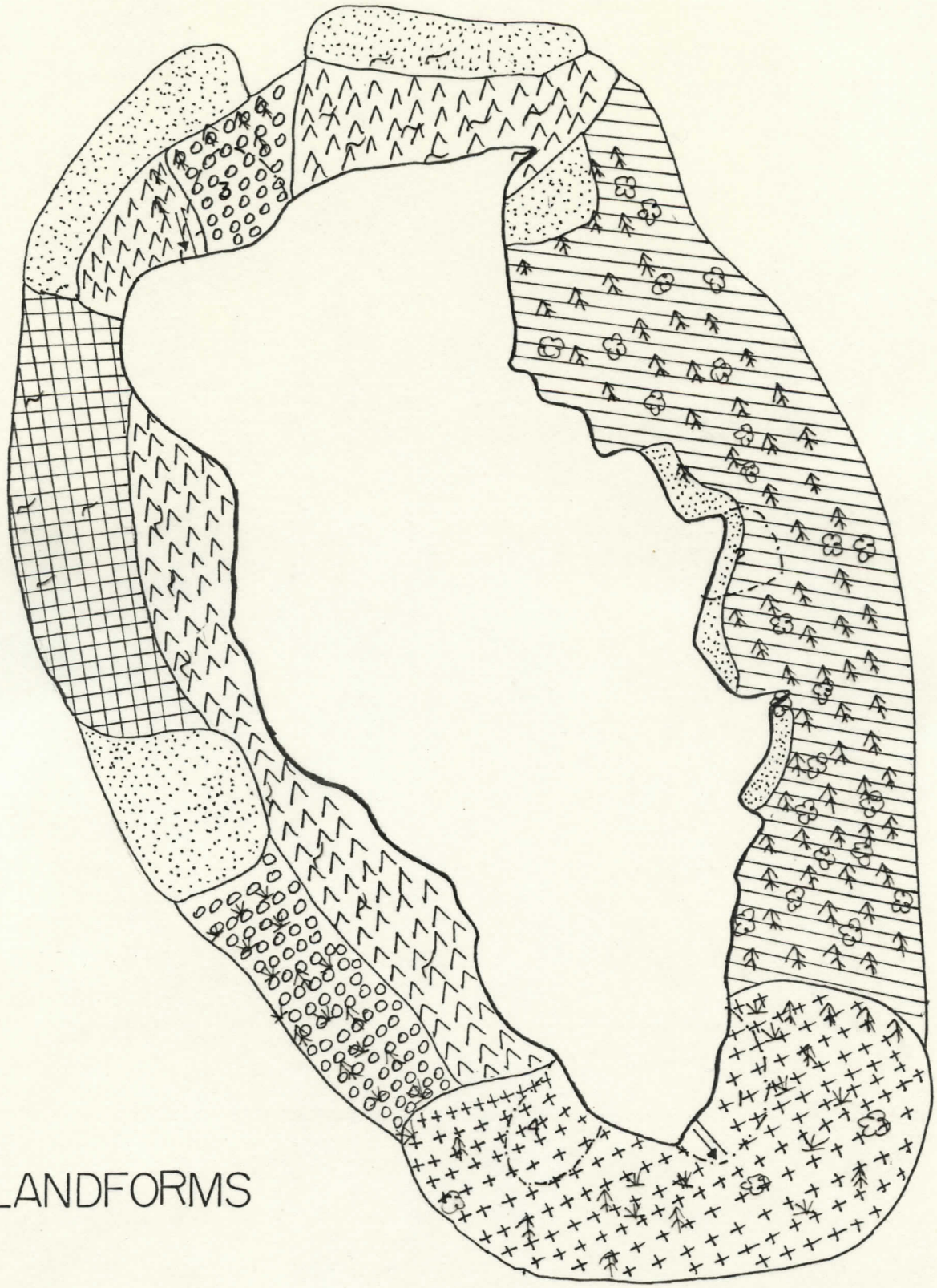
LANDFORMS

scale = 1:3600

FIG IIC

NOAKES LAKE

N



LANDFORMS

VEGETATION

scale = 1:3600

BOB LAKE

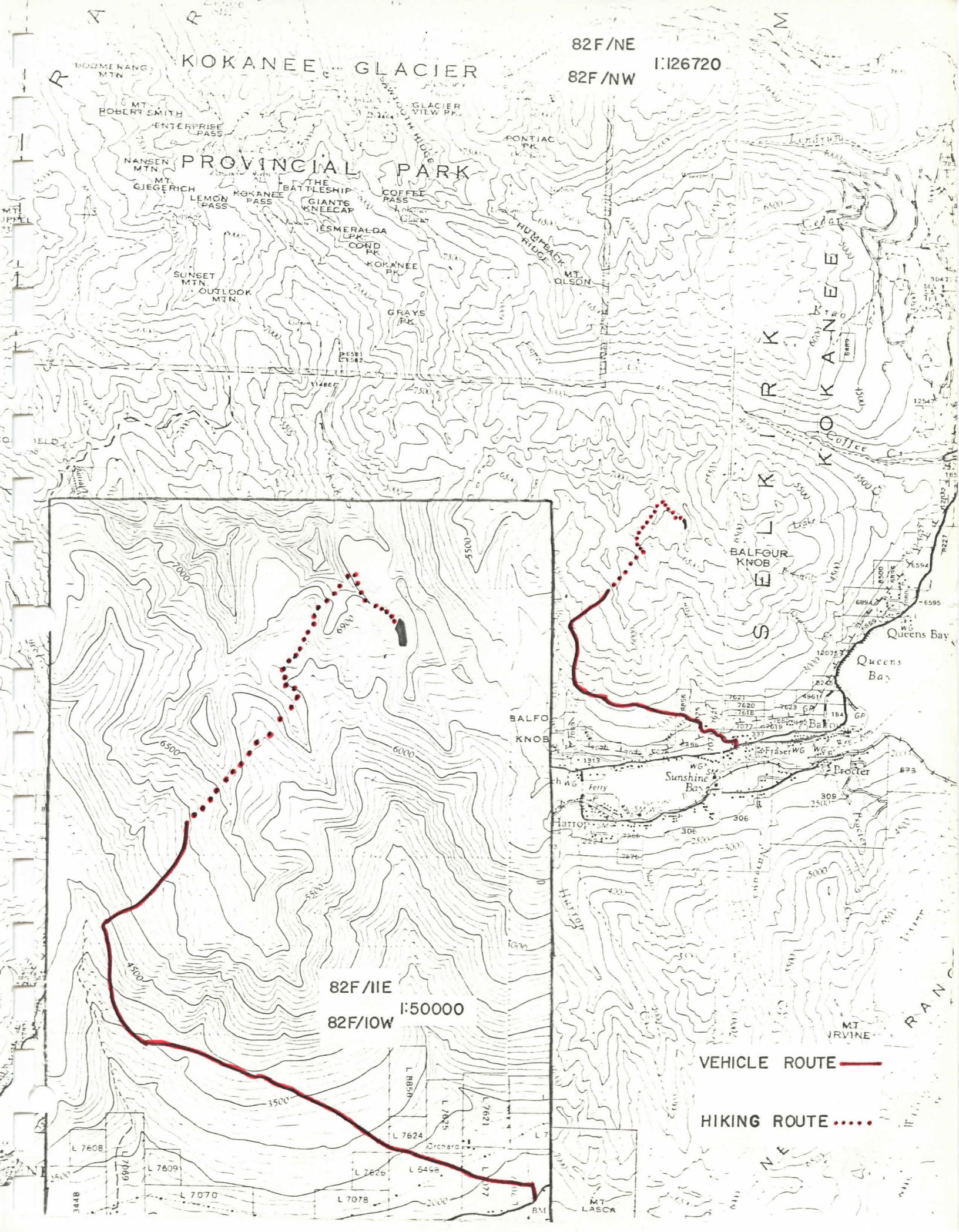
DATE STUDIED: July 29th, 1980

I. LOCATION:

- 49° 41' N., 117° 1.5' W.
- Department of Mines and Technical Surveys Map: Kokanee Peak, Kootenay District, B.C., 82F/11E, 1:50,000; Grid Reference 985031. (Note: This map does not separate Noakes Lake from Bob Lake.)
- Department of Lands, Forests and Water Resources Map: Slocan, B.C. 82F/NW, 1:126,720
- Aerial photographs #BC 5348-045, #BC 5348-046

II. ACCESS:

See "ACCESS" to Noakes Lake. Bob Lake is approximately 300 meters downstream from Noakes Lake.


82F/NE
1:126720
82F/NW
KOKANEE GLACIER
PROVINCIAL PARK
BOOMERANG MTN.
MT. ROBERT SMITH
ENTERPRISE PASS
NANSEN MTN.
MT. GIEGERICH
LEMON PASS
KOKANEE PASS
THE BATTLESHIP
GIANTS KNEECAP
COFFEE PASS
GLACIER VIEW PK.
PONTIAC PK.
HUMPBACK RIDGE
MT. OLSON
ESMERALDA PK.
COND PK.
KOKANEE PK.
SUNSET MTN.
OUTLOOK MTN.
GRAYS PK.
KOKANEE RANGE
SELKIRK
BALFOUR
KNOB
Queens Bay
Balfour
Fraser
Procter
Sunshine Bay
Ferry
Harrop
MT. IRVINE
82F/11E
1:50000
82F/10W
MT. LASCA
VEHICLE ROUTE
HIKING ROUTE

III. GENERAL DESCRIPTION:

Bob Lake is a small, shallow, moraine dammed lake located at an elevation of 2050 meters.

This southeasterly exposed lake is fed on the north end by the braided Noakes Creek, the lower portion of which is suitable for spawning. Bob Lake is drained on the south end by Bob Creek, which is also suitable for spawning during spring high water levels. Bob Creek flows into Laird Creek which in turn flows into the west arm of Kootenay Lake.

