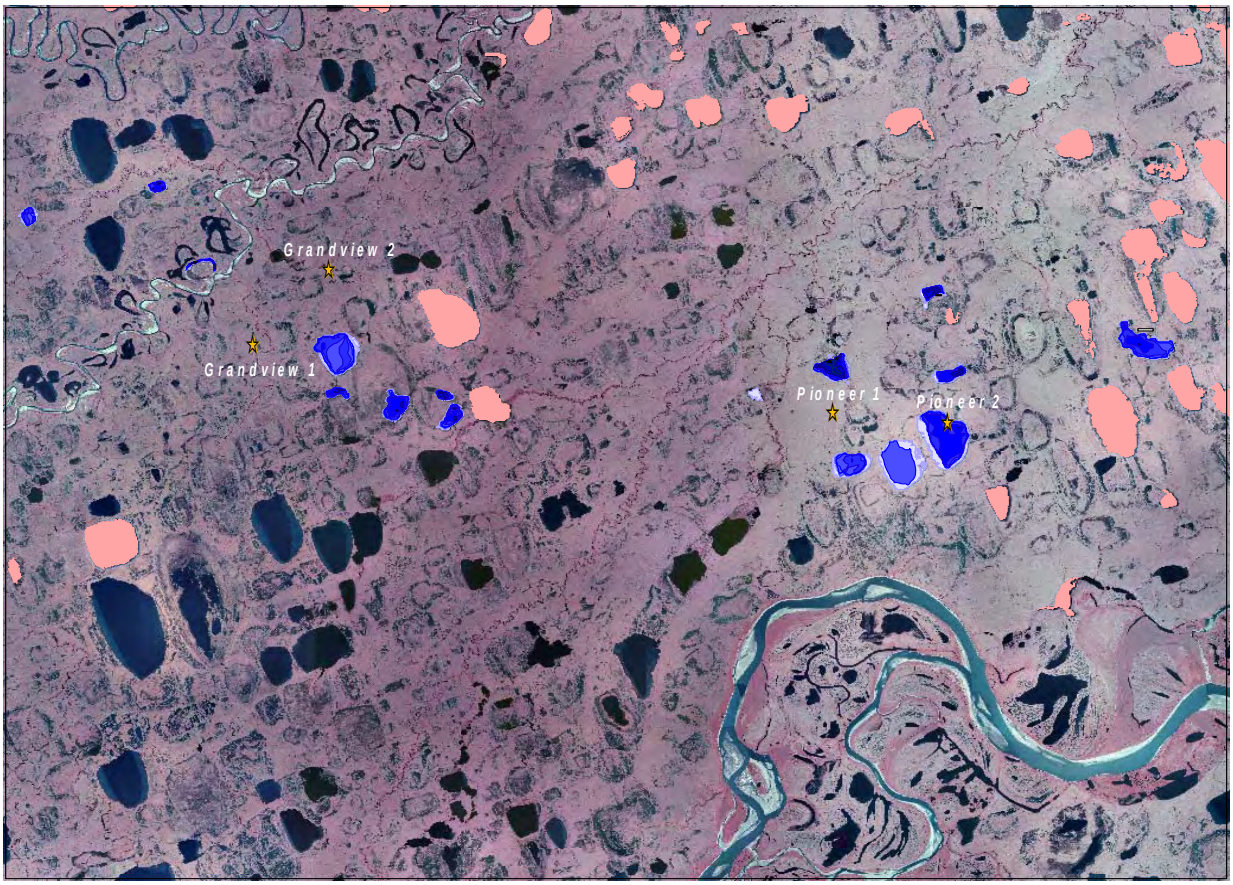
SURVEY OF LAKES IN SUPPORT OF CPAI EXPLORATION PROSPECTS – 2008

Final Report

September 2008



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The Woodlands, TX

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INTRODUCTION

ConocoPhillips (Alaska) plans to continue exploring for oil and gas deposits in the eastern portion of NPRA. Activities associated with exploration require withdrawal of water from lakes during winter to support industrial and domestic needs. 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 2008 survey sampled 17 lakes for potential use as water sources during winter exploration. The surveyed lakes were selected to support potential activities at four exploration sites:

1. Char – 1 lake,
2. Pioneer – 8 lakes,
3. East Grandview – 5 lakes, and
4. West Grandview – 3 lakes

Additional lakes in this region have been previously surveyed by MJM Research beginning in 1998 and continuing through 2007. The goals of this study were to conduct surveys of selected lakes to estimate the volume of water available for use, and to document fish presence and habitat use in lakes for lakes that may be used to support exploration activities.

The objectives of the survey were to:

1) obtain lake bathymetry and estimate water volumes for selected lakes,

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.

The selected lakes may be used as sources of freshwater during oil exploration and development 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.

METHODS

The biological survey consisted of sampling with:

- gill nets for sensitive species,
- minnow traps,
- 20 ft beach seine, and
- 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.

At lakes where bottom contours allowed, a 20 ft beach seine was pulled through vegetation beds or detritus deposits along the lakeshore to detect small fishes.

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, 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 2020 turbidity meter. A water sample was sent to Arctic Fox 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. 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 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 or 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.

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 (M0804) of the 17 lakes evaluated for fish contained Arctic grayling, while M0014 was documented to contain least cisco during 2001 (Table 2). Ninespine stickleback were detected at 9 additional lakes. Fish were not detected at 4 of the 17 evaluated lakes.

Water Chemistry Measurements

Water chemistry parameters measured in the studied lakes are presented Table 3. Surface water temperature during the July 11-16 sampling in 2008 averaged 16.6^{o}C, ranging from 14.6^{o}C to 19.8^{o}C. As expected for natural surface waters, dissolved oxygen was high, averaging around 9.6 mg/l. Specific conductance ranged from 60 to 382 microSiemens/cm, with the exception of 3,170 microSiemens/cm. at M0801, at coastal lake subject to flooding by marine water. PH ranged from 7.48 to 8.35.

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, the 17 lakes surveyed in the eastern NPRA Study Area during 2008 should provide 135.8 million gallons of water for under-ice withdrawal during winter.

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 687.3 acres of ice chips from lakes surveyed for the exploration use, which is equivalent to 53.8 million gallons of water.

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Table 1. Summary of lakes sampled in 2008 for winter water use at CPAI exploration areas

Area	Lake Name	Latitude (NAD83)	Longitude (NAD83)	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Lake Volume (mill. gals)
Char									
	M0801	70.37948	151.12308	12N	4E	21	35.3	8.6	65.55
Pioneer									
	M0802	70.15803	151.24688	9N	3/4E	1/12/6/7	244.1	7.2	387.11
	M0803	70.17538	151.41234	10N	3E	32/33	55.4	8.5	87.57
	M0804	70.15369	151.48985	9N	2/3E	1/12/6/7	143.0	11.3	286.67
	M0805	70.15138	151.40034	9N	3E	8/9	78.7	8.5	120.92
	M0806	70.13345	151.40545	9N	3E	16/17/20/21	481.2	7.1	700.08
	M0807	70.12651	151.48133	9N	3E	17/18/20	370.9	<5	--
	M0808	70.12651	151.48133	9N	3E	18/19	172.4	6.1	198.29
	M0809	70.14755	151.55264	9N	2E	11	21.7	<5	--
Grandview East									
	M0016	70.16054	151.87870	9N	1E	3/4/9/10	306.2	6.2	411.60
	M0810	70.14903	151.79554	9N	1E	11/12	26.8	8.3	49.46
	R0059	70.15034	151.87935	9N	1E	9/10	35.3	7.6	58.09
	R0060	70.14578	151.83337	9N	1E	10/11	115.0	8.2	191.65
	R0067	70.14255	151.78975	9N	1E	11/12/13/14	80.5	7.5	120.32
Grandview West									
	M0103	70.20961	152.01622	10N	1W	24	34.6	8.1	56.45
	M0110	70.20166	152.11790	10N	1W	22	51.0	6.4	60.85
	M0114	70.18799	151.98649	10N	1E	30	18.3	11.7	19.49

Table 2. Summary of fish sampling for lakes surveyed in 2008 at CPAI exploration areas.

			Gill Nets		Minnow Traps		Seine		Visual Survey	
Area	**Lake Name**	**Sample Date**	**Set Duration (hours)**	**Fish Species[1]**	**Set Duration (hours)**	**Fish Species[2]**	**Effort**	**Fish Species[2]**	**Distance (yards)**	**Fish Species[2]**
Char										
	M0801	Jul 11 08	5.5	None	7.6	None	3 hauls	None	300	None
Pioneer										
	M0802	Jul 14 08	6.2	None	5.3	NSSB	0	--	0	--
	M0803	Jul 11 08	6.3	None	0.0	--	0	--	50	NSSB
	M0804	Jul 13 08	5.3	GRAY	0.2	NSSB	0	--	0	--
	M0805	Jul 13 08	6.2	None	4.6	None	2	NSSB	0	--
	M0806	Jul 13 08	7.2	None	7.4	None	2	NSSB	0	--
	M0808	Jul 11 08	6.3	None	4.7	NSSB	0	--	0	--
Grandview East										
	M0016	Jul 14 08	6.6	None	6.6	NSSB	0	--	100	NSSB
	M0810	Jul 15 08	6.6	None	0.0	--	0	--	5	NSSB
	R0059	Jul 16 08	8.5	None	8.4	None	6	None	220	None
	R0060	Jul 15 08	6.6	None	0.0	--	0	--	100	NSSB
	R0067	Jul 15 08	6.6	None	0.0	--	0	--	150	NSSB
Grandview West										
	M0103	Jul 15 01	11.9	None	0.0	--	0	--	0	--
		Jul 12 08	6.2	None	10.3	None	3 hauls	None	100	None
	M0110	Jul 19 01	7.3	None	0.0	--	0	--	0	--
		Jul 12 08	6.3	None	10.7	None	3 hauls	None	100	None
	M0114	Jul 23 01	12.6	LSCS	0.0	--	0	--	0	--

[1] BDWF = broad whitefish, PIKE = northern pike, LSCS = least cisco, RDWF = round whitefish, GRAY = Arctic grayling
+= additional species caught

[2] NSSB = ninespine stickleback, BKFH = Alaska blackfish

Table 3. Water chemistry parameters measured in conjunction with 2008 lake sampling at CPAI exploration areas.

Exploration Area	Lake	Date	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Calcium (mg/l)	Magnesium (mg/l)	Sodium[1] (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)
Char												
	M0801	Jul 11 08	14.6	9.3	3,170	1.9	8.35	41.4	60.2	553	998	351
Pioneer												
	M0802	Jul 14 08	15.4	9.7	89	2.0	7.48	11.2	2.07	2.58	8.75	36.5
	M0803	Jul 11 08	17.1	9.1	211	1.0	8.34	27.4	4.20	5.69	24.0	85.6
	M0804	Jul 13 08	16.6	--	148	1.5	7.92	18.1	3.44	4.93	21.7	59.3
	M0805	Jul 13 08	16.3	10.1	169	1.2	7.90	21.7	3.29	4.57	19.3	67.6
	M0806	Jul 13 08	15.6	9.3	268	1.6	8.03	36.4	5.48	8.79	31.5	113
	M0807	Jul 14 08	15.9	9.6	153	5.0	7.79	20.1	3.45	4.62	15.5	64.4
	M0808	Jul 11 08	17.2	10.0	131	0.8	8.17	17.2	2.47	3.05	11.4	53.2
	M0809	Jul 14 08	19.8	--	114	0.9	7.83	14.3	2.72	3.87	11.3	46.9
Grandview East												
	M0016	Jul 14 08	17.3	10.0	117	1.6	7.72	13.6	2.55	4.44	15.5	44.4
	M0810	Jul 15 08	17.0	10.0	170	0.7	7.82	15.9	3.96	8.24	30.0	56.0
	R0059	Jul 16 08	16.3	9.4	59	1.3	8.15	5.39	1.23	3.25	9.58	18.5
	R0060	Jul 15 08	16.2	9.5	144	1.2	7.80	13.7	2.83	7.60	23.4	45.9
	R0067	Jul 15 08	16.4	9.5	179	0.9	7.83	21.9	3.61	6.60	24.9	69.6
Grandview West												
	M0103	Jul 12 08	16.6	10.0	297	1.6	8.27	33.9	5.70	16.0	43.1	108
	M0110	Jul 12 08	15.5	9.3	382	2.2	8.23	40.5	7.32	23.9	60.6	131
	M0114	Jul 12 08	17.6	9.5	154	1.8	8.18	23.1	3.33	3.82	8.55	71.4

Table 4. Recommended maximum water volumes available for under-ice water withdrawal from lakes surveyed in 2008 for CPAI exploration needs (does not include volume related to ice aggregate).

(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 fish are likely to be present, 20% of total lake volume when no fish are present)

Area	Lake	Surface Area (acres)	Max. Depth (feet)	Calculated Volume (mill. gals)	20% of Total Lake Volume (mill. gals)	30% of Water Under 5 ft of Ice (mill. gals)	15% of Water Under 7 ft of Ice (mill. gals)	Sensitive Fish Species Present[1]	Resistant Fish Species Present[2]	Recommended Maximum Under-Ice Withdrawal (mill. gals)
Char										
	M0801	35.3	8.6	65.55	13.11	4.21	0.23	none	none	13.11
Pioneer										
	M0802	244.1	7.2	387.11	77.42	11.969	0.004	none	NSSB	11.97
	M0803	55.4	8.5	87.57	17.51	6.91	0.841	none	NSSB	6.908
	M0804	143.0	11.3	286.67	57.33	26.580	4.884	GRAY	NSSB	4.884
	M0805	78.7	8.5	120.92	24.18	7.480	0.471	none	NSSB	7.480
	M0806	481.2	7.1	700.08	140.02	32.18	0.01	none	NSSB	32.18
	M0807	370.9	<5	--	--	--	--	--	--	--
	M0808	172.4	6.1	198.29	39.66	1.94	0.000	none	NSSB	1.939
	M0809	21.7	<5	--	--	--	--	--	--	--
Grandview East										
	M0016	306.2	6.2	411.60	82.32	4.79	0.00	none	NSSB	4.790
	M0810	26.8	8.3	49.46	9.89	3.35	0.23	none	NSSB	3.354
	R0059	35.3	7.6	58.09	11.62	2.55	0.05	none	none	11.62
	R0060	115.0	8.2	191.65	38.33	9.23	0.05	none	NSSB	9.230
	R0067	80.5	7.5	120.32	24.06	4.82	0.04	none	NSSB	4.825
Grandview West										
	M0103	34.6	8.1	56.45	11.29	2.57	0.04	none	none	11.29
	M0110	51.0	6.4	60.85	12.17	0.54	0.00	none	none	12.17
	M0114	18.3	11.7	19.49	3.90	0.57	0.070	LSCS	--	0.070

[1] Sensitive species include grayling, whitefishes, char, burbot, slimy sculpin, etc.
BDWF = broad whitefish LSCS = least cisco + = additional species also caught
GRAY = Arctic grayling PIKE = northern pike

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

-- = not estimated

Table 5. Estimated area available for removing ice aggregate, based on the area covered by water shallower than 4 feet, surveyed in 2008 at CPAI exploration areas.

(ice thickness is typically 4 ft by early January)

Area	Lake	Surface Area (acres)	Max. Depth (feet)	Acres covered by Water shallower than 4 feet	Gallons of Water As Chips (mill. gals)
Char					
	M0801	35.3	8.6	5.5	0.433
Pioneer					
	M0802	244.1	7.2	46.7	3.65
	M0803	55.4	8.5	20.2	1.58
	M0804	143.0	11.3	31.7	2.48
	M0805	78.7	8.5	27.4	2.14
	M0806	481.2	7.1	147.4	11.53
	M0807	370.9	<5	137.8	10.78
	M0808	172.4	6.1	70.4	5.51
	M0809	21.7	<5	21.7	1.70
Grandview East					
	M0016	306.2	6.2	75.5	5.90
	M0810	26.8	8.3	5.0	0.391
	R0059	35.3	7.6	8.2	0.643
	R0060	115.0	8.2	26.4	2.07
	R0067	80.5	7.5	24.6	1.92
Grandview West					
	M0103	34.6	8.1	7.9	0.615
	M0110	51.0	6.4	19.2	1.50
	M0114	18.3	11.7	11.8	0.924

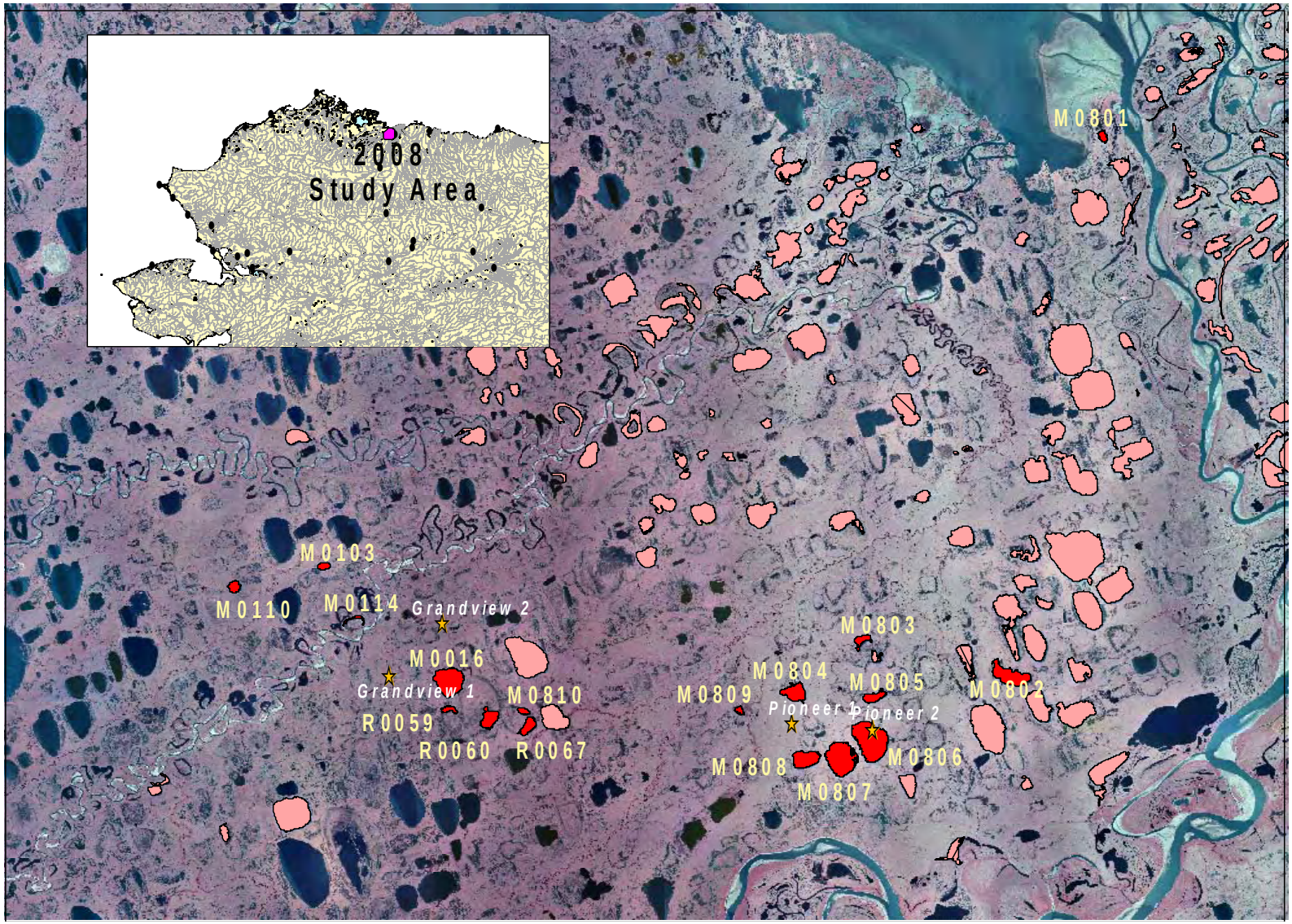


Figure 1. Study area surveyed in 2008 for potential water source lakes to support ConocoPhillips (Alaska) exploration projects (red = lakes surveyed in 2008, pink = lakes surveyed in previous years).

