SURVEY OF LAKES IN ASSOCIATION WITH KOKODA REGION PROSPECTS: 2004

Final Data Report

December 2004

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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.

Objectives of the study were 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 2004 generally lies between the south side of Teshekpuk Lake and the Pik Dunes area (Figure 1), termed the Kokoda region in this report.

The objectives of the survey were to:

1) inventory fish species in the various lakes within the project study area (sampling area 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 2004 field effort continued sampling begun in 1999 in the eastern NPR-A Exploration Area, and in 2002 for the Kokoda region. Previous surveys in the Kokoda region are reported in Moulton (2003).

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. Surveys in lakes consisted of short-

duration gill net sampling in July, supplemented with minnow trap sets, seine hauls, and visual observations.

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, 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 (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. 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 2002-2003, 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 an H.F. Scientific DRT15CE turbidity meter. A water sample was sent to Northern Test Labs for laboratory determination of chloride, sodium, calcium, magnesium, and hardness (as CaCO3).

Bathymetric data were collected to allow estimating lake volume. In 2002 and 2003, 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 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. 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 1977-1986
L = Lobdell; water chemistry sampling in 1991-1999
M = Moulton; fish sampling in 1995-2004
MB = Michael Baker Jr., Inc. water chemistry sampling in 2002-2004
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 20 lakes were sampled in 2004 in connection with potential exploration in the Kokoda region of NPR-A (Table 1, Figure 2). Lake trout, broad whitefish, least cisco, round whitefish, and/or Arctic grayling were captured by gill net or observed in 6 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 caught or observed in an additional 5

lakes. Length information is presented for each fish-bearing lake in the Lake Summaries.

Lakes in the Kokoda region are predominantly deflation lakes, which are characterized by wide sandy shoals on the west and east sides, where sand dunes have eroded into the lakes (Figure 3). 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 11 to 30, 2004: 13.5 ^{o}C (range: 9.2 to 17.2^{o}C).

Dissolved oxygen was high, averaging around 95% saturation. The observed frequency of specific conductance and pH values from 54 lakes surveyed in the region since 2002 are graphed in Figure 5. The generally low specific conductance and low ion concentration indicates little marine influence in most lakes in this region.

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, 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 6 containing sensitive species and an additional 5 containing only ninespine stickleback. Lakes containing sensitive fish species in this region are connected to nearby streams at least during a portion of the open-water season (Figure 4). Fish were not detected in the remaining 9 lakes.

Based on the above analysis, 1,324.3 million gallons of water are likely to be available for winter use from lakes surveyed during 2004 in association with the Kokoda region.

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, 4,207 acres are likely to be available for ice chips from lakes surveyed during 2004 in association with the Kokoda region.

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Table 1. Summary of lakes sampled in or near Kokoda Region prospects in 2004.

Area	Lake Name	Latitude (NAD83)	Longitude (NAD83)	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Calculated Volume (mill. gals)
Kokoda									
	B84057	70.28272	153.00426	11N	4/5W	19/20/29/30/24/25	1,800.6	43.0	5,758.69
	M0410	70.31566	153.22983	11N	5W	7/8/17/18	682.7	37.7	1,431.01
	M0411	70.32325	153.19757	11N	5W	8/9	182.4	8.7	213.49
	M0412	70.34478	153.17784	12N	5W	33	31.4	7.6	36.83
Noatak									
	M0413	70.36272	153.16085	12N	5W	28	43.2	9.5	41.78
	M0414A	70.36841	153.15570	12N	5W	28	27.7	5.8	14.34
	M0414B	70.37354	153.15347	12N	5W	21/28	29.3	4.1	16.55
	M0415	70.39628	153.09250	12N	5W	14	209.2	6.1	183.44
Nugget									
	M0416A	70.25355	152.99526	10/11N	4/5W	1/6/31	683.2	27.9	1,495.20
	M0416B	70.25581	152.95238	10/11N	4W	4/5/32/33	803.0	37.1	2,040.86
	M0417A	70.27446	152.95056	11N	4W	29/32	475.3	38.4	1,342.75
	M0417B	70.27388	152.92015	11N	4W	28/33	250.1	28.5	533.18
Bounty									
	M0404	70.31562	153.50552	11N	6W	7/18	235.2	22.1	426.67
	M0405	70.32823	153.49310	11N	6W	6/7	110.6	6.8	97.95
	M0406A	70.32802	153.47480	11N	6W	5/8	111.0	7.0	58.38
	M0406B	70.32975	153.46716	11N	6W	5/8	74.1	--	--
Defiance									
	M0401A	70.37899	153.61156	12N	7W	22/23	183.0	11.4	277.21
	M0401B	70.38237	153.59761	12N	7W	23	222.0	13.6	312.41
	M0402	70.40731	153.55904	12N	7W	12	84.4	8.5	69.89
	M0403	70.38960	153.52083	12N	6/7W	18/19/13/24	400.7	6.9	437.21
	M0407A	70.35703	153.41198	12N	6W	27/28/33/34	30.0	6.8	490.96
	M0407B	70.35848	153.44023	12N	6W	28/33	73.2	6.9	73.18
	M0407C	70.36169	153.43353	12N	6W	28	18.9	6.4	18.85
	M0407D	70.36234	153.39198	12N	6W	27	491.0	7.5	29.96
	M0408	70.37295	153.36591	12N	6W	22/23/26/27	270.0	9.2	258.92
	M0409	70.36423	153.31113	12N	6W	25/26	551.9	27.8	747.34
Hornet									
	M0418	70.18332	152.93221	10N	4W	28/32/33	49.8	9.7	88.92
	M0419	70.18778	152.89309	10N	4W	27/28	144.7	15.8	246.48

-- = not determined

Table 2. Catches of fish from lakes sampled in or near Kokoda Region prospects in 2004.

			Gill Nets		Minnow Traps		Seine and Observation	
Area	Lake Name	Sample Date	Set Duration (hours)	Fish Species[1]	Set Duration (hours)	Fish Species[2]	Number of Hauls	Fish Species[2]
Kokoda								
	B84057	Jul 24 04	6.1	BDWF,LSCS,RDWF LKTR (Bendock&Burr 84)	10.4	NSSB	0	
	M0410	Jul 17 04	10.0	GRAY (obs.)	connected to M0411		assumed	NSSB
	M0411	Jul 11 04	8.8	GRAY (assumed)	11.3	NSSB	0	
	M0412	Jul 26 04	9.1	none	11.9	none	3	none
Noatak								
	M0413	Jul 26 04	8.2	none	10.9	none	3	none
	M0414	Jul 27 04	7.2	none	11.1	none	3	none
	M0415	Jul 17 04	7.2	none	0.0		5	none
Nugget								
	M0416	Jul 25 04	16.1	LKTR,LSCS	0.0		observed	NSSB
	M0417	Jul 15 04	7.1	LKTR	0.0		observed	NSSB
Bounty								
	M0404	Jul 24 04	7.5	LSCS	7.0	NSSB	observed	NSSB
	M0405	Jul 27 04	8.6	none	11.3	none	3	none
	M0406	Jul 28 04	8.2	none	10.8	none	0	
Defiance								
	M0401	Jul 14 04	9.0	none	0.0		observed	NSSB
	M0402	Jul 30 04	7.9	none	10.3	none	3	none
	M0403	Jul 14 04	7.0	none	0.0		observed	NSSB
	M0407	Jul 29 04	8.3	none	11.8	none	3	none
	M0408	Jul 23 04	9.5	none	12.0	none	3	none
	M0409	Jul 23 04	9.3	none	10.8	NSSB	0	
Hornet								
	M0418	Jul 16 04	9.2	none	0.0		1	NSSB
	M0419	Jul 16 04	9.0	none	0.0		observed	NSSB

[1] BDWF = broad whitefish, RDWF = round 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 or near Kokoda Region prospects in 2004.

Area	Lake	Date	Water Temp (^{o}C)	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)
Kokoda													
	B84057	Jul 24 04	15.1	9.4	94	182	8.15	0.4	28.6	2.8	4.4	9.1	83
	M0410	Jul 17 04	10.7	10.8	98	110	7.91	2.2	16.9	1.9	3.5	6.2	50
	M0411	Jul 11 04	10.4	10.5	94	108	7.76	0.9	14.9	1.7	3.3	6.1	44
	M0412	Jul 26 04	16.6	8.2	90	78	7.10	0.9	10.8	1.5	2.7	4.7	33
Noatak													
	M0413	Jul 26 04	17.0	8.7	93	169	7.72	0.6	27.6	3.0	4.2	7.6	81
	M0414	Jul 27 04	15.1	8.3	87	105	7.80	1.2	12.6	9.1	5.7	11.0	69
	M0415	Jul 17 04	14.7	10.0	99	142	8.11	0.6	21.7	2.4	3.6	6.6	64
Nugget													
	M0416	Jul 25 04	14.2	9.7	96	198	8.20	0.7	34.0	3.3	4.2	9.8	98
	M0417	Jul 15 04	11.7	10.8	99	202	8.18	1.0	29.7	2.8	4.4	9.7	86
Bounty													
	M0404	Jul 24 04	14.6	9.6	95	87	7.92	0.8	10.4	1.7	3.5	7.7	33
	M0405	Jul 27 04	16.0	8.7	92	94	7.98	1.9	13.0	3.2	3.3	6.0	45
	M0406	Jul 28 04	11.6	9.5	90	118	7.97	1.1	16.7	2.9	4.3	7.6	54
Defiance													
	M0401	Jul 14 04	10.3	11.2	100	184	8.10	1.1	28.0	2.5	4.5	9.4	80
	M0402	Jul 30 04	9.2	10.2	90	165	8.15	1.6	27.7	2.9	4.3	8.9	81
	M0403	Jul 14 04	13.0	10.0	95	75	7.80	1.0	11.2	1.1	1.3	2.6	32
	M0407	Jul 29 04	9.9	10.6	95	73	8.19	0.6	12.5	1.4	2.1	3.4	37
	M0408	Jul 23 04	17.2	9.2	96	177	8.07	0.4	31.9	3.3	4.1	7.1	93
	M0409	Jul 23 04	14.8	9.5	94	171	7.91	0.7	28.9	3.4	5.3	10.1	86
Hornet													
	M0418	Jul 16 04	12.9	10.4	99	181	7.95	0.9	26.8	2.9	7.9	14.9	79
	M0419	Jul 16 04	14.3	9.7	95	203	8.11	0.8	29.0	3.1	6.3	13.8	85

[1] NM = not measured

Table 4. Estimated water volumes available for winter withdrawal from surveyed lakes in or near Kokoda Region prospects in 2004.

(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)	Volume Under 4ft of Ice (mil. gals)	30% of 5 ft Winter Volume (mil. gals)	15% of 7 ft Winter Volume (mil. gals)	Sensitive Fish Species Present[1]	Resistant Fish Species Present[2]	Available Water (mil. gals)
Kokoda										
	B84057	1,800.6	43.0	5,758.69	4,155.61	1,164.45	516.71	LKTR,BDWF, LSCS,RDWF	NSSB	516.71
	M0410	682.7	37.7	1,431.01	870.26	236.24	102.38	GRAY	NSSB	102.38
	M0411	182.4	8.7	213.49	57.91	10.16	0.24	GRAY	NSSB	0.24
	M0412	31.4	7.6	36.83	3.81	0.32	0.01	none	none	3.81
Noatak										
	M0413	43.2	9.5	41.78	8.25	1.31	0.09	none	none	8.25
	M0414A	27.7	5.8	14.34	0.72	0.04	0.00	none	none	0.72
	M0414B	29.3	4.1	16.55	0.00	0.00	0.00	none	none	0.00
	M0415	209.2	6.1	183.44	25.98	1.83	0.00	none	none	25.98
Nugget										
	M0416A	683.2	27.9	1,495.20	747.36	187.70	65.40	LKTR,LSCS	NSSB	65.40
	M0416B	803.0	37.1	2,040.86	1,155.02	299.85	115.38	LKTR,LSCS	NSSB	115.38
	M0417A	475.4	38.4	1,342.75	861.56	230.21	93.16	LKTR	NSSB	93.16
	M0417B	249.9	28.5	533.18	288.10	72.32	26.00	LKTR	NSSB	26.00
Bounty										
	M0404	235.2	22.1	426.67	194.57	47.75	15.88	LSCS	NSSB	15.88
	M0405	110.6	6.8	97.95	11.49	0.79	0.00	none	none	11.49
	M0406A	111.0	7.0	58.38	2.19	0.28	0.00	none	none	2.19
	M0406B	74.1	--	--	--	--	--	none	none	0.00
Defiance										
	M0401A	183.0	11.4	277.21	118.40	26.57	6.20	none	NSSB	26.57
	M0401B	222.0	13.6	312.41	109.69	23.64	5.16	none	NSSB	23.64
	M0402	84.4	8.5	69.89	10.83	1.63	0.06	none	none	10.83
	M0403	400.7	6.9	437.21	82.08	6.13	0.05	none	NSSB	6.13
	M0407A	491.0	6.8	490.96	74.03	8.26	0.50	none	none	74.03
	M0407B	73.2	6.9	73.18	20.43	2.36	0.18	none	none	20.43
	M0407C	18.9	6.4	18.85	0.96	0.07	0.00	none	none	0.96
	M0407D	30.0	7.5	29.96	3.44	0.29	0.00	none	none	3.44
	M0408	270.0	9.2	258.92	95.35	20.07	2.22	none	none	95.35
	M0409	551.9	27.8	747.34	224.89	47.84	13.36	none	NSSB	47.84
Hornet										
	M0418	49.8	9.7	88.92	39.25	8.95	1.96	none	NSSB	8.95
	M0419	144.7	15.8	246.48	89.24	18.53	4.89	none	NSSB	18.53

[1] Sensitive species include grayling, whitefishes, char, burbot, slimy sculpin, etc.
LKTR = lake trout LSCS = least cisco GRAY = arctic grayling
BDWF = broad whitefish RDWF = round whitefish

[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 or near Kokoda Region prospects in 2004.

Area	Lake	Surface Area (acres)	Max. Depth (feet)	Acres covered by Water shallower 4 feet
Kokoda				
	B84057	1,800.6	43.0	901.7
	M0410	682.7	37.7	391.1
	M0411	182.4	8.7	103.4
	M0412	31.4	7.6	15.7
Noatak				
	M0413	43.2	9.5	28.6
	M0414A	27.7	5.8	25.3
	M0414B	29.3	4.1	29.2
	M0415	209.2	6.1	131.3
Nugget				
	M0416A	683.2	27.9	281.7
	M0416B	803.0	37.1	280.9
	M0417A	475.4	38.4	162.1
	M0417B	249.9	28.5	90.4
Bounty				
	M0404	235.2	22.1	115.8
	M0405	110.6	6.8	70.5
	M0406A	111.0	7.0	106.1
	M0406B	74.1	--	74.1
Defiance				
	M0401A	183.0	11.4	87.2
	M0401B	222.0	13.6	121.4
	M0402	84.4	8.5	65.9
	M0403	400.7	6.9	180.2
	M0407A	491.0	6.8	334.5
	M0407B	73.2	6.9	27.1
	M0407C	18.9	6.4	15.5
	M0407D	30.0	7.5	19.1
	M0408	270.0	9.2	180.9
	M0409	551.9	27.8	302.7
Hornet				
	M0418	49.8	9.7	19.5
	M0419	144.7	15.8	44.8

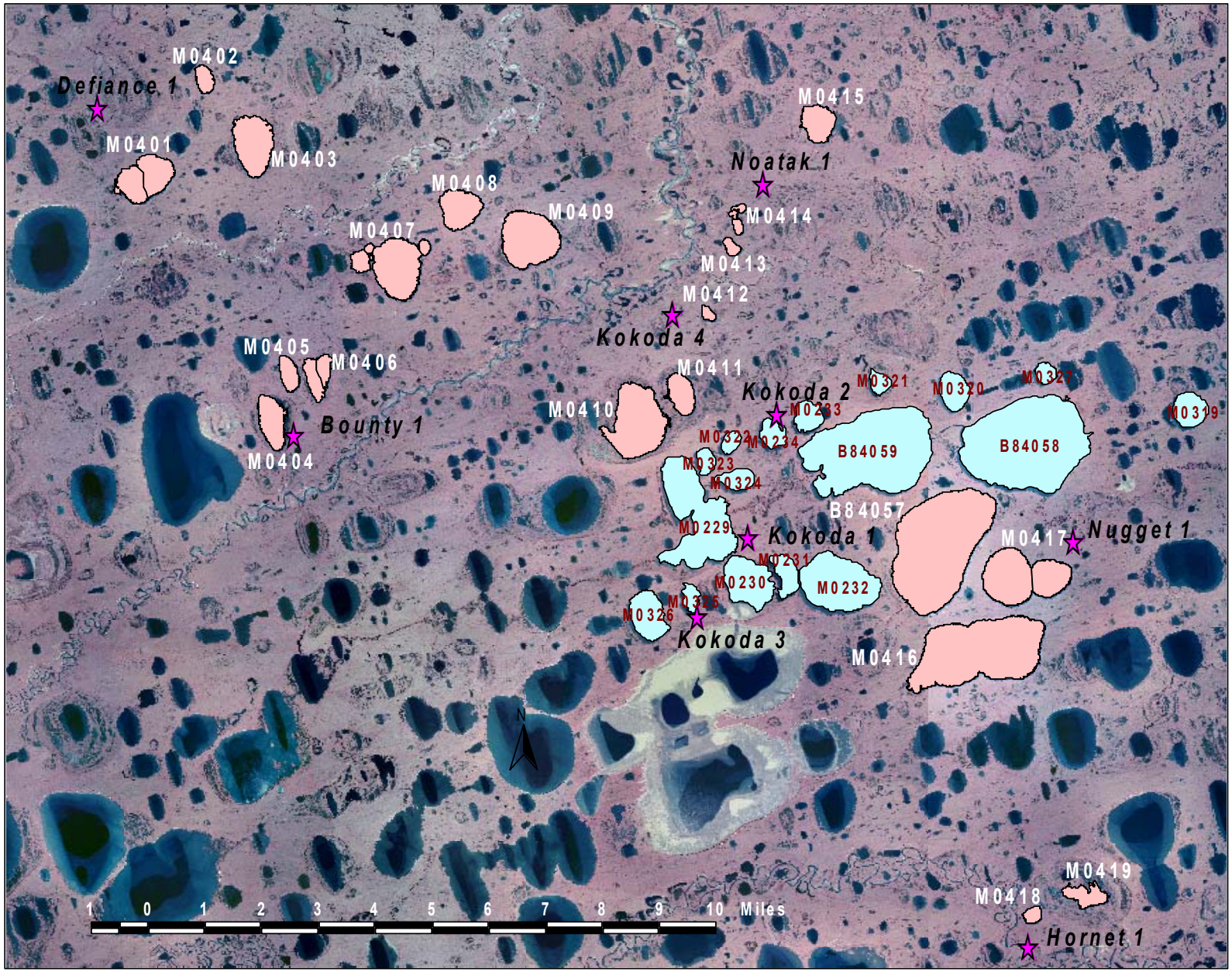


Figure 1. Lakes sampled in the Kokoda region of NPR-A (lakes in red sampled in 2004, lakes in blue sampled in 2002-2003).