The best camping area is situated on the northeast side of the lake. Firewood was in adequate supply.

Rainbow trout up to 20 cm in length and weighing approximately 70 grams were caught in the lake.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

No vegetation was observed in the lake.

Sites

Bob Lake is located in the Engelmann Spruce-Alpine Fir Bio-geoclimatic Zone. Although Engelmann Spruce was not present in the sites, it was observed in the general vicinity of the lake. The sites are illustrated in Figure 12C.

Bob Lake is a shallow moraine-dammed lake that is fed by Noakes Lake. In the summer, water levels drop significantly, possibly to a depth of 3 meters or less. The entire western shore is a low-lying, flat moraine. A delta has been formed

IV. VEGETATION AND GEOMORPHOLOGY:

Sites (cont'd)

on the north shore by Noakes Creek. On the east shore there is a large meadow, which has a clear, shallow (50 cm deep) pond approximately 40 m. from the lake. This pond probably occurred as the result of the impermeability of the glacial till and because of the flatness of the moraine.

Site 1

This site was located on the delta on the north shore. At the time of this study the site was mainly dry (wetter near the streams) but the ground is probably much damper at other times of the year.

Slope:	8°
Exposure:	South
Moisture Regime:	Dry to wet by the stream
Vegetation Classification:	Arnica Association for the ESSFn Biogeoclimatic Zone*

Vegetation

Trees:

Larix lyallii (Alpine Larch)

Abies lasiocarpa (Alpine Fir)

Shrubs:

Salix arctica (Alpine Willow)

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Phyllodoce glanduliflora (Yellow Heather)

Vaccinium vitis-idaea (Mountain Bilberry)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

Vegetation (cont'd)

Flowers:

Leptarrhena amplexifolia (Leptarrhena)

Anemone occidentalis (Western Anemone)

Castilleja sp. (Indian Paintbrush)

Erigeron aureus (Golden Fleabane)

Antennaria sp. (White Pussytoes)

Kalmia polifolia microphylla (Alpine Swamp Laurel)

Potentilla sp. (Cinquefoil)

Erythronium montanum (Avalanche Lily)

Arnica cordifolia (Heart-Leaf Arnica)

Heuchera glabella (Alumroot)

Myosotis sylvatica var. alpestris (Mountain Forget-Me-Not)

Veronica alpina (Veronica)

Mosses:

Sphagnum sp.

Pohlia nutans

Lichens:

Lecanora sp.

Site 2

This site was situated in the large meadow on the eastern shore. The flora was sparse - - mainly grass and dried moss with flowers and low shrubs growing near rocks.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2 (cont'd)

Slope: 0°

Exposure: South

Moisture Regime: Dry on top layer and damp beneath

Vegetation Classification: Arnica Association for the ESSFn Biogeoclimatic Zone*

Vegetation

Trees:

Larix lyallii (Alpine Larch)

Shrubs:

Cassiope mertensiana (White Moss Heather)

Phyllodoce empetriformis (Red Heather)

Flowers:

Kalmia polifolia microphylla (Alpine Swamp Laurel)

Anemone occidentalis (Western Anemone)

Antennaria sp. (White Pussytoes)

Erigeron aureus (Golden Fleabane)

Haplopappus lyallii (Lyall's Goldenweed)

Arnica cordifolia (Heart-Leaf Arnica)

Myosotis sylvatica var. alpestris (Mountain Forget-Me-Not)

Veronica alpina (Veronica)

Veratrum eschocholtzii (Indian Hellebore)

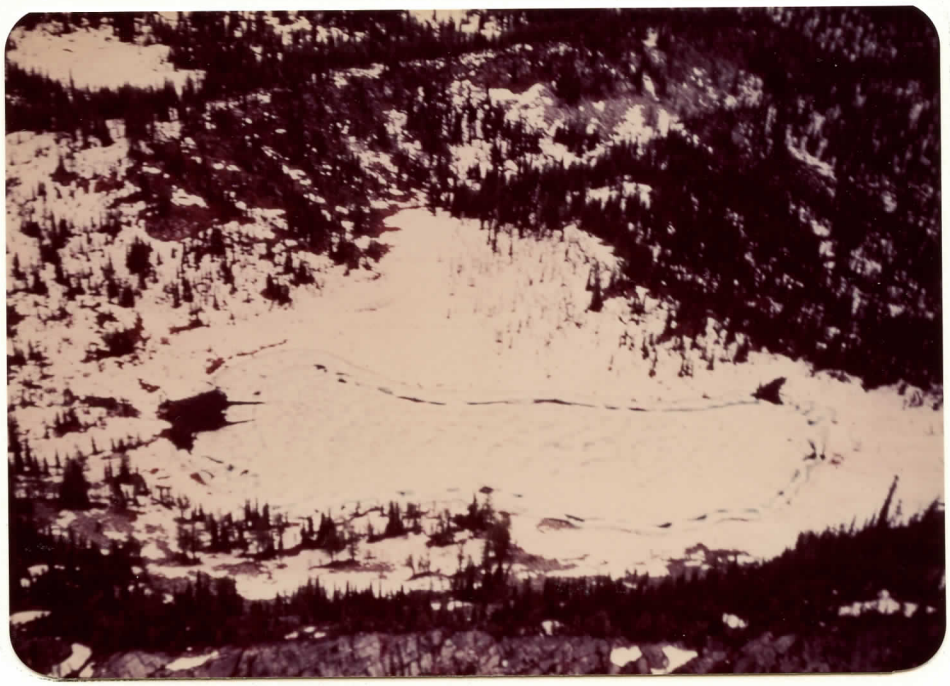
Mosses:

Polytrichum juniperinum

Aulacomnium androgynum

Bryum capillare

Sedges: Unidentified



Aerial photograph indicates some evidence of ice breakup on June 17th.

Outflow end of lake.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

This site was located on the south end of the lake, just east of the outflow stream. The soil was very thin (up to 10 cm) and was underlain by rock.

Slope: 5°

Exposure: South

Moisture Regime: Dry

Vegetation Classification: Arnica Association for the ESSFn Biogeoclimatic Zone*

Vegetation

Trees:

Abies lasiocarpa (Alpine Fir)

Larix lyallii (Alpine Larch)

Shrubs:

Phyllodoce empetriformis (Red Heather)

Cassiope mertensiana (White Moss Heather)

Flowers:

Antennaria sp. (White Pussytoes)

Anemone occidentalis (Western Anemone)

Castilleja sp. (Indian Paintbrush) - 2 species

Erigeron aureus (Golden Fleabane)

Erythronium montanum (Avalanche Lily)

Pedicularis bracteosa (Wood Betony)

Arnica cordifolia (Heart-Leaf Arnica)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

Vegetation

Flowers: (cont'd)

Arnica latifolia (Borad-Leaf Arnica)

Heuchera glabella (Alumroot)

Myosotis sylvatica var. alpestris (Mountain Forget-Me-Not)

Viola adunca (Blue Violet)

Veratrum eschocholtzii (Indian Hellebore)

Ferns:

Polypodium vulgare (Licorice Fern)

Mosses:

Aulacomnium androgynum

Lichens:

Lecanora sp.

Alectoria sp. (Old Man's Beard)

Physcia sp.

Grasses:

Unidentified

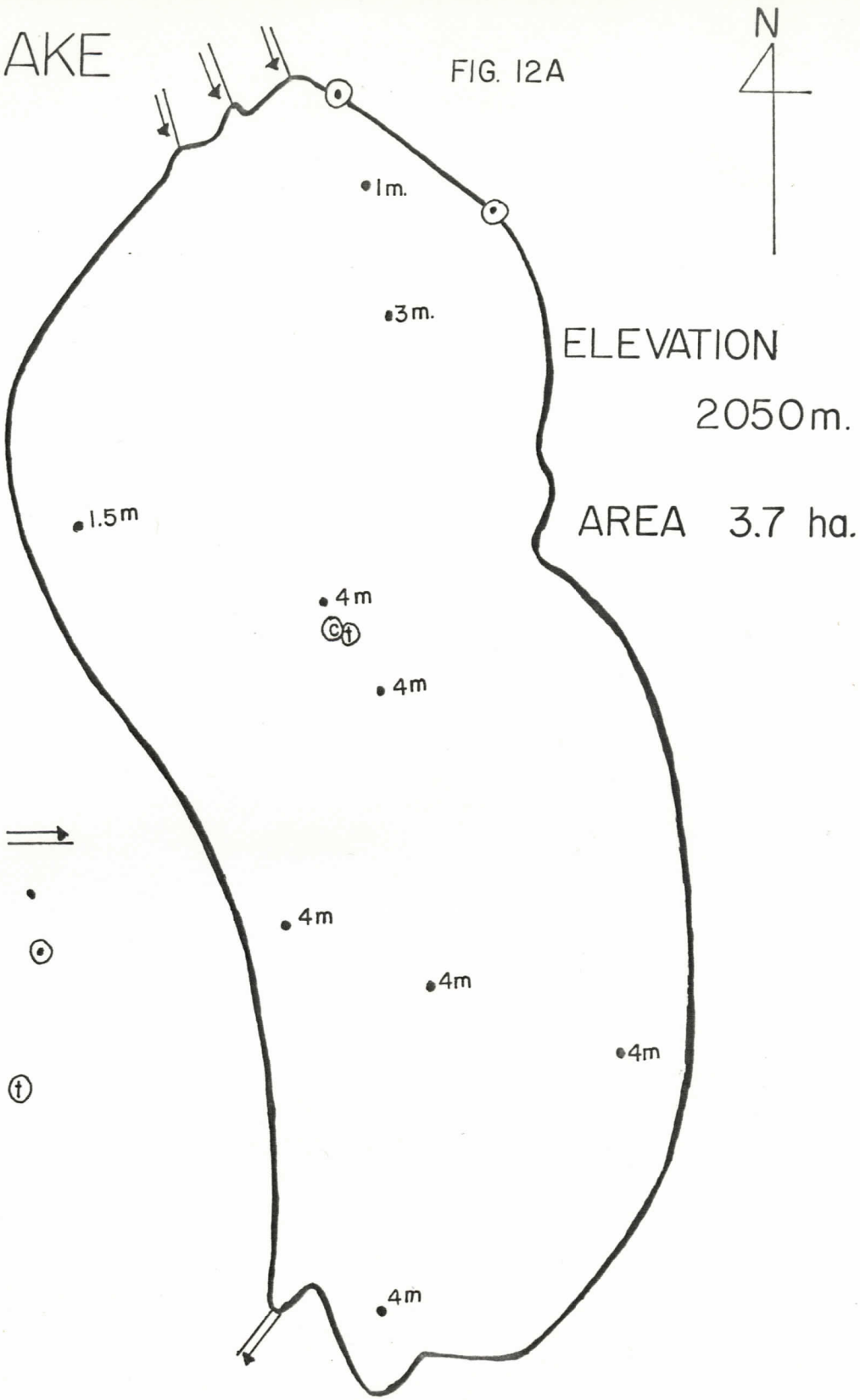
Sedges:

Unidentified

* The association classifications for the sites were developed from Utzig's Guide For Tree Species Selection in the Nelson Forest District under the biogeoclimatic Zone Engelmann Spruce-Subalpine Fir Zone (ESSFn).

BOB LAKE

FIG. 12A



ELEVATION

2050m.

AREA 3.7 ha.

LEGEND

inflow/outflow streams

depth soundings

plane table stations

chemical record

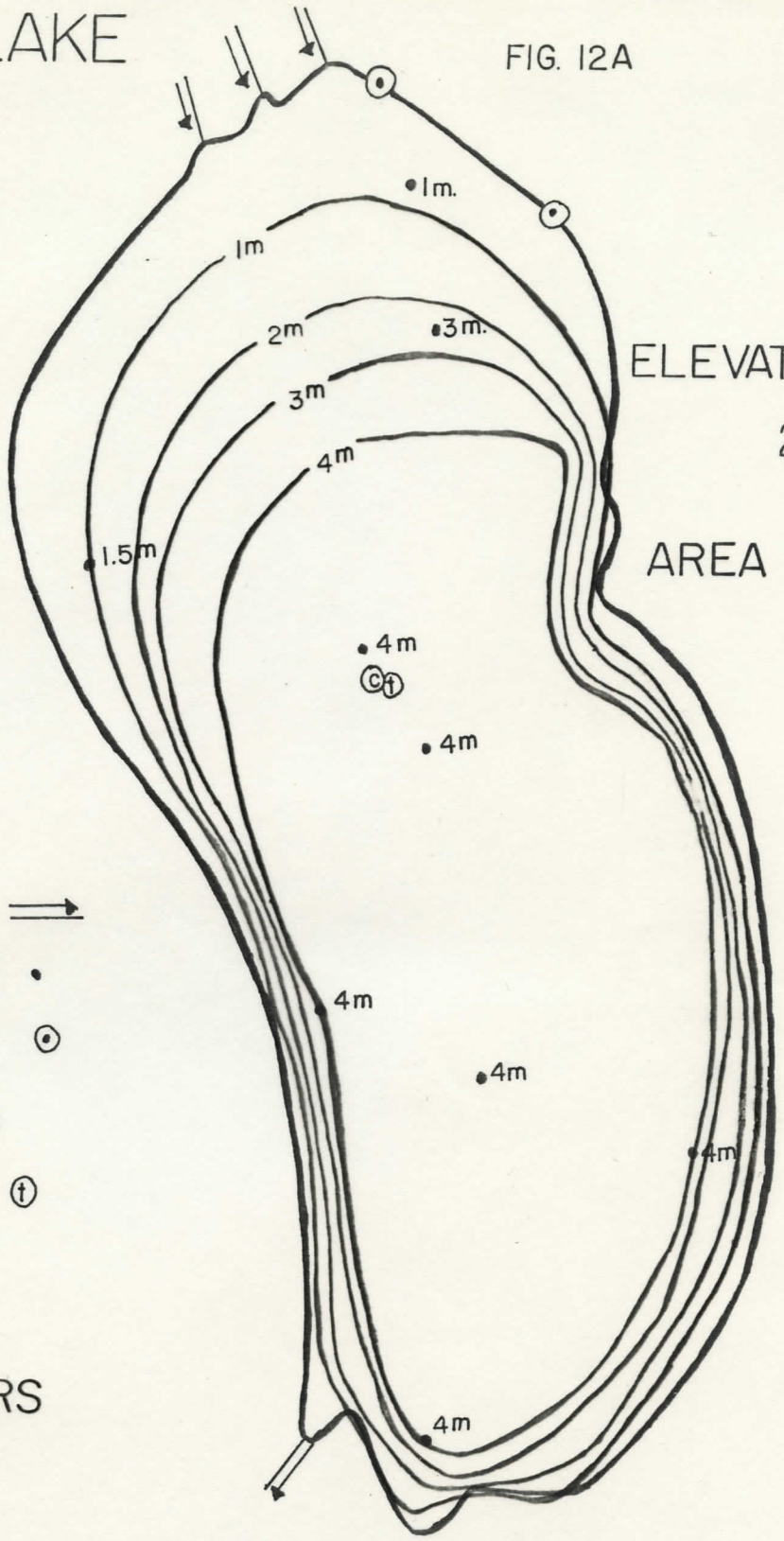
temperature record

PLANE TABLE SURVEY

scale = 1:1700

BOB LAKE

FIG. 12A



ELEVATION

2050m.

AREA 3.7 ha.

LEGEND

inflow/outflow streams

depth soundings

plane table stations

chemical record

temperature record

CONTOURS

PLANE TABLE SURVEY

scale = 1:1700

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test	Result
Temperature	- Surface - 17.9°C
	- Bottom - 18.1°C
Secchi Disc	- Limit of visibility
	- visible on lake bottom at a depth of 4 meters
	- Weather conditions - clear sky (July 29th, 6:00 p.m.)
	- Water conditions - slight ripple
Bottom Composition	- Some rock, mostly muck
pH	- 7.0
Total Alkalinity	- 5 ppm
Total Dissolved Solids	- 7 ppm
Lake Level	- Approximately 80 cm below high water mark

B) Inflow

Average width	- 1.6 meters
Average depth	- 12 centimeters
Velocity	- 0.20 meters/second
Volume of Flow	- 38 liters/second
Temperature	- 12.8°C
Bottom Composition	- Particles ranging in size from sand to small cobbles 10 cm in length
	- Occassional moss covered large boulders 1 m in length

V. PHYSICAL AND CHEMICAL DATA:

B) Inflow (cont'd)

Comments: - braided stream

C) Outflow

Average width - 3.5 meters

Average depth - 10 centimeters

Velocity - 0.22 meters/second

Volume of Flow - 77 liters/second

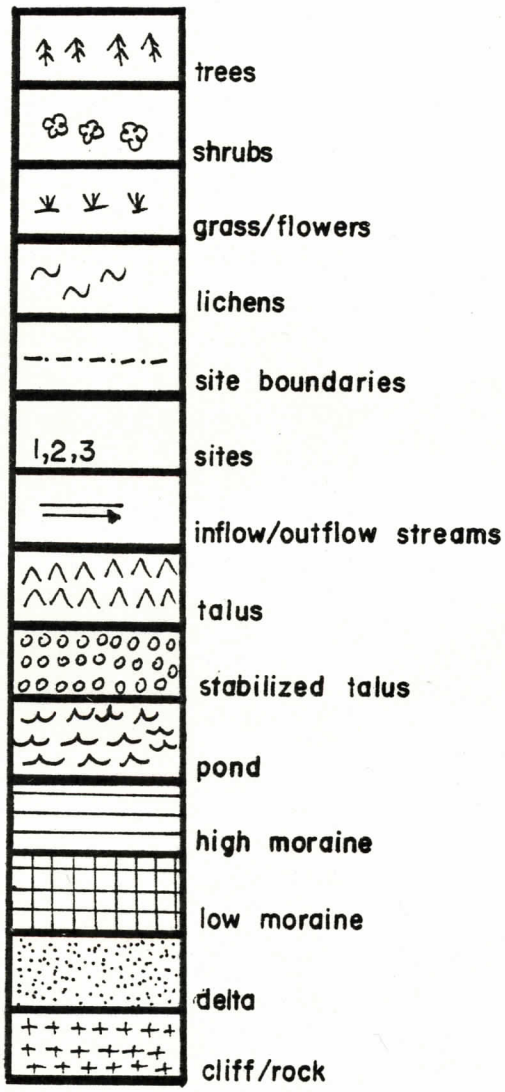
Temperature - 18.4°C

Bottom Composition - Moss and particles ranging in size from very coarse sand to large boulders 1 m in length