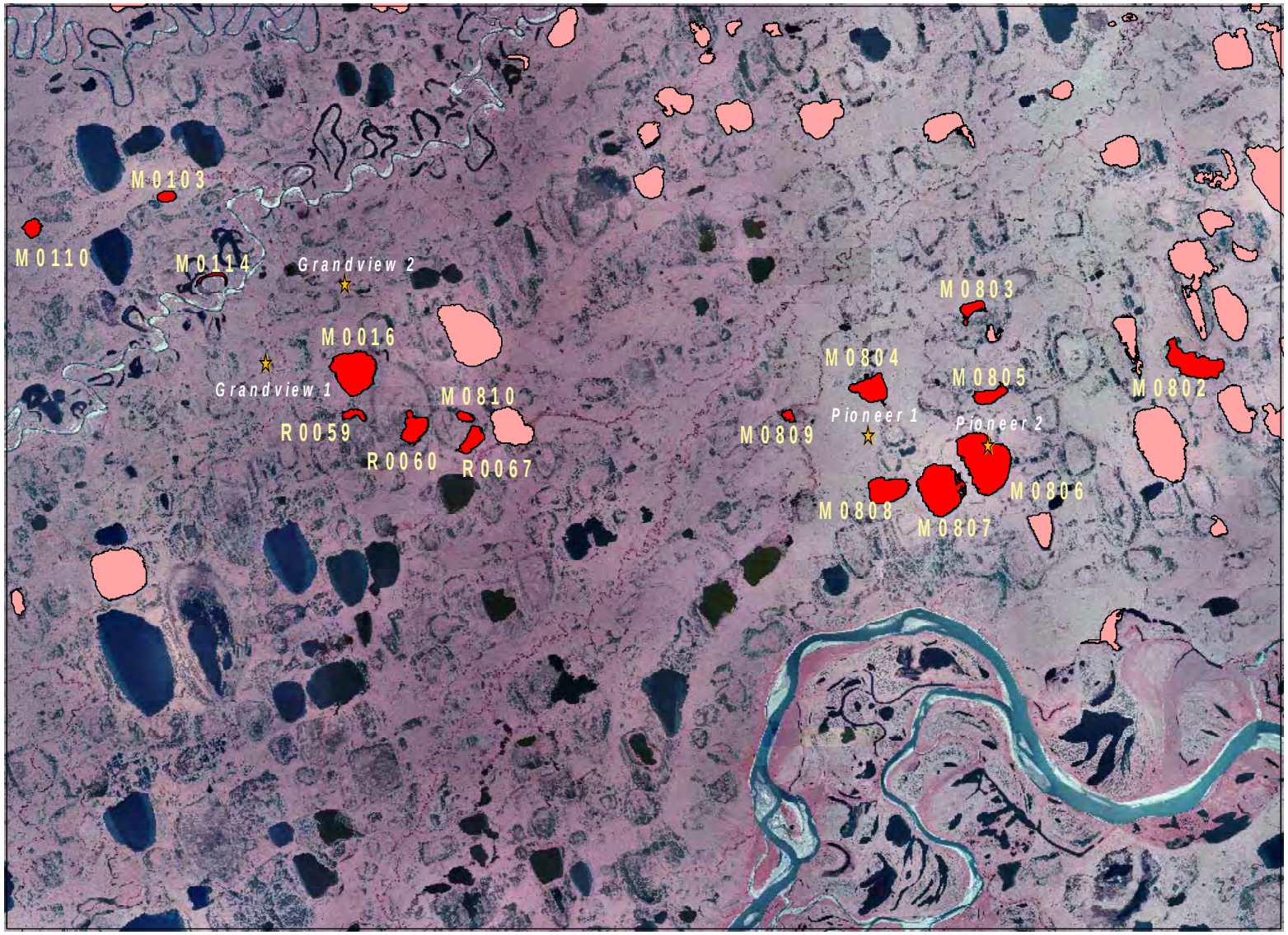
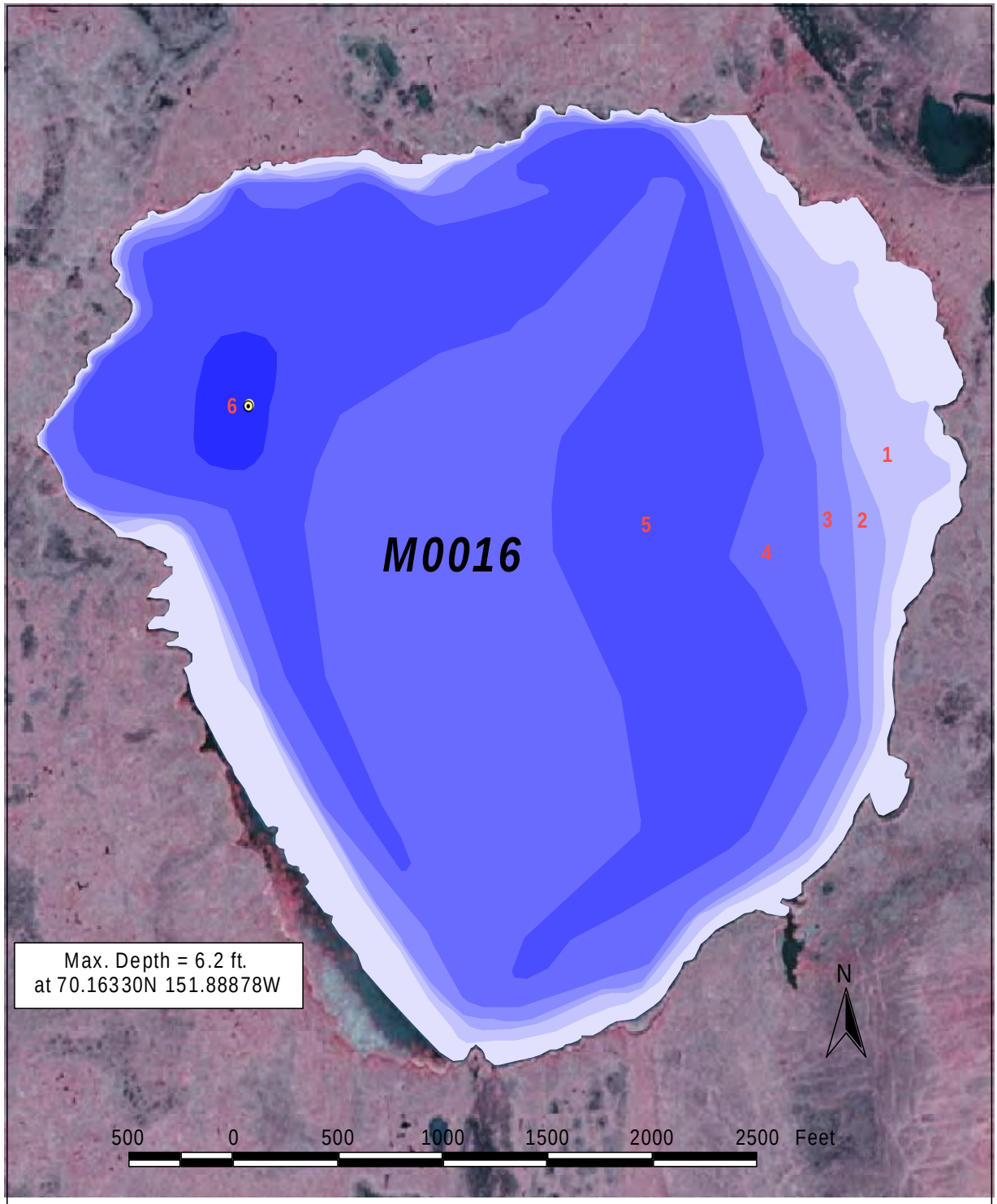


Figure 2. Lakes surveyed in 2008 as potential water sources to support the Pioneer and Grandview prospects for ConocoPhillips (Alaska) (red = lakes surveyed in 2008, pink = lakes surveyed in previous years)

Lake Summaries



Depth contours of lake M0016 based on transects surveyed on July 14, 2008
(depth in 1 foot intervals).

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

Lake M0016

Other Names: None Known
Location: 70.16054°N 151.87870°W
USGS Quad Sheet: Harrison Bay A-4: T9N R1E, Sec. 3/4/9/10
Habitat: Tundra Lake
Area: 306 acres
Maximum Depth: 6.2 feet
Active Outlet: No
Total Lake Volume: 411.60 million gallons (Jul 14, 2008 data)
Water Volume Under 4 ft of ice: 71.12 million gallons
Water Volume Under 5 ft of ice: 15.97 million gallons
Water Volume Under 7 ft of ice: 0.00 million gallons

Potential Ice Aggregate: 75.46 acres (water depth 4 ft or less)
5.90 million gallons

Maximum Recommended Winter Removal: **4.79 million gallons**
(30% of water volume under 5 ft of ice)

Water Chemistry:

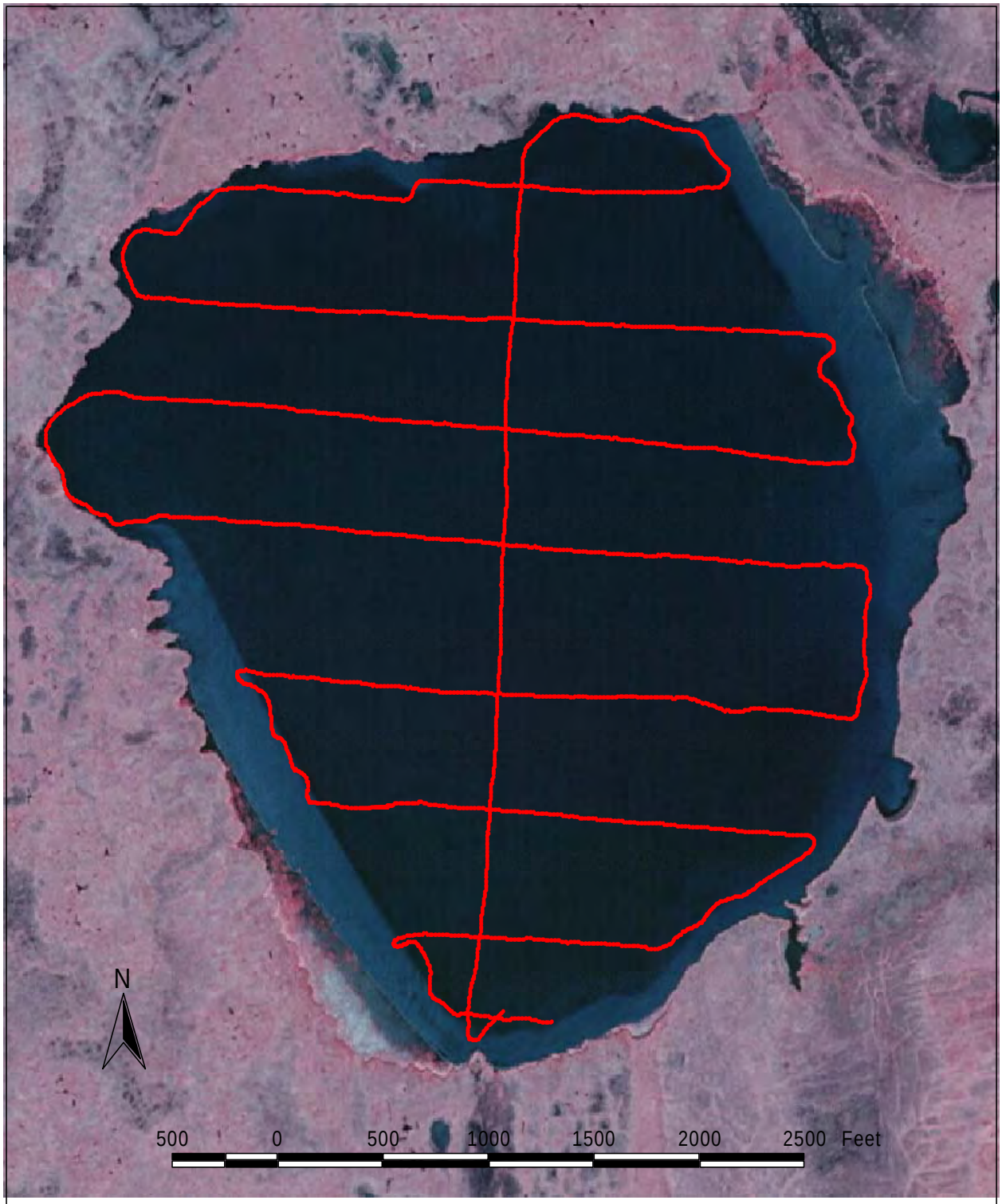
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2000	14.4	2.8	5.2	14.8	47.6	124	--	7.77	L. Moulton
2008	13.6	2.55	4.44	15.5	44.4	117	1.62	7.72	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 22 00	12.7	None	0	
	Jul 14 08	6.6	None		
Minnow Traps	Jul 22 00	14.0	Ninespine stickleback	1	59
	Jul 14 08	6.6	None	0	
Observed	Jul 14 08	--	Ninespine stickleback	+	

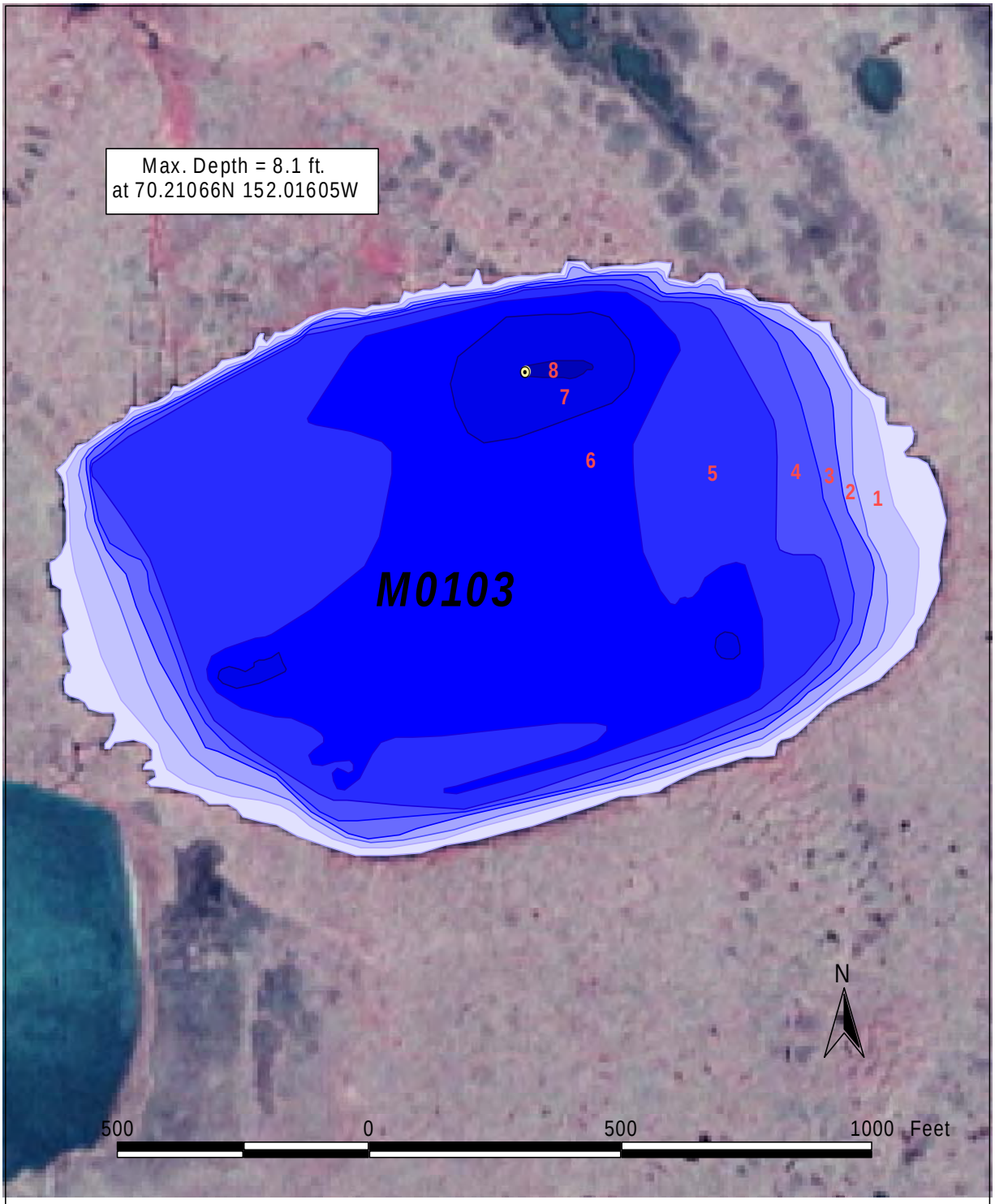
Regions of lake M0016 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 14, 2008.

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



Depth transects surveyed at lake M0016 on July 14, 2008.

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



Depth contours of lake M0103 based on transects surveyed on July 12, 2008
(depth in 1 foot intervals).

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

Lake M0103

Other Names:
Location: 70.20961°N 152.01622°W
USGS Quad Sheet: Harrison Bay A-4: T10N R1W, Sec. 24
Habitat: Tundra Lake
Area: 35 acres
Maximum Depth: 8.1 feet
Active Outlet: No
Total Lake Volume: 56.45 million gallons (July 12, 2008 data)
Water Volume Under 4 ft of ice: 16.90 million gallons
Water Volume Under 5 ft of ice: 8.56 million gallons
Water Volume Under 7 ft of ice: 0.24 million gallons

Potential Ice Aggregate: 7.86 acres (water depth 4 ft or less)
0.615 million gallons

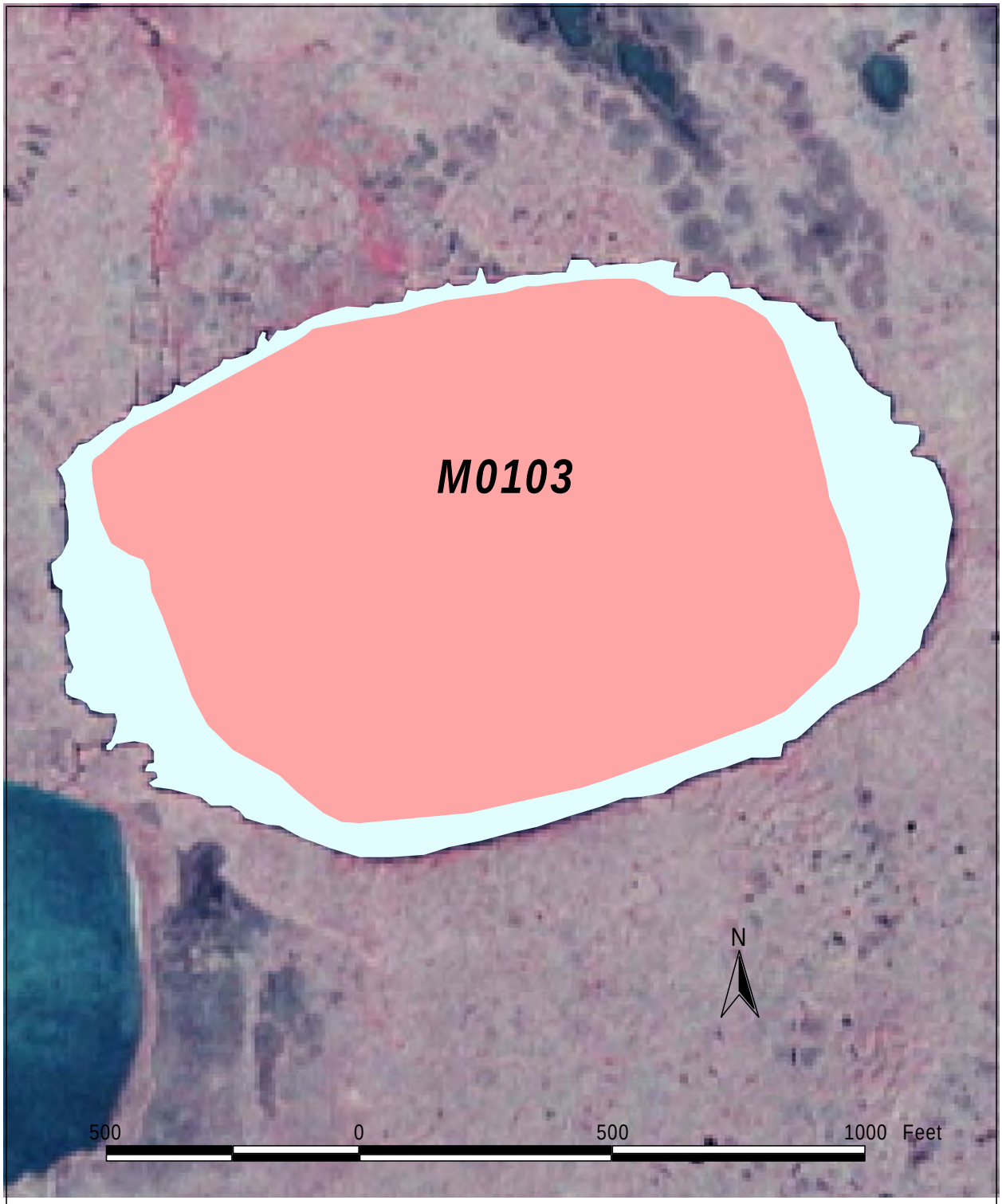
Maximum Recommended Winter Removal: **11.29 million gallons**
(20% of lake volume)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2001	34	5.9	17	37	110	271	1.3	8.21	L. Moulton
2008	33.9	5.7	16	43.1	108	297	1.6	8.27	L. Moulton

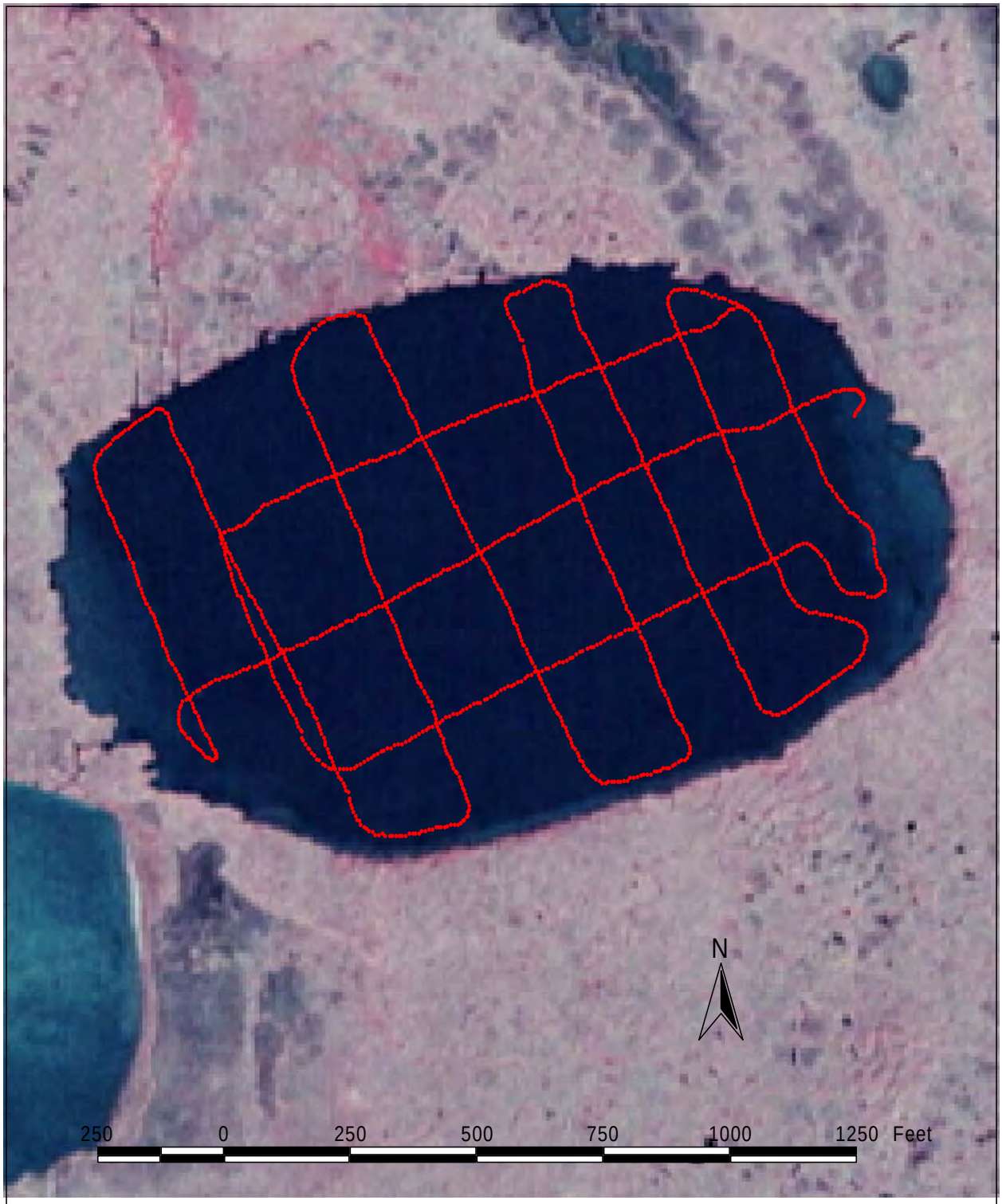
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 15 01	11.9	None	0
	Jul 12 08	6.2	None	0
Minnow Traps	Jul 12 08	10.3	None	0
Seine	Jul 12 08	3 hauls	None	0



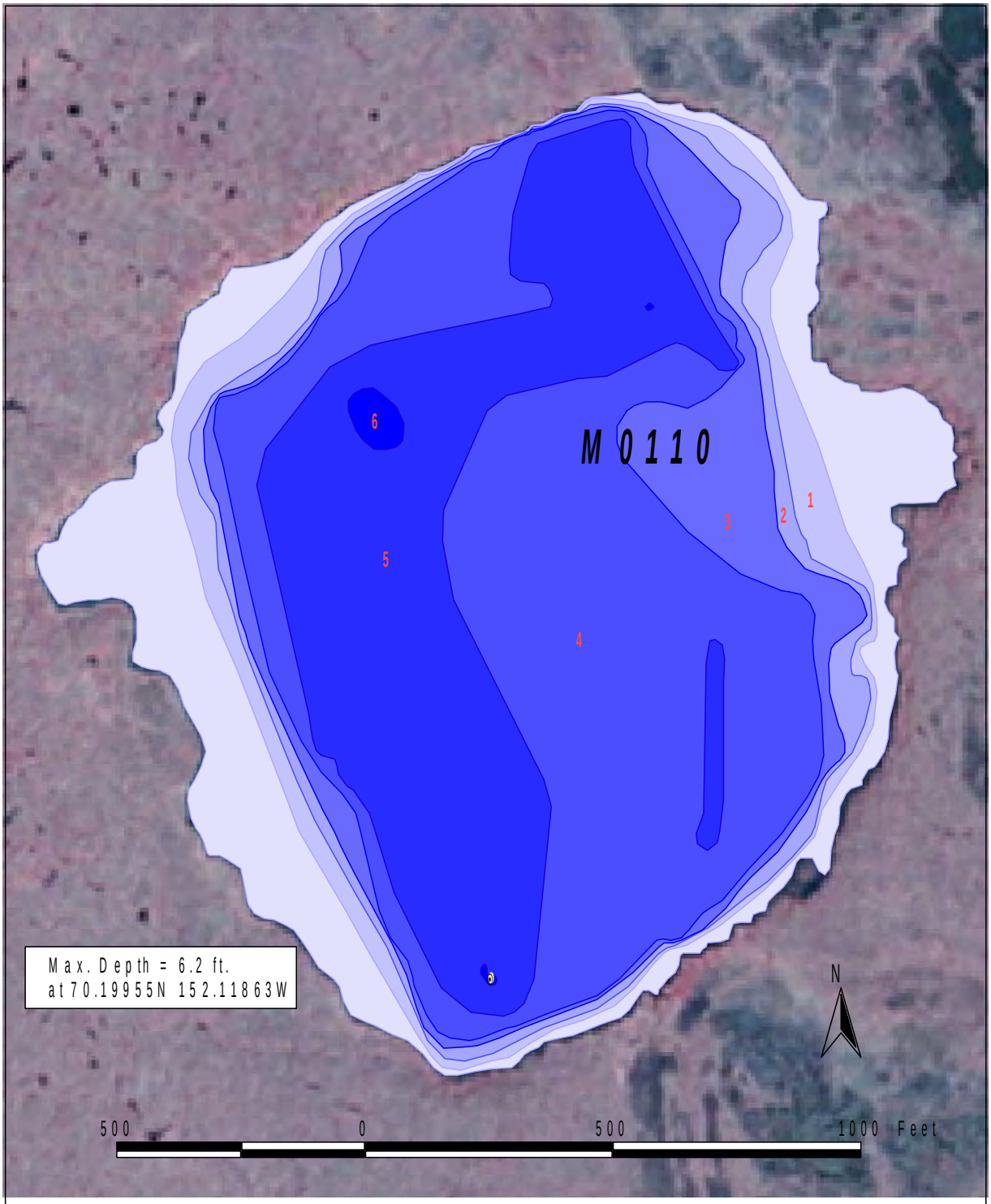
Regions of lake M0103 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 12, 2008.

