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U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

LAKE AND STREAM SURVEY
WHITMAN NATIONAL FOREST

BY
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BAKER, OREGON
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INTRODUCTION

Purpose of Survey:

This is the second report of the conditions existing in the lakes and streams of the Whitman National Forest, Region 6. The first survey, conducted in the summer of 1938, and this survey, conducted in the summer of 1939, were under the supervision of the Whitman National Forest.

The purpose of this survey is:

(1) To determine the need for lake and stream improvements on the Whitman National Forest.

(2) To develop a practical stocking program.

(3) To determine whether or not present fishing regulations are satisfactory and to recommend such changes as seem advisable.

Approximately one week was spent in making a general survey of Eagle and East Eagle Creeks. This was done while waiting for the lake survey equipment to arrive. After the arrival of the lake survey equipment, the rest of the time was spent on lake surveys.

Up to this time very little was known about the existing conditions in these lakes, and plantings of fish in most cases were guesses at the most. Although this survey is by no means complete, it does give a general idea of the conditions existing in these lakes and problems connected with them. Until the time when a more complete survey can be made, the stocking program and recommendations given in this report should be adequate if carried out.

Personnel:

The survey party consisted of Thomas A. Taylor, a graduate of Utah State Agricultural College in Wildlife, who was in charge of the survey work; and Norbert L. Sieg, senior in Fish and Game Management at Oregon State College, assistant.

Time Spent in the Field:

Between July 6 and August 29, approximately 40 days were spent in actual survey work. The rest of the time, about 13 days, was spent on fire suppression and presuppression. Since these lakes could only be reached by trail, some time was lost packing from one lake to another. The work terminated abruptly August 28, due to a call to the Big Cow Creek fire.

Equipment:

The survey equipment was obtained by the Whitman National Forest from the U. S. Bureau of Fisheries at Palo Alto, California. The equipment borrowed consisted of an Eckman dredge and messenger, plankton net and cup, water sample bottle, counting pan and sieve, and sounding cord. Chemical analysis set, plain table and board, steel chain, and camping utensils were furnished by the Whitman National Forest.

General Description of Area:

All of these lakes are located at an elevation between 6800 to 8000 feet and all vegetation found around them is alpine type. The main species of trees found were alpine fir and white barked pine with alpine fir predominating. Other vegetation found near these lakes consisted of sedges, ranunculus, heath, onions, and sandock. Generally speaking, the vegetation surrounding these lakes is sparse for the soil is very rocky and numerous cliffs and rock slides extend to the water's edge. The high rugged peaks surrounding most of these lakes are composed of granite.

All of these lakes are accessible only by trail; therefore, fishing is comparatively light. These lakes are located in the Minam Division of the Whitman National Forest, about fifty miles from the town of Baker.

The winters in this region are quite severe, especially at the elevation of these lakes. The winter season lasts six months or more and from three to eight feet of snow covers the ground. At some of these lakes, snow remains the year around. It is readily seen that the growing season for fish is comparatively short in this region.

Acknowledgments:

The writer wishes to express his gratitude to Mr. Lester Moncrief, Supervisor of the Whitman National Forest, Mr. F. G. Whitney, Assistant Supervisor of the Whitman National Forest, Mr. Melvin Burke, Assistant Range Examiner of the Whitman National Forest, Mr. Glenn Mitchell, Senior Range Examiner for Region Six, and the District Rangers for their interest, assistance, and suggestions in this work.

Thanks are due Mr. Braden Pillow, Fish and Game Management student at Oregon State College, and Robert Braunwant, Washington State College, for fish stomach analysis; and Dr. Paul R. Needham, U. S. Bureau of Fisheries, for the identification of bottom samples.

TABULATED LAKE SURVEY DATA

Physical Features:

All of the lakes surveyed are located at an elevation very near timberline. Eagle Lake is the only one surveyed that did not have any trees surrounding the shoreline or on its watershed.

Four of the seven lakes surveyed have been made into reservoirs for irrigation water. This has been done by constructing a dam at the outflow of the lake. Crater Lake and Upper Pine Lake were surveyed during high water; Eagle and Lookingglass lakes during low water. The carrying capacity of a lake for fish is determined by its low water level.

The water replacement for lakes was determined from the volume of the lake and the outflow. Lower Pine Lake and the fastest water replacement of 15 days, while Eagle Lake had the slowest replacement of 436 days. However, Eagle Lake has a surface acreage of 30, while Lower Pine Lake has a surface acreage of only 2.8.

The stream volume of the outlet was calculated by the equation

$$V = K \frac{W. D. L.}{T}$$

V = Velocity (second feet)

K = Constant for bottom friction .8

W = Average width of sector

D = Average depth of sector

L = Length of sector

T = Time (seconds) required for a surface float to pass through the sector.

Surface acres were determined by triangulation.

PHYSICAL FEATURES

Lake	Average Depth	Deepest Water	Outlet Sec. Ft.	Acre Feet	Cubic Feet	Water Replacement in Days	Surface Acres	Flu in L
	5.5'	12'	1.56	50.105	2,182,574	26.1	9.11	
	24.0'	57'	2.96	373.44	16,267,046	188.2	15.56	
	6.7'	28'	1.18	48.776	2,124,683	25.6	7.28	
	28.6'	52'	2.48	863.434	37,611,185	436.1	30.19	
	6.9'	14'	3.5	129.168	5,626,558	65.1	18.72	
ss	22.2'	35'	6.0	727.938	31,708,979	368.1	32.79	
r)	10.4'	23'	3.0	29.12	1,268,467	15.1	2.80	
r)	35.7'	65'	3.0	638.316	27,805,045	322.1	17.88	

kes have artificial dams constructed at the outflow, making the lake a reservoir.

PHYSICAL FEATURES

Lake	Color	Bottom Type	Type of Shoreline	Type of Watershed	Nature of Water
	Greenish due to algae	Sand 10% Silt 20% Muck 60% Gravel & Boulders 10%	Rocky 5% Meadow 50% Timbered 45%	Mountains Alpine fir	Melting snow Springs
	Clear	Sand 20% Silt 10% Muck 60% Gravel & Boulders 10%	Rocky 80% Meadow 5% Timbered 15%	Mountains Alpine fir Vegetation sparse	Melting snow Springs
	Clear	Sand 5% Silt 40% Muck 50% Gravel & Boulders 5%	Timbered 30% Meadow 50% Rocky 20%	Mountains Alpine fir Alpine meadows	Melting snow Springs
	Clear	Sand 5% Silt 5% Muck 60% Gravel & Boulders 30%	Meadow 5% Rocky 95%	Mountains Trees absent Alpine vegetation	Melting snow Springs Stream from a sma lake
	Clear	Sand 5% Silt 20% Muck 70% Gravel & Boulders 5%	Timbered 25% Meadow 75%	Mountains Alpine fir sparse Alpine meadows	Melting snow Springs
s	Clear	Sand 10% Silt 5% Muck 60% Gravel & Boulders 25%	Timbered 40% Meadow 20% Rocky 40%	Alpine meadows Mountains Alpine fir White-barked pine	Melting snow Springs
per)	Clear	Sand 5% Silt 10% Muck 75% Gravel & Boulders 10%	Timbered 40% Rocky 10% Meadow 50%	Mountains Alpine fir Alpine meadows	Melting snow Springs
wer)	Clear	Sand 20% Silt 20% Muck 45% Gravel & Boulders 15%	Meadow 50% Rocky 50%	Mountains Alpine fir Alpine meadows	Melting snow Springs

Table 2.

Location, Elevation, Accessibility & Size

Name of Lake	Location	Elevation	Accessibility	Size (Acres)
Bear	T R S 5S 44E 29 Union County	7400'	Trail - 5 miles	9.11
Crater	T R S 6S 44E 12 Baker County	7500'	Trail-3½ miles	15.56
Culver	T R S 5S 44E 32 Union County	7600'	Trail-4½ miles	7.28
Curtiss	T R S 5S 44E 35 Union County	8000'	Trail-2 miles	2 (est.)
Eagle	T R S 5S 44E 21 Union County	7400'	Trail-6 miles	30.19
Hidden	T R S 5S 44E 9 Union County	7000'	Trail-8 miles	18.72
Lookingglass	T R S 6S 44E 5,6 5S 44E 31,32 Union-Baker Counties	7500'	Trail-5 miles	32.79
Moon	T R S 5S 44E 9 Union County	7000'	Trail-8½ miles	4 (est.)
Pine (Lower)	T R S 6S 45E 19 Baker County	7500'	Trail-2½ miles	2.80
Pine (Upper)	T R S 6S 45E 18,19 Baker County	7500'	Trail-2½ miles	17.88
Two Color	T R S 6S 44E 8 Baker County	6800'	Trail-5 miles	3 (est.)

Chemical Analysis:

Chemical analysis consisted of the determination of p^H, oxygen content, and methyl orange alkalinity. Samples of water to be analyzed were taken at the surface of the lake. No samples were taken below the surface.

All the lakes, except Culver Lake, were found to be slightly acid with a range of 6.5 to 5.5 p^H. Culver Lake was slightly on the alkaline side with a p^H of 8. Since mitrazine paper was used to determine the p^H, these figures are open to question.

Oxygen, carbon dioxide, and methyl orange alkalinity were measured in parts per million. Crater, Culver, and Hidden lakes all had an oxygen content of 5 ppm. While this oxygen content is low, it is not too low for fish life unless the carbon dioxide content is extremely high. Culver Lake was the only lake that had a low oxygen and a high carbon dioxide content, but apparently it was not affecting the fish life.

The methyl orange alkalinity test represents the amount of calcium carbonate in parts per million. Carbonates are necessary for fish life and the production of fish food organisms. Tests showed that the lakes that were tested are fairly well supplied.

Chemical Analysis of Lake Waters

Chemical Tests	Name of Lakes: (Crater (7-21-39)	Pine Lakes & Reservoir (7-26-39)	Looking-glass (8-3-39)	Culver (8-17-39)	Bear (8-18-39)	Eagle (8-25-39)	Hidden (7-17-39)
Temperature*	59°F	59°F	60°F	64°F	66°F	63°F	56°F
p^H	6.0	5.5	6.0	8.0	6.0	6.5	6.0
Oxygen	5.0 ppm	7.5 ppm	7.5 ppm	5.0 ppm	7.5 ppm	7.5 ppm	5.0 ppm
Carbon Dioxide	3.5 ppm	5.0 ppm	7.5 ppm	12.0 ppm	4.0 ppm	4.0 ppm	2.0 ppm
Methyl Orange	--	--	7.0 ppm	8.0 ppm	12.0 ppm	8.0 ppm	--

* Temperatures were taken at the surface.

Temperature of the Lakes:

Since most of these lakes are about the same elevation and are all located close together, the water temperatures are about the same. The highest surface temperature was found at Culver Lake with a temperature of 64°F and the lowest surface temperature at Hidden Lake, which was 56°F. The temperatures of these lakes probably do not increase much more than the temperatures recorded in Table 4, for this survey was conducted in the middle of the summer. Undoubtedly, the temperatures are much colder during winter months for ice and snow completely cover the lakes. Snow banks were found along the edge of some of these lakes as late as August 12.

Bear and Hidden Lakes, 10 and 12 feet deep respectively, did not have a thermocline. (A drop of 1°C per meter was considered a thermocline). Culver Lake had the most pronounced thermocline. The water temperature dropped from 64°F at the surface to 41°F at the 20 foot depth. This sudden drop was undoubtedly caused by the snow water running into the lake.

