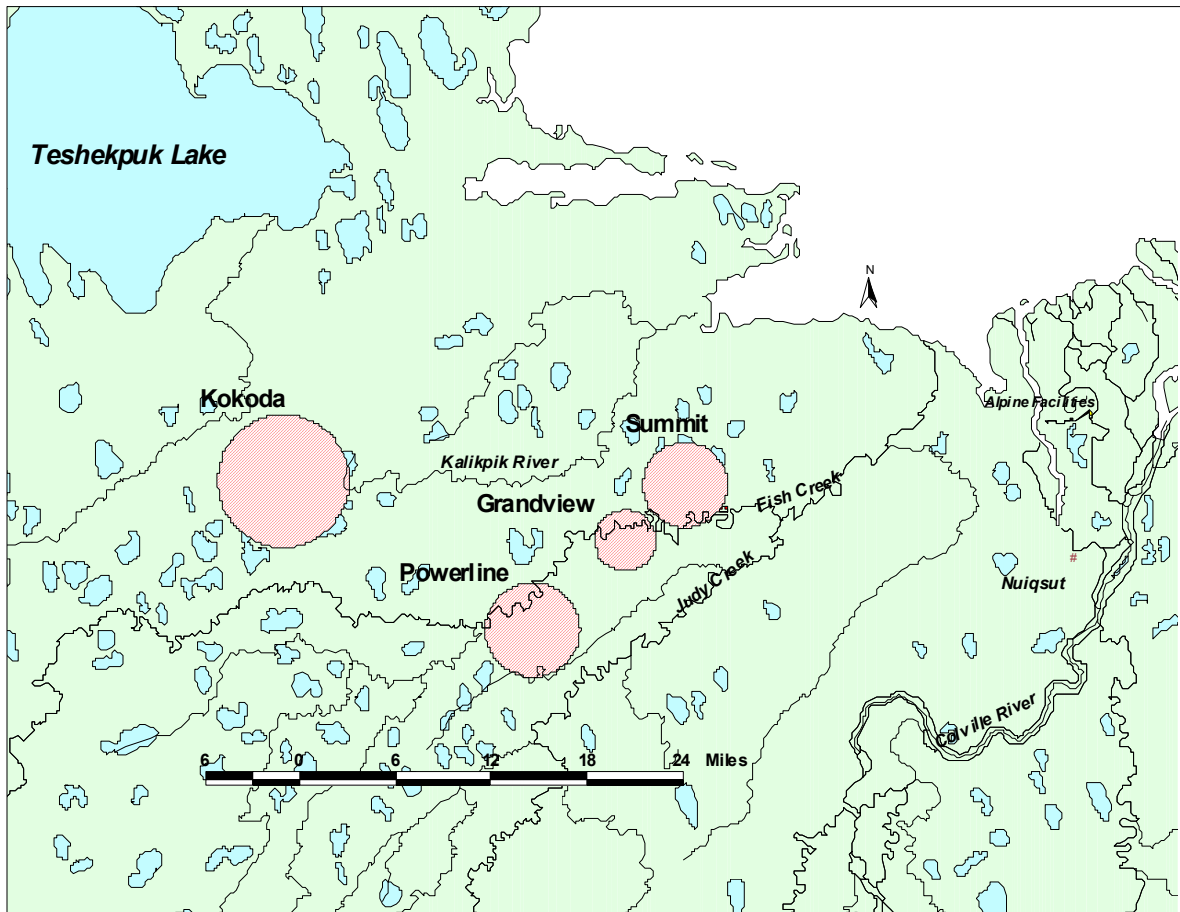


FISH UTILIZATION OF LAKES IN THE UPPER FISH CREEK REGION OF EASTERN NPR-A: 2002

Final Data Report

January 2003



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EXECUTIVE SUMMARY

ConocoPhillips Alaska Inc. has been exploring for oil within the eastern portion of the National Petroleum Reserve–Alaska (NPR-A) since the winter of 1999/2000. Exploration includes crossing rivers and lakes with ice roads and withdrawal of water from lakes to support both industrial and domestic needs. During review of exploration, and potentially development, permits, information is required on the biological sensitivity of lakes in the region. The study was designed to provide physical and biological information on these lakes to understand their use by various fish species.

The objectives of the study are to document fish presence and habitat use in eastern NPR-A lakes for lakes that may be used to support exploration activities. The region surveyed during 2002 generally lies between the confluence of Fish and Judy creeks and the southeast corner of Teshekpuk Lake and is collectively referred to in this report as the Upper Fish Creek region. Four exploration prospects, Kokoda, Powerline, Grandview and Summit, are included in the general region.

The objectives of the survey were to:

- 1) inventory fish species in the various lakes within the project study areas,
- 2) obtain information on relative abundance of species in different water bodies sampled, especially from lakes that may be proposed for water withdrawal during exploration and field development,
- 3) obtain basic descriptive population data for the species captured,
- 4) measure lake depths to estimate lake volumes, and
- 5) measure water chemistry parameters to assess suitability of water for potential uses.

The biological survey consisted of sampling with gill nets, minnow traps and seine combined with physical measurements. Lakes were sampled with short-duration gill net sets (typically 4 to 6 hours) using a multimesh gill net. Since the objective of the gill netting is to document presence/absence, the nets were pulled after fish were detected. Minnow traps and seines were used to identify smaller fish species that may not be detected by gill nets. Water chemistry measurements included surface measures of water temperature, specific conductance, dissolved oxygen, pH, and turbidity. A water sample was sent to Northern Test Labs for laboratory determination of chloride, sodium, calcium, magnesium, hardness (as CaCO₃) and total dissolved solids (TDS).

Bathymetric data were collected to allow estimating lake volume. Location and depth were recorded with an integrated GPS/depth sounder. Lake volume was estimated by contour mapping of depth intervals. The surface area of each contour was obtained, then the volume was estimated using the formula for truncated cones. The amount allowed for winter water withdrawal when sensitive fish species are present is currently set at 15% of the volume of the lake deeper than 7 feet. When resistant fish species (i.e. ninespine stickleback and Alaska blackfish) are present, the current

allocation is 30% of the volume deeper than 5 feet. There is no withdrawal limit if fish are not present.

The area potentially available for ice aggregate was estimated by calculating the area of the lake shallower than 4 feet, assuming that the ice would grow to at least 4 feet prior to the need for aggregate. If the ice is shallower than 4 feet at the time of ice removal, then the area available will be less.

Seventeen lakes were sampled for the first time in 2002 in connection with potential exploration in the Upper Fish Creek region of NPR-A. Broad whitefish, humpback whitefish, least cisco, and arctic grayling were captured by gill net in nine of the NPR-A lakes, which is consistent with earlier reports from the region. Ninespine stickleback were also caught in two lakes by seine.

Lakes in the Upper Fish Creek region, and especially in the Kokoda area, were deflation lakes. These lakes are characterized by wide sandy shoals on the west and east sides, where sand dunes have eroded into the lakes. Deep water is often confined to a relatively small portion of the lake surface, as compared to lakes farther east, which tend to deepen rapidly near shore.

Information from fish sampling and depth measurements was used to evaluate each lake regarding its potential to support fish. Obviously, if fish were captured during gill net sampling, the lake was classified as fish-bearing. Gill net sets were relatively short, however, so absence of catch does not necessarily mean a lake does not support fish. Lakes also were assessed for their proximity to fish-bearing streams and their depth. Lakes deeper than 7 feet are likely to retain unfrozen water during winter, thus have potential to overwinter fish. Deep lakes that are near fish-bearing streams and are likely to have a connection with the stream at some point during the year are classified as potential fish-bearing lakes, with additional sampling needed if further clarification of the designation is desired. Results of the evaluation are included in Table 4.

When sensitive fish are present, the amount of water available during winter is limited to 15% of the volume under 7 feet of ice. The water withdrawal criteria are relaxed when only resistant fish species are present because of the greater tolerance to lower dissolved oxygen and higher concentrations of dissolved solids. In this case, up to 30% of the water volume under 5 feet of ice is allowed for winter withdrawal. For lakes that do not contain fish, there is currently no limit to the amount taken. For practical reasons, the volume available is limited to the volume of unfrozen water under the ice at the time of withdrawal. In most cases, the withdrawal occurs when the ice is 4 feet thick or greater. In order to provide some estimate of water likely to be available, the volume of water under 4 feet of ice is provided.

Based on the lake evaluation, 11 lakes were confirmed to contain fish, with 9 containing sensitive species and 2 containing ninespine stickleback. One additional lake likely supports resistant species, but was not sampled for them. Fish were not detected in the remaining five lakes.

The following amounts of water are likely to be available for winter use in the four areas from lakes surveyed in 2002:

Area	Million Gallons Available
Kokoda	49.71
Grandview	98.34
Powerline	231.47
Summit	58.07

The area covered by water less than 4 feet deep, and therefore likely to be suitable for removing ice aggregate, was estimated for each lake. The following table summarizes the area available for ice aggregate near each exploration prospect surveyed in 2002:

Area	Acres Available
Kokoda	2,077.3
Grandview	69.9
Powerline	1,019.0
Summit	428.8

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INTRODUCTION

ConocoPhillips Alaska Inc. has been exploring for oil within the eastern portion of the National Petroleum Reserve–Alaska (NPR-A) since the winter of 1999/2000. Exploration includes crossing rivers and lakes with ice roads and withdrawal of water from lakes to support both industrial and domestic needs.

During review of exploration, and potentially development, permits, information is required on the biological sensitivity of lakes in the region. The study was designed to provide physical and biological information on these lakes to understand their use by various fish species. In addition, results of the survey can be used, in concert with previous surveys within the area, to direct any future investigations that may be needed.

The objectives of the study are to document fish presence and habitat use in eastern NPR-A lakes for lakes that may be used to support exploration activities. The region surveyed during 2002 generally lies between the confluence of Fish and Judy creeks and the southeast corner of Teshekpuk Lake (Figure 1), and is collectively referred to in this report as the Upper Fish Creek region. Four exploration prospects, Kokoda, Powerline, Grandview and Summit, are included in the general region.

The objectives of the survey were to:

- 1) inventory fish species in the various lakes within the project study areas (sampling areas identified in Figure 1),
- 2) obtain information on relative abundance of species in different water bodies sampled, especially from lakes that may be proposed for water withdrawal during exploration and field development,
- 3) obtain basic descriptive population data for the species captured,
- 4) measure lake depths to estimate lake volumes, and
- 5) measure water chemistry parameters to assess suitability of water for potential uses.

The 2002 field effort continued sampling begun in 1999 in the eastern NPR-A Exploration Area. Lakes in the area may be needed as sources of freshwater during oil exploration, for ice road and ice pad construction, as well as for short-term potable water supplies. Permitting decisions on water withdrawal will need to consider potential impacts to fish that depend on an adequate water supply for surviving winter. The inventory of fish and fish habitat provides information for assisting permitting decisions regarding water use and ice road routing. The surveys in lakes consisted of short-duration gill net sampling in July and August, supplemented with minnow trap sets and seine

hauls.

Bathymetric and water chemistry data were collected in conjunction with fish sampling. The bathymetric information allows estimating lake volumes. Water chemistry parameters measured include water temperature, specific conductance, dissolved oxygen, pH and turbidity.

METHODS

The biological survey consisted of sampling with gill nets and minnow traps combined with physical measurements. Lakes were sampled with short-duration gill net sets (typically 4 to 6 hours) using a multimesh gill net (120 feet long, six panels of variable mesh, mesh size ranging from 1 to 3.5 inches stretched mesh). These nets have been previously used to collect inventory-level data from lakes throughout the Colville Delta and nearby areas. The sets were kept to a short duration to minimize the chance for entangling waterfowl and to minimize fish mortality. Since the objective of the gill netting is to document presence/absence, the nets were pulled after fish were detected. Fish captured were measured and released if not severely injured. Duration of each set was recorded to allow calculation of catch rates.

In 2002, minnow traps and seines were used to identify smaller fish species that may not be detected by gill nets. Minnow traps baited with preserved salmon eggs were set in pairs at the edge of surveyed lakes. The traps were set and retrieved in concert with the gill net sampling. At lakes where bottom contours allowed, a 20 ft seine was pulled through vegetation beds along the lakeshore to detect small fishes. Where this method was employed, three hauls were made at each lake.

Water chemistry parameters were measured to assess habitat conditions and provide information on the suitability of the water for domestic and industrial uses. Water chemistry measurements included surface measures of water temperature, specific conductance, dissolved oxygen, pH, and turbidity. Temperature, specific conductance and dissolved oxygen were *in situ* surface measurements taken along the edge of each lake with a YSI Model 85 meter. A sample was returned to the field office to measure pH and turbidity. PH was measured with an Oaktron Acorn Series pH5 meter. Turbidity was measured with a LaMotte Model 2020 turbidity meter. A water sample was sent to Northern Test Labs for laboratory determination of chloride, sodium, calcium, magnesium, hardness (as CaCO₃) and total dissolved solids (TDS).

Bathymetric data were collected to allow estimating lake volume. In 2002, location and depth were recorded on a Lowrance Model LCX-15MT integrated GPS/depth sounder. Location and depth were recorded at approximately 1-2 second intervals. The study design was to record at least six to eight depth transects on each lake. Lake volume was estimated by contour mapping of depth intervals. Contour maps were prepared by plotting the position and depth data obtained by GPS on GIS basemaps and plotting the contours in 1 or 2 ft intervals on maps of the surveyed lakes. One foot intervals were plotted for lakes where the maximum depth was 10 ft or less, two foot intervals were used on deeper lakes. The surface area of each 1 ft contour was obtained, then the volume was estimated using the formula for truncated cones:

$$V = h/3*(A1+A2+(A1*A2) (1/2))$$

Where h = vertical depth of the stratum, A1 = area of the upper surface, and A2 = area of the lower surface of the stratum whose volume is to be determined. The volumes of individual strata are summed to obtain the volume of the desired depth intervals.

The amount allowed for winter water withdrawal when sensitive fish species are present is currently set at 15% of the volume of the lake deeper than 7 feet. When resistant fish species (i.e. ninespine stickleback and Alaska blackfish) are present, the current allocation is 30% of the volume deeper than 5 feet. There is no withdrawal limit if fish are not present.

The area potentially available for ice aggregate was estimated by calculating the area of the lake shallower than 4 feet, assuming that the ice would grow to at least 4 feet prior to the need for aggregate. If the ice is shallower than 4 feet at the time of ice removal, then the area available will be less

Lake Summaries

This report uses lake numbering based a researcher/year code. The lake number contains several pieces of information, including the code of the sampler and the year of sampling.

Sampler Code:

MC = McElderry and Craig (1981); sampling in 1979

B = Bendock sampling from 1997-1986

L = Lobdell; water chemistry sampling in 1991-1999

M = Moulton; fish sampling in 1995-2002

N = Netsch et al. (1977) NPRA sampling in 1977

First Two Numerals:

Year of Initial Sampling

(if Moulton sampled a lake previously sampled by McElderry and Craig, then the McElderry and Craig lake number is used)

Last Two Numerals:

Numbers from 1 to 99 used to identify the individual lake sampled within a given year

Information contained for each surveyed lake (if measured) includes:

1. A diagram of the lake,
2. Other names utilized for the same lake,
3. Lake location, in latitude/longitude,
4. The USGS quadrangle sheet and the township and range in which the lake is situated
5. Habitat classification,
6. Surface area in acres, obtained from USGS digital maps,
7. Maximum depth in feet,

8. Presence or absence of an outlet,
9. pH,
10. Calculated lake volume and volume of water permitted for winter withdrawal,
11. Water chemistry measurements,
12. Catch record, including gear used, date sampled, species caught and size range,
13. Where appropriate data exist, the length frequency of dominant species is plotted,
14. The depth distribution based on bathymetric transects that were recorded.

Six different lake types are defined, based primarily on the potential for access by fish. Definitions for the lake types are as follows:

Perched (Frequent Flooding) = Perched lake near a floodplain, but above the water surface elevation of the active channel, with an obvious high water channel. These lakes are likely subject to annual flooding.

Perched (Infrequent Flooding) = Perched lake near a floodplain, but above the water surface elevation of the active channel, with no obvious high water channel. These lakes are likely subject to flooding on an infrequent basis (every five years or more).

Deflation = Deflation lake, a lake formed when sand dunes become revegetated and the basins between the dunes become filled with water. Deflation lakes are typically the deepest coastal plain lakes.

Drainage = Drainage Lake, a lake that is part of a defined drainage system, i.e. there is an active connection to a creek.

Oxbow = Oxbow lake, formed from abandoned river channels.

Tundra = Tundra Lake, a thaw lake not within or connected to a river drainage, little potential for fish access on a regular basis.

RESULTS AND DISCUSSION

Biological Observations

A total of 17 lakes were sampled for the first time in 2002 in connection with potential exploration in the Upper Fish Creek region of NPR-A (Table 1). Broad whitefish, humpback whitefish, least cisco, and arctic grayling were captured by gill net in nine of the NPR-A lakes (Table 2), which is consistent with earlier reports from the region (Netsch et al. 1977, McElderry and Craig 1981, Bendock and Burr 1984). Ninespine stickleback were also caught in two lakes by seine. Length information is presented for each fish-bearing lake in the Lake Summaries.

Lakes in the Upper Fish Creek region, and especially in the Kokoda area, were deflation lakes.

These lakes are characterized by wide sandy shoals on the west and east sides, where sand dunes have eroded into the lakes. Deep water is often confined to a relatively small portion of the lake surface, as compared to lakes farther east, which tend to deepen rapidly near shore.

Water Chemistry Measurements

Water chemistry parameters measured in the studied lakes are presented Table 3. Mean water temperatures during the survey ranged as follows:

Jul 24 to Aug 21, 2002: 9.8°C (range: 6.9 to 13.0°C).

Dissolved oxygen was high, averaging 90.9% saturation. The observed frequency of specific conductance and pH values from surveyed lakes are graphed in Figure 7.

Evaluation of Fish Concerns

Information from fish sampling and depth measurements was used to evaluate each lake regarding its potential to support fish. Obviously, if fish were captured during gill net sampling, the lake was classified as fish-bearing. Gill net sets were relatively short, however, so absence of catch does not necessarily mean a lake does not support fish. Lakes also were assessed for their proximity to fish-bearing streams and their depth. Lakes deeper than 7 feet are likely to retain unfrozen water during winter, thus have potential to overwinter fish. Deep lakes that are near fish-bearing streams and are likely to have a connection with the stream at some point during the year are classified as potential fish-bearing lakes, with additional sampling needed if further clarification of the designation is desired. Results of the evaluation are included in Table 4.

Lakes in which fish were verified as present are divided into those lakes containing species sensitive to habitat changes likely to be associated with water withdrawal and those containing species more resistant to such changes. Species sensitive to impacts of water withdrawal (such as reduced dissolved oxygen and increased dissolved solids) include broad whitefish, least cisco and arctic grayling, while the more resistant species are Alaska blackfish and ninespine stickleback. Alaska blackfish are particularly resistant to low dissolved oxygen, being able to breathe atmospheric oxygen (Armstrong 1994). Residents of the Yukon Delta have reported observing Alaska blackfish oriented along cracks in the ice during winter to use oxygen in ponds that have gone anoxic. Ninespine stickleback can also withstand low dissolved oxygen (Lewis et al. 1972), although not the same extent as Alaska blackfish. Ninespine stickleback, however, can withstand higher levels of dissolved solids, and often frequent brackish nearshore waters during summer.

When sensitive fish are present, the amount of water available during winter is limited to 15% of the volume under 7 feet of ice. The water withdrawal criteria are relaxed when only resistant fish species are present because of the greater tolerance to lower dissolved oxygen and higher concentrations of dissolved solids. In this case, up to 30% of the water volume under 5 feet of ice is allowed for winter withdrawal. For lakes that do not contain fish, there is currently no limit to the amount taken. For practical reasons, the volume available is limited to the volume of unfrozen water

under the ice at the time of withdrawal. In most cases, the withdrawal occurs when the ice is 4 feet thick or greater. In order to provide some estimate of water likely to be available, the volume of water under 4 feet of ice is provided.

Based on the above lake evaluation, 11 lakes were confirmed to contain fish, with 9 containing sensitive species and 2 containing ninespine stickleback. One additional lake (M0233) likely supports resistant species, but was not sampled for them. Fish were not detected in the remaining five lakes.

Based on the above analysis, the following amounts of water are likely to be available for winter use in the four areas from lakes surveyed in 2002:

Area	Million Gallons Available
Kokoda	49.71
Grandview	98.34
Powerline	231.47
Summit	58.07

The area covered by water less than 4 feet deep, and therefore likely to be suitable for removing ice aggregate, was estimated for each lake (Table 5). A map of the potential ice aggregate area for each lake is included in the individual lake summaries. The following table summarizes the area available for ice aggregate near each exploration prospect surveyed in 2002:

Area	Acres Available
Kokoda	2,077.3
Grandview	69.9
Powerline	1,019.0
Summit	428.8

Extensive shoals in the Kokoda lakes account for the high value in that prospect; on average, over 70% of the Kokoda lakes were less than 4 feet deep, even though the lakes were the deepest surveyed.

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Table 1. Summary of lakes sampled near Upper Fish Creek prospects in 2002.

Area	Lake Name	Latitude (NAD27)	Longitude	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Calculated Volume (mill. gals)
Kokoda									
	M0229	70.28549	153.17409	11N	5W	17/20/21/28/29	1,031.2	7.7	470.54
	M0230	70.27226	153.14708	11N	5W	27/28/33/34	414.1	4.5	not calc.
	M0231	70.27486	153.11686	11N	5W	27/34	164.9	9.6	205.48
	M0232	70.27204	153.07891	11N	5W	25/26/27/34/35/36	740.8	22.1	943.69
	M0233	70.31650	153.10141	11N	5W	10/11	149.2	10.6	151.88
	M0234	70.31238	153.12843	11N	5W	10/15	122.2	27.8	225.94
Grandview									
	M0235	70.23652	152.18481	10N	1W	8	223.7	7.7	327.04
Powerline									
	M0236	70.15160	152.42619	9N	2W	4/5/8/9	950.4	18.8	1,657.28
	M0237	70.16678	152.46644	9N	2W	5/6	56.0	16.2	123.07
	M0238	70.14878	152.50286	9N	2W	17	206.5	7.5	272.41
	M0239	70.13664	152.48114	9N	2W	18	145.4	7.8	129.29
	M0240	70.13056	152.44089	9N	2W/3W	7/12	498.2	13.6	815.29
	M0241	70.17155	152.38019	9N/10N	2W	3/4/33/34	1,477.3	13.8	2,970.33
Summit									
	M0242	70.26905	151.92188	11N	1E	32/33	57.3	11.0	58.27
	M0243	70.26624	151.97587	11N	1E	31	48.2	7.1	41.26
	M0244	70.29139	152.00479	11N	1E/1W	13/24/19	405.2	6.7	235.17
	M0245	70.29638	151.91481	11N	1E	20/21	79.1	7.6	79.81

Table 2. Catches of fish from lakes sampled near the Upper Fish Creek prospects, 2002.

Area	Lake Name	Sample Date	Gill Nets		Minnow Traps		Seine and Observation	
			Set Duration (hours)	Fish Species ¹	Set Duration (hours)	Fish Species ²	Number of Hauls	Fish Species ²
Kokoda								
	M0229	Jul 27 02	3.0	3 BDWF, 3 LSCS	0.0		0	NSSB observed
	M0230	Jul 27 02	0.0	BDWF, LSCS	0.0		0	NSSB observed
	M0231	Jul 26 02	3.5	5 LSCS	0.0		0	
	M0232	Jul 26 02	0.0	LSCS	0.0		0	
	M0233	Jul 24 02	8.1	None	0.0		0	
	M0234	Jul 25 02	2.4	3 LSCS	0.0		0	
Grandview								
	M0235	Aug 13 02	10.3	None	10.7	None	3	None
Powerline								
	M0236	Aug 21 02	5.3	2 LSCS	6.3	None	3	None
	M0237	Aug 18 02	4.3	None	12.5	None	3	None
	M0238	Aug 19 02	5.3	2 LSCS	5.0	None	3	None
	M0239	Aug 18 02	4.7	None	0.0		3	3 NSSB
	M0240	Aug 19 02	5.0	None	5.7	None	3	2 NSSB
	M0241	Aug 17 02	5.5	1 GRAY	6.3	None	0	
Summit								
	M0242	Aug 16 02	4.2	2 HBWF	5.3	None	0	
	M0243	Aug 14 02	4.0	None	5.2	None	0	
	M0244	Aug 14 02	5.3	None	7.0	None	3	None
	M0245	Aug 16 02	4.0	None	6.5	None	3	None

¹ BDWF = broad whitefish, HBWF = humpback whitefish, LSCS = least cisco, GRAY = arctic grayling, LKTR = lake trout

² NSSB = ninespine stickleback

Table 3. Water chemistry parameters measured in conjunction with lake sampling in the Upper Fish Creek areas, 2002.

Area	Lake	Date	Water Temp (oC)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (%)	Specific Conductance (microS/cm)	pH	Turbidity (NTU)	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)
Kokoda														
	M0229	Jul 27 02	7.1	10.9	91	204	7.5	1.4	23.9	2.8	7.0	17.0	71.3	110
	M0230	not sampled, too shallow												
	M0231	Jul 26 02	9.1	11.3	99	204	7.5	1.8	29.7	2.7	4.8	10.3	85.3	110
	M0232	Jul 26 02	10.4	11.0	99	196	7.5	1.3	19.0	2.1	4.4	9.6	56.2	80
	M0233	Jul 24 02	13.0	9.9	93	144	7.4	0.6	21.1	2.2	3.8	7.7	61.6	100
	M0234	Jul 25 02	10.8	9.9	90	165	7.7	0.9	24.2	2.4	4.2	8.6	70.3	110
Grandview														
	M0235	Aug 13 02	6.9	11.7	98	179	7.7	1.2	28.3	4.6	10.3	30.3	89.6	NM
Powerline														
	M0236	Aug 21 02	NM	8.4	92	135	8.0	2.2	20.1	3.0	6.8	19.0	62.6	NM
	M0237	Aug 18 02	9.9	10.7	95	183	7.9	1.5	26.2	4.6	6.2	12.3	84.4	NM
	M0238	Aug 19 02	8.8	11.7	99	200	7.9	2.8	32.7	3.5	7.1	15.9	96.1	NM
	M0239	Aug 18 02	11.3	10.0	93	79	8.1	3.1	9.7	1.7	4.0	8.9	31.4	NM
	M0240	Aug 19 02	9.6	9.9	87	251	8.1	3.1	35.5	4.6	11.8	32.2	107.6	NM
	M0241	Aug 17 02	9.0	8.9	77	195	7.9	3.4	24.9	3.6	7.6	20.4	77.0	NM
Summit														
	M0242	Aug 16 02	11.0	8.3	75	79	7.7	2.4	7.9	1.8	3.3	9.7	27.3	NM
	M0243	Aug 14 02	12.4	9.6	92	101	8.3	1.7	11.5	2.4	3.7	9.9	38.8	NM
	M0244	Aug 14 02	8.8	10.4	90	117	8.2	1.0	12.1	2.5	4.8	13.8	40.4	NM
	M0245	Aug 16 02	9.1	9.8	85	68	8.2	2.7	5.5	1.7	3.9	9.8	20.5	NM

¹ NM = not measured

Table 4. Estimated water volumes available for winter withdrawal from surveyed lakes near the Upper Fish Creek areas, 2002.

(requested water based on 15% of winter volume deeper than 7 ft when sensitive species are present, 30% of winter volume deeper than 5 ft when resistant or no fish are likely to be present).

Area	Lake	Surface Area (acres)	Max. Depth (feet)	Calculated Volume (mil. gals)	Sensitive Fish Species Present ¹	Resistant Fish Species Present ²	15% of 7 ft Winter Volume (mil. gals)	30% of 5 ft Winter Volume (mil. gals)	4 ft Winter Volume (mil. gals)	Available Water (mil. gals)
Kokoda										
	M0229	1,031.2	7.7	470.54	BDWF, LSCS	not sampled	0.02			0.02
	M0230	414.1	4.5	not calc.	BDWF, LSCS	not sampled	0.00			ice chips
	M0231	164.9	9.6	205.48	LSCS	not sampled	0.10			0.10
	M0232	740.8	22.1	943.69	LSCS	not sampled	24.43			24.43
	M0233	149.2	10.6	151.88	none caught	not sampled	1.39	10.28		10.28
	M0234	122.2	27.8	225.94	LSCS	not sampled	14.88			14.88
Grandview										
	M0235	223.7	7.7	327.04	none caught	none caught	0.13	0.42	98.34	no limit
Powerline										
	M0236	950.4	18.8	1,657.28	LSCS	none caught	11.62			11.62
	M0237	56.0	16.2	123.07	none caught	none caught	3.41	6.83	63.94	no limit
	M0238	206.5	7.5	272.41	LSCS	none caught	0.18			0.18
	M0239	145.4	7.8	129.29	none caught	NSSB	0.00	8.99		8.99
	M0240	498.2	13.6	815.29	none caught	NSSB	13.55	73.13		73.13
	M0241	1,477.3	13.8	2,970.33	GRAY	none caught	73.61			73.61
Summit										
	M0242	57.3	11.0	58.27	HBWF	none caught	0.93			0.93
	M0243	48.2	7.1	41.26	none caught	none caught	0.00	1.23	5.83	no limit
	M0244	405.2	6.7	235.17	none caught	none caught	0.00	3.77	28.54	no limit
	M0245	79.1	7.6	79.81	none caught	none caught	0.13	6.74	22.77	no limit

¹ Sensitive species include grayling, whitefishes, char, burbot, slimy sculpin, etc.

BDWF = broad whitefish

LSCS = least cisco

HBWF = humpback whitefish

GRAY = arctic grayling

² Resistant species are Alaska blackfish (BKFH) and ninespine stickleback (NSSB)

Table 5. Estimated area available for removing ice aggregate, based on the area covered by water shallower than 4 feet, in the Upper Fish Creek areas, 2002.

Area	Lake	Surface Area (acres)	Max. Depth (feet)	Acres covered by Water shallower 4 feet
Kokoda				
	M0229	1,031.2	7.7	862.6
	M0230	414.1	4.5	414.1
	M0231	164.9	9.6	82.1
	M0232	740.8	22.1	540.3
	M0233	149.2	10.6	96.1
	M0234	122.2	27.8	82.0
Grandview				
	M0235	223.7	7.7	69.9
Powerline				
	M0236	950.4	18.8	211.2
	M0237	56.0	16.2	16.9
	M0238	206.5	7.5	80.2
	M0239	145.4	7.8	96.8
	M0240	498.2	13.6	208.2
	M0241	1,477.3	13.8	405.8
Summit				
	M0242	57.3	11.0	12.7
	M0243	48.2	7.1	35.4
	M0244	405.2	6.7	331.6
	M0245	79.1	7.6	49.1

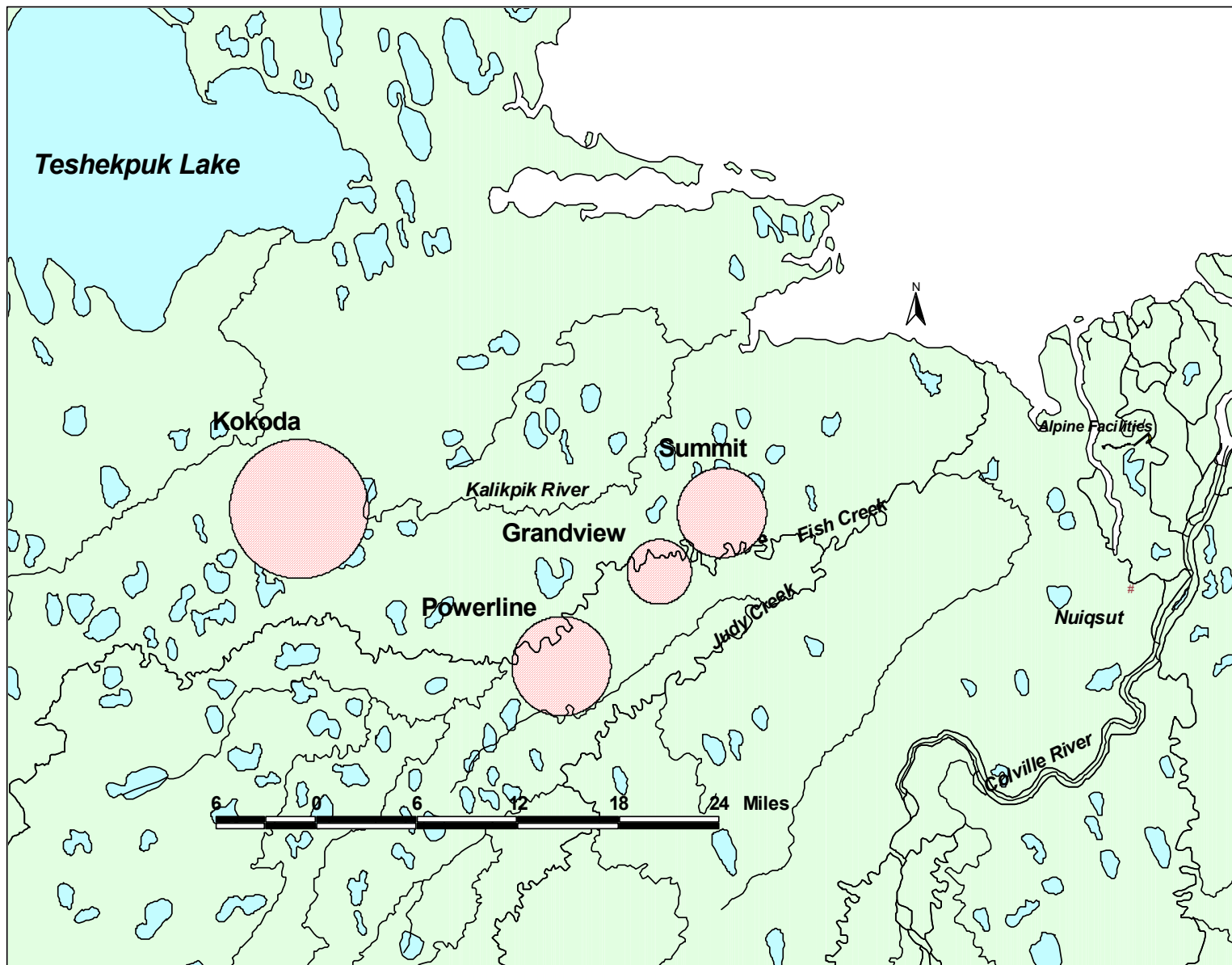


Figure 1. Upper Fish Creek exploration areas surveyed for fish-bearing lakes in 2002.