Comments: - low water level

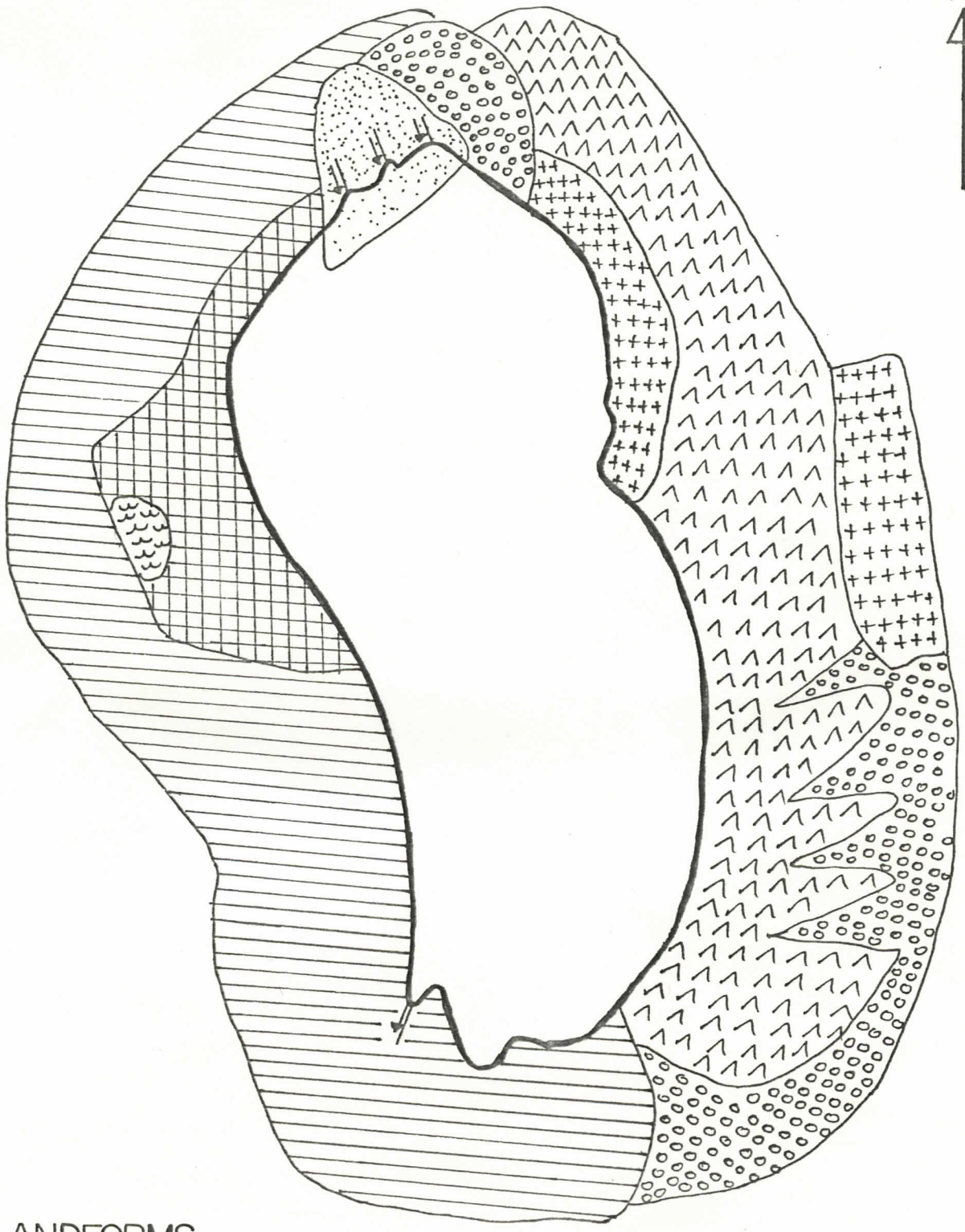
fig. 12B

legend



BOB LAKE

FIG. 12C

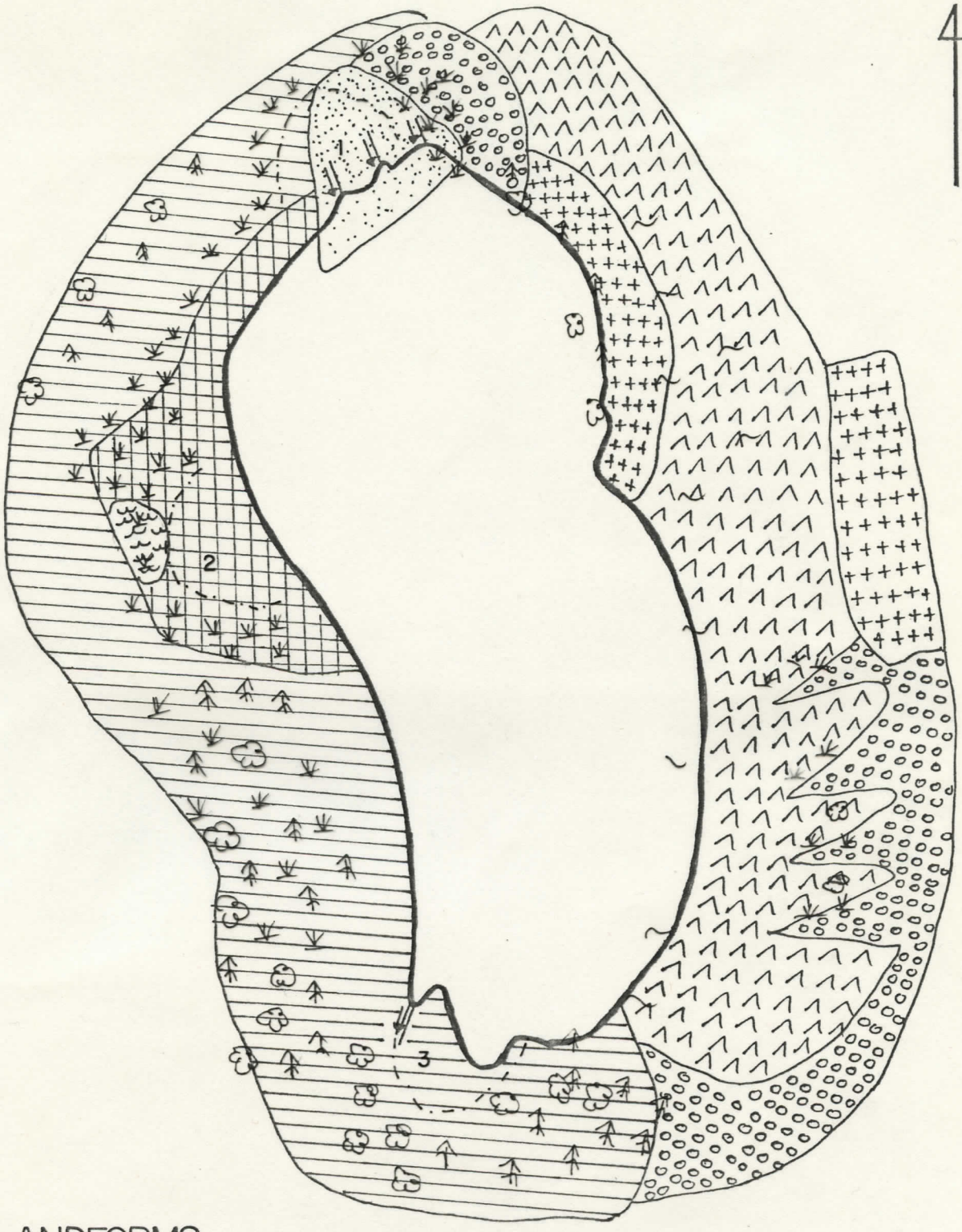


LANDFORMS

scale = 1: 2300

BOB LAKE

FIG. 12C



LANDFORMS
VEGETATION

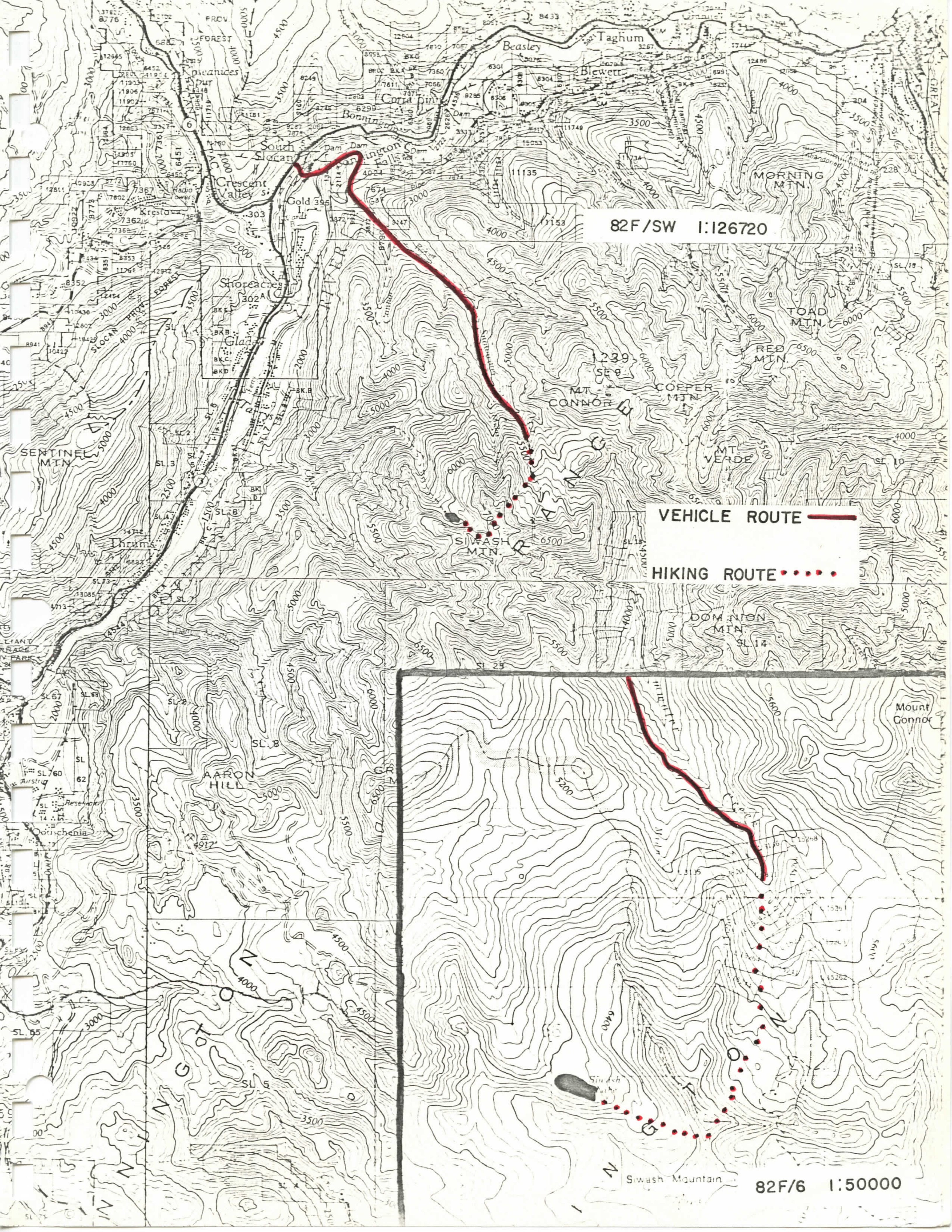
scale = 1: 2300

SIWASH LAKE

DATED STUDIED: August 20th, 1980

I. LOCATION:

- 49° 22' N., 117° 28' W.
- Department of Energy, Mines and Resources Map: Nelson, B.C. 82F/6, 1:50,000. Grid Reference 663679
- Department of Lands and Forests Map: Trail, B.C., 82F/SW, 1:126,720
- Aerial photographs #BC 5356-101, #BC 5356-102