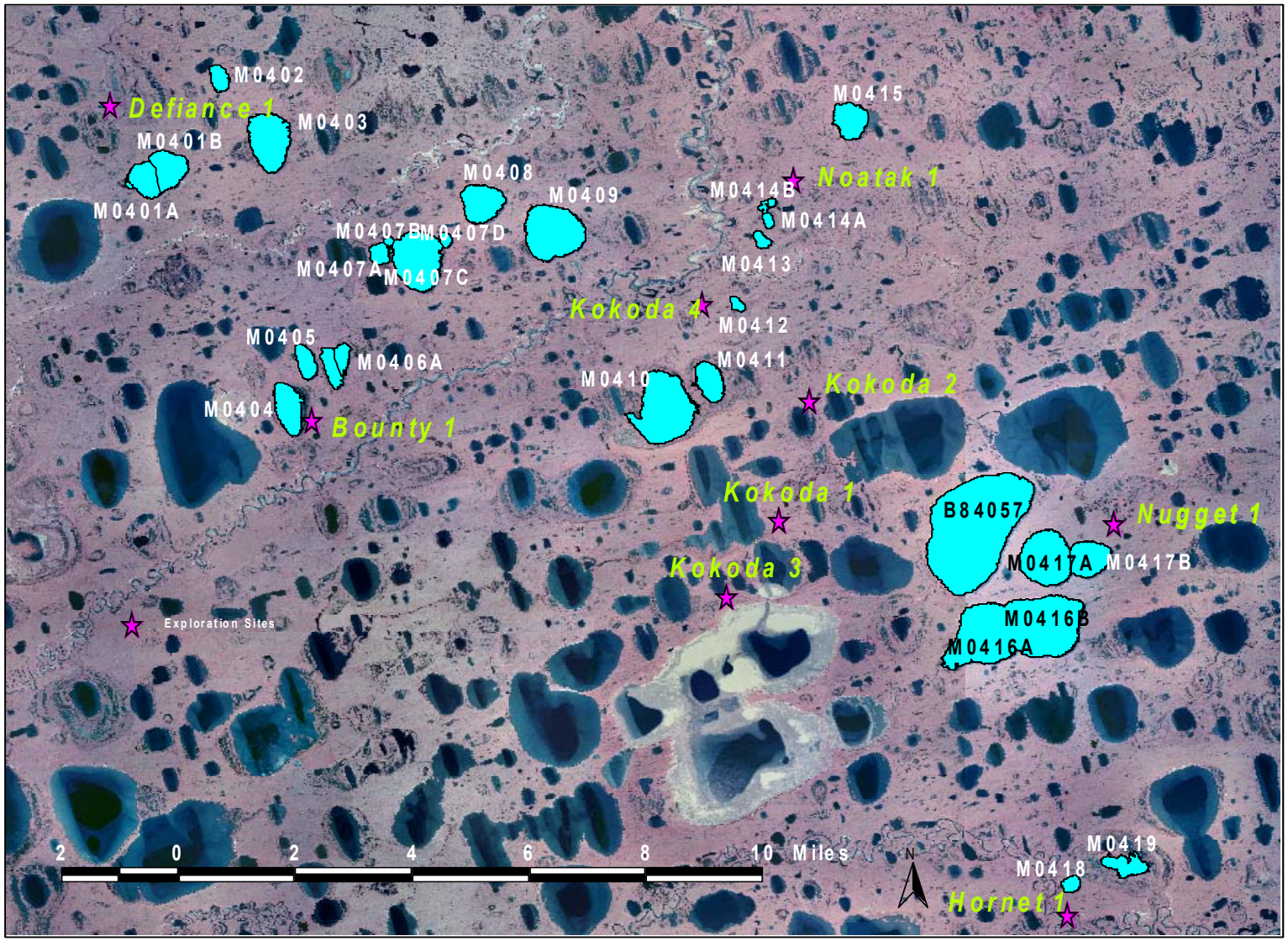


Figure 2. Lakes sampled for fish in the Kokoda region during 2004.

Figure 3. Typical lake in the Kokoda Study Area, showing wide sandy shoals along the lake margin and deep area restricted to the center of the lake.

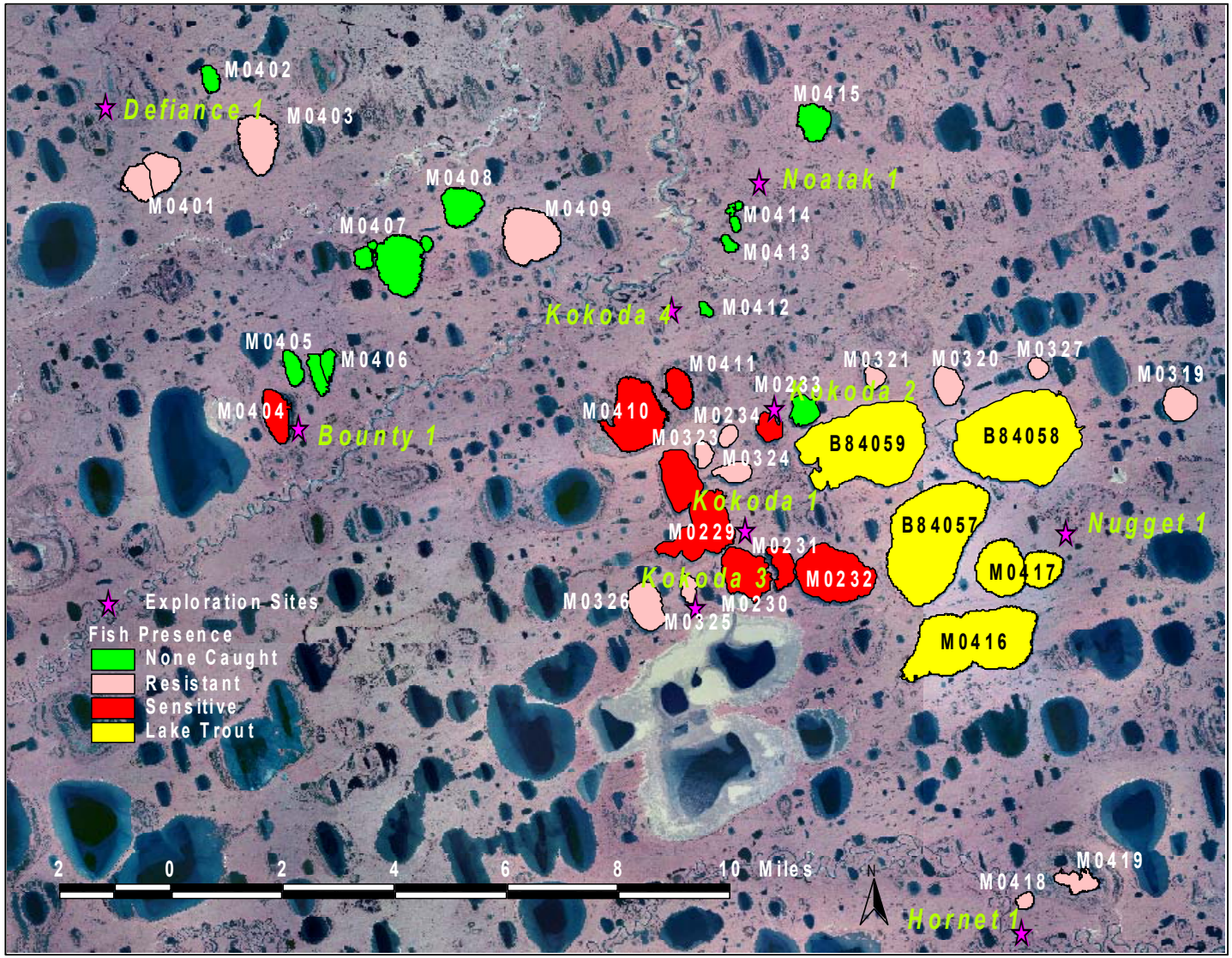
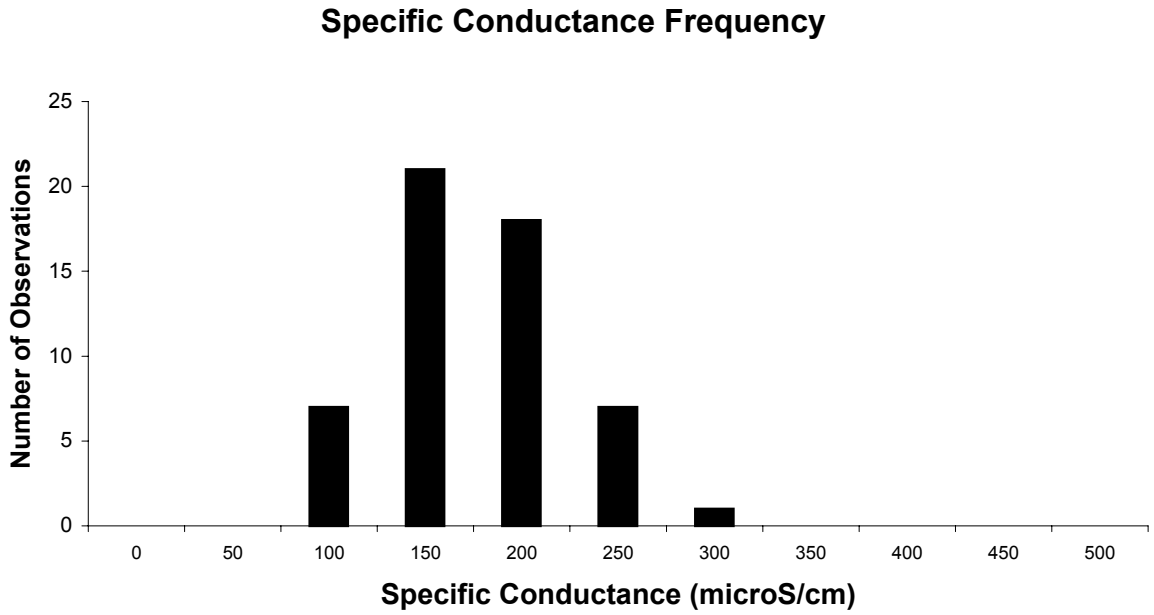


Figure 4. Distribution of sensitive and resistant fish species in lakes sampled in the Kokoda Study Area during 2002-2004 summer field seasons.



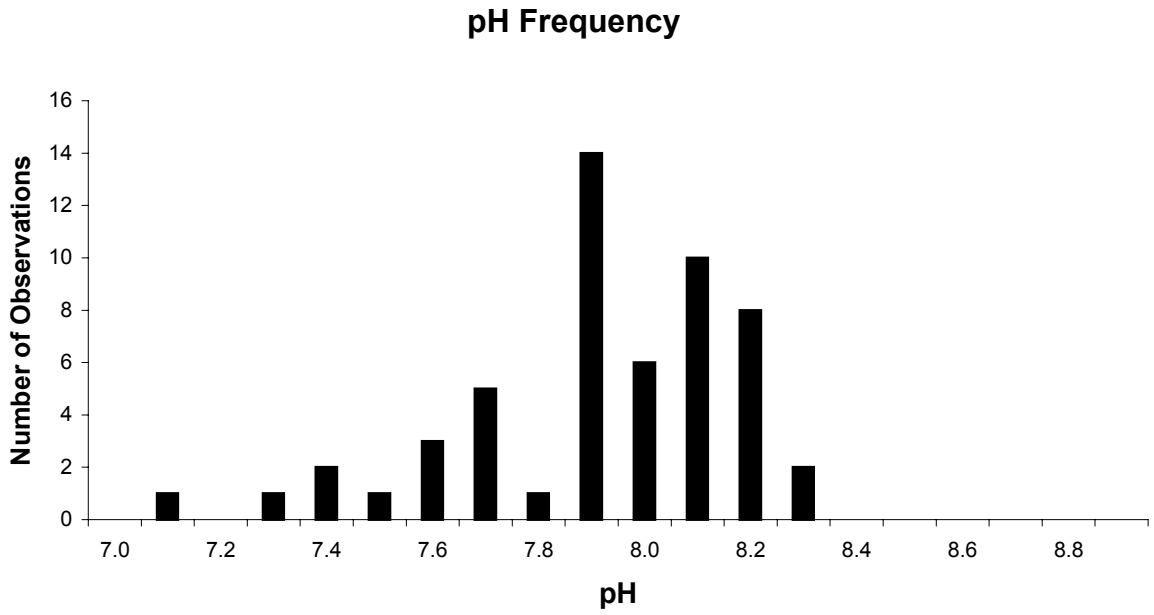
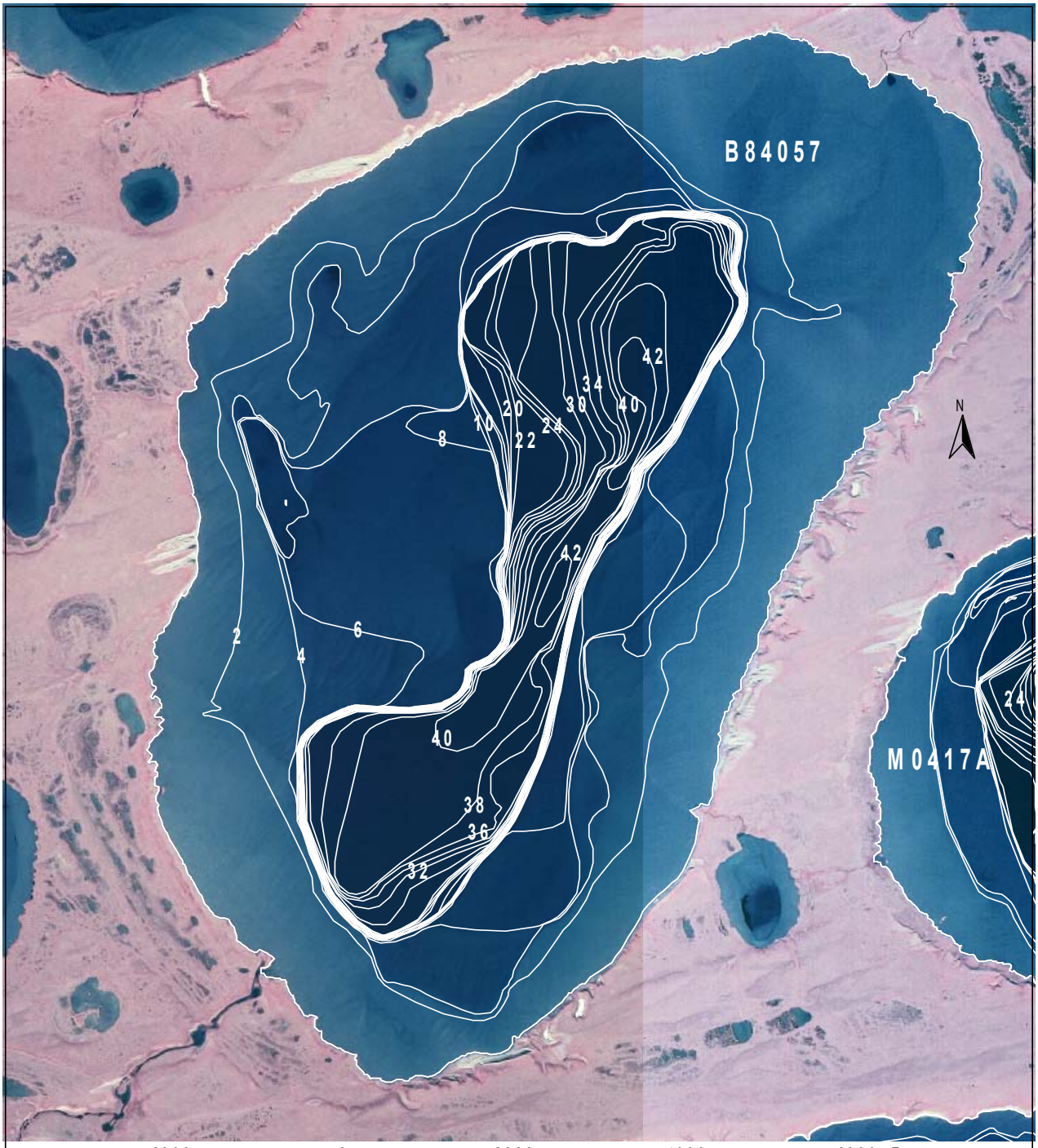


Figure 5. Frequency distribution of specific conductance and pH measurements taken during summer from 54 lakes associated with the Kokoda prospect, 2002-2004.

