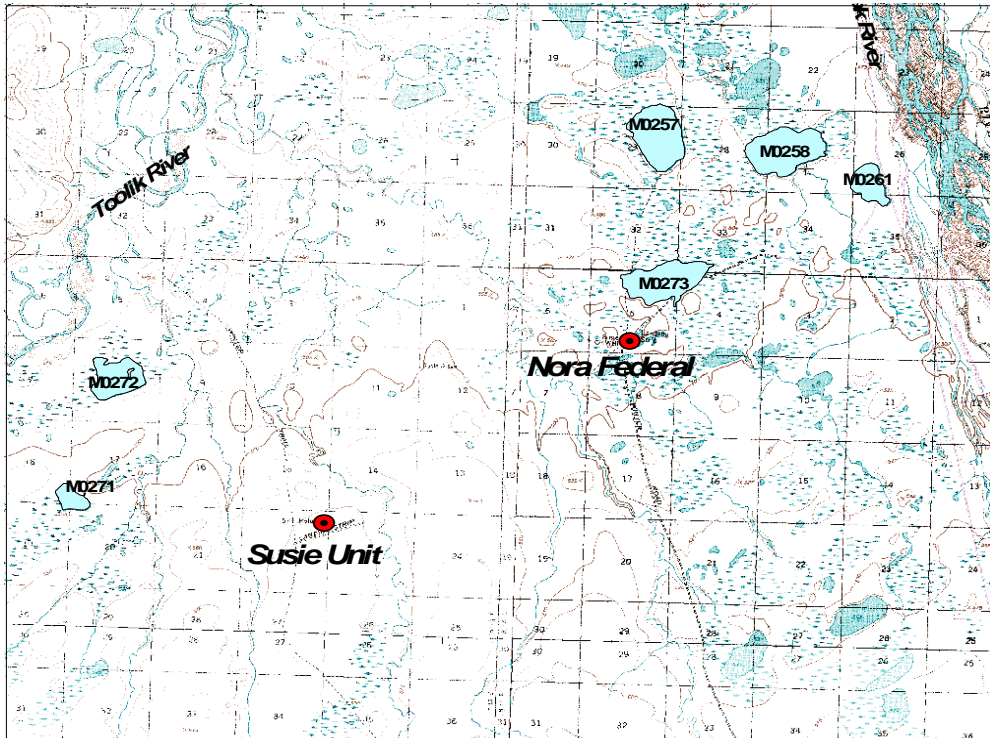


SURVEY OF LAKES IN SUPPORT OF NORA-SUSIE WELL SITE REMEDIATION – 2009

Final Report

November 2009



Prepared by:

MJM Research
1012 Shoreland Drive
Lopez Island, WA

Prepared for:

ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, AK

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TABLE OF CONTENTS

INTRODUCTION..... 1

METHODS 2

RESULTS AND DISCUSSION 5

 Biological Observations 5

 Water Chemistry Measurements 5

 Evaluation of Fish Concerns 5

LITERATURE CITED 7

LAKE SUMMARIES2-1

LIST OF TABLES

Table 1. Summary of lakes sampled in support of the Nora-Susie Remediation Project, 2009.	8
Table 2. Catches of fish from lakes sampled in support of the Nora-Susie Remediation Project, 2009.	9
Table 3. Water chemistry parameters measured in support of Nora-Susie Remediation Project, 2009.	10
Table 4. Estimated water volumes available for winter withdrawal from lakes surveyed in support of the Nora-Susie Remediation Project, 2009.	11
Table 5. Estimated area available for removing ice aggregate, based on the area covered by water shallower than 4 feet, in lakes surveyed for the Nora-Susie Remediation Project, 2009.	12

LIST OF FIGURES

Figure 1. Study area surveyed for potential water source lakes to support remediation efforts at Nora and Susie well sites, 2009.	13
Figure 2. Lakes surveyed as potential water sources to support remediation efforts at Nora and Susie well sites, 2009.	14

Index to Lake Summaries

<u>Lake</u>	<u>Page</u>
M0257	2-2
M0258	2-6
M0261	2-10
M0271	2-14
M0272	2-18
M0273	2-22

INTRODUCTION

ConocoPhillips (Alaska) plans to conduct remediation efforts at two abandoned exploration sites, Nora and Susie, in the vicinity of the Dalton Highway (Figure 1). An ice road will need to be constructed to access the two remediation sites during winter. During review of permit applications for water withdrawal, information is required on the biological sensitivity of lakes proposed for use. 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.

This 2009 survey sampled 6 lakes for potential use as water sources during winter activity to support the remediation effort. These lakes were previously surveyed in 2002 to support ice road permitting associated with a different project. The goals of the 2009 study were to update information on water depth, fish presence and habitat use in lakes for lakes that may be used to support winter activities.

The objectives of the survey were to:

- 1) obtain lake bathymetry and estimate water volumes,
- 2) identify fish species present in selected lakes within the project study area, and
- 3) measure water chemistry parameters to assess suitability of water for potential uses.

METHODS

The biological survey consisted of sampling with:

- gill nets for sensitive species,
- minnow traps,
- visual survey for resistant species.

Lakes were sampled with short-duration gill net sets (typically 5 to 9 hours of total soak time). The gill nets are multimesh, 120 feet long, with 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 North Slope for similar surveys. 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 placed in habitats expected to be used by fish for feeding or moving between feeding areas, and were pulled after fish were detected. Fish captured were measured and released. Duration of each set was recorded to allow calculation of catch rates.

Minnow traps 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 at the edge of surveyed lakes in areas expected to provide cover or feeding areas for ninespine stickleback. The traps were set and retrieved in concert with the gill net sampling.

When conditions were appropriate, a visual survey was conducted. Ninespine stickleback are often observed in shallow water along the lake shore. The length of the visual survey was measured with a handheld GPS. If stickleback were observed, minnow traps and seines were not used.

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 and specific conductance 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 2020 turbidity meter. A water sample was sent to Pollen Environmental for laboratory determination of chloride, sodium, calcium, magnesium, and hardness (as CaCO₃).

Bathymetric data were collected to allow estimating lake volume. 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 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 ft intervals on maps of the surveyed lakes. The surface area of each 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 allowed by Alaska Dept. of Natural Resources is 30% of the volume deeper than 5 feet. In 2007, Alaska Department of Natural Resources initiated a limit of 20% of the total lake volume if fish are not present. This amount may or may not be present at the time of withdrawal, depending on ice thickness at the time water is needed.

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. The amount of water available in the top 1 foot of ice cover, where total depth is less than 4 feet, is given as the likely amount available as ice chips.

Lake Summaries

This report uses lake numbering based on 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); fish sampling in 1979
B = Bendock fish sampling from 1977-1986
L = Lobdell; water chemistry sampling in 1991-1999
M = Moulton; fish sampling in 1995-2006
MB = Michael Baker Jr., Inc. water chemistry sampling in 2002-2004
N = Netsch et al. (1977) NPRA fish sampling in 1977
R = Reanier depth sampling in 2000-2007

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. Surface area in acres, obtained from USGS digital maps,
6. Maximum depth in feet,
7. Presence or absence of an outlet,
8. Calculated total lake volume
9. Water volume under 4 feet of ice,
10. Water volume under 5 feet of ice
11. Water volume under 7 feet of ice
12. Acres of potential ice aggregate for road construction,
13. Gallons of water represented by the surface area available for ice aggregate,
14. Maximum recommended under-ice water withdrawal,
15. Water chemistry measurements,
16. Catch record, including gear used, date sampled, species caught and size range,
17. Where appropriate data exist, the length frequency of dominant species is plotted,
18. Map of potential ice aggregate removal areas, and
19. Map showing measured depth transects.

RESULTS AND DISCUSSION

Biological Observations

One (M0258) of the 6 lakes evaluated for fish contained Arctic grayling (Table 2). Ninespine stickleback were detected at 3 additional lakes during 2009 (M0257, M0261 and M0273). Fish were not detected at 2 of the 6 lakes in 2009 (M0271 and M0272). Lake M0271 contained ninespine stickleback when sampled in 2002, but they appeared to be absent in 2009.

Water Chemistry Measurements

Water chemistry parameters measured in the studied lakes are presented Table 3. Surface water temperature during the Aug 9-13 sampling in 2009 averaged 9.5°C, ranging from 8.5°C to 10.5°C. Specific conductance ranged from 123 to 228 microSiemens/cm. PH ranged from 7.78 to 8.08.

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 lake trout, 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, the current policy is to limit the

water withdrawal to 20% of the total lake volume. For practical reasons, the volume available may be 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. On some occasions, the limit of 20% of total lake volume may exceed the amount of water available at the time of removal. A closer examination of these water withdrawals may be warranted if large volumes are needed from these lakes.

Based on the above lake evaluation, 42.6 million gallon of water can likely be permitted from the 6 lakes surveyed during 2009. Two of these lakes (M0271 and M0272) are considered to be devoid of fish at this time, thus they can be permitted for 20% of the lake volume. It is possible, however, that there will be less water than that amount available, depending on the time of withdrawal.

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. Based on the above analysis, the surveyed lakes should provide 503.2 acres of ice chips from lakes surveyed for the exploration use, which is equivalent to 149.2 million gallons of water in the top 1 foot of ice.

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- Lewis, D.B., M. Walkey, and H.J.G. Dartnall. 1972. Some effects of low oxygen tensions on the distribution of the three-spined stickleback *Gasterosteus aculeatus* L. and the nine-spined stickleback *Pungitius pungitius* (L). J. Fish. Biol. 4: 103-108.
- McElderry, H.I. and P.C. Craig. 1981. A fish survey in the lower Colville River drainage with an analysis of spawning use by Arctic and least cisco. Appendix 2. Final Report, Simpson Lagoon (Part 4, Fish). In: Environmental Assessment of the Alaskan Continental Shelf, Final Reports (Vol. 7). BLM/NOAA OCSEAP, Boulder, Colorado. p. 657-678.

Table 1. Summary of lakes sampled in support of the Nora-Susie Remediation Project, 2009

Lake Name	Latitude (NAD27)	Longitude	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Calculated Volume (mill. gals)
M0257	69.58814	148.73836	3N	14E	29	233.7	5.7	262.66
M0258	69.58673	148.67821	3N	14E	27/28	250.1	7.6	354.24
M0261	69.58093	148.63756	3N	14E	26/35	90.0	6.1	85.82
M0271	69.52205	149.01511	2N	13E	17/18/19/20	52.1	6.2	42.65
M0272	69.54346	148.99494	2N	13E	8	141.2	7.2	161.40
M0273	69.56287	148.73409	2/3N	14E	4/5/32/33	224.9	10.4	279.73

Table 2. Catches of fish from lakes sampled in support of the Nora-Susie Remediation Project, 2009.

Lake Name	Date	Gill Nets		Minnow Traps		Seine		Visual Survey	
		Set Duration (hours)	Fish Species ¹	Set Duration (hours)	Fish Species	Number of Hauls	Fish Species	Distance (yards)	Fish Species
M0257	7/15/2002	14.0	None	9.0	None	3	2 NSSB	--	
	8/10/2009	6.5	None	177.1	None	--		50	1 NSSB
M0258	7/15/2002	0.2	4 GRAY	--		--		--	
	8/11/2009	--	GRAY assumed			--		--	
M0261	7/17/2002	9.5	None	9.5	2 NSSB	3	None	--	
	8/11/2009	4.3	None	6.8	3 NSSB	--		--	
M0271	7/23/2002	6.3	None	5.3	1 NSSB	3	None	--	
	8/13/2009	8.6	None	11.6	None	--		235	None
M0272	7/23/2002	6.0	None	5.0	None	3	None	--	
	8/12/2009	9.7	None	72.9	None	--		--	
M0273	7/24/2002	6.2	None	5.5	None	3	None	--	
	8/11/2009	6.6	None	96.1	1 NSSB	--		--	

-- = not sampled

¹GRAY = arctic grayling

NSSB = ninespine stickleback

Table 3. Water chemistry parameters measured in support of Nora-Susie Remediation Project, 2009.