Table 4. Thermal Stratification

Name of Lakes, Date, & Temperature of Water

Depth of Reading	Crater 7-21-39	Pine Lakes & Reservoir 7-26-39	Looking-glass 8-3-39	Culver 8-17-39	Bear 8-18-39	Eagle 8-25-39	Hidden 7-17-39
0	59°F	59°F	60°F	64°F	66°F	63°F	56°F
4'						61°	55°
5'	58°	58°	60°	60°	65°		
8'						59°	54°
10'	57°	57°	59°	48°	64°		
12'						57°	53°
15'	57°	54°	58°	44°			
16'						55°	
20'	53°	52°	55°	41°		53°	
24'						51°	
25'	51°	50°	54°	41°			
28'				41°		49°	
30'	50°	48°	54°				
32'						44°	
35'	48°	46°	54°				
36'						42°	
40'	47°	45°				41°	
44'						41°	
45'	46°	44°					
48'						41°	
50'	45°	43°					
52'						40°	
55'	45°	42°					
56'							
60'		42°					
65'		42°					
Thermocline	15'-20'	10' - 15'	15' - 20'	0' - 20'	(None)	28' - 32'	(None)

Fish Stomach Analysis:

Two groups of fish stomachs were sent away for analysis. Fish stomachs from Lookingglass Lake, Pine Lake and Reservoir, Hidden Lake, and Crater Lake were sent to Washington State College and were identified by Robert Braunwant. The other group of stomachs from Bear Lake, Culver Lake, Eagle Lake, and Eagle Creek were identified by Braden Pillow, graduate student in Fish and Game Management, Oregon State College. The findings of each of these students are incorporated in this report. Although these two stomach analysis reports differed somewhat in form, they both gave the necessary data. Fish stomachs from Crater Lake were apparently lost.

Lookingglass Lake:

It was found that there were about twenty obvious groupings that the material from this lake seemed to fall into. Of the forty-six stomachs from Lookingglass Lake, twenty-three, or 50%, were found to be empty. The contents of the others varied from .1 cc to 1.3 cc, making an average total content for this group .21 cc. The most common organism found here was mosquito larvae. These larvae were found in about one-fourth the stomachs. About one-fifth had some small spores which could not be identified. They were probably from some aquatic moss or algae. Coleoptera were next with eighteen percent occurrence. These beetles, though not identified more closely than order, were apparently divided about 50-50 between aquatic and terrestrial forms. The Hemipterous insects noted in the stomachs from Lookingglass Lake, as well as the other lakes, were almost entirely aquatic ones of the general Corixa and Notonecta.

Table 5.

Occurrence of Fish Food Organisms in Stomachs of Fish from Lookingglass Lake
Forty-Six Stomachs

Food Organisms	Occurrence in Stomachs	Percent of Occurrence
Mosquito larvae	11	24
Coleoptera adult	8	18
Spores	8	18
Hemiptera	7	13
Wood	7	13
Caddis fly larvae	5	11
Ants	5	11
Other Hymenoptera	5	11
Conifer needles	4	9
Ticks	3	7
Damsel fly	3	7
Spiders	3	7
Chironomous larvae	3	7
Orthoptera	2	4
Diptera	2	4
Simulium	2	4
Mosquito adult	1	2
Rocks	1	2
Coleoptera larvae	1	2

Table 6. Stomach Analysis - Lookingglass Lake

Specimen Number	Mosquitoe (larvae)	Mosquitoe (adult)	Simulium (larvae)	Chironomous (larvae)	Caddis fly (larvae)	Ticks	Spiders	Ants	Other Hymenoptera	Coleoptera (adults)	Hemiptera	Damsel fly	Unidentified Spores	Wood	Rocks	Conifer Needles	Coleoptera (larvae)	Orthoptera	Mayflies	Total Volume
1	2																			.1 cc
2																				.1
3	1		3		4								35	1						.15
4					4															1
5	1		1			1														.1
6					4	1							33							.2
7					1			1	4				15							.2
8	1				1								5							
9				1										1						
10	1															1	1			.1
11																				.2
12																				
13	3																	1		
14																				.2
15																				.1
16																				
17																				
18											1									
19																				
20												2								
21	2												35							.2
22						3	1			1		3	9					1		1.2
23																				
24										5	2			3	2					.3
25	1	36					1	1	2		1					1				1
26							1			1										1.1
27																				
28				1						2										
29				1						3	1		50						1	.2
30																				
31																				
32	1																		1	
33								1	1	1	3									1.3
34																				
35														1						
36																				
37	1			9																
38																				.5
39																				
40														2						
41														1						
42																				
43																				.8
44																				
45								4	3	3	2					1				1.0
46	3							3	1	2						1				.6

Pine Lake and Reservoir:

Fifteen stomachs were analyzed from these two bodies of water. Stomachs were not kept separate from Pine Lake and the Reservoir because the two bodies of water are so close together and are connected by a small stream. The stomachs contained next to the highest average volume--.95 cc. Coleoptera were the most plentiful in regard to the frequency of occurrence for they were found in forty-seven percent of the stomachs. Forty percent contained Hemiptera and thirty-three percent contained adult mosquitoes. The remainder was divided almost equally among Chironomous larvae, ants, other Hymenoptera, and Orthoptera.

It is significant to note the total absence of wood, rocks, conifer needles, or other foreign bodies in the stomachs of the fish from these lakes.

Table 7.

Occurrence of Fish Food Organisms in Stomachs of Fish from Pine Lake & Reservoir
Fifteen Stomachs

Food Organism	Occurrence in Stomachs	Percent of Occurrence
Coleoptera	7	47
Hemiptera	6	40
Mosquito adult	5	33
Chironomous larvae	4	26
Ants	4	26
Other Hymenoptera	4	26
Orthoptera	3	20
Canned Corn	2	13
Diptera	1	7
Spiders	1	7

Stomach Analysis - Pine Lake & Reservoir

Specimen Number	Mosquitoes (adult)	Chironomous (larvae)	Caddis fly (larvae)	Spiders	Ants	Other Hymenoptera	Coleoptera	Hemiptera	Damsel fly	Unidentified Spores	Wood	Rocks	Conifer Needles	Coleoptera (larvae)	Orthoptera	Diptera	Canned Corn	Mayflies	Total Volume
1	1					2		13											1.5 cc
2																			.1
3						2		2											.15
4					8		16	4											1.9
5															1		11		3.0
6															1		7		1.8
7	1	2					3												.1
8					1		3												.1
9	5	8					17									2			1.1
10								1											
11	2	5		1			2												.4
12	31				11	1													1.1
13					1		3	1							1				1.0
14						3	2												2.0
15								1											.1

Hidden Lake:

The thirty stomachs from Hidden Lake showed an average volumetric content of .62 cc. As in the case of the analysis of the Pine Lake group, the stomachs from Hidden Lake show the predominance of Coleoptera. This order leads with 37% occurrence, followed by caddis fly larvae and Simulium larvae with 23% and 20% respectively. This figure is probably not very representative in the case of the caddis fly larvae as the cases were included with the larvae.

Table 9.

Occurrence of Fish Food Organisms in Stomachs of Fish from Hidden Lake
Thirty Stomachs

Food Organisms	Occurrence in Stomachs	Percent of Occurrence
Coleoptera	11	37
Caddis fly larvae	7	23
Simulium larvae	6	20
Ants	3	10
Leech	3	10
Conifer needles	3	10
Hemiptera	2	7
Damsel fly	2	7
Rocks	2	7
Mosquito larvae	1	3
Simulium adult	1	3
Spider	1	3
Hymenoptera	1	3
Wood	1	3
Orthoptera	1	3
Mayfly	1	3
Odonata adult	1	3

Table 10.

Stomach Analysis - Hidden Lake

Specimen Number	Mosquitoes (larvae)	Mosquitoes (adults)	Simulium (larvae)	Simulium (adult)	Caddis fly (larvae)	Spiders	Ants	Other Hymenoptera	Coleoptera	Hemiptera	Damsel fly	Wood	Rocks	Conifer Needles	Orthoptera	Mayflies	Leech	Odonata (adult)	Total Volume
1	1								1				3		1				1.2 cc
2			150																1.8
3				1					2							2			2.7
4			200																2.3
5			15																.2
6																			.2
7			175																2.0
8														2					.2
9			1																.1
10													1						1.0
11																			
12					5												1		1.0
13					2							2							1.5
14					1				1										1.5
15					1														.4
16									1										1.0
17					1														1.1
18					1														.3
19														1					.1
20							2		4										.8
21						1			2		1								.2
22																			.15
23																			
24			20																.3
25									1									1	.1
26									12								1		.15
27									9										.1
28								1			1						5		.2
29									2	4									1.4
30									2	3									.2

Bear Lake:

The fourteen stomachs examined from Bear Lake contained an average volume of .91 cc. A predominance of winged, terrestrial insects was being fed upon. Although the percentage of occurrence for the order Hymenoptera was 71% as compared with 93% for midge larvae (Diptera), the Hymenoptera formed the bulk of the food. Trash was present in 64% of the stomachs and Hemiptera 33%.

Table 11.

Occurrence of Fish Food Organisms in Stomachs of Fish from Bear Lake
Fourteen Stomachs Examined

Food Organisms	Occurrence in Stomachs	Number of Insects	Volume in cc's
Spittle bugs (Homoptera)	2	3	.03
Beetles (Coleoptera)	3	5	.20
Adult flies (Diptera)	2	3	.25
Midge larvae (Diptera)	13	672	1.72
Ants & Wasps (Hymenoptera)	10	300	7.28
Waterbugs (Hemiptera)	5	7	.27
Dragon flies (Odonota)	3	4	2.01
Caddis flies (Trichoptera)	2	30	.14
Snake flies (Neuroptera)	2	2	.28
Marchfly larvae (Diptera)	4	31	.93
Grasshopper parts (Orthoptera)	1		.04
Clams (Mollusca)	1	2	.10
Trash	9		.53
Vegetation	1		.03

Culver Lake:

The series of ten stomachs examined from this lake showed an average volume of .81 cc. Time did not permit the analysis of any more than ten stomachs.

This lake also shows a preponderance of winged, terrestrial insects. The ants and wasps showed up the heaviest with terrestrial beetles second. The percentage of occurrence of material found in stomachs is as follows: Hymenoptera 100%, Coleoptera 100%, trash 90%, Homoptera 80%, Hemiptera 70%. A small mollusca contributed heavily to the diet of two fish from this lake.

Table 12.

Occurrence of Fish Food Organisms in Stomachs of Fish from Culver Lake
Ten Stomachs Examined

Food Organisms	Occurrence in Stomachs	Number of Insects	Volume in cc's
Spittle bugs (Homoptera)	8	47	.62
Beetles (Coleoptera)	10	80	.92
Adult flies (Diptera)	4	16	.45
Midge larvae (Diptera)	4	33	.09
Ants & Wasps (Hymenoptera)	10	210	4.65
Water bugs (Hemiptera)	7	30	.21
Mayflies (Ephemerida)	1	3	.02
Mayfly Nymphs (Ephemerida)	1	1	.09
Clams (Mollusca)	2	14	.51
Ticks (Arachnida)	1	1	.01
Grasshopper parts	1		.02
Trash	9		.53

Eagle Lake:

The average volume of the stomach content of fish from this lake was 3.17 cc. Of this, 2.91 cc. consisted of ants and wasps and formed the bulk of the diet at the time the fish were taken. Spittle bugs were eaten to some extent and midge larvae were high in numbers but formed a small part of the bulk. The percentage of occurrence for Homoptera was 100%, Hymenoptera 100%, Coleoptera 80%, Hemiptera 80%, Diptera (midge larvae) 60%, trash 50%.

Table 13.