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



Depth transects surveyed at lake M0103 on July 12, 2008.

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



Depth contours of lake M 0110 based on transects surveyed on July 12, 2008
(depth in 1 foot intervals).

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

Lake M0110

Other Names:
Location: 70.20166°N 152.11790°W
USGS Quad Sheet: Harrison Bay A-4: T10N R1W, Sec. 22
Habitat: Tundra Lake
Area: 51 acres
Maximum Depth: 6.4 feet
Active Outlet: No
Total Lake Volume: 60.85 million gallons (Jul 12, 2008 data)
Water Volume Under 4 ft of ice: 9.11 million gallons
Water Volume Under 5 ft of ice: 1.80 million gallons
Water Volume Under 7 ft of ice: 0.00 million gallons

Potential Ice Aggregate: 19.17 acres (water depth 4 ft or less)
1.500 million gallons

Maximum Recommended Winter Removal: **12.17 million gallons**
(20% of lake volume)

Water Chemistry:

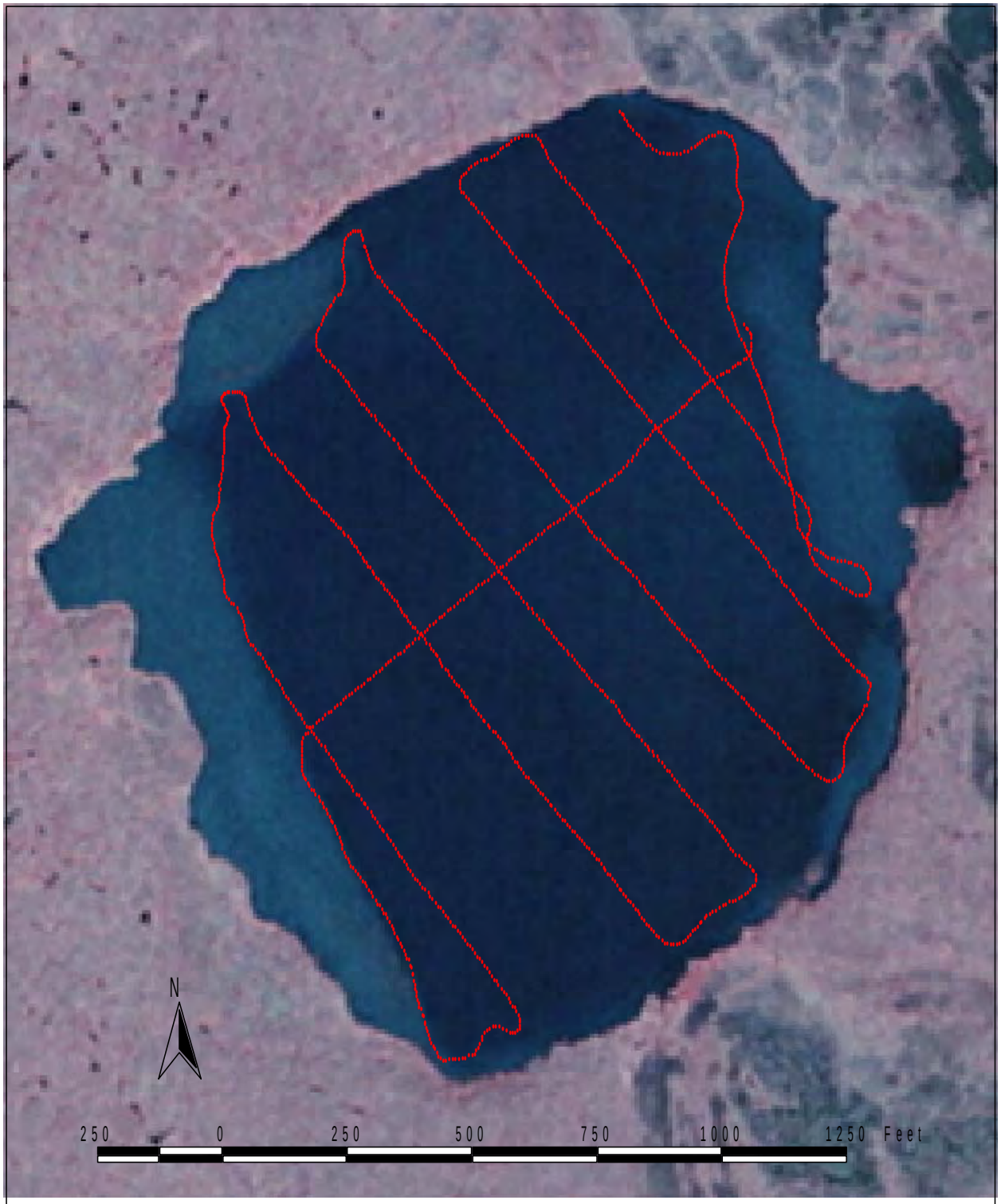
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2001	38	6.6	22	49	120	338	1.7	8.32	L. Moulton
2008	40.5	7.32	23.9	60.6	131	382	2.2	8.23	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 19 01	7.3	None	0
	Jul 12 08	6.3	None	0
Minnow Traps	Jul 12 08	10.7	None	0
Seine	Jul 12 08	3 hauls	None	0

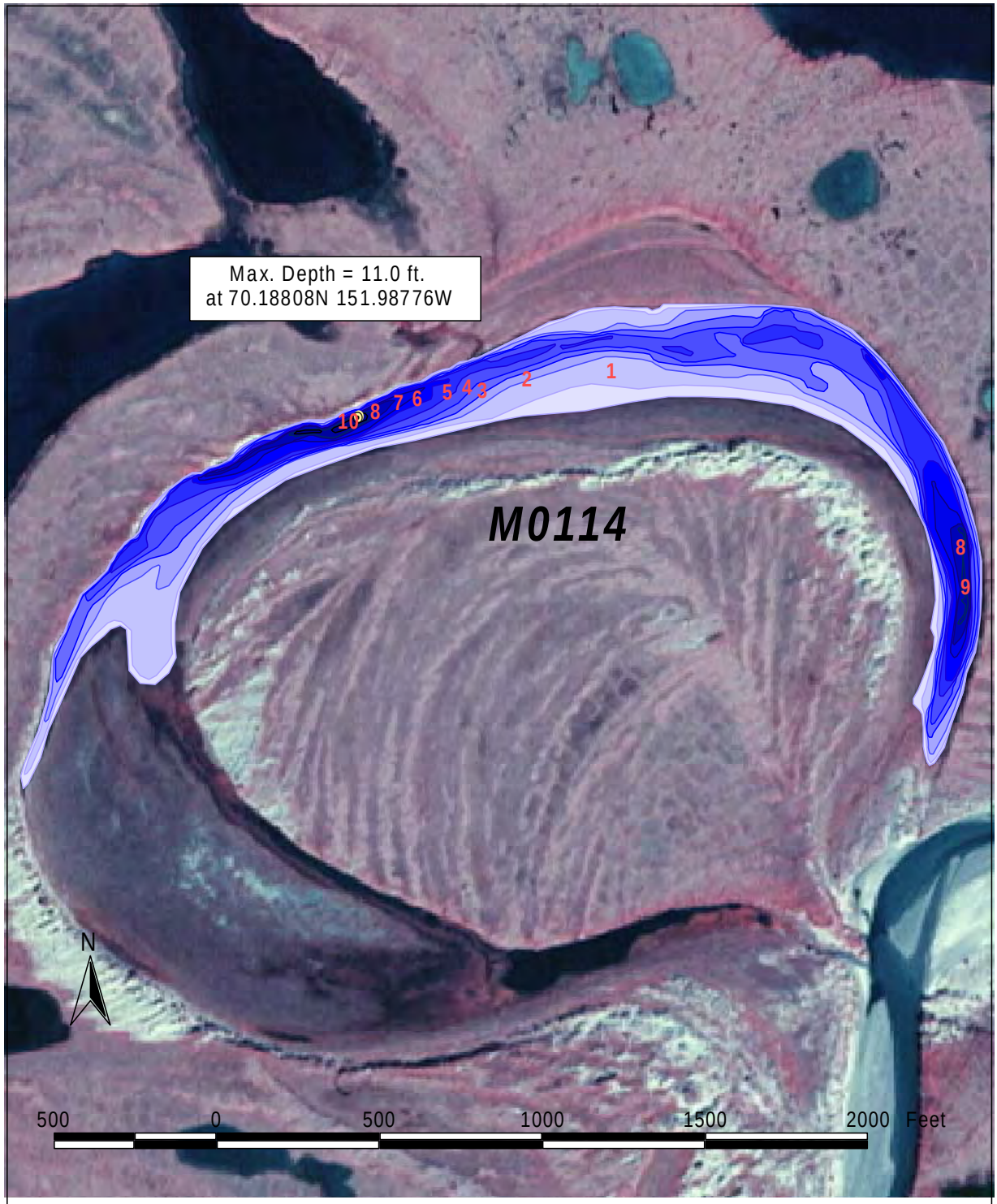
Regions of lake M 0110 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 12, 2008.

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



Depth transects surveyed at lake M 0110 on July 12, 2008.

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



Depth contours of lake M0114 based on transects surveyed on July 12, 2008
(depth in 1 foot intervals).

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

Lake M0114

Other Names:
Location: 70.18799°N 151.98649°W
USGS Quad Sheet: Harrison Bay A-4: T10N R1E, Sec. 30
Habitat: Oxbow Lake
Area: 18 acres
Maximum Depth: 11.7 feet
Active Outlet: Yes
Total Lake Volume: 19.49 million gallons (Jul 12, 2008 data)
Water Volume Under 4 ft of ice: 3.56 million gallons
Water Volume Under 5 ft of ice: 1.92 million gallons
Water Volume Under 7 ft of ice: 0.47 million gallons

Potential Ice Aggregate: 11.80 acres (water depth 4 ft or less)
0.924 million gallons

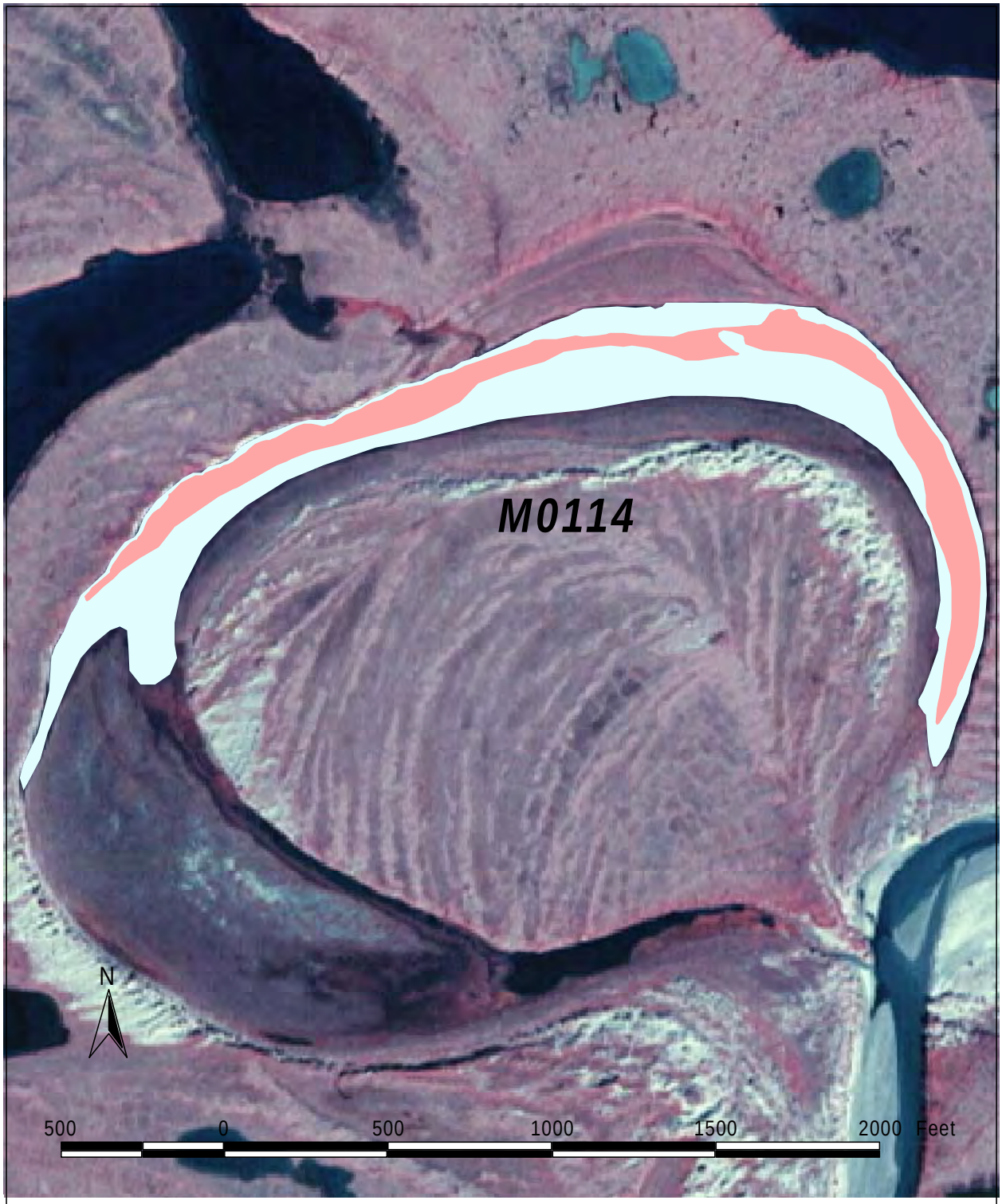
Maximum Recommended Winter Removal: **0.070 million gallons**
(15% of volume under 7 feet of ice)

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
2001	25	3.2	4.2	7	75	158	1.6	8.32	L. Moulton
2008	23.1	3.33	3.82	8.55	71.4	154	1.8	8.18	L. Moulton

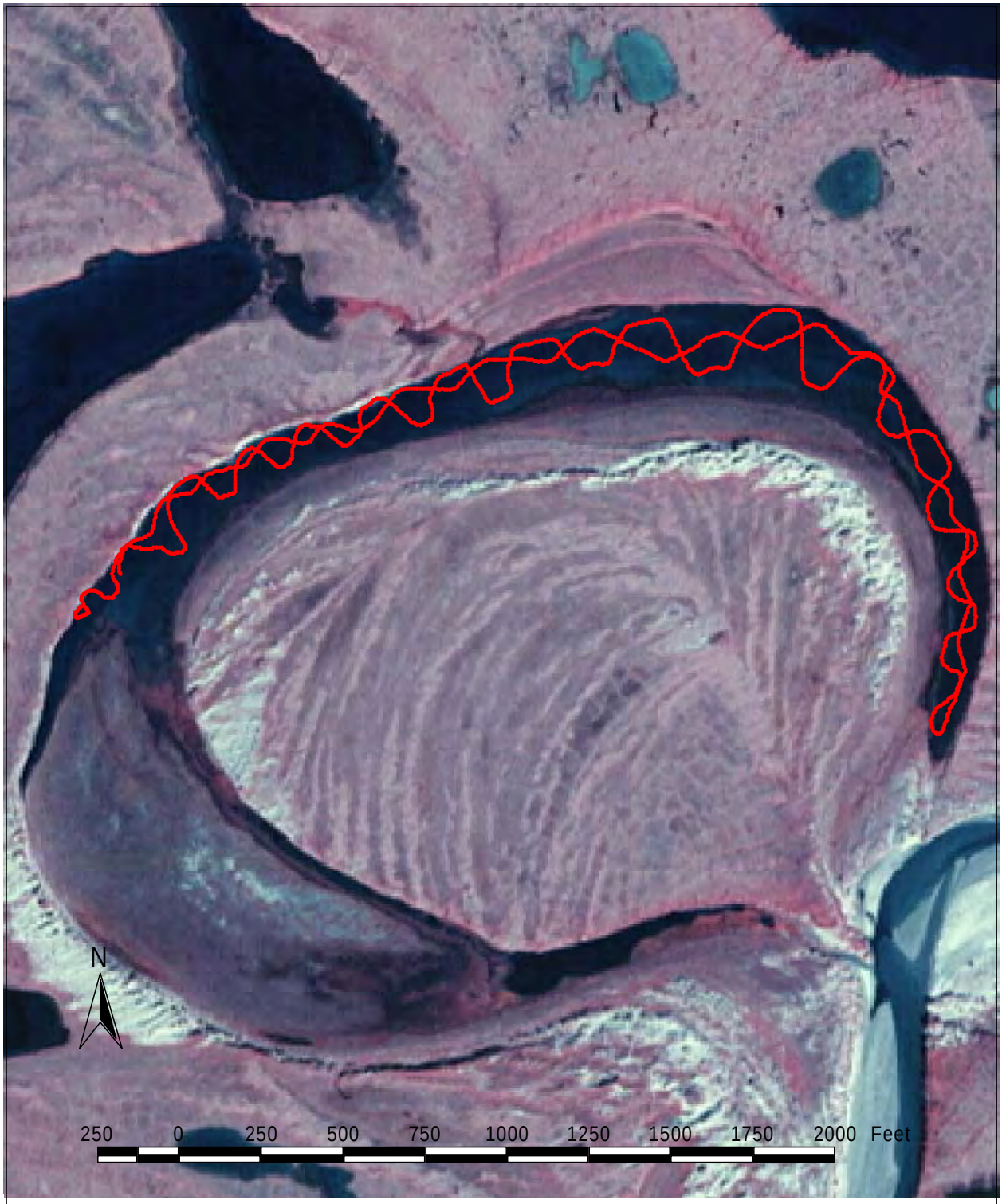
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 23 01	12.6	Least cisco	1	255



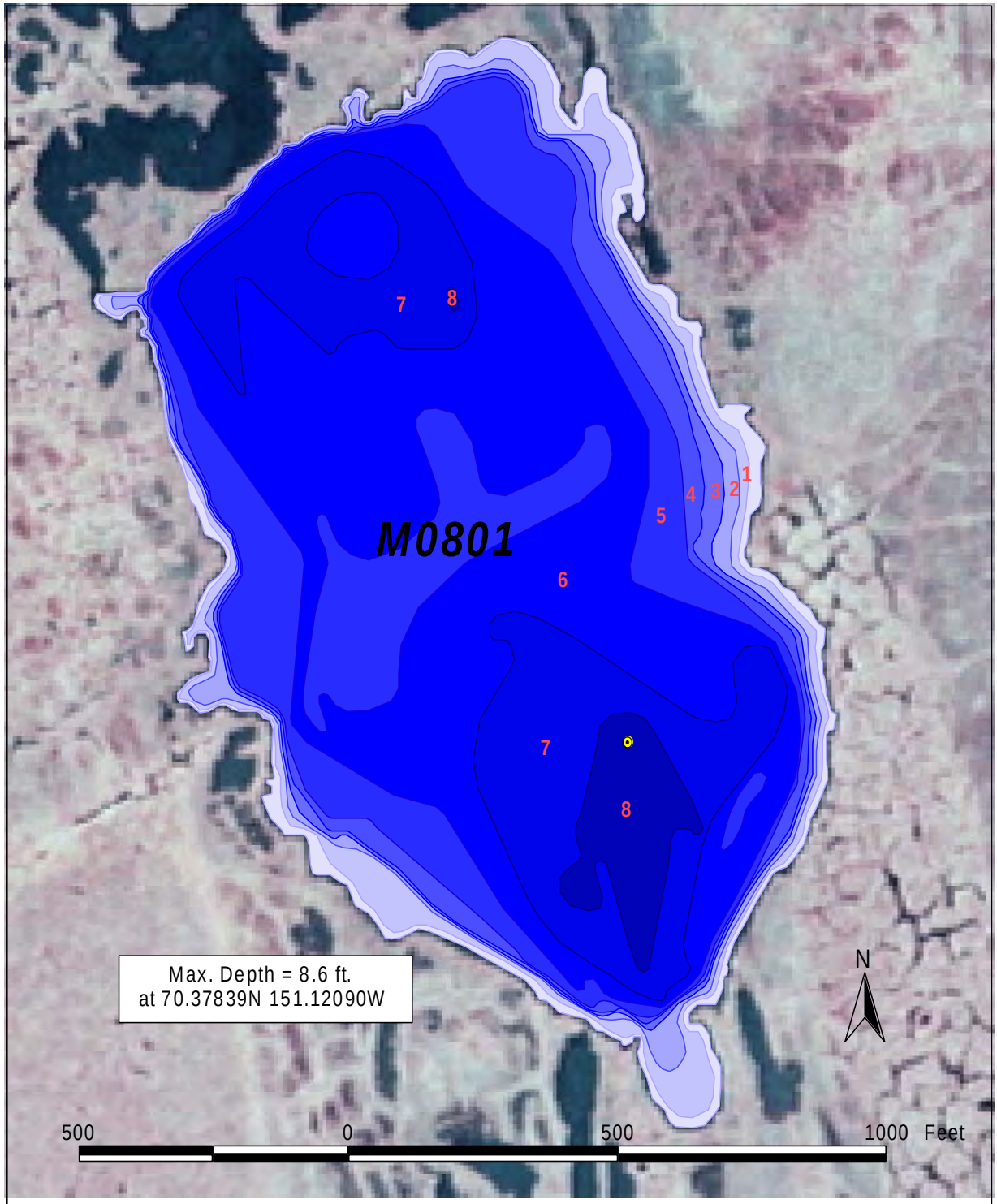
Regions of lake M0114 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 12, 2008.