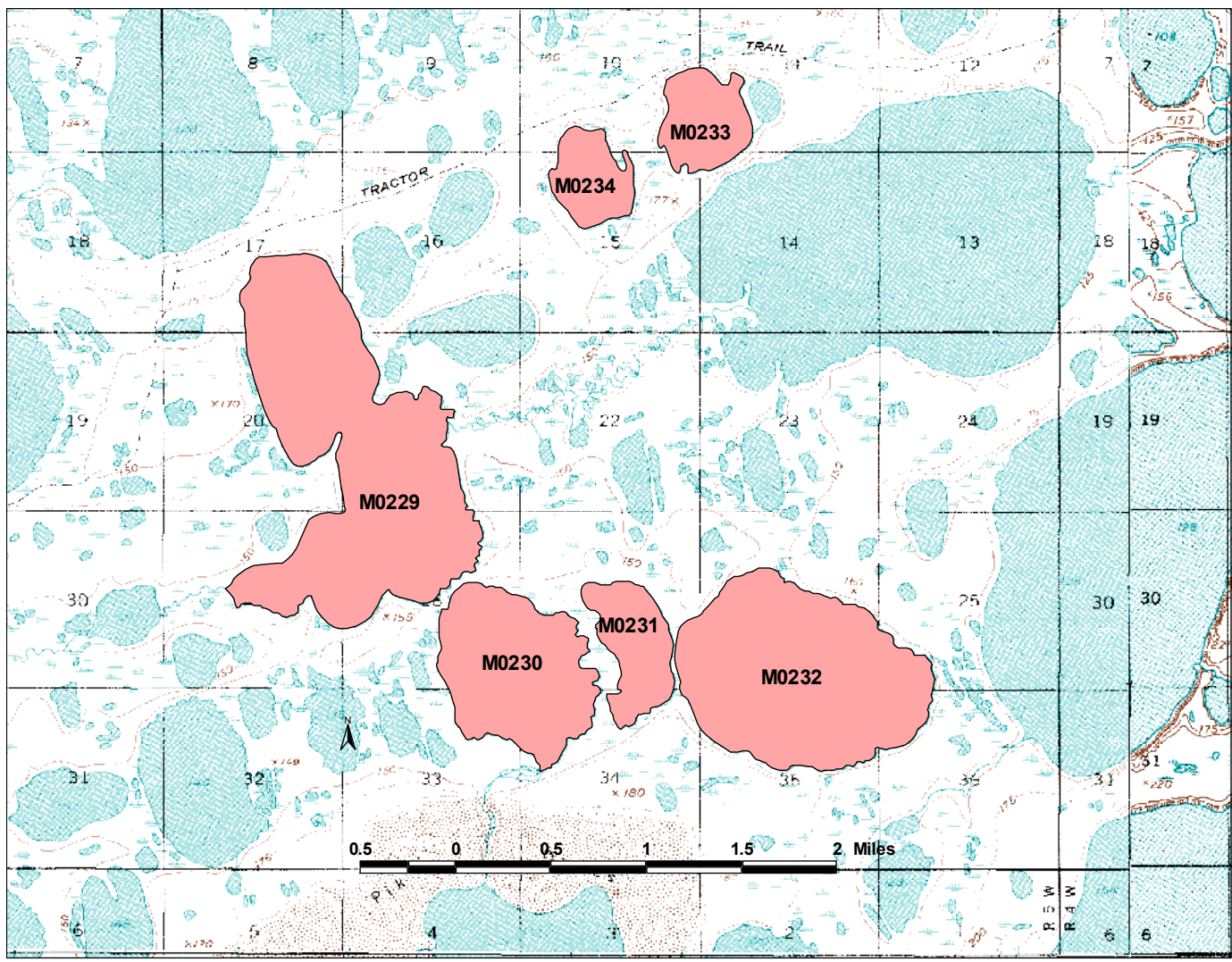


Figure 2. Lakes sampled for fish in the Kokoda area during 2002.

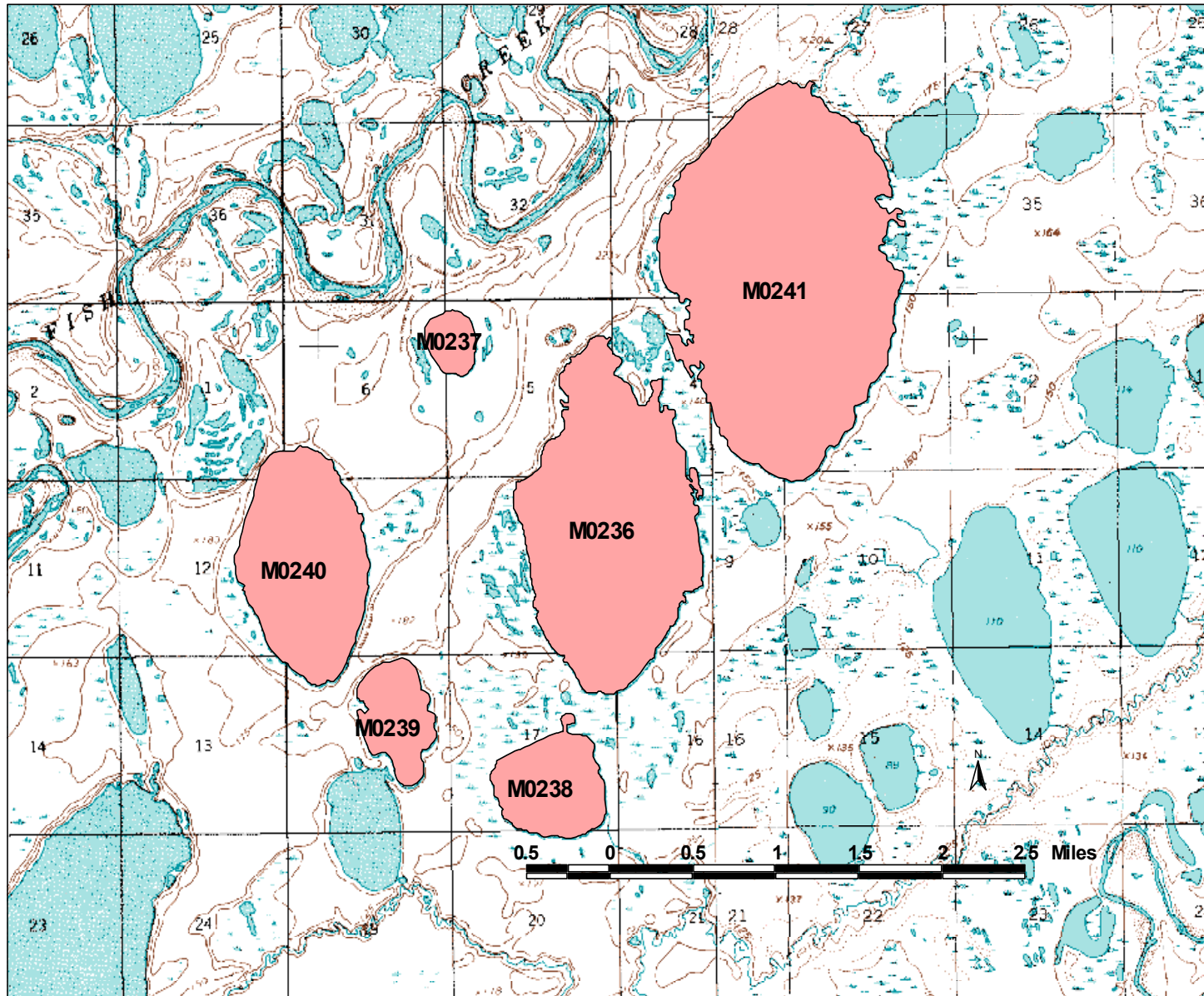


Figure 3. Lakes sampled for fish in the Powerline area during 2002.

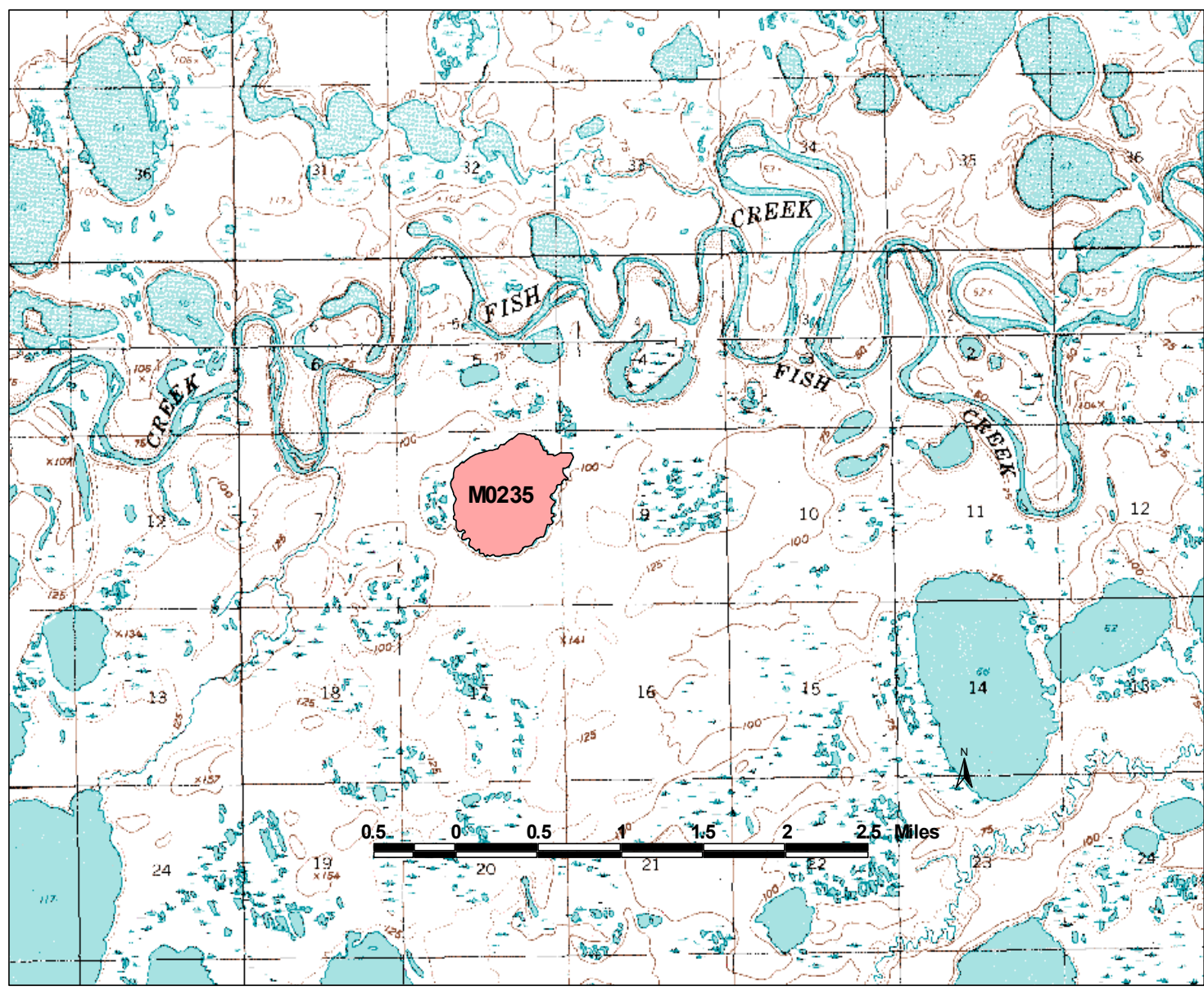


Figure 4. Lake sampled for fish in the Grandview area during 2002.

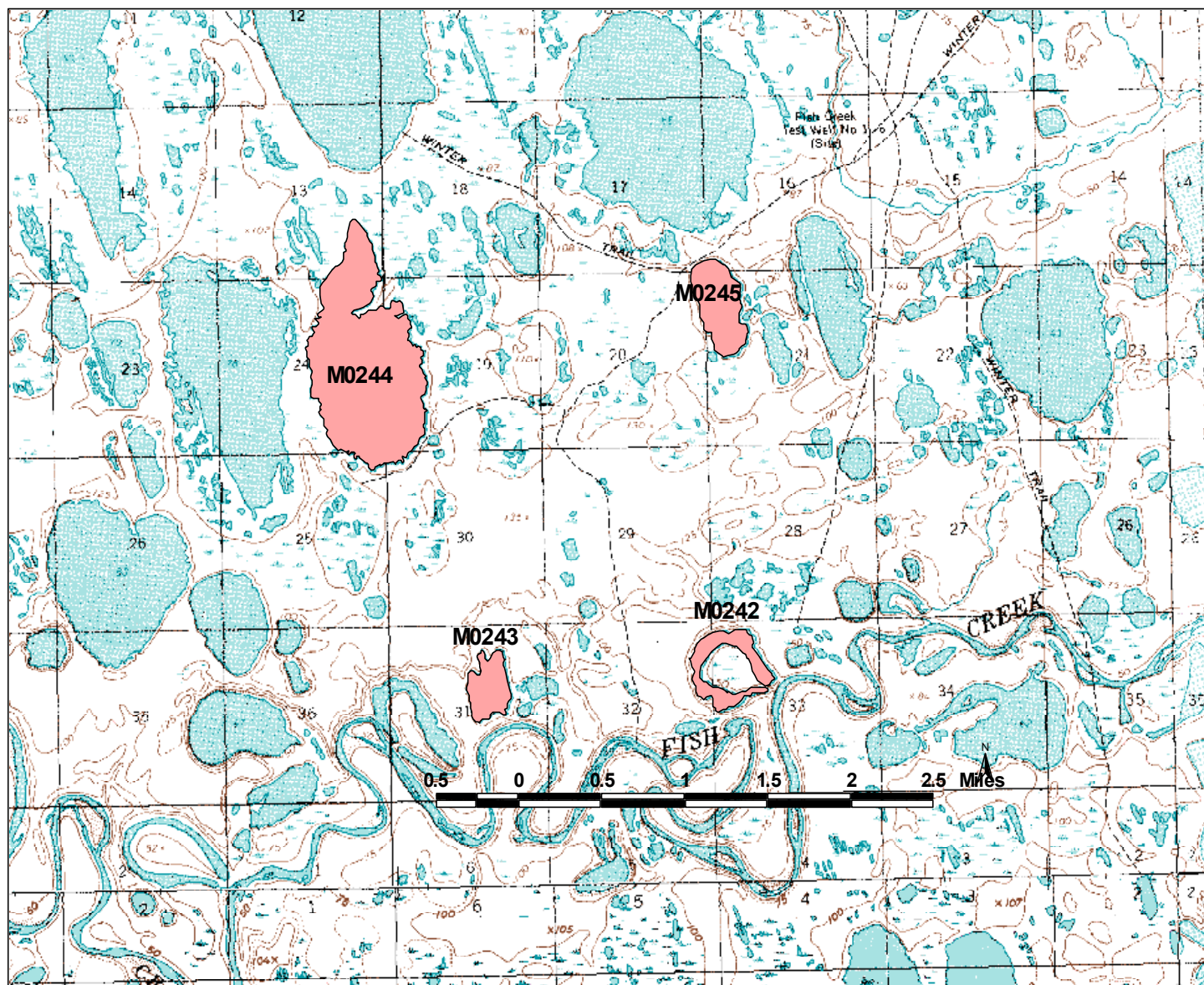


Figure 5. Lakes sampled for fish in the Summit area during 2002.

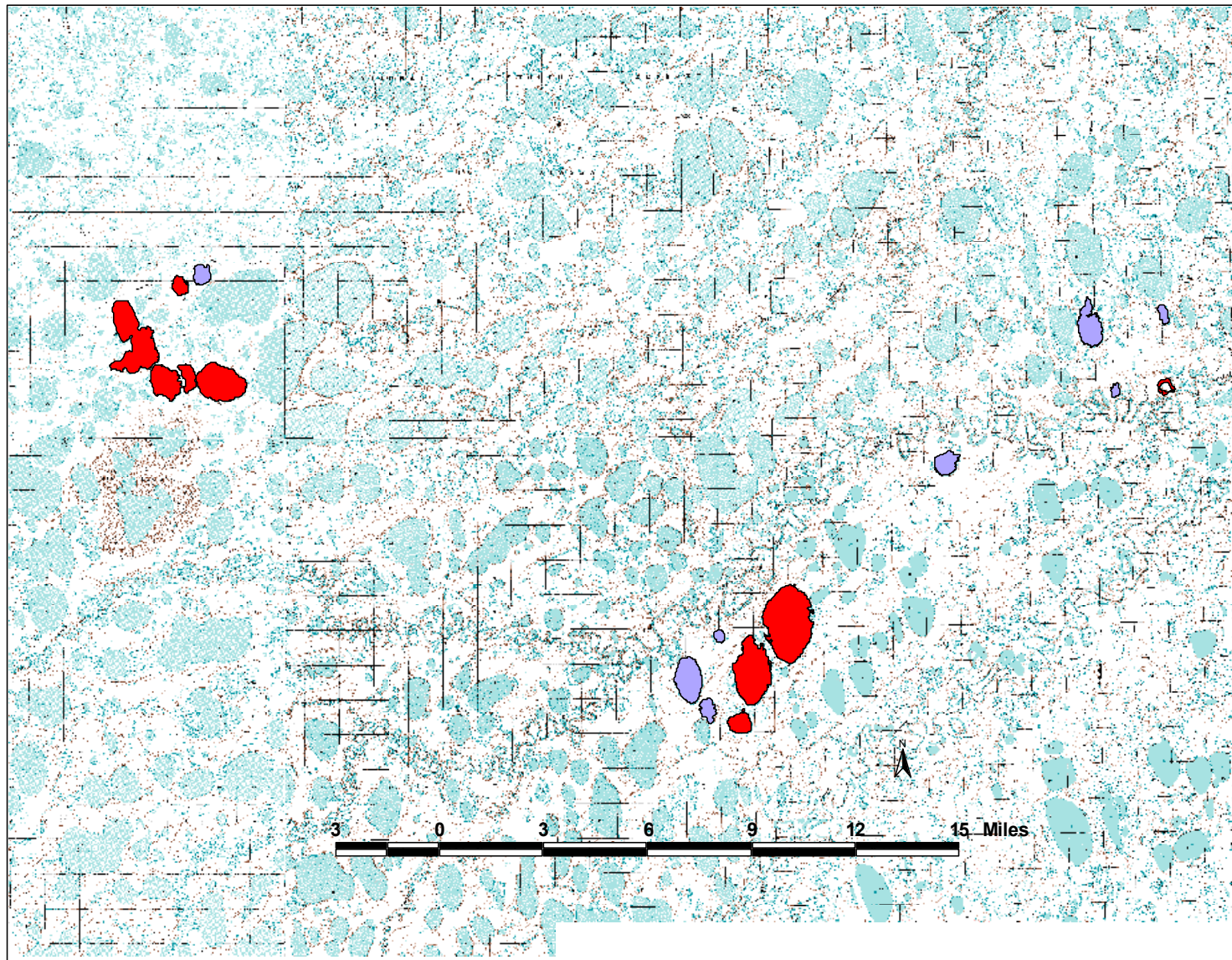


Figure 6. Distribution of sensitive fish species in lakes sampled in the Upper Fish Creek region during 2002 summer field seasons. (lakes in red contain sensitive fish species)

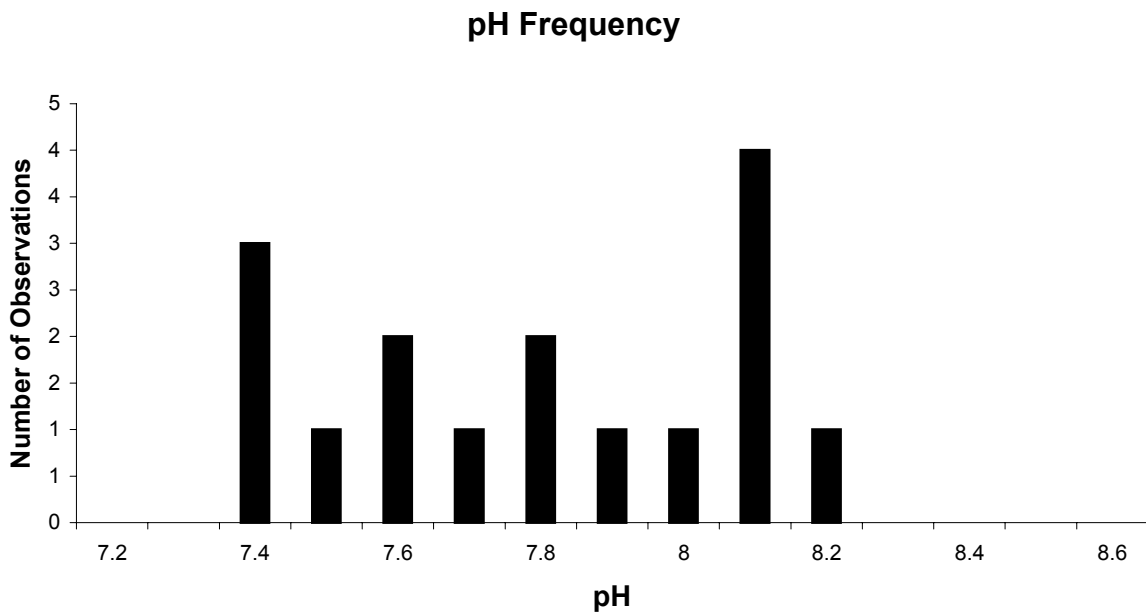
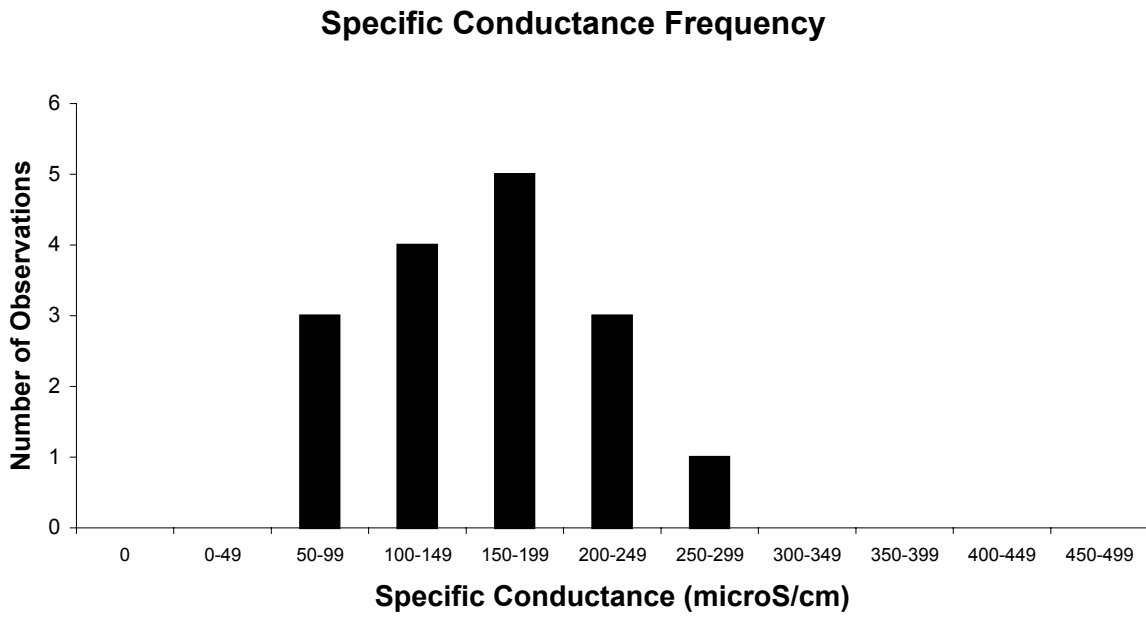
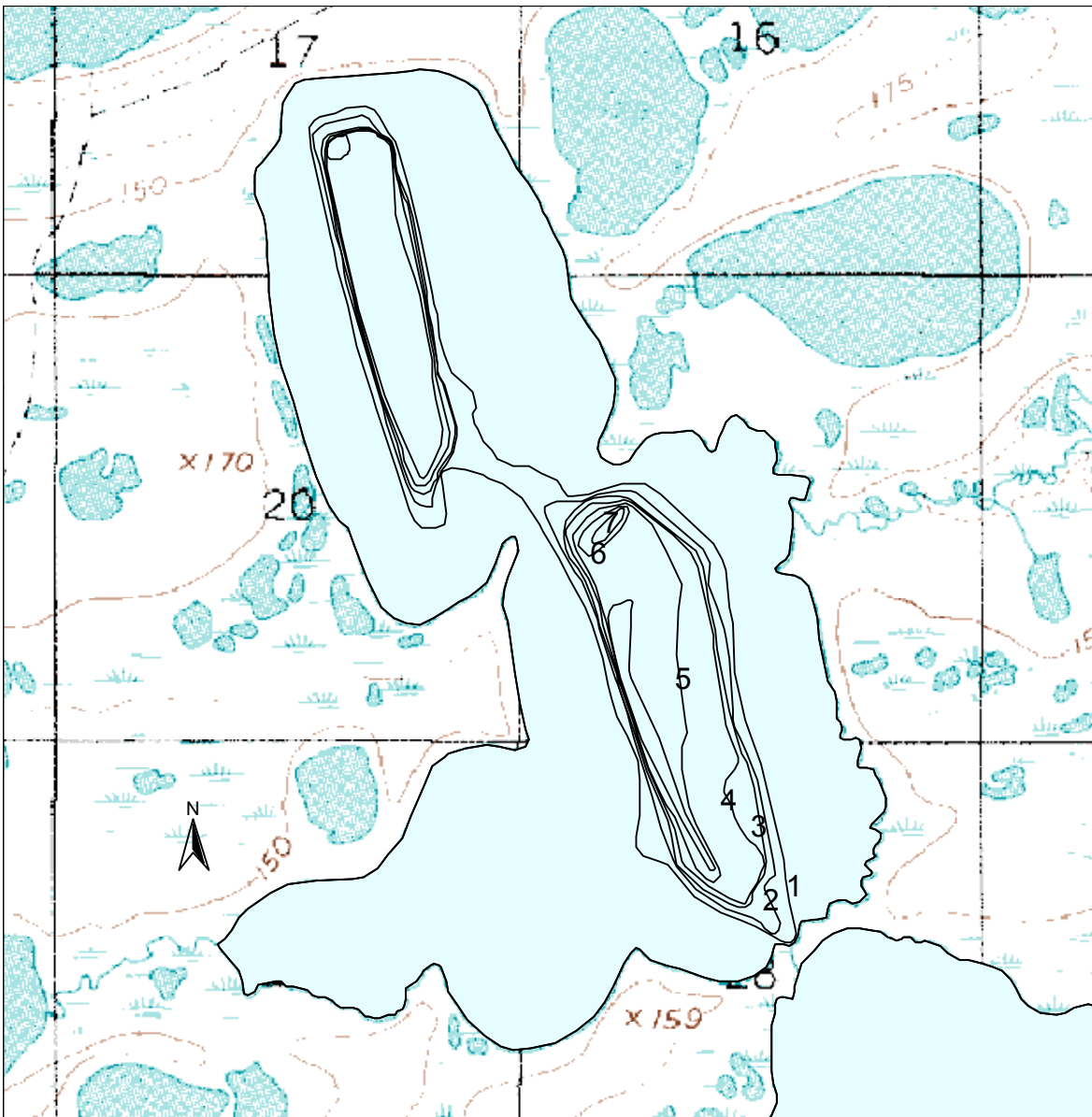


Figure 7 Frequency distribution of specific conductance and pH measurements taken during summer from 17 lakes in the Upper Fish Creek region, 2002.

Lake Summaries



1000 0 1000 2000 3000 4000 Feet

Depth contours of M0229, based on transects surveyed on July 27, 2002 (depth intervals in 1 foot increments).

Lake M0229

Other Names:

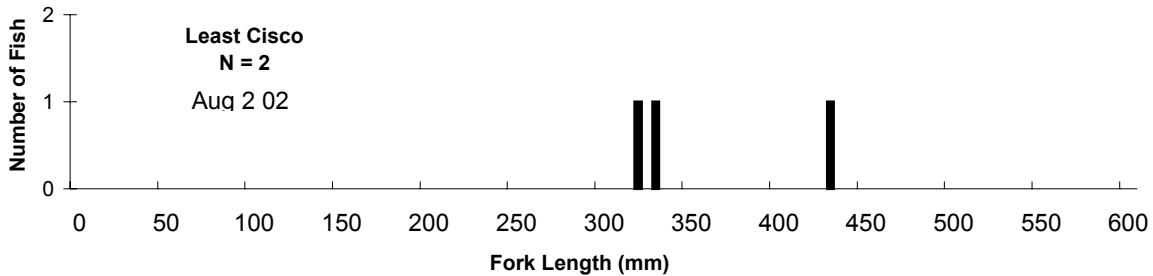
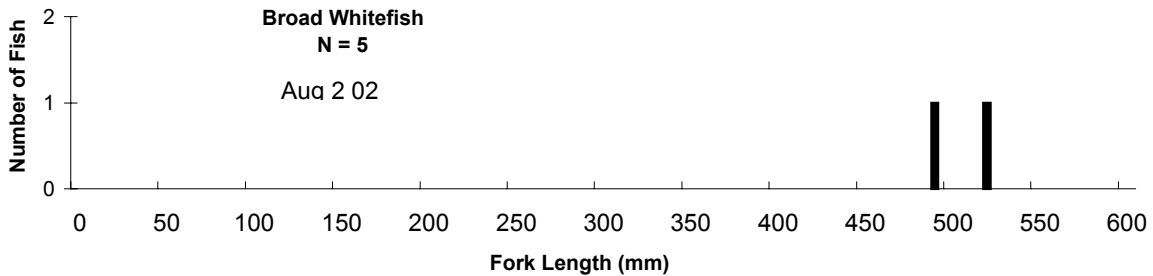
Location: 70° 17' 7.8"N 153° 10' 26.7"W
USGS Quad Sheet: T11N R5W, Sec. 17/20/21/28/29
Habitat:
Area: 1,031.2 acres
Maximum Depth: 7.7 feet
Active Outlet:
Turbidity: 1.4 NTU
Spec. Conductance: 203.8 µS/cm
pH: 7.5
Calculated Volume: 470.54 million gallons
Permittable Volume: 0.02 million gallons
Potential Aggregate: 862.65 acres (water depth 4 ft or less)

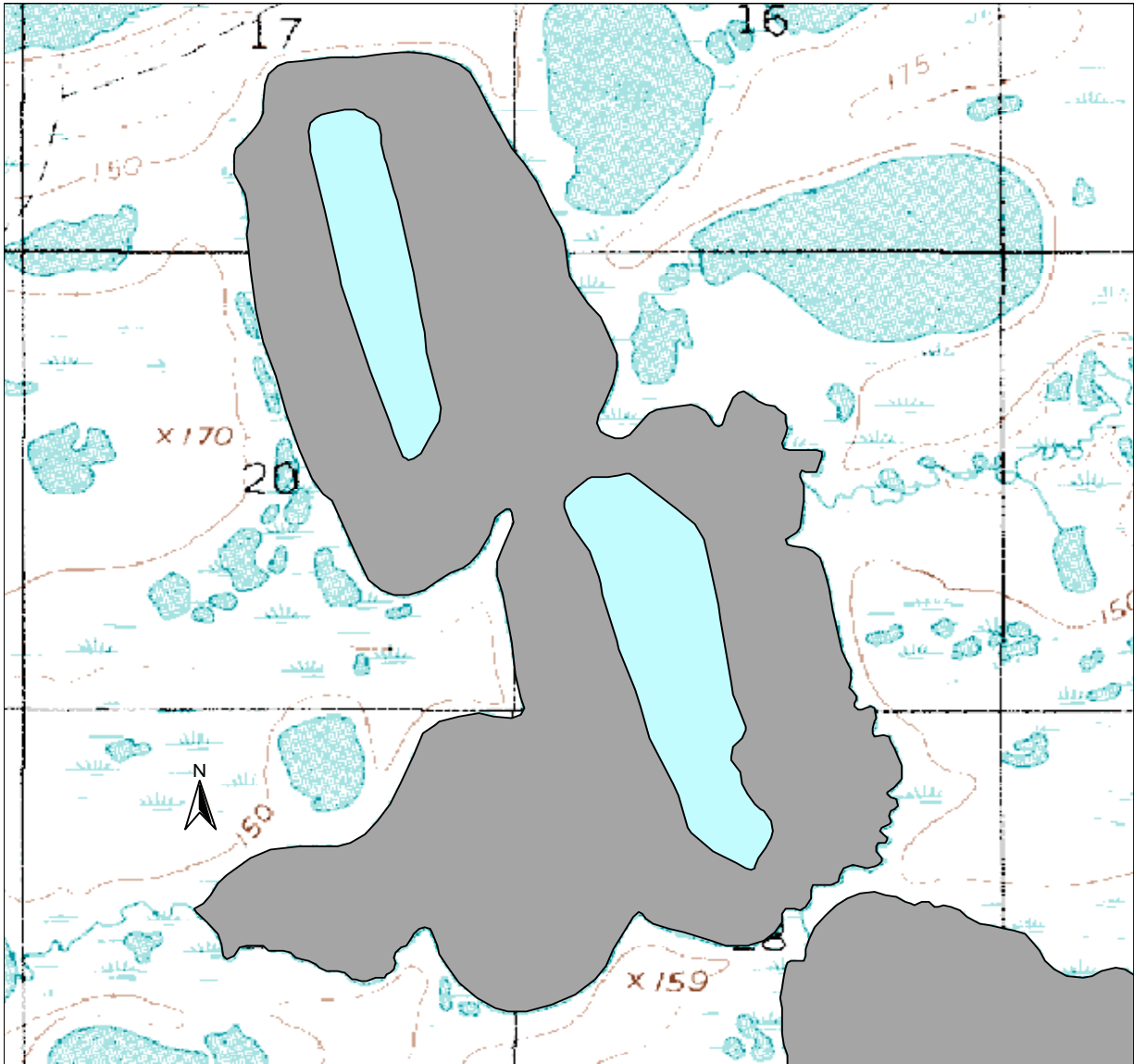
Water Quality:

Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	23.9	2.8	7.0	17.0	71	110	this study