Lake Summaries



Depth contours of lake B84057, based on transects surveyed on July 24-25, 2004
(depth intervals in 2 foot increments)

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

Lake B84057

Other Names:
Location: 70.28272°N 153.00426°W
USGS Quad Sheet: Harrison Bay B-5: T11N R4/5W Sec. 19/20/29/30/24/25
Habitat: Drainage Lake
Area: 1,800.6 acres
Maximum Depth: 43.0 feet
Active Outlet: Yes
Calculated Volume: 5,758.69 million gallons
Permittable Volume: 516.71 million gallons
Potential Aggregate: 901.7 acres (water depth 4 ft or less)

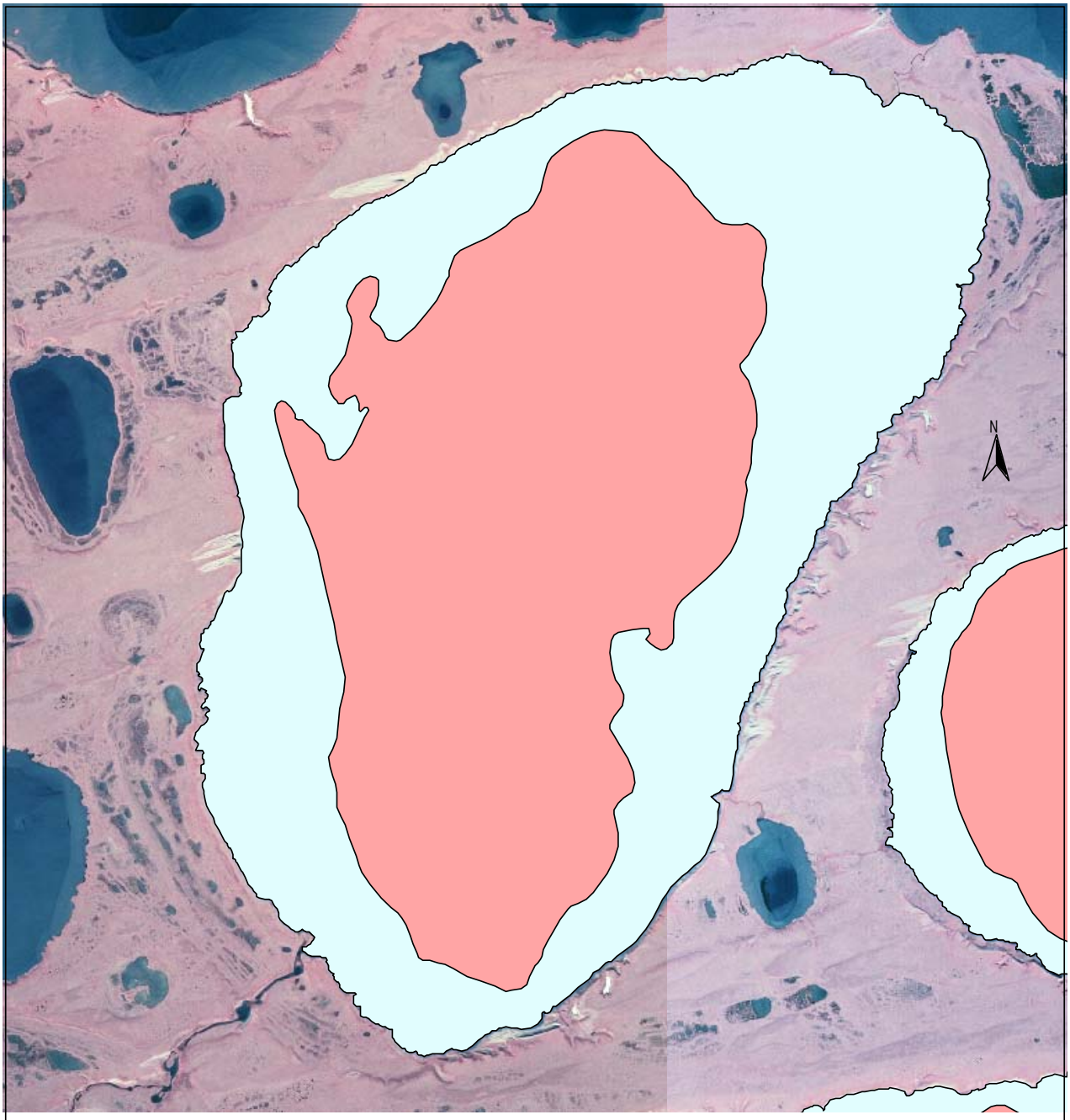
Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	28.6	2.8	9.1	4.4	83	182	0.4	8.15	This Study

Catch Record:

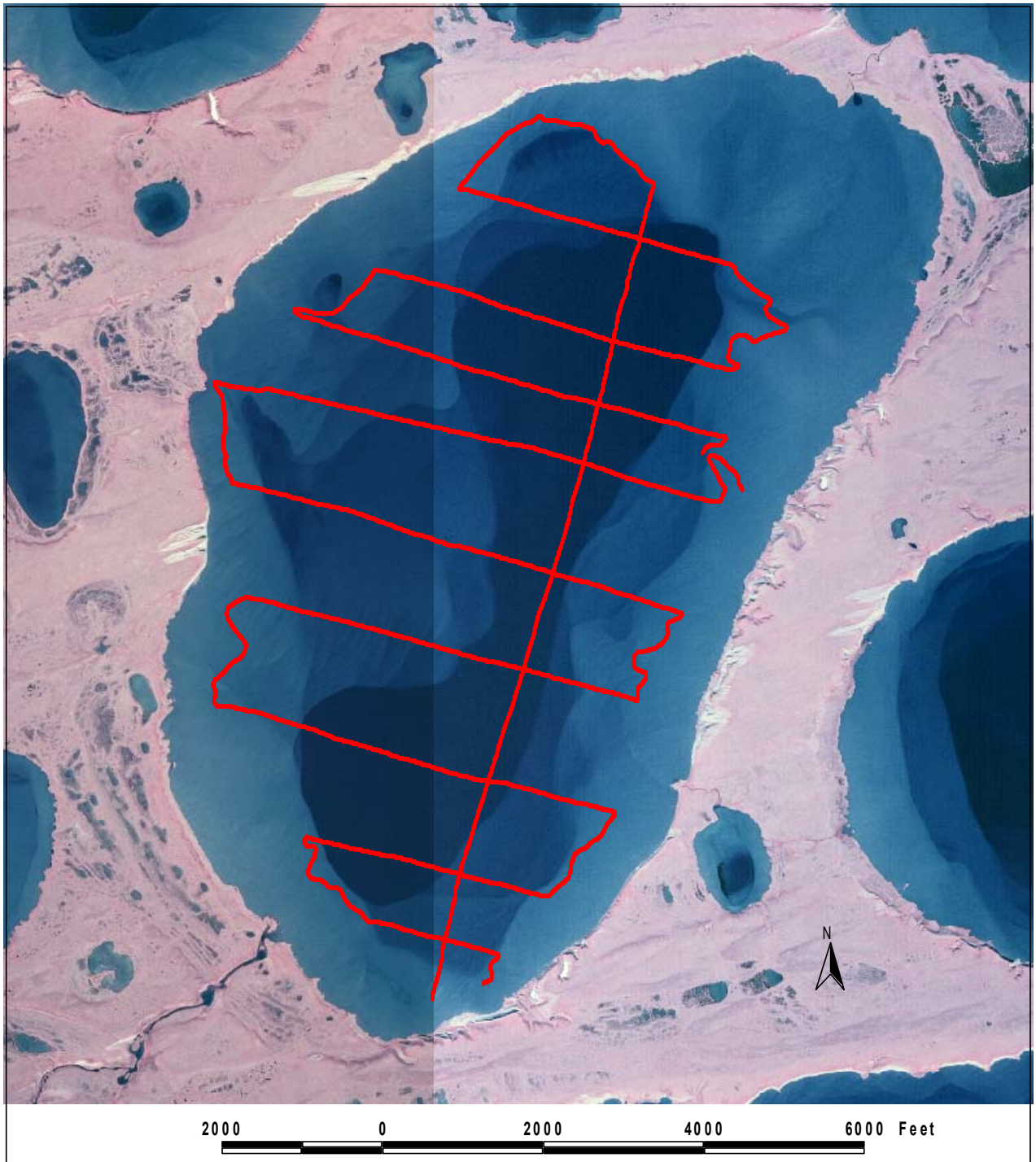
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 21 81	~24	Lake trout	1	890
+observation			Least cisco	11	255-380
			Ninespine stickleback		
Fyke Net	Jul 24 04	6.1	Broad whitefish	4	382-560
			Round whitefish	1	420
			Least cisco	6	166-365
Minnow Trap	Jul 24 04	10.4	Ninespine stickleback	3	

(1981 catches reported by Bendock and Burr 1984)



Regions of lake B84057 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 24-25, 2004

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



Depth transects surveyed at lake B84057 on July 24 and 25, 2004.

Depth contours of lake M0401, based on transects surveyed on July 14, 2004
(depth intervals in 1 foot increments)

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

Lake M0401

	Basin A	Basin B
Other Names:		
Location:	70.37899°N 153.61156°W	70.38237°N 153.59761°W
USGS Quad Sheet:	Teshekpuk B-1/B-2: T12N R7W Sec. 22/23	Teshekpuk B-1: T12N R7W Sec. 23
Habitat:	Drainage Lake	Drainage Lake
Area:	183.0 acres	222.0 acres
Maximum Depth:	11.4 feet	13.6 feet
Active Outlet:	Yes	Yes
Calculated Volume:	277.21 million gallons	312.41 million gallons
Permittable Volume	26.57 million gallons	23.64 million gallons
Potential Aggregate	87.2 acres (water 4 ft or less)	121.4 acres (water 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	28.0	2.5	9.4	4.5	80	184	1.1	8.10	This Study

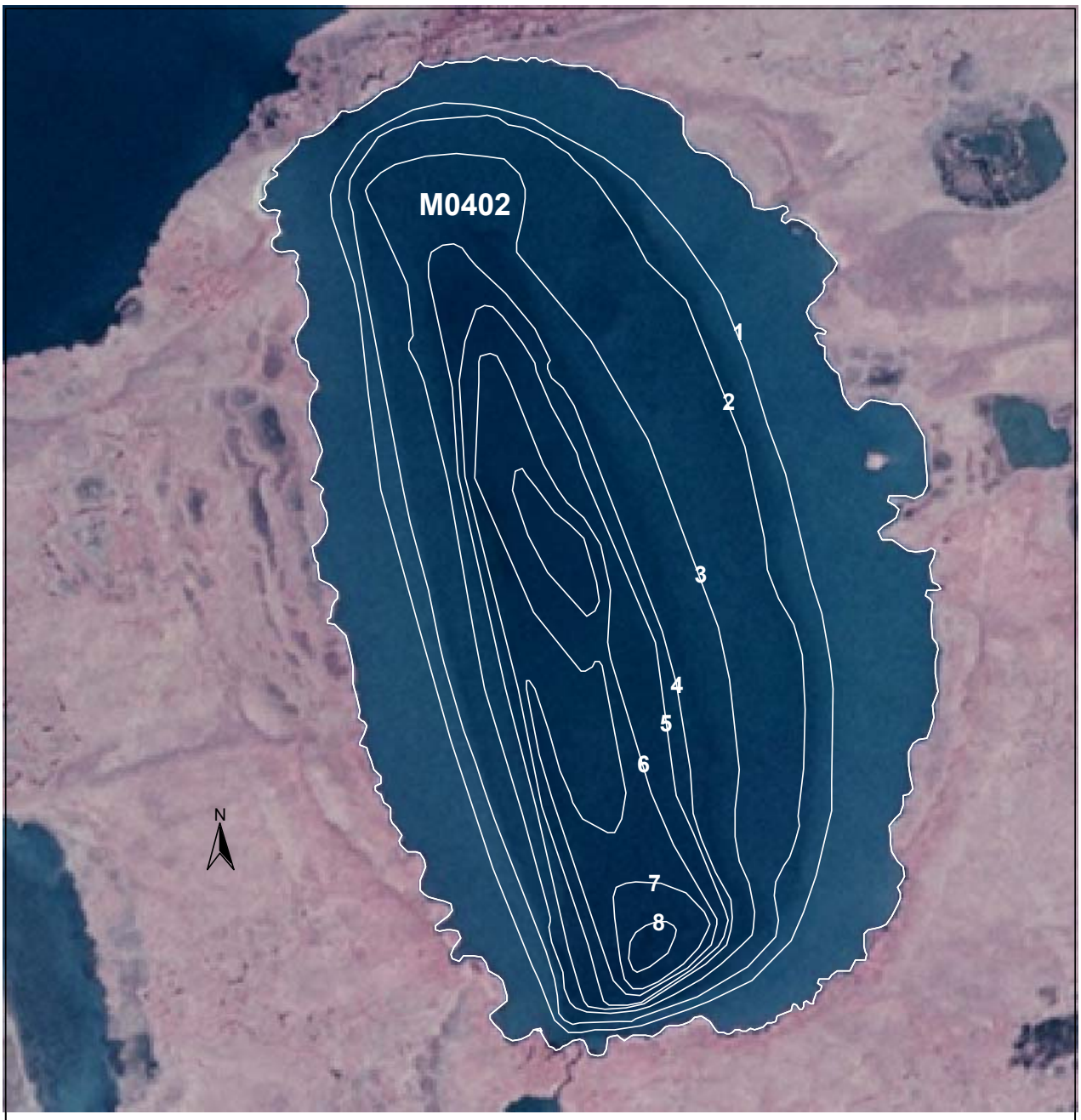
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 14 04	9.0	None	0
Minnow Trap		0.0		
Observed	Jul 14 04		Ninespine stickleback	3

Regions of lake M0401 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 14, 2004

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

Depth transects surveyed at lake M0401 on July 14, 2004.



Depth contours of lake M0402, based on transects surveyed on July 30, 2004
(depth intervals in 1 foot increments)

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

Lake M0402

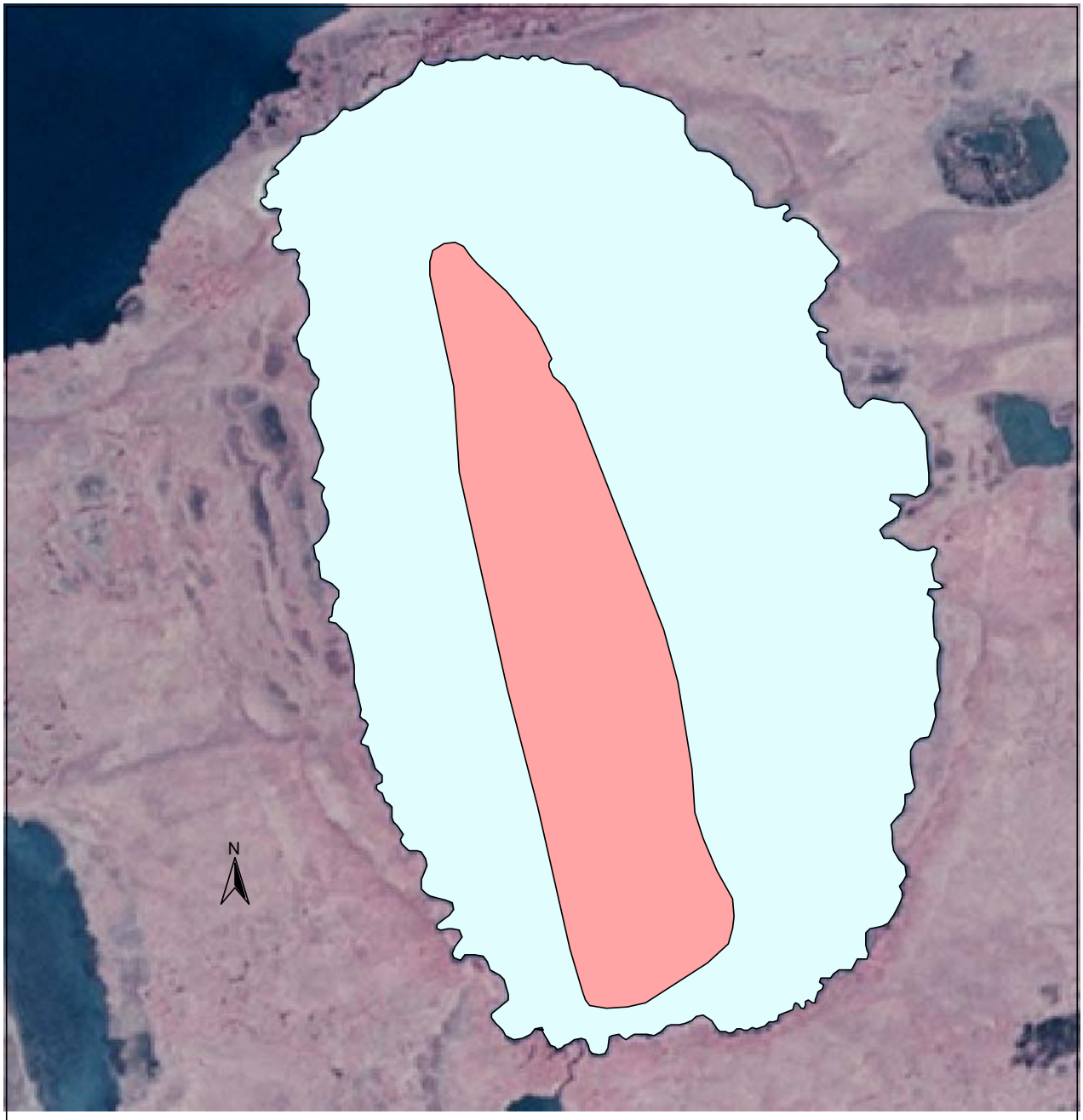
Other Names:
Location: 70.40731°N 153.55904°W
USGS Quad Sheet: Teshekpuk B-1: T12N R7W Sec. 12
Habitat: Drainage Lake
Area: 84.4 acres
Maximum Depth: 8.5 feet
Active Outlet: Yes
Calculated Volume: 69.89 million gallons
Permittable Volume 10.83 million gallons
Potential Aggregate 65.9 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	27.7	2.9	8.9	4.3	81	165	1.6	8.15	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 30 04	7.9	None	0
Minnow Trap	Jul 30 04	10.3	None	0
Seine	Jul 30 04	3 hauls	None	0



Regions of lake M0402 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 30, 2004

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

Depth transects surveyed at lake M0402 on July 30, 2004.