Lake	Date	Water Temp (oC)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)
M0257	7/15/2002	15.2	174	1.91	8.08	28.4	2.09	0.70	0.70	79.6
	8/9/2009	9.2	173	0.82	7.93	34.4	2.70	<1.00	1.21	97.0
M0258	7/15/2002	18.5	106	1.33	8.00	17.3	1.03	0.36	0.70	47.3
	8/9/2009	10.5	123	1.28	7.78	24.3	1.39	<1.00	1.37	66.5
M0261	7/17/2002	18.4	201	3.07	8.40	30.0	2.54	0.77	7.30	85.5
	8/11/2009	8.5	198	1.15	7.91	37.1	3.29	<1.00	11.80	106.0
M0271	7/23/2002	15.8	171	1.33	8.02	26.2	3.56	0.57	1.30	80.0
	8/13/2009	9.5	157	1.54	7.80	28.7	3.88	<1.00	1.82	87.7
M0272	7/23/2002	16.7	168	1.24	8.33	30.6	2.49	0.48	0.80	86.8
	8/12/2009	9.7	152	1.71	8.07	29.3	2.51	<1.00	1.25	83.4
M0273	7/24/2002	16.2	252	1.85	8.33	39.5	3.52	1.44	4.70	113.0
	8/9/2009	9.7	228	1.74	8.08	43.9	4.40	1.55	6.41	128.0

Table 4. Estimated water volumes available for winter withdrawal from lakes surveyed in support of the Nora-Susie Remediation Project, 2009.

Lake	Surface Area (acres)	Max. Depth (feet)	Calculated Volume (mil. gals)	Sensitive Fish Species Present¹	Resistant Fish Species Present²	15% of Winter Volume (mil. gals)	30% of 5 ft Winter Volume (mil. gals)	20% of Total Volume (mil. gals)	Available Water (mil. gals)
M0257	233.7	5.7	262.66	none caught	NSSB	0.000	0.017	52.5	0.017
M0258	250.1	7.6	354.24	GRAY	none caught	0.003	7.58	70.8	0.003
M0261	90.0	6.1	85.82	none caught	NSSB	0.000	0.097	17.2	0.097
M0271	52.1	6.2	42.65	none caught	none caught	0.000	0.099	8.53	8.53
M0272	141.2	7.2	161.40	none caught	none caught	0.000	0.417	32.3	32.3
M0273	224.9	10.4	279.73	none caught	NSSB	0.030	1.675	55.9	1.675

¹ GRAY = arctic grayling

² NSSB = ninespine stickleback

Table 5. Estimated area available for removing ice aggregate, based on the area covered by water shallower than 4 feet, in lakes surveyed for the Nora-Susie Remediation Project, 2009.

(gallons of water is the water content of the upper 1 foot of ice)

Lake Name	Surface Area (acres)	Maximum Depth (feet)	Acres covered by Water shallower than 4 feet	Gallons of Water As Chips (millions gallons)
M0257	233.7	5.7	155.48	46.1
M0258	250.1	7.6	83.78	24.8
M0261	90.0	6.1	65.86	19.5
M0271	52.1	6.2	37.55	11.1
M0272	141.2	7.2	70.21	20.8
M0273	224.9	10.4	90.31	26.8

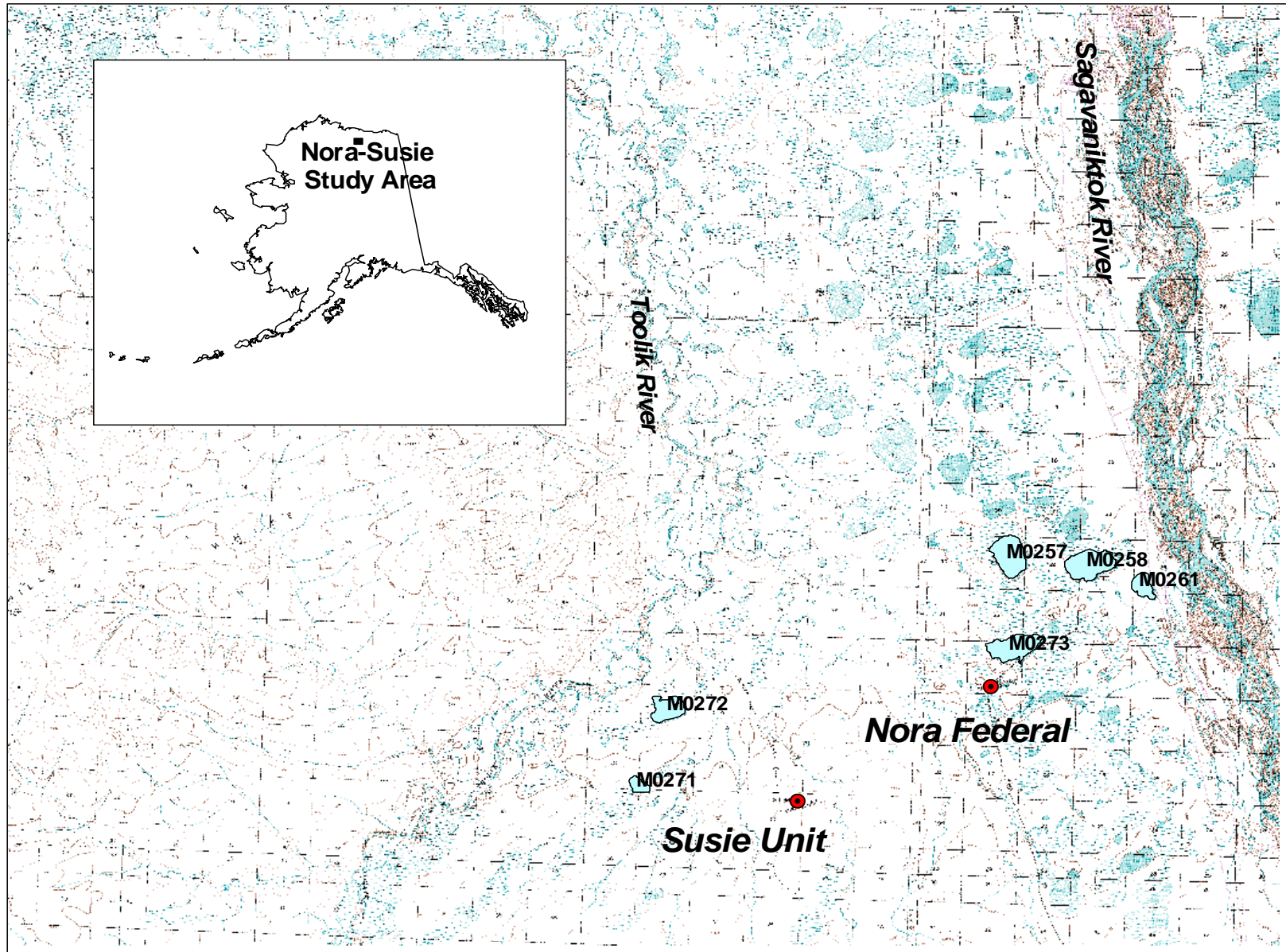


Figure 1. Study area surveyed for potential water source lakes to support remediation efforts at Nora and Susie well sites, 2009.

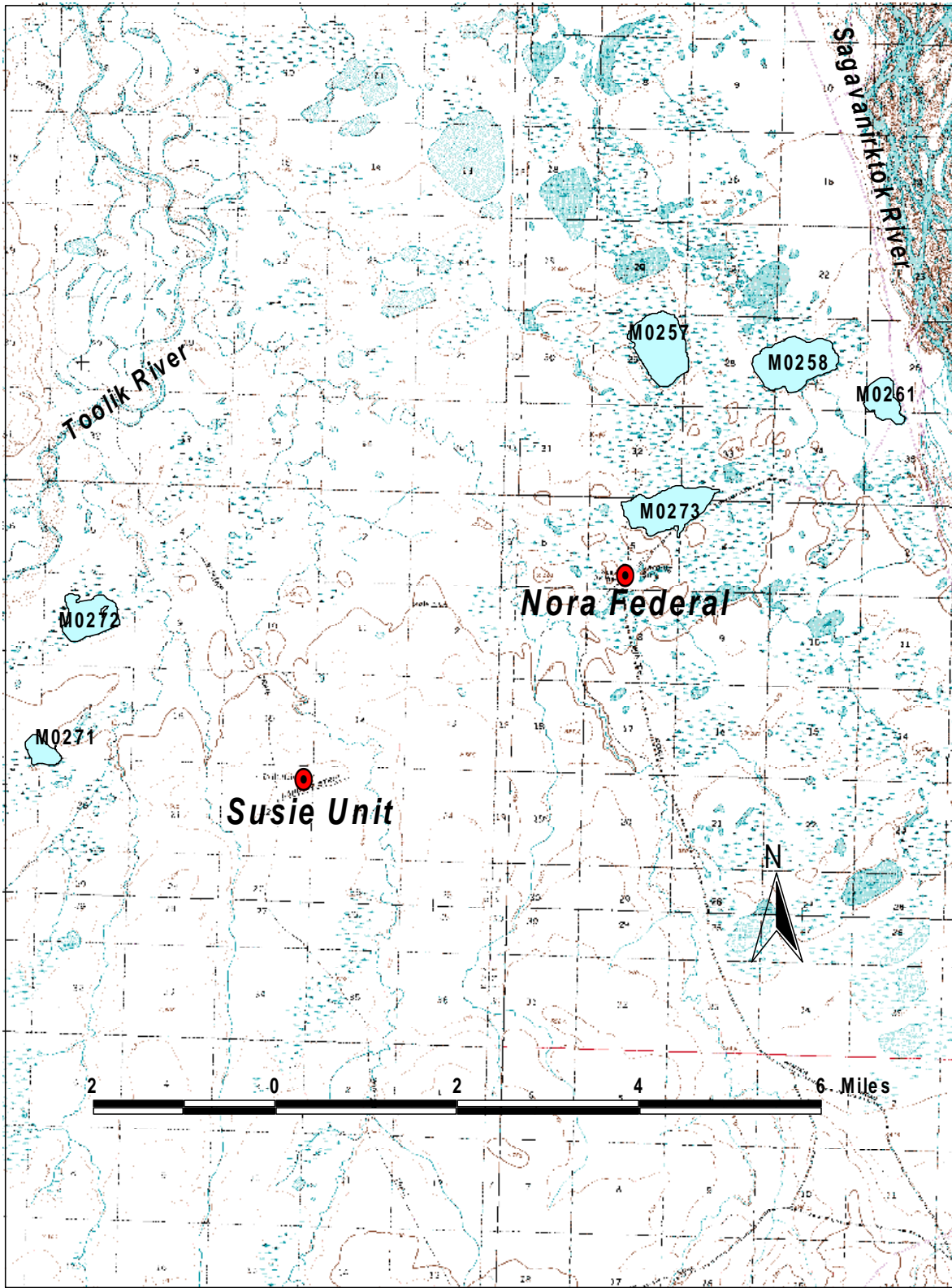
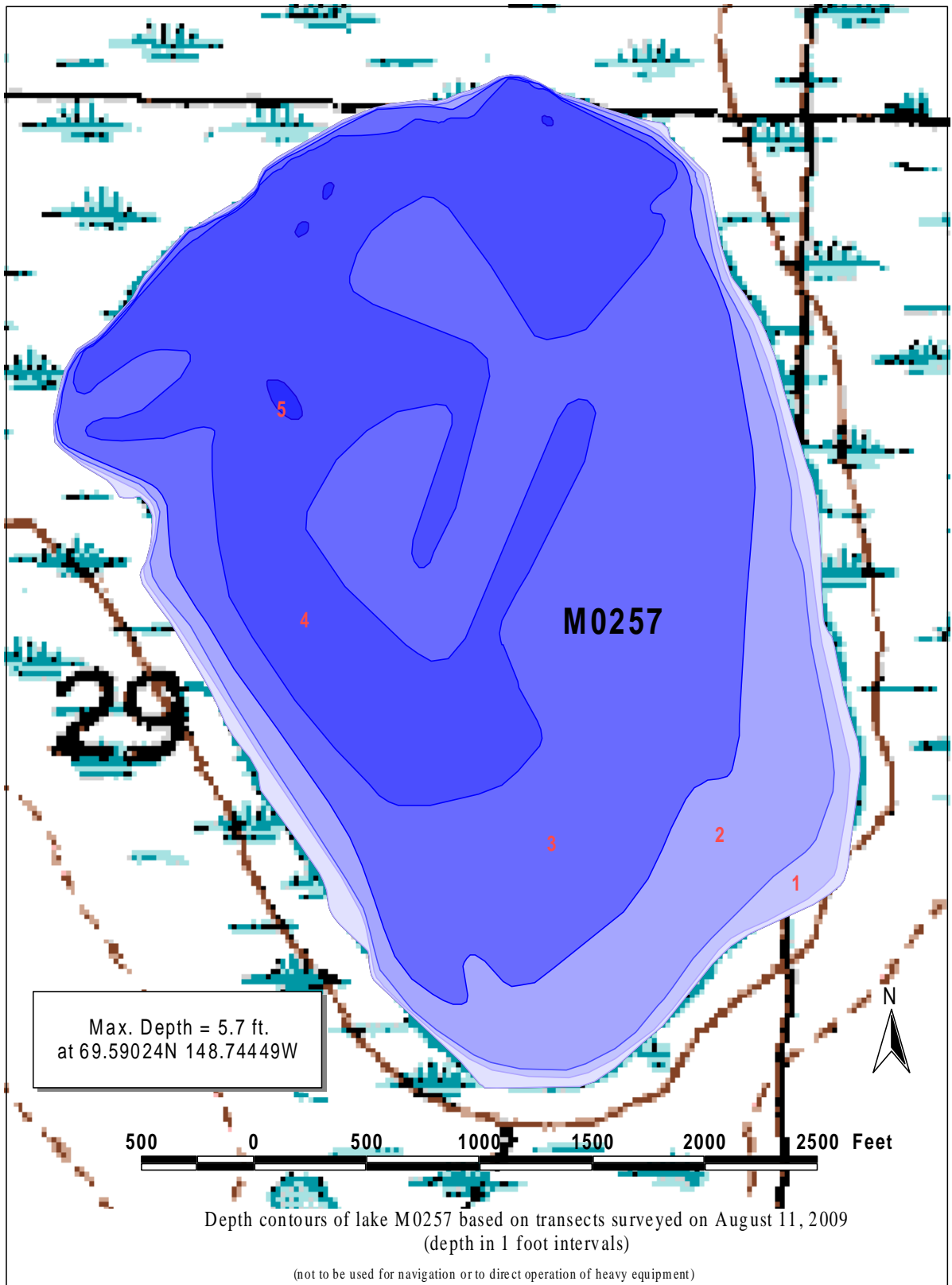