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



Depth transects surveyed at lake M0114 on July 12, 2008.

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



Depth contours of lake M0801 based on transects surveyed on July 11, 2008
(depth in 1 foot intervals).

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

Lake M0801

Other Names: None Known
Location: 70.37948°N 151.12308°W
USGS Quad Sheet: Harrison Bay B-2: T12N R4E, Sec. 21
Habitat: Coastal Lake
Area: 35 acres
Maximum Depth: 8.6 feet
Active Outlet: No
Total Lake Volume: 65.55 million gallons (Jul 11, 2008 data)
Water Volume Under 4 ft of ice: 23.48 million gallons
Water Volume Under 5 ft of ice: 14.04 million gallons
Water Volume Under 7 ft of ice: 1.53 million gallons

Potential Ice Aggregate: 5.54 acres (water depth 4 ft or less)
0.433 million gallons

Maximum Recommended Winter Removal: **13.109 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 [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2008	41.4	60.2	553	998	351	3170	1.9	8.35	L. Moulton

Catch Record:

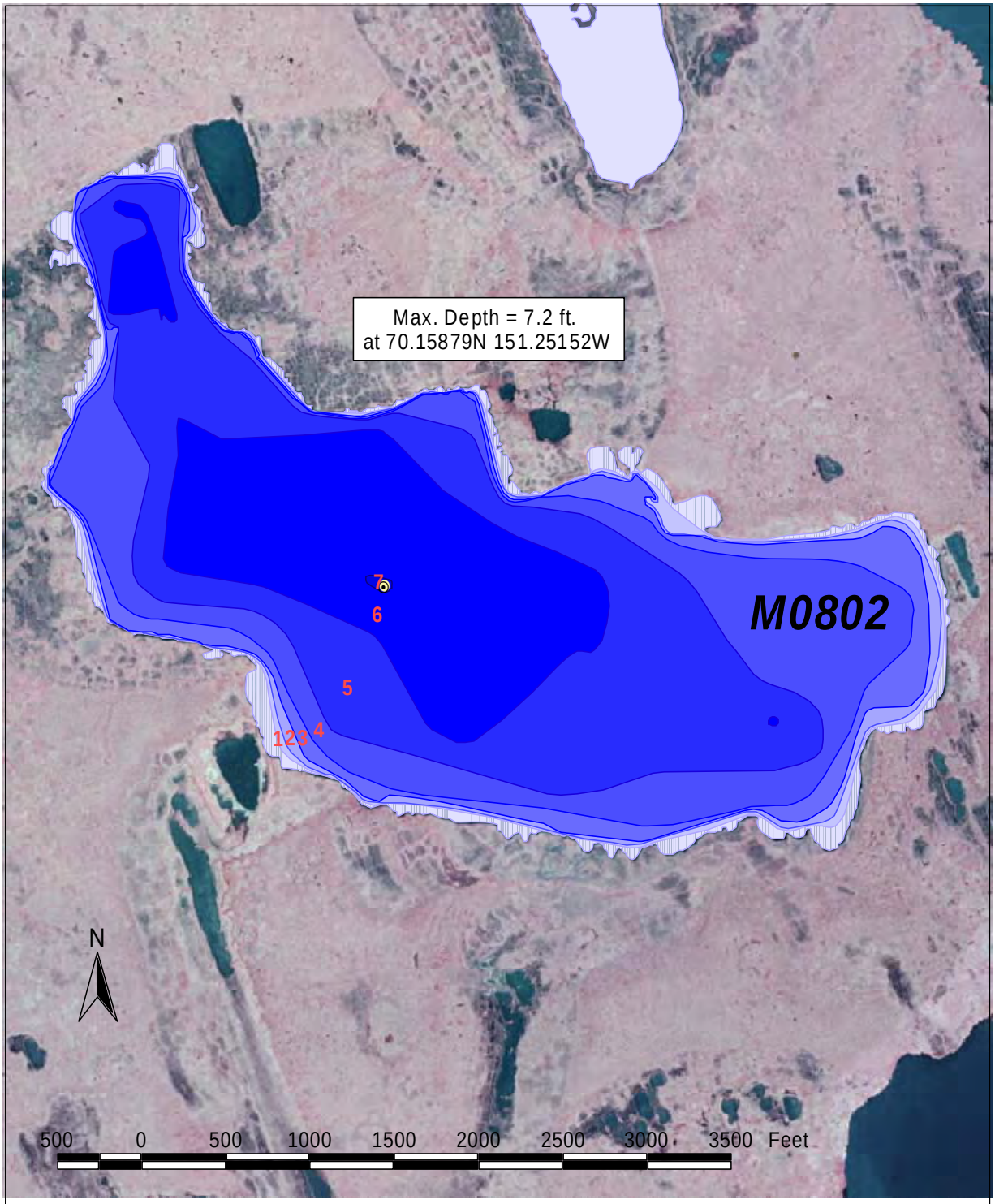
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 11 08	5.5	none	0
Minnow trap	Jul 11 08	7.6	none	0
Seine	Jul 11 08	3 hauls	none	0

Regions of lake M0801 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 11, 2008.

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

Depth transects surveyed at lake M0801 on July 11, 2008.

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



Depth contours of lake M0802 based on transects surveyed on July 14, 2008
(depth in 1 foot intervals).

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

Lake M0802

Other Names: None Known
Location: 70.15803°N 151.24688°W
USGS Quad Sheet: Harrison Bay A-3: T9N R3/4E, Sec. 1/12/6/7
Habitat: Tundra Lake
Area: 244 acres
Maximum Depth: 7.2 feet
Active Outlet: No
Total Lake Volume: 387.11 million gallons (Jul 14, 2008 data)
Water Volume Under 4 ft of ice: 95.22 million gallons
Water Volume Under 5 ft of ice: 39.90 million gallons
Water Volume Under 7 ft of ice: 0.02 million gallons

Potential Ice Aggregate: 46.67 acres (water depth 4 ft or less)
3.65 million gallons

Maximum Recommended Winter Removal: **11.97 million gallons**
(30% of water volume under 5 ft of ice)

Water Chemistry:

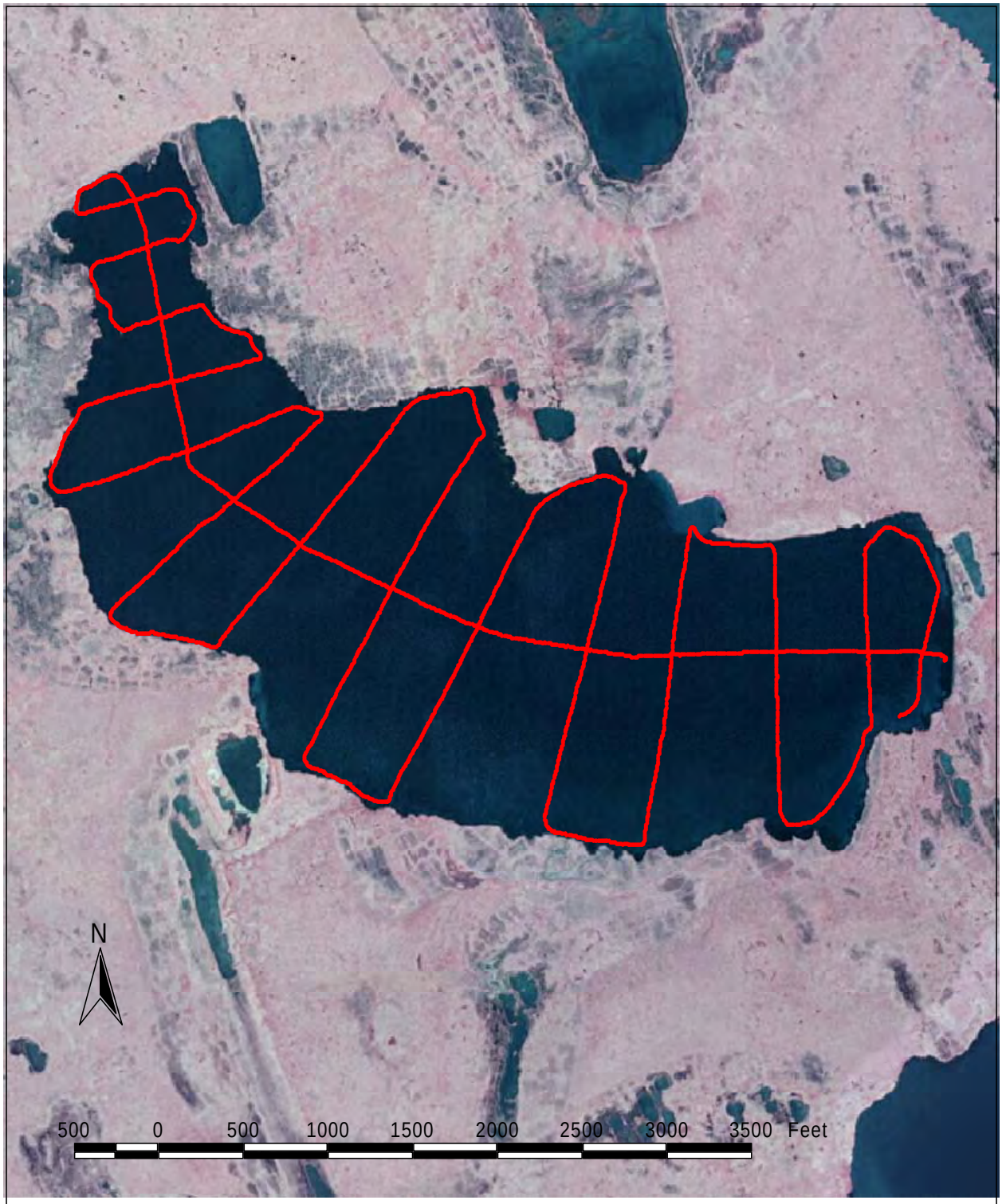
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2008	11.2	2.1	2.6	8.8	37	89	2.0	7.48	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 14 08	6.2	None	0
Minnow Trap	Jul 14 08	5.3	Ninespine stickleback	2

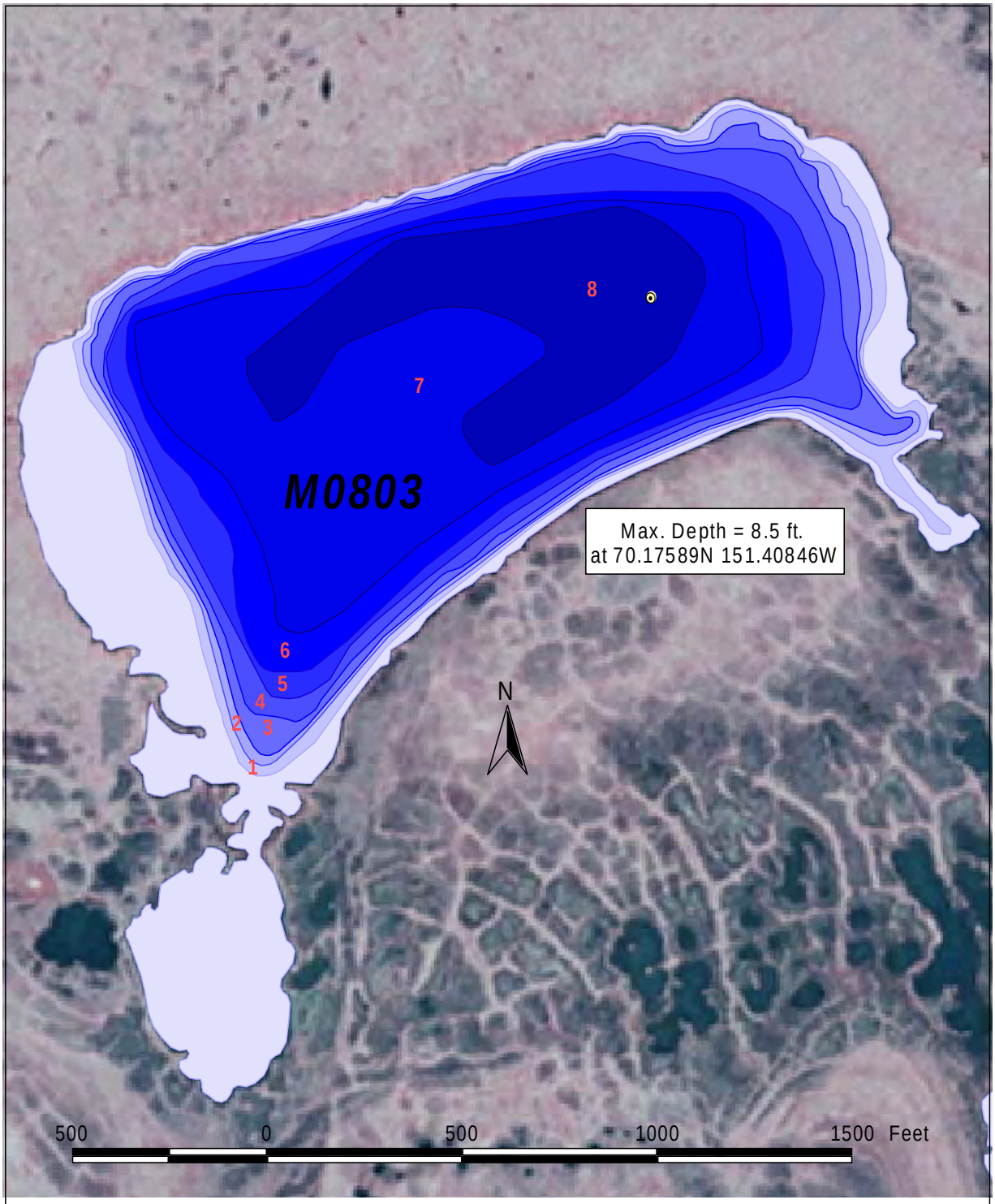
Regions of lake M0802 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 14, 2008.

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



Depth transects surveyed at lake M0802 on July 14, 2008.

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



Depth contours of lake M0803 based on transects surveyed on July 11, 2008
(depth in 1 foot intervals).

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

Lake M0803

Other Names: None Known
Location: 70.17538°N 151.41234°W
USGS Quad Sheet: Harrison Bay A-3: T10N R3E, Sec. 32/33
Habitat: Tundra Lake
Area: 55 acres
Maximum Depth: 8.5 feet
Active Outlet:
Total Lake Volume: 87.6 million gallons (Jul 11, 2008 data)
Water Volume Under 4 ft of ice: 33.85 million gallons
Water Volume Under 5 ft of ice: 23.03 million gallons
Water Volume Under 7 ft of ice: 5.61 million gallons

Potential Ice Aggregate: 20.23 acres (water depth 4 ft or less)
1.58 million gallons

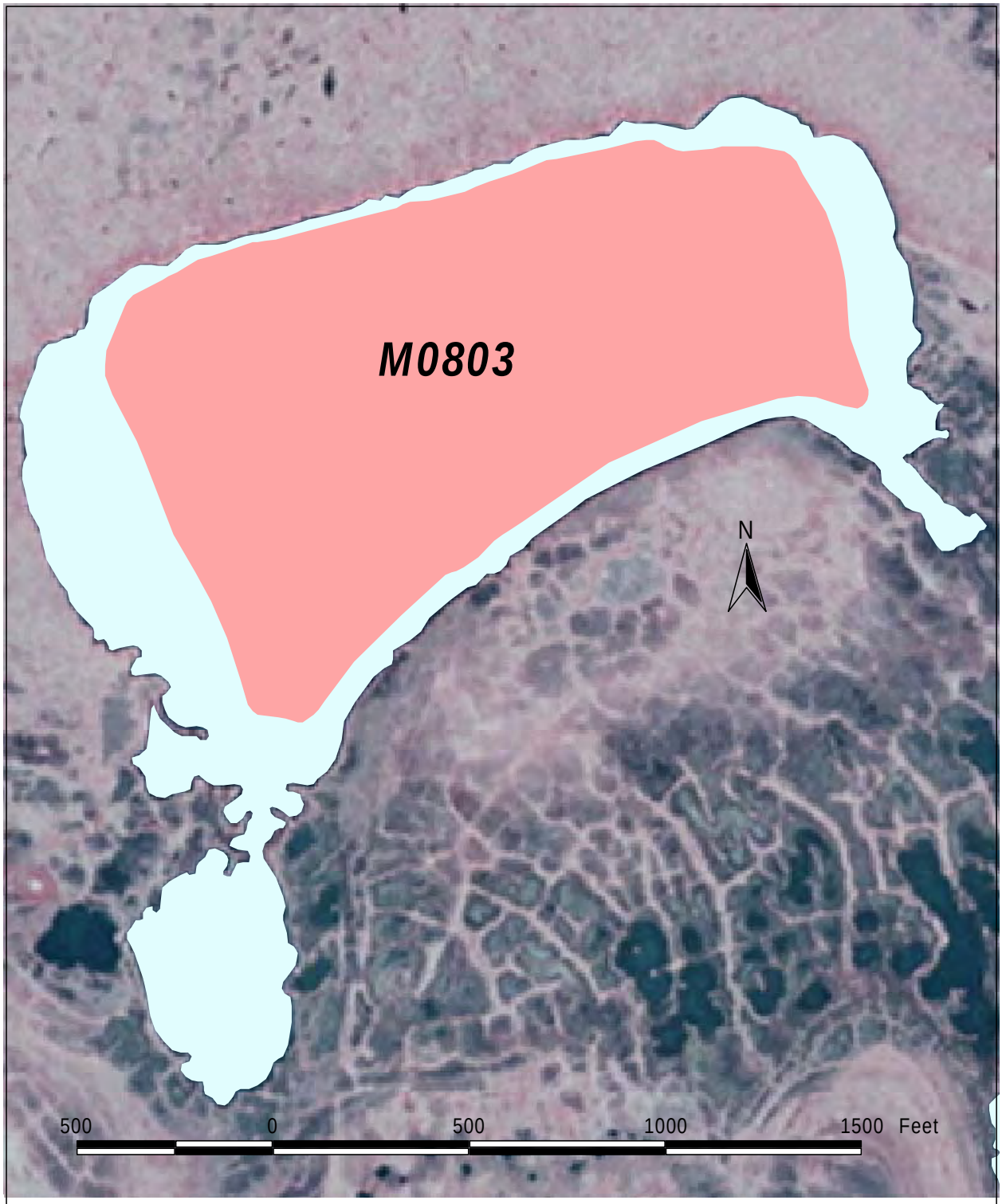
Maximum Recommended Winter Removal: **6.91 million gallons**
(30% of water volume under 5 ft of ice)

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
2008	27.4	4.2	5.7	24	86	211	1.0	8.34	L. Moulton

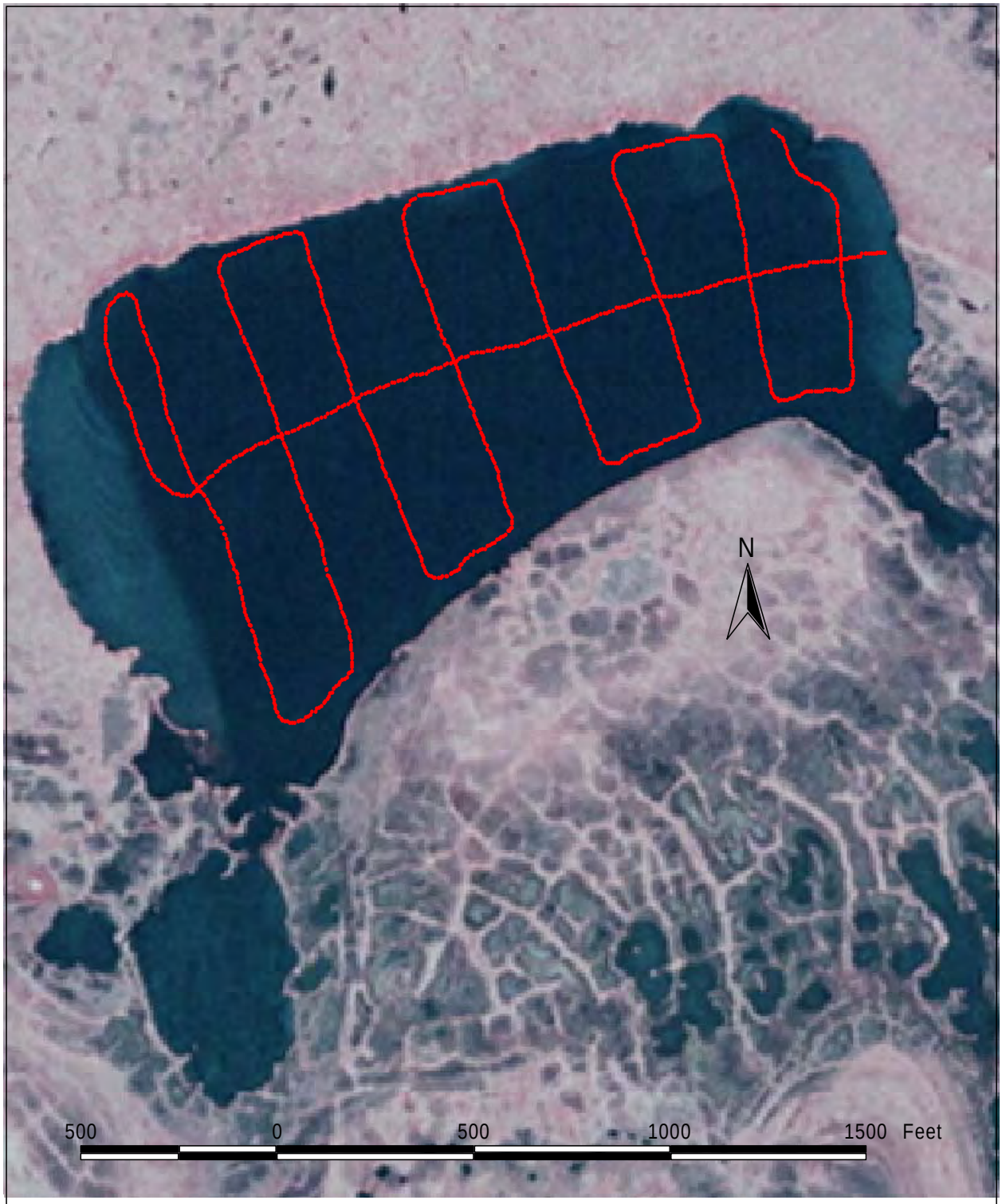
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 11 08	6.3	none	0
Observation	Jul 11 08	--	Ninespine stickleback	25