82F/SW 1:126720
VEHICLE ROUTE
HIKING ROUTE
82F/6 1:50000
Taghum
Beasley
Blewett
Corra Linn
Bonnington Falls
South Slocan
Crescent Valley
Krestova
Shoreacres
Glade
Gold
MORNING MTN.
TOAD MTN.
RED MTN.
MT. CONNOR
COPPER MTN.
MT. VERDE
SENTINEL MTN.
SIWASH MTN.
Thrums
DOMINION MTN.
AARON HILL
Mount Connor
Siwash Mountain

II. ACCESS:

Vehicle Route

Drive to South Slocan (Highway 3A) and the Kootenay Canal turnoff. Proceed as follows:

DISTANCE (km)	FEATURE	ROUTE
0.6	- Kootenay Canal Bridge over Kootenay River	
0.9	- Fork in road	L
3.4	- Bridge over Kootenay Canal	
3.6	- Rover Creek Forest Service road	R
6.6	- Fork in road	R
7.6	- Rover Creek Bridge	
8.7	- Fork in road	L
12.7	- Fork in road	R
16.5	- Midas Creek	
18.0	- End of road	

NOTE:

The road was being extended at the time of study. In future years it may be possible to drive further up the mountain.

Hiking Route

From the end of the road there is a marked trail going up Snowwater Creek which eventually reaches an old mining cabin.

II. ACCESS:

Hiking Route (cont'd)

Hiking time to the cabin is 1 3/4 hours. From the cabin, head towards the top of the ridge, angling to the right up the talus. It takes approximately 1 1/2 hours to reach this location. The lake can now be seen. To hike down into the lake descend the ridge and keep to the left of the valley as close to the talus on the base of Siwash Mountain as possible (there is thick bush in the middle of the valley). It takes approximately 1 1/2 hours to get to the lake from the top of the ridge. Total hiking time is approximately 4 3/4 hours.

Alternative Route

Hike up Midas Creek from the logging road and head up a talus slope towards the ridge separating the Midas Creek Valley from the Siwash Creek Valley. Walk along the top of the ridge until the lake can be seen and angle down talus to the lake. This route may cut down on hiking time but it is a steeper climb. Care must be taken to stay on top of the ridge until the lake is seen or there is impossible bushwhacking.

III. GENERAL DESCRIPTION:

Siwash Lake is a northwesterly exposed, moraine dammed lake located at an elevation of 1810 m. At the time of this study the lake was approximately three meters below high water level and up to 12 meters away from its high water shoreline. Thus the surveyed area of the lake is much smaller than it would be at high water level.

III. GENERAL DESCRIPTION: (cont'd)

At high water level the lake is surrounded by dense forest and few suitable camping spots can be found. At low water level however, there are several good camping areas around the lake, especially on the south east shore by the inflow stream. Also, there is a small cabin located near the outflow stream that is in adequate condition and may be used for shelter. Firewood is in good supply.

The lake is fed by many inflow streams and drained by Siwash Creek on the northwest end. Siwash Creek forms a tributary of Glade Creek which empties into Skattebo Reach (Kootenay Lake). The outflow has an old water control gate at its source (dated 1934). There is a substantial amount of driftwood at the outflow end that stretches approximately 10 meters into the lake at high water level. Two inflows and the outflow stream seem to have spawning potential but no fish were observed in the lake. Stocking of this lake would probably be a success.

IV. VEGETATION AND GEOMORPHOLOGY:

Aquatic Vegetation

Very little algal growth was observed in the lake.

Sites

Siwash Lake is situated in the Engelmann Spruce-Alpine Fir Biogeoclimatic zone. The site areas are illustrated in Figure 13C.

IV. VEGETATION AND GEOMORPHOLOGY:

Sites (cont'd)

Siwash Lake is located in a glacial-U-shaped valley on the northwest side of Siwash Mountain. A high, thickly forested moraine on the north and west sides block the lake. Situated in the Nelson Plutonic Zone, the primary rock types are porphyritic granite and granodiorete. Talus slopes make up a large percentage of the southwest side of the lake which is closed in by the base of Siwash Mountain. The inflow streams on the southeast and north edges have both built up relatively large deltas and when the lake is at low level (as it was at the time of this study) they become large, grassy meadows.

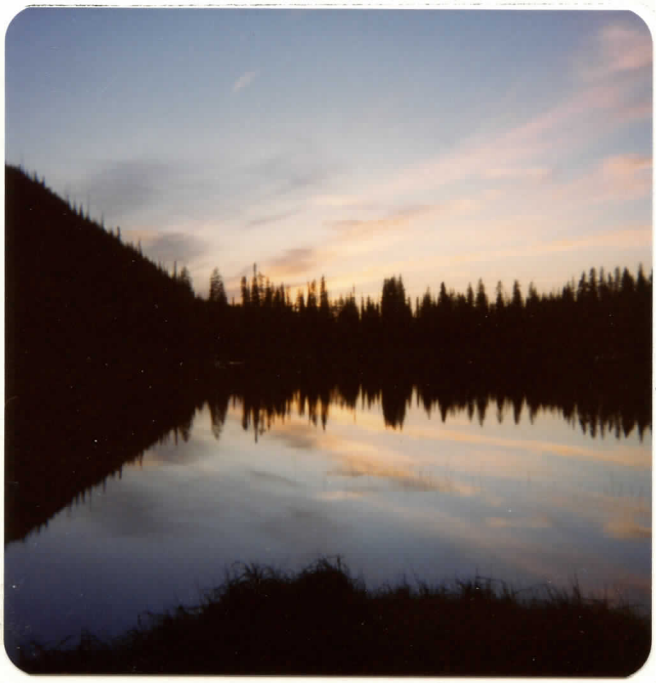
Site 1

This site was located on the delta of the inflow stream on the southeast end of the lake. The soil was mainly made of fine silt and sand and was moderately moist. The site also included some vegetation on the upper edge of the delta (i.e. forested area above high water mark).

Slope:	0° - 2°
Exposure:	Northwest
Moisture Regime:	Damp
Vegetation Classification:	Equisetum Association for the ESSFw Biogeoclimatic Zone*

Siwash campsite at southeastern end of lake.

Log debris abundant at outflow end.



A Siwash sunset...finally, after three tries!

IV. VEGETATION AND GEOMORPHOLOGY:

Site 1

Vegetation

Trees:

Pinus flexilus (Limber Pine)

Picea glauca ssp. engelmannii (Engelmann Spruce)

Tsuga mertensiana (Mountain Hemlock)

Abies lasiocarpa (Alpine Fir)

Abies amabilis (Amabilis Fir)

Shrubs:

Lonicera involucrata (Black Twinberry)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Flowers:

Anemone occidentalis (Western Anemone)

Daucus carota (Wild Carrot)

Viola glabella (Yellow Violet)

Equisetum hyemale (Scouring Rush)

Equisetum arvense (Common Horsetail)

Mosses:

Pohlia wahlenbergii

Brachythecium asperrimum

Sphagnum sp.

Lichens:

Alectoria sp. (Old Man's Beard)

Grasses: Unidentified

Sedges: Unidentified

IV. VEGETATION AND GEOMORPHOLOGY: (cont'd)

Site 2

This site was located on the northeast side of the lake in a thickly forested area on the moraine. Soil development was good and there was a humus layer of approximately 4 cm thick.

Slope: 12°

Exposure: West

Moisture Regime: Slightly Damp

Vegetation Classification: Equisetum Association for the ESSFw Biogeoclimatic Zone*

Vegetation

Trees:

Picea glauca ssp. engelmannii (Engelmann Spruce)

Abies lasiocarpa (Alpine Fir)

Abies amabilis (Amabilis Fir)

Shrubs:

Lonicera involucrata (Black Twinberry)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Ribes divaricatum (Wild Gooseberry)

Ribes lacustre (Swamp Gooseberry)

Flowers:

Leptarrhena amplexifolia (Leptarrhena)

Streptopus amplexifolius (Twisted Stalk)

Tiarella unifoliata (Foam Flower)

Parnassia fimbriata (Fringed Grass of Parnassus)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 2

Vegetation

Flowers: (cont'd)

Daucus carota (Wild Carrot)

Oxyria digyna (Mountain Sorrel)

Viola Glabella (Yellow Violet)

Epilobium angustifolium (Fireweed)

Veratrum eschocholtzii (Indian Hellebore)

Equisetum arvense (Common Horsetail)

Ferns:

Dryopteris austriaca (Spiny Wood-Fern)

Mosses:

Polytrichum juniperinum

Brachythecium asperrimum

Pohlia wahlenbergii

Sphagnum sp.