Figure 2. Lakes surveyed as potential water sources to support remediation efforts at Nora and Susie well sites, 2009

**Nora-Susie
Lake Summaries**



Lake M0257

Other Names: L213
Location: 69.58814N 148.73669W
USGS Quad Sheet: Sagavanirktok C-3: T3N R14E, Sec. 29
Habitat: Tundra Lake
Area: 234 acres
Maximum Depth: 5.7 feet
Active Outlet: No
Total Lake Volume: 262.7 million gallons
Water Volume Under 4 ft of ice: 9.29 million gallons
Water Volume Under 5 ft of ice: 0.06 million gallons
Water Volume Under 7 ft of ice: 0.00 million gallons

Potential Ice Aggregate: 155.5 acres (water depth 4 ft or less)
 46.1 million gallons available from upper 1 foot of ice

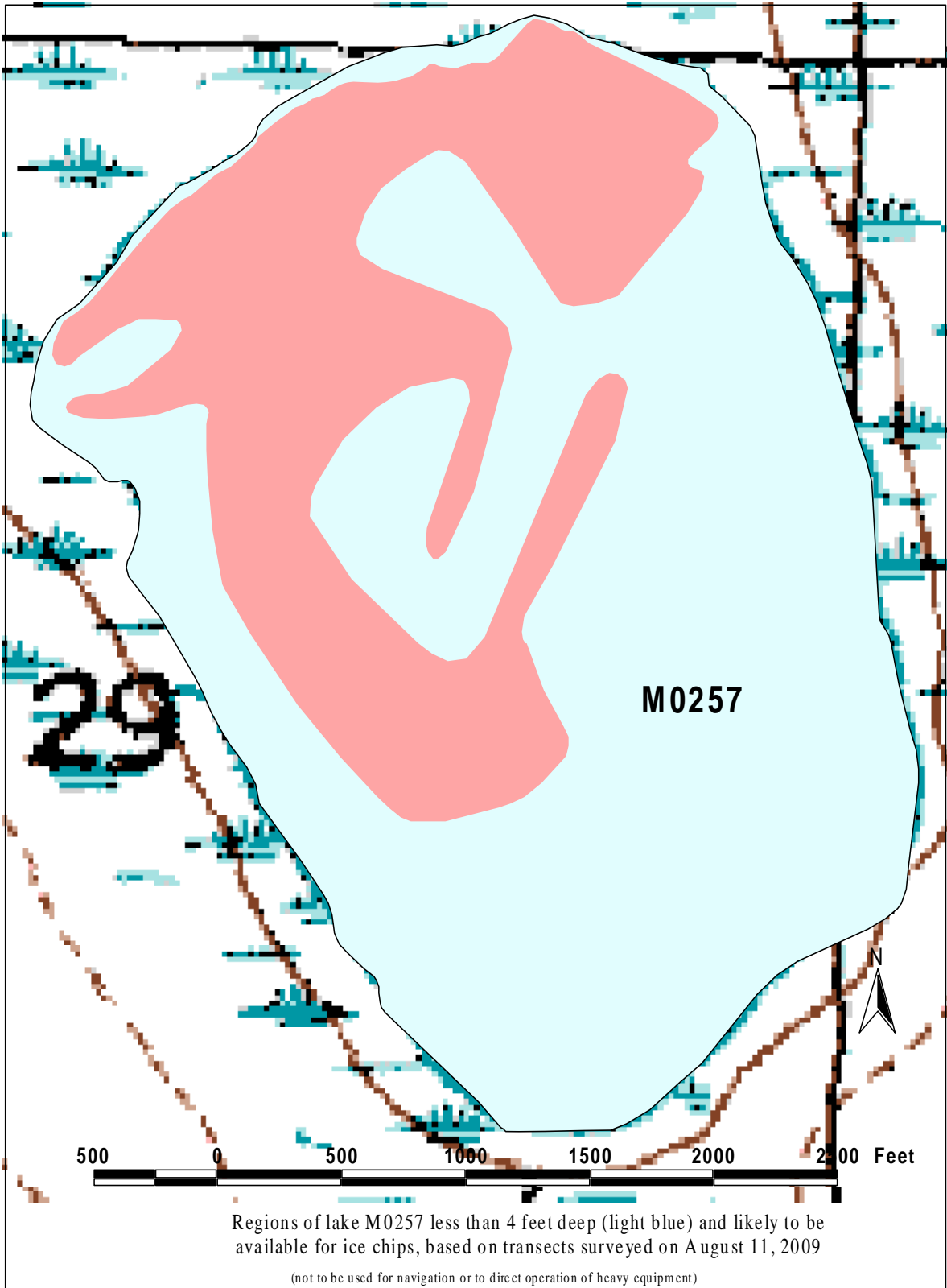
Maximum Recommended Winter Removal: **0.017 million gallons**
 (30% of water volume under 5 ft of ice)

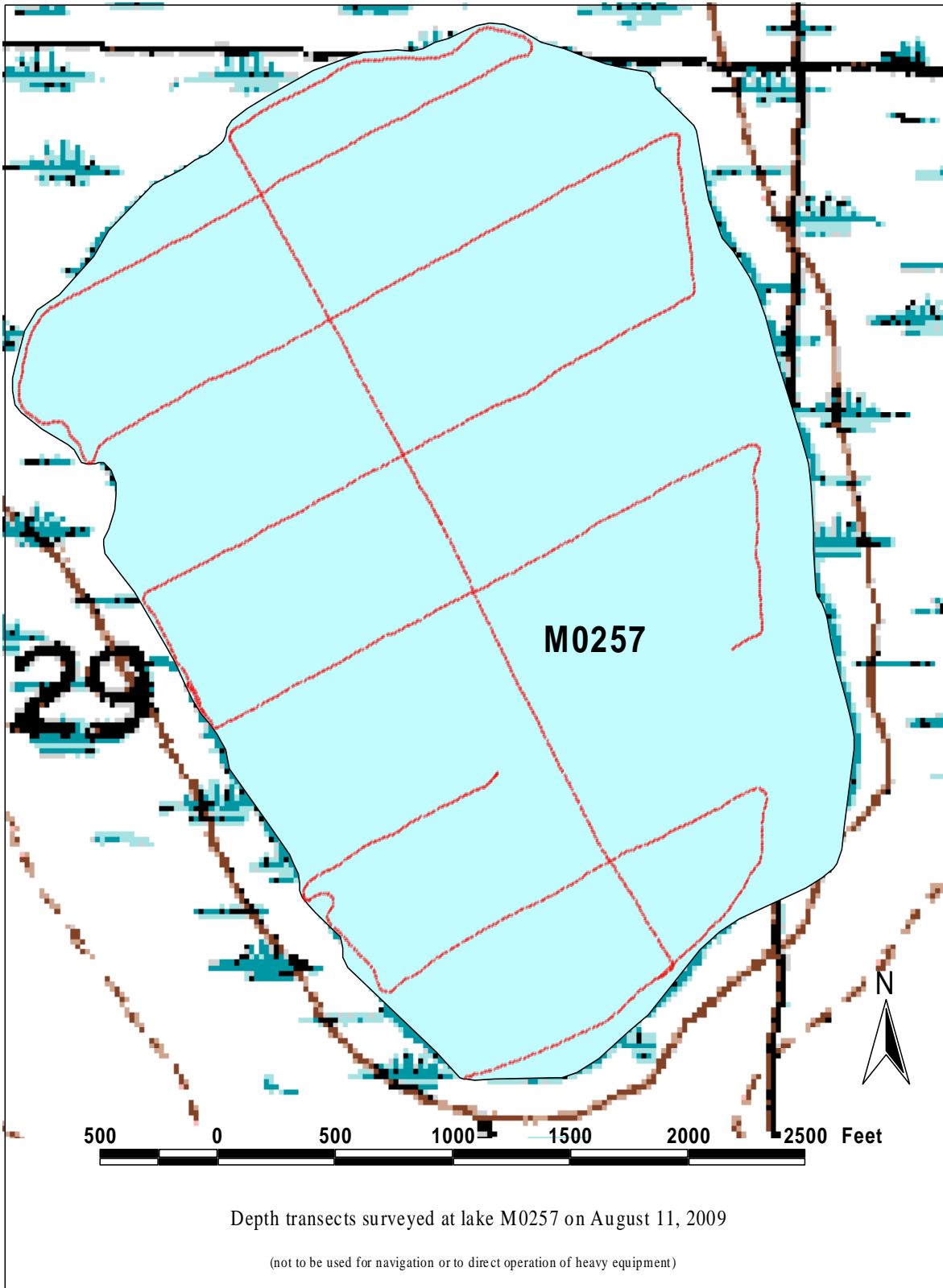
Water Chemistry:

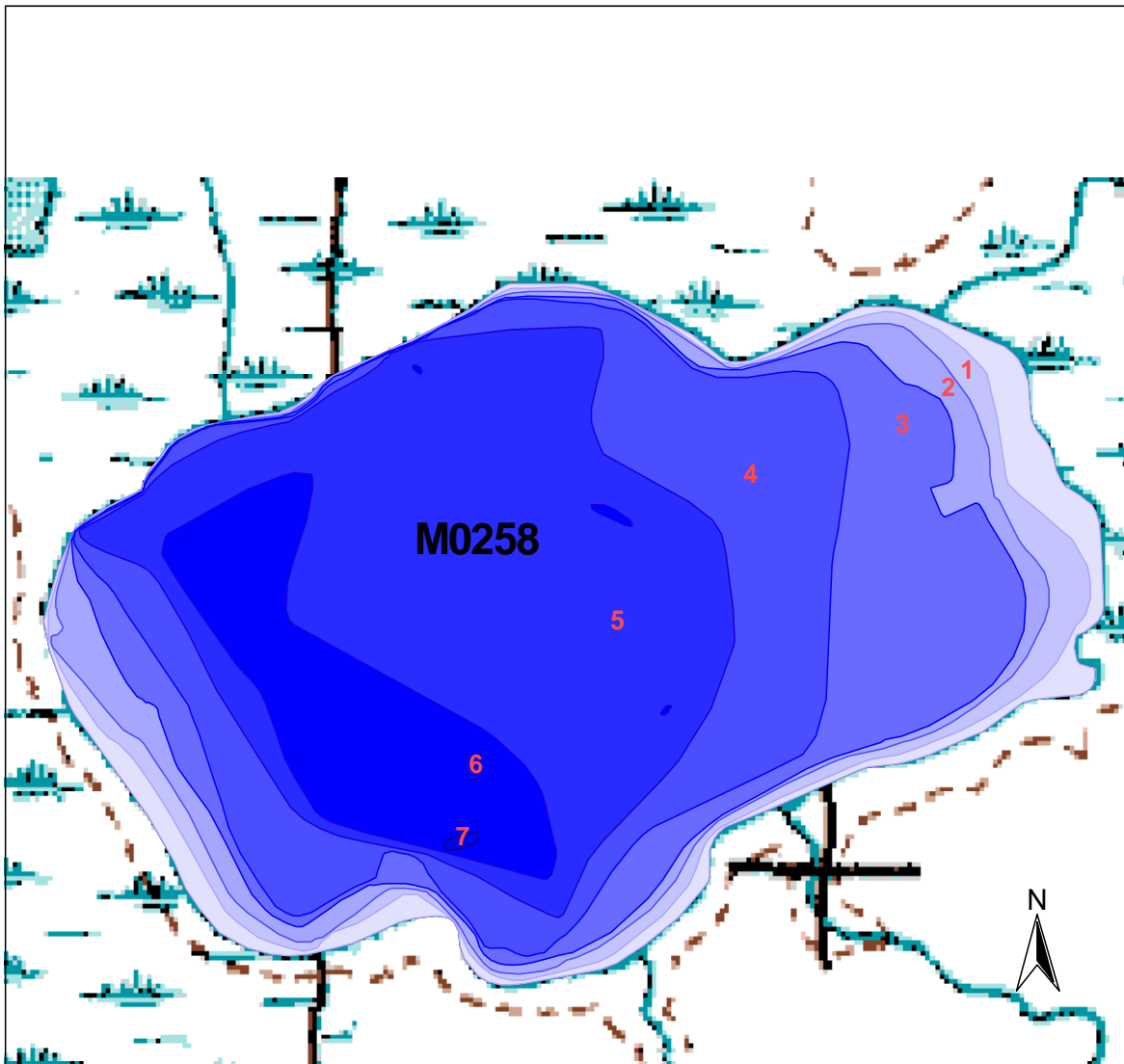
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2002	28.4	2.09	0.70	0.70	79.6	174	1.91	8.08	L. Moulton
2009	34.4	2.70	<1.00	1.21	97.0	173	0.82	7.93	this study

Catch Record:

Gear	Date	Effort		Species	Number Caught
		(hours)	other		
Gill Net	Jul 15 02	14.0		None	0
	Aug 10 09	6.5		None	0
Minnow Trap	Jul 15 02	9.0		None	0
	Aug 10 09	177.1		None	0
Seine Hauls	Jul 15 02		3 hauls	Ninespine stickleback	3
Visual Survey	Aug 10 09		50 yds	Ninespine stickleback	1







Max. Depth = 7.6 ft.
at 69.58365N 148.67941W

1000 0 1000 2000 3000 Feet

Depth contours of lake M0258 based on transects surveyed on August 11, 2009
(depth in 1 foot intervals)

(not to be used for navigation or to direct operation of heavy equipment)

Lake M0258

Other Names: L216
Location: 69.58673N 148.67821W
USGS Quad Sheet: Sagavanirktok C-3: T3N R14E, Sec. 27/28
Habitat: Drainage Lake
Area: 250.1 acres
Maximum Depth: 7.6 feet
Active Outlet: Yes
Total Lake Volume: 354.2 million gallons
Water Volume Under 4 ft of ice: 70.74 million gallons
Water Volume Under 5 ft of ice: 25.27 million gallons
Water Volume Under 7 ft of ice: 0.02 million gallons

Potential Ice Aggregate: 83.8 acres (water depth 4 ft or less)
 24.8 million gallons available from upper 1 foot of ice

Maximum Recommended Winter Removal: **0.003 million gallons**
 (15% of water volume under 7 ft of ice)

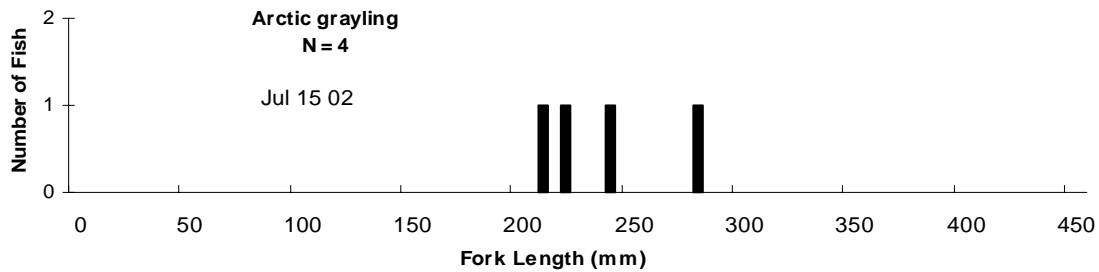
Water Chemistry:

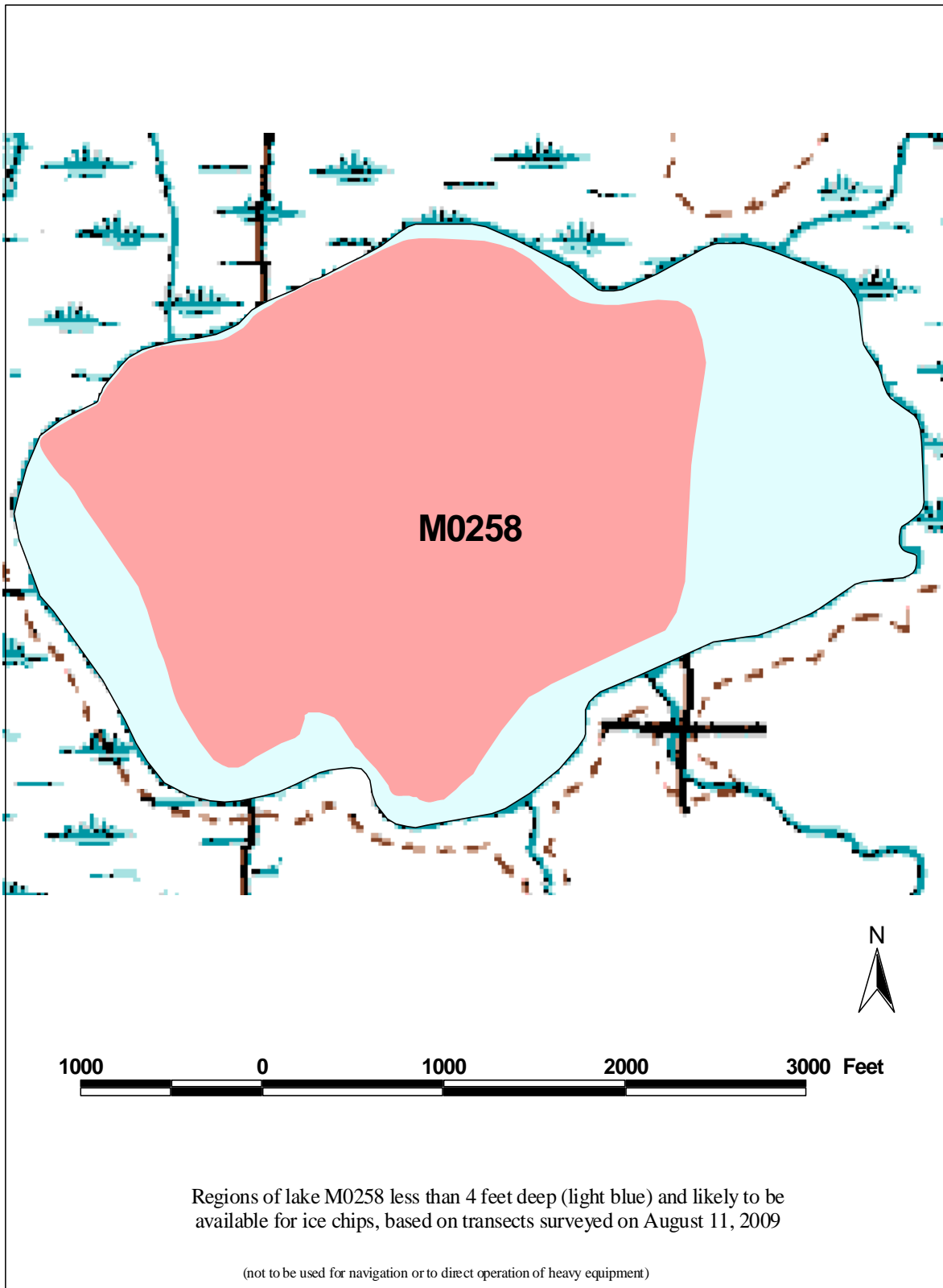
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2002	17.3	1.03	0.36	0.70	47.3	106	1.33	8.00	L. Moulton
2009	24.3	1.39	<1.00	1.37	66.5	123	1.28	7.78	this study