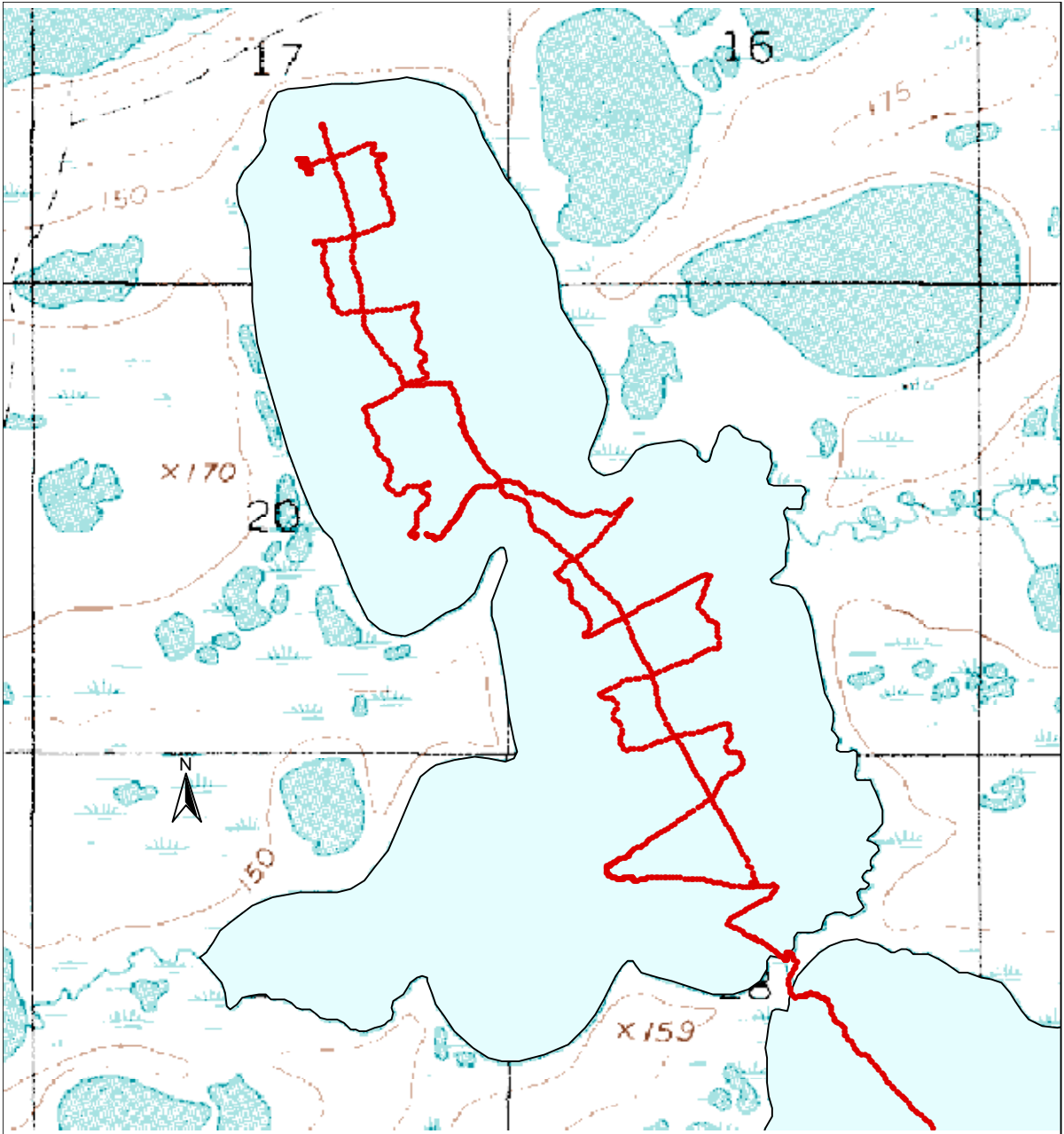
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 27 02	3.0	Broad whitefish	3	495-524
			Least cisco	3	321-438



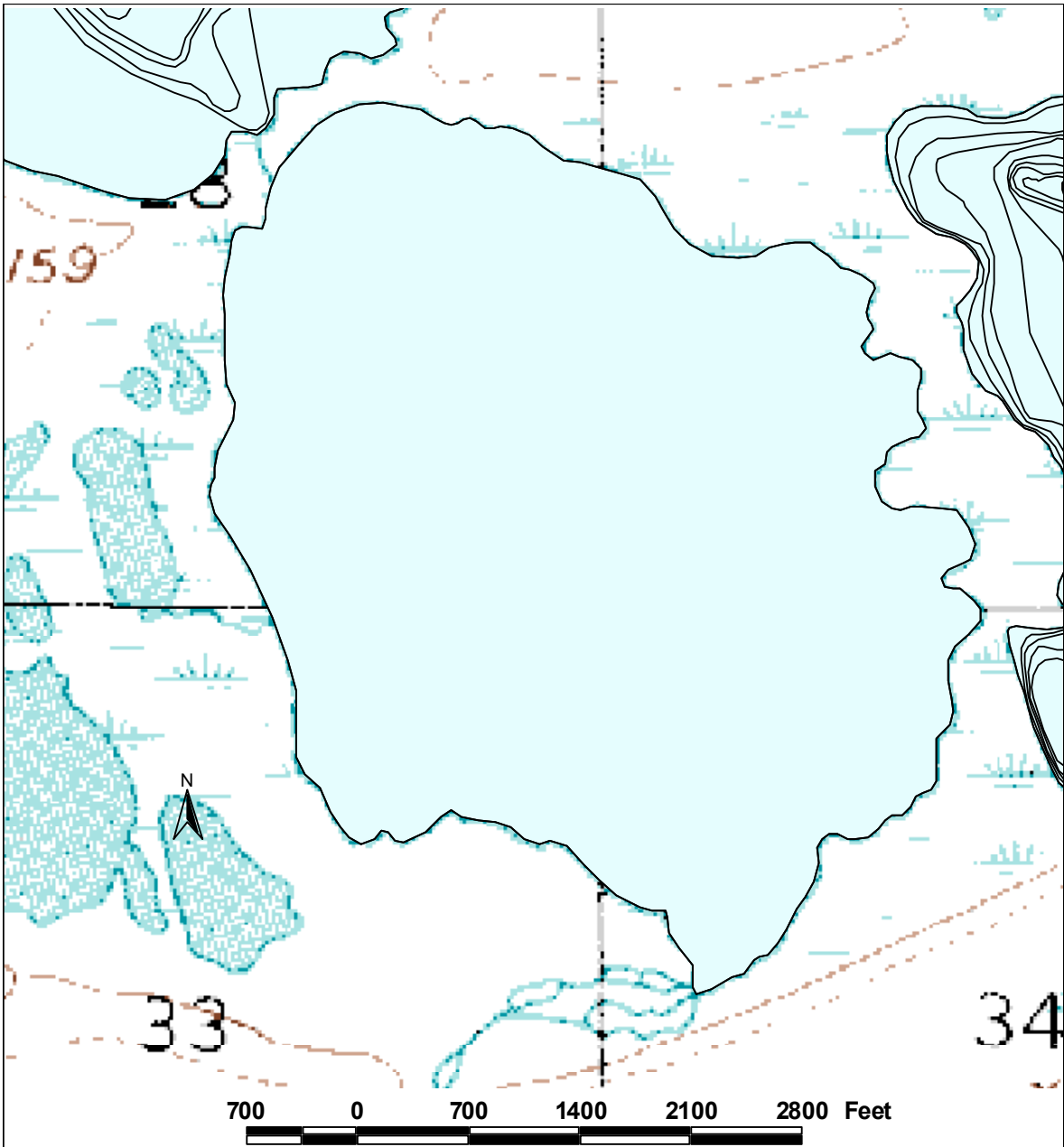


Regions of lake M0229 less than 4 ft deep (shaded), and likely to be available for ice chips, based on transects surveyed on July 27, 2002.



1000 0 1000 2000 3000 4000 5000 Feet

Depth transects surveyed on M0229 on July 27, 2002.



Lake M02430 was not contoured, maximum depth recorded = 4.5 ft on July 27, 2002.

Lake M0230

Other Names:

Location: 70° 16' 20.1"N 153° 8' 49.5"W

USGS Quad Sheet: T11N R5W, Sec. 27/28/33/34

Habitat:

Area: 414.1 acres

Maximum Depth: 4.5 feet

Active Outlet:

Turbidity: NTU

Spec. Conductance: μ S/cm

pH:

Calculated Volume: not calculated

Permittable Volume: suitable for ice chips

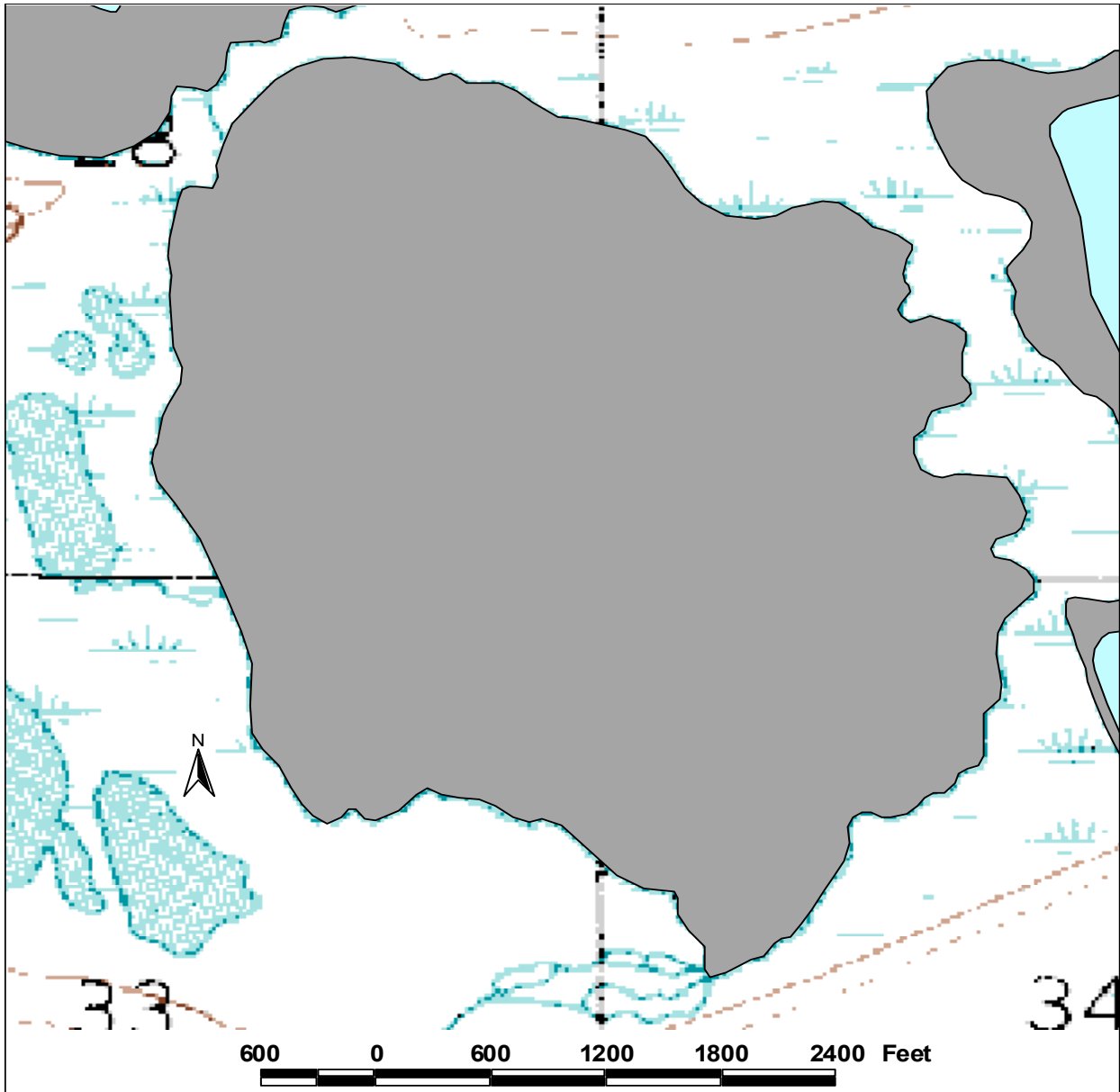
Potential Aggregate: 414.136 acres (water depth 4 ft or less)

Water Quality:

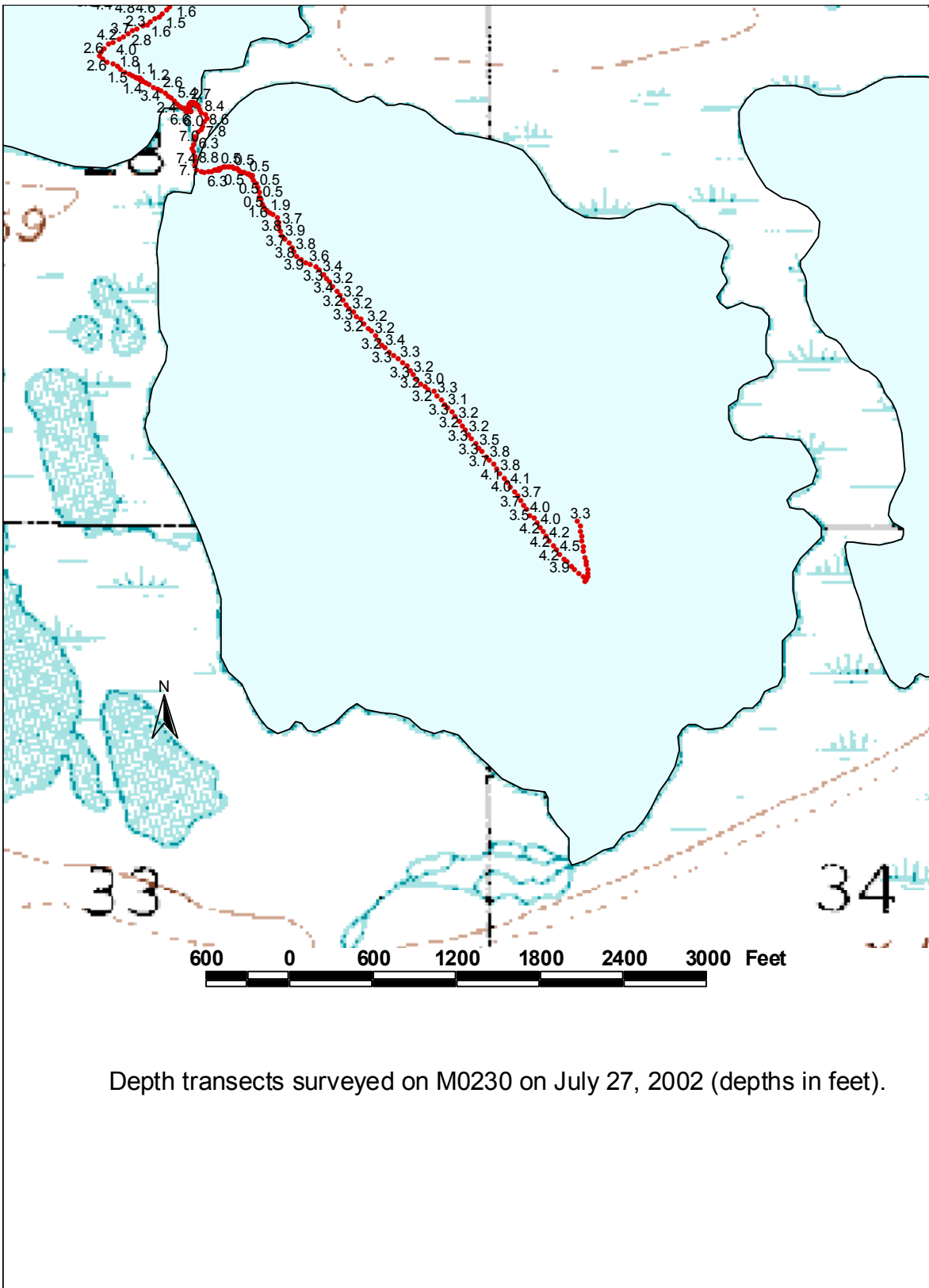
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	31.5	3.2	4.9	11.4	92	130	this study

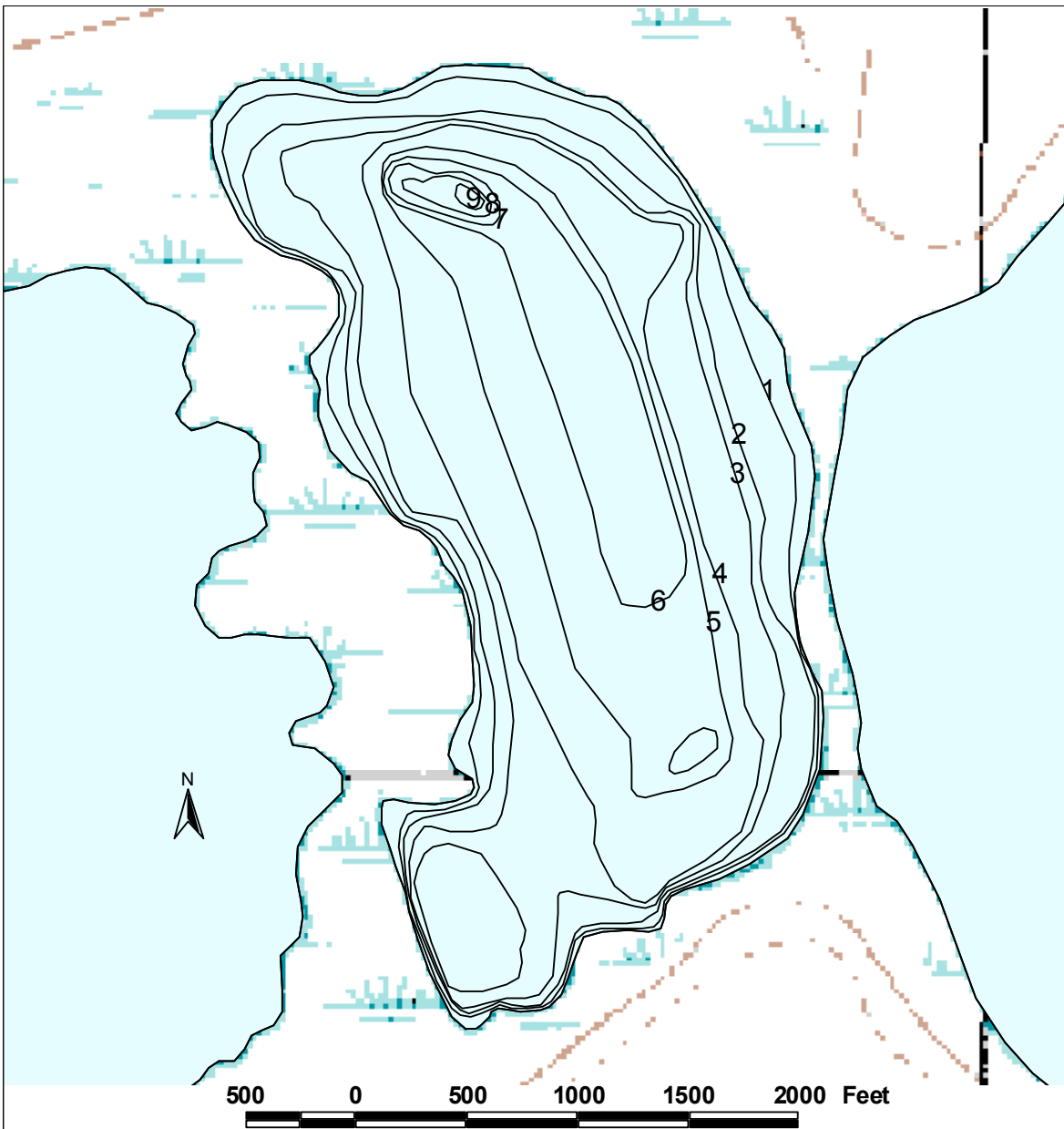
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
not sampled, connected to M0229				



Regions of lake M0230 less than 4 ft deep (shaded), and likely to be available for ice chips, based on transects surveyed on July 27, 2002.





Depth contours of M0231, based on transects surveyed on July 26, 2002 (depth intervals in 1 foot increments).

Lake M0231

Other Names:

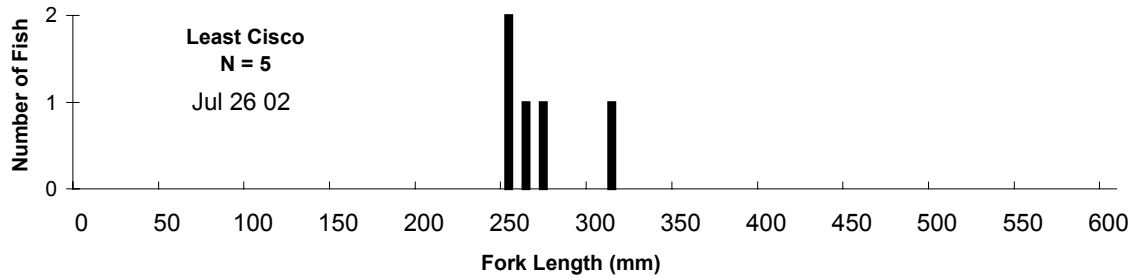
Location: 70° 16' 29.5"N 153° 7' 0.7"W
USGS Quad Sheet: T11N R5W, Sec. 27/34
Habitat:
Area: 164.9 acres
Maximum Depth: 9.6 feet
Active Outlet:
Turbidity: 1.8 NTU
Spec. Conductance: 203.8 µS/cm
pH: 7.5
Calculated Volume: 205.48 million gallons
Permittable Volume: 0.10 million gallons
Potential Aggregate: 82.05 acres (water depth 4 ft or less)

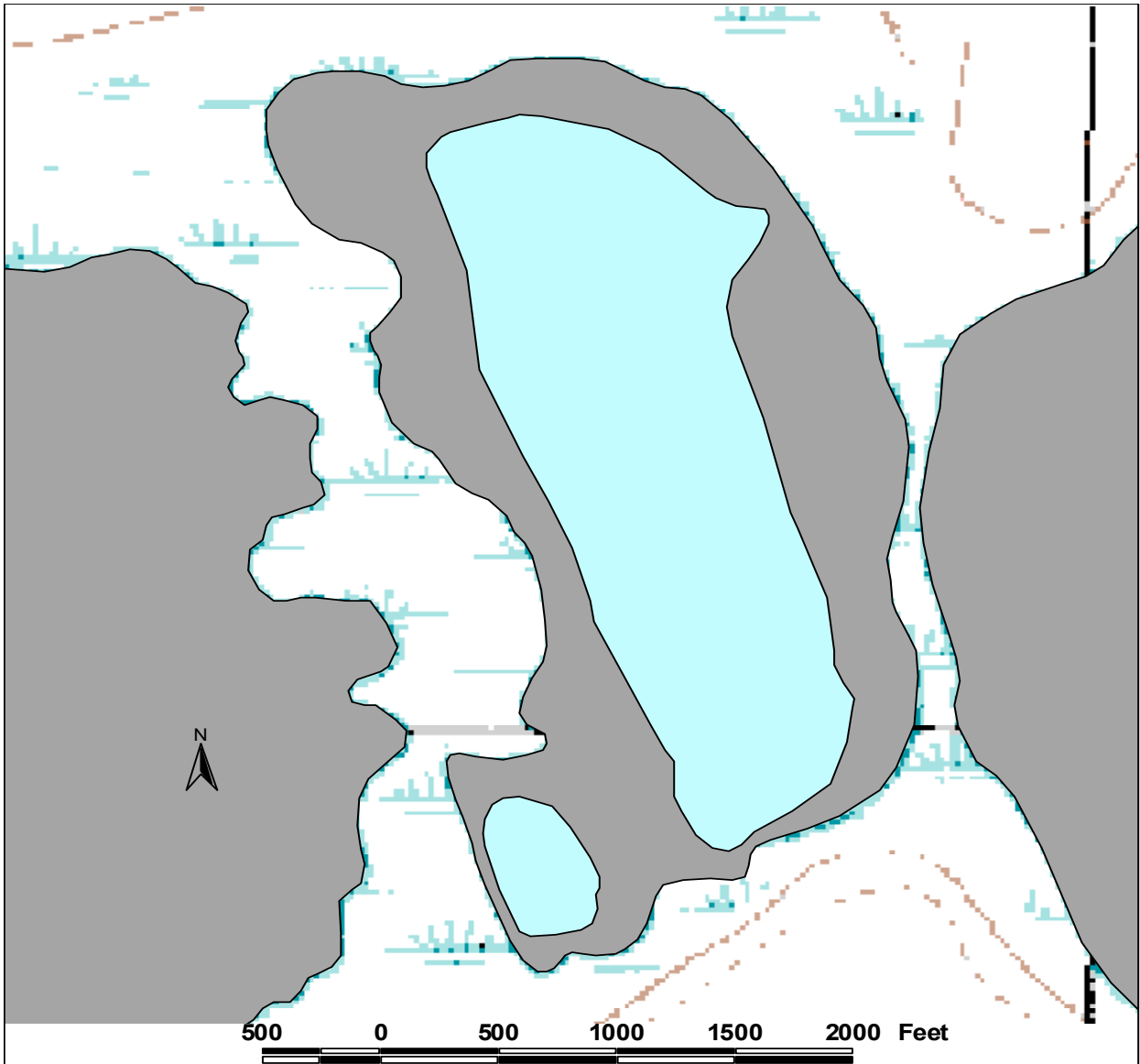
Water Quality:

Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	29.7	2.7	4.8	10.3	85	110	this study

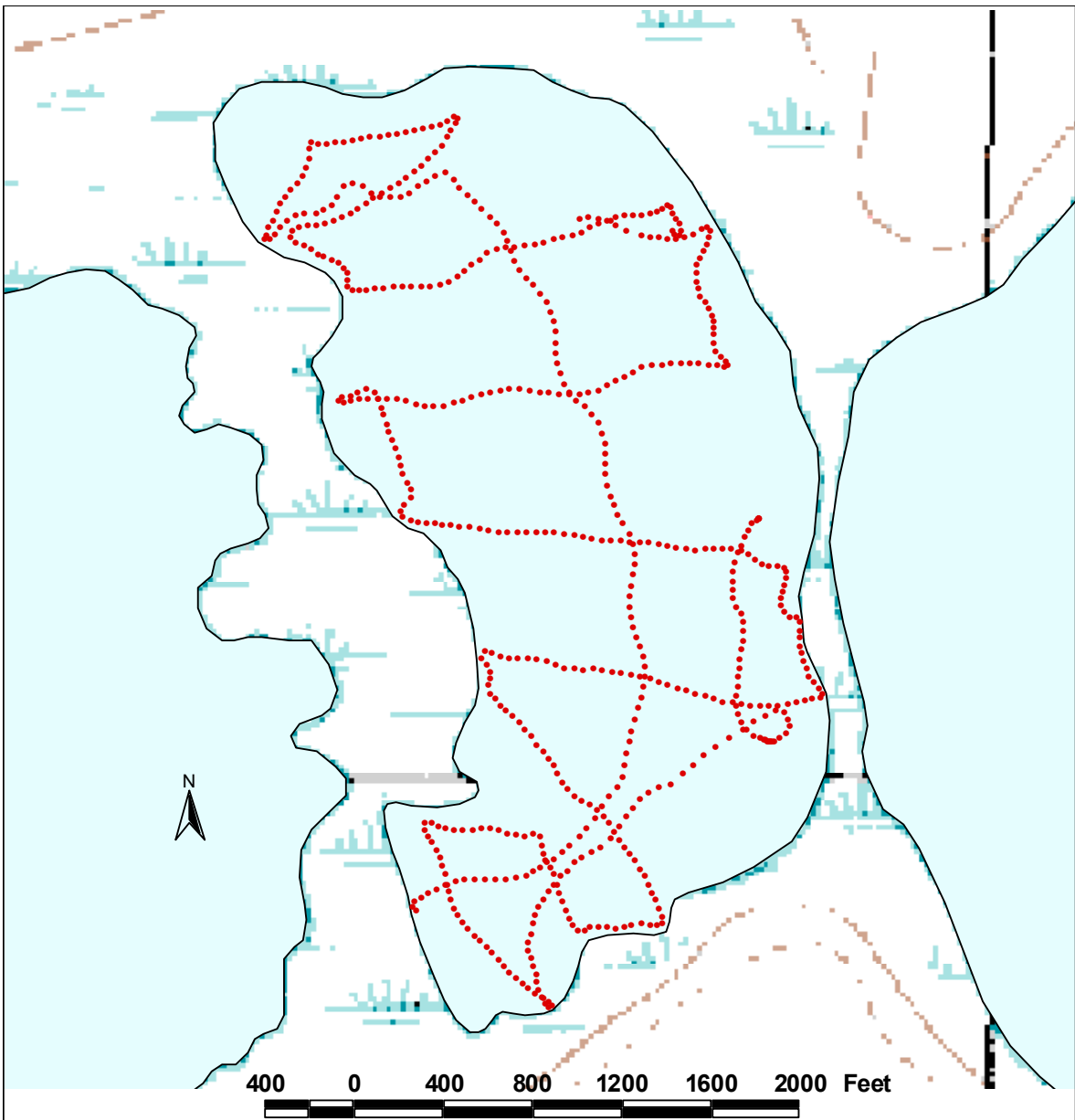
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 26 02	3.5	Least cisco	5	251-312

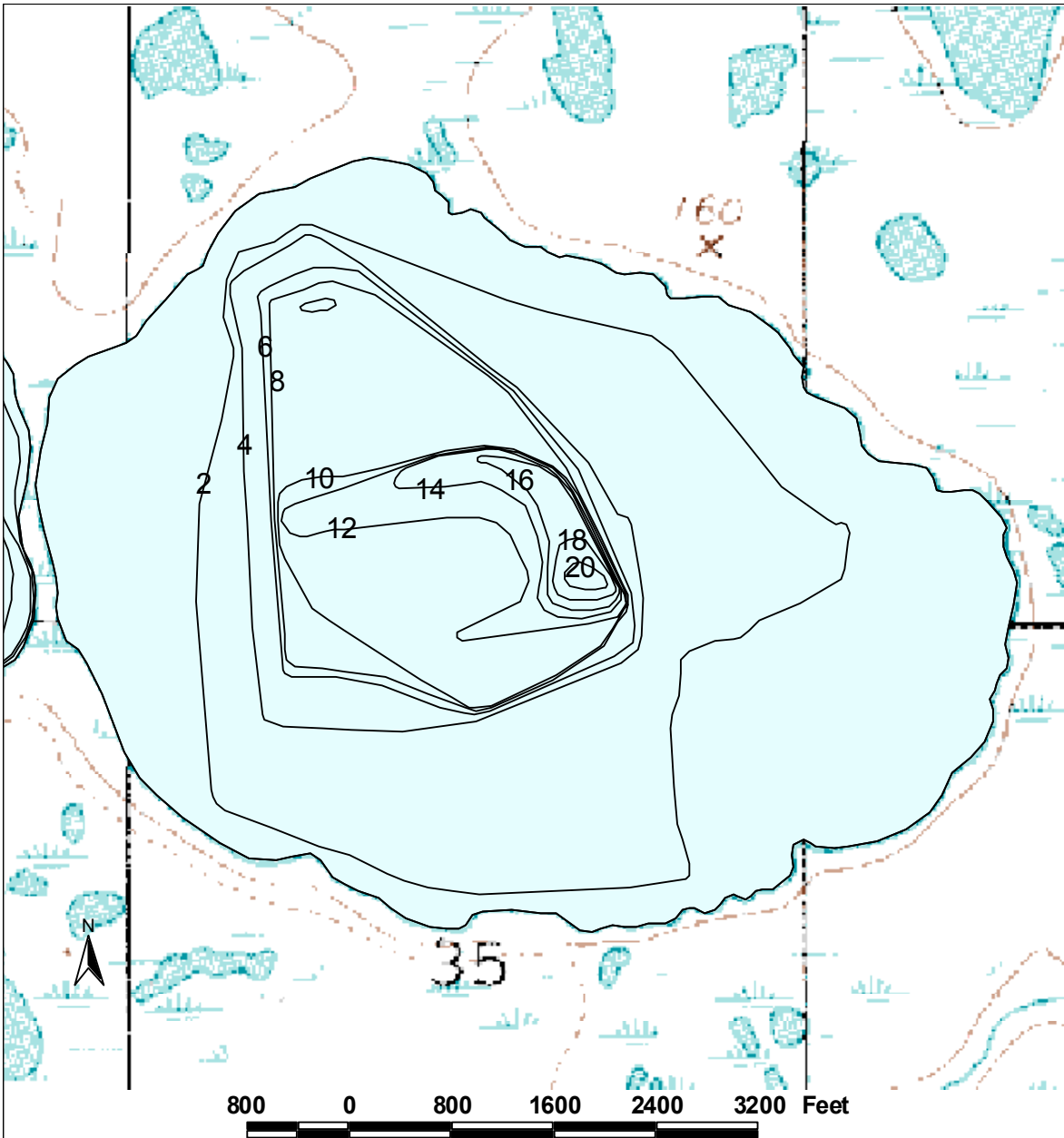




Regions of lake M0231 less than 4 ft deep (shaded), and likely to be available for ice chips, based on transects surveyed on July 26, 2002.



Depth transects surveyed on M0231 on July 26, 2002.



Depth contours of M0232, based on transects surveyed on July 26, 2002 (depth intervals in 2 foot increments).