Occurrence of Fish Food Organisms in Stomachs of Fish from Eagle Lake
Ten Stomachs Examined

Food Organisms	Occurrence in Stomachs	Number of Insects	Volume in cc's
Spittle bugs (Homoptera)	10	107	1.00
Beetles (Coleoptera)	8	22	.46
Ants & Wasps (Hymenoptera)	10	869	29.16
Water bugs (Hemiptera)	8	19	.19
Midge larvae (Diptera)	6	166	.25
Alder fly (Neuroptera)	1	1	.01
Grasshoppers (Orthoptera)	1	1	.03
Grasshopper parts (Orthoptera)	1		.32
Leafhopper (Homoptera)	1	1	.01
Trout eggs*	1	1	.02
Trash	5		.17
Vegetation	1		.11

* This might possibly be a feed egg or small bait egg.

Bottom Food Samples:

Bottom food samples were taken with an Eckman dredge, which takes one-fourth square foot samples of the lake bottom in one dredging. Three to four dredgings were taken in each lake. Although this number of dredgings is entirely too small to show the true food value of a lake, it gives a general idea of the kind of organisms present on the lake bottom. Apparently most of the bottom samples were lost or were not identified for notes as only one sample from each lake could be found. In determining the food grade for a lake, condition of the fish, stomach analysis, and bottom samples were taken into consideration. These data are given in the following table.

Table 14.

Bottom Food Samples

Food	Crater	Pine Lakes & Reservoir	Hidden	Looking-glass	Bear	Culver
Ephemerida (Mayflies)						3 N
Diptera (Flies)	8 L. 1 P.	12 L.		2 L.		3 L.
Coleoptera (Beetles)	1 A.			2 A.		
Trichoptera (Caddis flies)		4 L.				
Clams	14		24	25	19	5
Earth worms		5	1	3		
Total	24	21	25	32	19	8
Food Grade	Poor	Poor	Fair	Poor	Good	Poor

L = Larvae

P = Pupa

A = Adult

N = Nymph

Stocking Program:

In determining the number of fish to be planted in each lake, the following items were taken into consideration: (1) food grade, (2) spawning areas, (3) degree fished, and (4) acres of lake surface. Planting tables compiled by H. S. Davis in his pamphlet "Instructions for Conducting Stream and Lake Surveys" were used to determine the number of fish to be planted.

Eastern brook trout were recommended to be planted in all lakes because this trout is adapted to cooler waters than the rainbow. In addition, the eastern brook trout is a fall spawner, while the rainbow spawns in the spring. By spawning in the fall, the eastern brook fry hatch in the early spring and are able to take advantage of the entire growing season through the summer, whereas the rainbow probably does not hatch till early summer and consequently is not as far advanced when winter sets in. By not being as far advanced as the eastern brook fingerling, the rainbow fingerling probably has a greater winter kill. Although a few rainbow trout were taken from some of these lakes, the main species of fish present is the eastern brook trout.

Annual plantings were recommended where spawning areas were generally scarce. Hidden Lake and Pine Lake and Reservoir were the only lakes of this group that apparently had good spawning areas. Hidden Lake is closed to angling and the natural spawn will keep the lake stocked as long as the season remains closed, but Pine Lake and Reservoir will have to be stocked with a few fish each year to meet the fishing load.

Fingerlings at least three inches long should be planted in these lakes. The reasons for this are: (1) three inch fish or longer will be able to withstand the severe winter better than smaller fish, (2) since these lakes have large fish in them, three inch fish or longer will be more able to escape from the large fish, and (3) three inch fingerling will be more able to withstand the change from hatchery water to lake water.

All plantings should be done as early in the summer as possible to allow the fish to become adjusted to their new environment before winter.

The following stocking program should be considered as temporary for it probably will be altered from time to time as more information is gathered about these lakes.

Stocking Program for Lakes

of Lake	Location	Elevation	Size Acres	Species	Number	Size	Frequency	Remark
	T R S 6S 44E 12	7500'	15.5	EB	450	3"	Annually	
	5S 44E 35	8000'	2 (est.)	Unsuitable for fish				Inaccessible Too cold
	5S 44E 32	7600'	7.2	EB	250	3"	Annually	
	5S 44E 29	7400'	9.11	EB	1100	3"	"	
	5S 44E 21	7400'	30.19	EB	1000	3"	"	
	5S 44E 9	7000'	18.72	EB	Closed to fishing			
glass	5S 44E 5,6 6S 44E 31, 32	7500'	32.7	EB	1000	3"	Annually	
	5S 44E 9	7000'	4 (est.)	EB	200	3"	"	As an experi to determine winter kill
Lower)	6S 45E 19	7500'	2.8	EB	100	3"	"	
Upper)	6S 45E 18, 19	7500'	17.88	EB	450	3"	"	
Lor	6S 44E 8	6800'	3 (est.)	Unsuitable for fish				Too shallow

SUMMARY AND RECOMMENDATIONS

Bear Lake:

Bear Lake is apparently the most productive of the lakes surveyed and can produce as many or more fish than some of the larger lakes if kept properly stocked. This lake is stocked with both eastern brook and rainbow trout, and the fish that were taken were in excellent condition. The growing season is somewhat longer than that of Culver Lake because of the earlier breakup of snow and ice.

Any mechanical improvement is impractical on Bear Lake, due to the cost of such improvement for the returns that could be expected. This lake is lightly fished and if kept properly stocked will afford excellent fishing.

Curtiss Lake:

Only general observations were made on Curtiss Lake.

Curtiss Lake is located above timberline at an elevation of 8000 feet. Practically no vegetation was found in or near the lake, and large snow banks were still on the edge of the lake on July 19, 1939. These snow banks probably remain here the year around. This lake depends on snow and possibly underground springs for its supply of water; this probably keeps the temperature of the water too low for fish growth. Curtiss Lake has an area of about two acres and is estimated to be about 30 feet deep.

As far as known, fish have never been planted in this lake. The lake is accessible only on foot, over rough and hazardous terrain. It is recommended that fish should not be planted in Curtiss Lake because:

(1) The lake is inaccessible
(2) The water is too cold
(3) There is very little food
(4) There are no spawning areas
(5) The growing season is too short

Culver Lake:

Culver lake is surrounded by a slide formation and a small fringe of meadows backed by granite cliffs. There is practically no timber present for only a few alpine fir grow along the lower edge of the lake.

The growing season in this lake is extremely short for the lake is partially covered with snow until July or later. A small lake just above Culver Lake was filled with snow and ice and was furnishing most of the water for Culver Lake. The water coming from this small lake had a temperature of 36°F. Undoubtedly, this cold water running into Culver Lake causes the prominent thermocline here. (Table 4.) This lake is probably filling in rather fast for a rock slide formation surrounds about one-fourth of the lake;

also, several trees were up-rooted from snow slides.

Culver Lake is stocked with eastern brook trout and the fish that were caught were in fair condition. Because of the short growing season at least 3" fish should be planted here. Any mechanical improvement on this lake would be impractical.

Crater Lake:

Crater Lake is a volcanic, crater-like depression located at an elevation of 7800 feet. The surrounding timber type is very sparse alpine fir with only a few small scrubby trees near the lake. The soil surrounding the lake is of granitic texture and about 75% of the lake bottom is of the same composition. This type of bottom is unproductive for aquatic plant life supporting fish food organisms. A dam has been constructed over the natural outlet going down Cliff Creek and the water now goes through a tunnel at the opposite end of the lake and down Kettle Creek where it is used for irrigation purposes. The water level fluctuates approximately 7 feet. This lake has no inlet and all of the water comes from melting snow and underground springs.

Fish taken from this lake were in fair condition. Fingerling were numerous but fry were entirely absent. This fact can be accounted for in that no natural spawning takes place inthis lake and the fingerlings present were planted the year before--1938. A few fish between 14" and 16" were taken, but this size is not very abundant. The only specie caught from this lake was eastern brook. Like the rest of the lakes that were surveyed, this lake has a short growing season; however, the water warms up considerably during midsummer.

Under the present conditions, no improvements can be inaugurated for Crater Lake except through the stocking program. (Table 15). Stabilizing the water level of Crater Lake would improve the fish production; however, at the present time the fishing demand is not heavy enough to stop the benefits derived from using the water for irrigation.

Two lakes called Little Kettle Lakes are located just below Crater Lake. These lakes cover about one acre each and are not over 3 feet deep. They are, obviously, not suited for fish production.

Eagle Lake:

Although Eagle Lake does not have an elevation as high as some of the lakes surveyed, it is located above timberline and is surrounded by sloping rock walls, with practically no vegetation. Snow and ice remain on the lake often until July, making the growing season very short. The lake is stocked with eastern brook trout which were in fair condition at the time of this survey. Stomachs examined from fish of this lake contained an average volume of 3.17 cc. of food which was over three times the average volume for the rest of the lakes surveyed. However, of this amount 2.91 cc. consisted of ants and wasps which were only temporary terrestrial food. (Table 13.) The rest of the ten food items taken comprised only .26 cc.

In addition, half of the stomachs examined contained trash which tends to show that food might be scarce when terrestrial forms are not available. As this survey was interrupted by a call to a fire, bottom samples were not taken. However, judging from the condition of the fish, the quality of the food found in the stomachs, and the environment, the amount of fish foods present seemed to be low.

Since this lake has such a short growing season, is a reservoir, and is accessible only by six miles of trail, any mechanical improvements would be impractical. Three-inch eastern brook fingerlings should be planted annually in this lake. (Table 15.)

Hidden Lake:

At the time of this survey, Hidden Lake was closed to angling.

Hidden Lake is a shallow lake with a maximum depth of 14 feet and an average depth of 6.9 feet. Approximately 75% of the shoreline is meadows and 25% alpine fir timber, while the surrounding peaks are made up of granite. The soil around the lake and approximately 80% of the lake bottom are of granitic composition. The lake is supplied with water from melting snow, underground springs, and a small lake above the main lake.

The small stream feeding Hidden Lake contains good spawning areas, as does the small lake at the head of the stream. Both the small stream and lake had many fry and fingerlings in them. The natural spawn will maintain sufficient numbers of fish in this lake as long as it is closed to angling. When this lake is opened to angling, approximately 300 three-inch fingerling should be planted annually.

At the present time, mechanical improvements onthis lake are not advisable. If the utilization of this lake becomes heavy enough, a small dam can be constructed at the outlet and the lake raised 3 to 4 feet, thus increasing its size and productivity.

Lookingglass Lake:

Lookingglass Lake was the longest lake surveyed with a total of 32 acres. The vegetation around the lake is a very sparse alpine fir and white-barked pine type. Some high mountain meadows border the water's edge. High granite peaks surround the lake and extend to the water's edge as slides. The soil surrounding the lake is of granitic makeup and composes about 40% of the lake bottom.

Stomach content of fish taken from Lookingglass Lake was the lowest of all the lakes surveyed. Of the forty-six stomachs examined, fifty per cent of them contained no food. Also, the bottom food content of this lake seemed to be low. However, in spite of the low stomach content and low bottom food count, these fish were in good condition. (Conditioning factors were not taken of any of the fish, but the condition of fish was judged from experience). The good condition of the fish would indicate that the fish had been taking ample amounts of food.

a few areas that seemed suitable for spawning were noted in the shallow water along the edge of the lake. However, since this lake is a reservoir, these areas might be exposed during the spawning season of eastern brook trout in the fall. A few fry were seen here, indicating that some natural spawning takes place, but the natural spawn in Lookingglass Lake is probably small.

The greatest improvement that could be made on Lookingglass Lake would be to stabilize the water level, but under the present utilization program this is hardly justifiable. A more thorough investigation of the food content of this lake should be undertaken and a stocking program set up according to the results found.