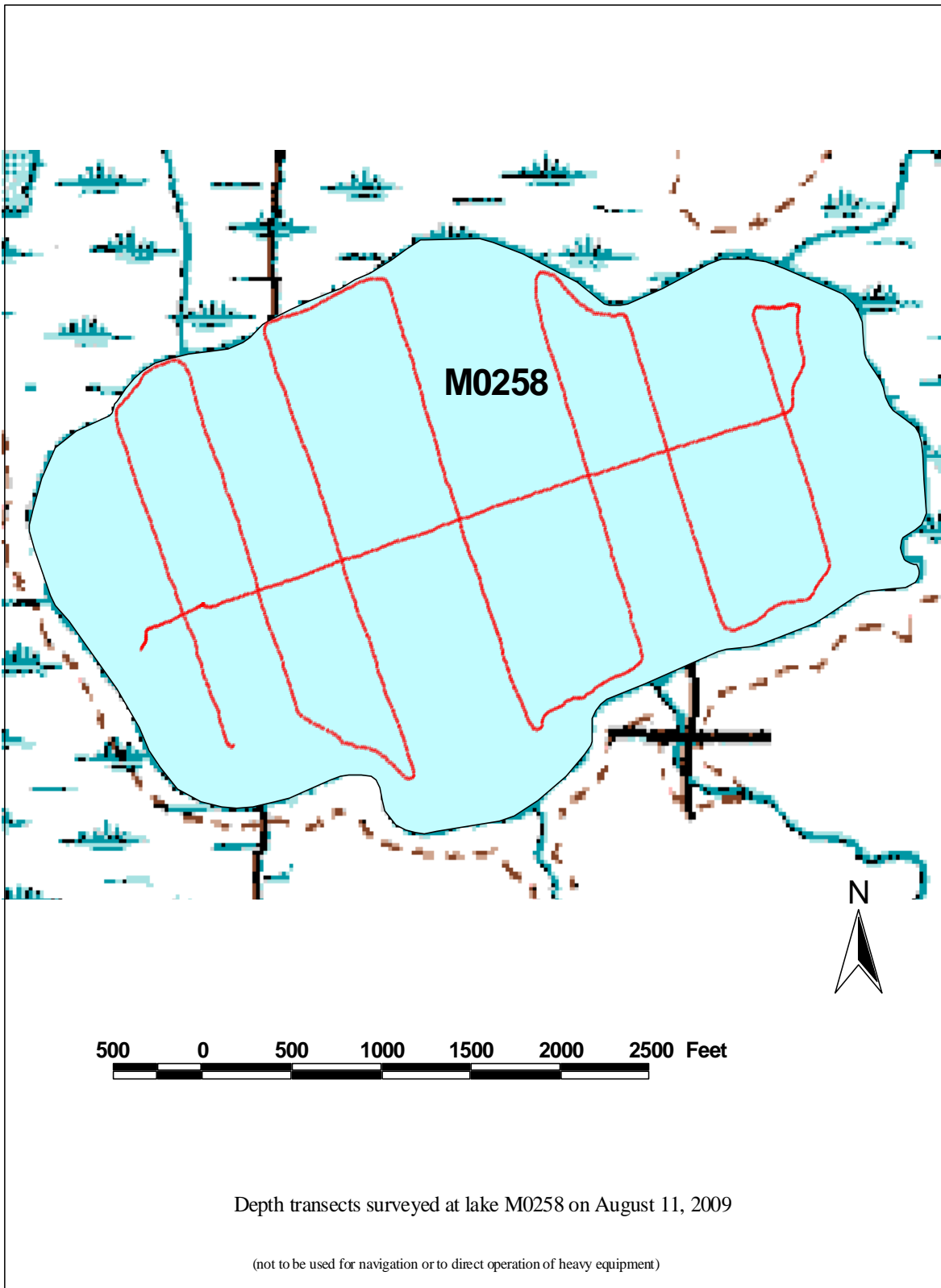
Catch Record:

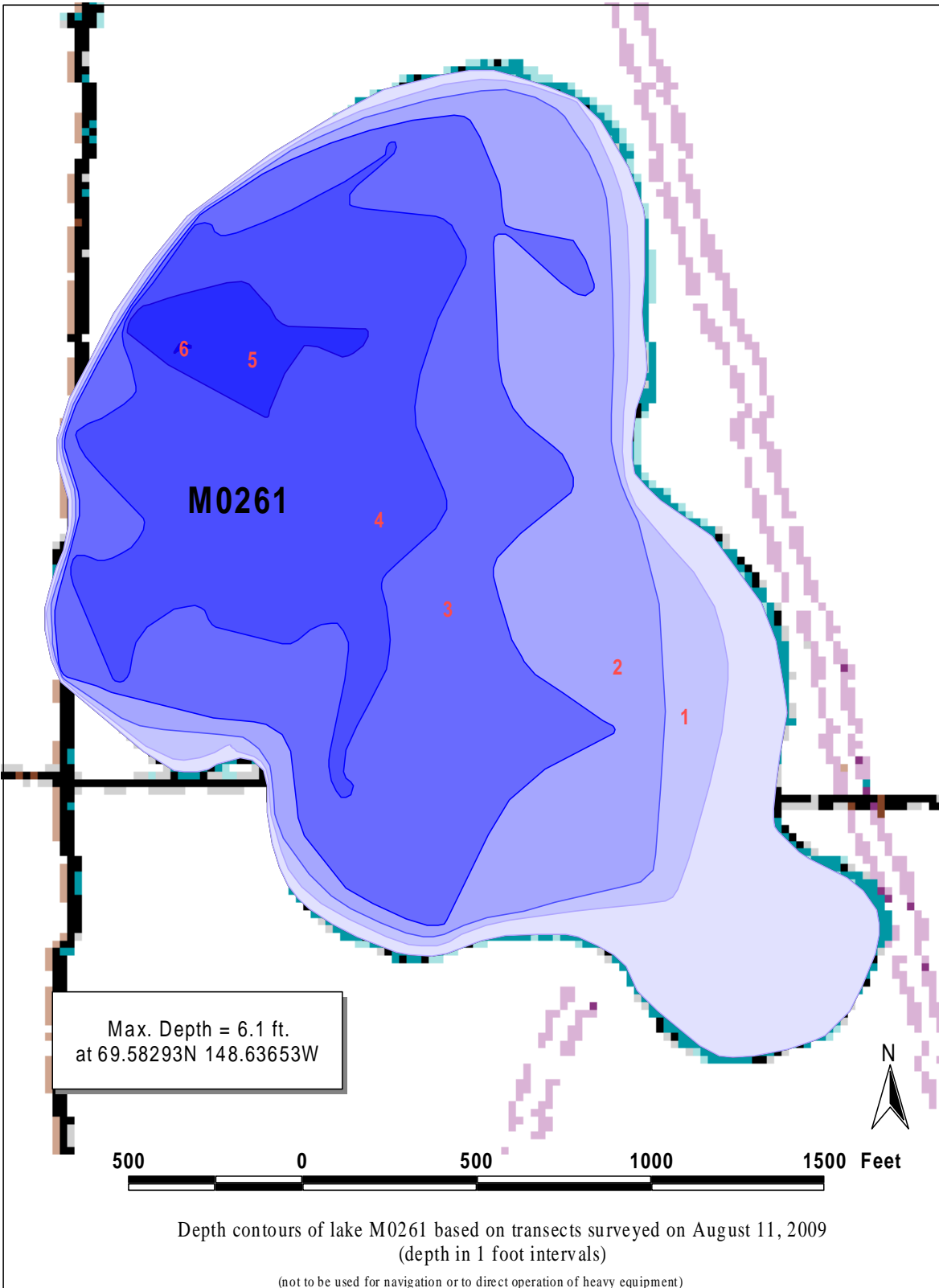
Gear	Date	Effort		Species	Number Caught	Fork Length (mm)
		(hours)	(hauls)			
Gill Net	Jul 15 02	0.2		Arctic grayling	4	215-284
Minnow Trap	Jul 15 02	0.0		None	0	
Seine Hauls					0	

(no fishing in 2009, Arctic grayling assumed to be present)









Lake M0261

Other Names: L217
Location: 69.58093N 148.63617W
USGS Quad Sheet: Sagavanirktok C-3: T3N R14E, Sec. 26/35
Habitat: Tundra Lake
Area: 90.0 acres
Maximum Depth: 6.1 feet
Active Outlet: No
Total Lake Volume: 85.8 million gallons
Water Volume Under 4 ft of ice: 4.13 million gallons
Water Volume Under 5 ft of ice: 0.32 million gallons
Water Volume Under 7 ft of ice: 0.00 million gallons

Potential Ice Aggregate: 65.9 acres (water depth 4 ft or less)
 19.5 million gallons available from upper 1 foot of ice

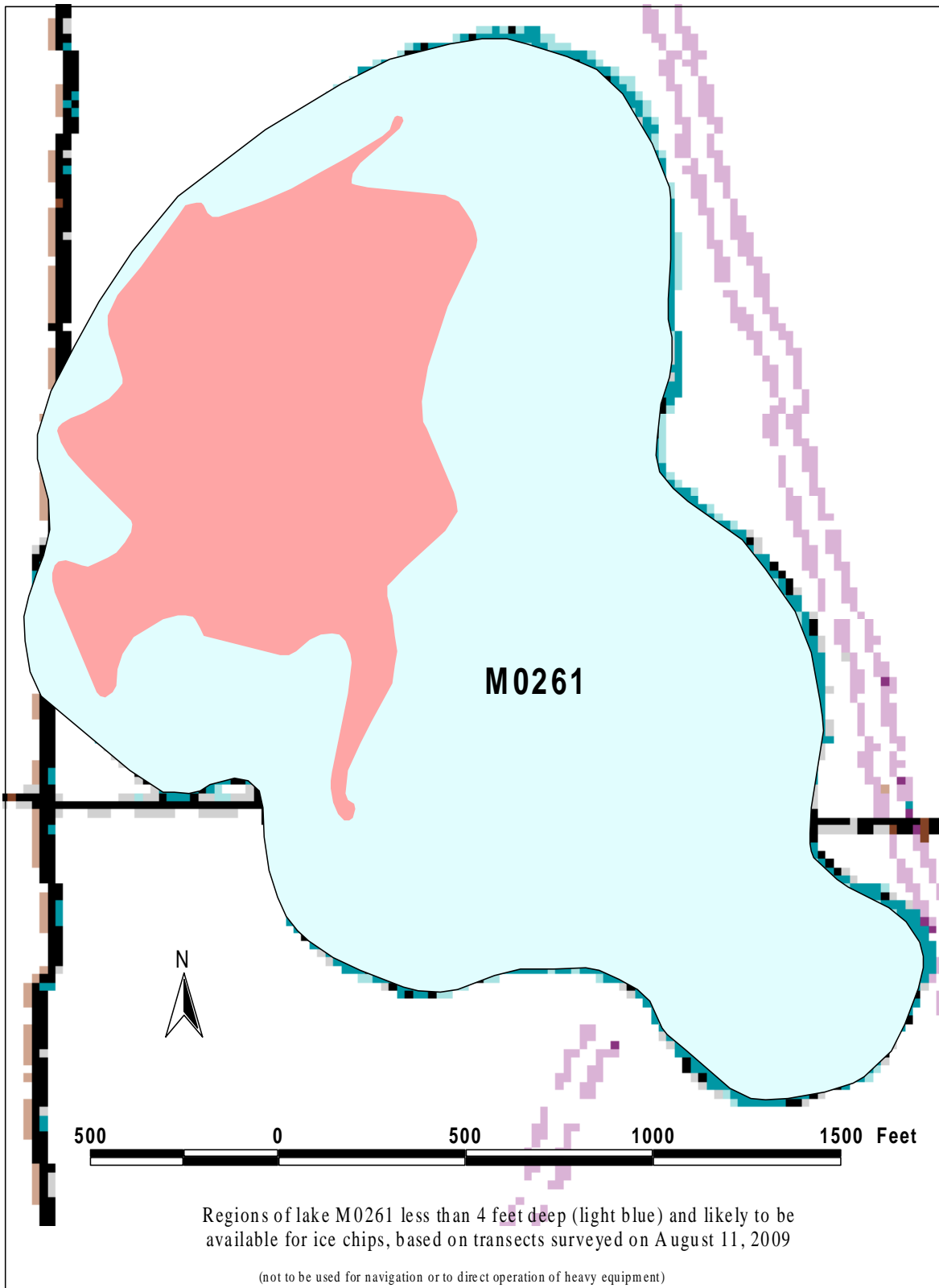
Maximum Recommended Winter Removal: **0.097 million gallons**
 (30% of water volume under 5 ft of ice)