Lichens:

Lecanora sp.

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

Sedges:

Unidentified

IV. VEGETATION AND GEOMORPHOLOGY: (cont'd)

Site 3

This site was much the same as site two but was located on the northwest shore by the outflow.

Slope: 5°

Exposure: South

Moisture Regime: Dry

Vegetation Classification: Engelmann Spruce-Alpine Fir-Black Huckleberry Association for the ESAF Biogeoclimatic Zone*

Vegetation

Trees:

Picea glauca ssp. engelmannii (Engelmann Spruce)

Abies amabilis (Amabilis Fir)

Shrubs:

Rubus pedatus (Trailing Rubus)

Lonicera involucrata (Black Twinberry)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rubus idaeus (Red Raspberry)

Rhododendron albiflorum (White Rhododendron)

Ribes divaricatum (Wild Gooseberry)

Flowers:

Clintonia uniflora (Queen's Cup)

Streptopus amplexifolius (Twisted Stalk)

Tiarella unifoliata (Foam Flower)

Arnica latifolia (Broad-Leaf Arnica)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 3

Vegetation

Flowers: (cont'd)

Epilobium angustifolium (Fireweed)

Ferns:

Dryopteris filix-mas (Male-Fern)

Mosses:

Mnium glabrescens

Polytrichum juniperinum

Brachythecium asperrimum

Pohlia wahlenbergii

Lichens:

Lecanora sp.

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

Sedges:

Unidentified

Site 4

This site was located on the west side of the lake on stabilized talus. Soil development was sporadic, reaching a depth from 0 - 10 cm.

IV. VEGETATION AND GEOMORPHOLOGY:

Site 4 (cont'd)

Slope: 10°

Exposure: Northwest

Moisture Regime: Slightly Damp

Vegetation Classification: Equisetum Association for the ESSFw Biogeoclimatic Zone*

Vegetation

Trees:

Picea glauca ssp. engelmannii (Engelmann Spruce)

Abies amabilis (Amabilis Fir)

Shrubs:

Phyllodoce empetriformis (Red Heather)

Vaccinium membranaceum (Black Mountain Huckleberry)

Rhododendron albiflorum (White Rhododendron)

Ribes divaricatum (Wild Gooseberry)

Lonicera involucrata (Black Twinberry)

Flowers:

Leptarrhena amplexifolia (Leptarrhena)

Parnassia fimbriata (Fringed Grass of Parnassus)

Streptopus amplexifolius (Twisted Stalk)

Arnica cordifolia (Heart-Leaf Arnica)

Veratrum eschocholtzii (Indian Hellebore)

Equisetum arvense (Common Horsetail)

IV. VEGETATION AND GEOMORPHOLOGY:

Site 4

Vegetation (cont'd)

Mosses:

Dicranella heteromalla

Aulacomnium palustre

Mnium insigne

Lichens:

Lecanora sp.

Cladonia sp. (Trumpet Lichen)

Alectoria sp. (Old Man's Beard)

Grasses:

Unidentified

Sedges:

Unidentified

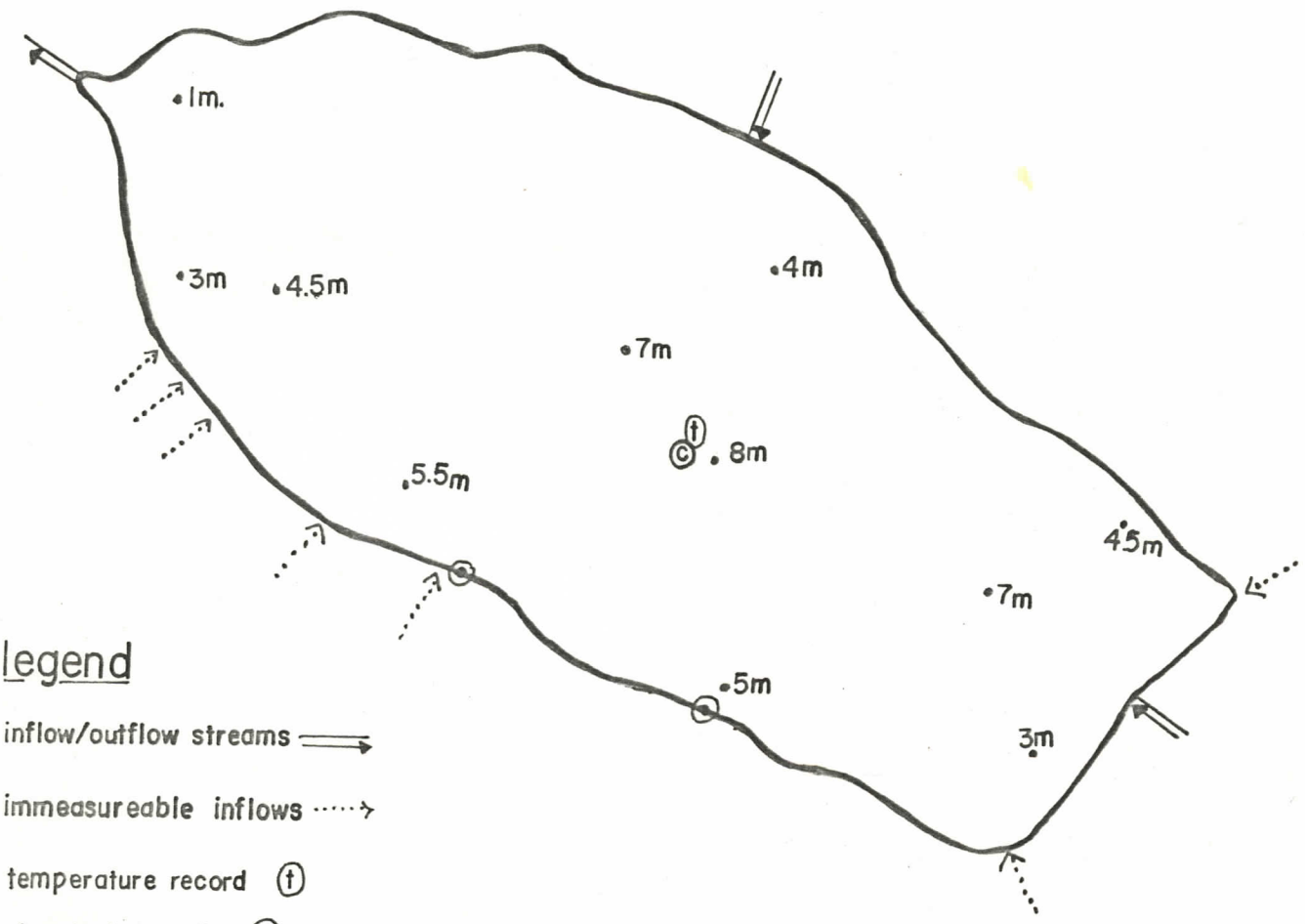
* The association classifications for sites 1, 2 and 4 were developed from Utzig's Guide for Tree Species Selection in the Nelson Forest District under the biogeoclimatic zone Engelmann Spruce-Subalpine Fir Zone (ESSFw). The Association for site 3 was classified within the associations given by the Forestry Handbook for British Columbia under the biogeoclimatic zone Engelmann Spruce-Alpine Fir Zone (ESAF).

fig. 13A

SIWASH LAKE

ELEVATION 1810 m.

AREA 6.8 ha.



legend

inflow/outflow streams ⟹

immeasureable inflows ·····→

temperature record (t)

chemical record (c)