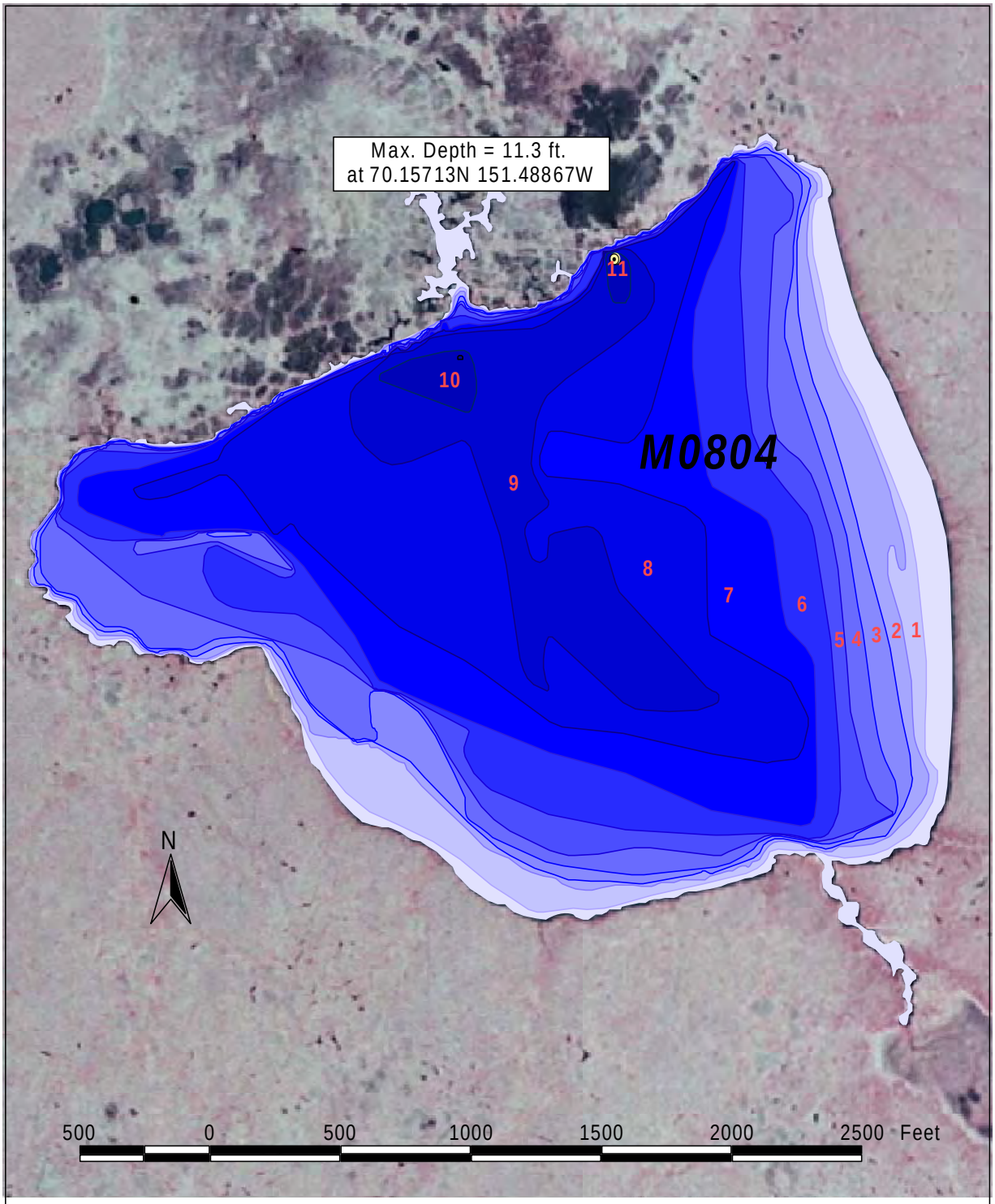
Regions of lake M0803 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 11, 2008.

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



Depth transects surveyed at lake M0803 on July 11, 2008.

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



Depth contours of lake M0804 based on transects surveyed on July 13, 2008
(depth in 1 foot intervals).

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

Lake M0804

Other Names: None Known
Location: 70.15369°N 151.48985°W
USGS Quad Sheet: Harrison Bay A-3: T9N R2/3E, Sec. 1/12/6/7
Habitat: Drainage Lake
Area: 143 acres
Maximum Depth: 11.3 feet
Active Outlet: Yes
Total Lake Volume: 286.67 million gallons (Jul 13, 2008 data)
Water Volume Under 4 ft of ice: 122.95 million gallons
Water Volume Under 5 ft of ice: 88.60 million gallons
Water Volume Under 7 ft of ice: 32.56 million gallons

Potential Ice Aggregate: 31.69 acres (water depth 4 ft or less)
2.48 million gallons

Maximum Recommended Winter Removal: **4.88 million gallons**
(15% of water volume under 7 ft of ice)

Water Chemistry:

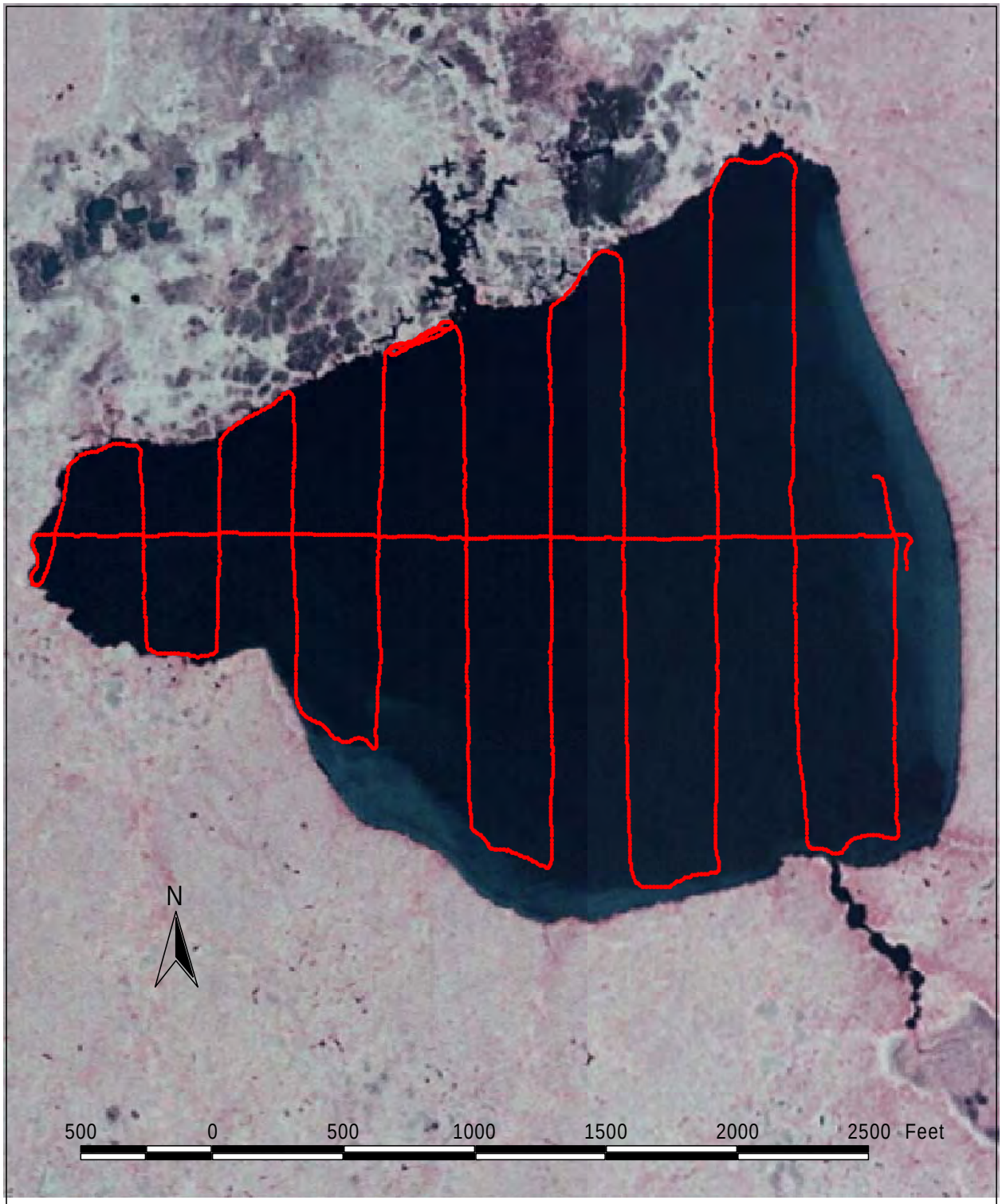
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2008	18.1	3.44	4.93	21.7	59.3	148	1.53	7.92	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 13 08	5.3	Arctic grayling	2
Minnow Trap	Jul 13 08	0.2	Ninespine stickleback	1

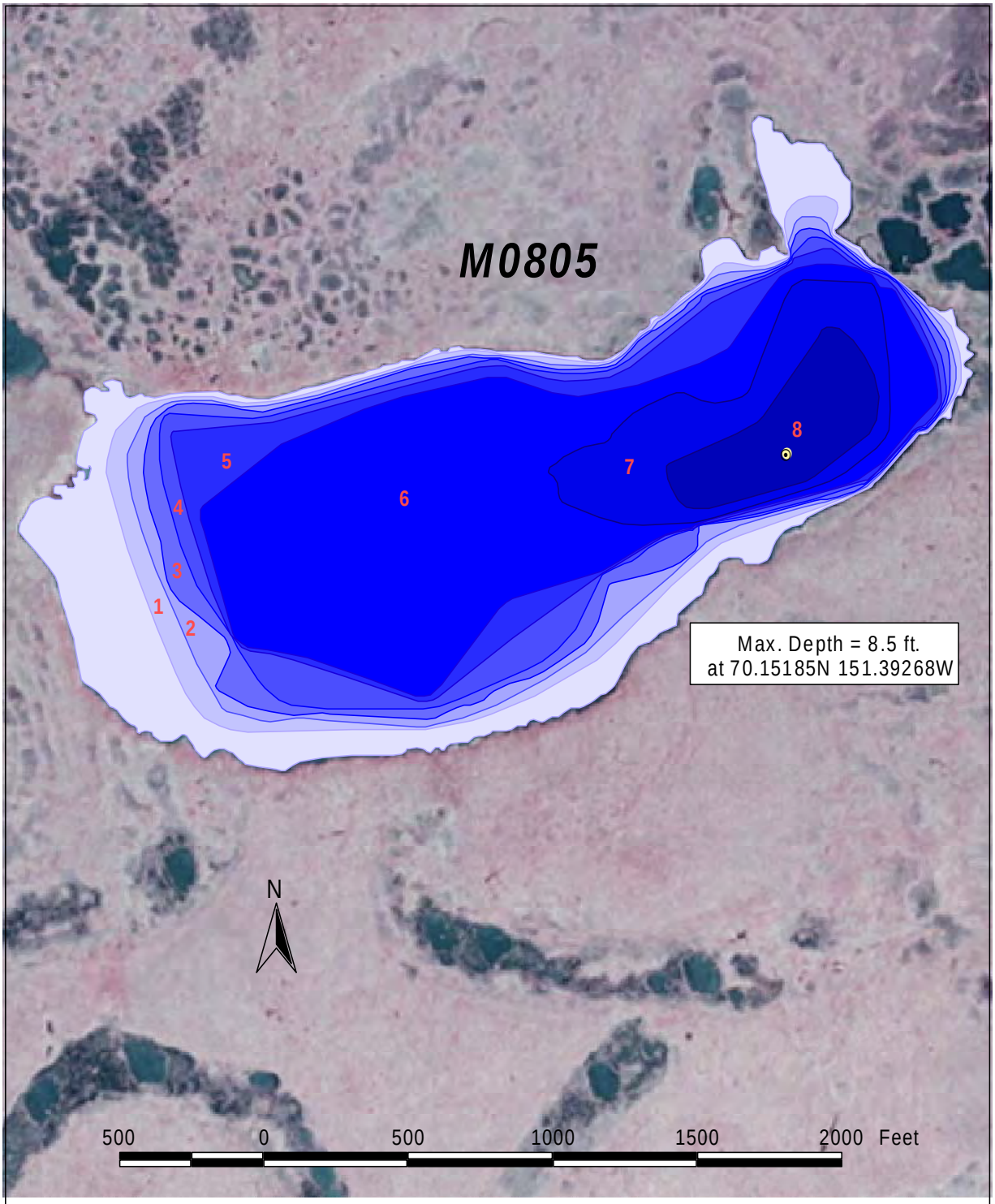
Regions of lake M0804 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 13, 2008.

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



Depth transects surveyed at lake M0804 on July 13, 2008.

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



Depth contours of lake M0805 based on transects surveyed on July 13, 2008
(depth in 1 foot intervals).

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

Lake M0805

Other Names: None Known
Location: 70.15138°N 151.40034°W
USGS Quad Sheet: Harrison Bay A-3: T9N R3E, Sec. 8/9
Habitat: Tundra Lake
Area: 79 acres
Maximum Depth: 8.5 feet
Active Outlet: No
Total Lake Volume: 120.92 million gallons (Jul 13, 2008 data)
Water Volume Under 4 ft of ice: 40.78 million gallons
Water Volume Under 5 ft of ice: 24.93 million gallons
Water Volume Under 7 ft of ice: 3.14 million gallons

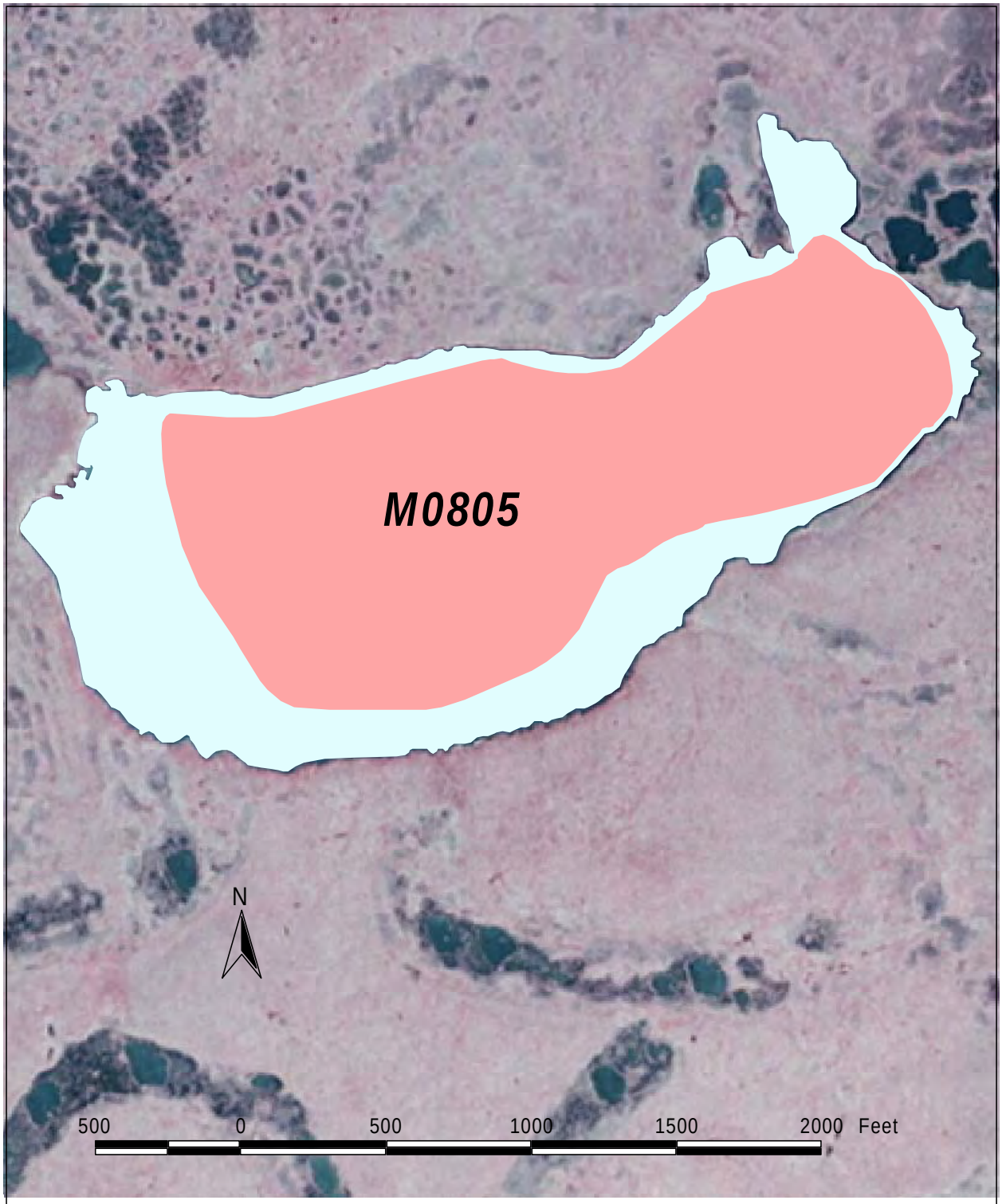
Potential Ice Aggregate: 27.41 acres (water depth 4 ft or less)
2.14 million gallons

Maximum Recommended Winter Removal: **7.48 million gallons**
(30% of water volume under 5 ft of ice)

Water Chemistry:

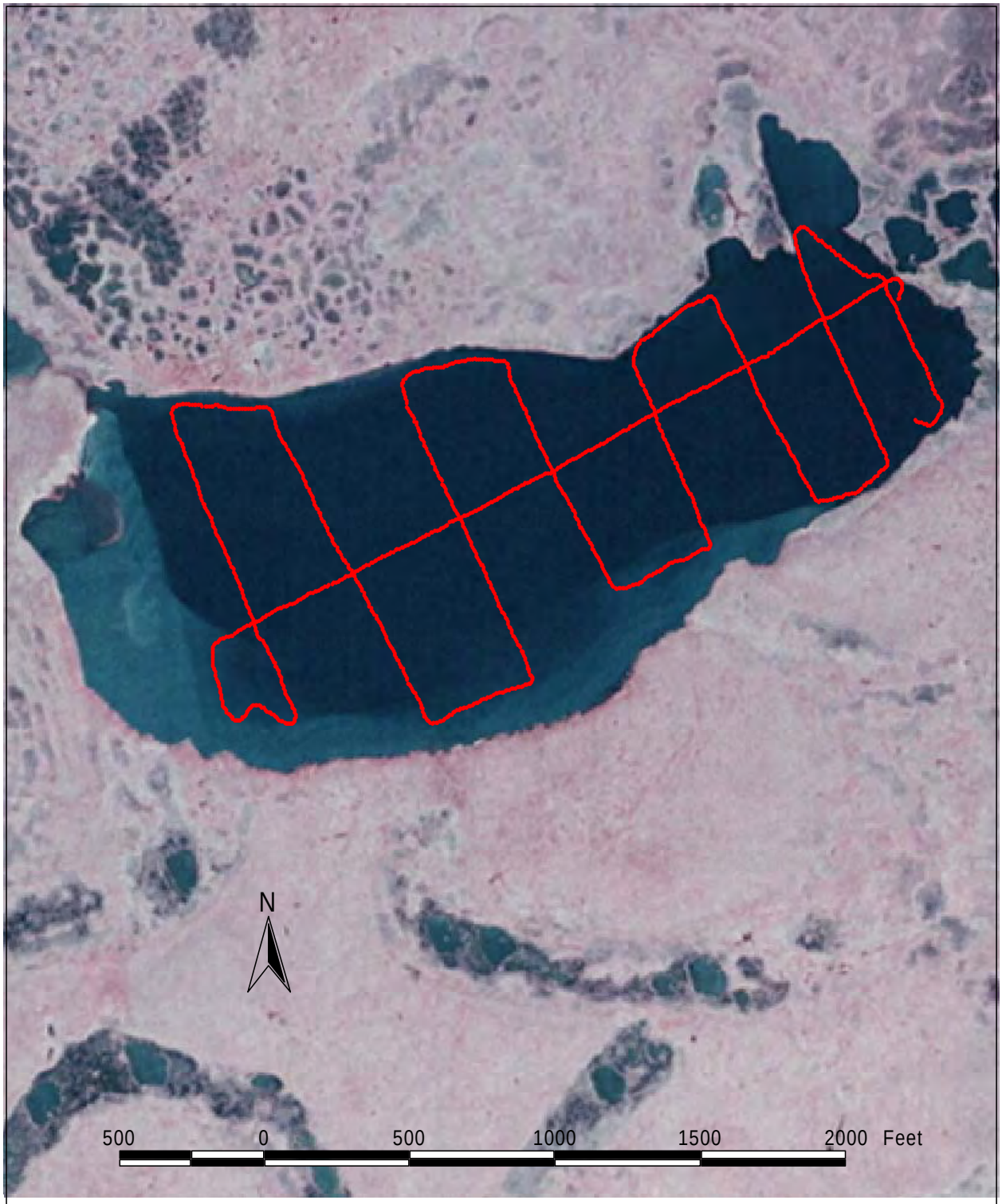
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2008	21.7	3.29	4.57	19.3	67.6	169	1.23	7.90	L. Moulton

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 13 08	6.2	none	0
Minnow trap	Jul 13 08	4.6	none	0
Seine	Jul 13 08	2 hauls	Ninespine stickleback	2



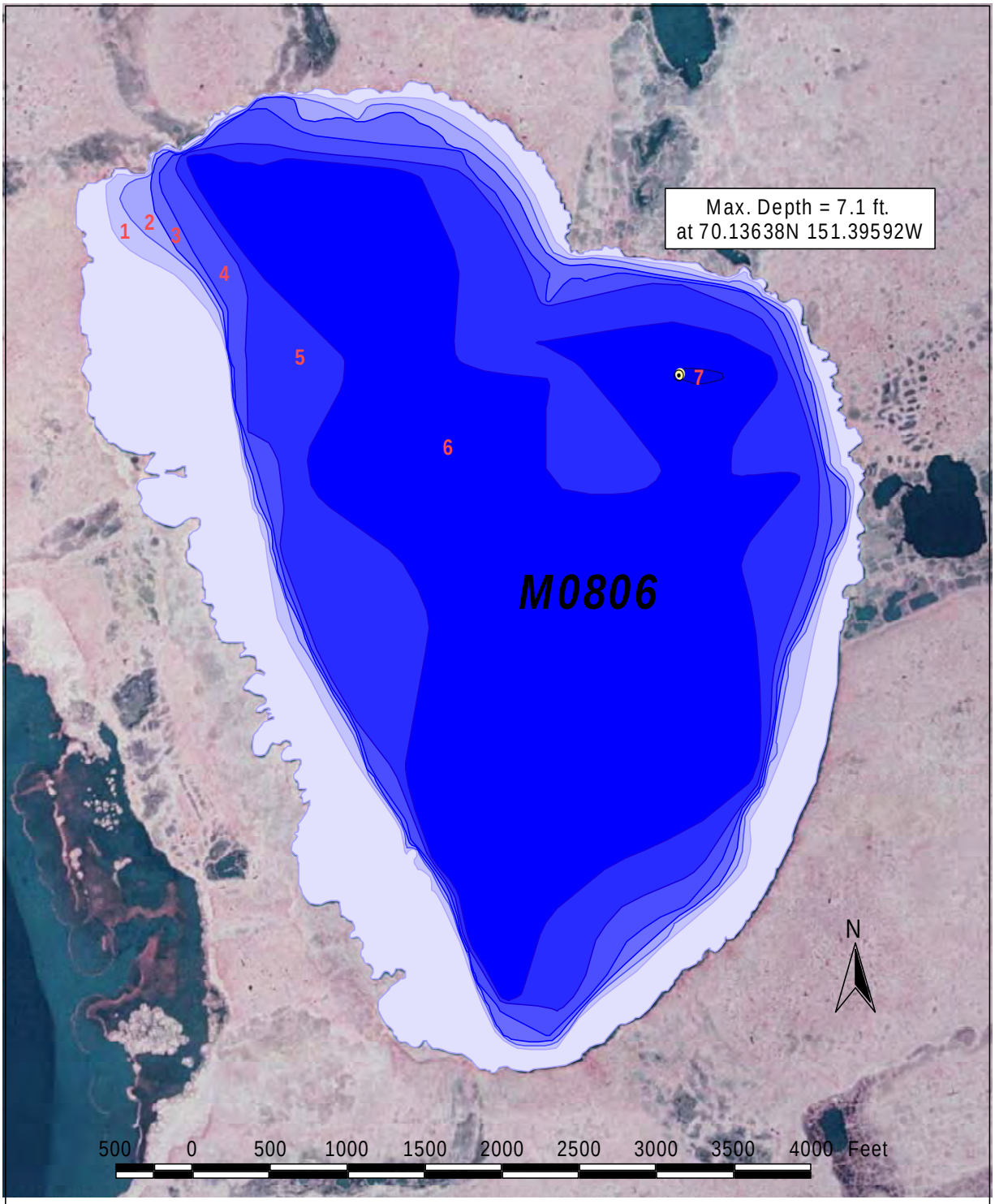
Regions of lake M0805 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 13, 2008.