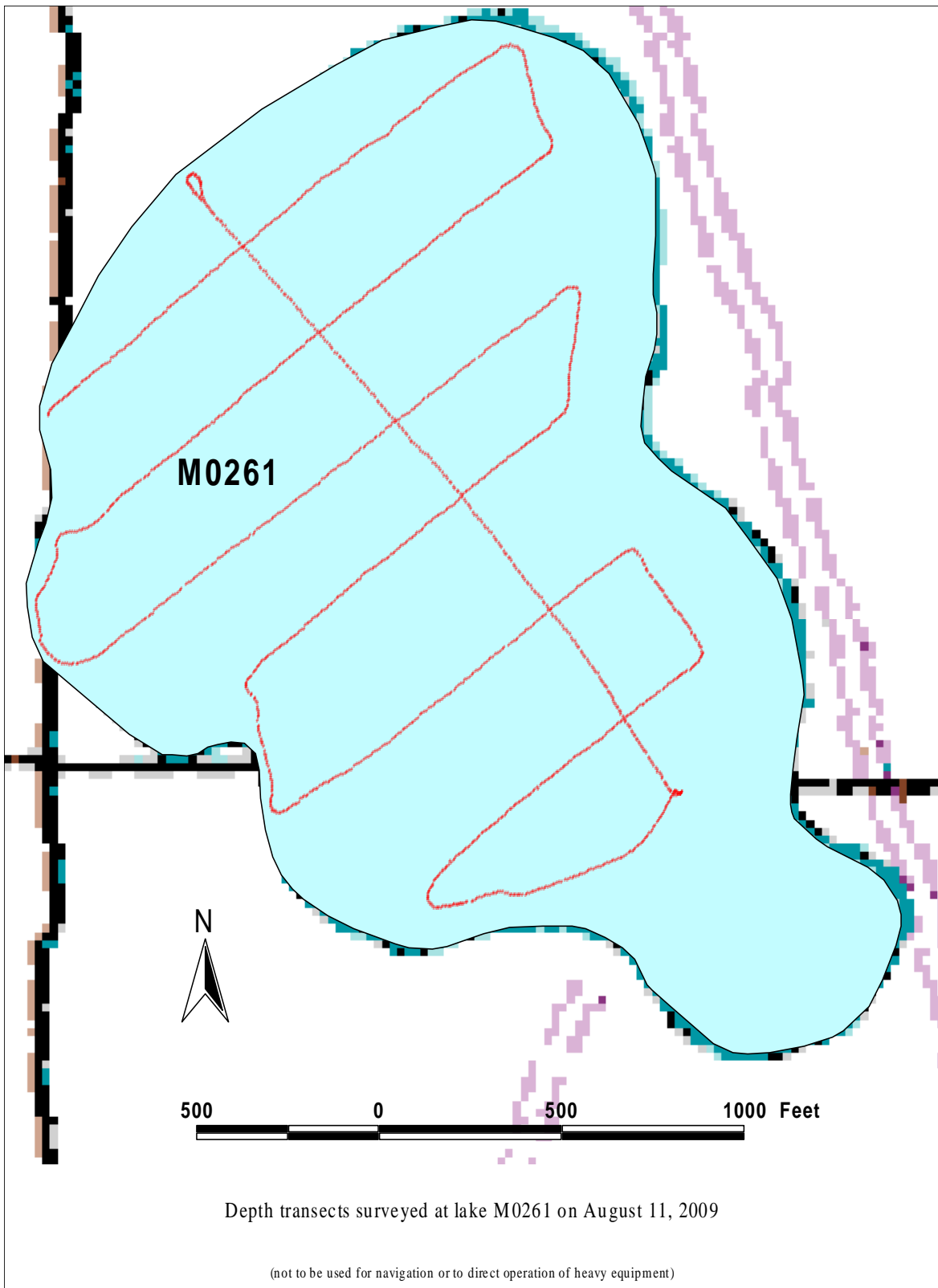
Water Chemistry:

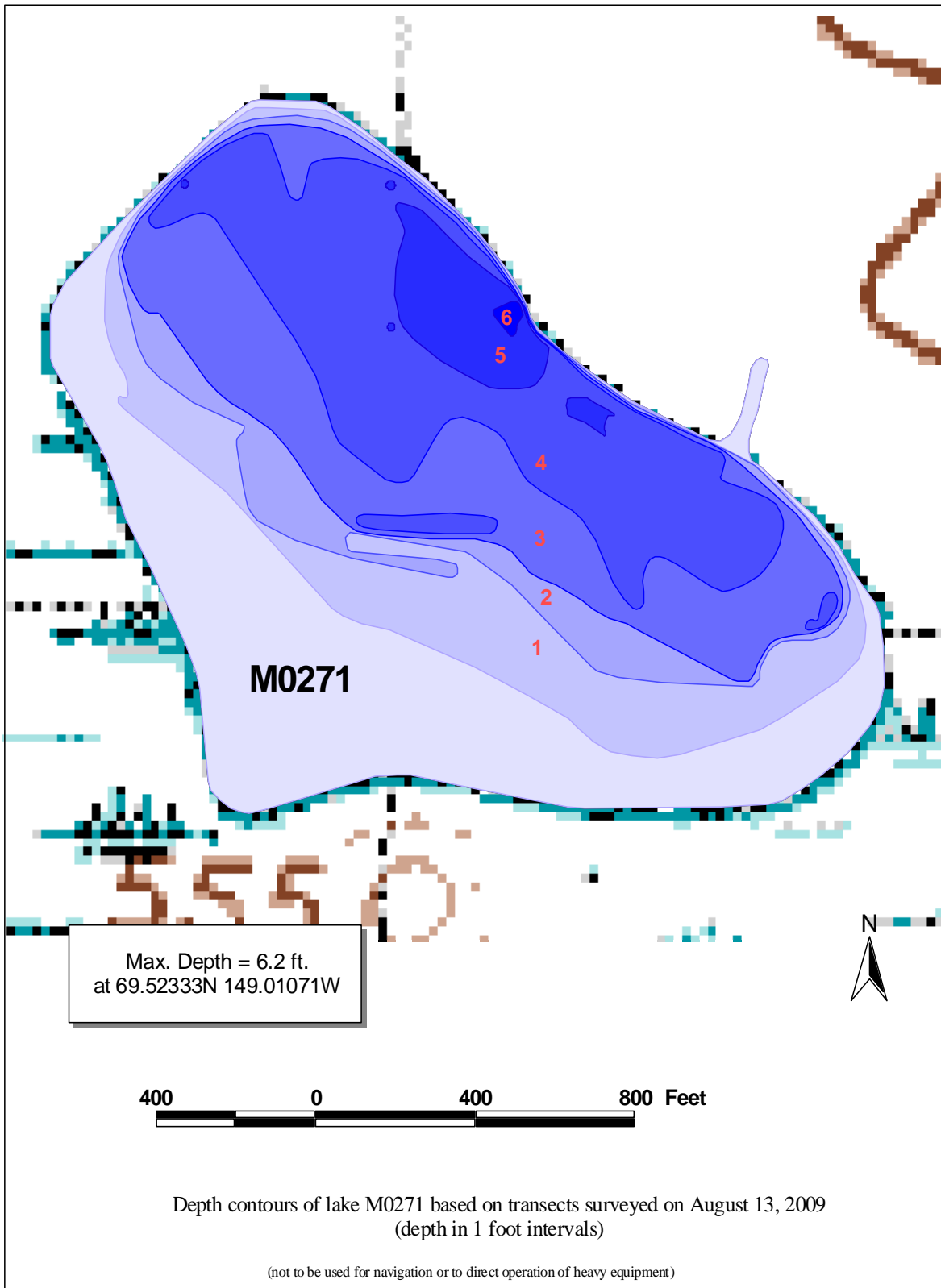
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2002	30.0	2.54	0.77	7.30	85.5	201	3.07	8.40	L. Moulton
2009	37.1	3.29	<1.00	11.80	106.0	198	1.15	7.91	this study

Catch Record:

Gear	Date	Effort		Species	Number Caught
		(hours)	(hauls)		
Gill Net	Jul 17 02	9.5		None	0
	Aug 11 09	4.3		None	
Minnow Trap	Jul 17 02	9.5		Ninespine stickleback	2
	Aug 11 09	6.8		Ninespine stickleback	3
Seine Hauls	Jul 17 02		3	None	0







Lake M0271

Other Names: L210
Location: 69.52177N 149.01261W
USGS Quad Sheet: Sagavanirktok C-4: T2N R13E, Sec. 17/18/19/20
Habitat: Tundra Lake
Area: 52.1 acres
Maximum Depth: 6.2 feet
Active Outlet: No
Total Lake Volume: 42.7 million gallons
Water Volume Under 4 ft of ice: 2.82 million gallons
Water Volume Under 5 ft of ice: 0.33 million gallons
Water Volume Under 7 ft of ice: 0.00 million gallons

Potential Ice Aggregate: 37.5 acres (water depth 4 ft or less)
 11.1 million gallons available from upper 1 foot of ice

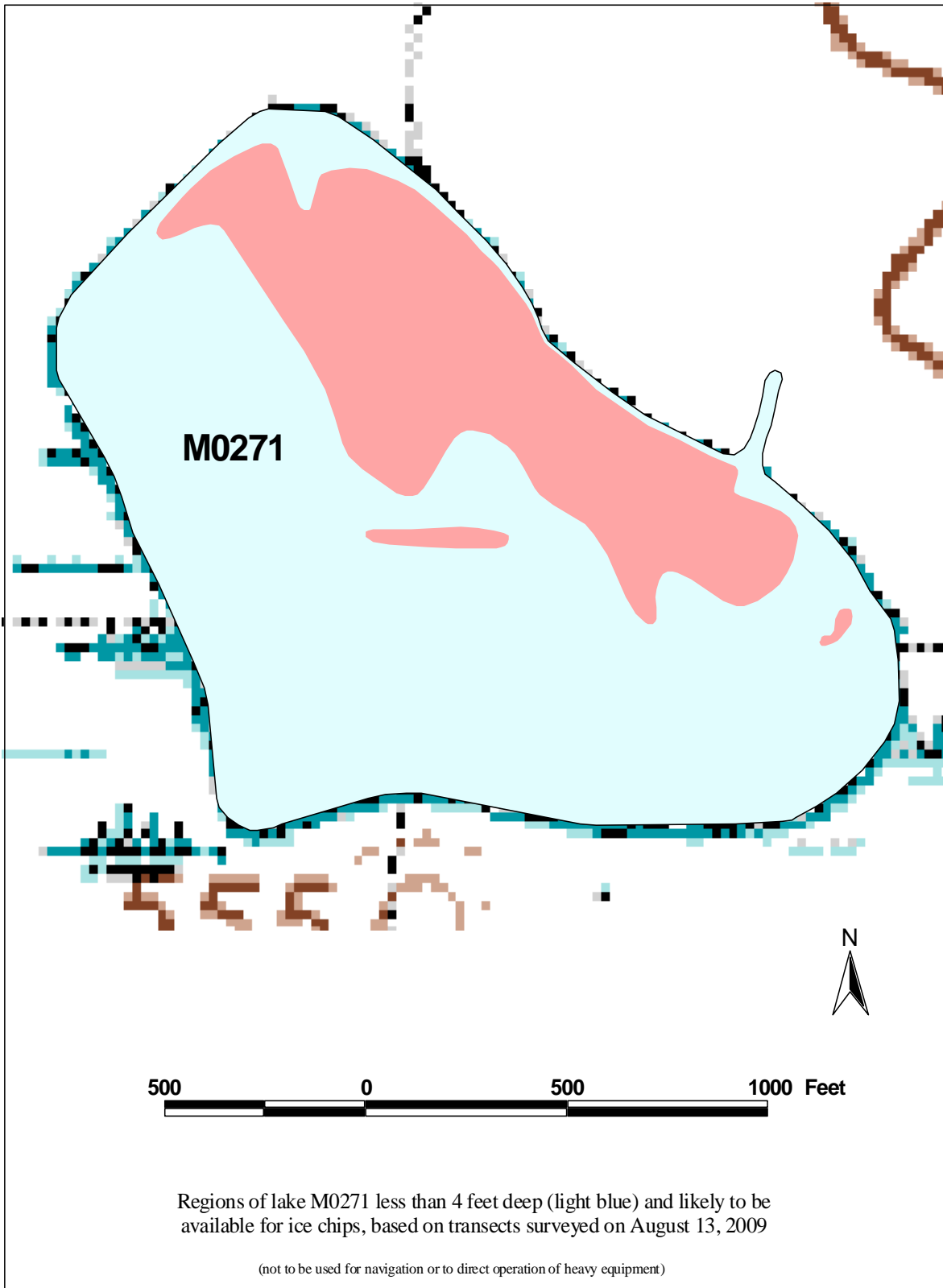
Maximum Recommended Winter Removal: **8.53 million gallons**
 (20% of lake volume)