Lake M0232

Other Names:

Location: 70° 16' 19.3"N 153° 4' 44.1"W
USGS Quad Sheet: T11N R5W, Sec. 25/26/27/34/35/36

Habitat:

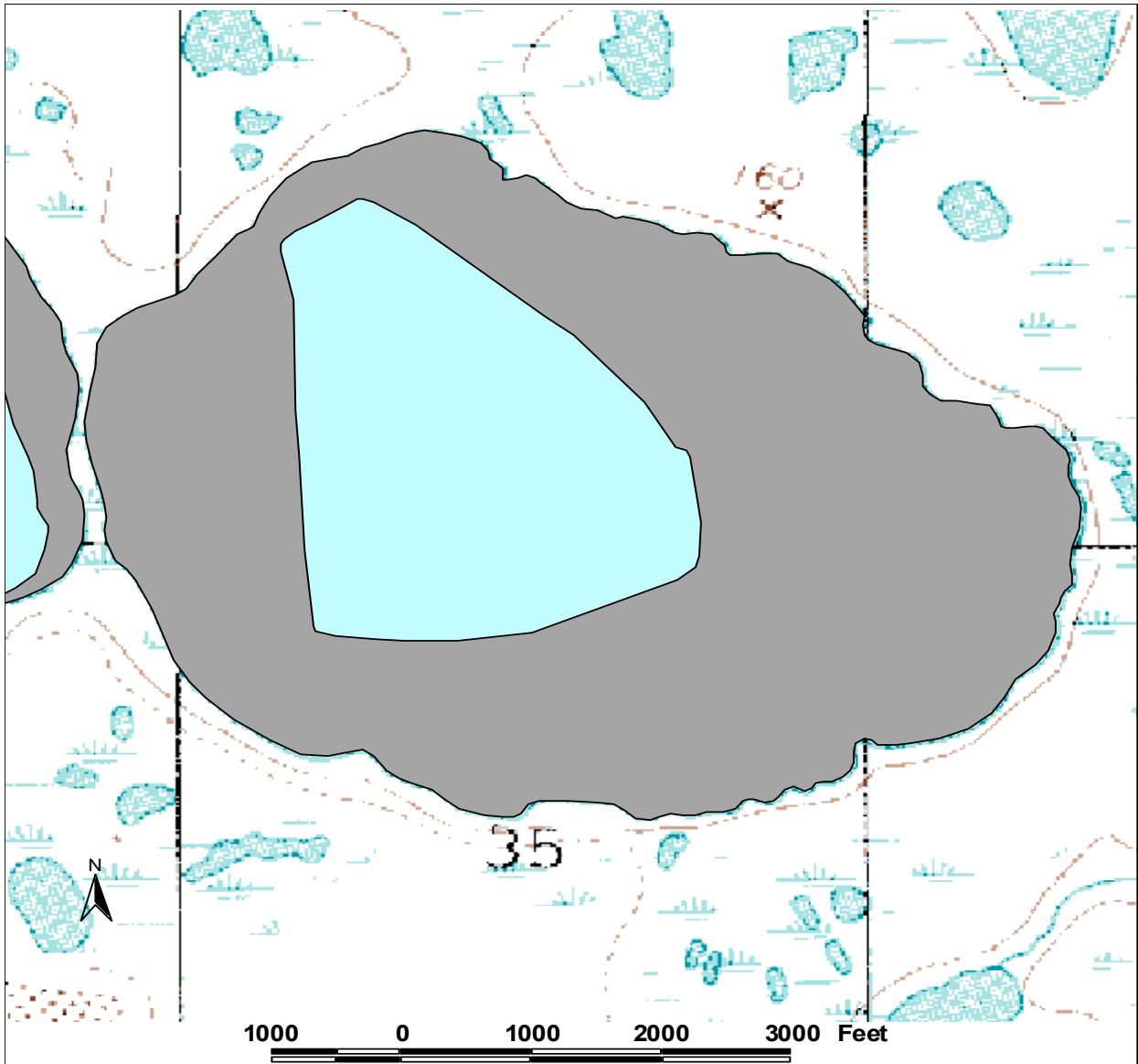
Area: 740.8 acres
Maximum Depth: 22.1 feet
Active Outlet:
Turbidity: 1.3 NTU
Spec. Conductance: 195.5 μ S/cm
pH: 7.5
Calculated Volume: 943.69 million gallons
Permittable Volume: 24.43 million gallons
Potential Aggregate: 540.31 acres (water depth 4 ft or less)

Water Quality:

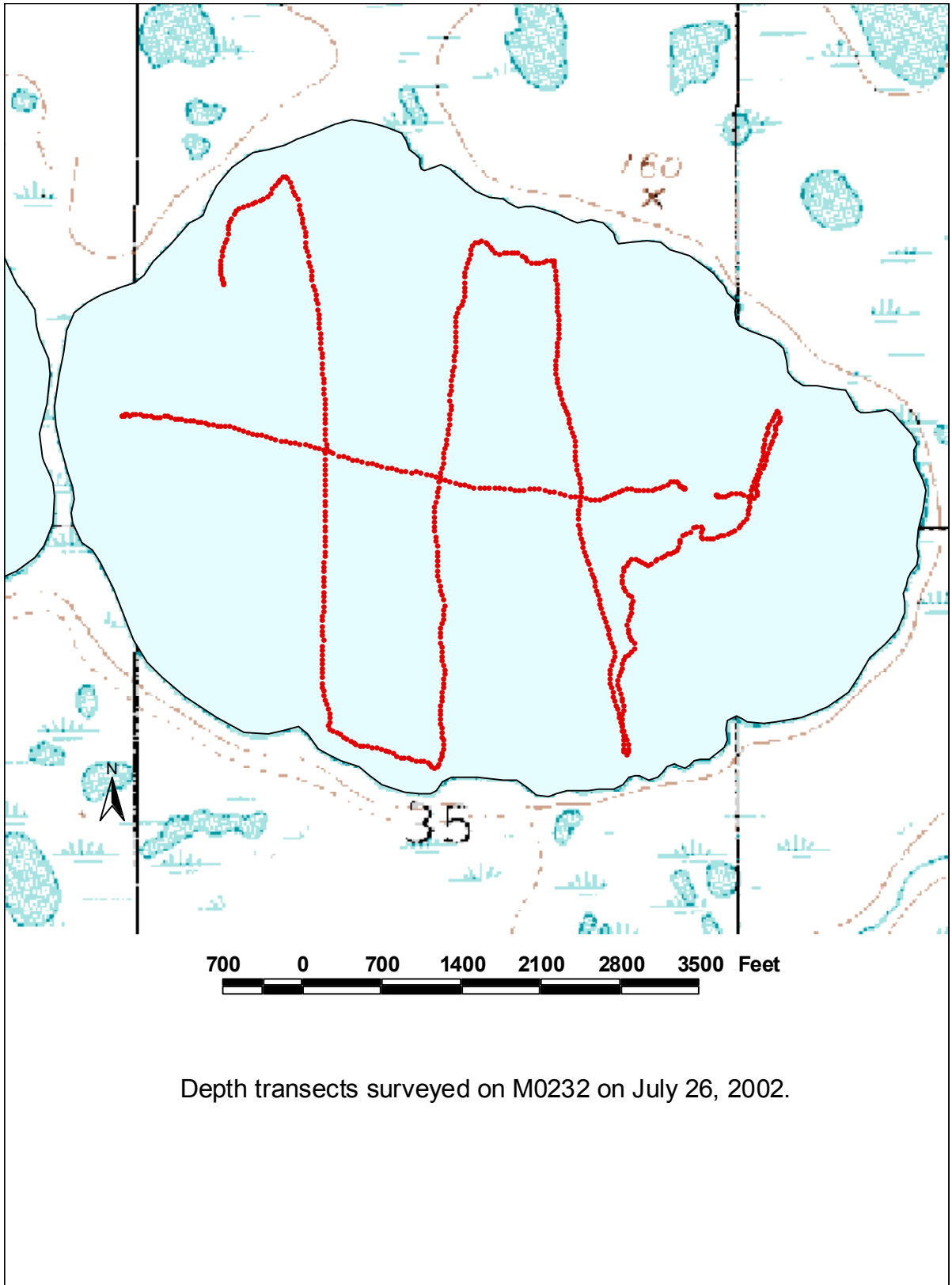
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	19.0	2.1	4.4	9.6	56	80	this study

Catch Record:

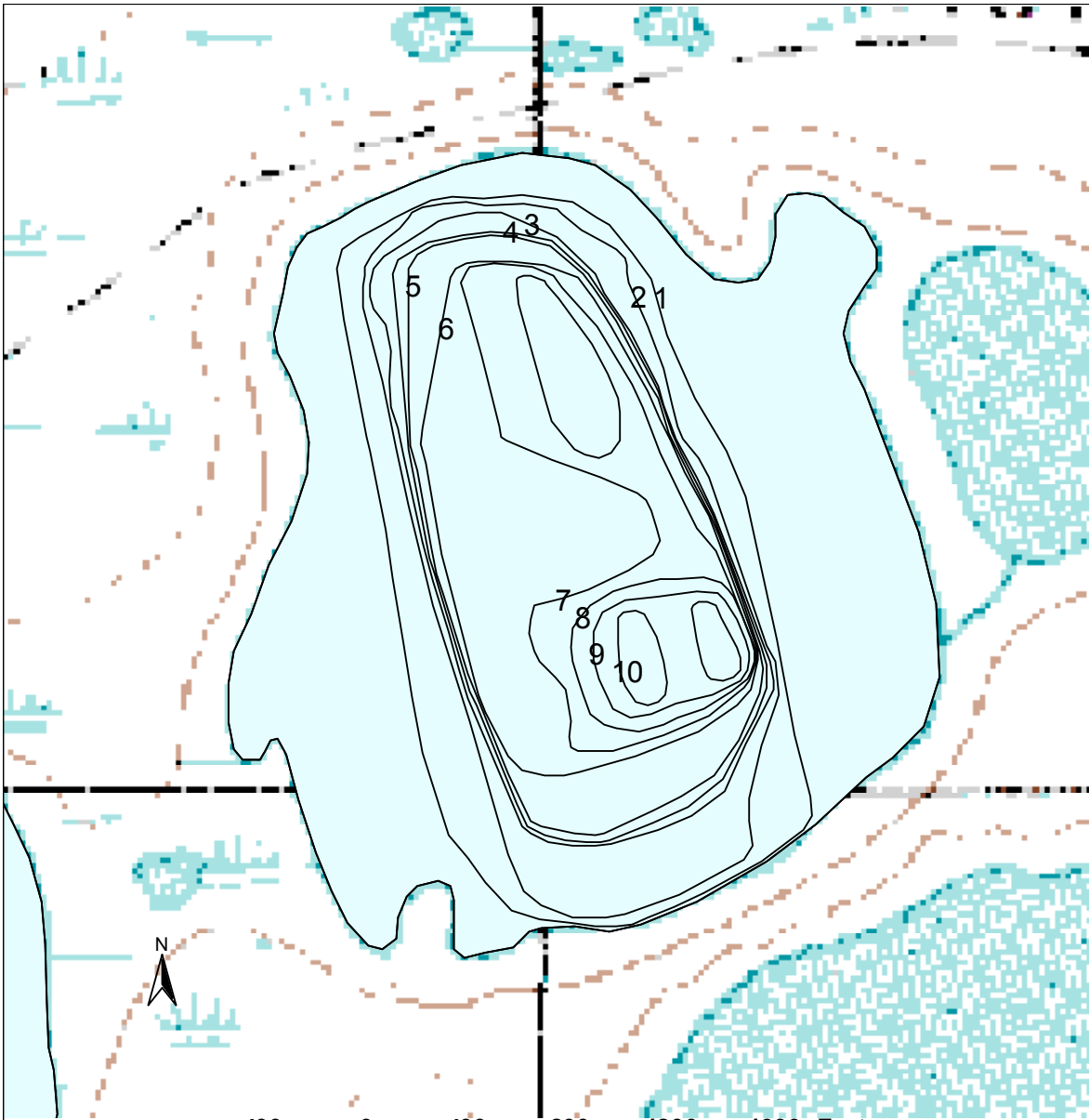
Gear	Date	Effort (hours)	Species	Number Caught
not sampled, connected to M0231				



Regions of lake M0232 less than 4 ft deep (shaded), and likely to be available for ice chips, based on transects surveyed on July 26, 2002.



Depth transects surveyed on M0232 on July 26, 2002.



Depth contours of M0233, based on transects surveyed on July 24, 2002 (depth intervals in 1 foot increments).

Lake M0233

Other Names:

Location: 70° 18' 59.4"N 153° 6' 5.1"W

USGS Quad Sheet: T11N R5W, Sec. 10/11

Habitat:

Area: 149.2 acres

Maximum Depth: 10.6 feet

Active Outlet:

Turbidity: 0.6 NTU

Spec. Conductance: 143.6 μ S/cm

pH: 7.4

Calculated Volume: 151.88 million gallons

Permittable Volume: 10.28 million gallons

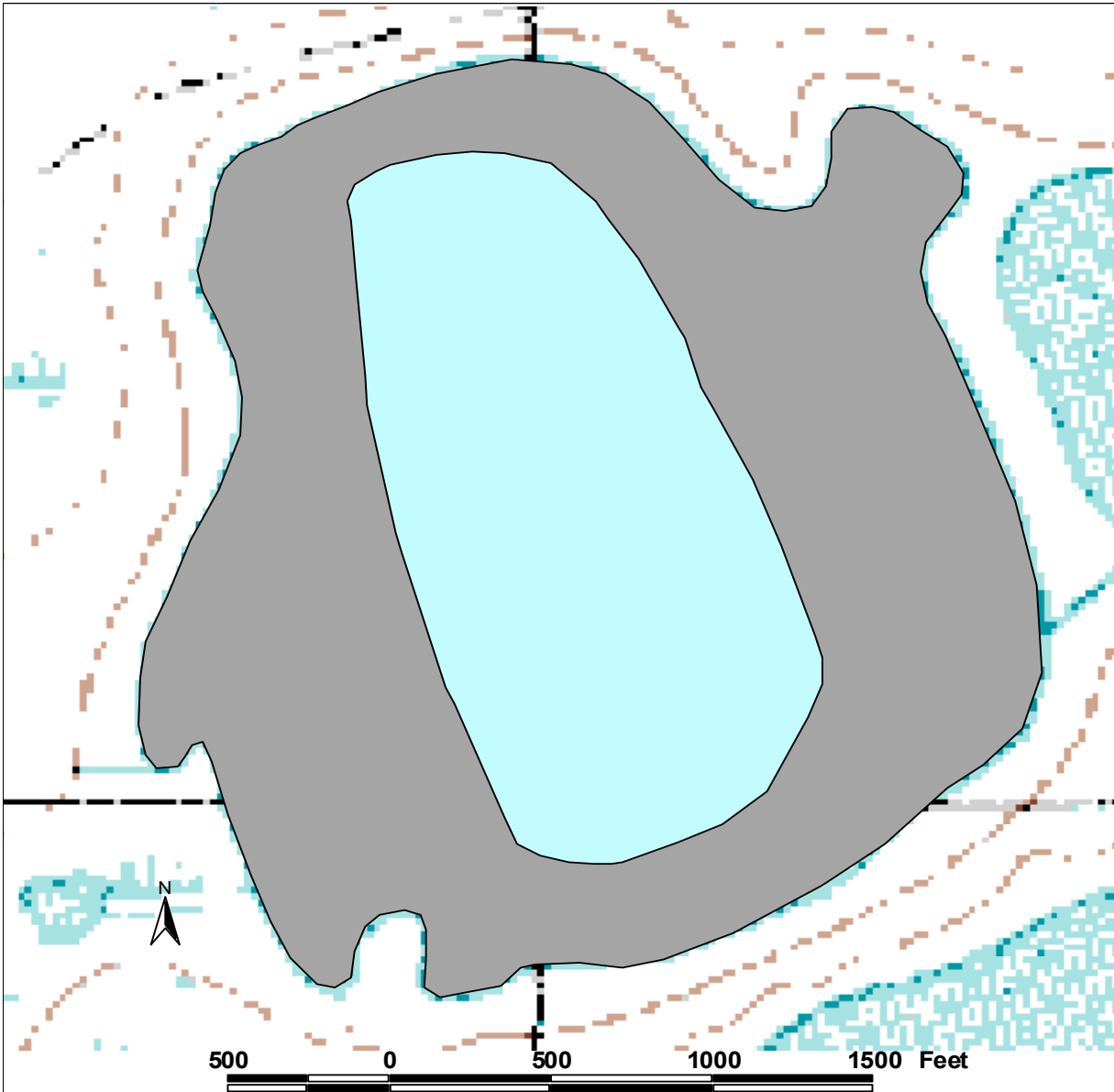
Potential Aggregate: 96.11 acres (water depth 4 ft or less)

Water Quality:

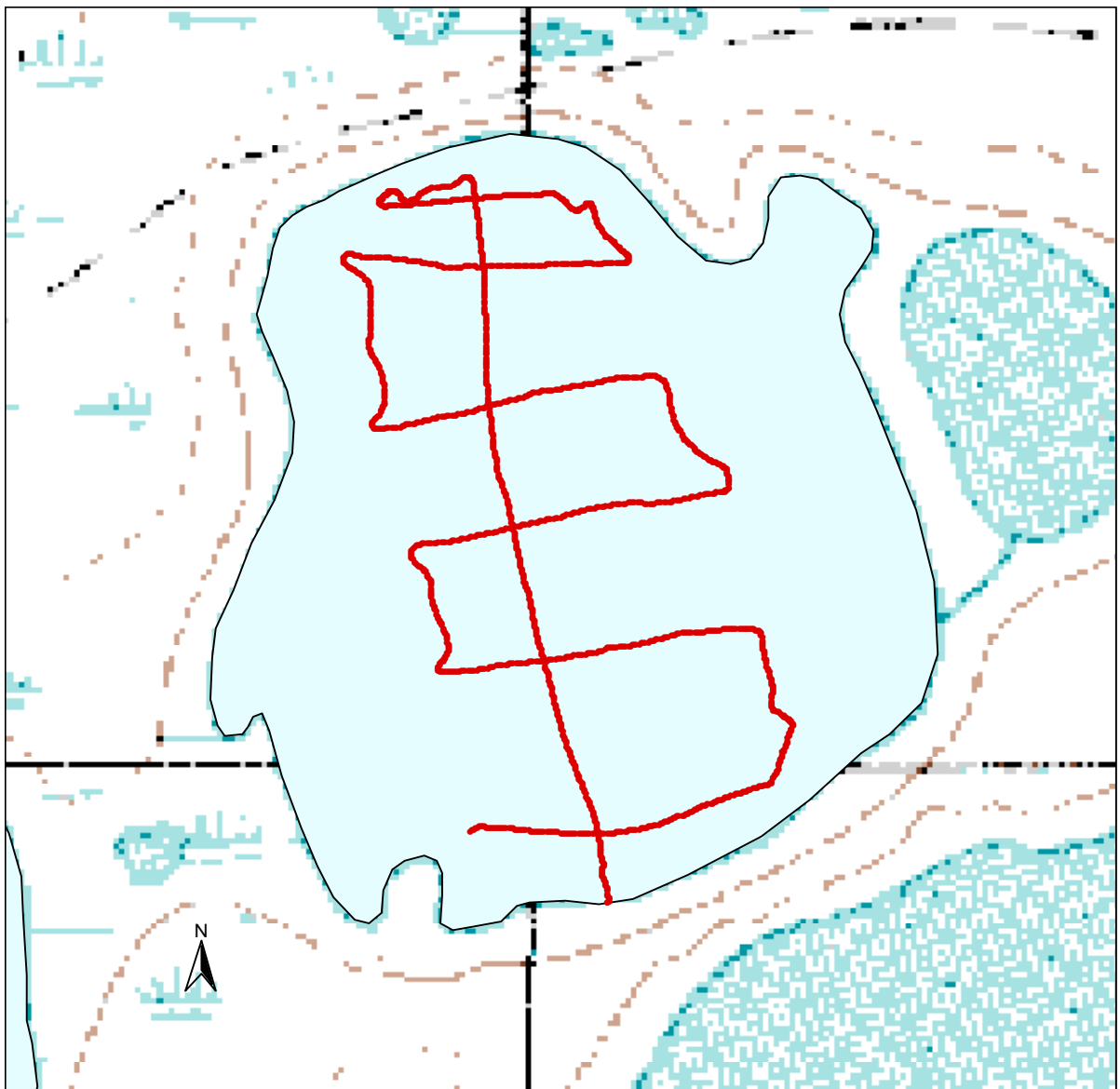
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	21.1	2.2	3.8	7.7	62	100	this study

Catch Record:

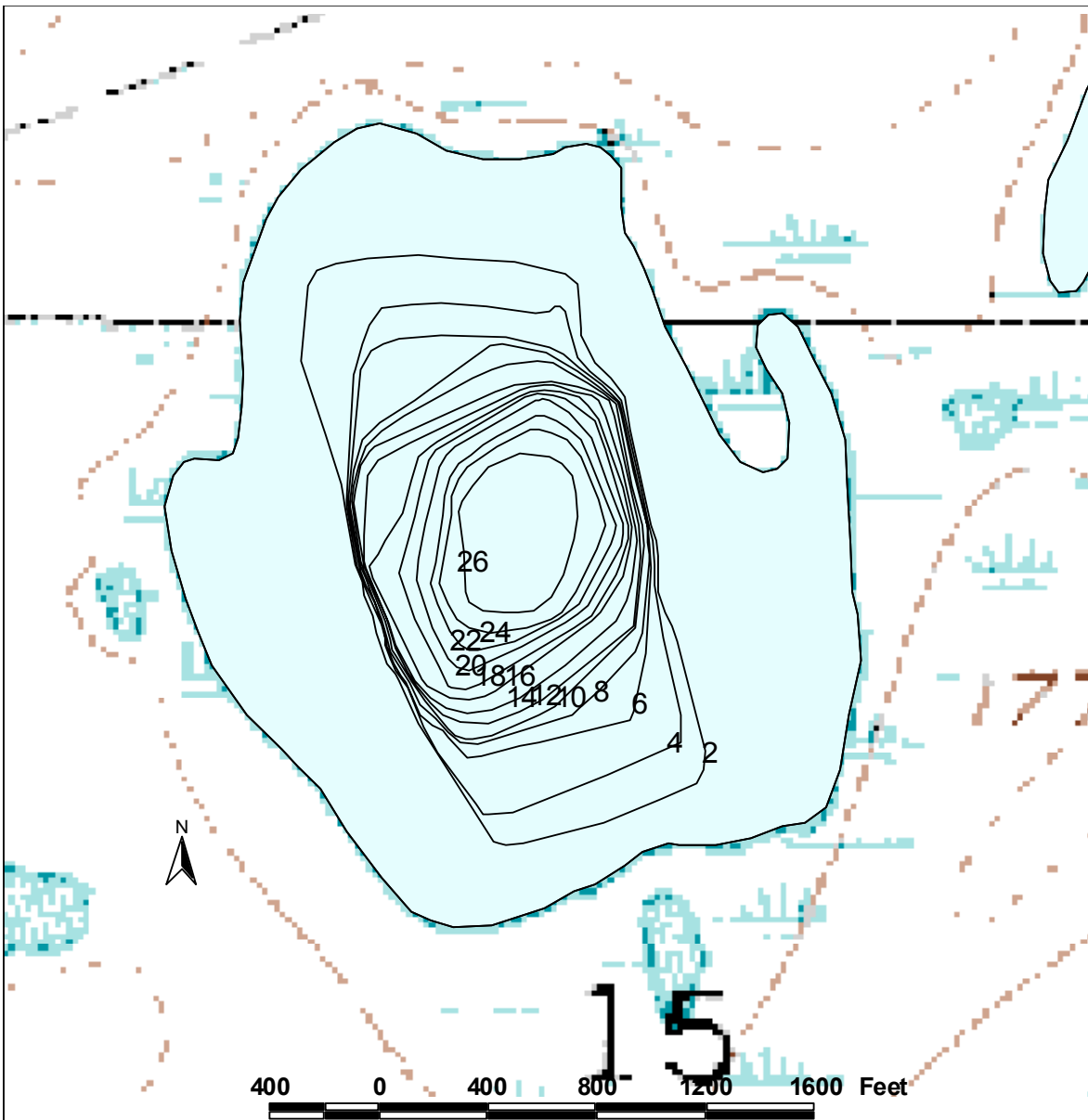
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 24 02	8.1	None	0



Regions of lake M0233 less than 4 ft deep (shaded), and likely to be available for ice chips, based on transects surveyed on July 24, 2002.



Depth transects surveyed on M0233 on July 24, 2002.



Depth contours of M0234, based on transects surveyed on July 25, 2002 (depth intervals in 2 foot increments).

Lake M0234

Other Names:

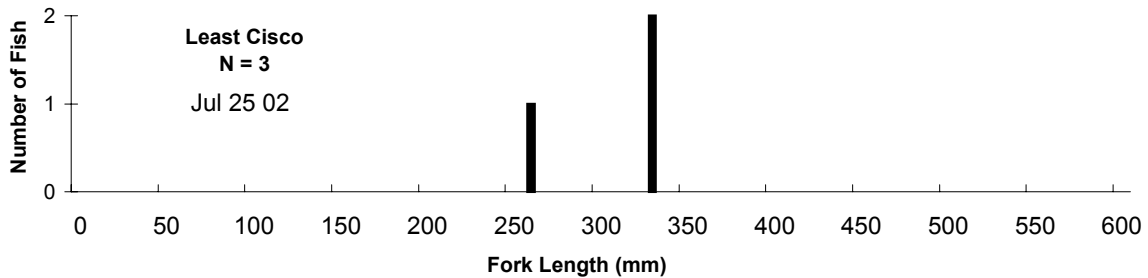
Location: 70° 18' 44.6"N 153° 7' 42.3"W
USGS Quad Sheet: T11N R5W, Sec. 10/15
Habitat:
Area: 122.2 acres
Maximum Depth: 27.8 feet
Active Outlet:
Turbidity: 0.9 NTU
Spec. Conductance: 165.3 µS/cm
pH: 7.7
Calculated Volume: 225.94 million gallons
Permittable Volume: 14.88 million gallons
Potential Aggregate: 82.01 acres (water depth 4 ft or less)

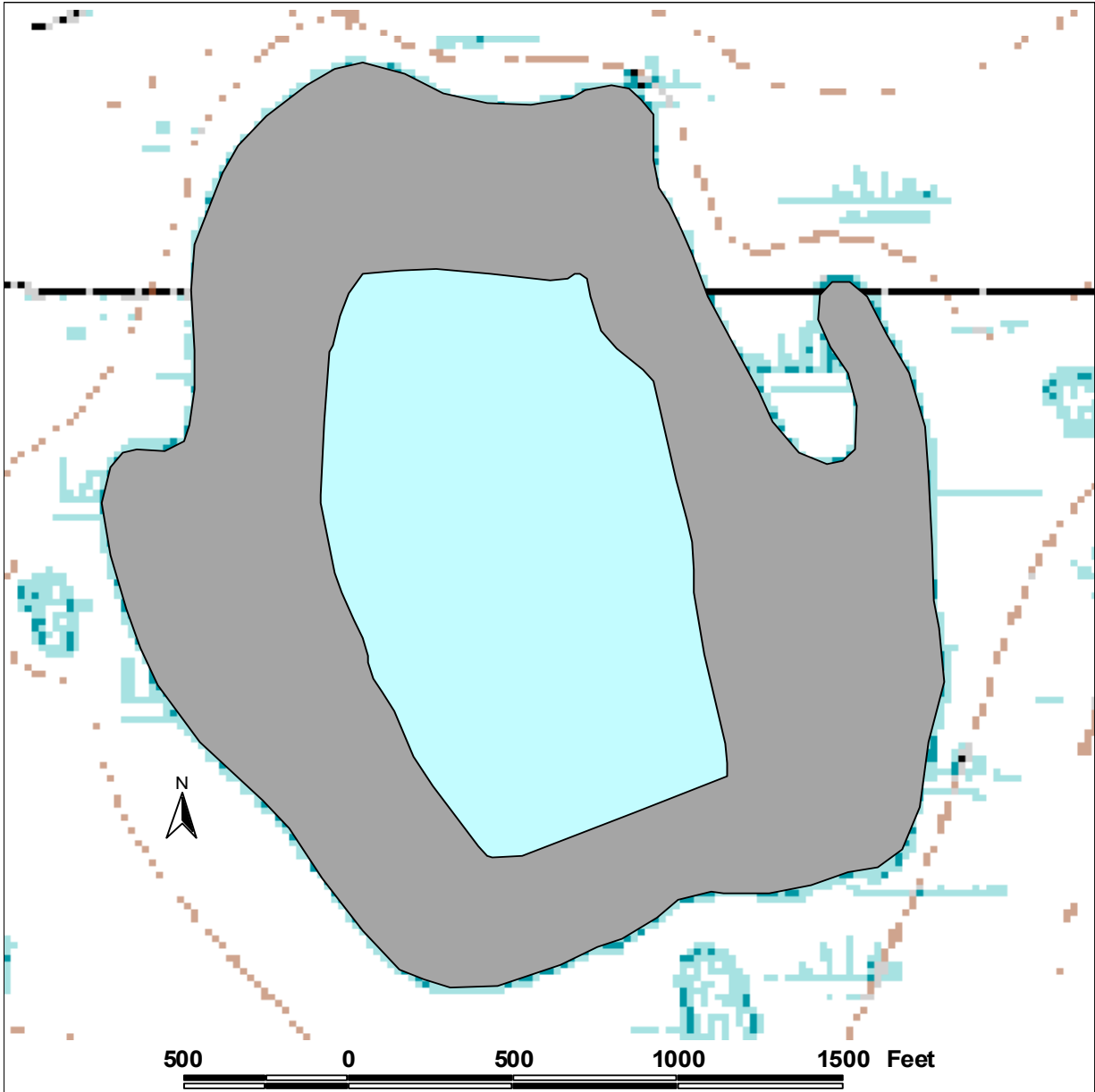
Water Quality:

Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	24.2	2.4	4.2	8.6	70	110	this study

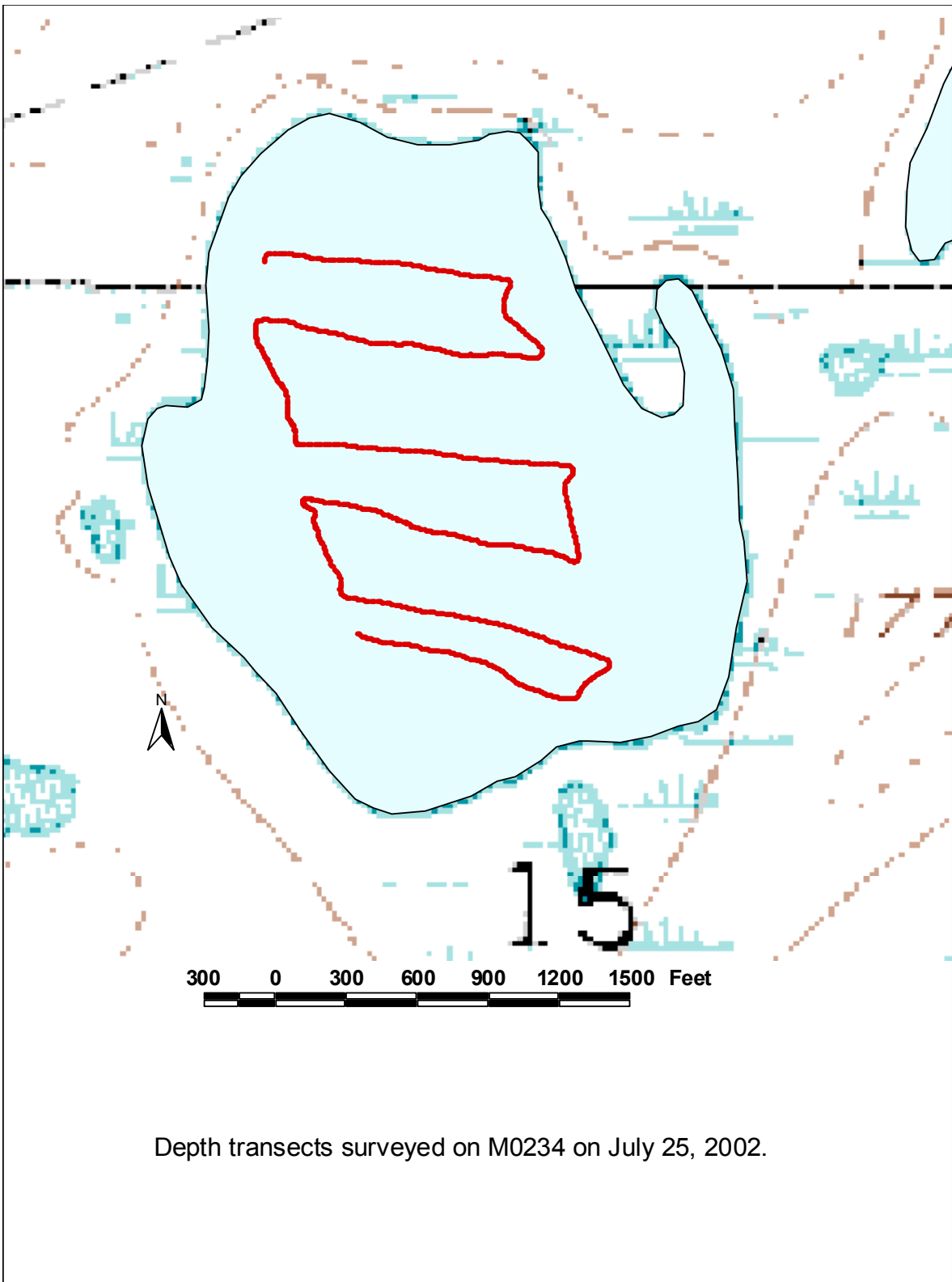
Catch Record:

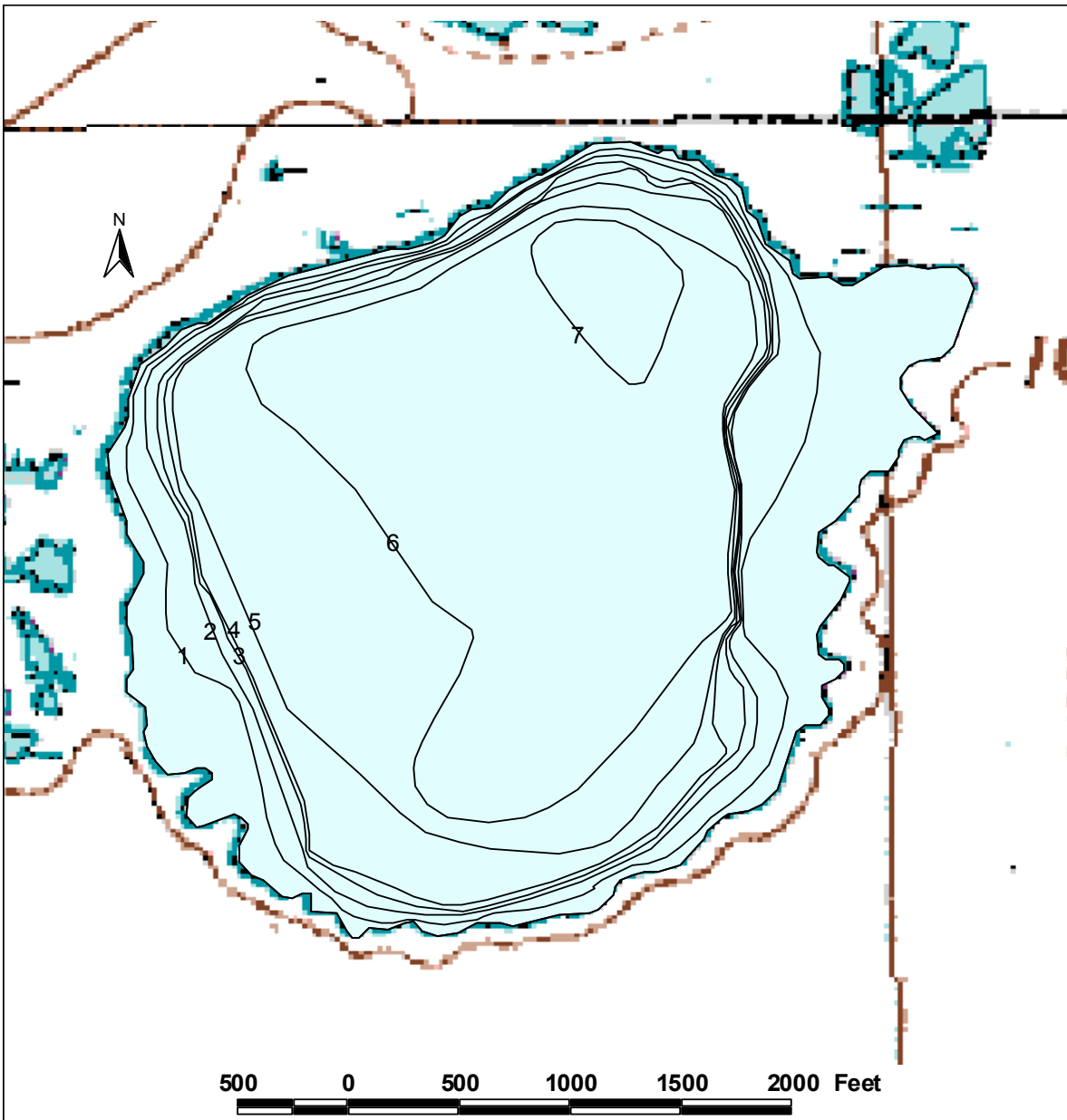
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 25 02	2.4	Least cisco	3	260-337





Regions of lake M0234 less than 4 ft deep (shaded), and likely to be available for ice chips, based on transects surveyed on July 25, 2002.