depth soundings •

plane table stations ⊙

PLANE TABLE SURVEY

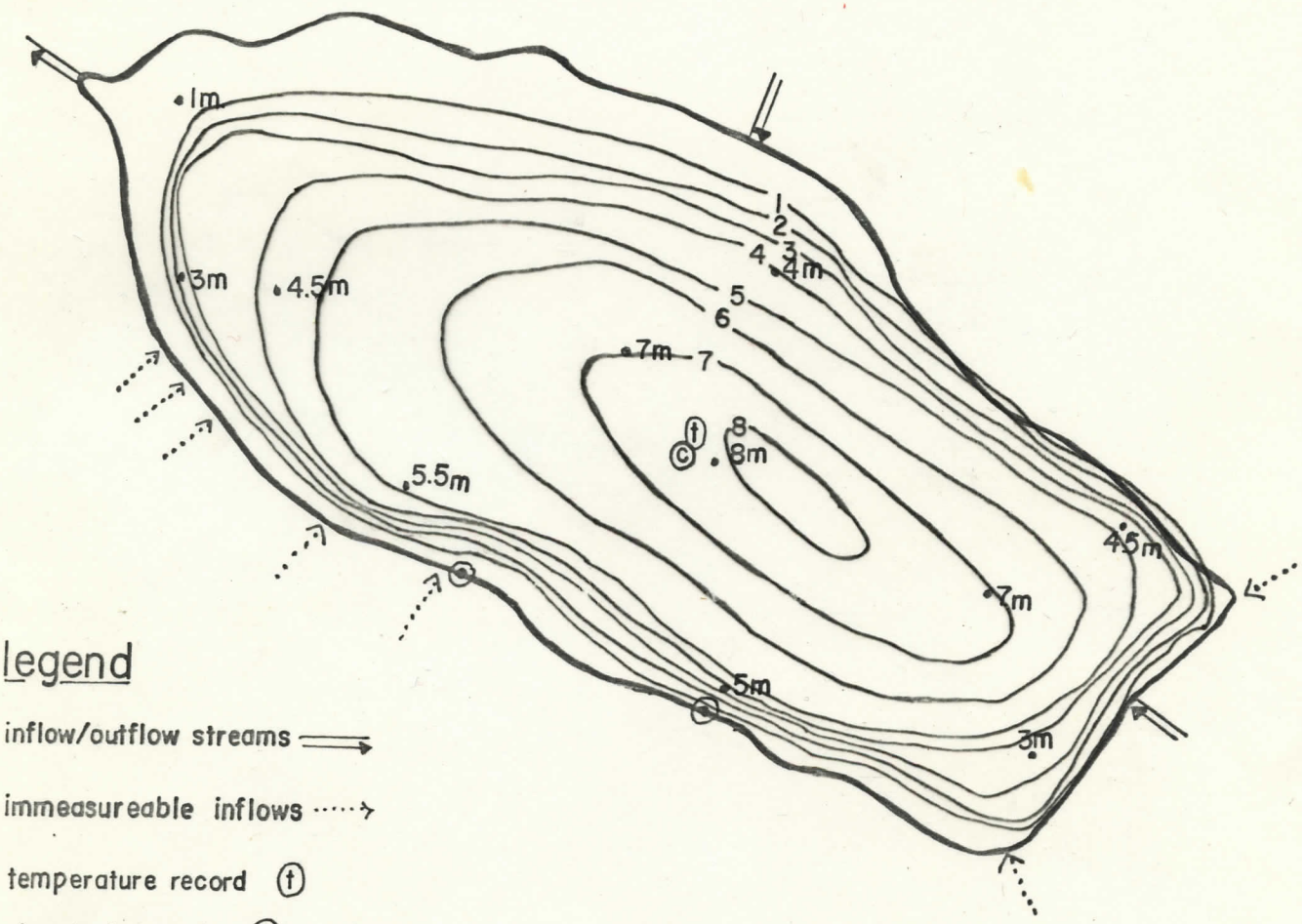
scale= 1:2700

fig. 13A

SIWASH LAKE

ELEVATION 1810 m.

AREA 6.8 ha.



legend

inflow/outflow streams ⟹

immeasureable inflows ⋯→

temperature record (t)

chemical record (c)

depth soundings •

plane table stations ⊙

Contours (meters)

PLANE TABLE SURVEY

scale= 1:2700

V. PHYSICAL AND CHEMICAL DATA:

A) Lake

Test		Result
Temperature	-	Surface - 14.5°C
	-	Bottom - 14.3°C
Secchi Disc	-	Limit of visibility - 5.9 m
	-	Weather conditions - cloudy (August 20th, 5:30 p.m.)
	-	Water conditions - ripples
Bottom Composition	-	Rocks, clay
pH	-	7.1
Total Alkalinity	-	10 ppm
Total Dissolved Solids	-	18 ppm
Lake Level	-	Approximately 3 meters below high water mark

B) Inflows

i) Inflow #1

Average width	-	1.0 meters
Average depth	-	11 centimeters
Velocity	-	0.22 meters/second
Volume of Flow	-	24 liters/second
Temperature	-	5.9°C
Bottom Composition	-	Clay and particles ranging in size from silt to fine gravel. Larger particles further upstream
Comments:	-	much log debris

V. PHYSICAL AND CHEMICAL DATA:

B) Inflows (cont'd)

ii) Inflow #2

Average width	-	0.8 meters
Average depth	-	6 centimeters
Velocity	-	0.18 meters/second
Volume of Flow	-	9 liters/second
Temperature	-	6.4°C
Bottom Composition	-	Clay and particles ranging in size from silt to fine gravel. Some humus
Comments:	-	some log debris.

C) Outflow

Average width	-	2.1 meters
Average depth	-	22 centimeters
Velocity	-	0.29 meters/second
Volume of Flow	-	134 liters/second
Temperature	-	14.6°C
Bottom Composition	-	Particles ranging in size from fine sand up to small cobbles 10 cm in length. Occasional particles up to small boulders 40 cm in length.
Comments:	-	flows under log jam for first 30 m
	-	some algal growth on stream bottom.

legend

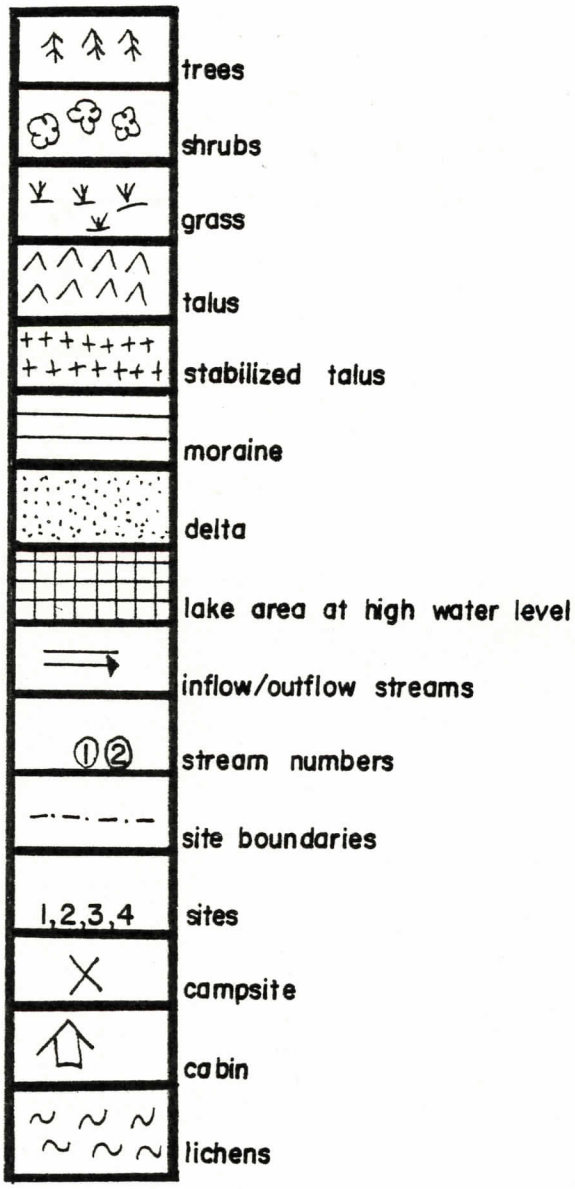
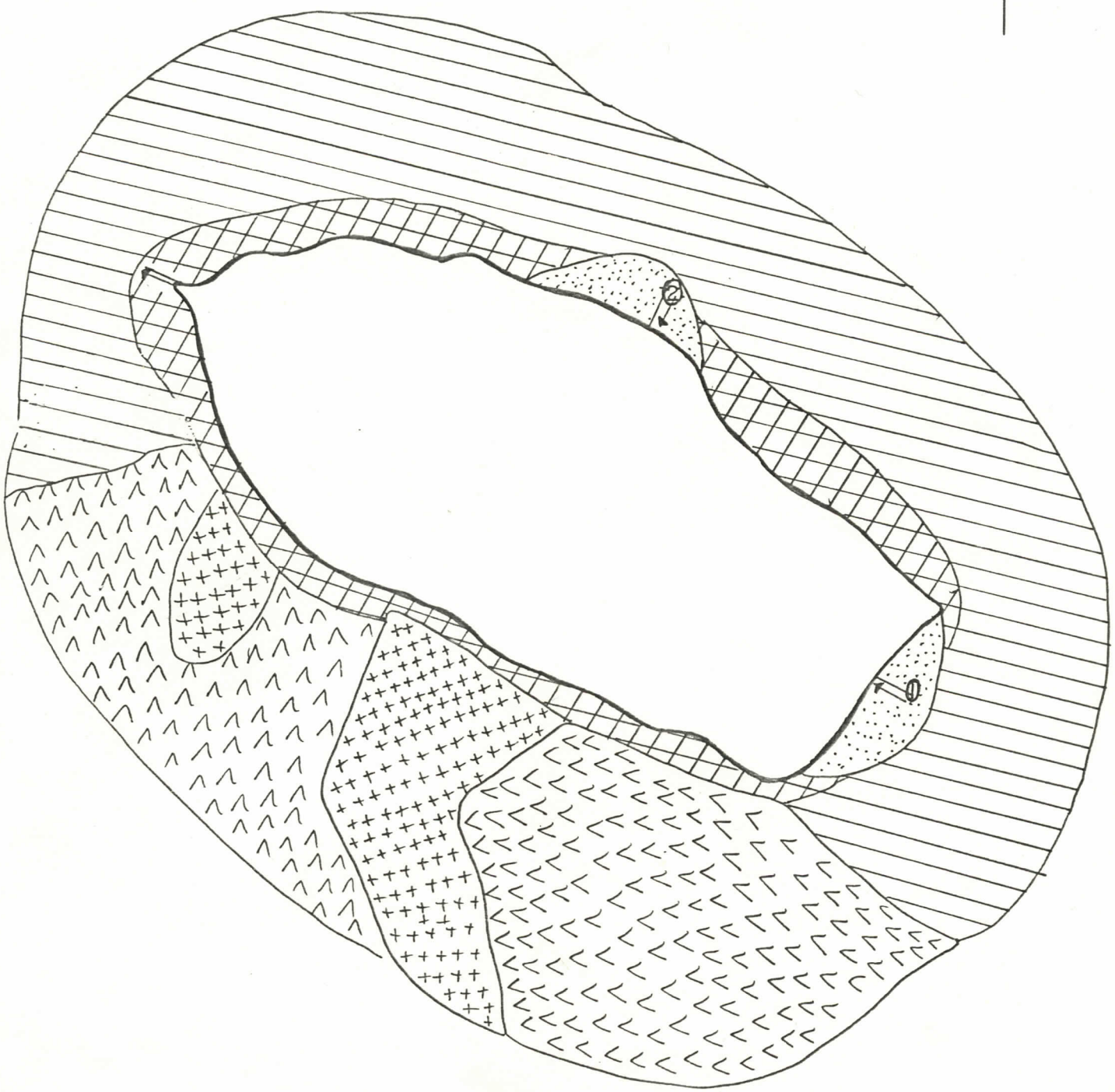