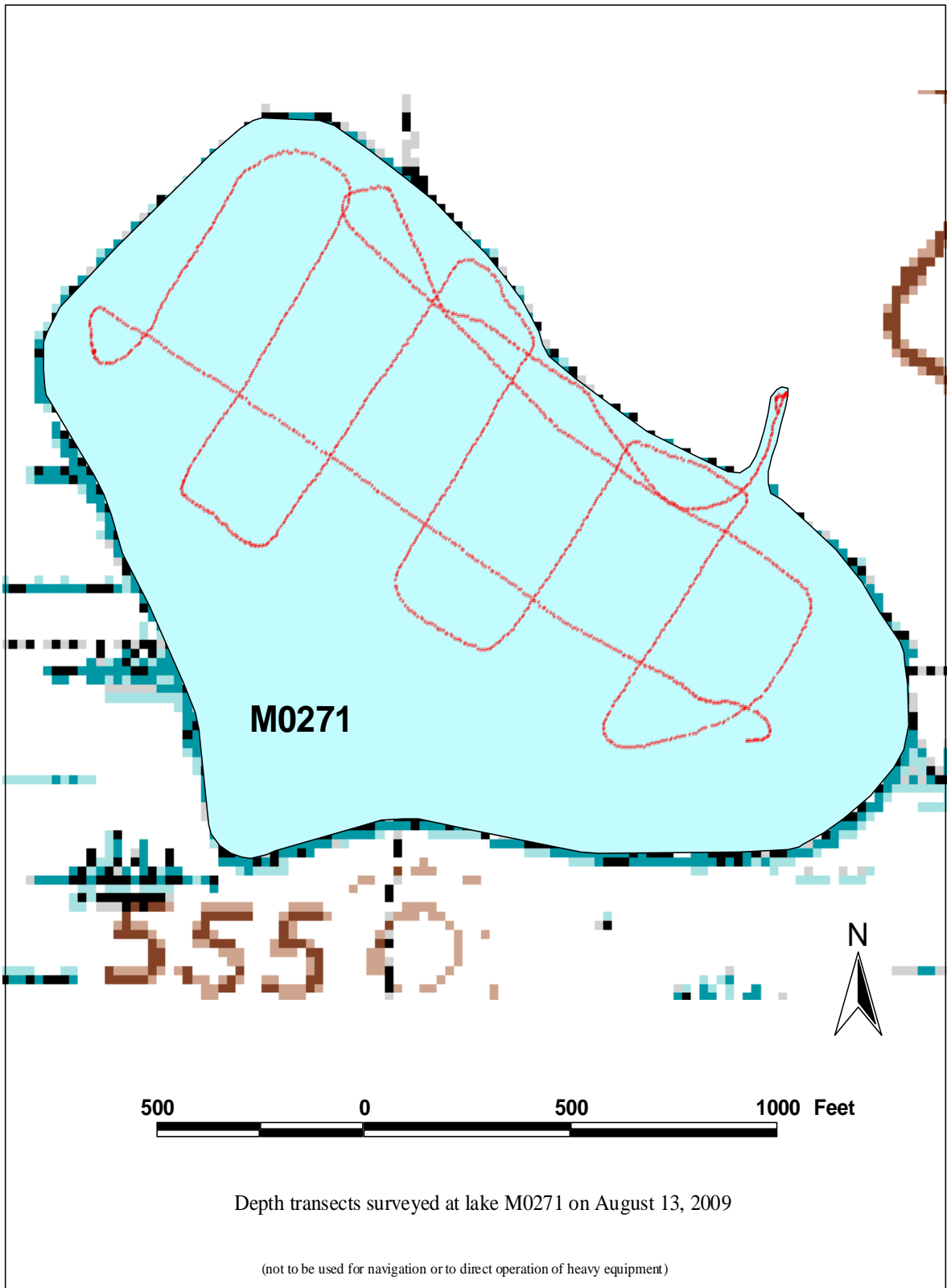
Water Chemistry:

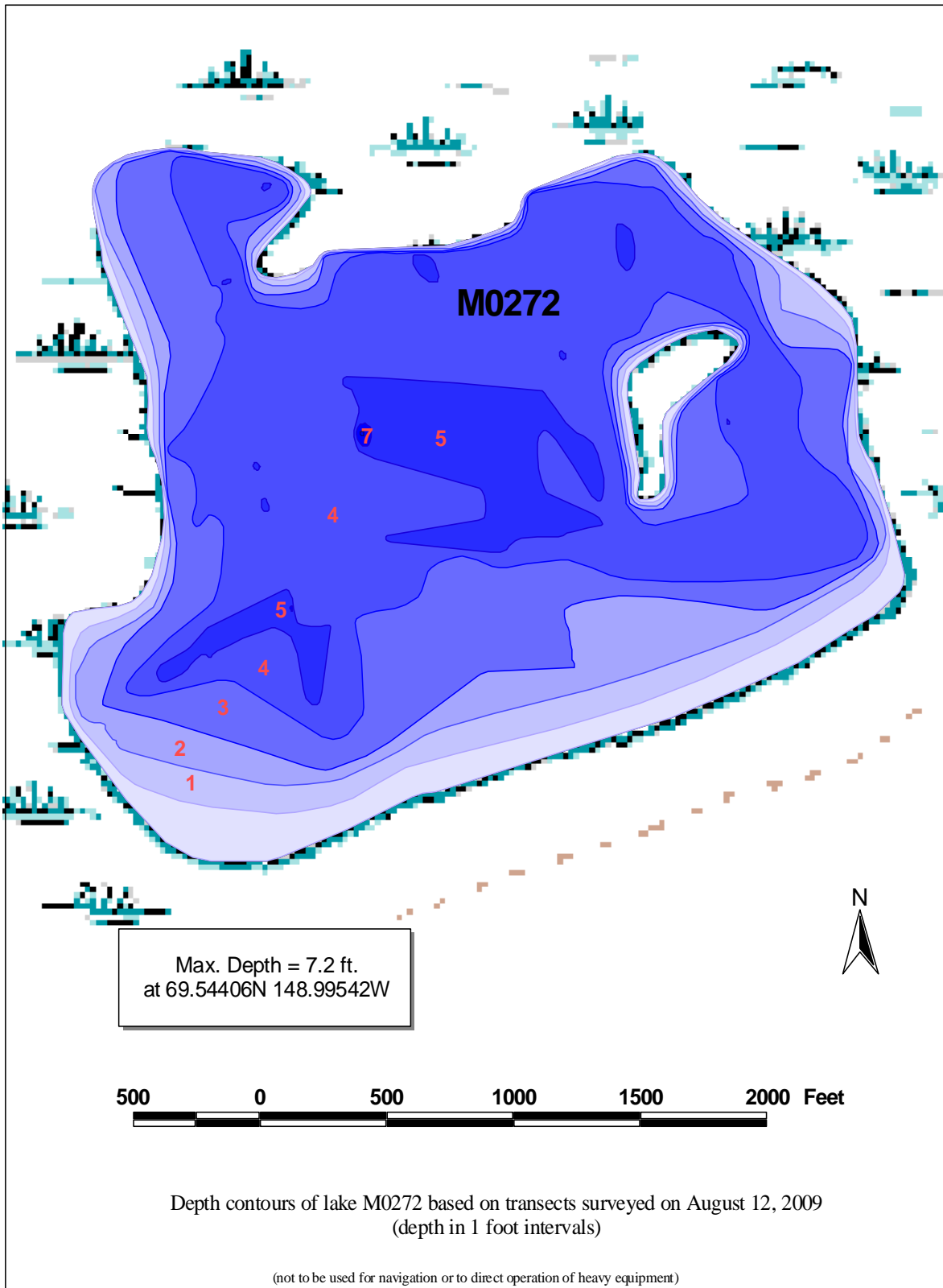
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total		Turbidity (NTU)	pH	Source
					Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)			
2002	26.2	3.56	0.57	1.30	80.0	171	1.33	8.02	L. Moulton
2009	28.7	3.88	<1.00	1.82	87.7	157	1.54	7.80	this study

Catch Record:

Gear	Date	Effort		Species	Number Caught
		(hours)	other		
Gill Net	Jul 23 02	6.3		None	0
	Aug 13 09	8.6		None	0
Minnow Trap	Jul 23 02	5.3		Ninespine stickleback	1
	Aug 13 09	11.6		None	0
Seine Hauls	Jul 23 02		3 hauls	None	0
Visual Survey	Aug 13 09		235 yd	None	0







Lake M0272

Other Names: L211
Location: 69.54346N 148.99188W
USGS Quad Sheet: Sagavanirktok C-4: T2N R13E, Sec. 8
Habitat: Tundra Lake
Area: 141.2 acres
Maximum Depth: 7.2 feet
Active Outlet: No
Total Lake Volume: 161.4 million gallons
Water Volume Under 4 ft of ice: 13.47 million gallons
Water Volume Under 5 ft of ice: 1.39 million gallons
Water Volume Under 7 ft of ice: 0.00 million gallons

Potential Ice Aggregate: 70.2 acres (water depth 4 ft or less)
 20.8 million gallons available from upper 1 foot of ice