Pine Lake and Reservoir:

Originally two natural lakes were located here; a large lake of about 17 acres, and a small lake of about 3 acres located below the large lake. A dyke has been constructed across the outlet of the large lake, the lake made into a reservoir and the water used for irrigation. All water flowing out of the large lake or reservoir flows into the small lake below it. Two streams flow into the reservoir. One of these streams originates in a high meadow above the reservoir and the other from a small shallow lake above the reservoir. These streams do not serve as spawning grounds but only as a source of water supply. The lake is surrounded by granite peaks. Considerable soil and sediment are in the lake and several small meadows are along the edges.

Apparently the natural spawn in these two bodies of water is good because considerable numbers of fry and fingerlings were seen. Fish taken from these lakes were in exceptionally good condition. Stomach analysis showed that the fish were taking an abundance of food but the bottom food content was apparently low.

Although this lake is only accessible by about three miles of trail, it appears to be used quite extensively by fishermen. It is probably fished in medium amounts in that approximately 40% of the legal sized fish are removed annually.

The small lake could be improved by the construction of a dam across the outlet to raise the water level, and the reservoir by stabilizing the water level, but under the present utilization of these lakes this would not be justified. A revised stocking program and a more complete study of the food present in the lakes are the only feasible improvements at the present time.

Moon Lake:

Only general observations were made on this lake as a regular survey was not made.

This lake covers approximately 4 acres and is not over 6 feet deep. The greater part of the bottom of this lake is of granitic makeup, although there are some sedimentary soil deposits. The timber type is sparse alpine fir. Some sedge meadow borders the lake and some grasses grow in the shallow water along the edge.

The level of the lake could be raised 6 or 7 feet by constructing a dam at the outlet. To raise the water this much, the dam would have to be about 40 feet long. If the depth of this lake could be increased to 12 or 14 feet, eastern brook trout would be able to survive in this lake. Possibly eastern brook trout could survive at the present time. This could be determined by planting approximately 200 three-inch fingerlings in this lake as an experiment. If this is done, the lake should be closed to angling and a follow-up made the next year.

There will probably never be any natural spawning in Moon Lake because of the lack of inflowing streams and gravel bars within the lake.

Two Color Lake:

Since Two Color Lake is too small and too shallow, a regular survey was not conducted here.

This lake is located at an elevation of 6800 feet in lodgepole and alpine fir timber type and occupies an area of approximately 3 acres. Since this lake has a depth of 3 to 4 feet, heavy winter snows and ice would make it valueless as a fish producing lake. An abundance of sedges and grass surrounds the lake and the entire bottom is muck and decomposing organic matter.

No feasible improvement is possible for the production of fish in Two Color Lake, and under present conditions fish should not be planted here.

EAGLE CREEK SURVEY

(July 7 - 11, 1939)

Before starting the lake survey on the Whitman National Forest, a stream survey was conducted on Eagle Creek and general observations were made on East Eagle Creek which empties into Eagle Creek. Although the stream survey equipment was limited, the data that were gathered can be used to some advantage in the future management of this stream.

This survey was made from the Main Eagle bridge just below the mouth of East Eagle to Puzzle Creek, a distance of about 10 miles.

Watershed:

The watershed of Eagle Creek consists mainly of rugged mountains. The chief vegetation on the watershed is ponderosa pine, red fir, white fir, and buck brush (Ceanothus).

Barriers:

None present.

Diversions:

None present.

Springs:

Quite an abundance of springs was noted along this section of Eagle Creek, but none of them had enough volume for rearing pools.

Gradient:

In some places the stream approaches a torrential nature while in other places a succession of pools and riffles is found. This section of the stream can be classed as having rather fast water.

Pools and Shelter:

Pools and shelter are rather scarce from the mouth of East Eagle to the mouth of Paddy Creek. (See map). Most of this section is deep riffles with abundant sheltering boulders. Below Paddy Creek large deep pools are abundant.

Bottom:

The bottom of this stream is practically all rock makeup. The following figures give the percentage of each kind of rock: boulders 30%, rubble and gravel 45%, and sand 25%.

Shade:

Although the banks of this stream are well vegetated, shade is scarce through the high light of the day from 10:00 A.M. to 4:00 P.M.

Aquatic Vegetation:

Aquatic vegetation is negligible.

Enemies:

Enemies are scarce and unimportant.

Spawning Areas:

Spawning gravel is abundant throughout the section surveyed.

Fish:

Rainbow trout is the most abundant fish of this stream, but a few eastern brook and dolly varden trout were present. It was reported that salmon migrate up this stream in August. However, no salmon fry or fingerlings were taken.

Fry were numerous in the quiet waters and shallow pools. Fingerlings were not as abundant as fry.

Accessibility:

About half the length of this stream is accessible by roads and the rest by trails.

Rearing Pool Sites:

No favorable rearing pool sites were found.

Square Foot Bottom Samples:

A regular square foot stream sampler was not available so a homemade one was used. Six samples were taken of this section of the river, but identification was completed on only three. (Table 16). Unfortunately, the weight was not taken of these samples, but from the number of organisms per square foot Eagle Creek seems to have a good food grade.

Table 16.

Square Foot Bottom Samples - Eagle Creek

Sample No.	Location	Insects					Total
		Trichoptera	Ephemerida	Diptera	Plecoptera	Coleoptera	
1	Bridge	14 L.	13 N.	7 L.	2 N.	1 A.	37
2	½ mile below bridge	11 L. 1 P.	12 N.	7 L.			31
3	1¼ miles below bridge	6 P. 14 L.	8 N.	1 L.	5 N.	1 A.	35

L = Larvae

P = Pupa

N = Nymph

A = Adult

Fish Stomach Analysis:

The average volumetric content of ten fish stomachs taken from Eagle Creek was 2 cc. May fly nymphs (Ephemerida), ants and wasps (Hymenoptera), and caddis fly larvae (Trichoptera) occurred in 100% of the stomachs. Aquatic fly larvae (Diptera) 30%, stonefly adults (Plecoptera) 50%, adult beetles (Coleoptera) 40%, and damsel flies (Odonata) 40%.

According to volume, mayfly nymphs composed 65% of the food taken. Caddis fly larvae came next, by composing 10% of the food taken. Apparently the fish had an abundance of food during this season of the year.

Table 17.

Occurrence of Fish Food organisms in Stomachs of Fish from Eagle Creek
Ten Stomachs

Food Organisms	Occurrence in Stomachs	Number of Insects	Volume in cc's.
Mayfly nymphs (Ephemerida)	10	200	12.89
Ants & Wasps (Hymenoptera)	10	43	1.67
Caddis fly larvae (Trichoptera)	10	142	2.18
Caddis fly adult (richoptera)	1	1	.16
Aquatic fly larvae (Diptera)	6	15	.27
Terrestrial fly larvae (Diptera)	5	23	1.01
Adult flies (Diptera)	5	22	1.11
Stonefly adult (Plecoptera)	5	6	.63
Stonefly nymph (Plecoptera)	3	3	.19
Adult beetles (Coleoptera)	4	5	.11
Water bugs (Hemiptera)	3	7	.14
Grasshopper parts (Orthoptera)	1		.33
Whole Grasshoppers (Orthoptera)	1	1	.18
Spiders (Arachnida)	2	2	.11
Damsel flies (Odonata)	4	4	.10
Trash	2		.10

Volume:

The volume of water that flows in Eagle Creek was determined by the equation.

$$R = K \frac{W.\ D.\ L.}{T}$$

K = Constant for bottom friction = .8

W = Average width of stream sector = 55'

D = Average depth = 1-1/6'

L = Length of sector = 100'

T = Time (in seconds) required for a surface float to pass through the sector = 20 seconds.

$$R = .8 \frac{55 \times 1\text{-}1/6 \times 100}{20} = 251.6 \text{ second feet}$$

251.6 sec. ft. = 120,780 gallon per minute

Degree Fished:

Eagle Creek is fished heavily in that about 70% of the legal sized fish are taken annually.

Improvements:

The section of Eagle Creek between the mouth of East Eagle Creek and Martin's bridge does not have enough cover. As stated before, this section of the stream is mainly riffles with very few pools or other types of cover. Different types of log and rock improvements could be easily made along this section because a road follows along the stream bank and plenty of rocks and logs are available. This section of Eagle Creek is reported as the poorest fishing section of this stream. Improvements on the rest of the stream are not necessary at present.

Stocking Program:

In determining the stocking program for Eagle Creek, the following items were taken into consideration: (1) average width of stream, (2) food grade, (3) stream conditions, (4) the number of miles to be stocked, and (5) degree fished. (Table 18.)

Up to this time very few fish have been planted below the mouth of East Eagle Creek, because it was thought that this section of the stream became too warm in the summer for fish. This survey was conducted from July 7 to 11, and during this time the highest temperature recorded was 64°F. Undoubtedly, the temperature of this stream raises higher than this during the hot days of August, but it is doubtful if it raises higher than 83°F, the maximum temperature rainbow trout are able to withstand. If the temperature of this stream did approach this maximum temperature during the day, the stream cools down from 10° to 12°F during the night and does not remain at this high temperature more than 4 or 5 hours.

Table 18.

Stocking Program for Eagle Creek *

	Number of Fish per mile	Size of Fish	Length of Section	Total
Mouth of E. Eagle Creek to Martin's Bridge	2000	3"	3 miles	6000
Martin's Bridge to Forest Boundary	1200	3"	8 "	9600
Mouth of E. Eagle Creek to Mouth of W. Eagle Creek	1800	3"	6 "	10800
Mouth of W. Eagle Creek to Two Color G. S.	1300	3"	3 "	3900
Two Color G. S. to Lookingglass	400	3"	5 "	2000
Total number of fish to be planted annually				32,300

* This stream should be stocked only with rainbow trout.

EAST EAGLE CREEK SURVEY

Only general observations were made on East Eagle Creek. This creek very closely resembles Eagle Creek. The stream is clear, cold, and fast, and apparently has an abundance of food. It is a typical rainbow stream and other species should not be introduced. Spawning areas are numerous, but the natural spawn cannot carry the present fishing load.

Approximately 800 three-inch rainbow fingerlings per mile should be planted annually from the mouth of East Eagle to the end of the road, a distance of 6 miles. Above the end of the road approximately 500 three-inch fingerlings per mile should be planted annually for a distance of three miles, biennially above this point.

REFERENCES USED

Leach, Glen C. -- 1939. "Artificial Propagation of Brook Trout and Rainbow Trout, with Notes on Three Other Species". U. S. Bureau of Fisheries Document No. 955.

Davis, H. S. -- 1938. "Instructions for Conducting Stream and Lake Surveys". U. S. Bureau Fisheries Circular No. 26.