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



Depth transects surveyed at lake M0805 on July 13, 2008.

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



Depth contours of lake M0806 based on transects surveyed on July 13, 2008
(depth in 1 foot intervals).

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

Lake M0806

Other Names: None Known
Location: 70.13345°N 151.40545°W
USGS Quad Sheet: Harrison Bay A-3: T9N R3E, Sec. 16/17/20/21
Habitat: Tundra Lake
Area: 481 acres
Maximum Depth: 7.1 feet
Active Outlet: No
Total Lake Volume: 700.08 million gallons (Jul 13, 2008 data)
Water Volume Under 4 ft of ice: 211.34 million gallons
Water Volume Under 5 ft of ice: 107.26 million gallons
Water Volume Under 7 ft of ice: 0.05 million gallons

Potential Ice Aggregate: 147.42 acres (water depth 4 ft or less)
11.53 million gallons

Maximum Recommended Winter Removal: **32.18 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
2008	36.4	5.48	8.79	31.5	113	268	1.6	8.03	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 13 08	7.2	none	0
Minnow trap	Jul 13 08	7.4	none	0
Seine	Jul 13 08	2 hauls	Ninespine stickleback	2

Regions of lake M0806 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 13, 2008.

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

Depth transects surveyed at lake M0806 on July 13, 2008.

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

Lake M0807 was estimated to be less than 5 feet deep when visited on July 14, 2008, and was not transected.

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

Lake M0807

Other Names: None Known
Location: 70.12651°N 151.48133°W
USGS Quad Sheet: Harrison Bay A-3: T9N R3E, Sec. 17/18/20
Habitat: Tundra Lake
Area: 371 acres
Maximum Depth: <5 feet
Active Outlet: No
Total Lake Volume: -- million gallons (Jul 14, 2008 data)
Water Volume Under 4 ft of ice: -- million gallons
Water Volume Under 5 ft of ice: -- million gallons
Water Volume Under 7 ft of ice: -- million gallons

Potential Ice Aggregate: 137.82 acres (water depth 4 ft or less)
10.78 million gallons

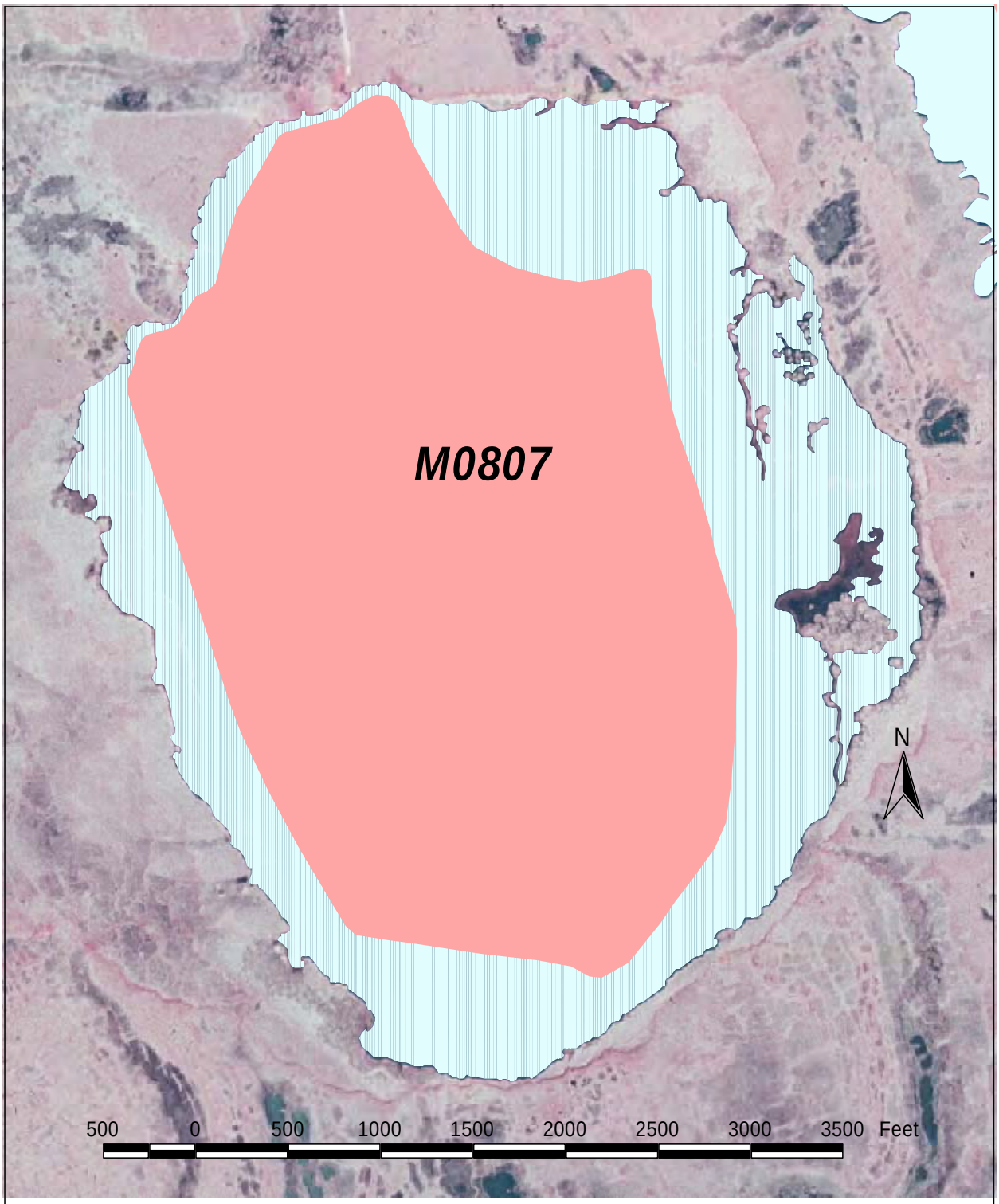
Maximum Recommended Winter Removal: too shallow to transect, use for ice chips only

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
2008	20.1	3.45	4.62	15.5	64.4	153	4.95	7.79	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
not fished, too shallow				

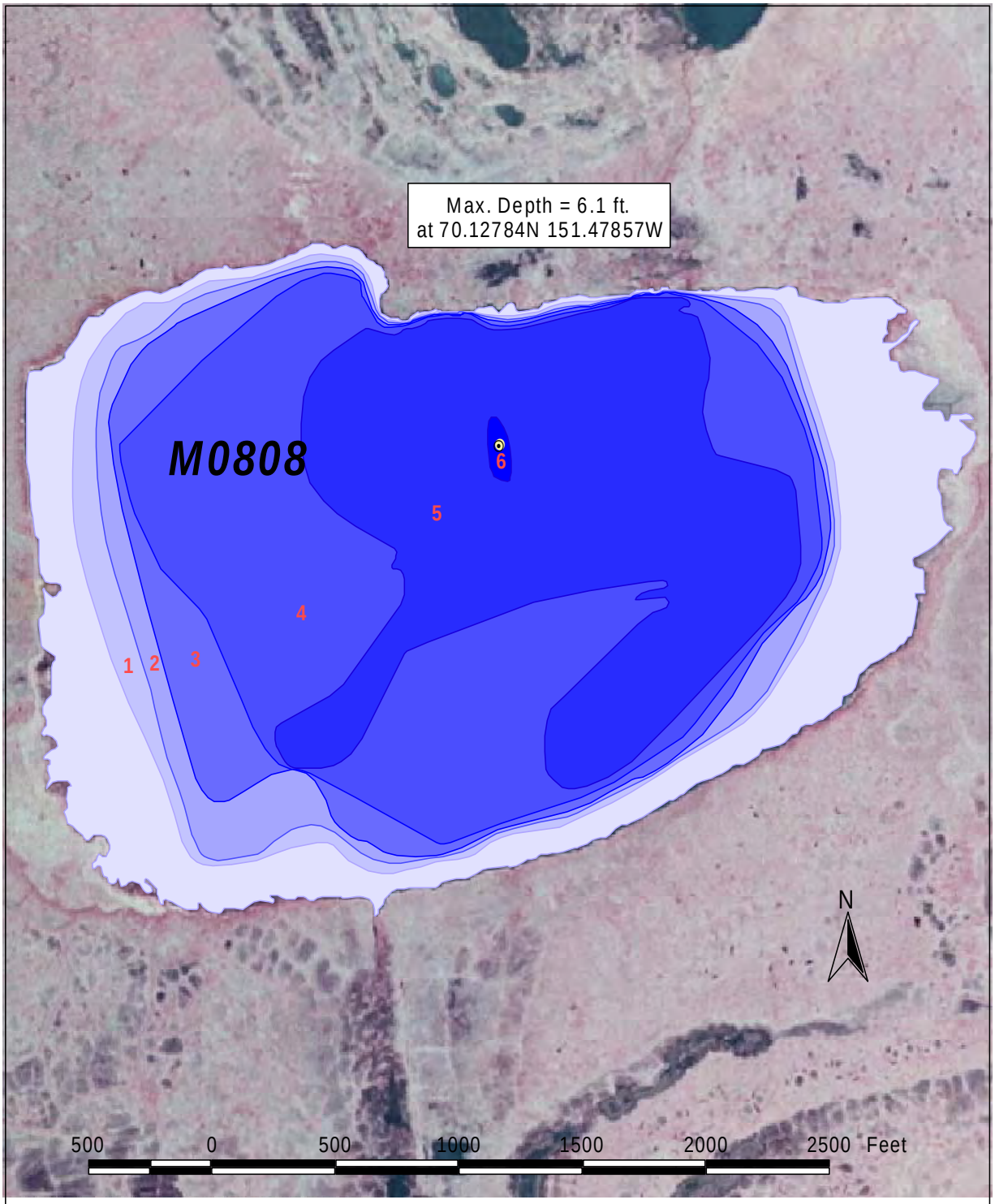


Regions of lake M0807 less than 4 feet deep (light blue) and likely to be available for ice chips, based on shoals visible on aerial photography.

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

Lake M0807 was estimated to be less than 5 feet deep when visited on July 14, 2008, and was not transected.

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



Depth contours of lake M0808 based on transects surveyed on July 11, 2008
(depth in 1 foot intervals).

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

Lake M0808

Other Names: None Known
Location: 70.12651°N 151.48133°W
USGS Quad Sheet: Harrison Bay A-3: T9N R3E, Sec. 18/19
Habitat: Tundra Lake
Area: 172 acres
Maximum Depth: 6.1 feet
Active Outlet: No
Total Lake Volume: 198.29 million gallons (Jul 11, 2008 data)
Water Volume Under 4 ft of ice: 31.44 million gallons
Water Volume Under 5 ft of ice: 6.46 million gallons
Water Volume Under 7 ft of ice: 0.00 million gallons

Potential Ice Aggregate: 70.37 acres (water depth 4 ft or less)
5.51 million gallons

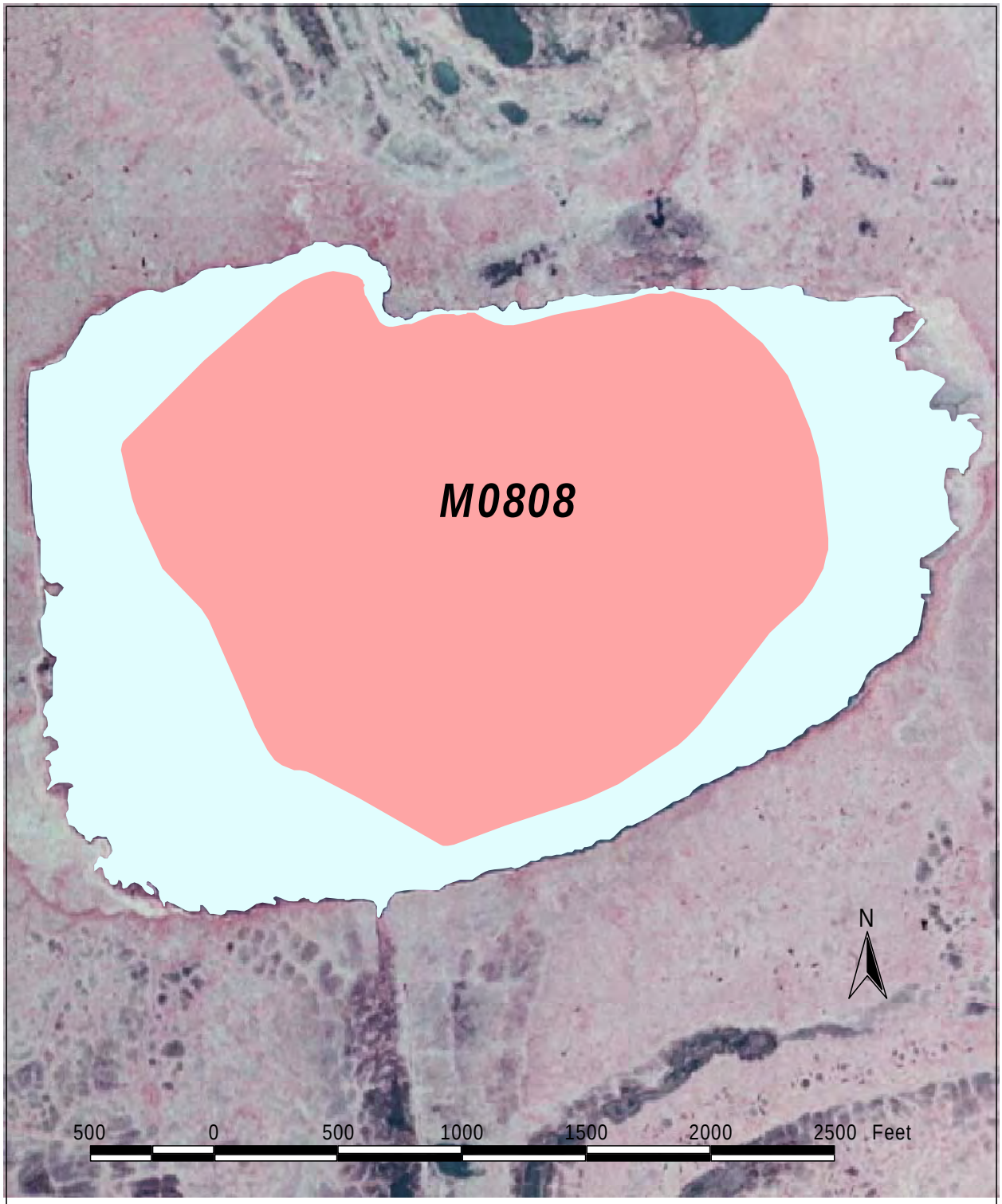
Maximum Recommended Winter Removal: **1.94 million gallons**
(30% of water volume under 5 ft of ice)

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
2008	17.2	2.5	3.1	11.4	53	131.3	0.8	8.17	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 11 08	6.3	none	0
Minnow trap	Jul 11 08	4.7	Ninespine stickleback	1

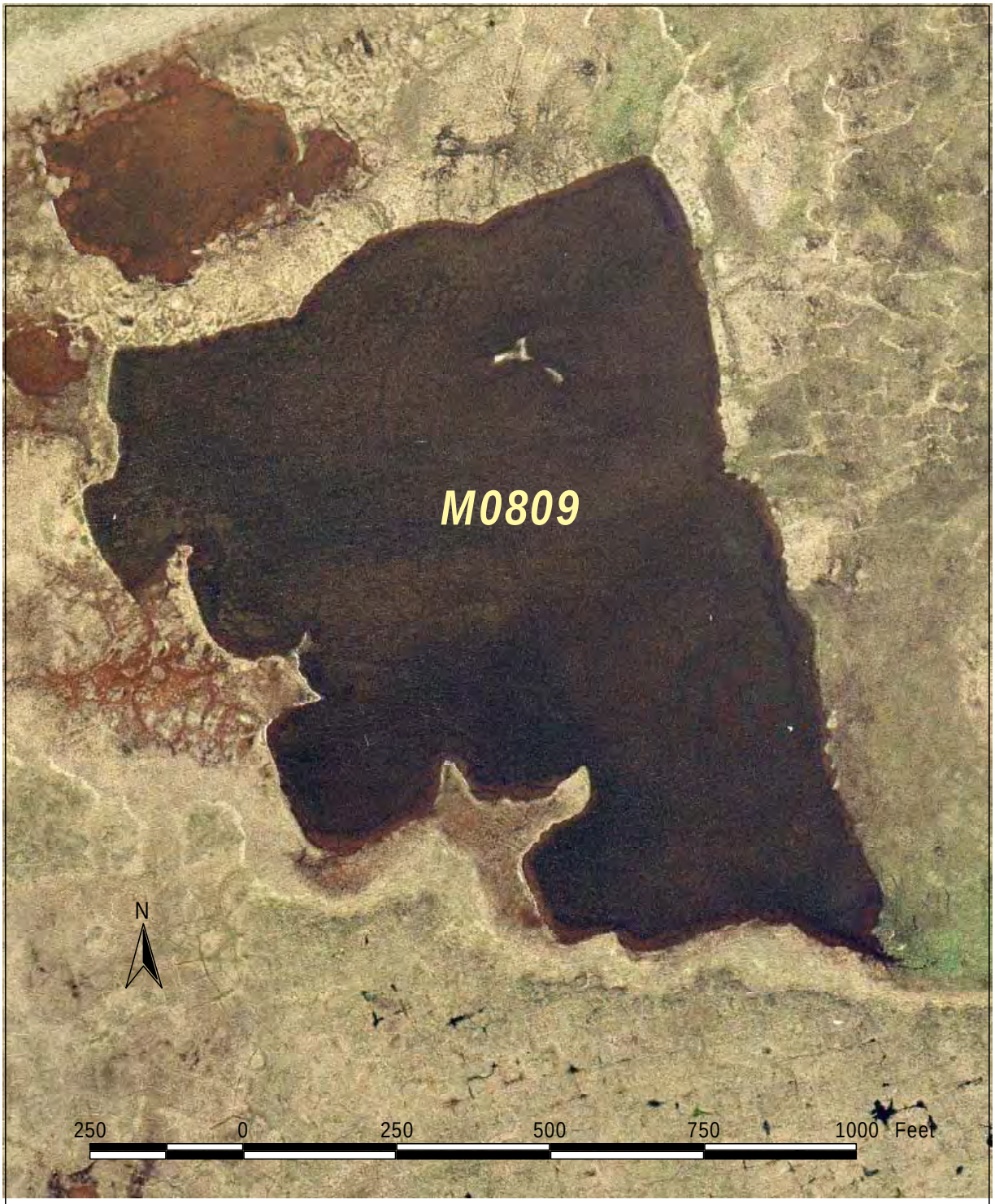


Regions of lake M0808 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 11, 2008.

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

Depth transects surveyed at lake M0808 on July 11, 2008.

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



Lake M0809 was estimated to be less than 5 feet deep when visited on July 15, 2008, and was not transected.