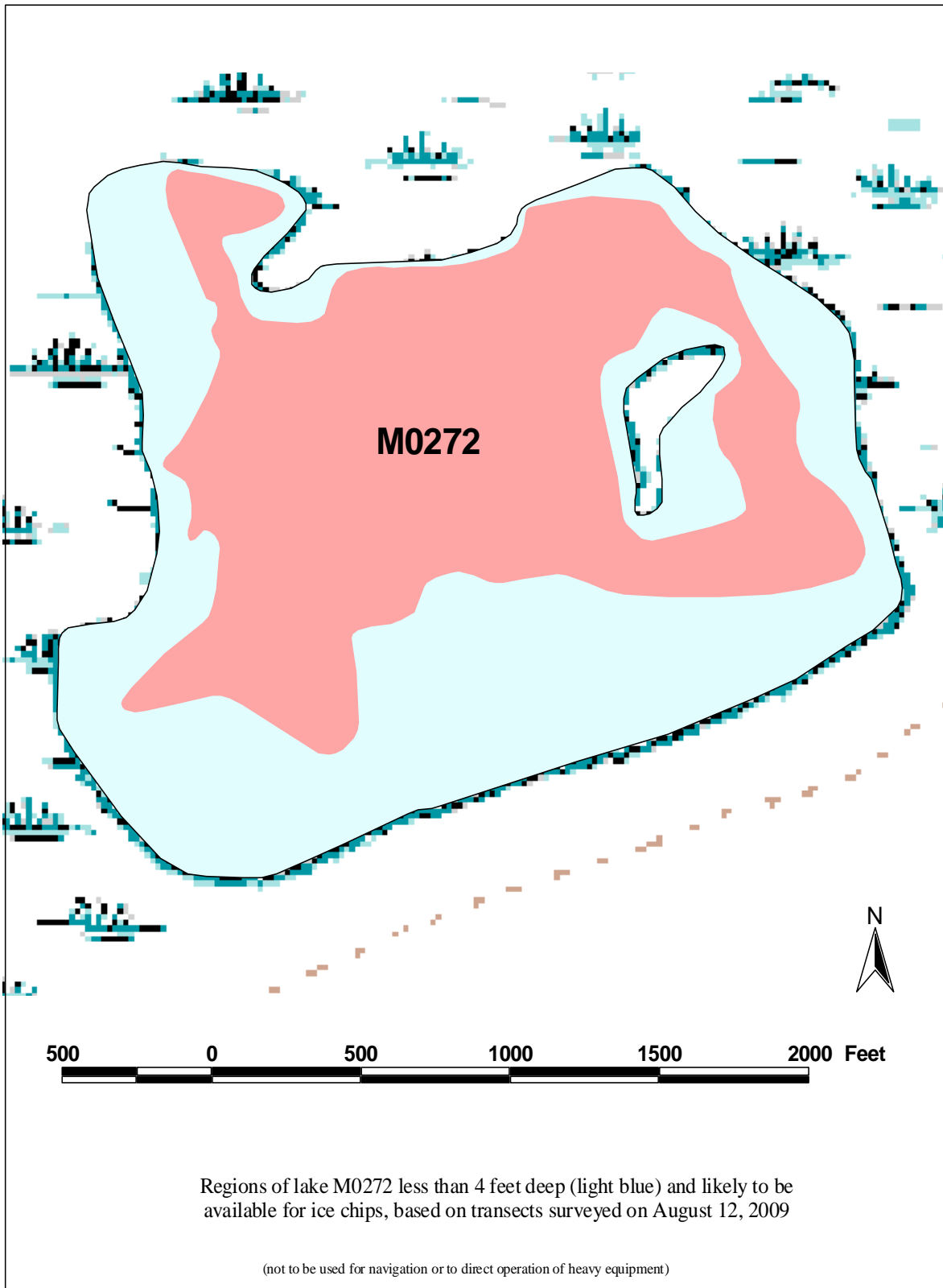
Maximum Recommended Winter Removal: **32.28 million gallons**
 (20% of lake volume)

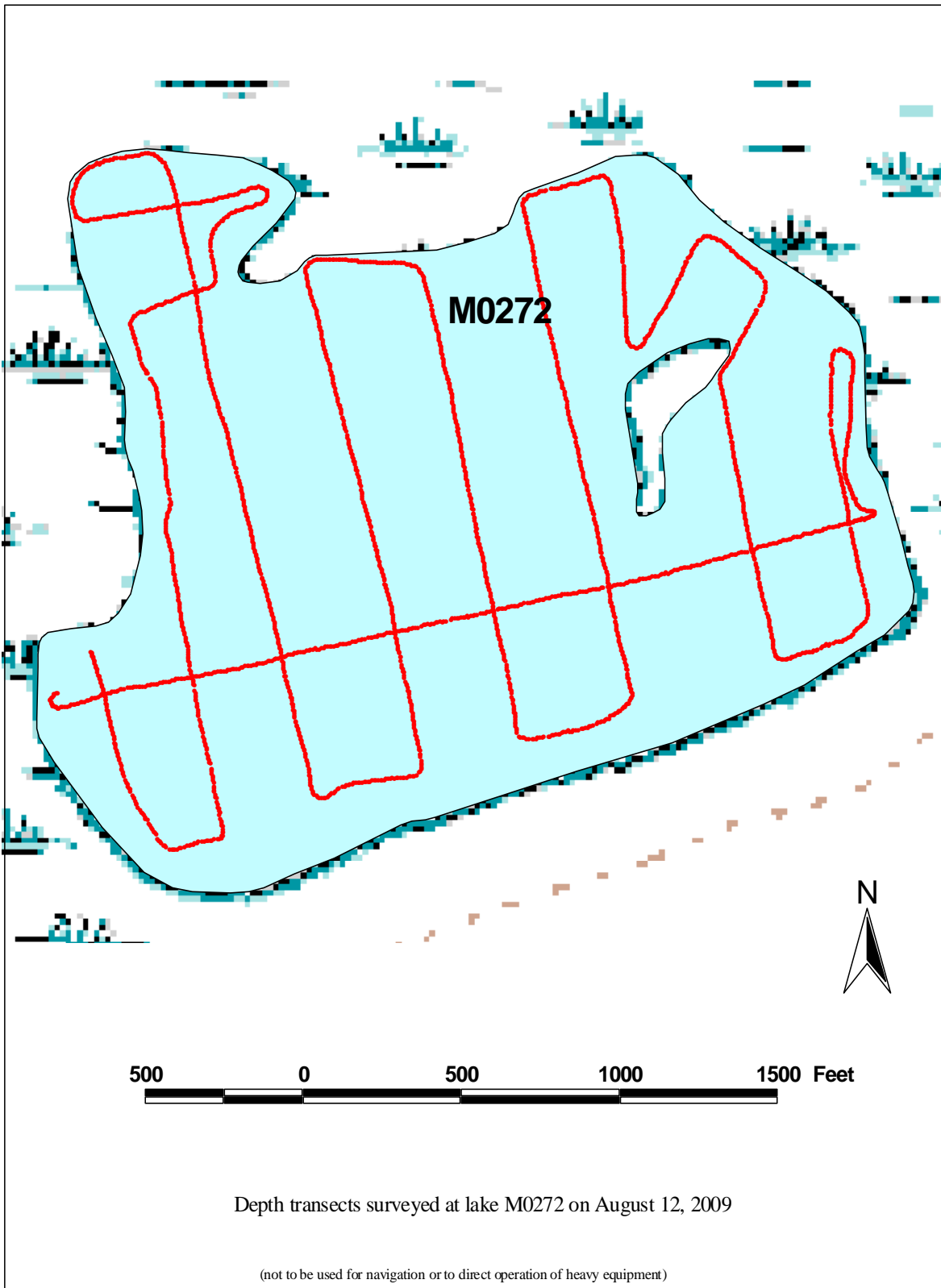
Water Chemistry:

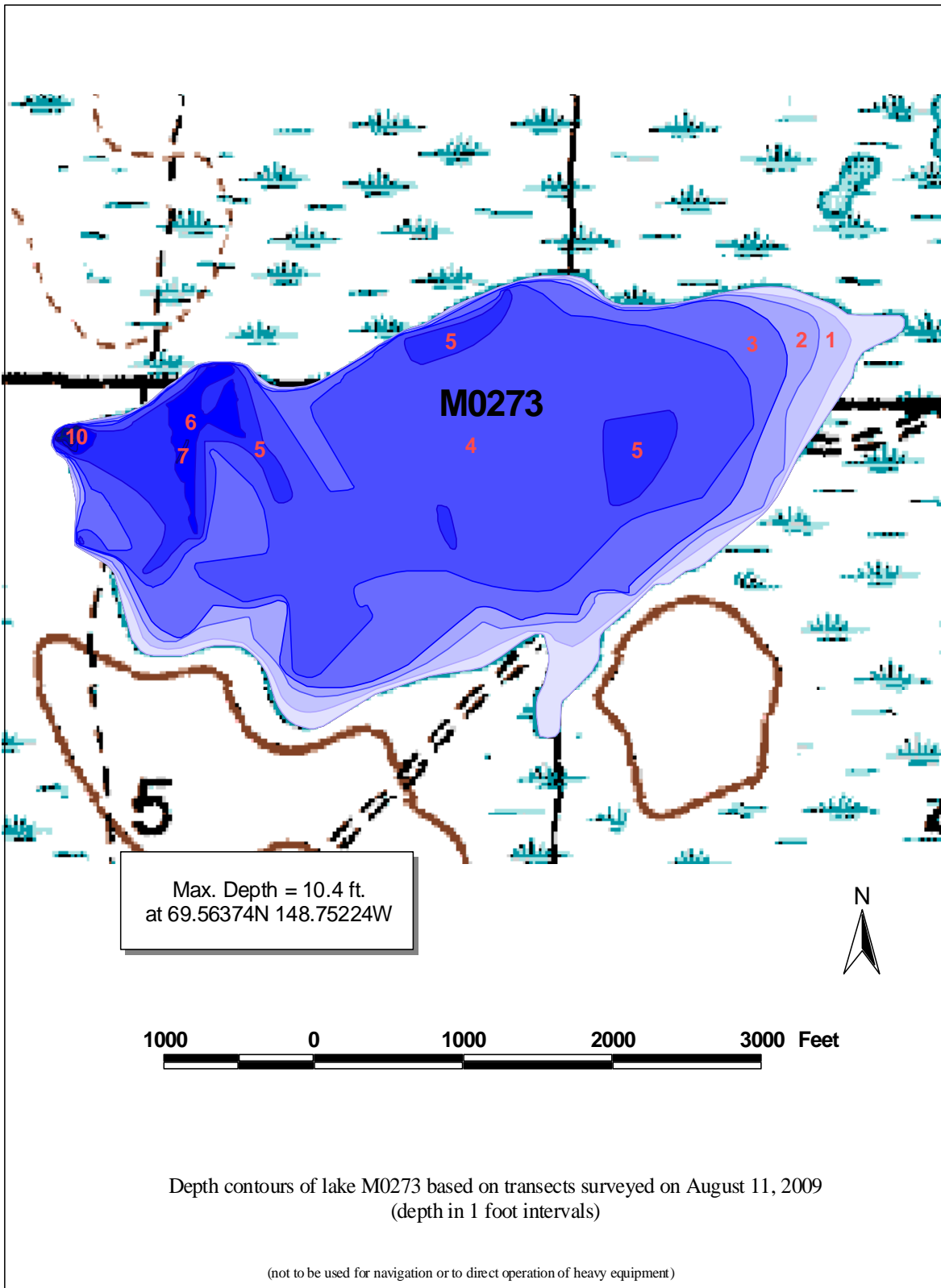
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO ₃] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2002	30.6	2.49	0.48	0.80	86.8	168	1.24	8.33	L. Moulton
2009	29.3	2.51	<1.00	1.25	83.4	152	1.71	8.07	this study

Catch Record:

Gear	Date	Effort		Species	Number Caught
		(hours)	(hauls)		
Gill Net	Jul 23 02	6.0		None	0
	Aug 12 09	9.7		None	0
Minnow Trap	Jul 23 02	5.0		None	0
	Aug 12 09	72.9		None	0
Seine Hauls	Jul 23 02		3	None	0







Lake M0273

Other Names: L212
Location: 69.56287N 148.73076W
USGS Quad Sheet: Sagavanirktok C-3: T2/3N R14E, Sec. 4/5/32/33
Habitat: Tundra Lake
Area: 224.9 acres
Maximum Depth: 10.4 feet
Active Outlet: No
Total Lake Volume: 279.7 million gallons
Water Volume Under 4 ft of ice: 29.37 million gallons
Water Volume Under 5 ft of ice: 5.58 million gallons
Water Volume Under 7 ft of ice: 0.20 million gallons

Potential Ice Aggregate: 90.3 acres (water depth 4 ft or less)
 26.8 million gallons available from upper 1 foot of ice

Maximum Recommended Winter Removal: **1.675 million gallons**
 (30% of water volume under 5 ft of ice)

Water Chemistry:

Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2002	39.5	3.52	1.44	4.70	113.0	252	1.85	8.33	L. Moulton
2009	43.9	4.40	1.6	6.41	128.0	228	1.74	8.08	this study

Catch Record:

Gear	Date	Effort		Species	Number Caught
		(hours)	(hauls)		
Gill Net	Jul 24 02	6.2		None	0
	Aug 11 09	6.6		None	
Minnow Trap	Jul 24 02	5.5		None	0
	Aug 11 09	96.1		Ninespine stickleback	1
Seine Hauls	Jul 24 02		3	None	0