Depth contours of M0235, based on transects surveyed on August 13, 2002 (depth intervals in 1 foot increments).

Lake M0235

Other Names:

Location: 70° 14' 11.5"N 152° 11' 5.3"W

USGS Quad Sheet: T10N R1W, Sec. 8

Habitat:

Area: 223.7 acres

Maximum Depth: 7.7 feet

Active Outlet:

Turbidity: 1.2 NTU

Spec. Conductance: 179.0 μ S/cm

pH: 7.7

Calculated Volume: 327.04 million gallons

Permittable Volume: 98.34 million gallons

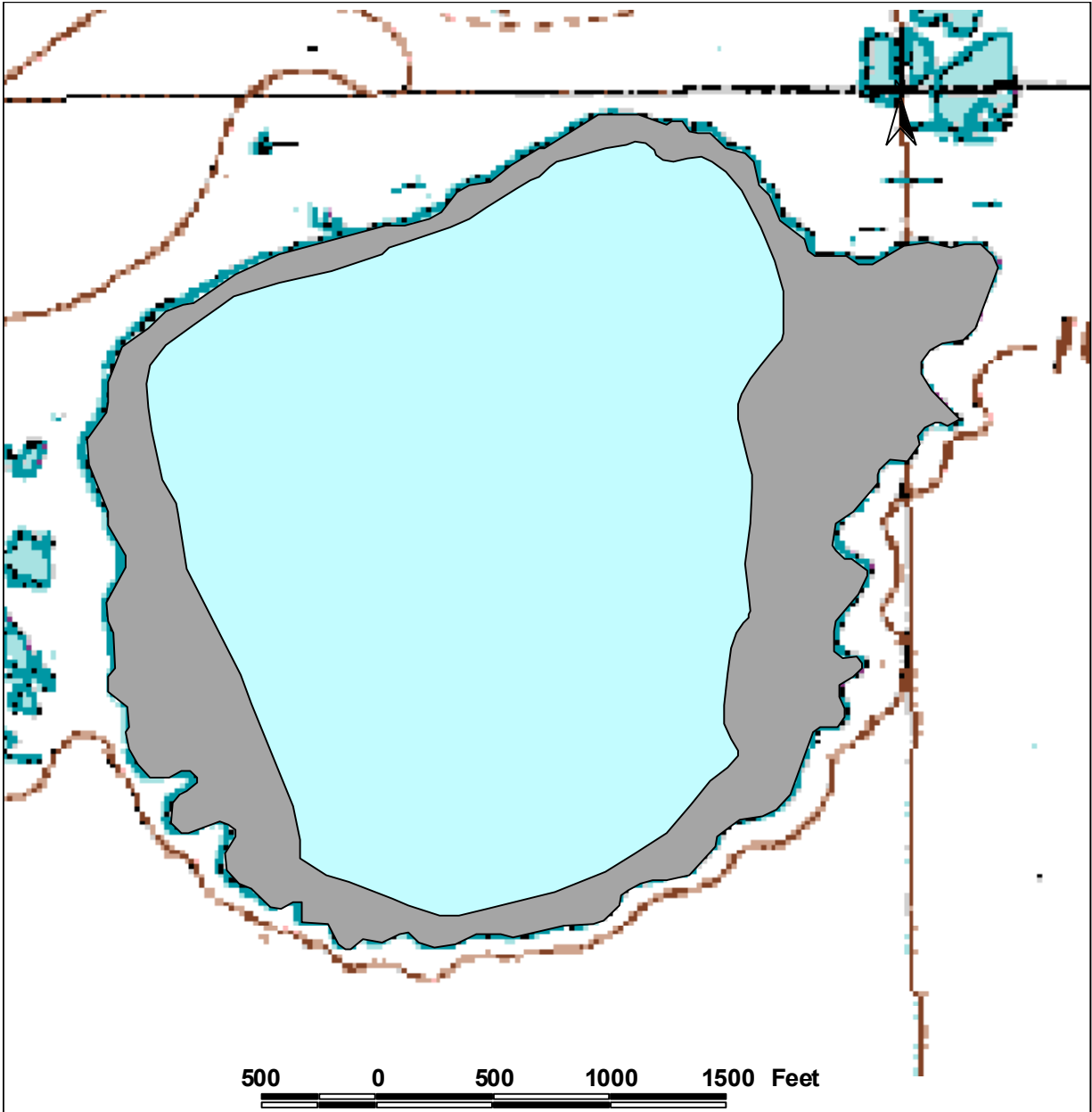
Potential Aggregate: 69.92 acres (water depth 4 ft or less)

Water Quality:

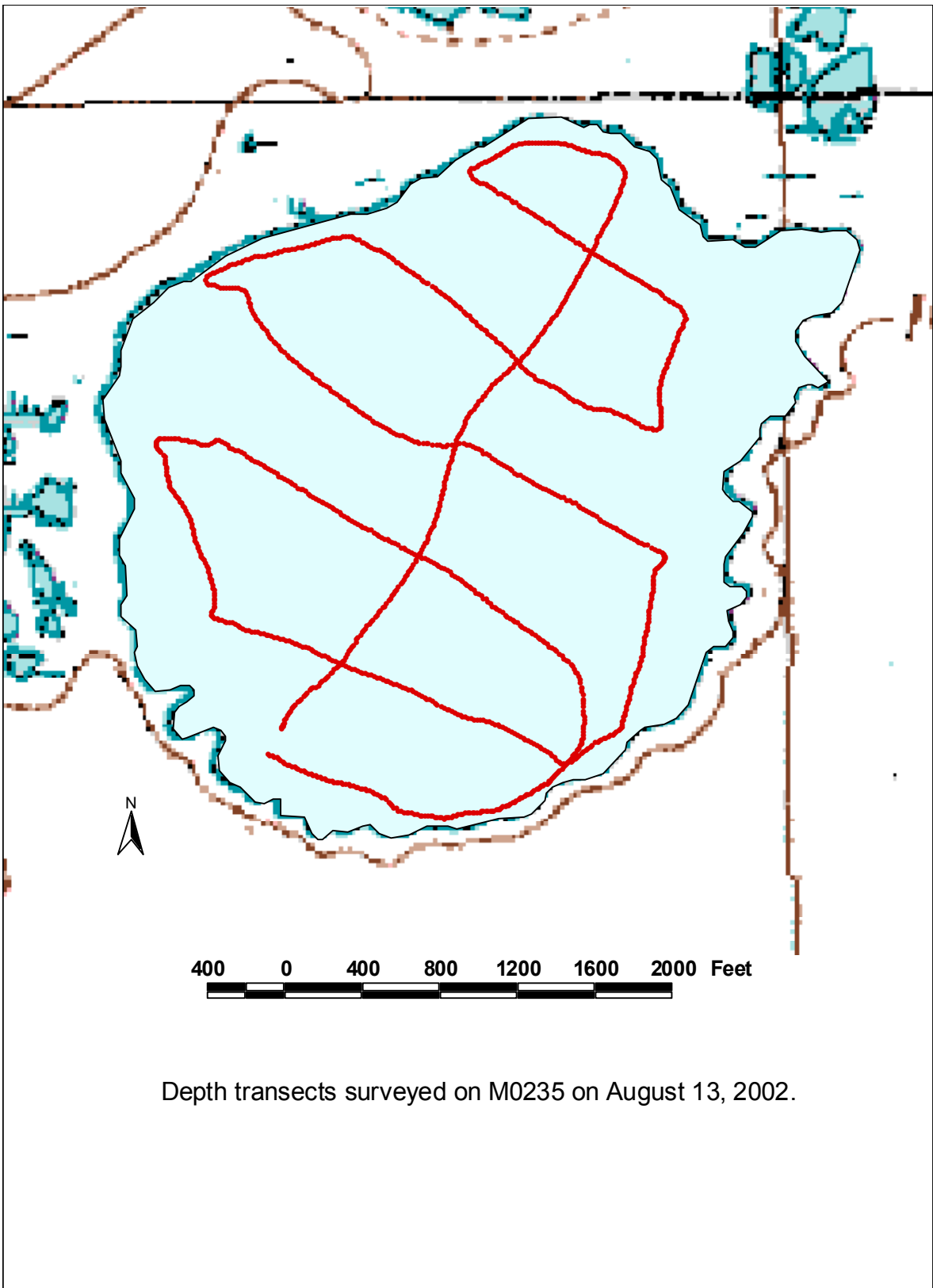
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	28.3	4.6	10.3	30.3	90		this study

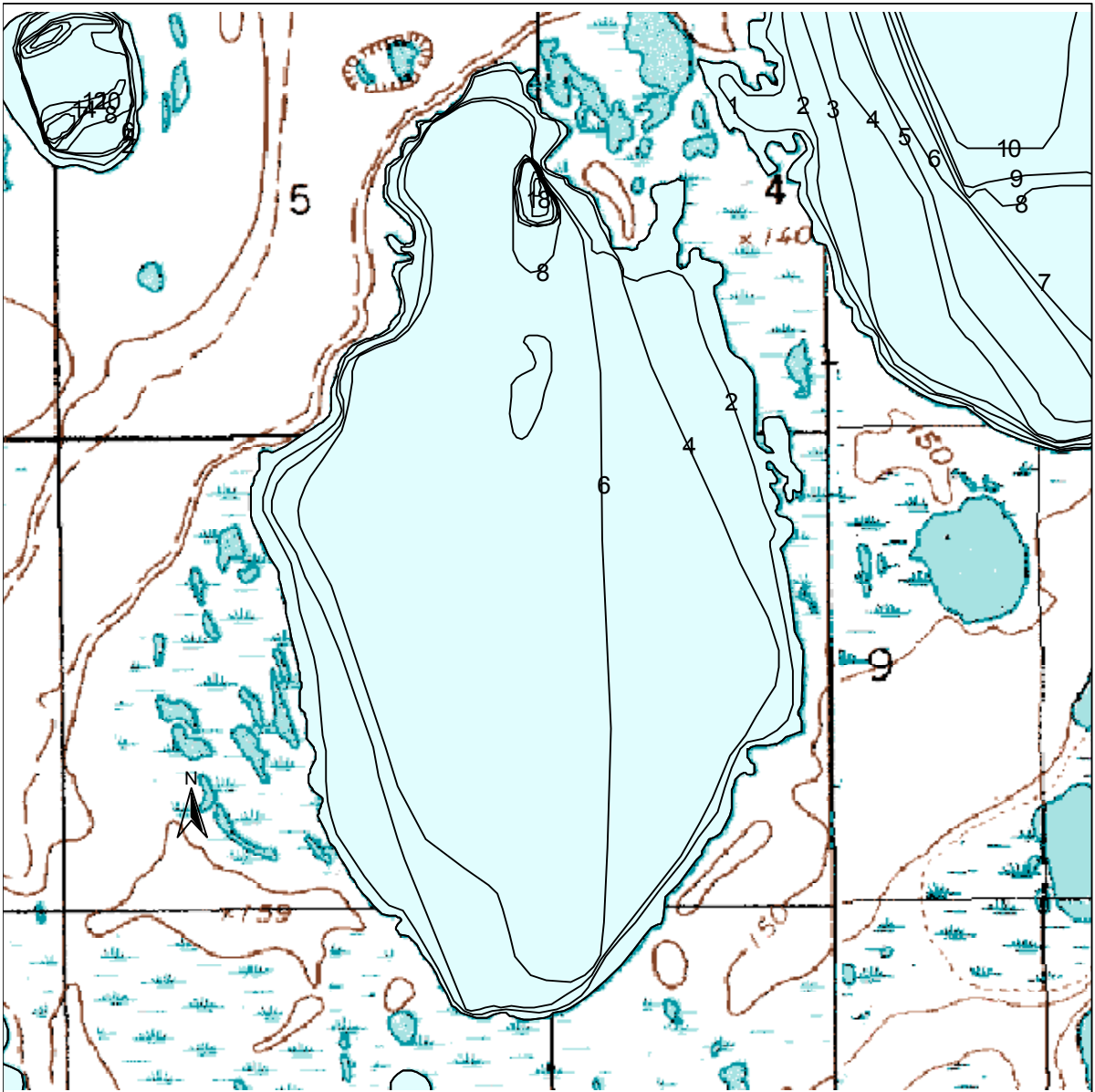
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 13 02	10.3	None	0
Minnow Trap	Aug 13 02	10.7	None	0
Seine	Aug 13 02	3 hauls	None	0



Regions of lake M0235 less than 4 ft deep (shaded) and likely to be available for ice chips, based on transects surveyed on August 13, 2002.





Depth contours of M0236, based on transects surveyed on August 21, 2002 (depth intervals in 2 foot increments).

Lake M0236

Other Names:

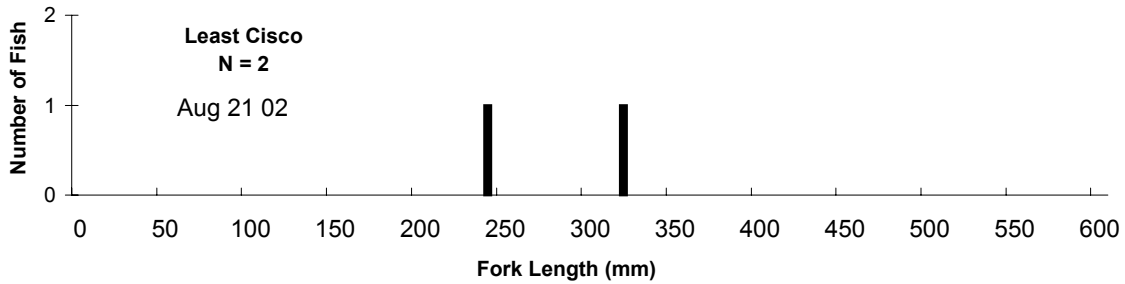
Location: 70° 9' 5.8"N 152° 25' 34.3"W
USGS Quad Sheet: T9N R2W, Sec. 4/5/8/9
Habitat:
Area: 950.4 acres
Maximum Depth: 18.8 feet
Active Outlet:
Turbidity: 2.2 NTU
Spec. Conductance: 135.4
pH: 8.0
Calculated Volume: 1,657.28 million gallons
Permittable Volume: 11.62 million gallons
Potential Aggregate: 211.19 acres (water depth 4 ft or less)

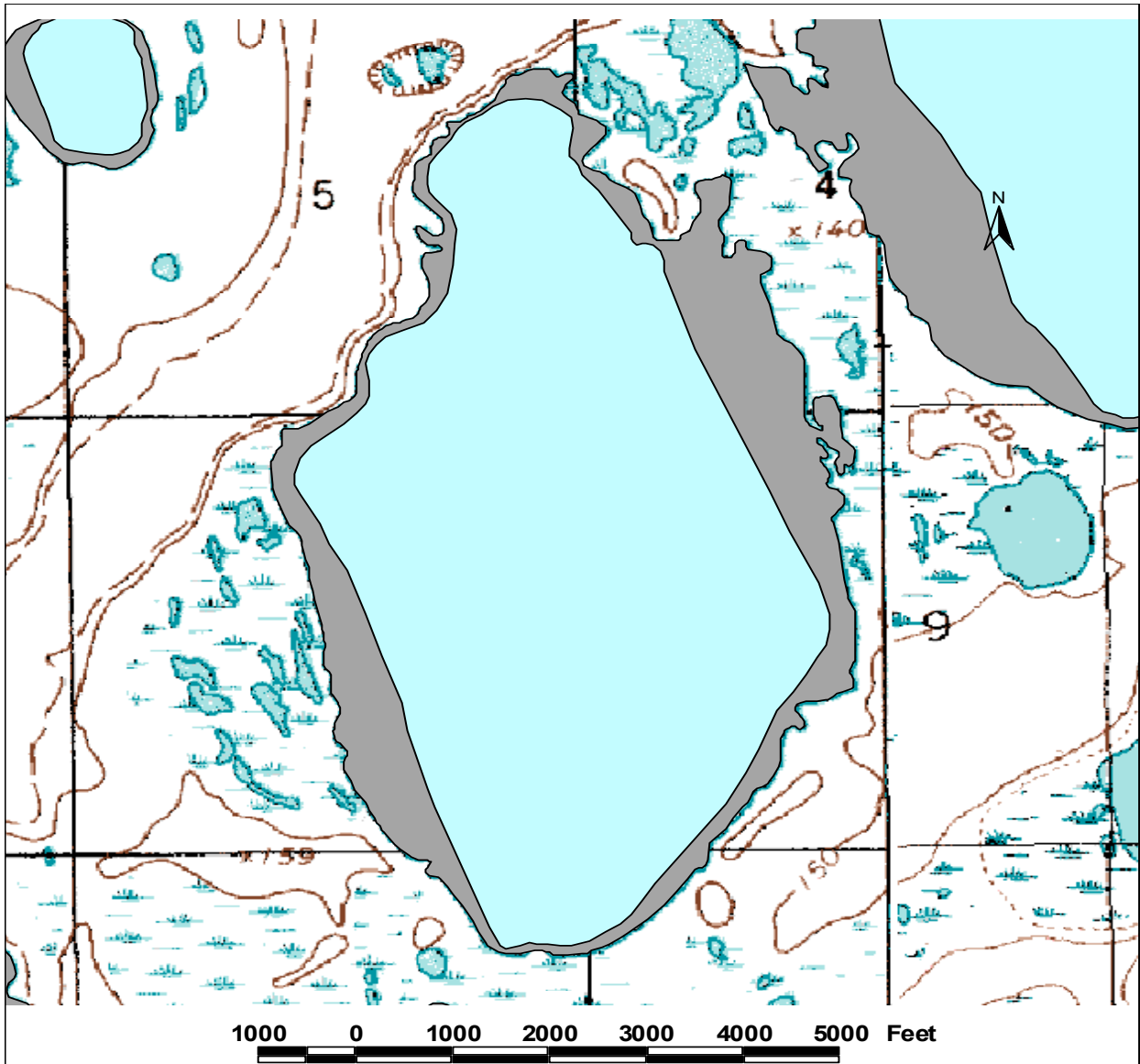
Water Quality:

Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	20.1	3.0	6.8	19.0	63		this study

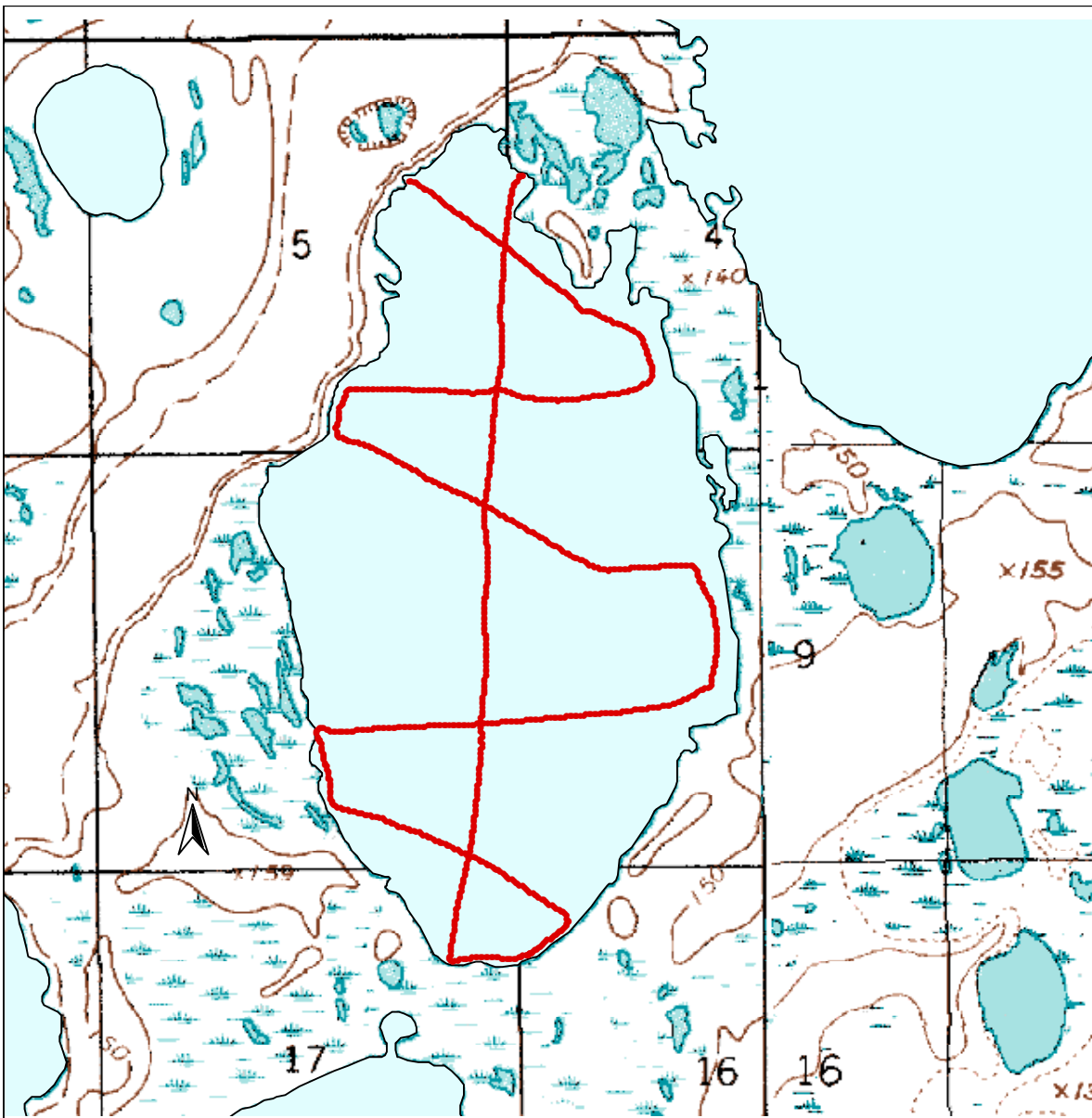
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 21 02	5.3	Least cisco	2	240-320
Minnow Trap	Aug 21 02	6.3	None	0	
Seine	Aug 21 02	3 hauls	None	0	

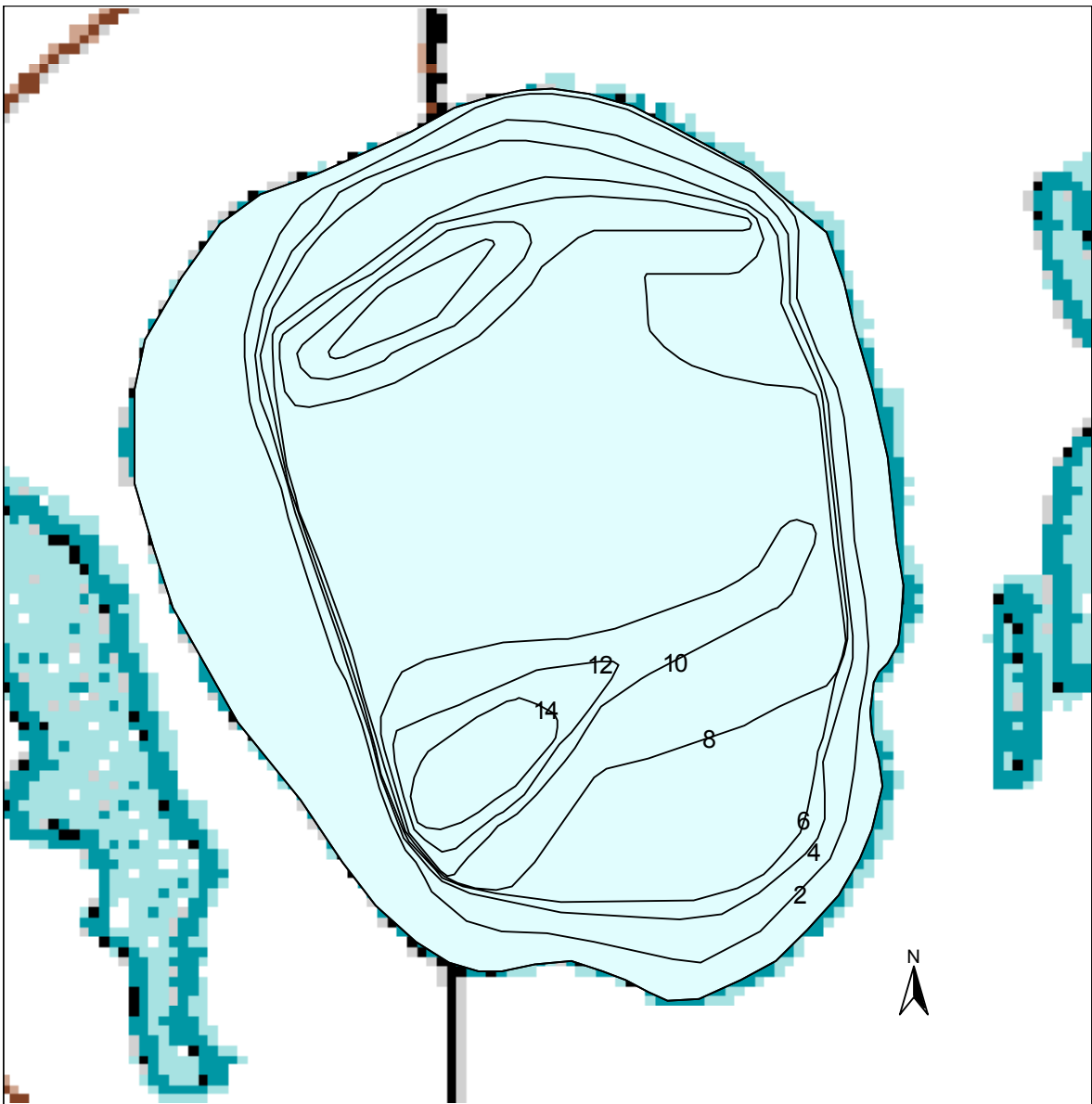




Regions of lake M0236 less than 4 ft deep (shaded) and likely to be available for ice chips, based on transects surveyed on August 21, 2002.



Depth transects surveyed on M0236 on August 21, 2002.



Depth contours of M0237, based on transects surveyed on August 18, 2002 (depth intervals in 2 foot increments).

Lake M0237

Other Names:

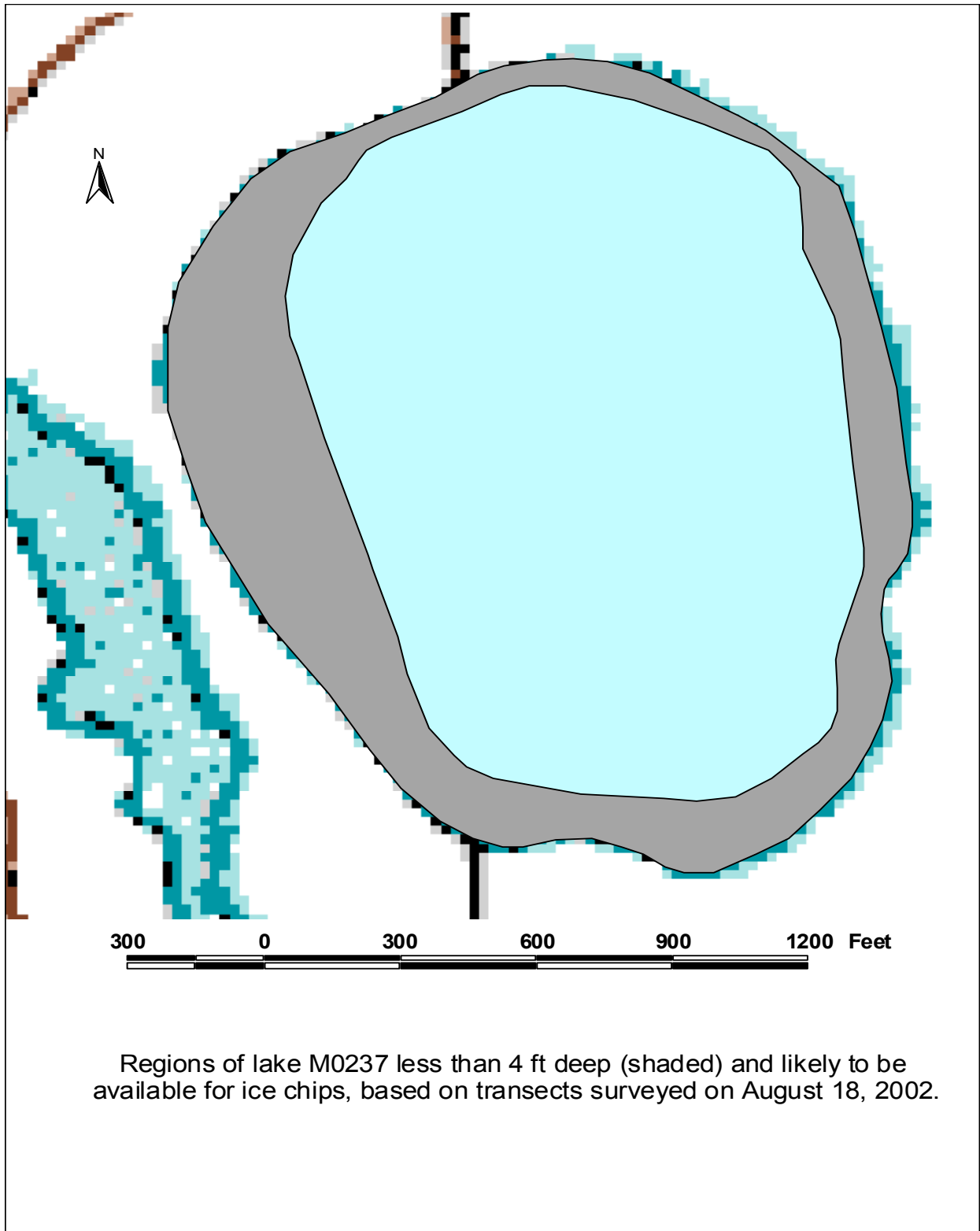
Location: 70° 10' 0.4"N 152° 27' 59.2"W
USGS Quad Sheet: T9N R2W, Sec. 5/6
Habitat:
Area: 56.0 acres
Maximum Depth: 16.2 feet
Active Outlet:
Turbidity: 1.5
Spec. Conductance: 183.2
pH: 7.9
Calculated Volume: 123.07 million gallons
Permittable Volume: 63.94 million gallons
Potential Aggregate: 16.94 acres (water depth 4 ft or less)