Depth contours of lake M0403, based on transects surveyed on July 14, 2004
(depth intervals in 1 foot increments)

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

Lake M0403

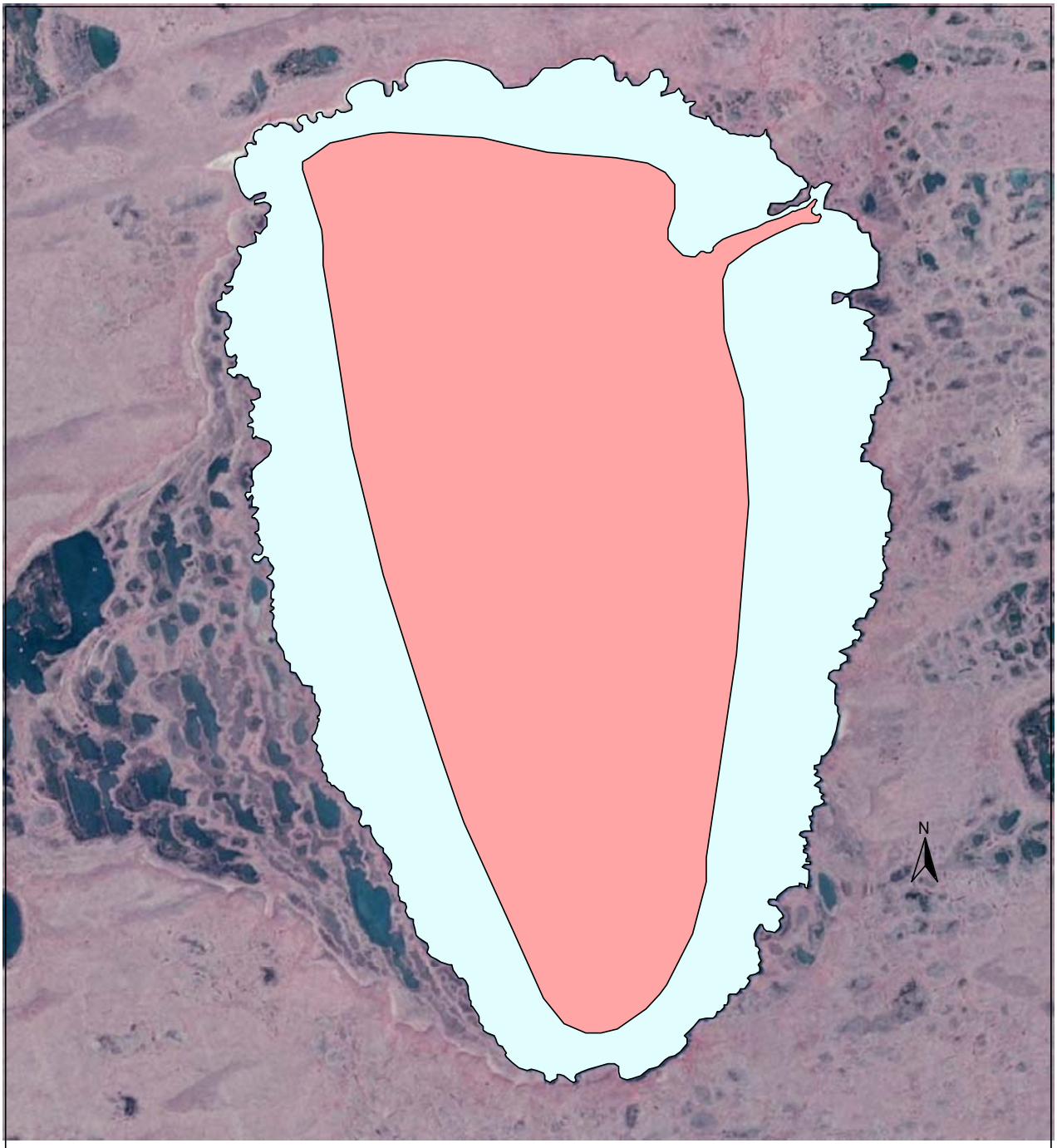
Other Names:
Location: 70.38960°N 153.52083°W
USGS Quad Sheet: Teshekpuk B-1: T12N R6/7W Sec. 18/19/13/24
Habitat: Tundra Lake
Area: 400.7 acres
Maximum Depth: 6.9 feet
Active Outlet: No
Calculated Volume: 437.21 million gallons
Permittable Volume 6.13 million gallons
Potential Aggregate 180.2 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	11.2	1.1	2.6	1.3	32	75	1.0	7.80	This Study

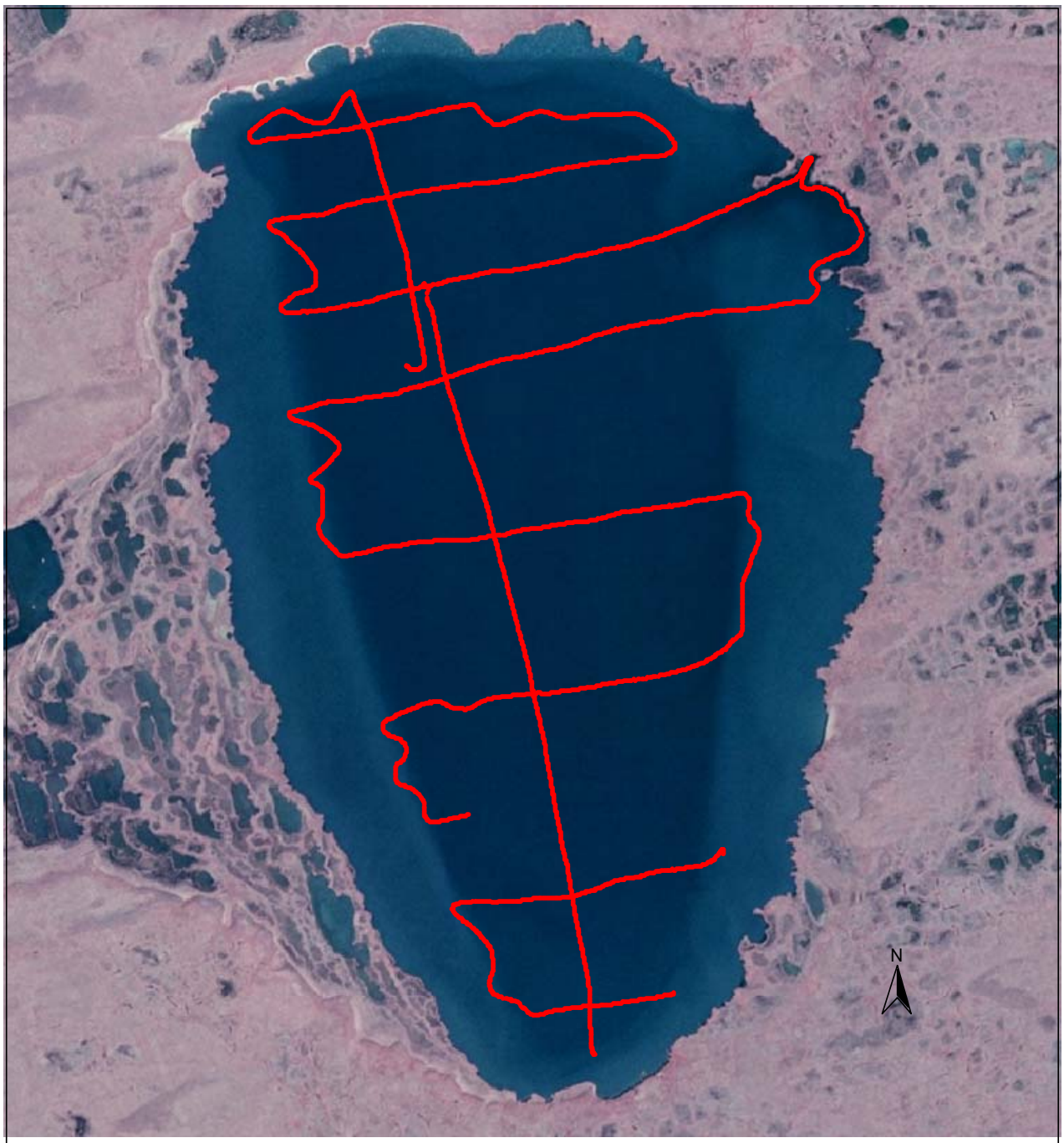
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 14 04	7.0	None	0
Minnow Trap		0.0		
Observed	Jul 14 04		Ninespine stickleback	2

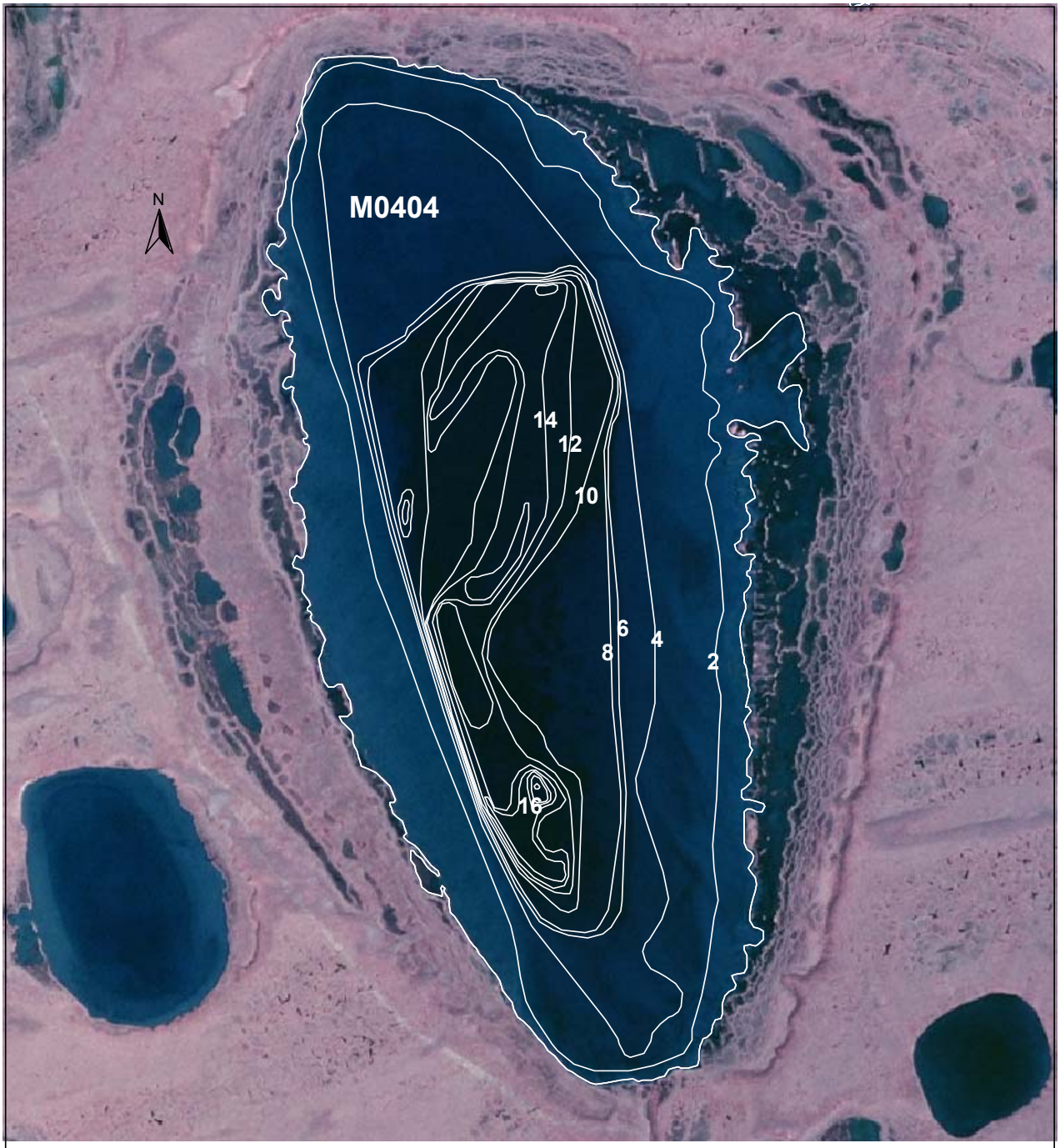


Regions of lake M0403 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 14, 2004

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



Depth transects surveyed at lake M0403 on July 14, 2004.



Depth contours of lake M0404, based on transects surveyed on July 24, 2004
(depth intervals in 2 foot increments)

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

Lake M0404

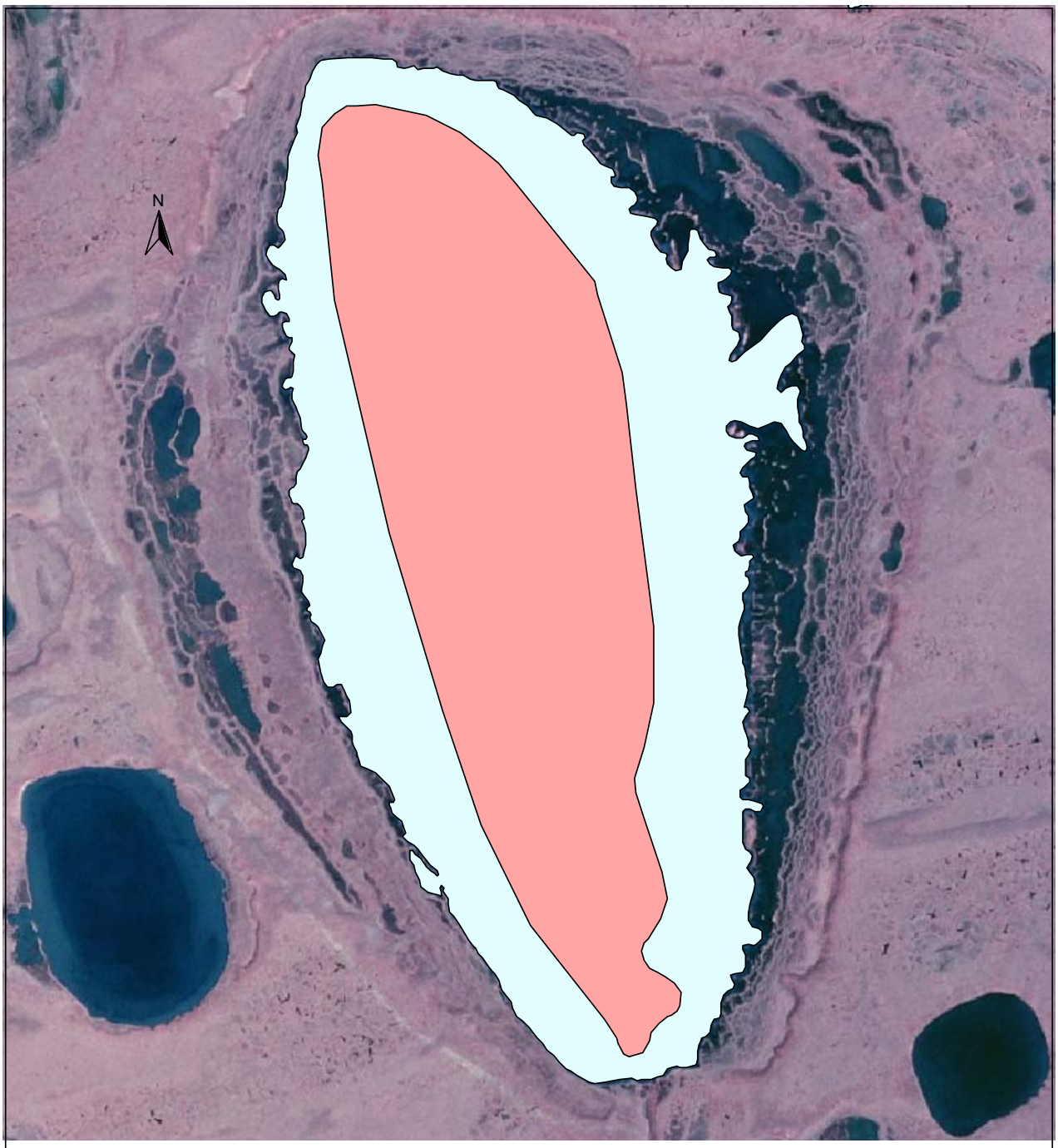
Other Names:
Location: 70.31562°N 153.50552°W
USGS Quad Sheet: Teshekpuk B-1: T11N R6W Sec. 7/18
Habitat: Drainage Lake
Area: 235.2 acres
Maximum Depth: 22.1 feet
Active Outlet: Yes
Calculated Volume: 426.67 million gallons
Permittable Volume 15.88 million gallons
Potential Aggregate 115.8 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	10.4	1.7	7.7	3.5	33	87	0.8	7.92	This Study

Catch Record:

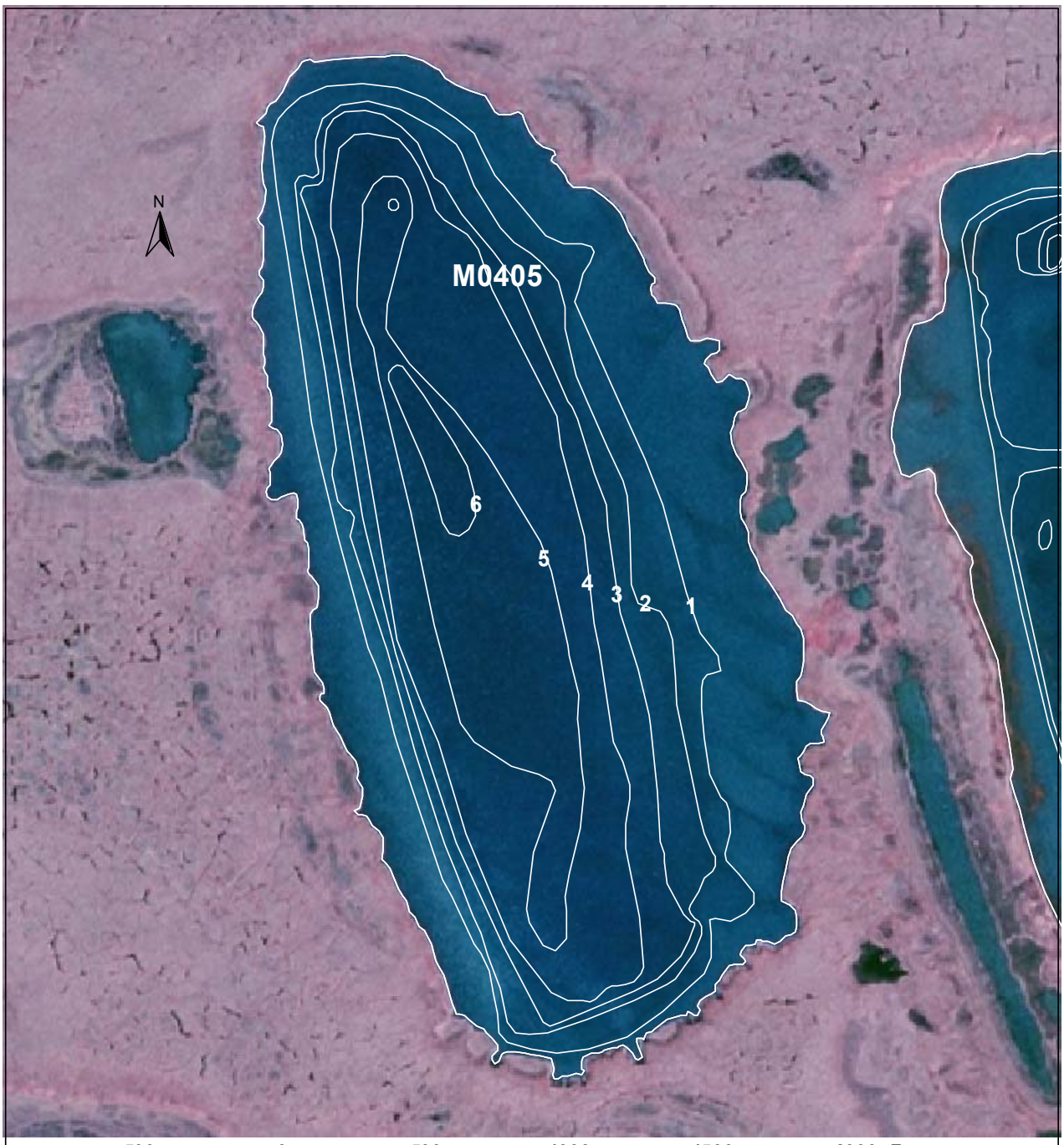
Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 24 04	7.5	Least cisco	4	129-238
Minnow Trap	Jul 24 04	7.0	Ninespine stickleback	3	
Observed	Jul 24 04		Ninespine stickleback	observed	



Regions of lake M0404 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 24, 2004

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

Depth transects surveyed at lake M0404 on July 24, 2004.



Depth contours of lake M0405, based on transects surveyed on July 27, 2004
(depth intervals in 1 foot increments)

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

Lake M0405

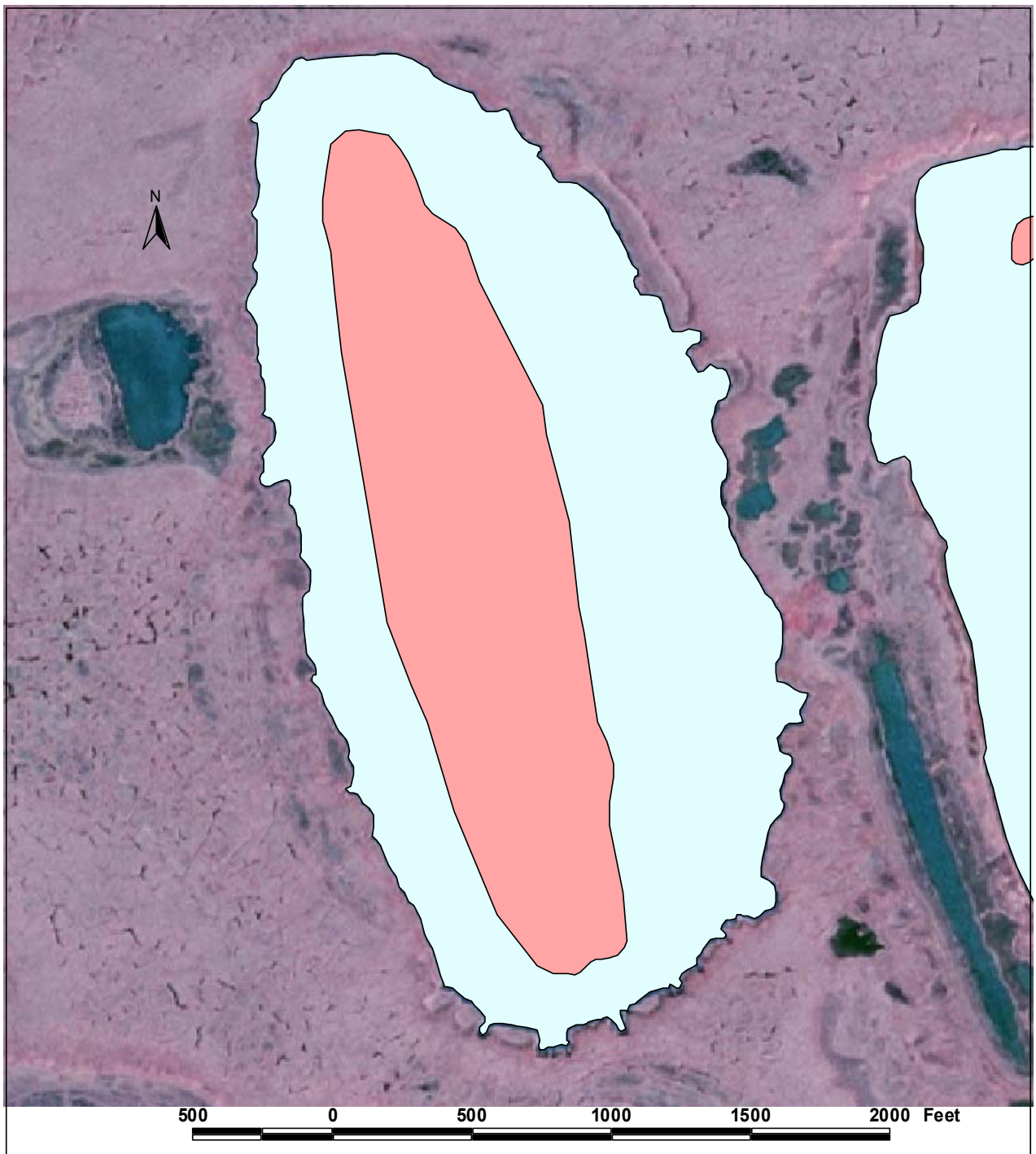
Other Names:
Location: 70.32823°N 153.49310°W
USGS Quad Sheet: Teshekpuk B-1: T11N R6W Sec. 6/7
Habitat: Tundra Lake
Area: 110.6 acres
Maximum Depth: 6.8 feet
Active Outlet: No
Calculated Volume: 97.95 million gallons
Permittable Volume 11.49 million gallons
Potential Aggregate 70.5 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	13.0	3.2	6.0	3.3	45	94	1.9	7.98	This Study

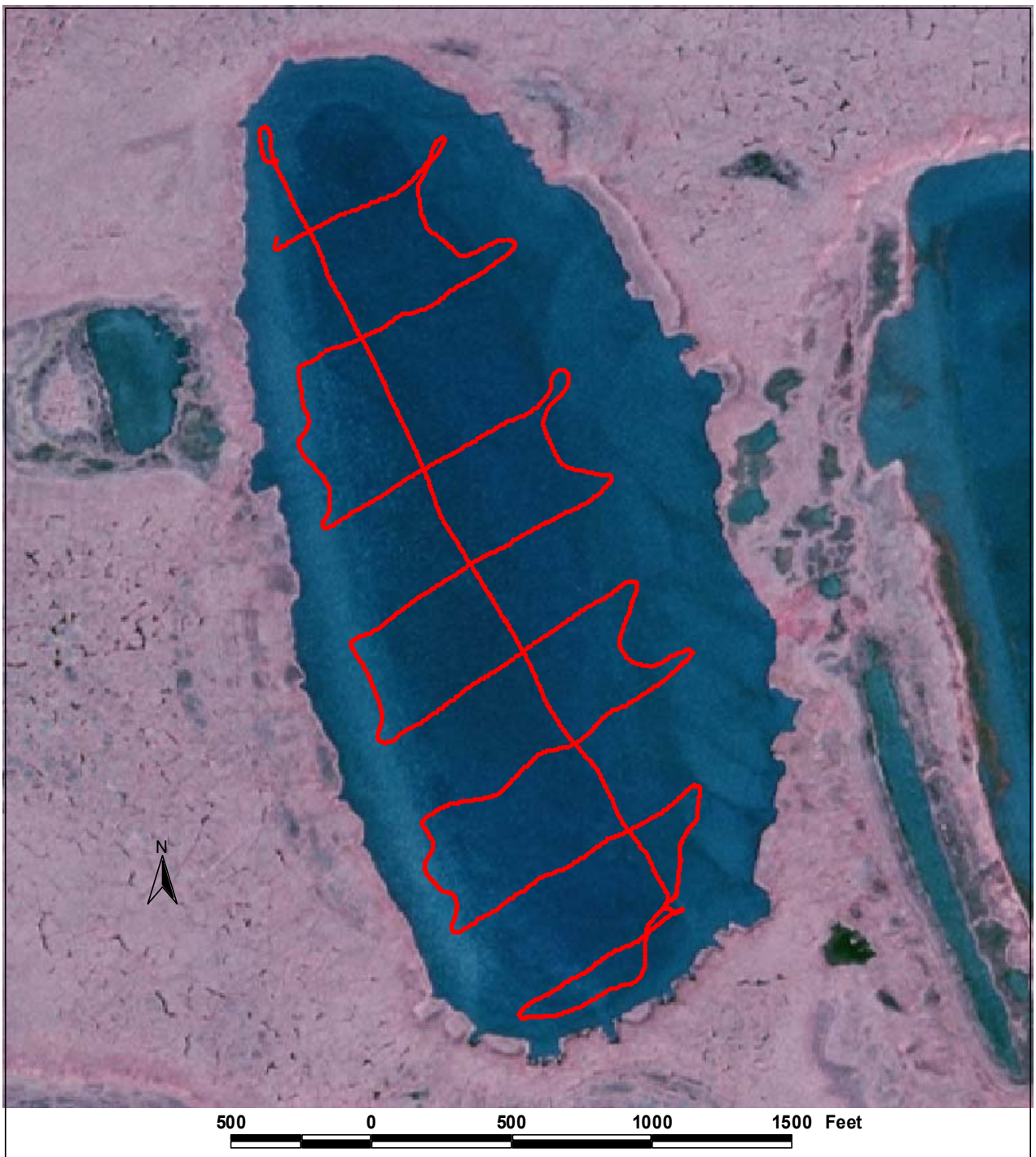
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 27 04	8.6	None	0
Minnow Trap	Jul 27 04	11.3	None	0
Seine	Jul 27 04	3 hauls	None	0

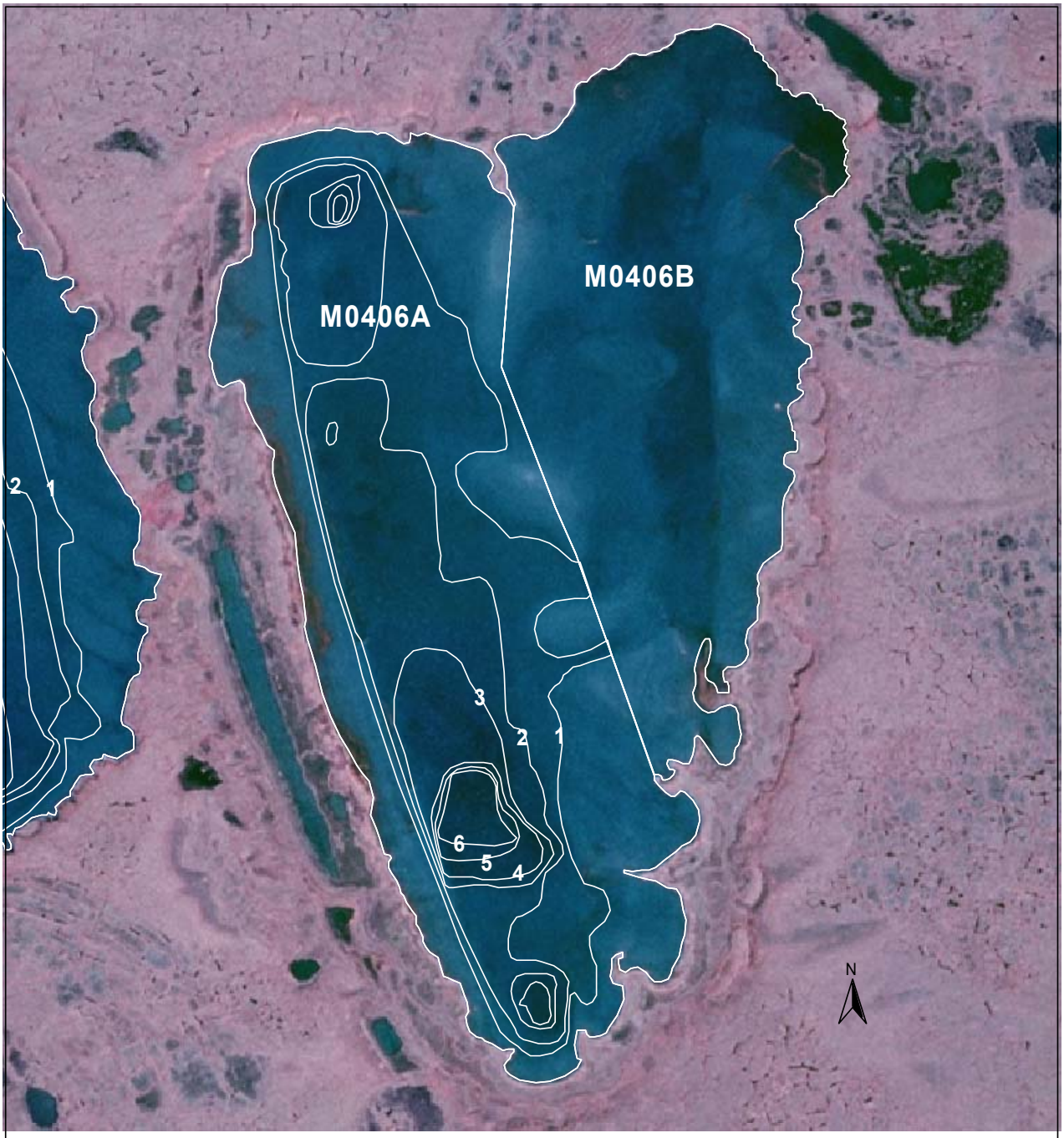


Regions of lake M0405 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 27, 2004

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



Depth transects surveyed at lake M0405 on July 27, 2004.