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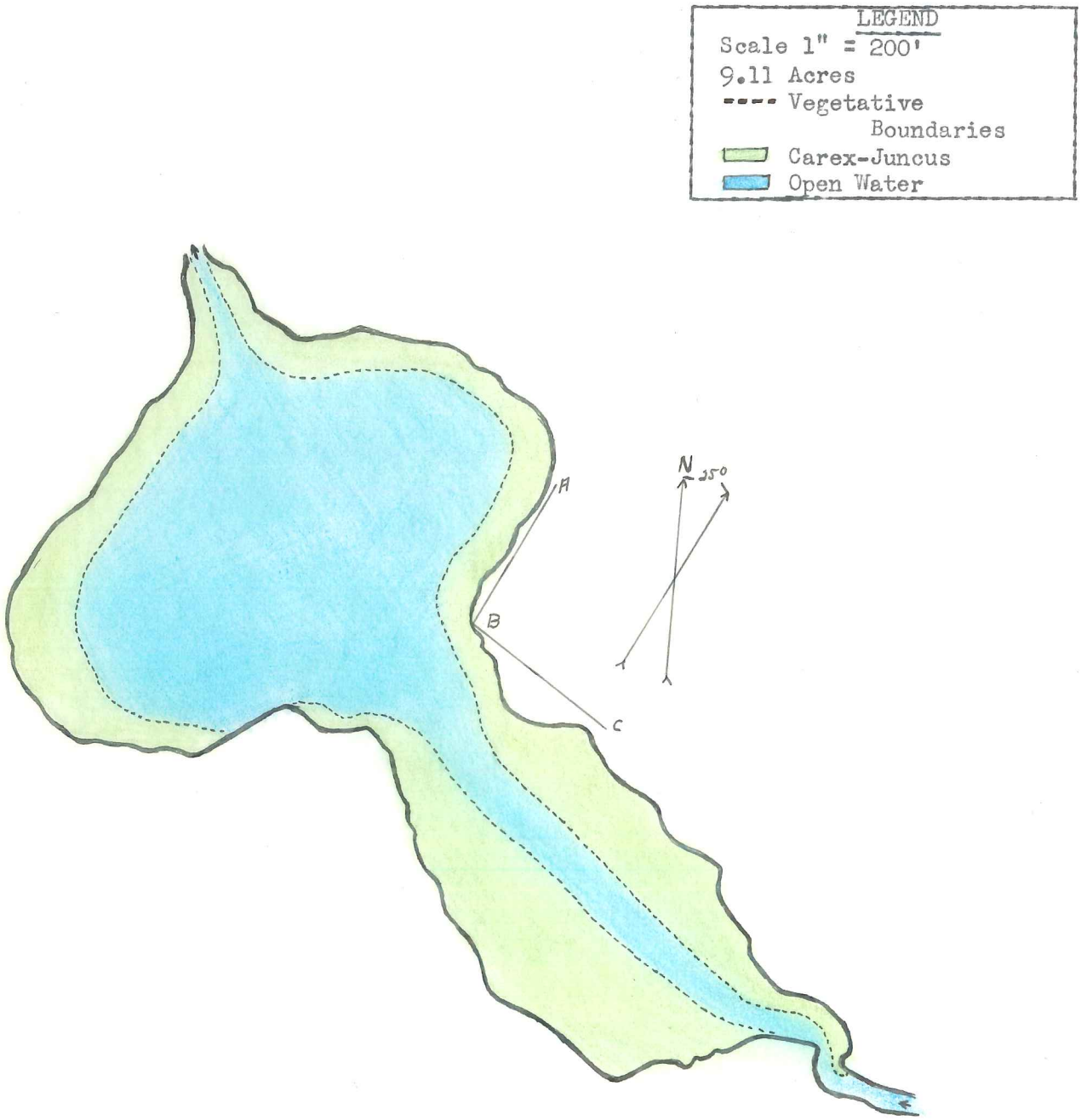
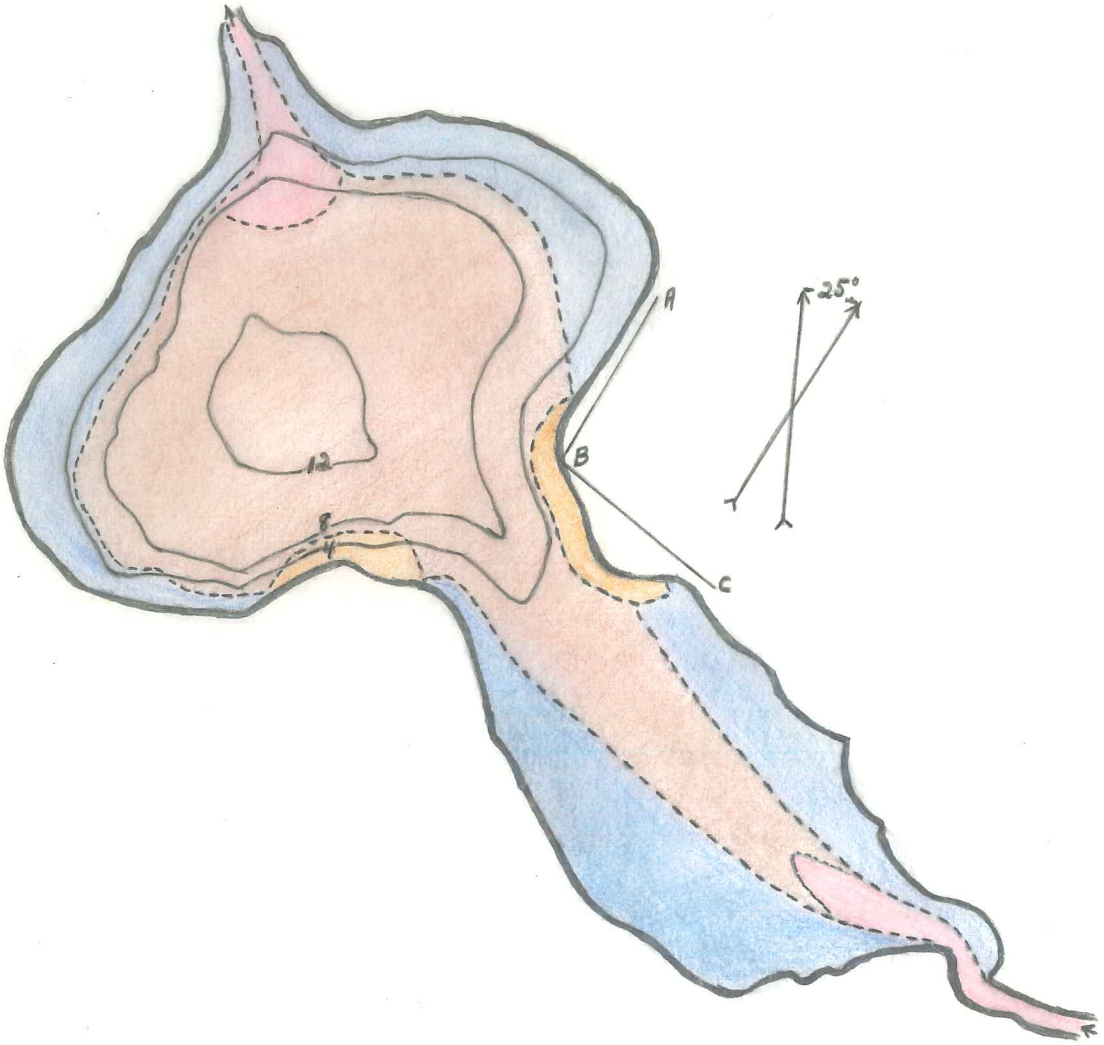
Welch, Paul S. -- 1935. "Limnology".

B E A R L A K E


LEGEND
Scale 1" = 200'
9.11 Acres
Vegetative Boundaries
Carex-Juncus
Open Water
N
35°
A
B
C

B E A R L A K E

LEGEND
Scale 1" = 200'
9.11 Acres
Contour Intervals = 4'
Sand Deposit
Silt Deposit
Muck
Gravel-Boulders
------Bottom Cont. Bndry



LOOKINGGLASS LAKE

LEGEND

Scale 1" = 400'

32.79 Acres

Piped Outlet

Contour Intervals = 4'