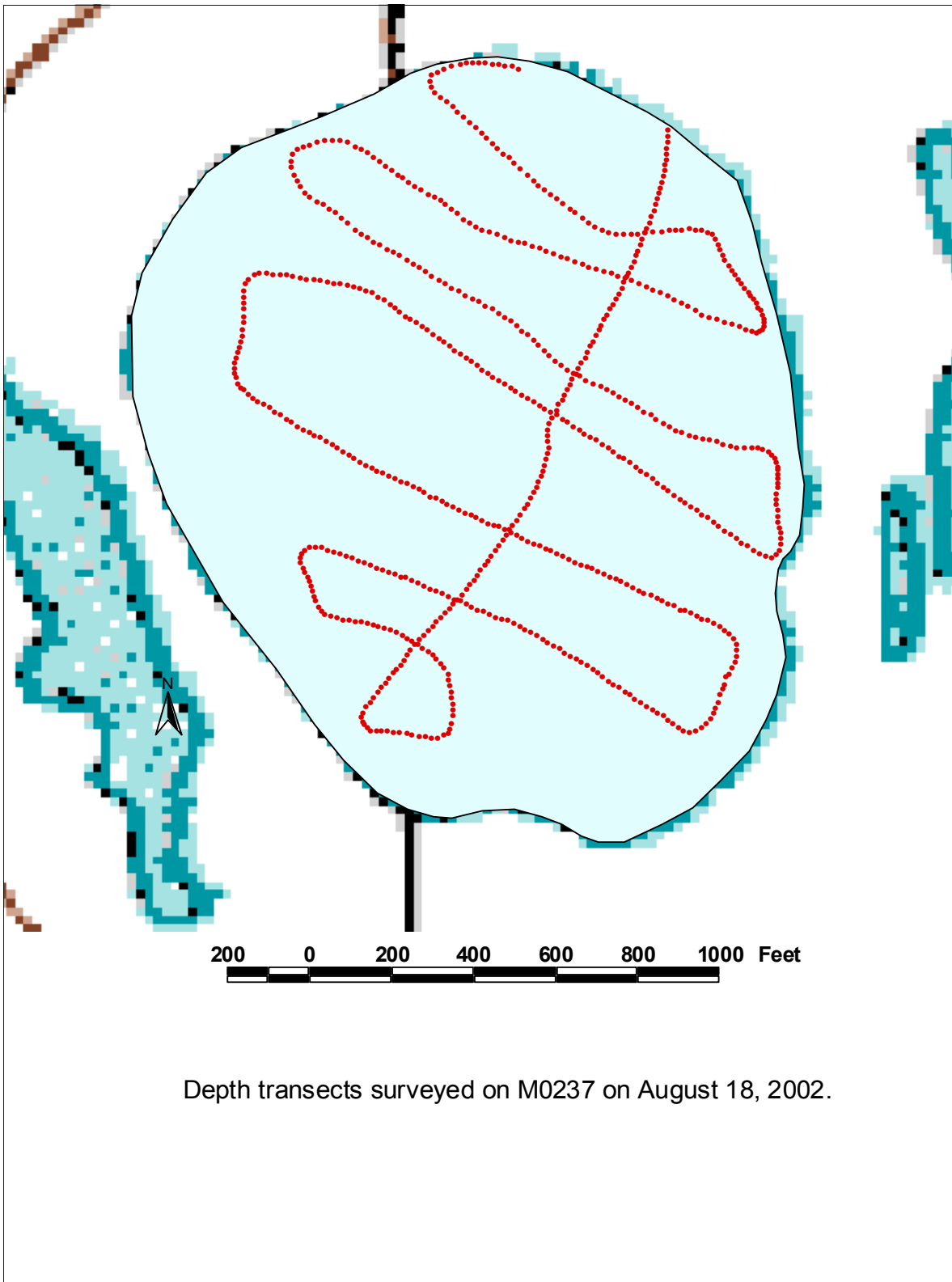
Water Quality:

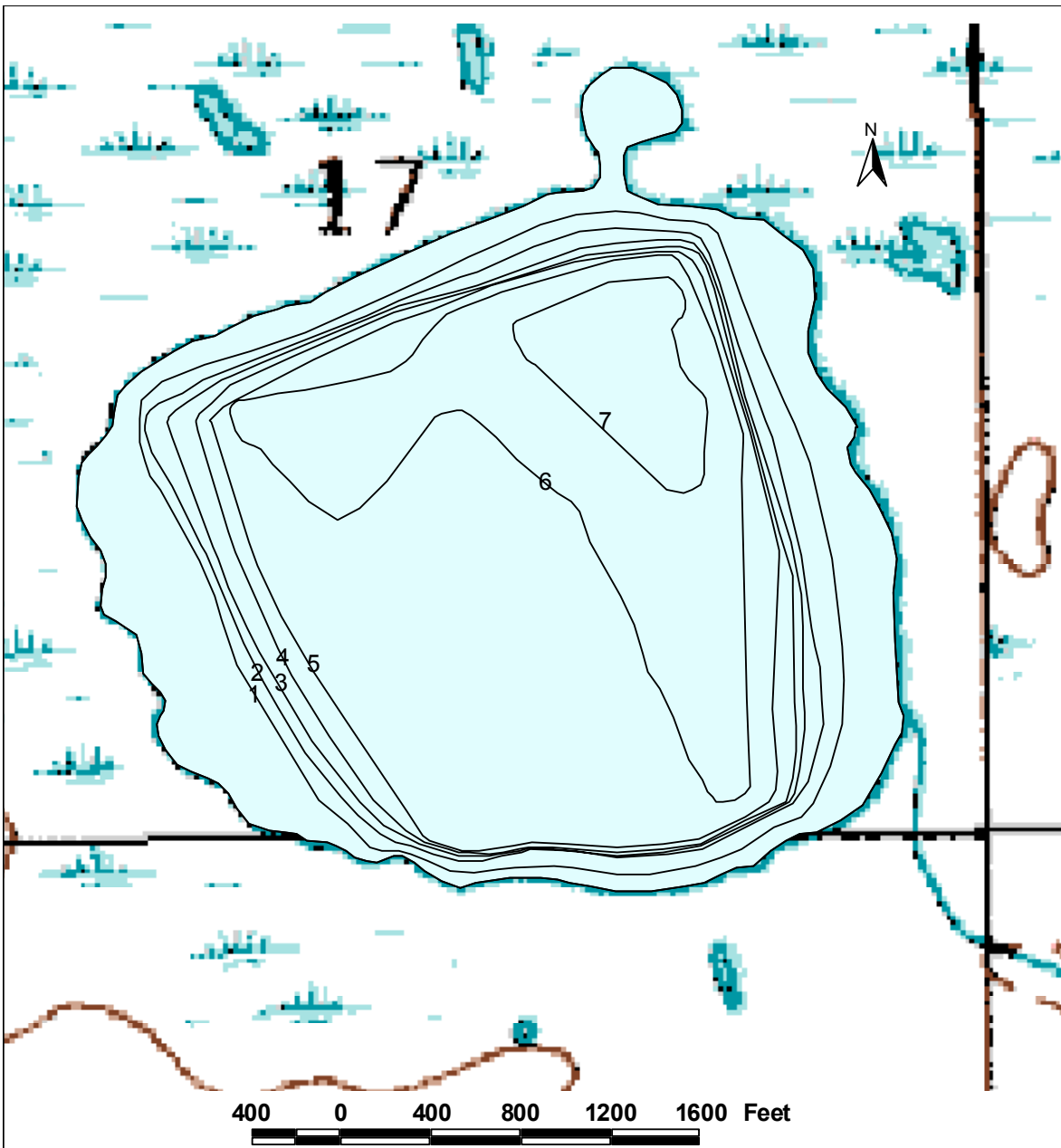
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	26.2	4.6	6.2	12.3	84		this study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 18 02	4.3	None	2
Minnow Trap	Aug 18 02	12.5	None	0
Seine	Aug 18 02	3 hauls	None	0







Depth contours of M0238 based on transects surveyed on August 19, 2002 (depth intervals in 1 foot increments).

Lake M0238

Other Names:

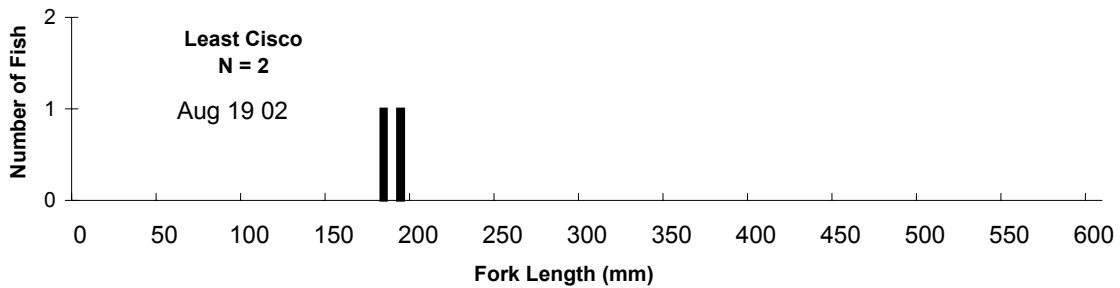
Location: 70° 8' 55.6"N 152° 30' 10.3"W
USGS Quad Sheet: T9N R2W, Sec. 17
Habitat:
Area: 206.5 acres
Maximum Depth: 7.5 feet
Active Outlet:
Turbidity: 2.8
Spec. Conductance: 200.3
pH: 7.9
Calculated Volume: 272.41 million gallons
Permittable Volume: 0.18 million gallons
Potential Aggregate: 80.19 acres (water depth 4 ft or less)

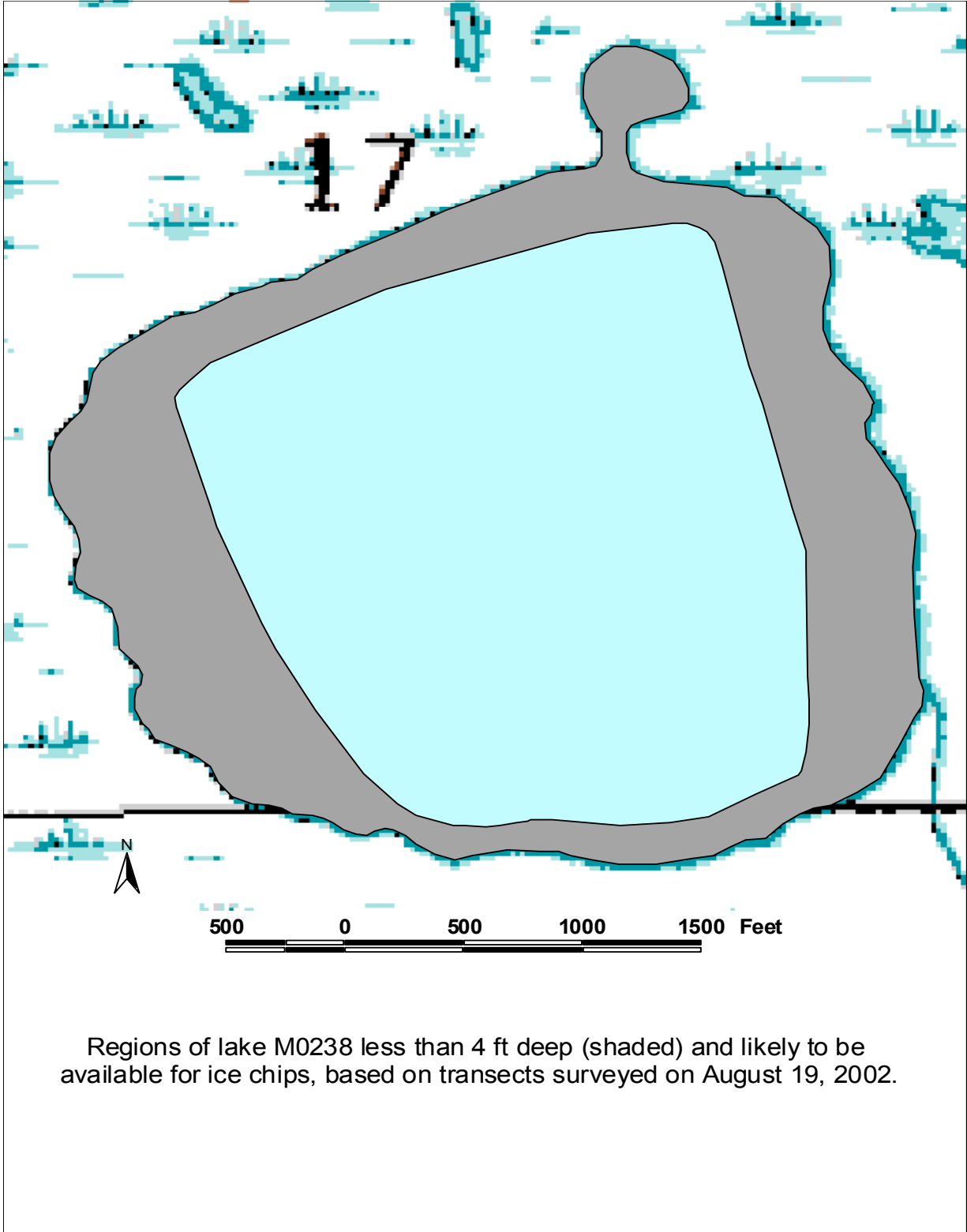
Water Quality:

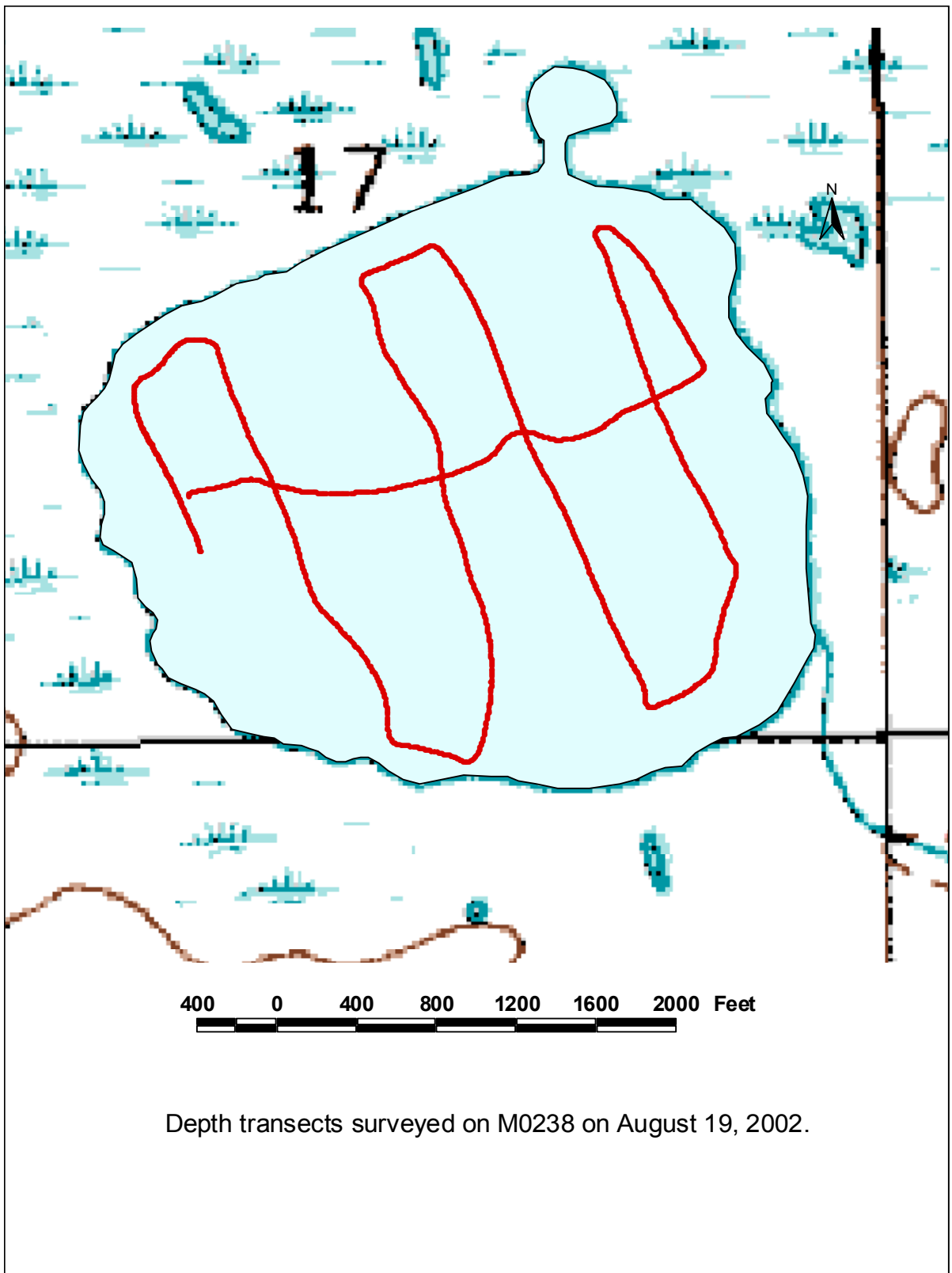
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	32.7	3.5	7.1	15.9	96		this study

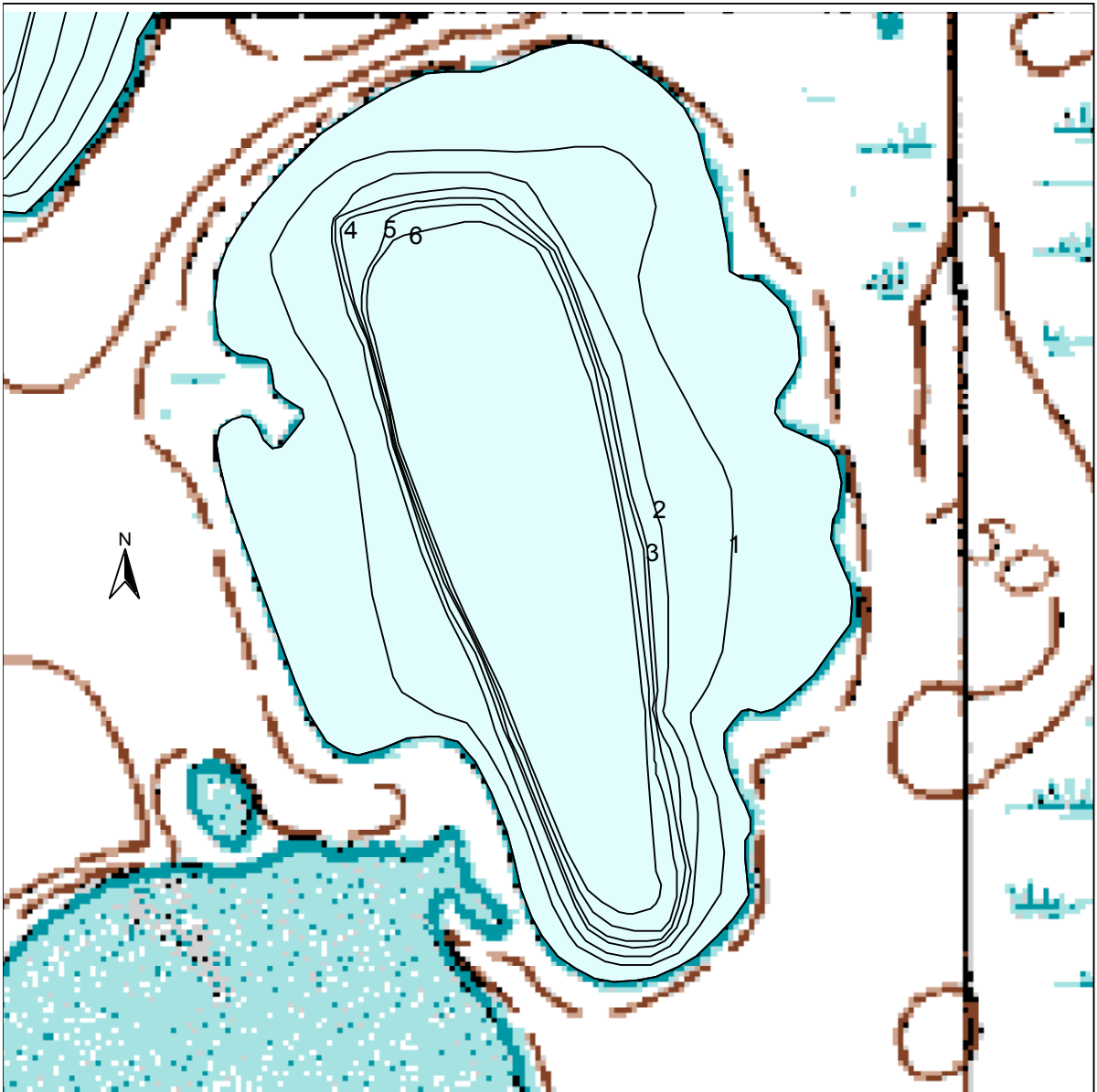
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 19 02	5.3	Least cisco	2	185-191
Minnow Trap	Aug 19 02	5.0	None	0	
Seine	Aug 19 02	3 hauls	None	0	









Depth contours of M0239, based on transects surveyed on August 18, 2002 (depth intervals in 1 foot increments).

Lake M0239

Other Names:

Location: 70° 8' 11.9"N 152° 28' 52.1"W

USGS Quad Sheet: T9N R2W, Sec. 18

Habitat:

Area: 145.4 acres

Maximum Depth: 7.8 feet

Active Outlet:

Turbidity: 3.1

Spec. Conductance: 78.5

pH: 8.1

Calculated Volume: 129.29 million gallons

Permittable Volume: 8.99 million gallons

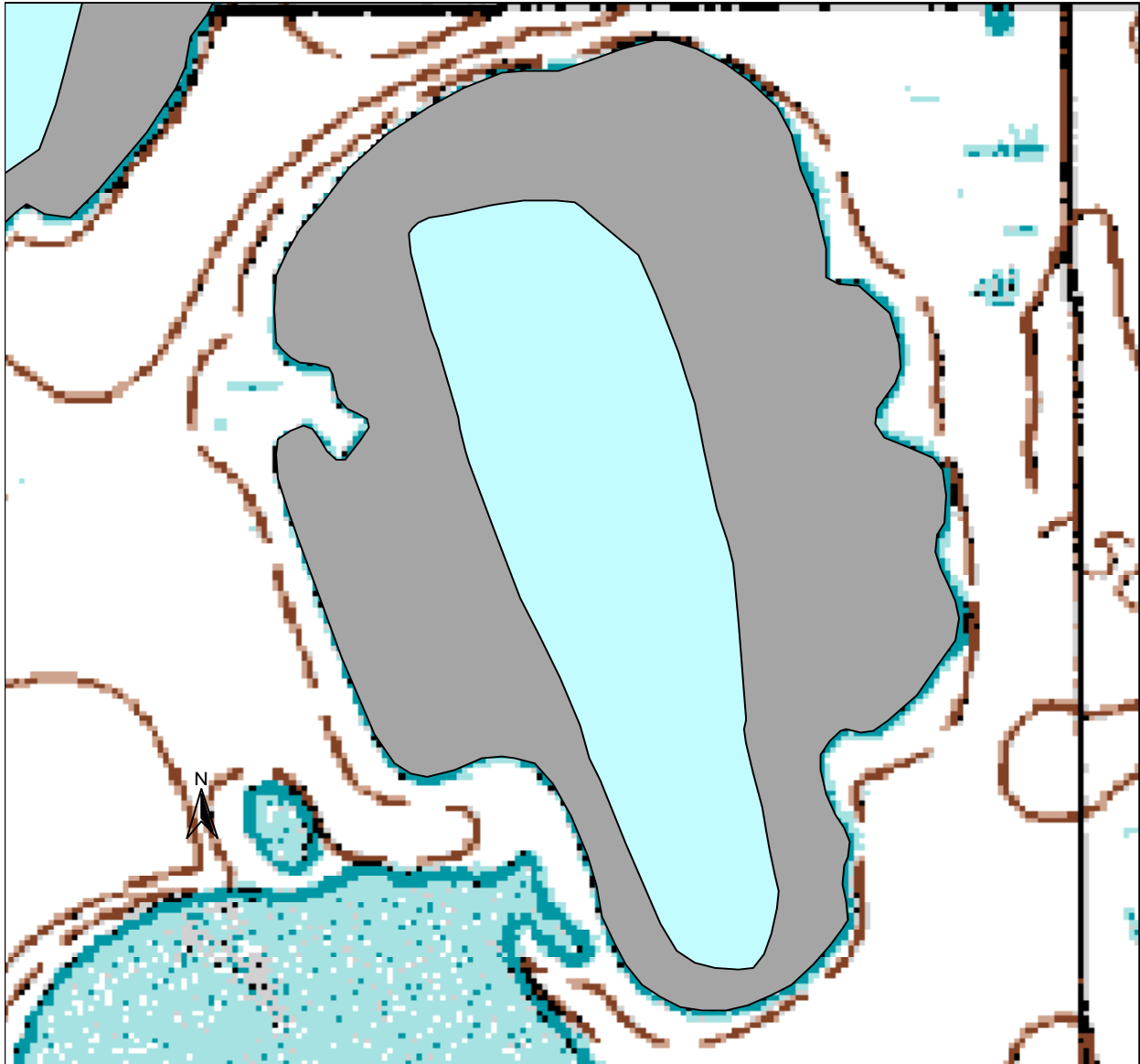
Potential Aggregate: 96.75 acres (water depth 4 ft or less)

Water Quality:

Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	9.7	1.7	4.0	8.9	31		this study

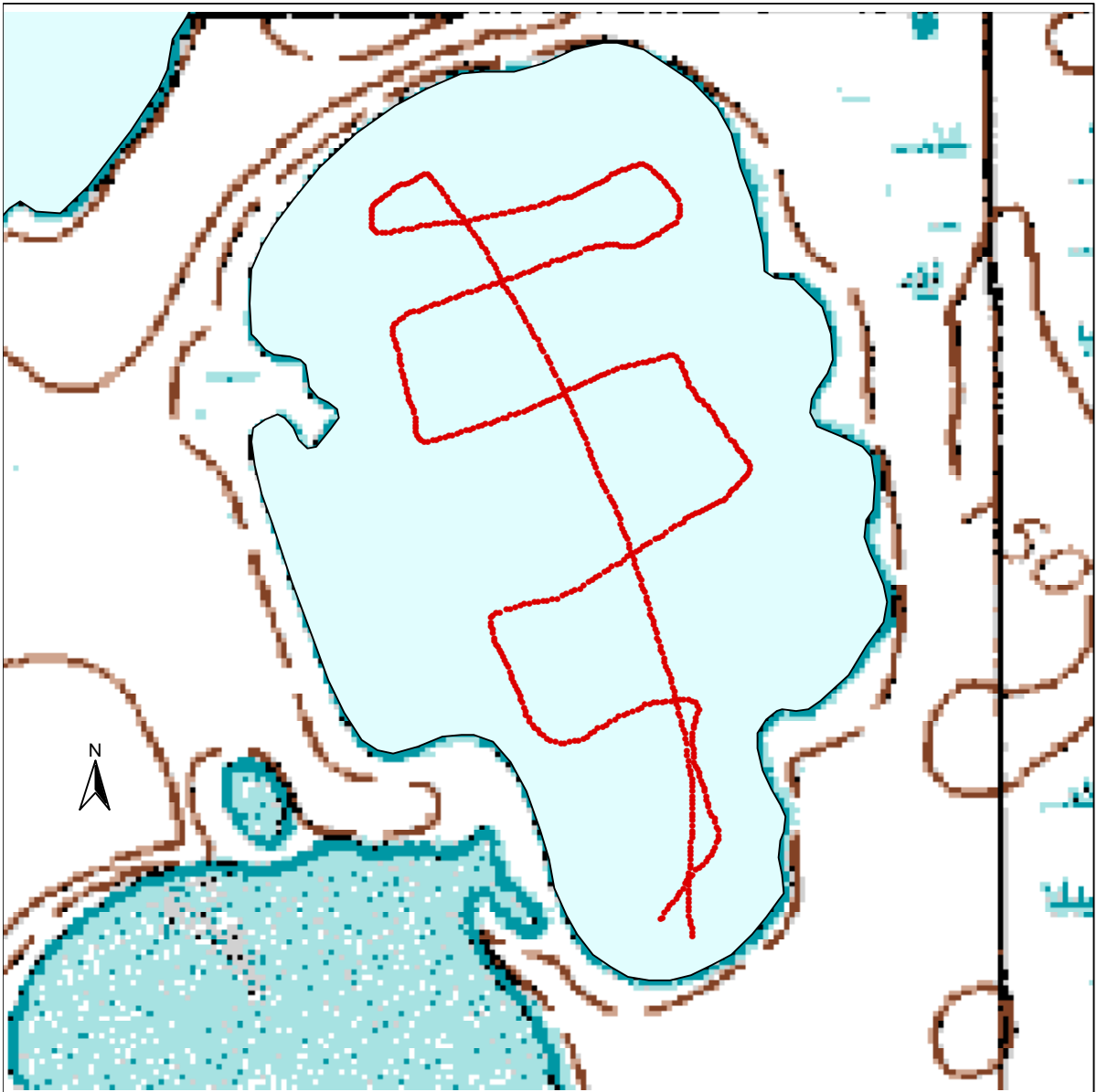
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 18 02	4.7	None	
Seine	Aug 18 02	3 hauls	Ninespine stickleback	3



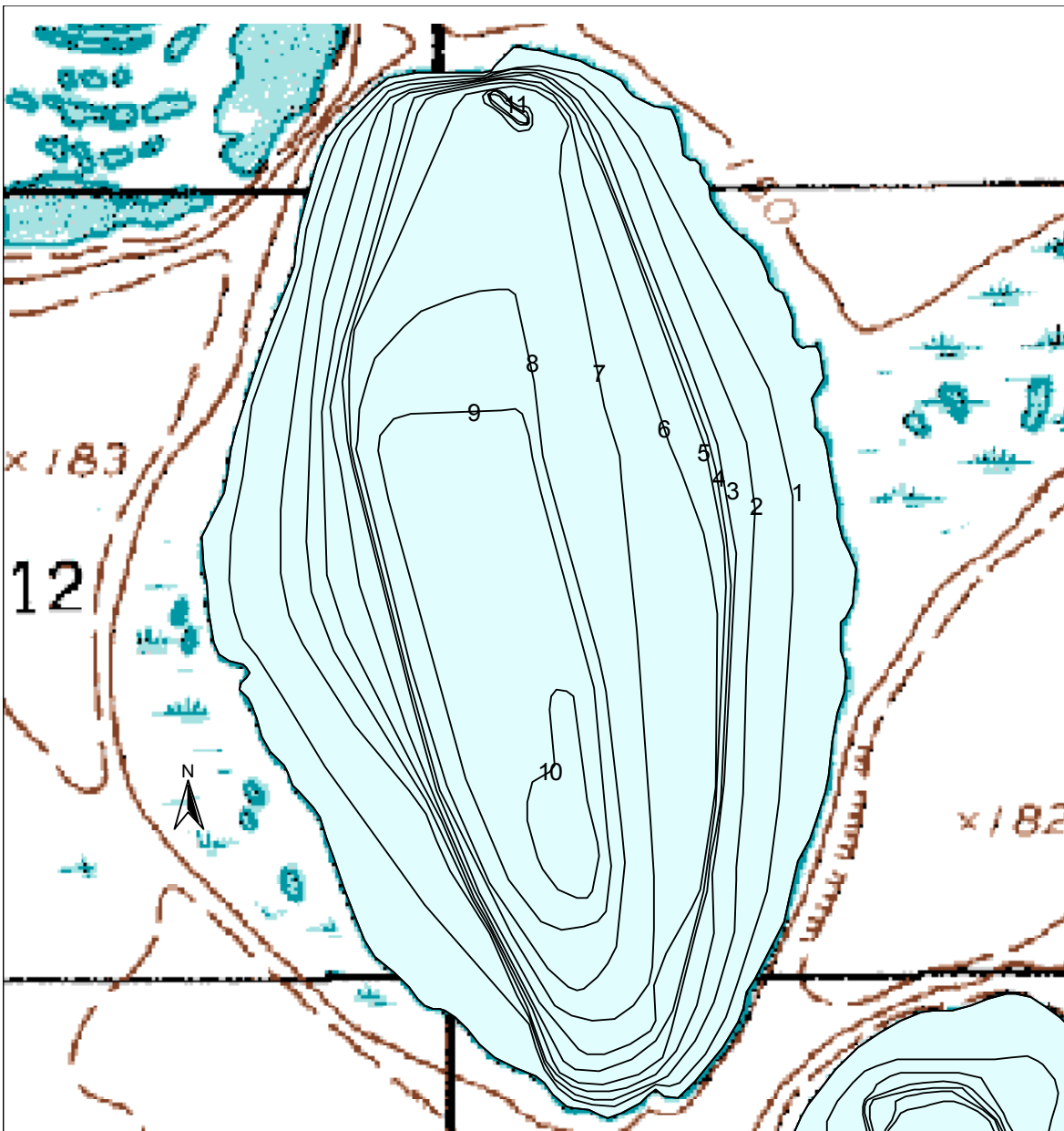
500 0 500 1000 1500 2000 Feet

Regions of lake M0239 less than 4 ft deep (shaded) and likely to be available for ice chips, based on transects surveyed on August 18, 2002.



400 0 400 800 1200 1600 2000 Feet

Depth transects surveyed on M0239 on August 18, 2002.



Depth contours of M0240, based on transects surveyed on August 19, 2002 (depth intervals in 1 foot increments).