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

Lake M0809

Other Names: None Known
Location: 70.14755°N 151.55264°W
USGS Quad Sheet: Harrison Bay A-3: T9N R2E, Sec. 11
Habitat: Drainage Lake
Area: 22 acres
Maximum Depth: <5 feet
Active Outlet: No
Total Lake Volume: -- million gallons (Jul 14, 2008 data)
Water Volume Under 4 ft of ice: -- million gallons
Water Volume Under 5 ft of ice: -- million gallons
Water Volume Under 7 ft of ice: -- million gallons

Potential Ice Aggregate: 21.8 acres (water depth 4 ft or less)
1.70 million gallons

Maximum Recommended Winter Removal: too shallow to transect, use for ice chips only

Water Chemistry:

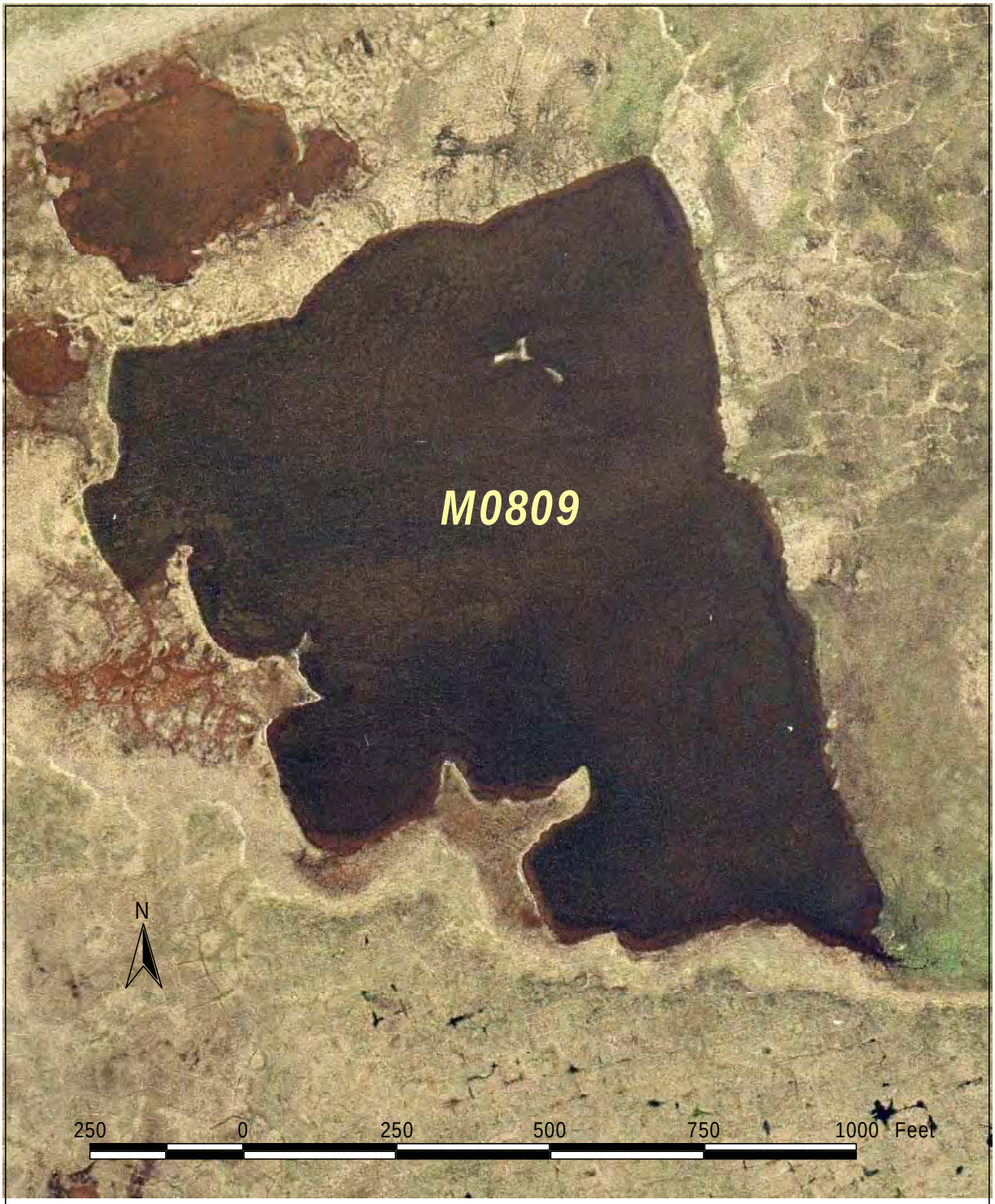
Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2008	14.3	2.72	3.87	11.3	46.9	114	0.92	7.83	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
not fished, too shallow				

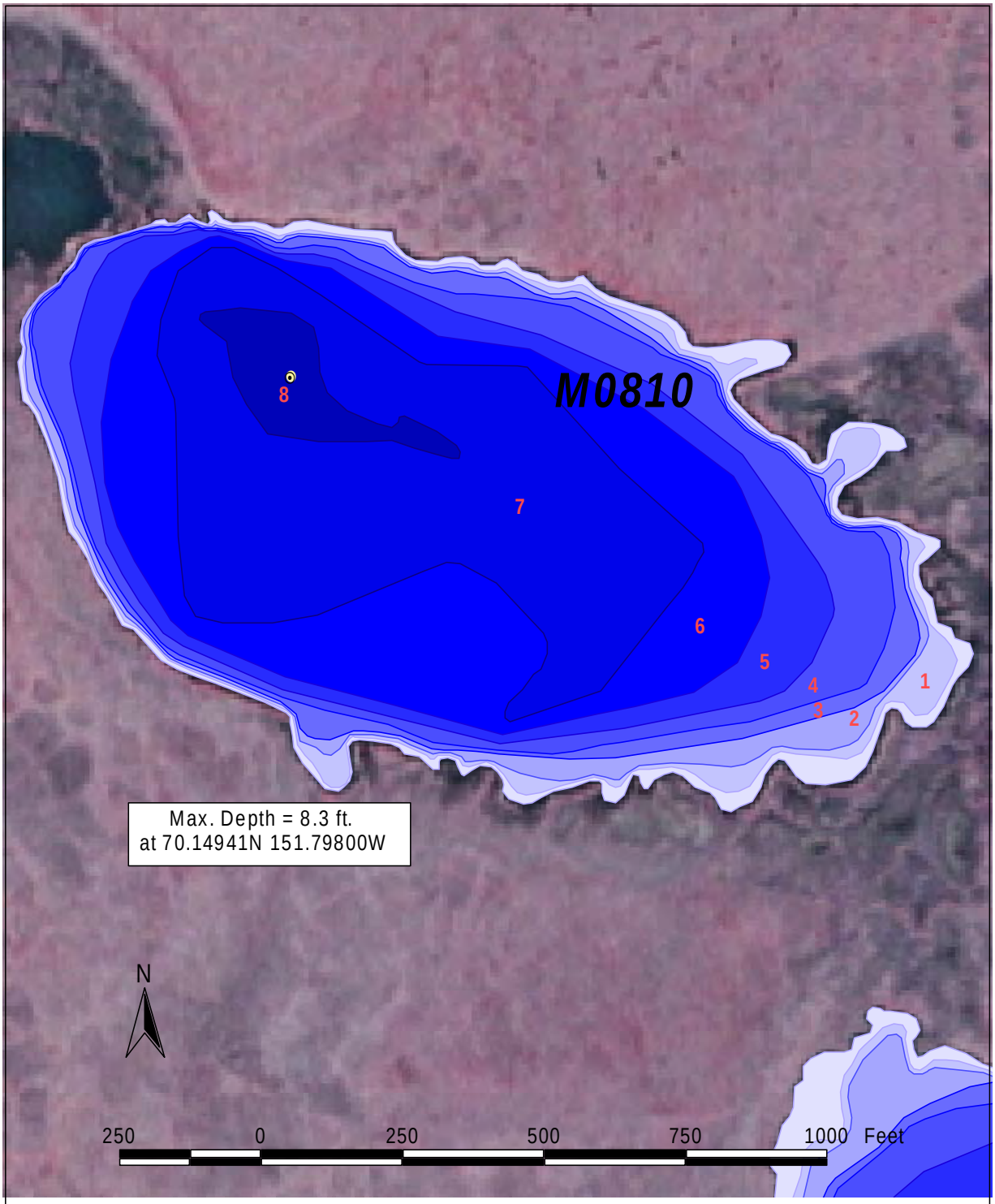
Lake M0809 was estimated to be less than 5 feet deep when visited on July 14, 2008 and likely to be available for ice chips.

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



Lake M0809 was estimated to be less than 5 feet deep when visited on July 15, 2008, and was not transected.

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



Depth contours of lake M0810 based on transects surveyed on July 15, 2008
(depth in 1 foot intervals).

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

Lake M0810

Other Names: None Known
Location: 70.14903°N 151.79554°W
USGS Quad Sheet: Harrison Bay A-3: T9N R1E, Sec. 11/12
Habitat: Tundra Lake
Area: 27 acres
Maximum Depth: 8.3 feet
Active Outlet: No
Total Lake Volume: 49.46 million gallons (Jul 15, 2008 data)
Water Volume Under 4 ft of ice: 17.76 million gallons
Water Volume Under 5 ft of ice: 11.18 million gallons
Water Volume Under 7 ft of ice: 1.56 million gallons

Potential Ice Aggregate: 5.00 acres (water depth 4 ft or less)
0.391 million gallons

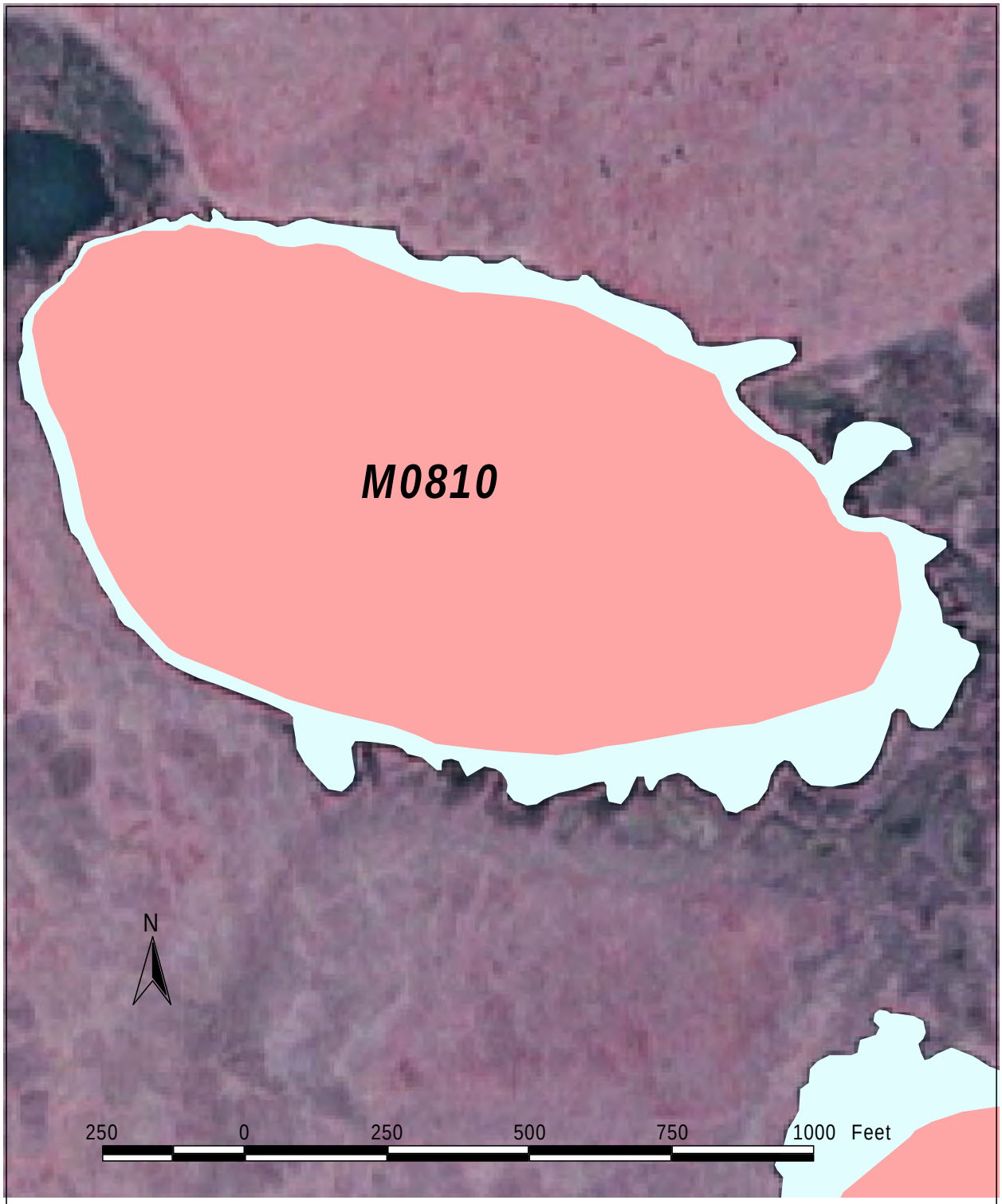
Maximum Recommended Winter Removal: **3.354 million gallons**
(30% of water volume under 5 ft of ice)

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
2008	15.9	3.96	8.24	30	56	170	0.69	7.82	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 15 08	6.6	None	0
Observed	Jul 15 08	--	Ninespine stickleback	8

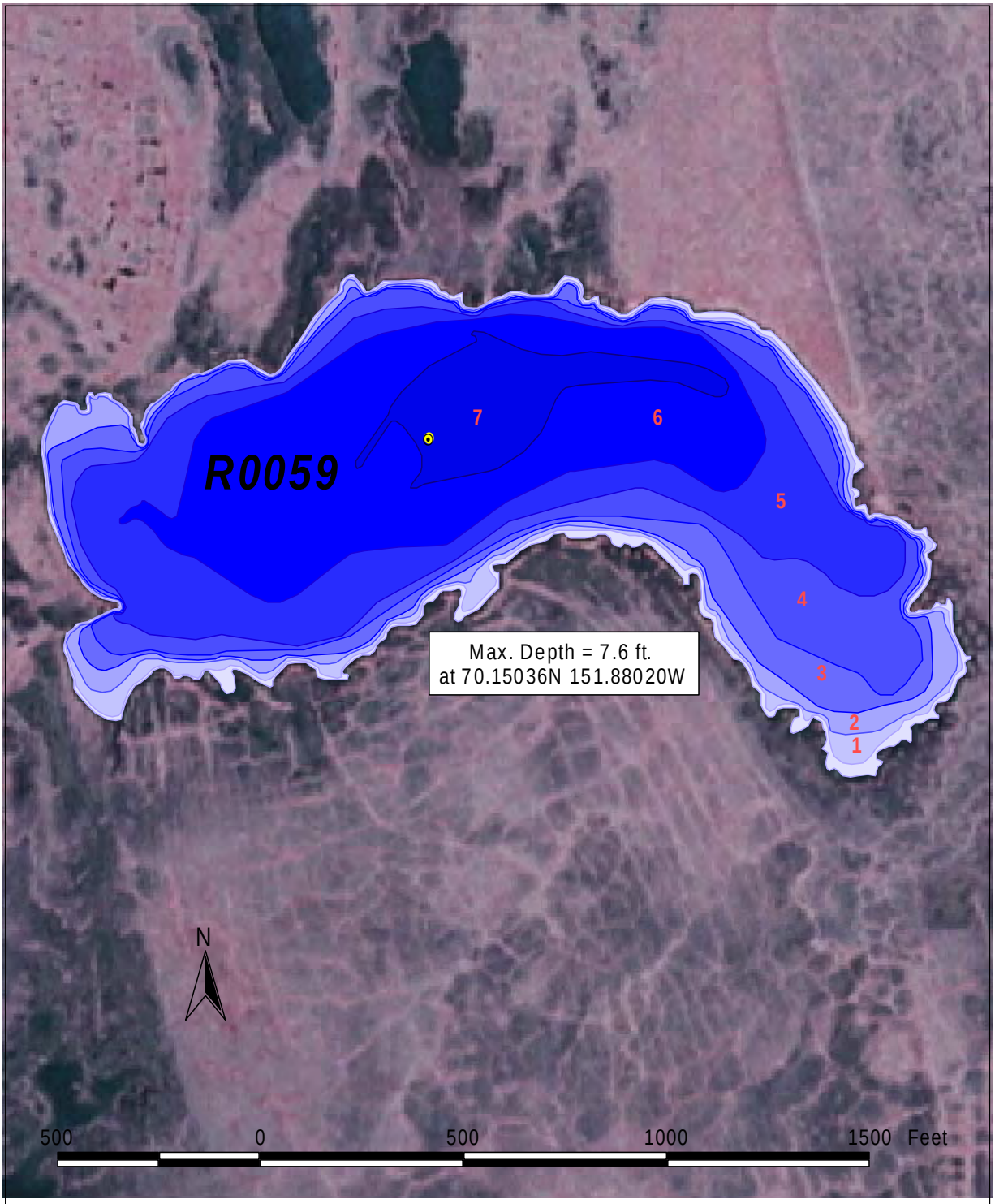


Regions of lake M0810 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 15, 2008.

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

Depth transects surveyed at lake M0810 on July 15, 2008.

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



Depth contours of lake R0059 based on transects surveyed on July 16, 2008
(depth in 1 foot intervals).

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

Lake R0059

Other Names: None Known
Location: 70.15034°N 151.87935°W
USGS Quad Sheet: Harrison Bay A-4: T9N R1E, Sec. 9/10
Habitat: Tundra Lake
Area: 35 acres
Maximum Depth: 7.6 feet
Active Outlet: No
Total Lake Volume: 58.09 million gallons (Jul 16, 2008 data)
Water Volume Under 4 ft of ice: 16.50 million gallons
Water Volume Under 5 ft of ice: 8.51 million gallons
Water Volume Under 7 ft of ice: 0.31 million gallons

Potential Ice Aggregate: 8.2 acres (water depth 4 ft or less)
0.643 million gallons

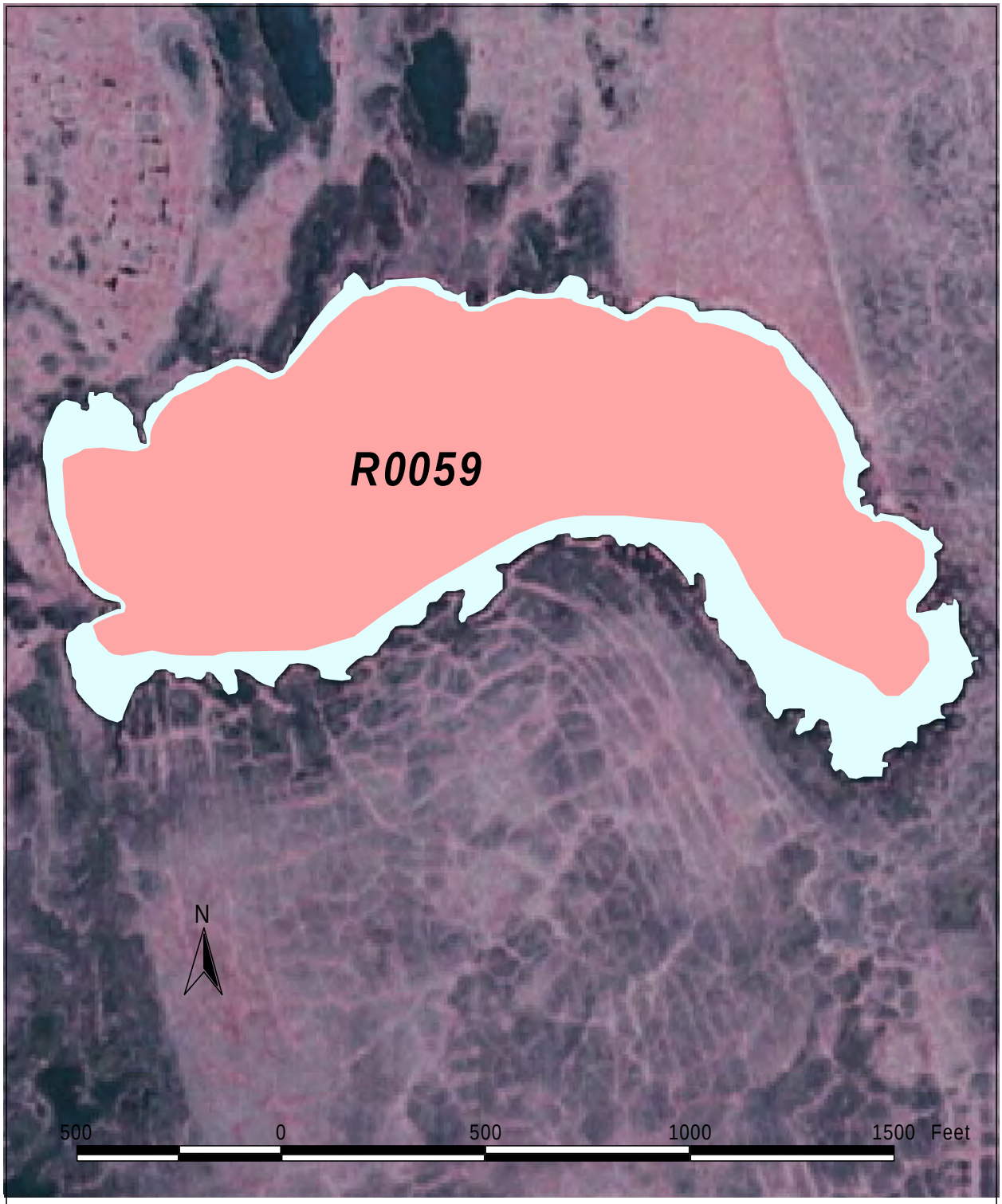
Maximum Recommended Winter Removal: **11.62 million gallons**
(20% of lake volume)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2008	5.4	1.2	3.3	9.6	19	59	1.3	8.15	L. Moulton

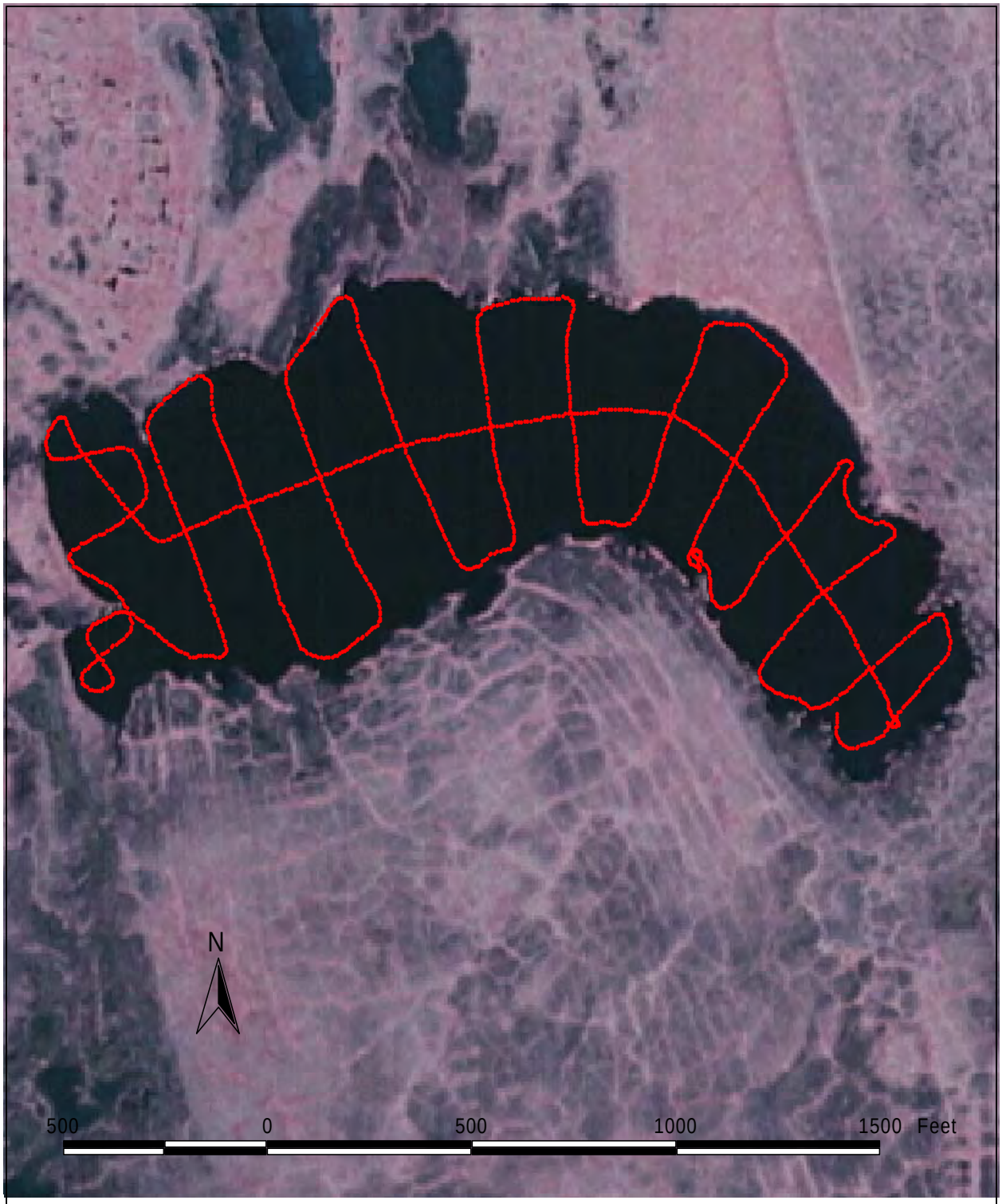
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 16 08	8.5	none	0
Minnow trap	Jul 16 08	8.4	none	0
Seine	Jul 16 08	6 hauls	none	0
Visual survey	Jul 16 08	220 yds	none	0