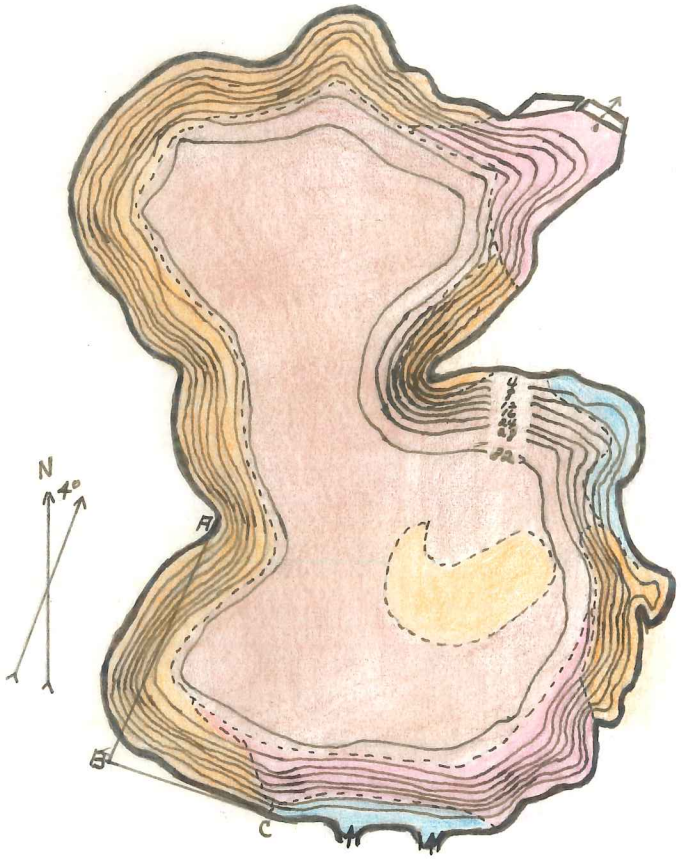
Sand Deposit

Silt Deposit

Muck

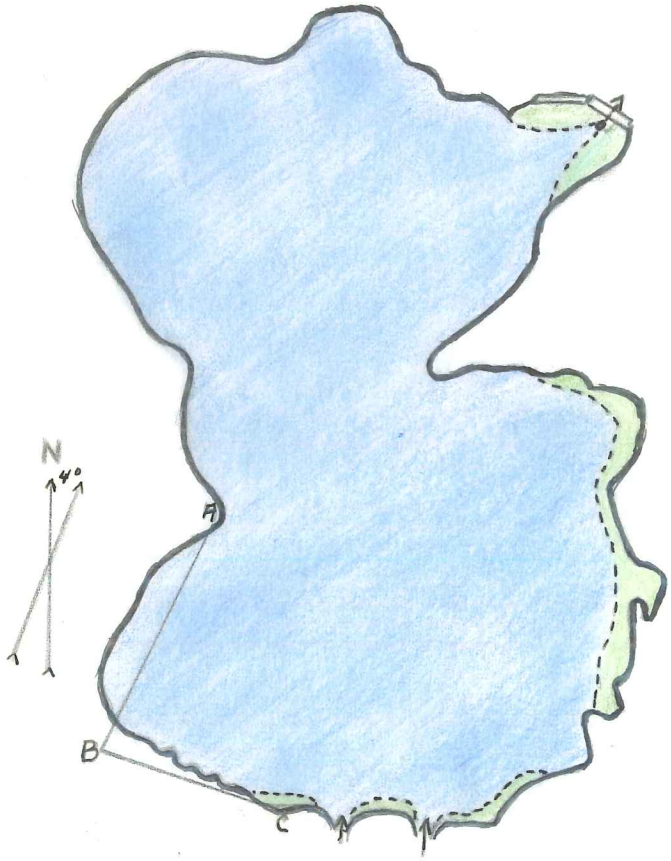
Gravel - Boulders

Bottom Cont.Boundary



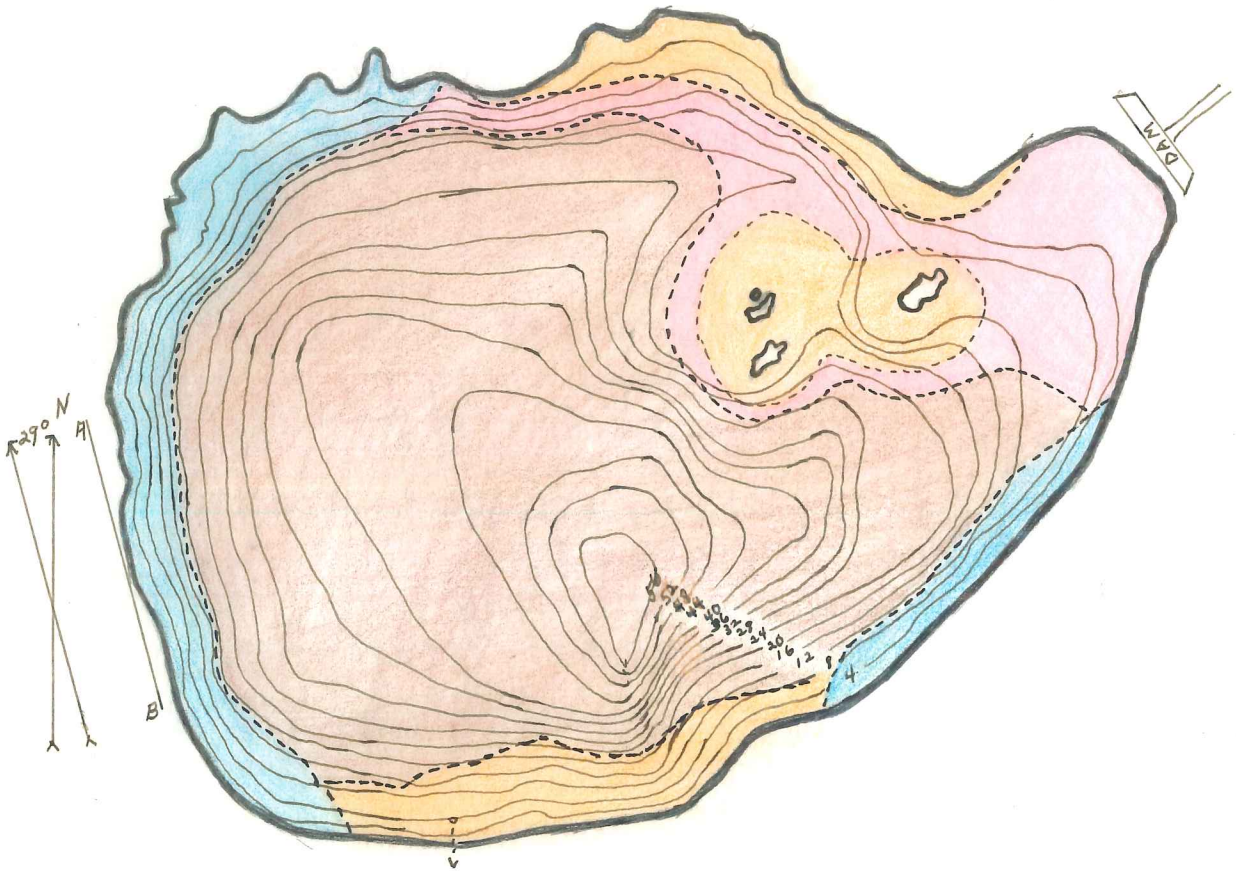
LOOKINGGLASS LAKE

LEGEND
Scale 1" = 400'
32.79 Acres
o---> Piped Outlet
- - - - Vegetative Boundaries
Carex-Juncus
Open Water



CRATER LAKE

LEGEND
Scale 1" = 200'
15.56 Acres
o---> Piped Outlet
Contour Intervals = 4'
Sand Deposit
Silt Deposit
Muck
Gravel-Boulders
---- Bottom Cont.Boundary



C R A T E R L A K E

LEGEND
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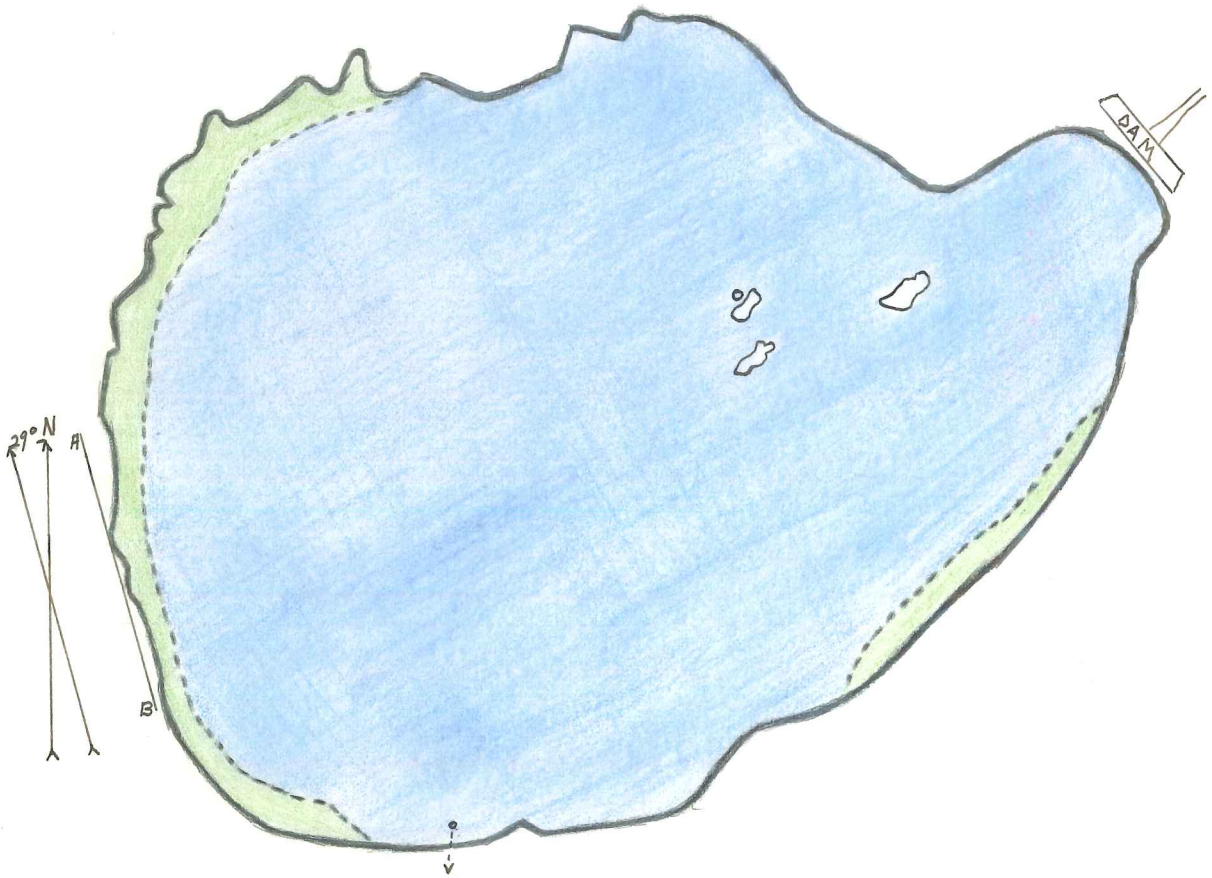
o----> Piped Outlet
----- Vegetative Boundaries
Carex-Juncus
Open Water