Lake M0240

Other Names:

Location: 70° 7' 50.0"N 152° 26' 27.2"W

USGS Quad Sheet: T9N R2W/3W, Sec. 7/12

Habitat:

Area: 498.2 acres

Maximum Depth: 13.6 feet

Active Outlet:

Turbidity: 3.1

Spec. Conductance: 250.8

pH: 8.1

Calculated Volume: 815.29 million gallons

Permittable Volume: 73.13 million gallons

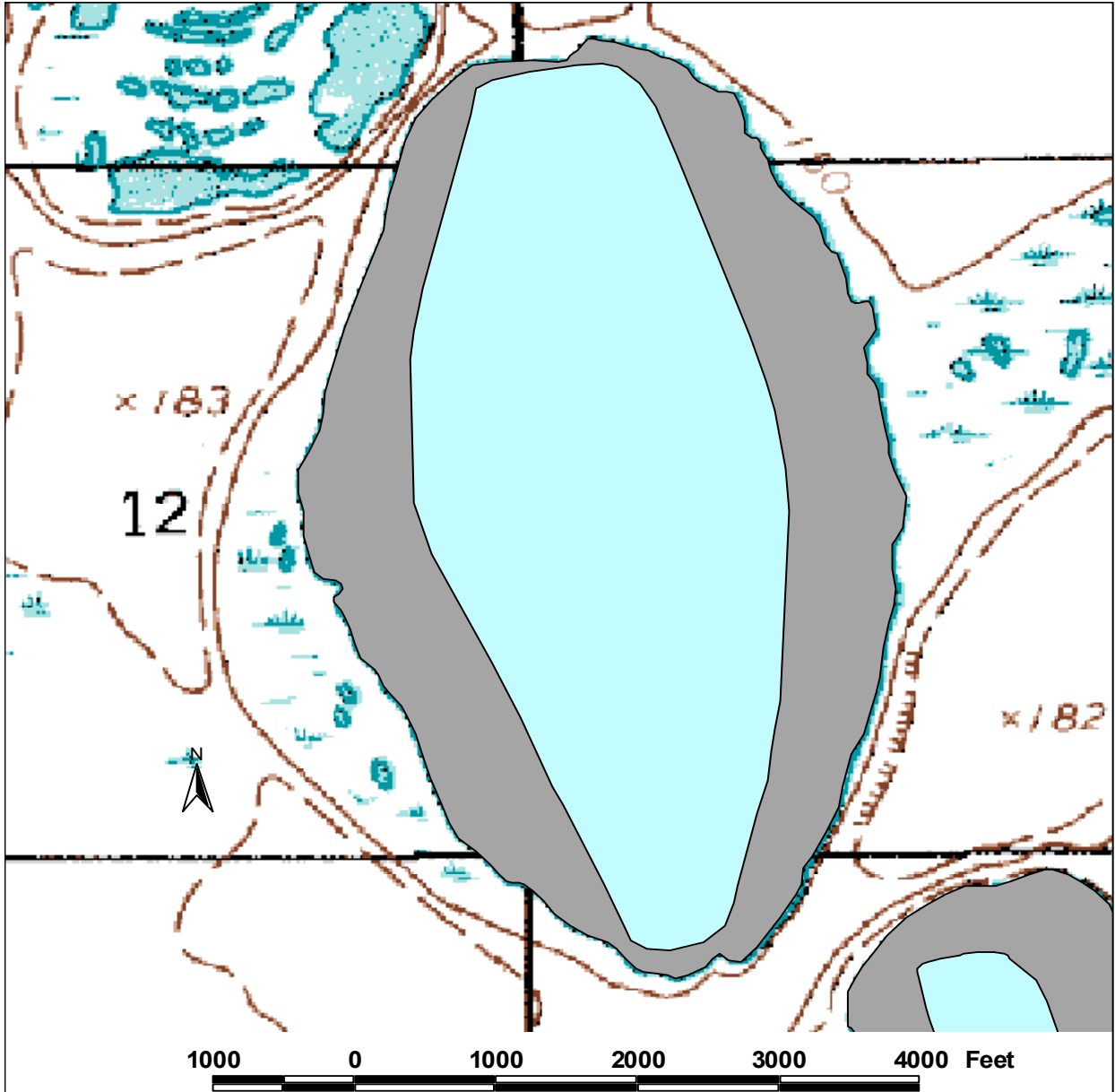
Potential Aggregate: 208.17 acres (water depth 4 ft or less)

Water Quality:

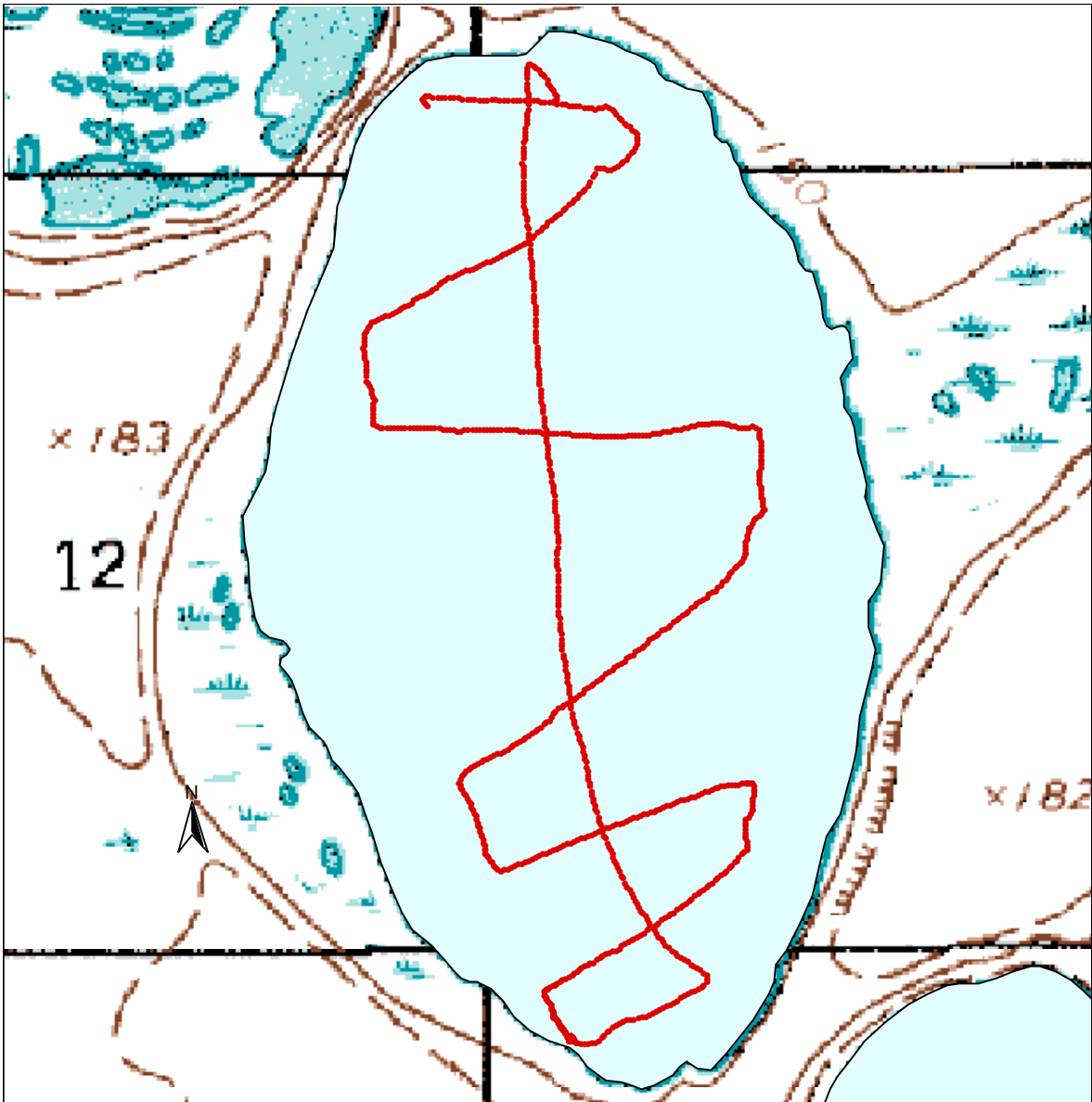
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	35.5	4.6	11.8	32.2	108		this study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 19 02	5.0	None	
Minnow Trap	Aug 19 02	5.7	None	
Seine	Aug 19 02	3 hauls	Ninespine stickleback	3

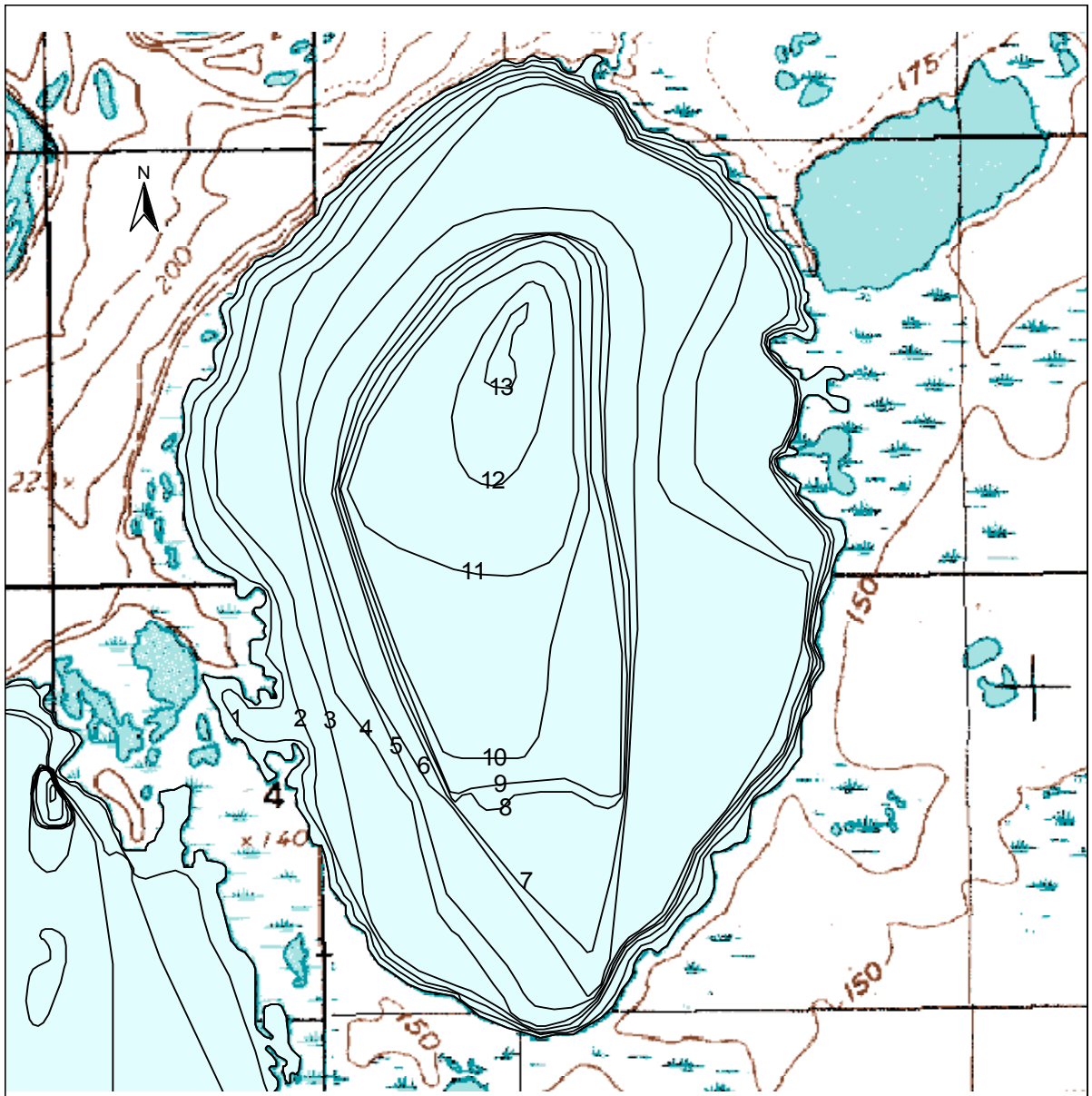


Regions of lake M0240 less than 4 ft deep (shaded) and likely to be available for ice chips, based on transects surveyed on August 19, 2002.



600 0 600 1200 1800 2400 3000 Feet

Depth transects surveyed on M0240 on August 19, 2002.



Depth contours of M0241, based on transects surveyed on August 21, 2002 (depth intervals in 1 foot increments).

Lake M0241

Other Names:

Location: 70° 10' 17.6"N 152° 22' 48.7"W

USGS Quad Sheet: T9N/10N R2W, Sec. 3/4/33/34

Habitat:

Area: 1,477.3 acres

Maximum Depth: 13.8 feet

Active Outlet:

Turbidity: 3.4

Spec. Conductance: 195.3

pH: 7.9

Calculated Volume: 2,970.33 million gallons

Permittable Volume: 73.61 million gallons

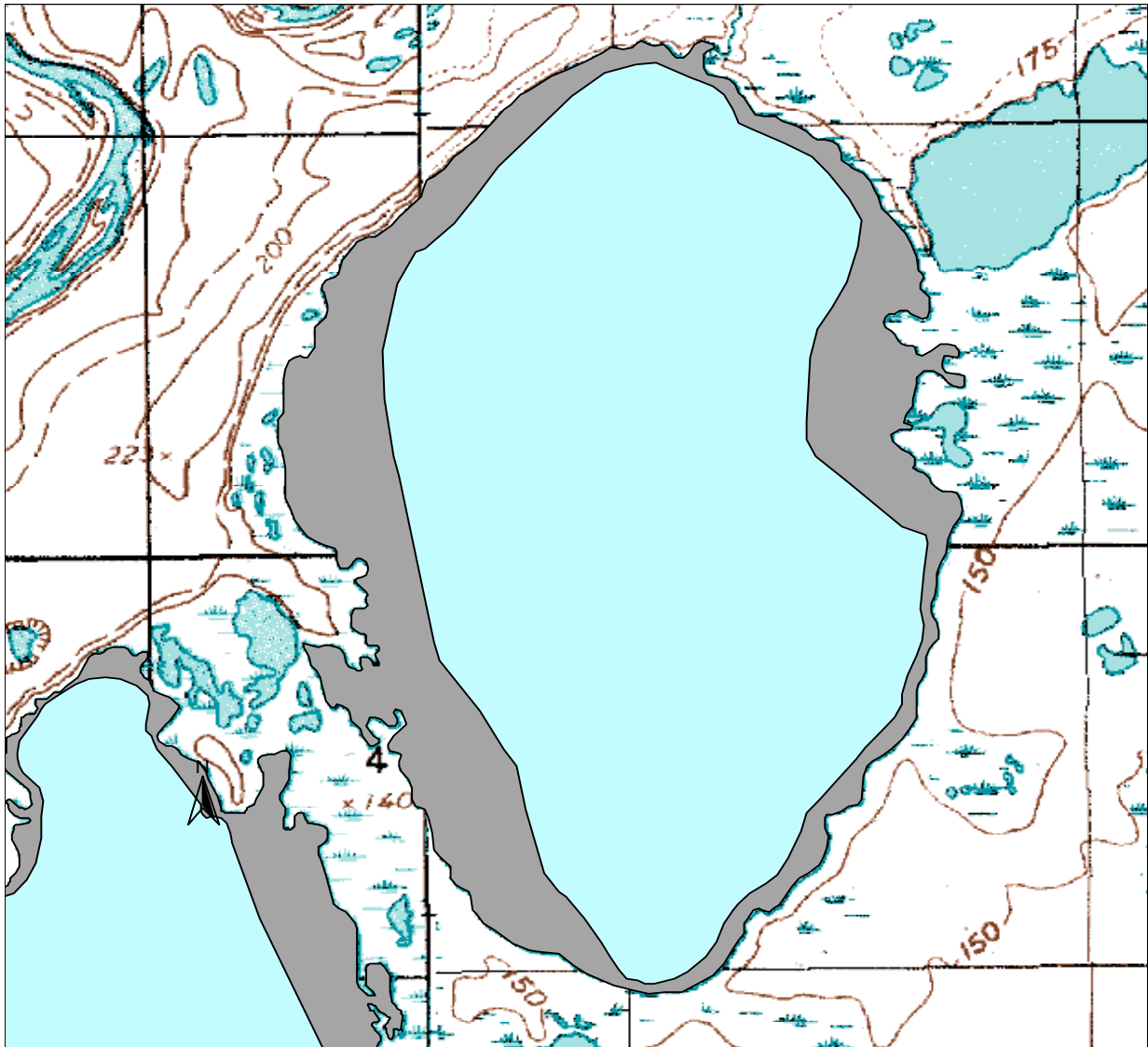
Potential Aggregate: 405.80 acres (water depth 4 ft or less)

Water Quality:

Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	24.9	3.6	7.6	20.4	77		this study

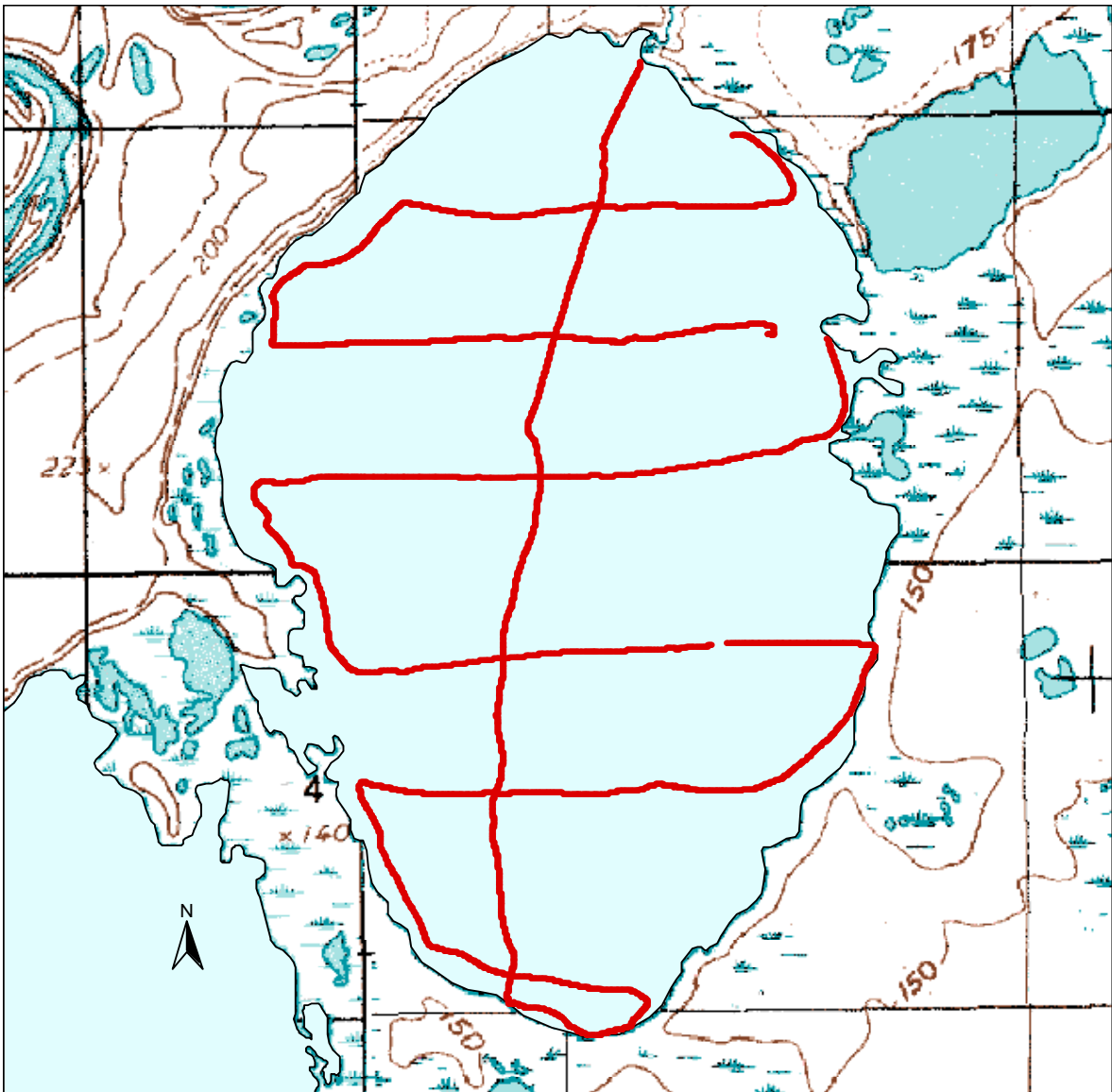
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 17 02	5.5	Arctic grayling	1	131
Minnow Trap	Aug 17 02	6.3	None	0	

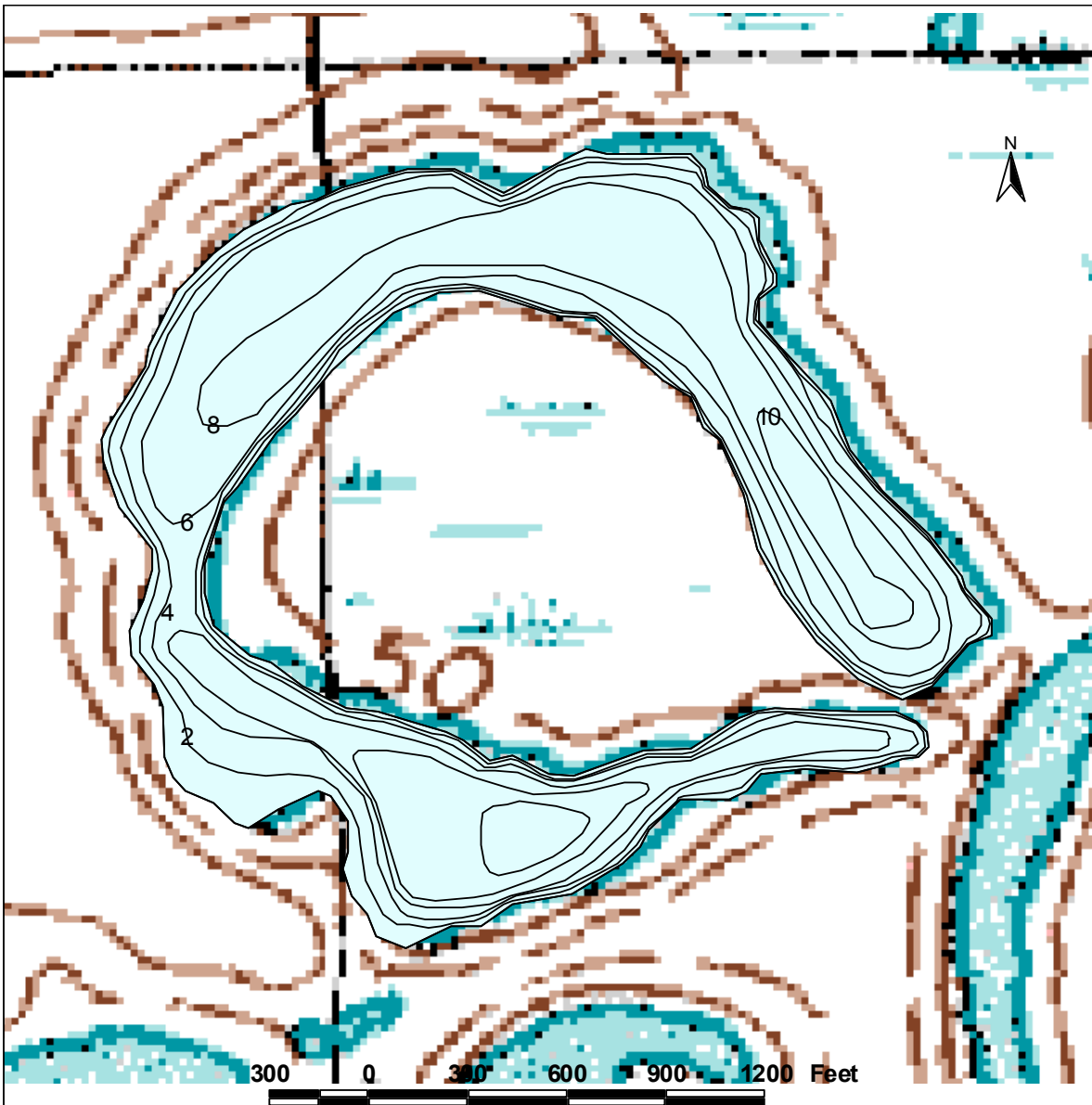


2000 0 2000 4000 6000 8000 Feet

Regions of lake M0241 less than 4 ft deep (shaded) and likely to be available for ice chips, based on transects surveyed on August 21, 2002.



Depth transects surveyed on M0241 on August 21, 2002.



Depth contours of M0242 based on transects surveyed on August 16, 2002
(depth intervals in 2 foot increments).

Lake M0242

Other Names:

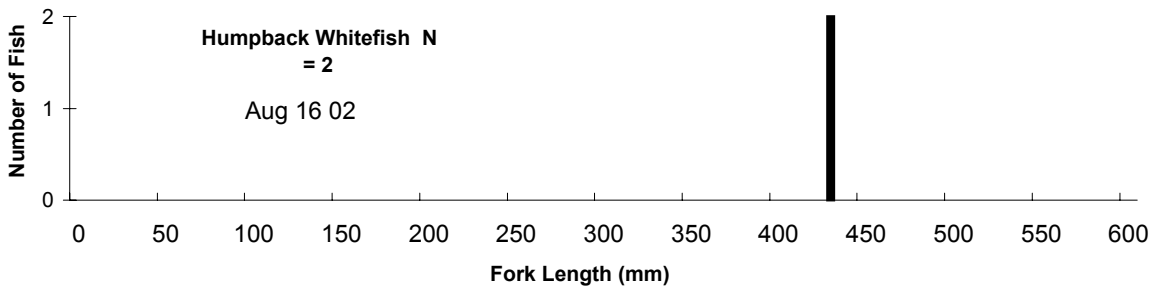
Location: 70° 16' 8.6"N 151° 55' 18.8"W
USGS Quad Sheet: T11N R1E, Sec. 32/33
Habitat:
Area: 57.3 acres
Maximum Depth: 11.0 feet
Active Outlet:
Turbidity: 2.4 NTU
Spec. Conductance: 79.0 µS/cm
pH: 7.7
Calculated Volume: 58.27 million gallons
Permittable Volume: 0.93 million gallons
Potential Aggregate: 12.70 acres (water depth 4 ft or less)

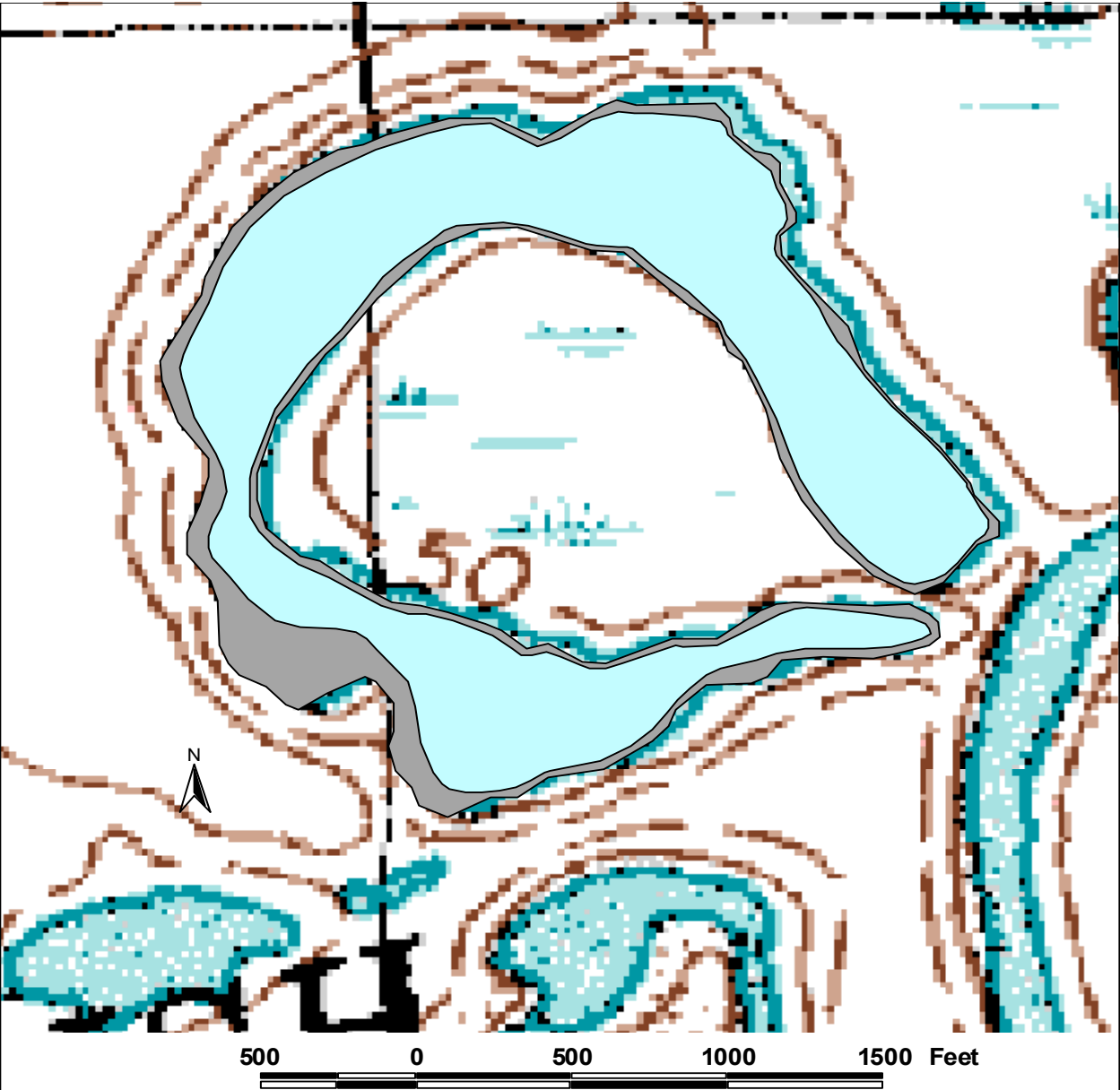
Water Quality:

Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	7.9	1.8	3.3	9.7	27		this study

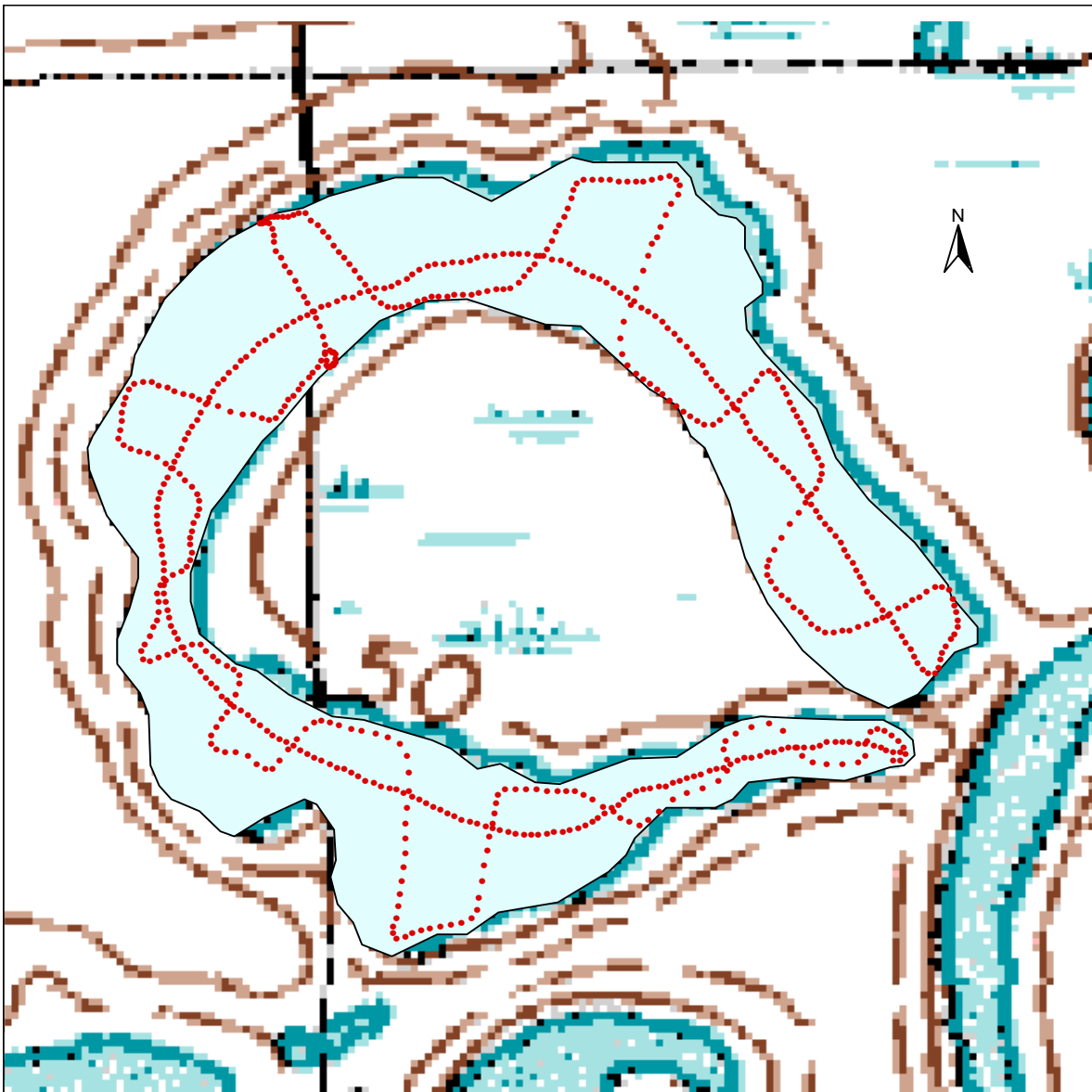
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 16 02	4.2	Humpback whitefish	2	430-435
Minnow Trap	Aug 16 02	5.3	None	0	



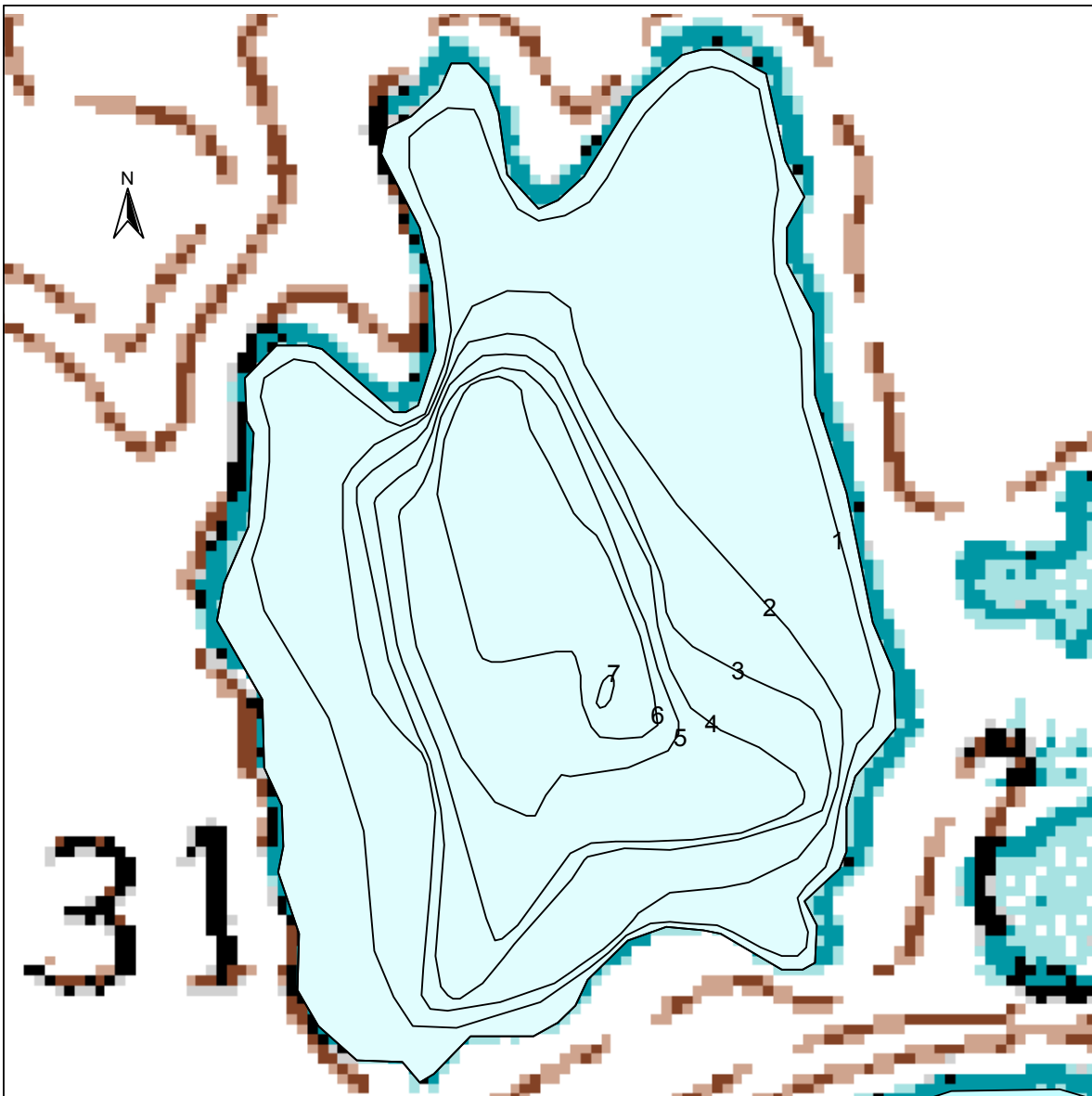


Regions of lake M0242 less than 4 ft deep (shaded) and likely to be available for ice chips, based on transects surveyed on August 16, 2002.