Depth contours of lake M0406, based on transects surveyed on July 28, 2004
(depth intervals in 1 foot increments)

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

Lake M0406

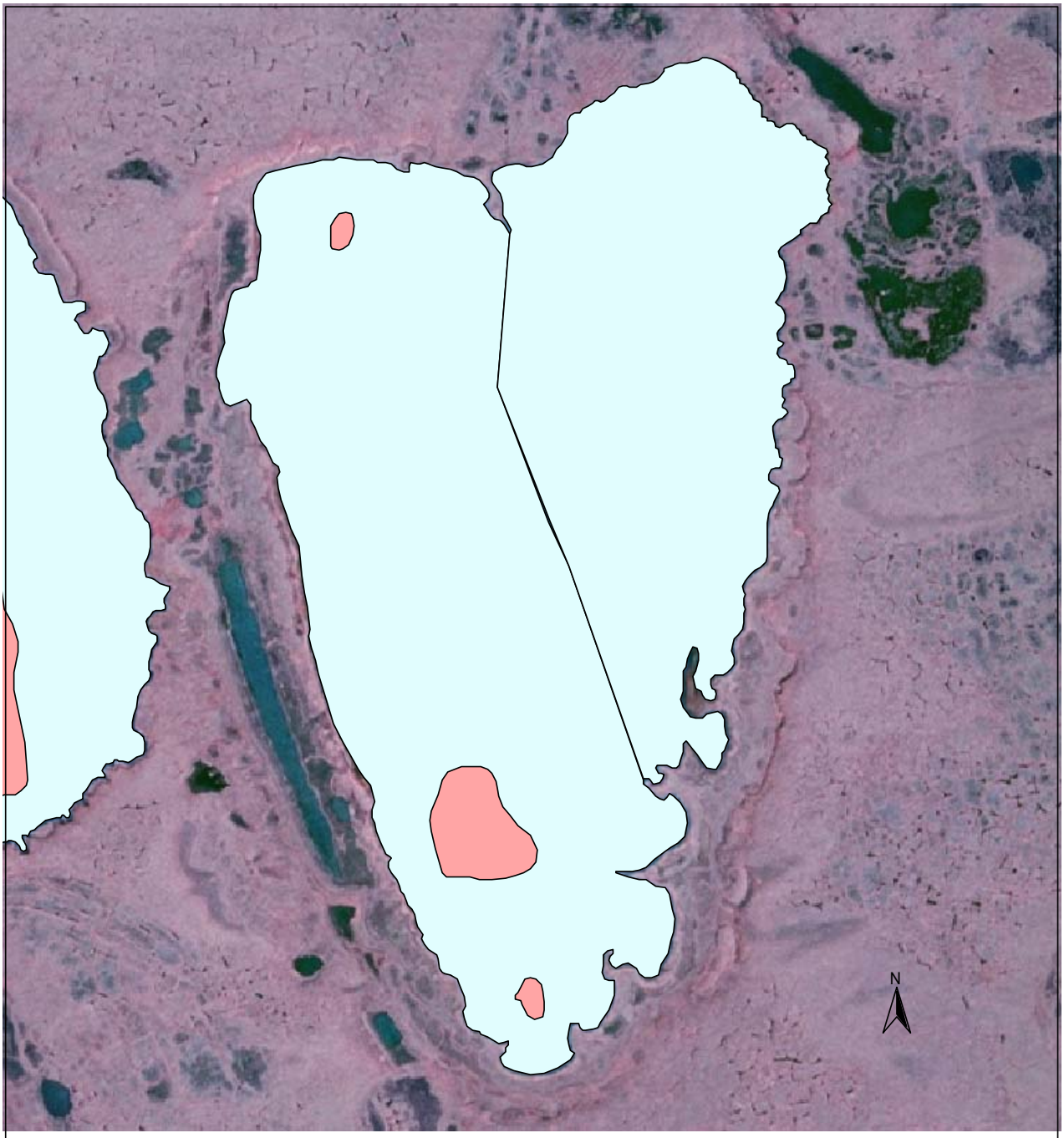
	Basin A	Basin B
Other Names:		
Location:	70.32802°N 153.47480°W	70.32975°N 153.46716°W
USGS Quad Sheet:	Teshekpuk B-1: T11N R6W Sec. 5/8	Teshekpuk B-1: T11N R6W Sec. 5/8
Habitat:	Tundra Lake	Tundra Lake
Area:	111.0 acres	74.1 acres
Maximum Depth:	7.0 feet	-- (shallow)
Active Outlet:	No	No
Calculated Volume:	58.38 million gallons	-- not calculated
Permittable Volume	2.19 million gallons	0.00 million gallons
Potential Aggregate	106.1 acres (water 4 ft or less)	74.1 acres (water 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	16.7	2.9	7.6	4.3	54	118	1.1	7.97	This Study

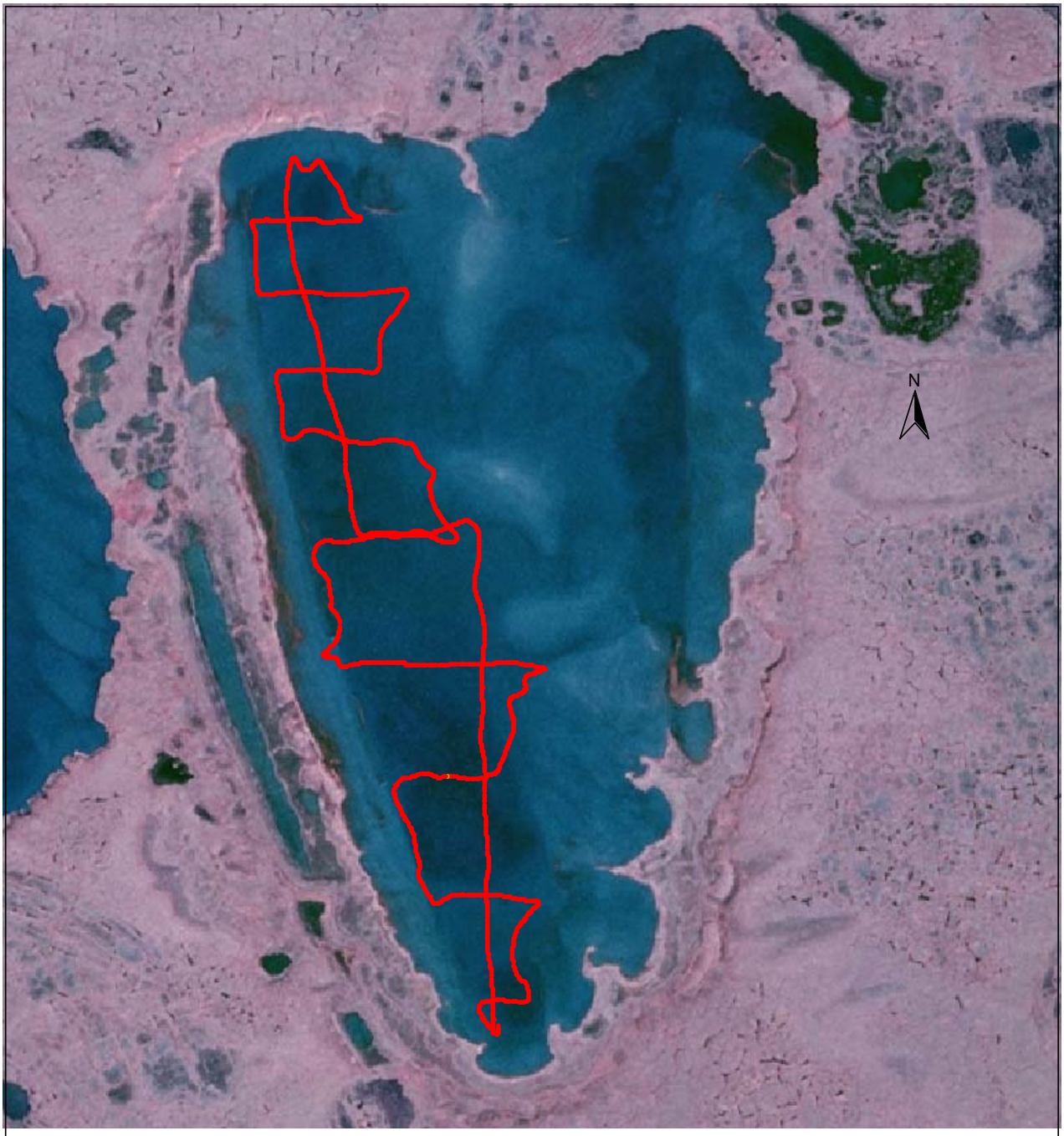
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 28 04	8.2	None	0
Minnow Trap	Jul 28 04	10.8	None	0
Seine	Jul 28 04	0 hauls		

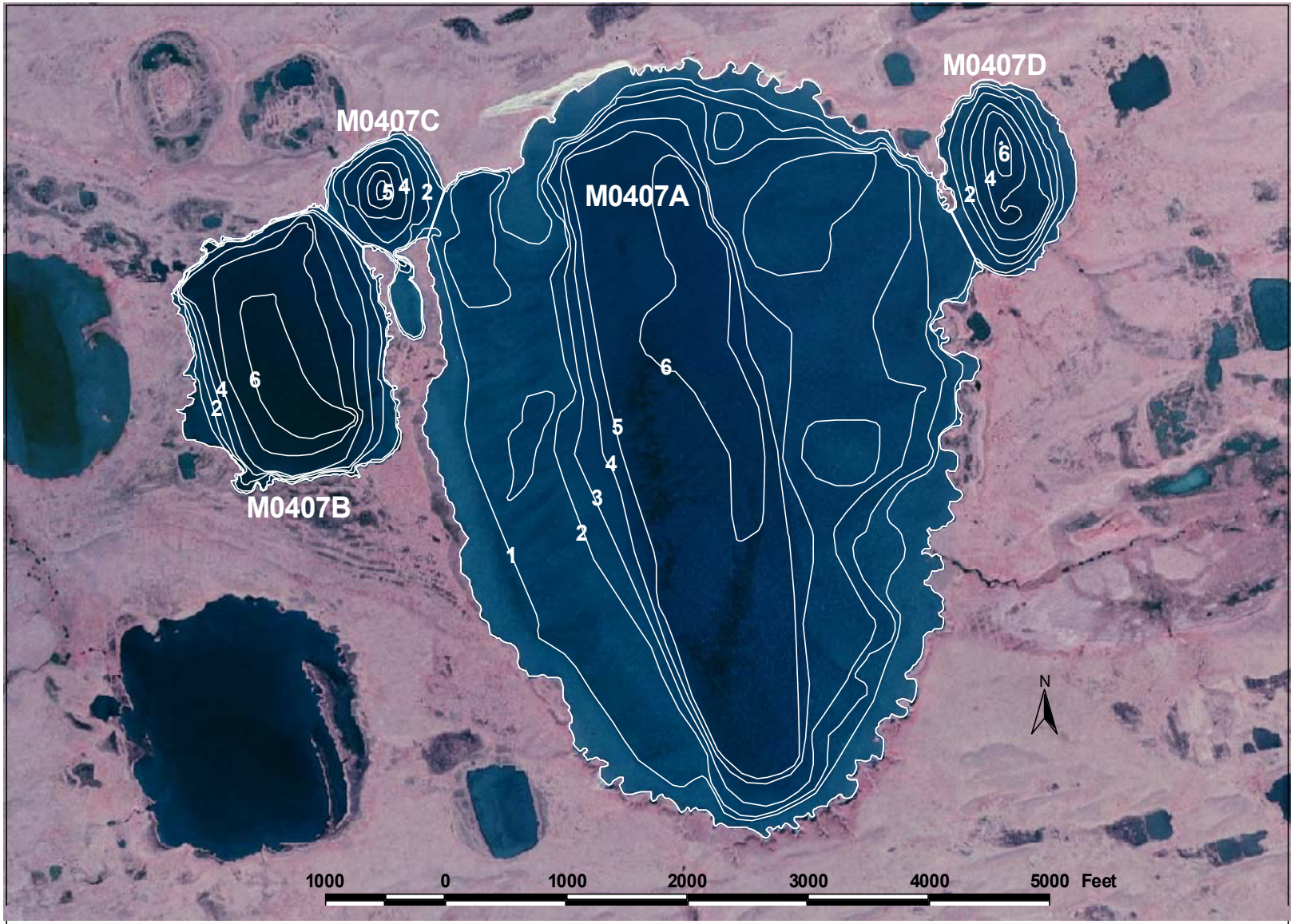


Regions of lake M0406 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 28, 2004

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



Depth transects surveyed at lake M0406 on July 28, 2004.



Depth contours of lake M0407, based on transects surveyed on July 29, 2004 (depth intervals in 1 foot increments)

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

Lake M0407

	Basin A	Basin B
Other Names:		
Location:	70.35703°N 153.41198°W	70.35848°N 153.44023°W
USGS Quad Sheet:	Teshekpuk B-1: T12N R6W Sec. 27/28/33/34	Teshekpuk B-1: T12N R6W Sec. 28/33
Habitat:	Tundra Lake	Tundra Lake
Area:	30.0 acres	73.2 acres
Maximum Depth:	6.8 feet	6.9 (shallow)
Active Outlet:	No	No
Calculated Volume:	490.96 million gallons	73.2 not calculated
Permittable Volume	74.03 million gallons	20.43 million gallons
Potential Aggregate	334.5 acres (water 4 ft or less)	27.1 acres (water 4 ft or less)

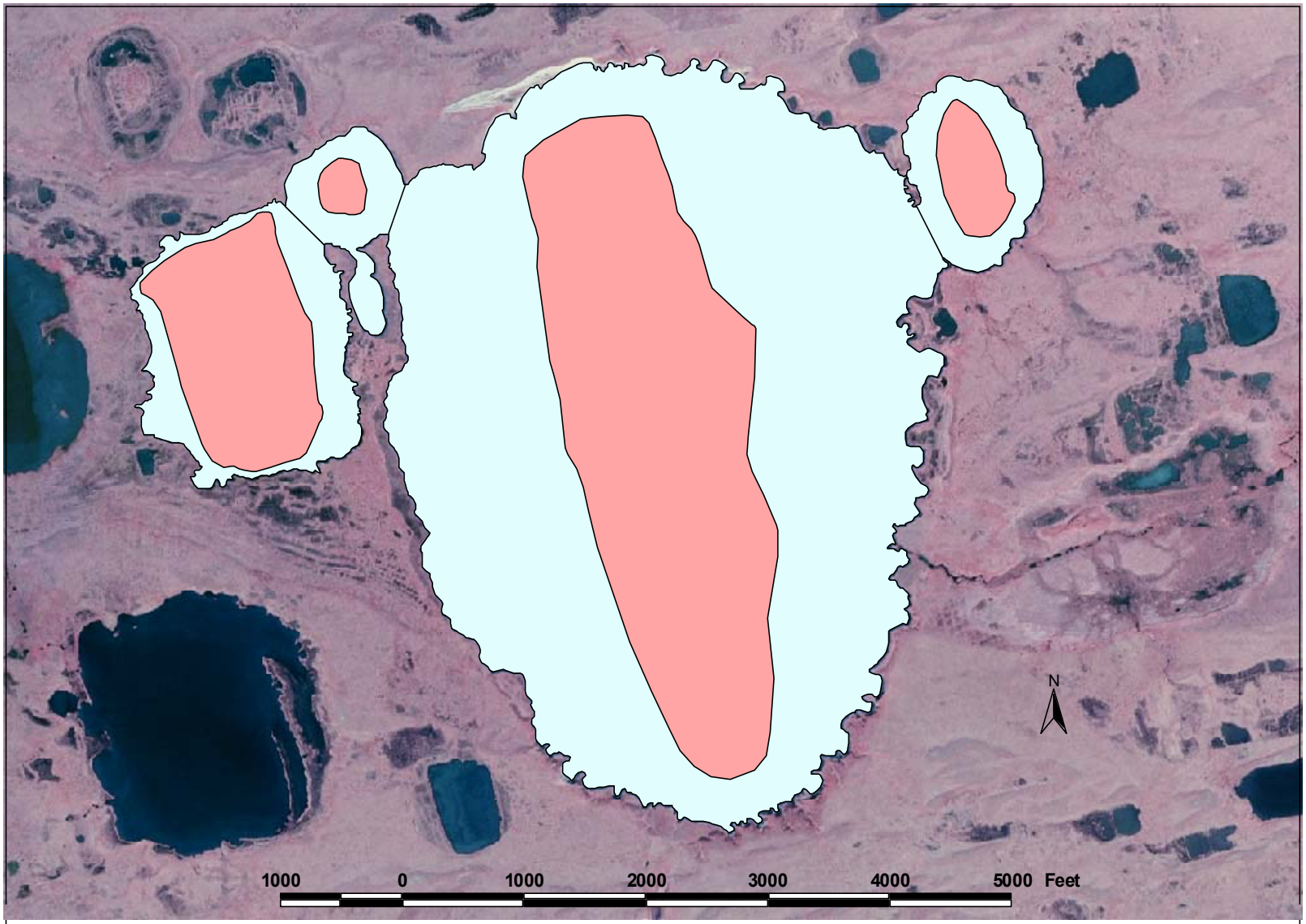
	Basin C	Basin D
Other Names:		
Location:	70.36169°N 153.43353°W	70.36234°N 153.39198°W
USGS Quad Sheet:	Teshekpuk B-1: T12N R6W Sec. 28	Teshekpuk B-1: T12N R6W Sec. 27
Habitat:	Tundra Lake	Tundra Lake
Area:	18.9 acres	491.0 acres
Maximum Depth:	6.4 feet	7.5 (shallow)
Active Outlet:	No	No
Calculated Volume:	18.85 million gallons	30.0 not calculated
Permittable Volume	0.96 million gallons	3.44 million gallons
Potential Aggregate	15.5 acres (water 4 ft or less)	19.1 acres (water 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	12.5	1.4	3.4	2.1	37	73	0.6	8.19	This Study

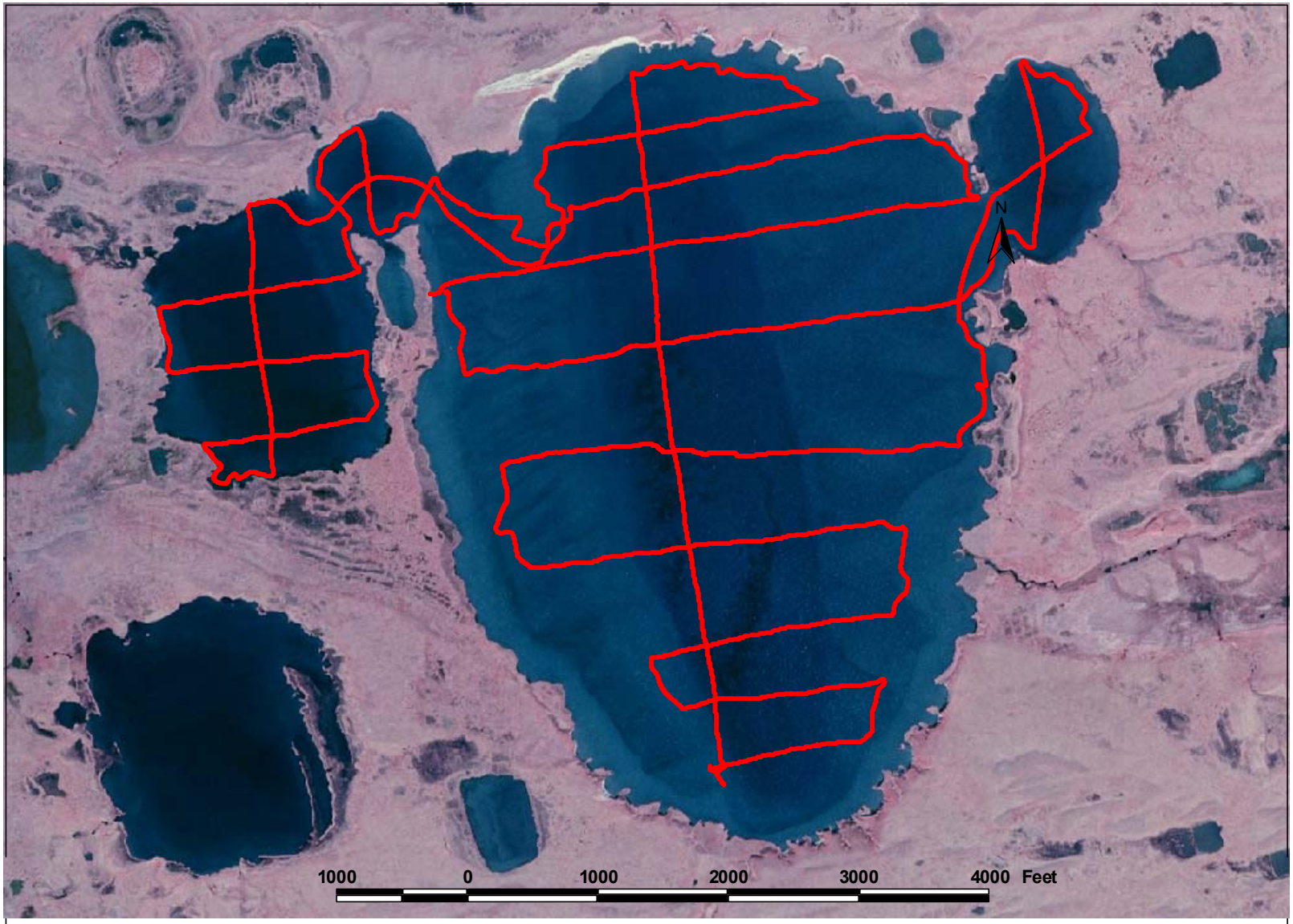
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 29 04	8.3	None	0
Minnow Trap	Jul 29 04	11.8	None	0
Seine	Jul 29 04	3 hauls	None	0



Regions of lake M0407 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 29, 2004

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



Depth transects surveyed at lake M0407 on July 29, 2004.