trees
shrubs
grass
talus
stabilized talus
moraine
delta
lake area at high water level
inflow/outflow streams
① ②
stream numbers
site boundaries
1,2,3,4
sites
campsite
cabin
lichens

fig. 13C

SIWASH LAKE



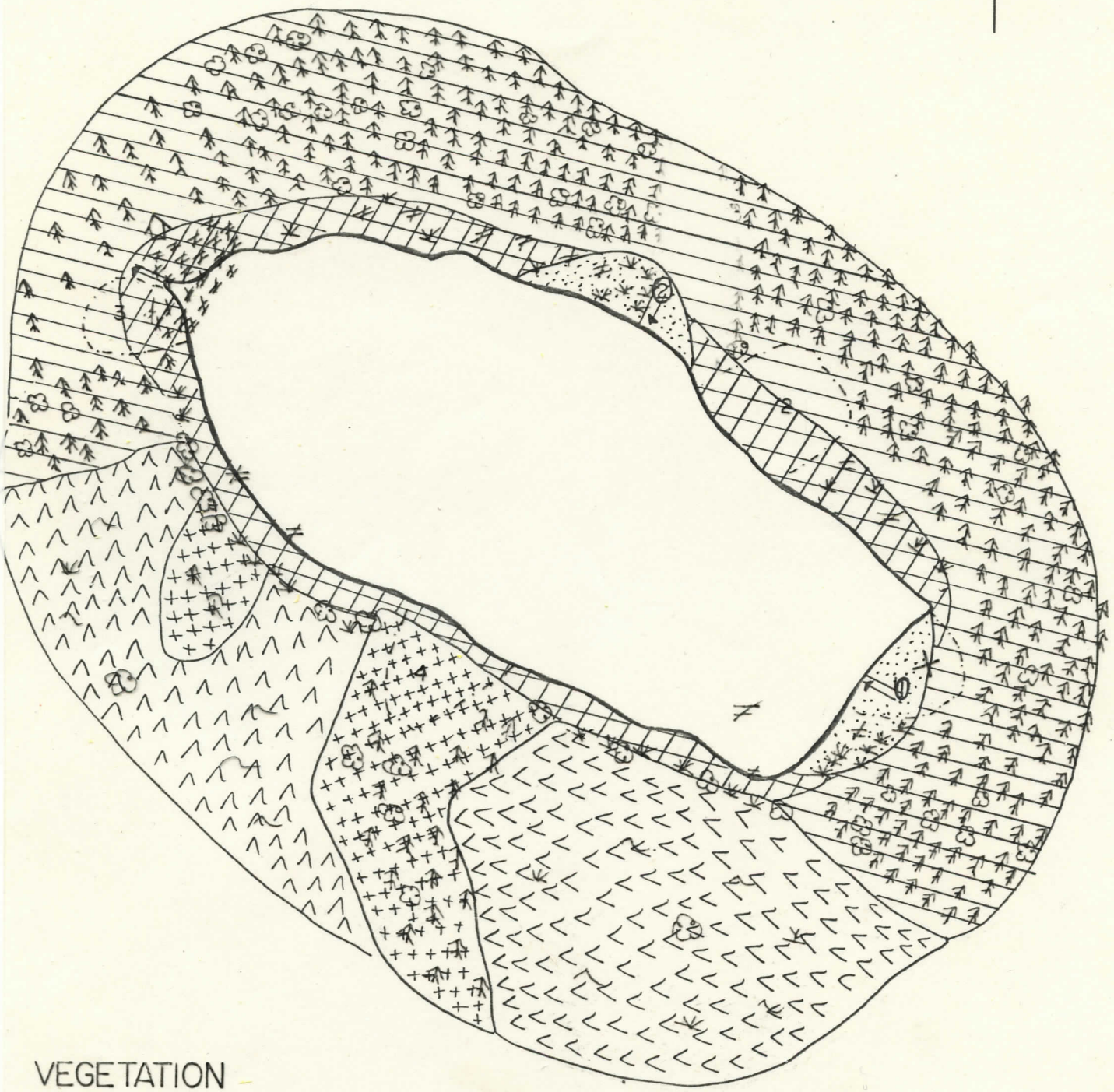
LANDFORMS

scale = 1:3200

fig. 13C

SIWASH LAKE

N



VEGETATION

LANDFORMS

scale = 1:3200

APPENDIX

CHEMICAL METHODS

The three chemical tests - pH, total alkalinity and total dissolved solids - were all conducted in the laboratory. Water samples were transported in polypropylene bottles and stored at 5°C as soon as possible. Water samples were analyzed as promptly as possible.

HYDROGEN ION CONCENTRATION (pH)

The results of this test were determined using a Corning Digital 112 pH meter which was standardized with a buffer solution (pH - 6.86).

TOTAL ALKALINITY

This measurement indicates the capacity of the water to neutralize a strong acid. 5 drops of the indicator methyl orange were added to a 100 ml sample of water, producing a yellow solution. This solution was titrated with 0.01 M sulfuric acid until an orange colour persisted. The volume of acid (in ml) required to reach this end point multiplied by 10 gives the total alkalinity in parts per million. This value indicates the amount of calcium carbonate ($CaCO_3$) present in the water.

TOTAL DISSOLVED SOLIDS (T.D.S.)

3 clean, dry 250 ml beakers were weighed to the nearest 0.0001 g. 100 ml of water were added to each beaker which was placed in a Fisher Econotemp Laboratory Oven at a temperature of 78° - 85°C. The beakers were kept in the oven for approximately 24 hours.

TOTAL DISSOLVED SOLIDS (T.D.S.) (cont'd)

They were then removed, cooled and reweighed. The difference in mass multiplied by 10,000 gives the amount of dissolved sediments in parts per million.

The two preceeding tests, total alkalinity and total dissolved solids, are both useful indicators of biological productivity. The amount of material dissolved in the water may control the number of plankton the lake can support. Thus, this may affect the first step in the food chain.

NOTE: Two chemical tests conducted in the 1977 and 1978 reports - dissolved oxygen and dissolved carbon dioxide - were deleted from this report. The reason is that the data obtained in the two previous reports was fairly consistent for each lake tested, thus it was not considered necessary to include these tests in the 1980 report.

PHYSICAL METHODS

The limit of visibility was determined for each lake. Data on stream characteristics were obtained for the outflows and most of the inflows.

LIMIT OF VISIBILITY

This measurement indicates the degree to which light is able to pentrate the water. In addition this measurement can serve as an indication of the amount of suspended matter in the water. The Secchi disc is lowered until it cannot be seen and the depth noted. The disc is then raised until it reappears and the depth again noted. The average of these two depths is the limit of visibility. The weather and water

LIMIT OF VISIBILITY (cont'd)

conditions were also recorded.

STREAM CHARACTERISTICS

Measurements were conducted to determine the average width and depth of each stream. The surface velocity of the stream was determined using the chip-flow method. The volume of flow (liters per second) is the product of the width, depth and velocity.

Stream bed particles were classified by size using the "Modified Wentworth Particle Size Scale" in the Instream Flow Information Paper: No. 3. (Bovee, Ken D. and Cochnauer, Tim, 1977)

SURVEY METHODS

The lake was surveyed using a plane table. Depth soundings were taken using the Secchi disc on a line with meter calibrations. The positions of these depth soundings were determined by either triangulation or using a range finder.

The surface area was calculated using a planimeter.

METHODS OF VEGETATION ANALYSIS

Vegetation, like any other aspect of nature, forms a continuum and this tends to complicate classification into biogeoclimatic zones and associations. The vegetation continuum is more irregular in mountainous areas than it is in flatter areas because environments may change abruptly over short distances in these areas whereas, in flatter areas, environmental change is spread over a greater distance.

METHODS OF VEGETATION ANALYSIS (cont'd)

The manner in which plant populations rise and fall along environmental gradients supports the hypothesis that competition usually does not generate sharp boundaries between species, and that evolution of species in relation to one another does not result in well-defined groups of species that have similar distributions. The centers and boundaries of the species are scattered along the environmental gradient.

This is in accordance with two principles, one of which is the principle species individuality, which is that "each species is distributed in its own way, according to its own genetic, physiological, and life-cycle characteristics and its way of relating to both physical environment and interactions with other species" (Ramensky and Gleason) and, thus, no two species have the same distribution. The second principle is the principle of community continuity developed by Ramensky and Gleason, which states that, rather than forming distinctly separated zones, most communities intergrade continuously along environmental gradients, as implied by the broad overlap and scattered centers of species groups along a gradient.

An attempt was made to classify areas of uniform vegetation around each lake and to provide data on the slope, exposure, moisture regime and landform of each area studied.

Site areas were chosen on the basis of uniform vegetation and differing moisture regime. The abundant flora was listed and the rare flora was also noted.

METHODS OF VEGETATION ANALYSIS (cont'd)

The biogeoclimatic zone of each lake was classified using the techniques and categories in pages 200 to 287 of the Forestry Handbook for British Columbia. The association classifications for the sites were mainly developed from Utzig's Guide For Tree Species Selection in the Nelson Forest District. Since Utzig's plant associations were developed from data collected in the general area of most of the lakes surveyed, they are more accurate than those in the Forestry Handbook.

Most of the vascular plants were primarily identified from Trees, Shrubs and Flowers to know in British Columbia (Lyons, C.P., 1952). Mosses were identified using Some Common Mosses of British Columbia (Schofield, W.B., 1969). Lichens were identified using How to Know the Lichens (Hale, Mason E., 1979). Ferns were classified using The Ferns and Fern-Allies of British Columbia (Taylor, T.M.C., 1963).

GEOLOGICAL AREAS

The geological areas were classified according to the Geology Map (82FW, Nelson) drawn by the Geological Survey of Canada in 1960 using the results of field work done by H.W. Little in 1948 to 1952.

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