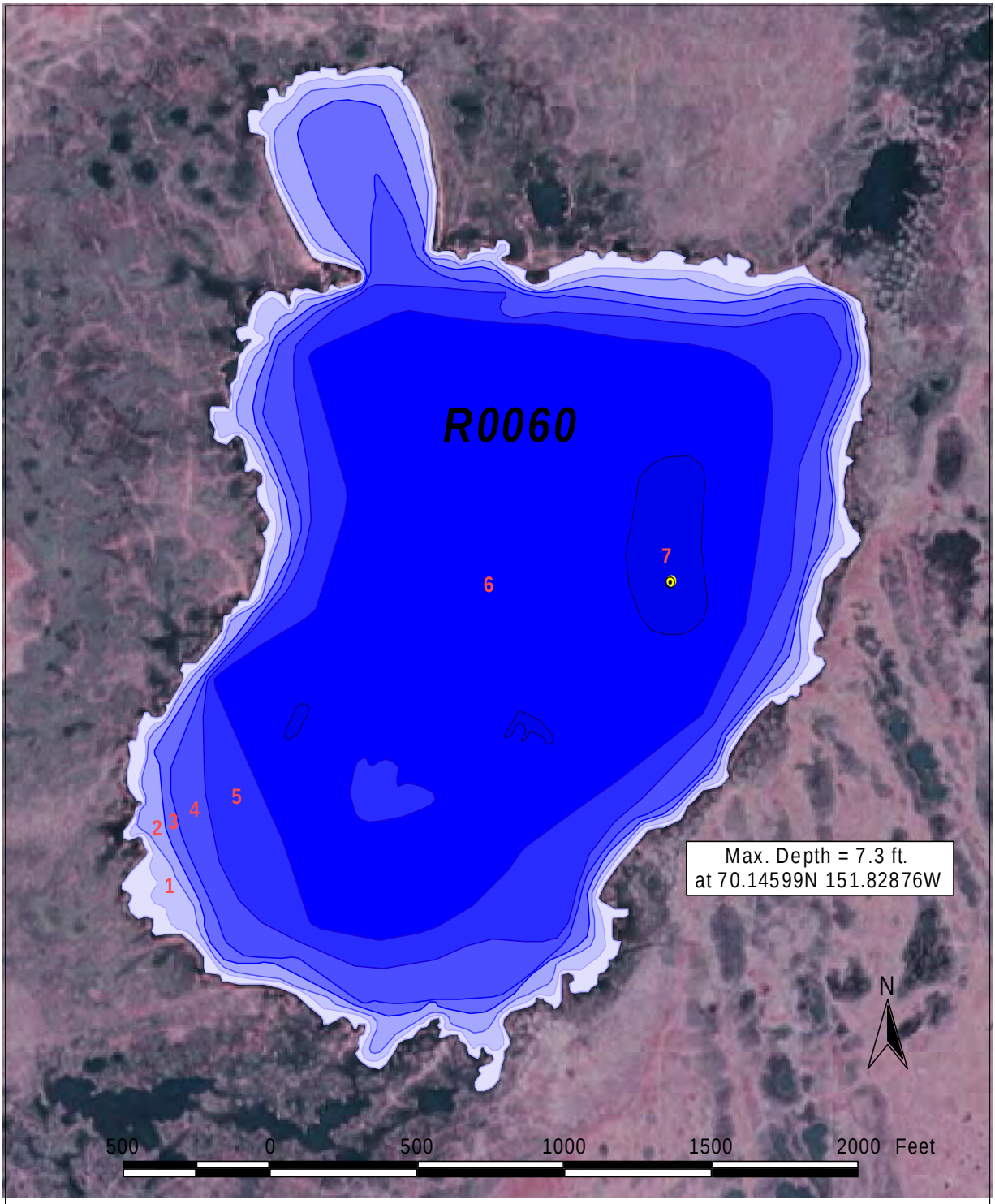
Regions of lake R0059 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 16, 2008.

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



Depth transects surveyed at lake R0059 on July 16, 2008.

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



Depth contours of lake R0060 based on transects surveyed on July 15, 2008
(depth in 1 foot intervals).

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

Lake R0060

Other Names: None Known
Location: 70.14578°N 151.83337°W
USGS Quad Sheet: Harrison Bay A-4: T9N R1E, Sec. 10/11
Habitat: Tundra Lake
Area: 115 acres
Maximum Depth: 8.2 feet
Active Outlet: No
Total Lake Volume: 191.65 million gallons (Jul 15, 2008 data)
Water Volume Under 4 ft of ice: 57.75 million gallons
Water Volume Under 5 ft of ice: 30.77 million gallons
Water Volume Under 7 ft of ice: 0.36 million gallons

Potential Ice Aggregate: 26.4 acres (water depth 4 ft or less)
2.07 million gallons

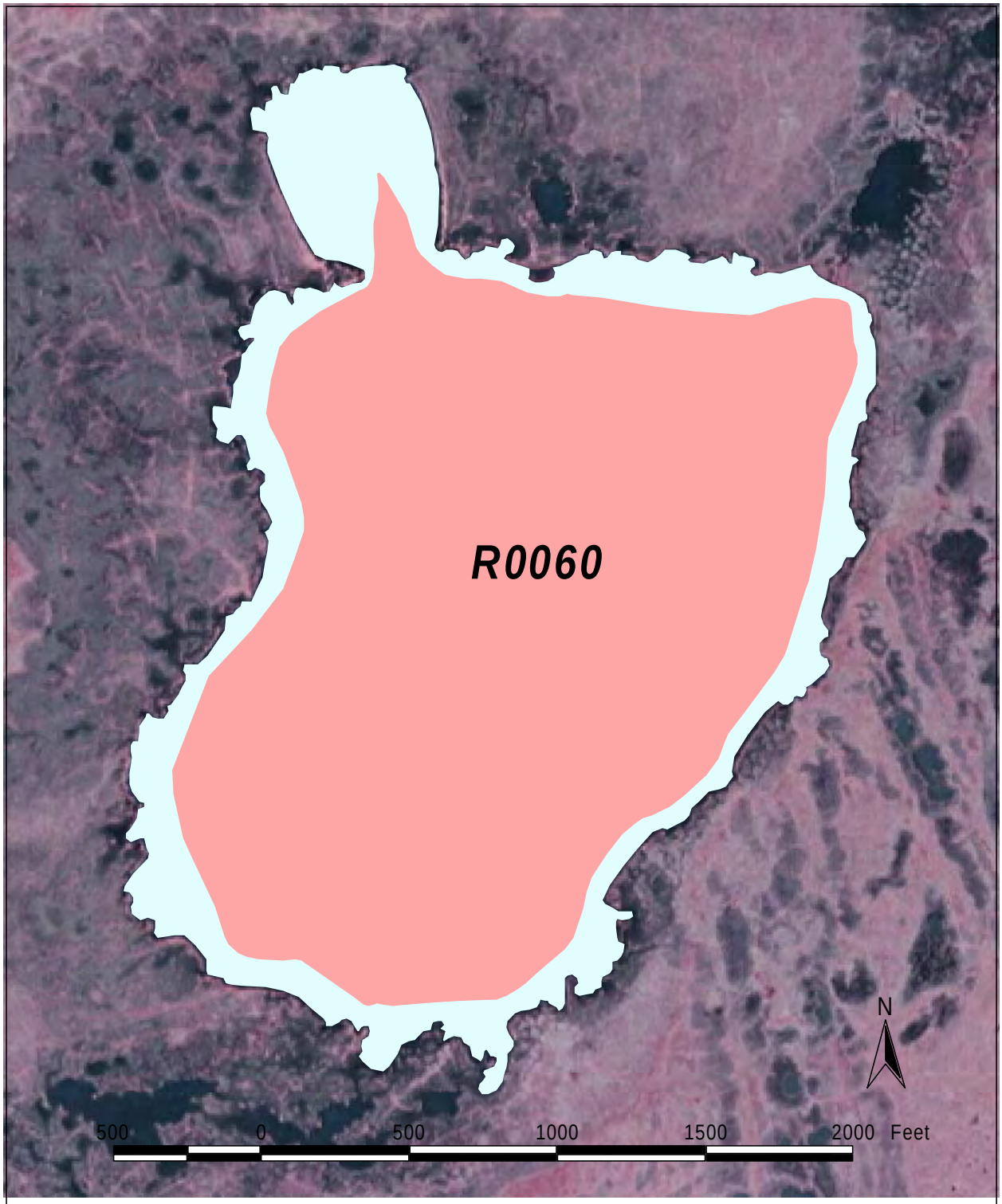
Maximum Recommended Winter Removal: **9.23 million gallons**
(30% of water volume under 5 ft of ice)

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
2008	13.7	2.8	7.6	23.4	46	144	1.2	7.80	L. Moulton

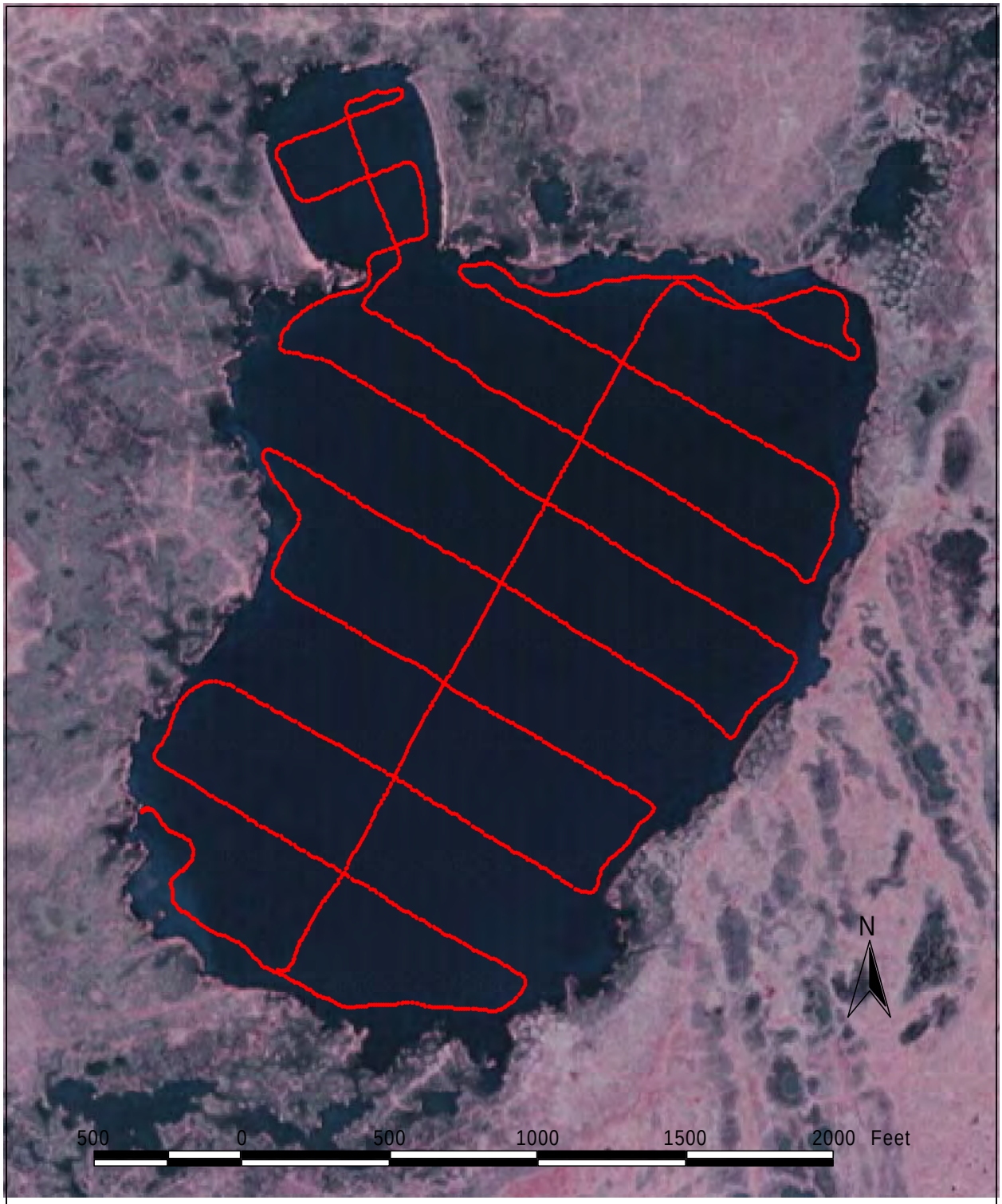
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 15 08	6.6	none	0
Observation	Jul 15 08	--	Ninespine stickeback	6



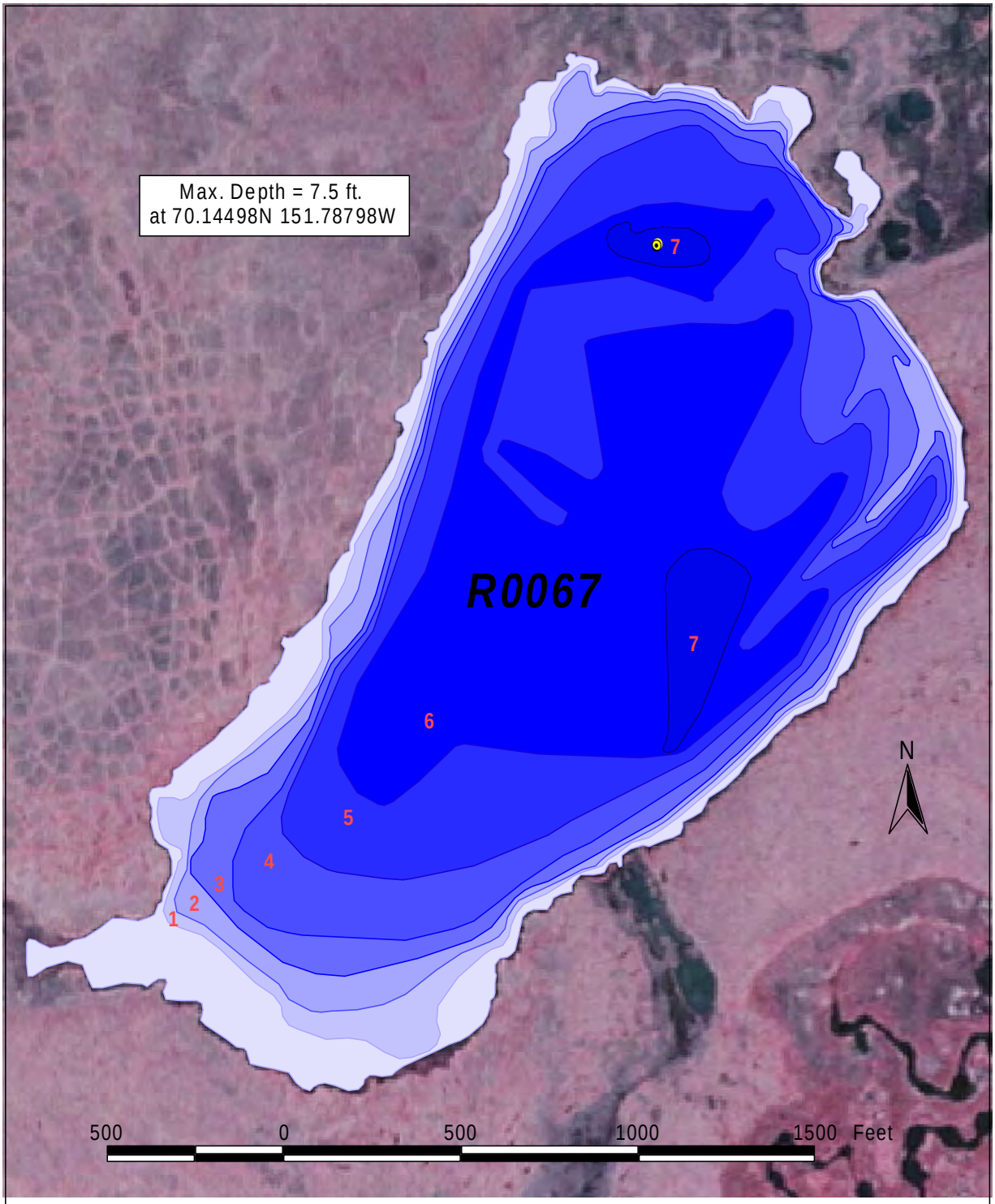
Regions of lake R0060 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 15, 2008.

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



Depth transects surveyed at lake R0060 on July 15, 2008.

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



Depth contours of lake R0067 based on transects surveyed on July 15, 2008
(depth in 1 foot intervals).

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

Lake R0067

Other Names: None Known
Location: 70.14255°N 151.78975°W
USGS Quad Sheet: Harrison Bay A-3: T9N R1E, Sec. 11/12/13/14
Habitat: Tundra Lake
Area: 80 acres
Maximum Depth: 7.5 feet
Active Outlet: No
Total Lake Volume: 120.32 million gallons (Jul 15, 2008 data)
Water Volume Under 4 ft of ice: 32.74 million gallons
Water Volume Under 5 ft of ice: 16.08 million gallons
Water Volume Under 7 ft of ice: 0.27 million gallons

Potential Ice Aggregate: 24.6 acres (water depth 4 ft or less)
1.92 million gallons

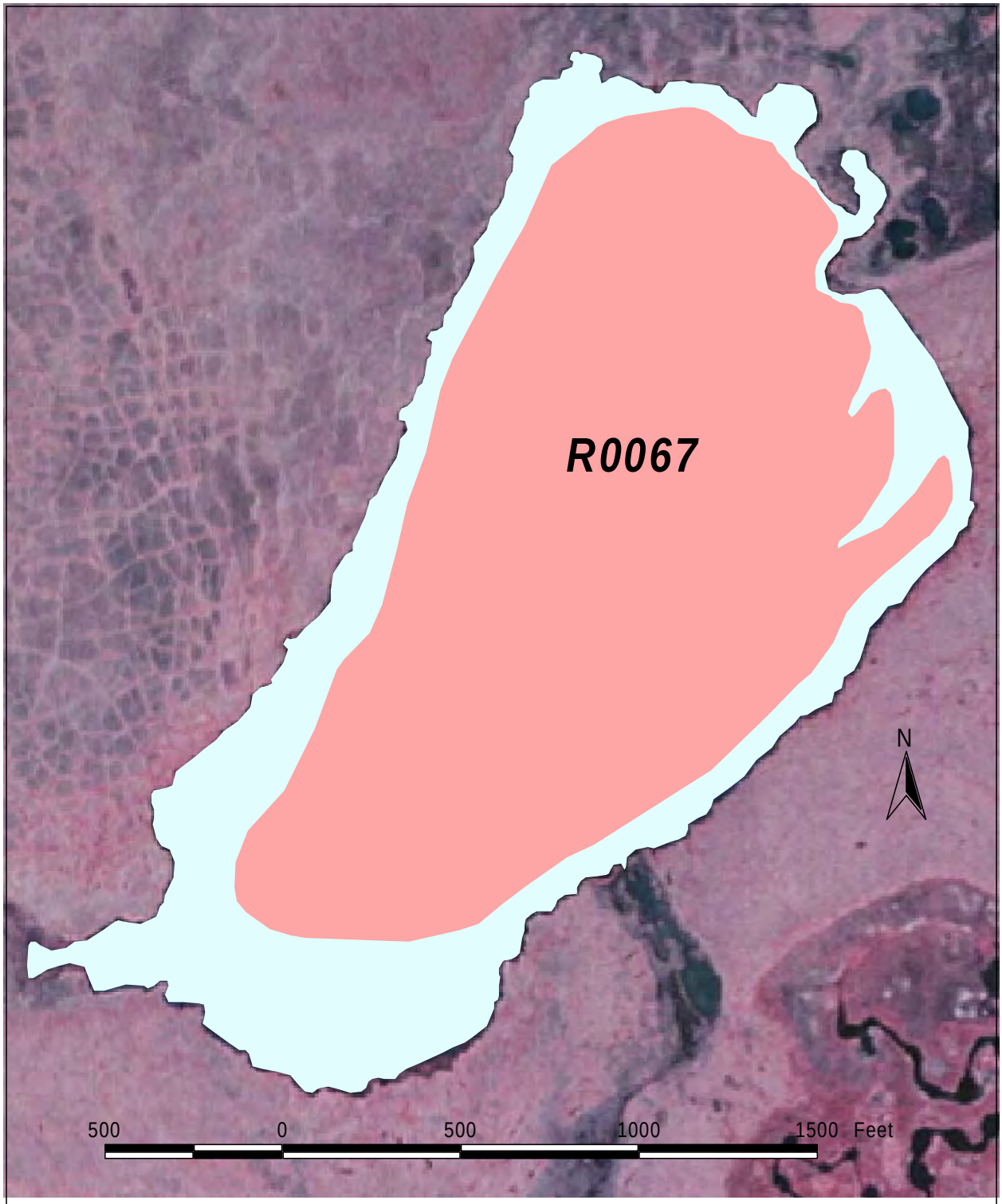
Maximum Recommended Winter Removal: **4.82 million gallons**
(30% of water volume under 5 ft of ice)

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
2008	21.9	3.6	6.6	24.9	70	179	0.9	7.83	L. Moulton

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 15 08	6.6	none	0
Observation	Jul 15 08	--	Ninespine stickeback	2



Regions of lake R0067 less than 4 feet deep (light blue) and likely to be available for ice chips, based on transects surveyed on July 15, 2008.

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

Depth transects surveyed at lake R0067 on July 15, 2008.

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