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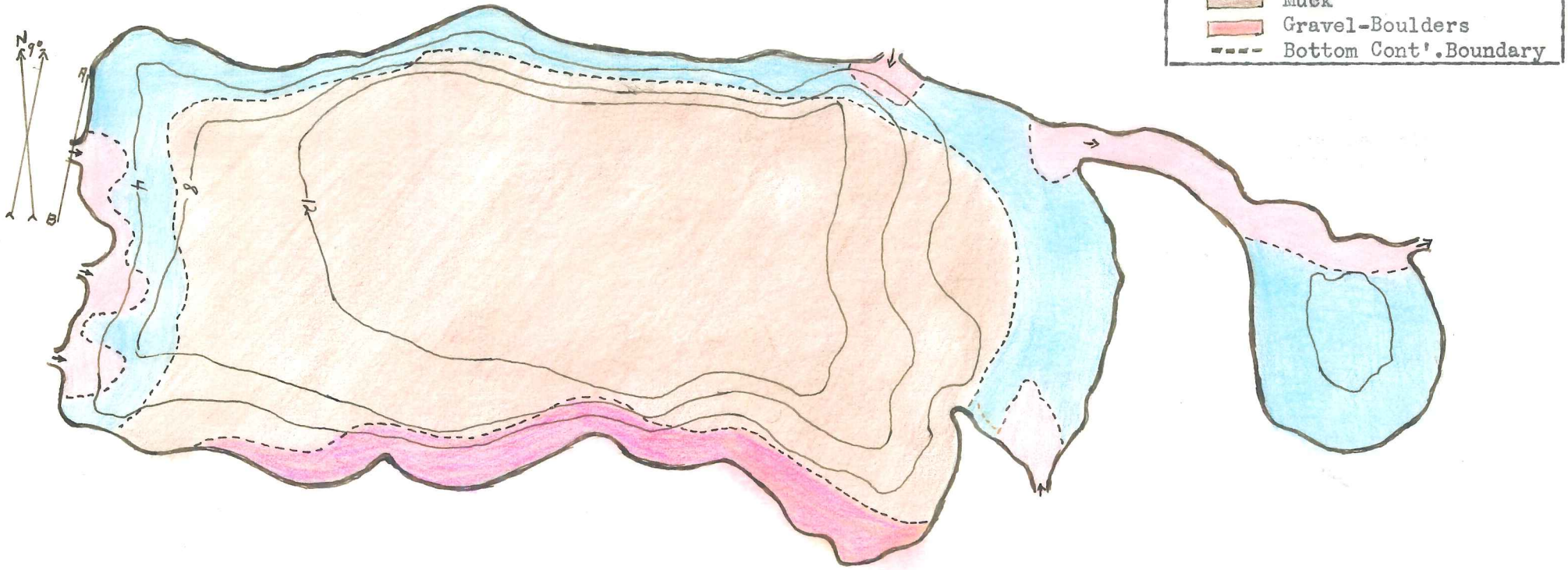
LEGEND
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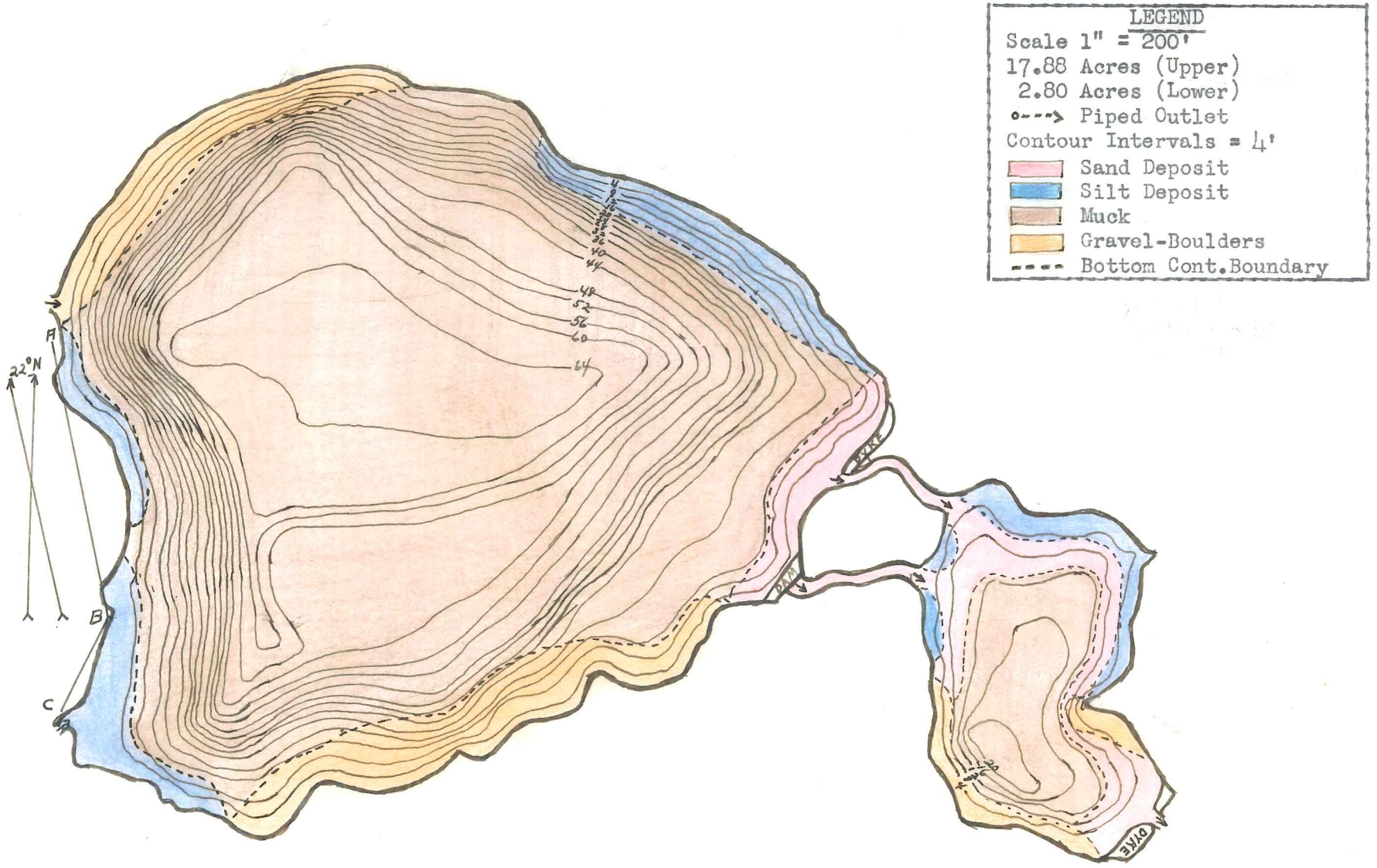
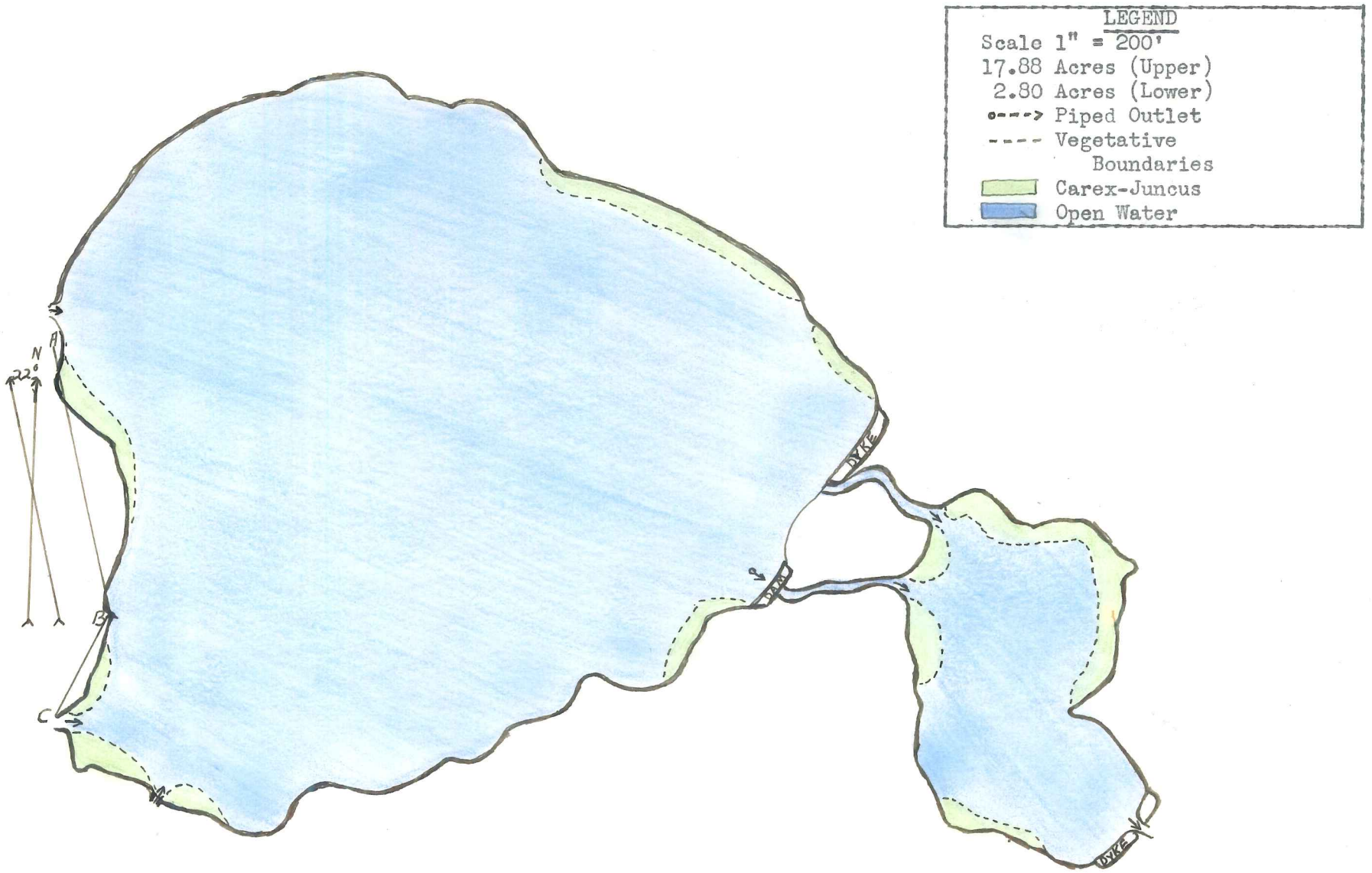
18.72 Acres
Contour Intervals = 4'
Sand Deposit
Silt Deposit
Muck
Gravel-Boulders
Bottom Cont'.Boundary
N
4
8
12

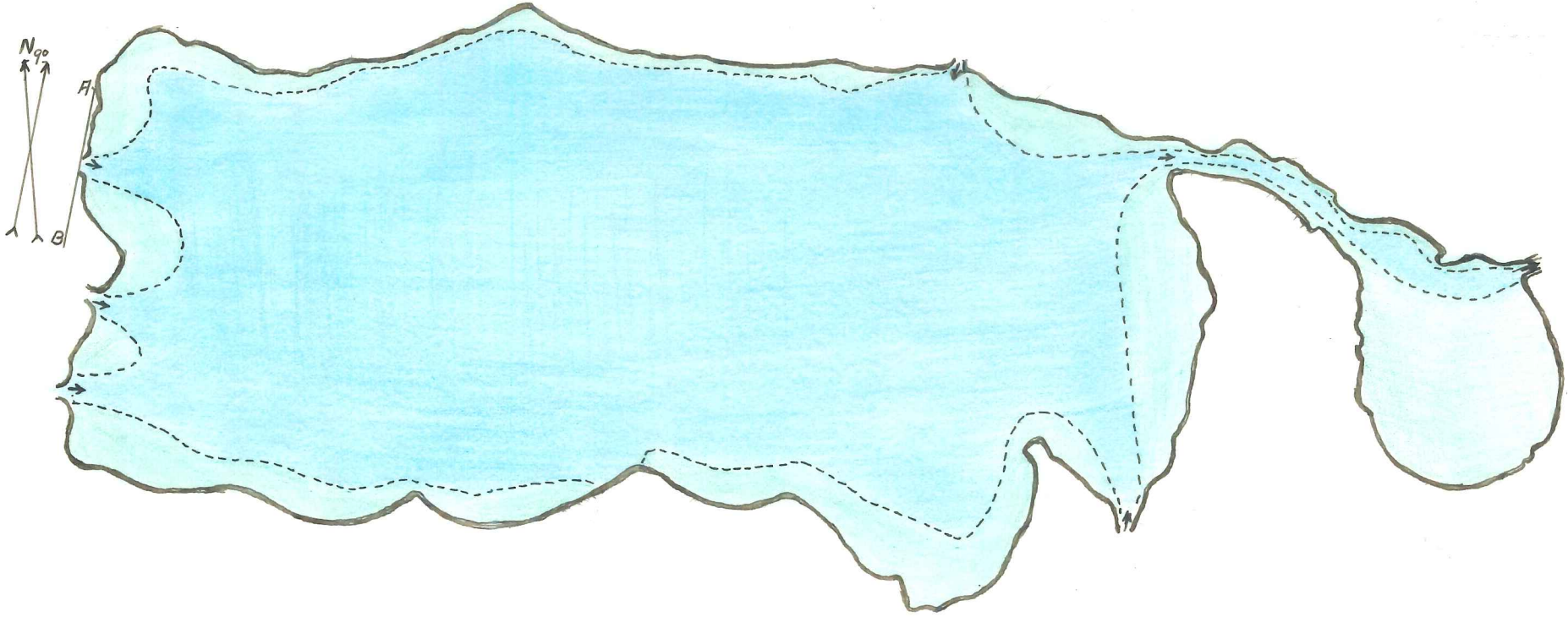
PINE LAKES AND RESERVOIR



PINE LAKES AND RESERVOIR

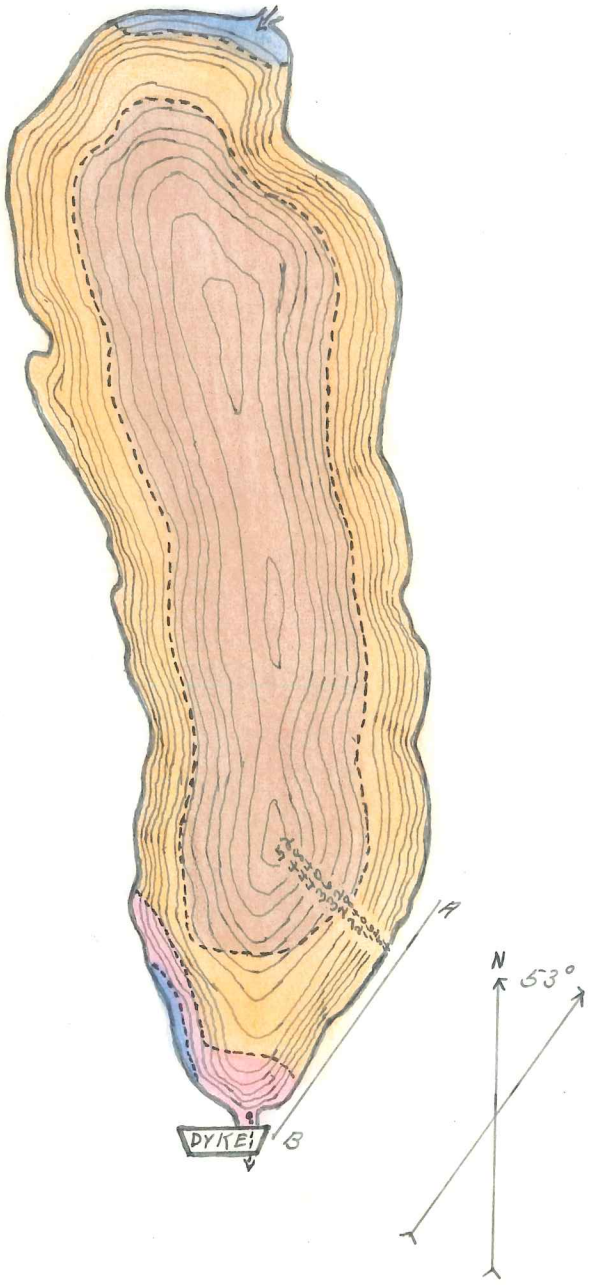


H.I D D E N L A K E


LEGEND
Scale 1" = 200'
18.72 Acres
Vegetative Boundaries
Carex - Juncus
Open Water
N
A
B