Depth contours of lake M0408, based on transects surveyed on July 23, 2004
(depth intervals in 1 foot increments)

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

Lake M0408

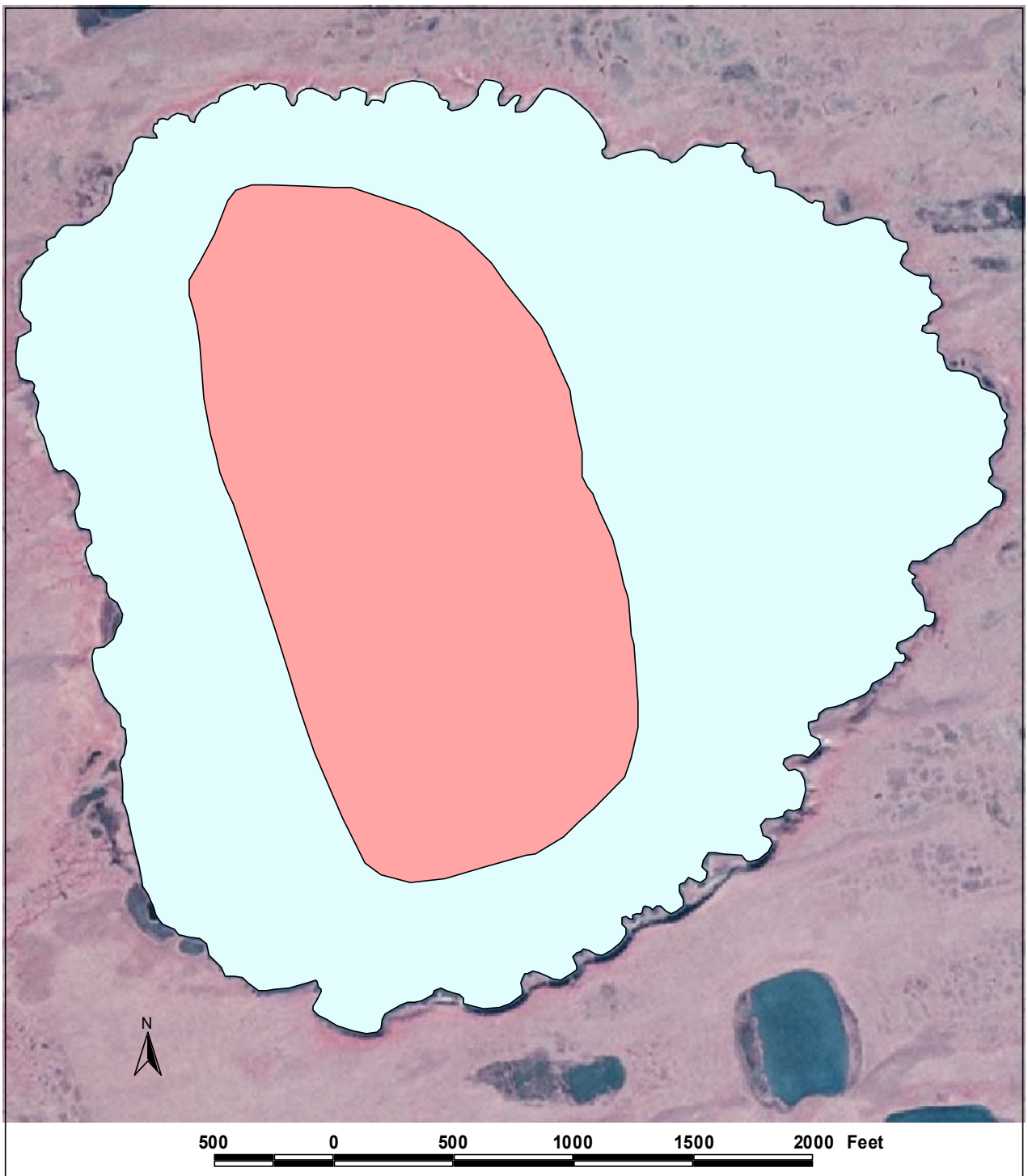
Other Names:
Location: 70.37295°N 153.36591°W
USGS Quad Sheet: Teshekpuk B-1: T12N R6W Sec. 22/23/26/27
Habitat: Tundra Lake
Area: 270.0 acres
Maximum Depth: 9.2 feet
Active Outlet: No
Calculated Volume: 258.92 million gallons
Permittable Volume 95.35 million gallons
Potential Aggregate 180.9 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	31.9	3.3	7.1	4.1	93	177	0.4	8.07	This Study

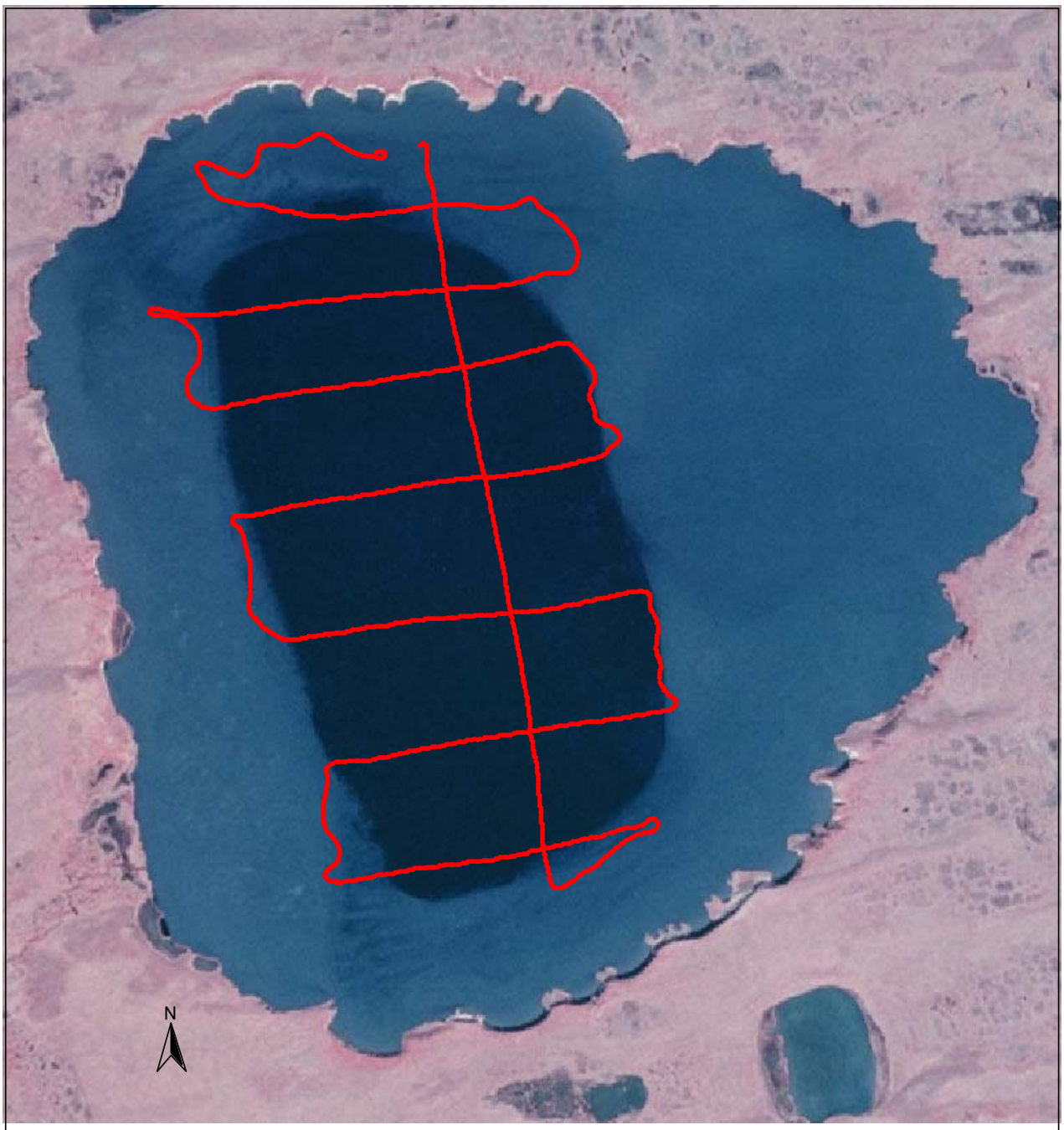
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 23 04	9.5	None	0
Minnow Trap	Jul 23 04	12.0	None	0
Seine	Jul 23 04	3 hauls	None	0

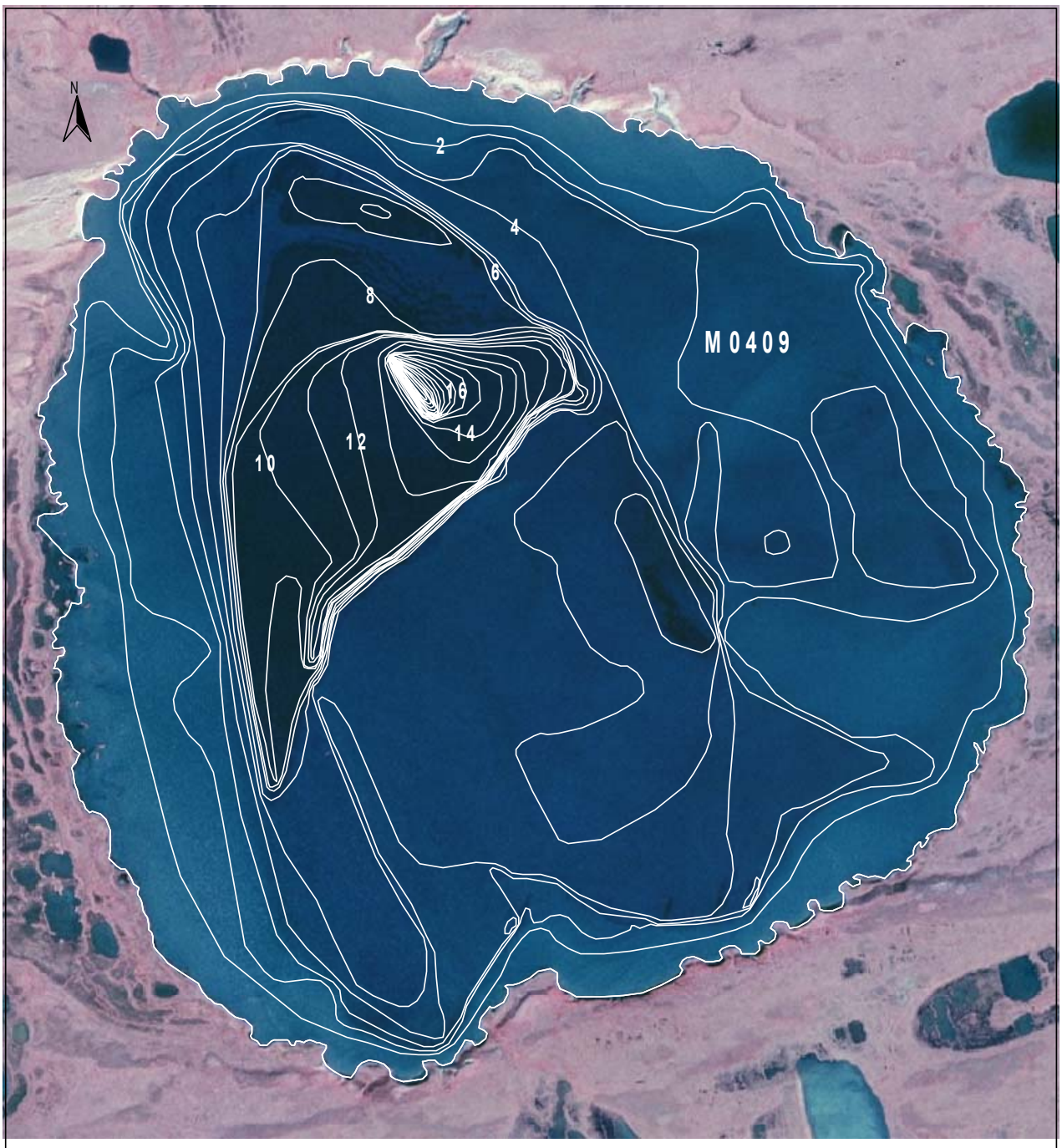


Regions of lake M0408 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 23, 2004

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



Depth transects surveyed at lake M0408 on July 23, 2004.



Depth contours of lake M0409, based on transects surveyed on July 26, 2004
(depth intervals in 1 foot increments)

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

Lake M0409

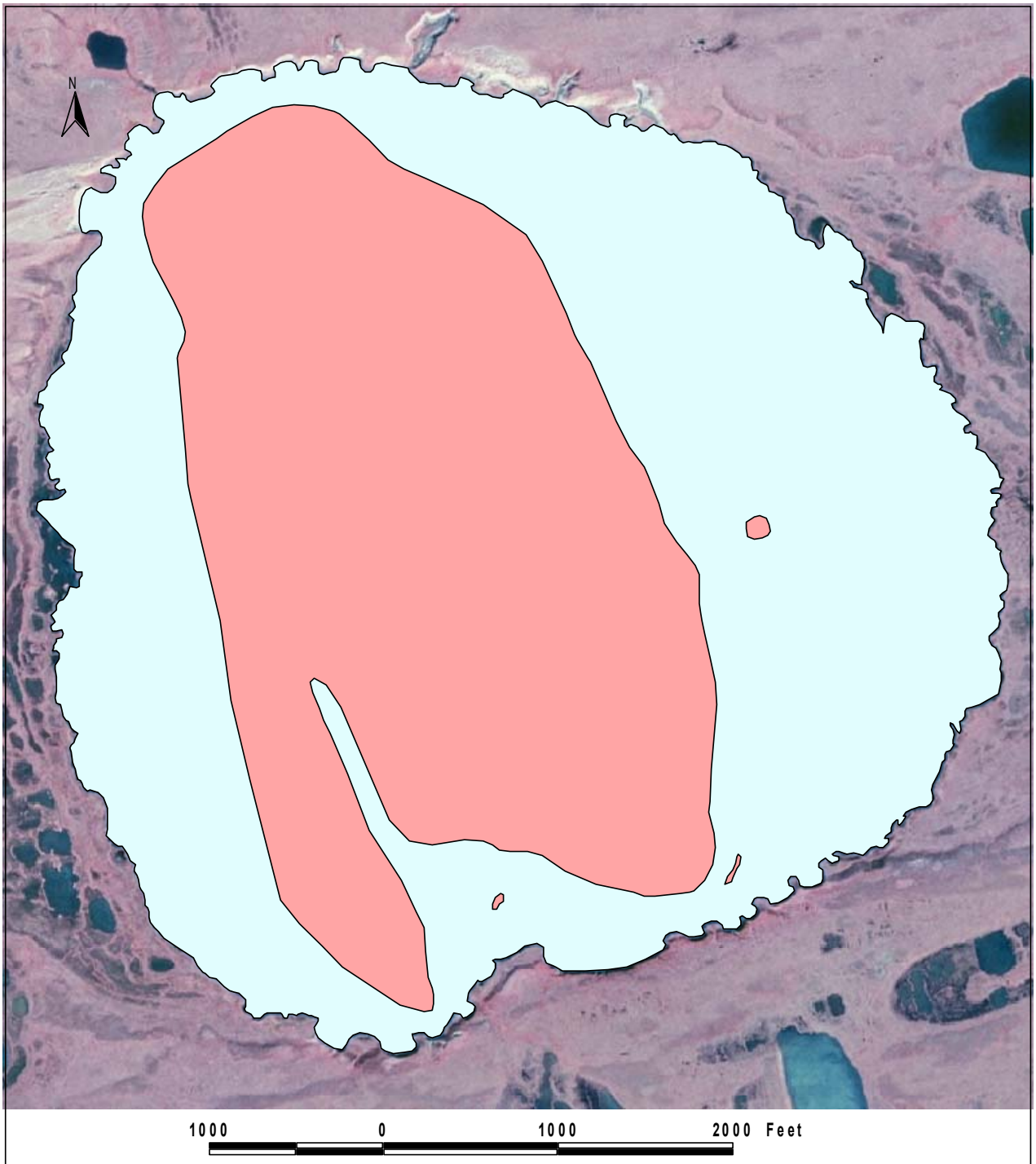
Other Names:
Location: 70.36423°N 153.31113°W
USGS Quad Sheet: Teshekpuk B-1: T12N R6W Sec. 25/26
Habitat: Drainage Lake
Area: 551.9 acres
Maximum Depth: 27.8 feet
Active Outlet: Yes
Calculated Volume: 747.23 million gallons
Permittable Volume 47.84 million gallons
Potential Aggregate 302.7 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	28.9	3.4	10.1	5.3	86	171	0.7	7.91	This Study