300 0 300 600 900 1200 1500 Feet

Depth transects surveyed on M0242 on August 16, 2002.



Depth contours of M0243, based on transects surveyed on August 14, 2002 (depth intervals in 1 foot increments).

Lake M0243

Other Names:

Location: 70° 15' 58.5"N 151° 58' 33.1"W

USGS Quad Sheet: T11N R1E, Sec. 31

Habitat:

Area: 48.2 acres

Maximum Depth: 7.1 feet

Active Outlet:

Turbidity: 1.7 NTU

Spec. Conductance: 101.2 μ S/cm

pH: 8.3

Calculated Volume: 41.26 million gallons

Permittable Volume: 5.83 million gallons

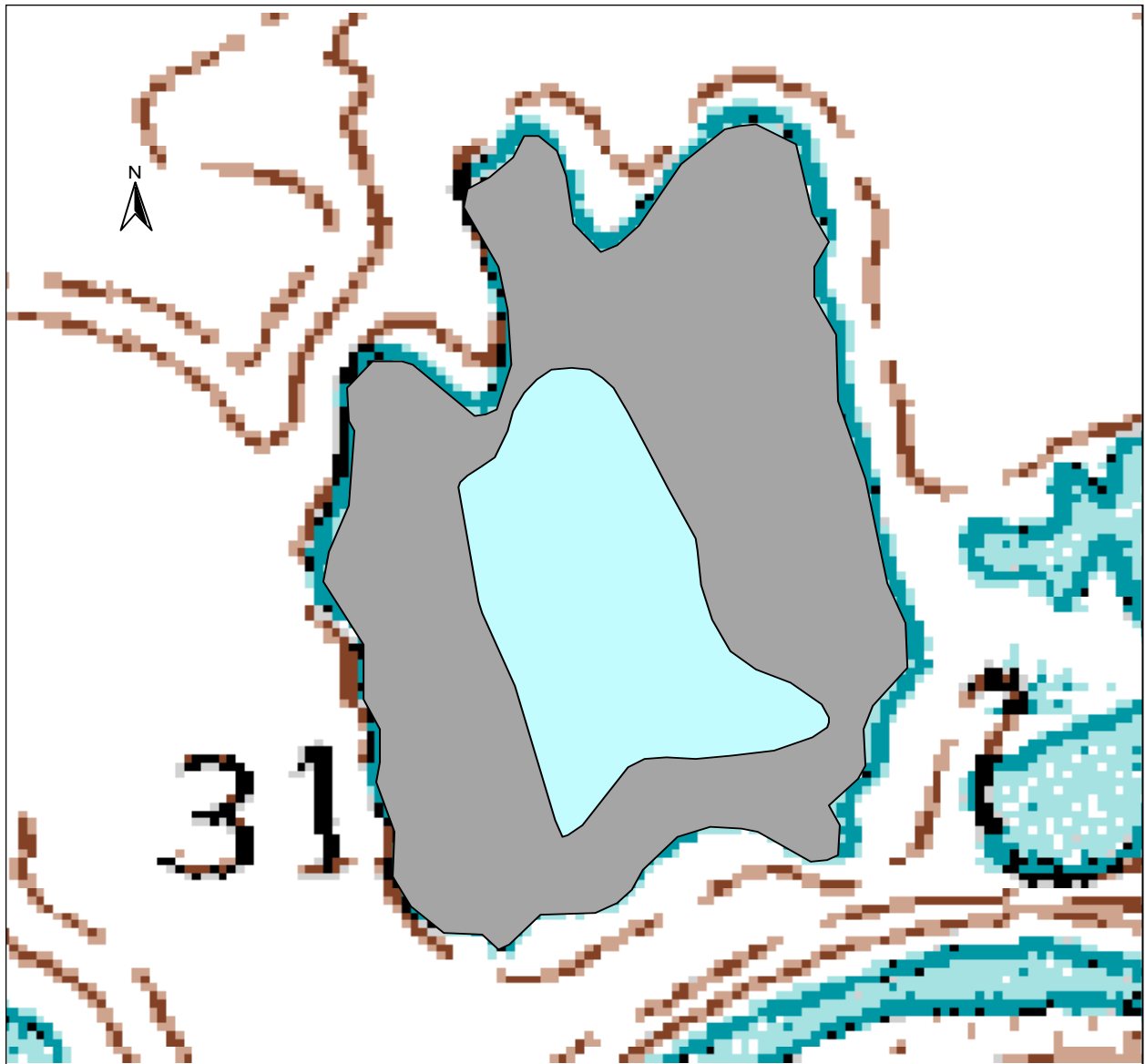
Potential Aggregate: 35.38 acres (water depth 4 ft or less)

Water Quality:

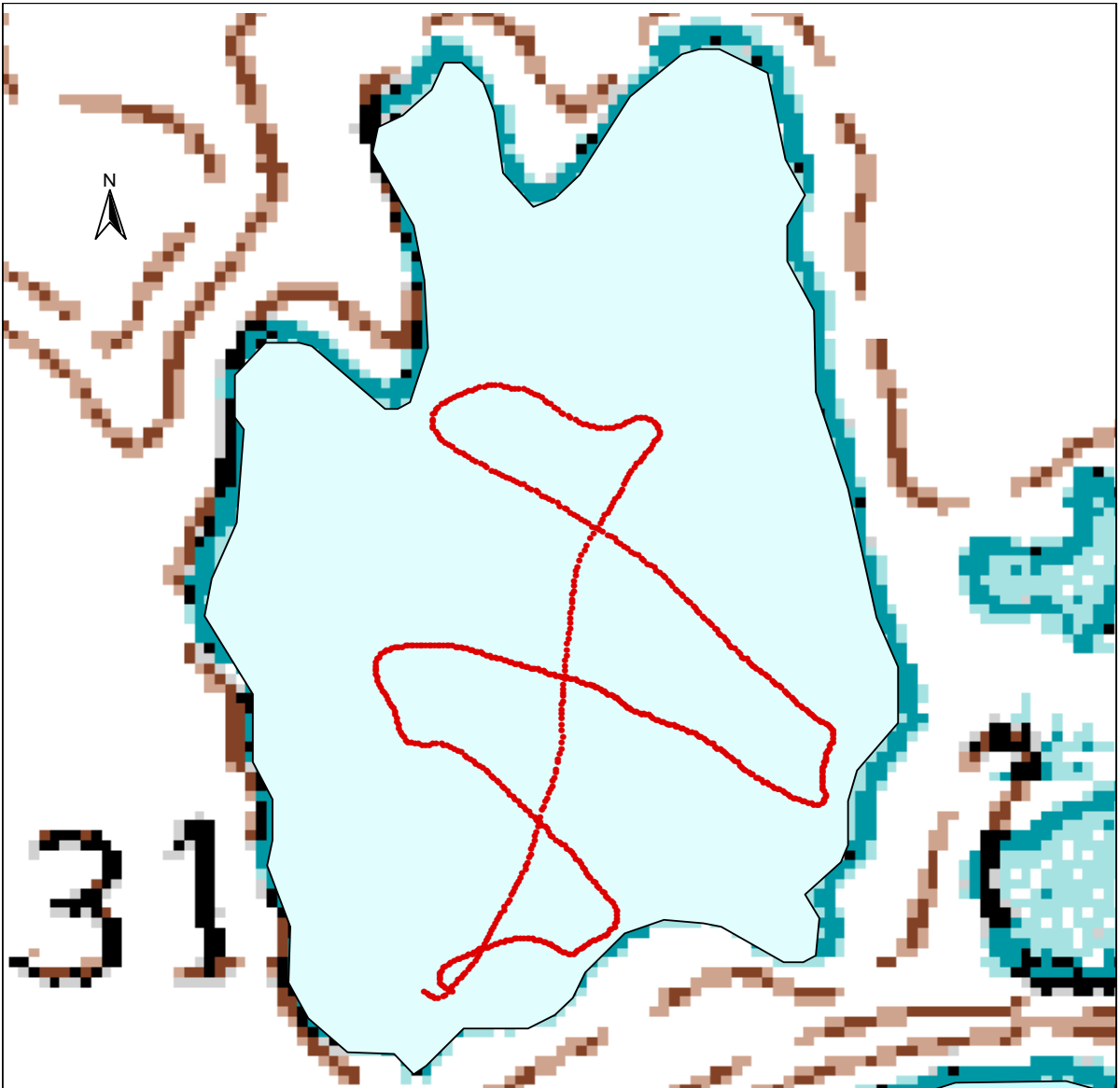
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	11.5	2.4	3.7	9.9	39		this study

Catch Record:

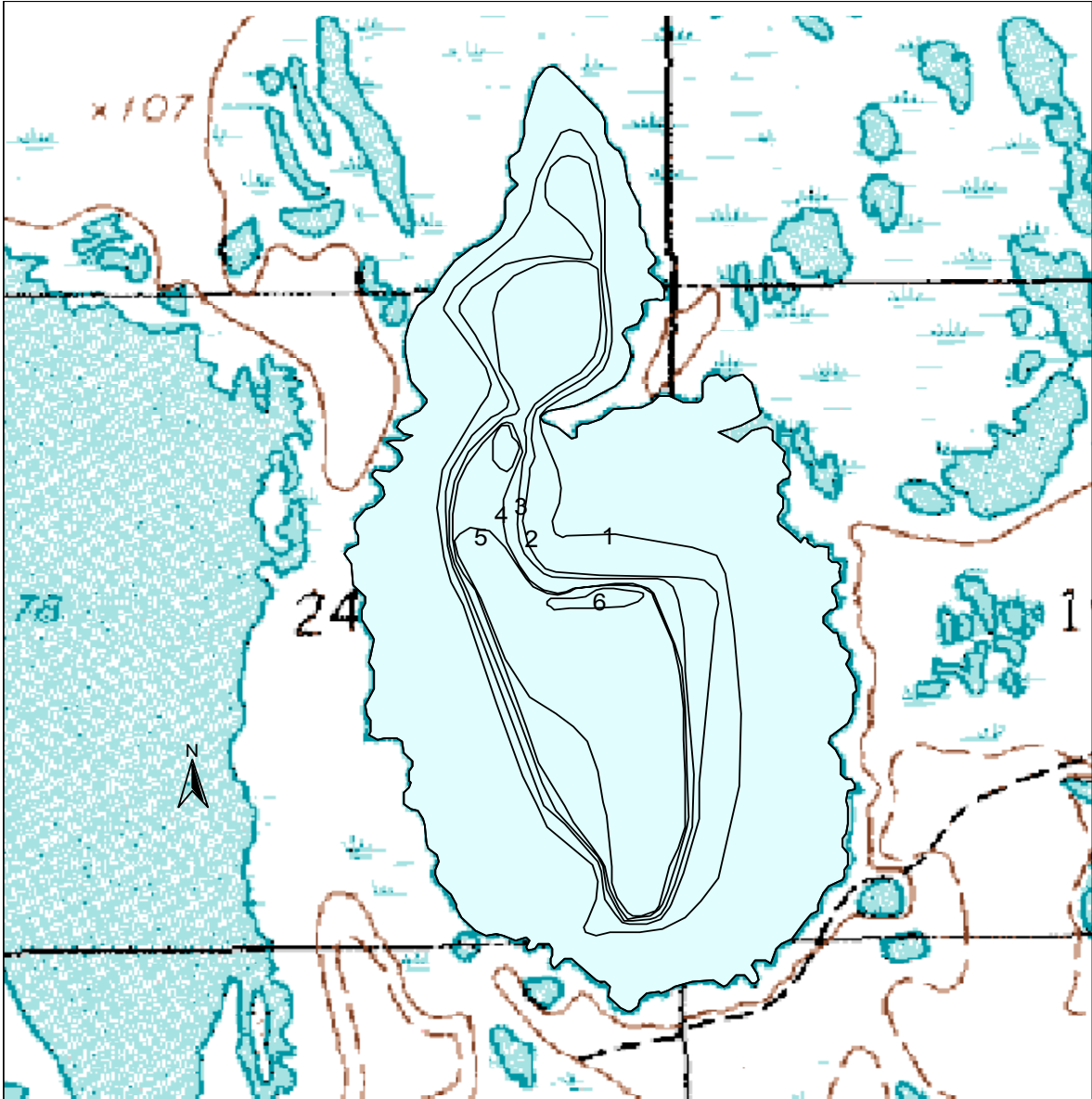
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 14 02	4.0	None	0
Minnow Trap	Aug 14 02	5.2	None	0



Regions of lake M0243 less than 4 ft deep (shaded) and likely to be available for ice chips, based on transects surveyed on August 14, 2002.



Depth transects surveyed on M0243 on August 14, 2002.



Depth contours of M0244, based on transects surveyed on August 14, 2002 (depth intervals in 1 foot increments).

Lake M0244

Other Names:

Location: 70° 17' 29.0"N 152° 0' 17.2"W

USGS Quad Sheet: T11N R1E/1W, Sec. 13/24/19

Habitat:

Area: 405.2 acres

Maximum Depth: 6.7 feet

Active Outlet:

Turbidity: 1.0 NTU

Spec. Conductance: 117.4 μ S/cm

pH: 8.2

Calculated Volume: 235.17 million gallons

Permittable Volume: 28.54 million gallons

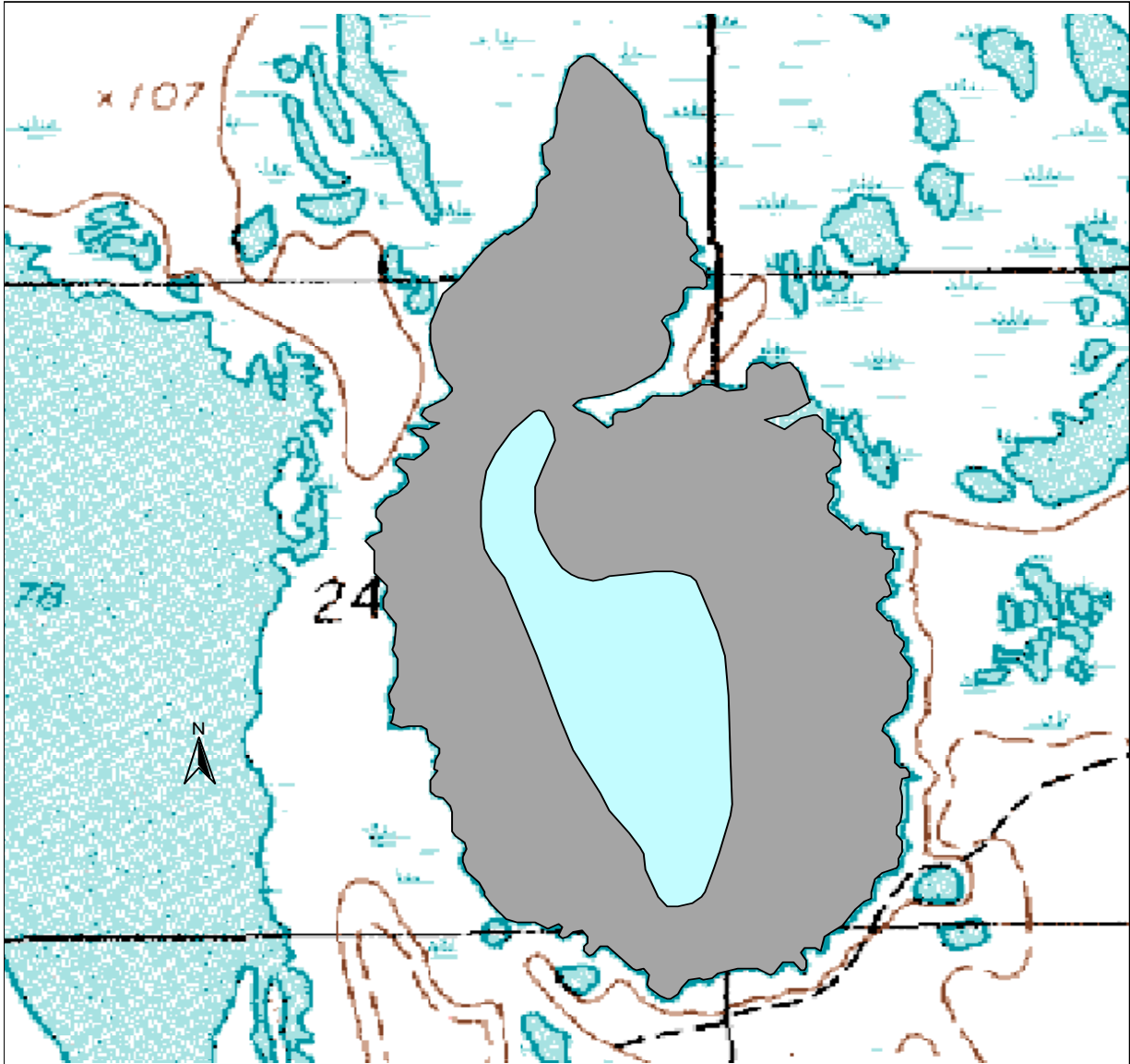
Potential Aggregate: 331.58 acres (water depth 4 ft or less)

Water Quality:

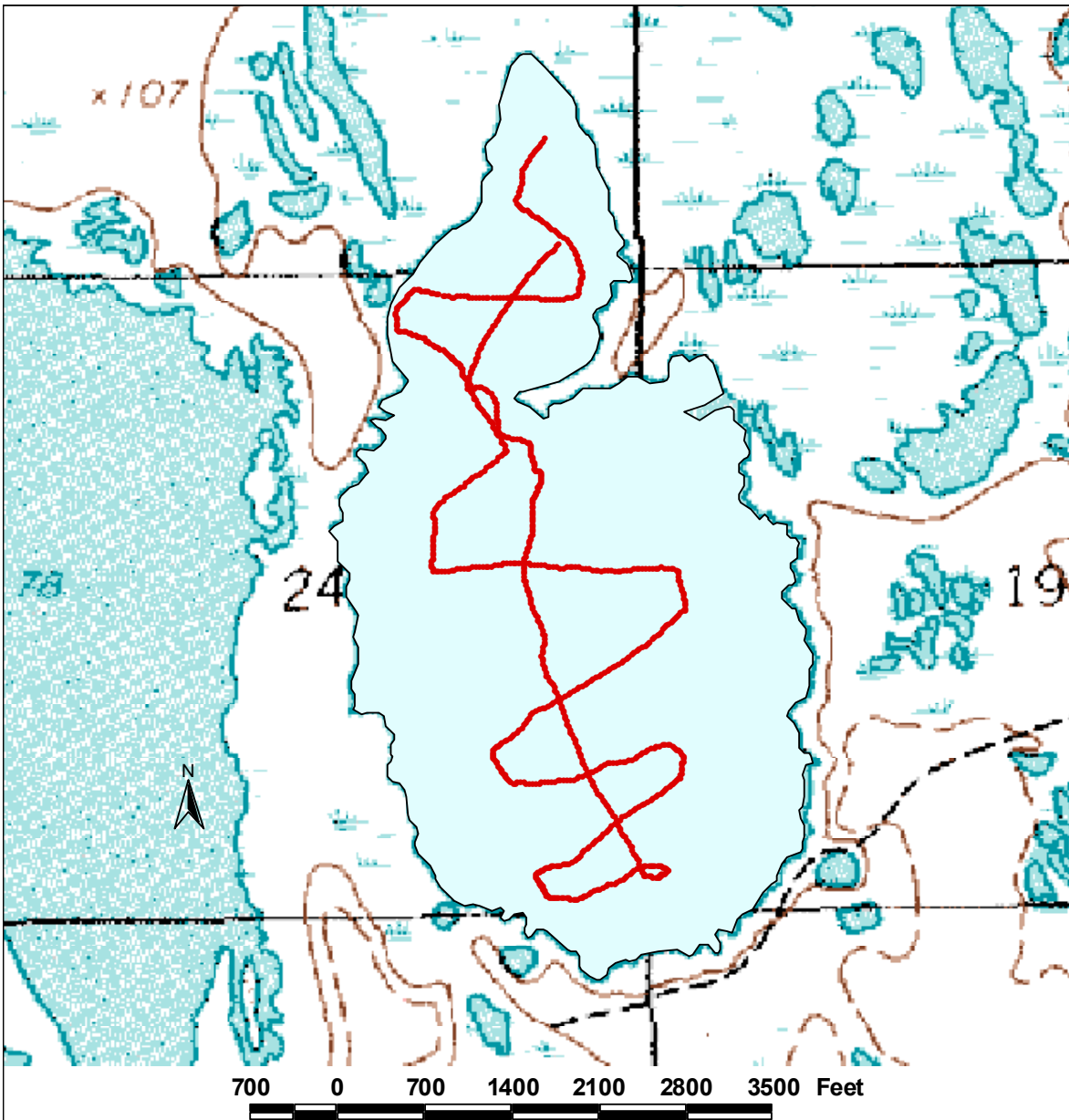
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	12.1	2.5	4.8	13.8	40		this study

Catch Record:

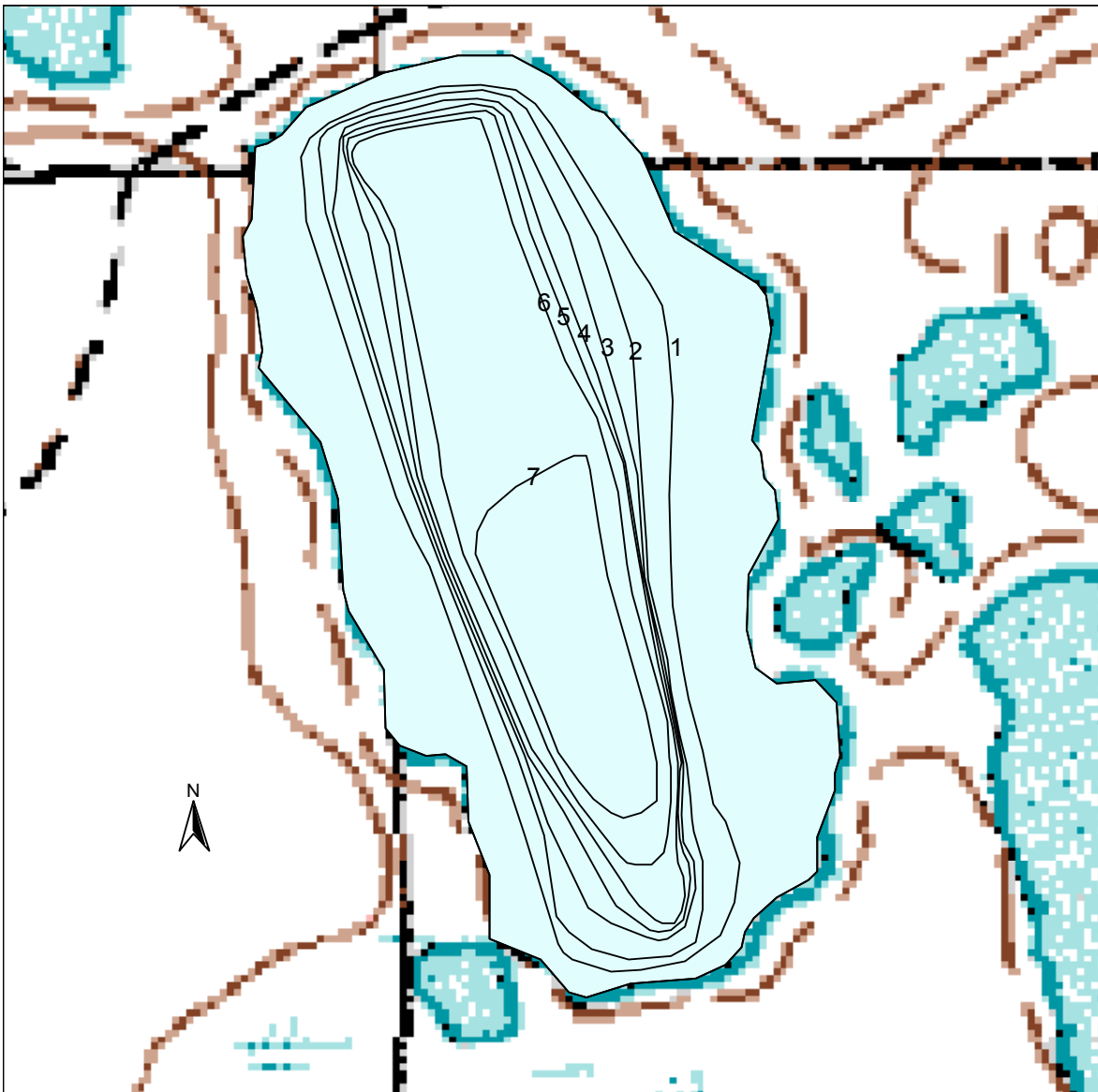
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 14 02	5.3	None	0
Minnow Trap	Aug 14 02	7.0	None	0
Seine	Aug 14 02	3 hauls	None	0



Regions of lake M0244 less than 4 ft deep (shaded) and likely to be available for ice chips, based on transects surveyed on August 14, 2002.



Depth transects surveyed on M0244 on August 14, 2002.



Depth contours of M0245, based on transects surveyed on August 16, 2002 (depth intervals in 1 foot increments).

Lake M0245

Other Names:

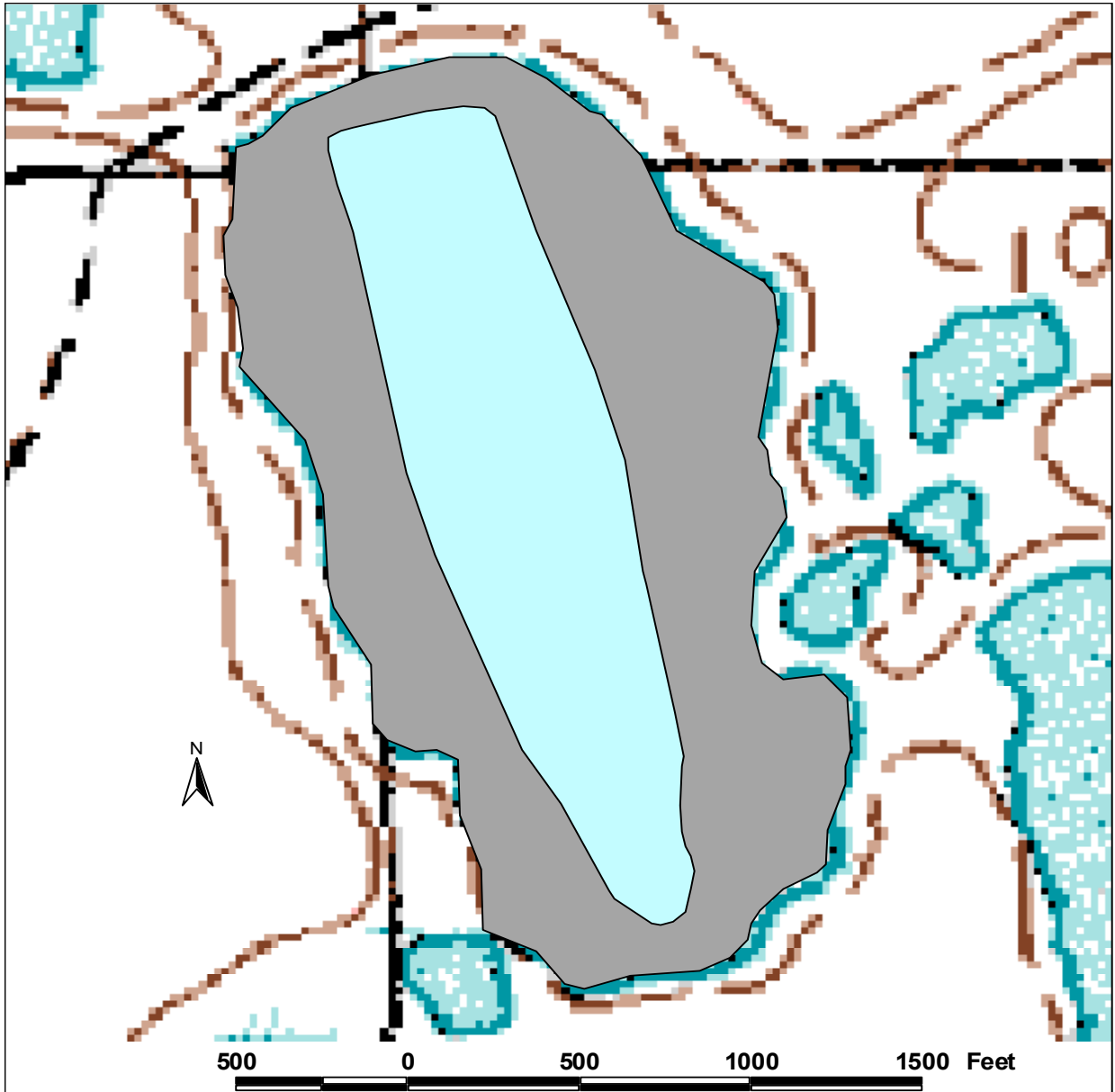
Location: 70° 17' 47.0"N 151° 54' 53.3"W
USGS Quad Sheet: T11N R1E, Sec. 20/21
Habitat:
Area: 79.1 acres
Maximum Depth: 7.6 feet
Active Outlet:
Turbidity: 2.7 NTU
Spec. Conductance: 67.5 µS/cm
pH: 8.18
Calculated Volume: 79.81 million gallons
Permittable Volume: 22.77 million gallons
Potential Aggregate 49.08 acres (water depth 4 ft or less)

Water Quality:

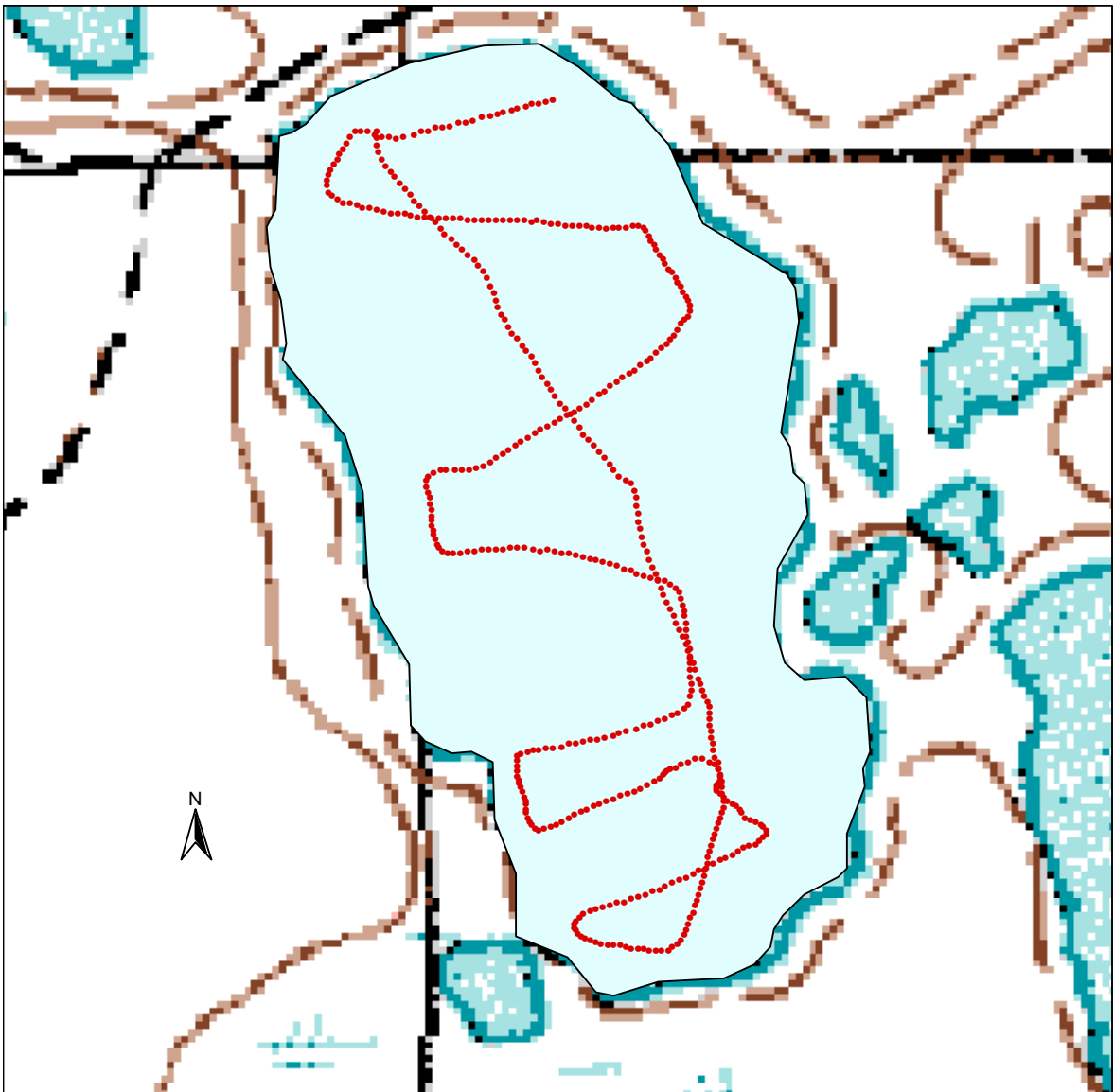
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Total Dissolved Solids (mg/l)	Source
2002	5.5	1.7	3.9	9.8	21		this study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Aug 16 02	4.0	None	0
Minnow Trap	Jul 18 02	6.5	None	0
Seine	Aug 14 02	3 hauls	None	0



Regions of lake M0245 less than 4 ft deep (shaded) and likely to be available for ice chips, based on transects surveyed on August 16, 2002.



Depth transects surveyed on M0245 on August 16, 2002.