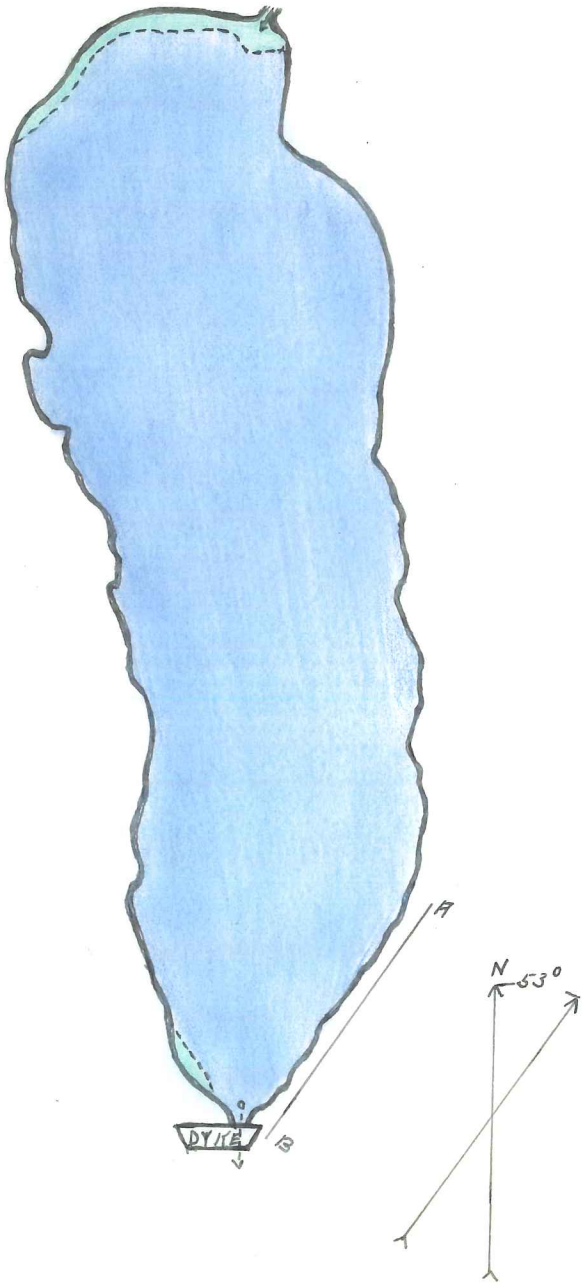
EAGLE LAKE

LEGEND
Scale 1" = 400'
30.19 Acres
•----→ Piped Outlet
Contour Intervals = 4'
Sand Deposit
Silt Deposit
Muck
Gravel-Goulders
- - - - Bottom Cont.Boundary

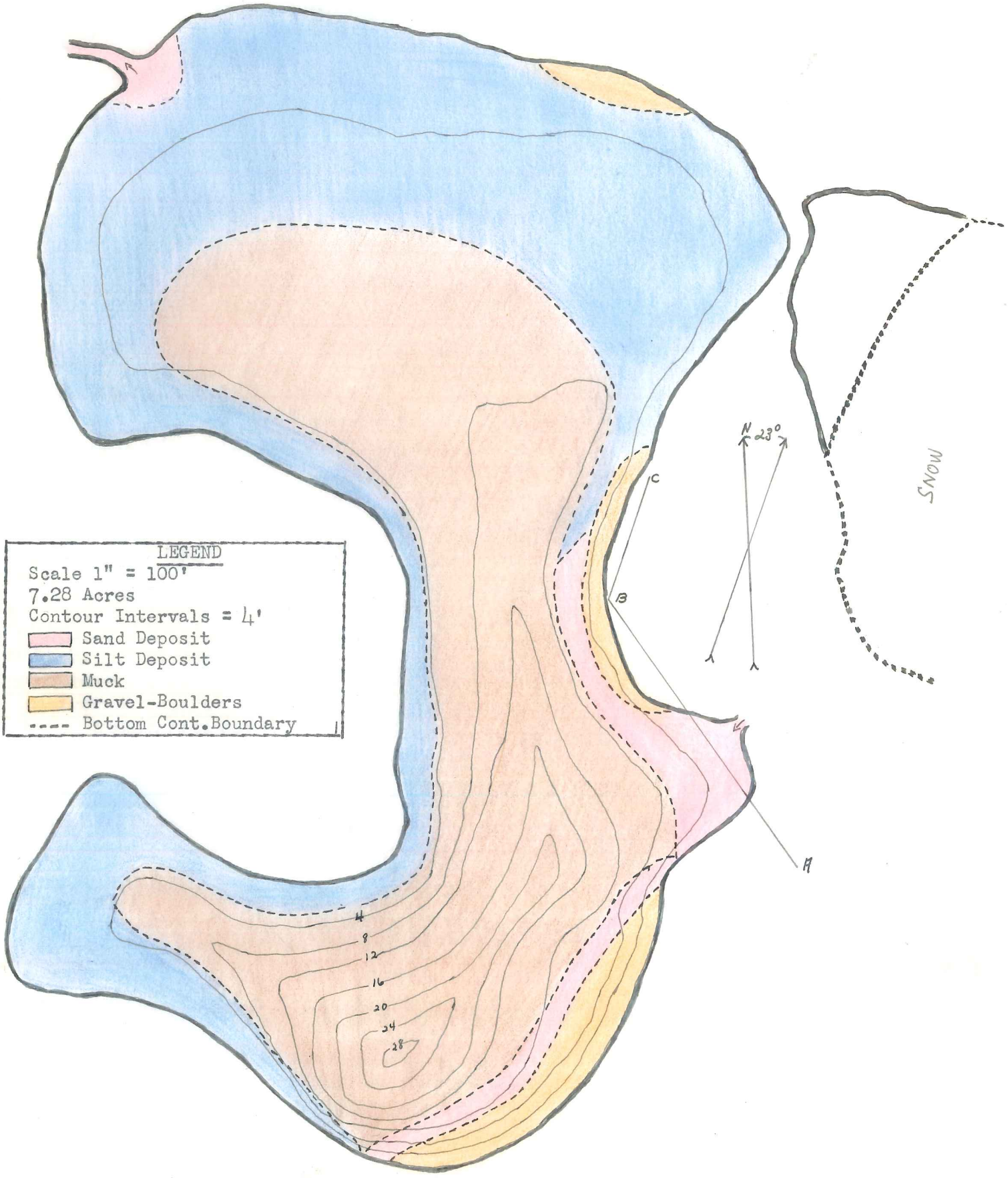


EAGLE LAKE

LEGEND
Scale 1" = 400'
30.19 Acres
Piped Outlet
Vegetative Boundaries
Carex-Juncus
Open Water



CULVER LAKE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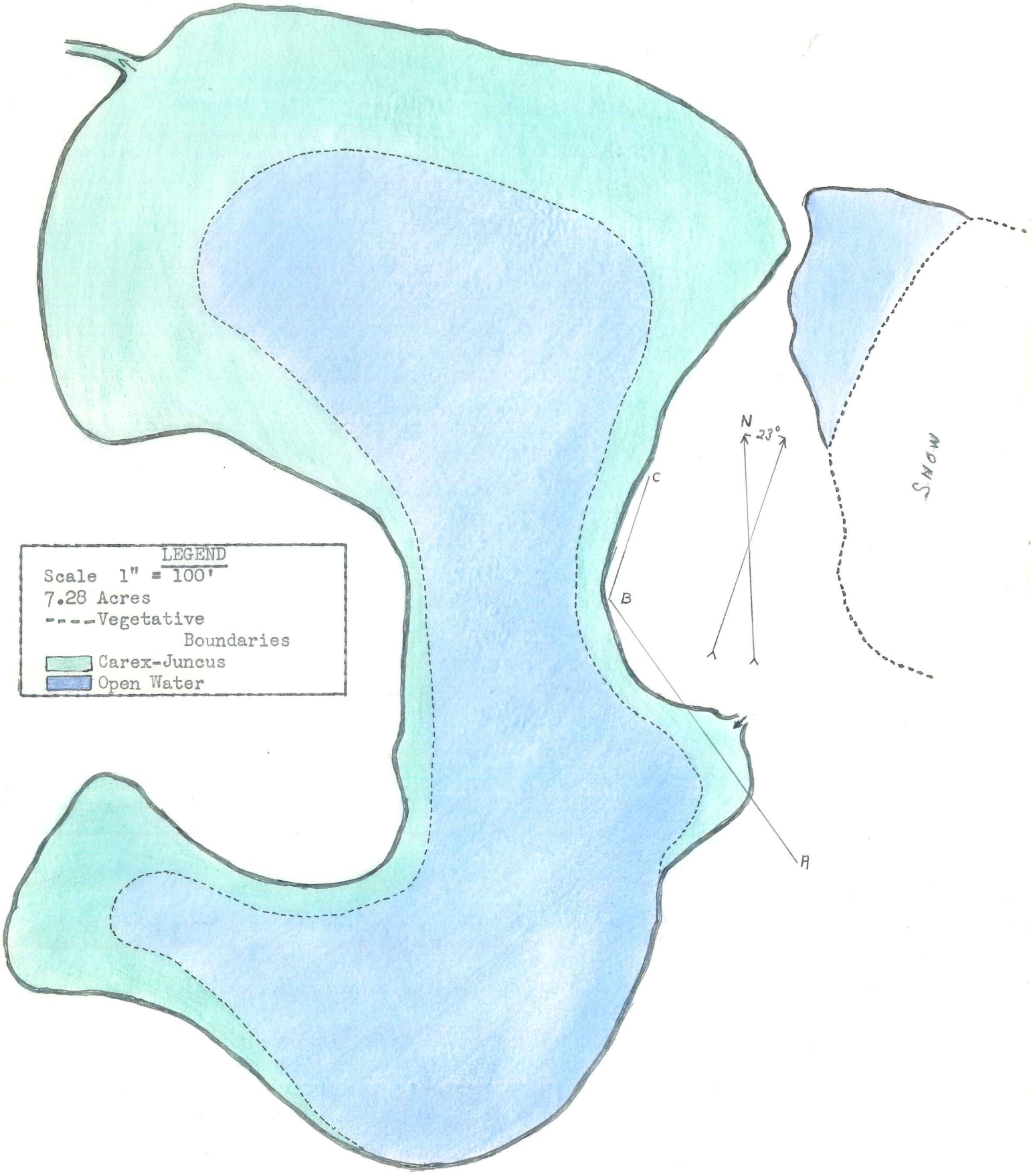
7.28 Acres
Contour Intervals = 4'
Sand Deposit
Silt Deposit
Muck
Gravel-Boulders
---- Bottom Cont.Boundary
A
B
C
N 23°
SNOW
4
8
12
16
20
24
28

CULVER LAKE


LEGEND
Scale 1" = 100'
7.28 Acres
----Vegetative Boundaries
Carex-Juncus
Open Water
N
23°
C
B
A
SNOW