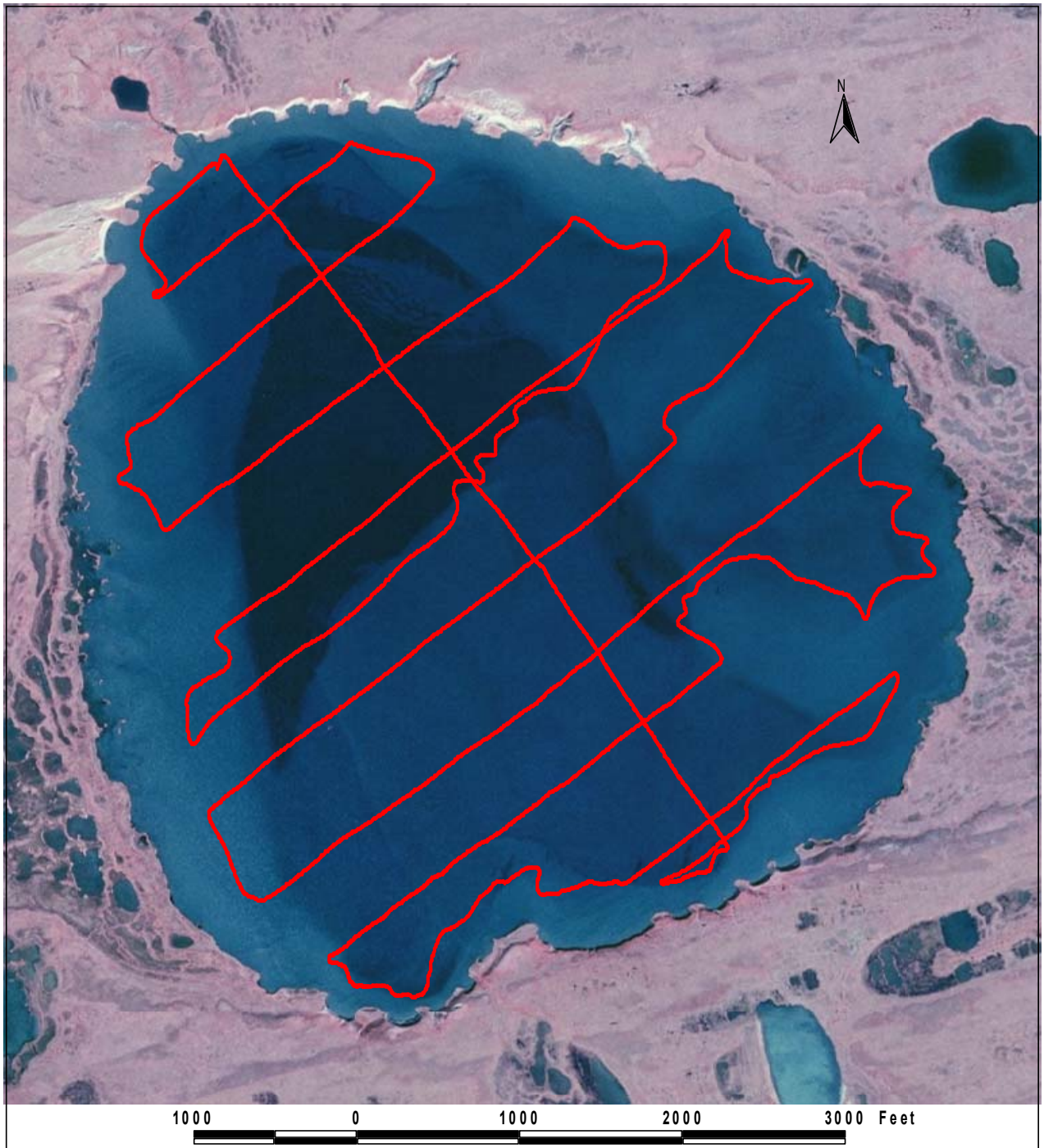
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 23 04	9.3	None	0
Minnow Trap	Jul 23 04	10.8	Ninespine stickleback	3
Observed	Jul 23 04		Ninespine stickleback	100's

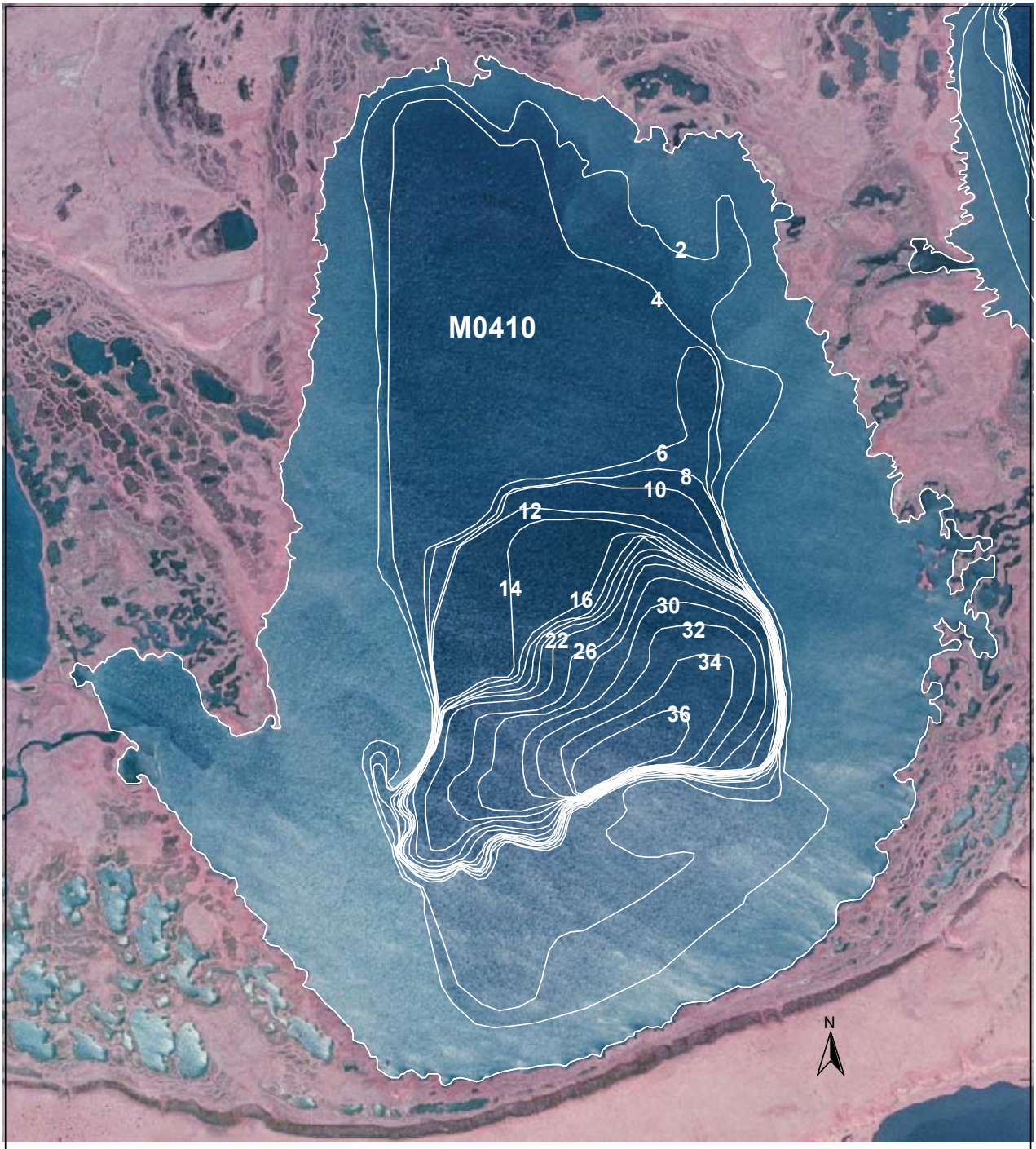


Regions of lake M0409 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 26, 2004

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



Depth transects surveyed at lake M 0409 on July 23, 2004.



Depth contours of lake M0410, based on transects surveyed on July 17, 2004
(depth intervals in 2 foot increments)

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

Lake M0410

Other Names:
Location: 70.31566°N 153.22983°W
USGS Quad Sheet: Teshekpuk B-1: T11N R5W Sec. 7/8/17/18
Habitat: Drainage Lake
Area: 682.7 acres
Maximum Depth: 37.7 feet
Active Outlet: Yes
Calculated Volume: 1,431.01 million gallons
Permittable Volume 102.38 million gallons
Potential Aggregate 391.1 acres (water depth 4 ft or less)

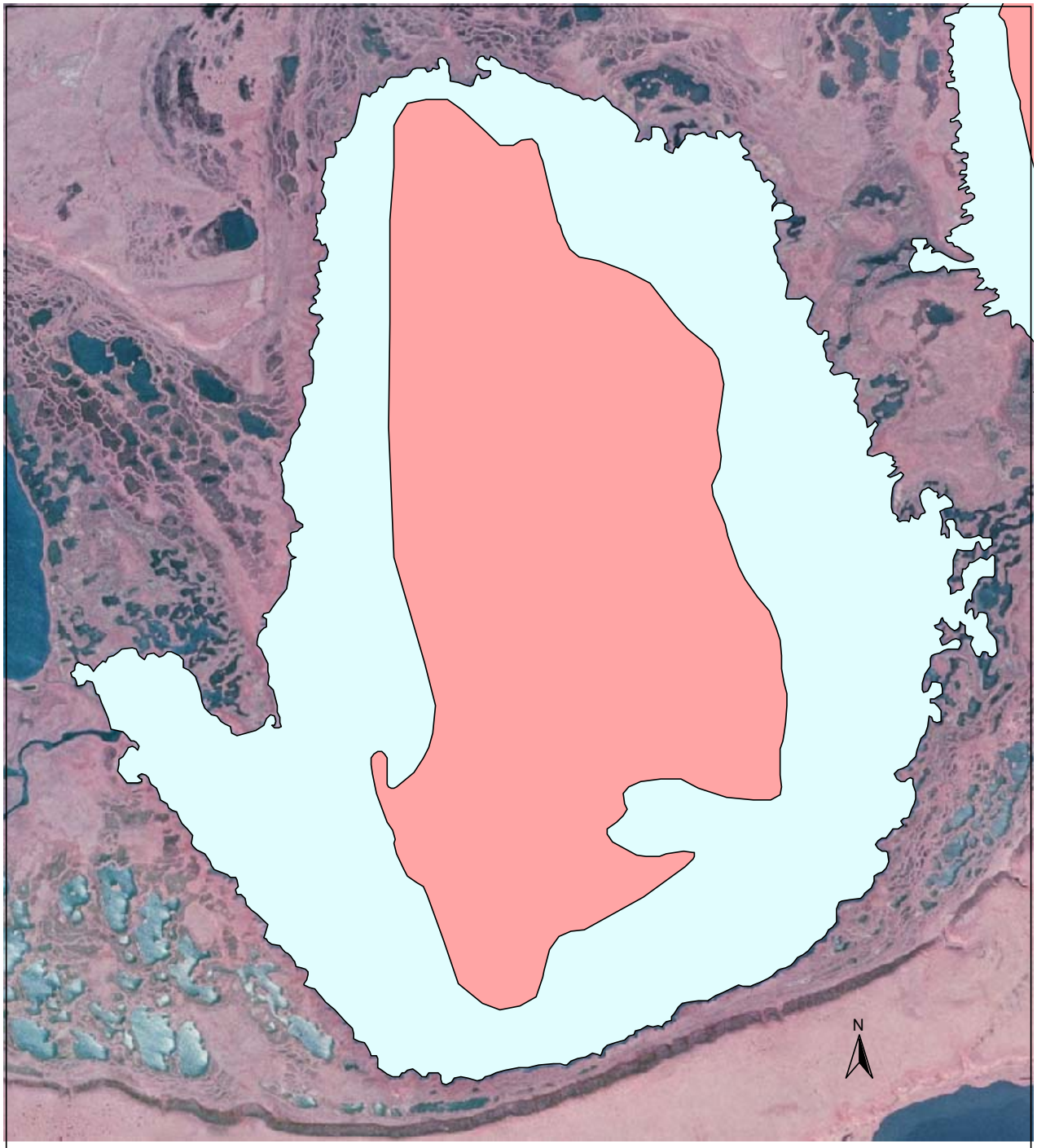
Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	16.9	1.9	6.2	3.5	50	110	2.2	7.91	This Study

Catch Record:

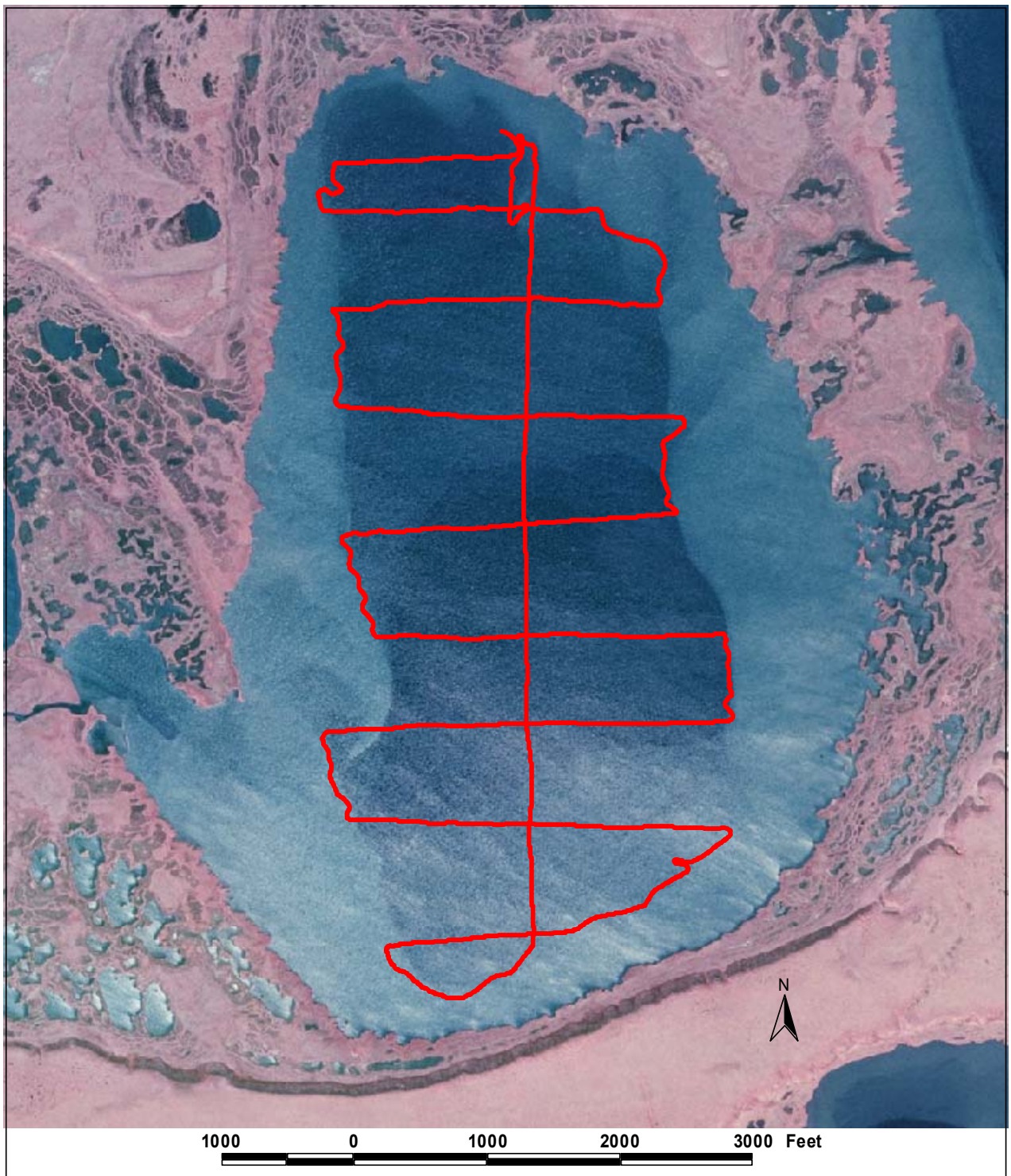
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 17 04	10.0	None	0
Observed	Jul 17 04		Arctic grayling	1

Ninespine stickleback assumed to be present, lake M0410 is connected to lake M0411

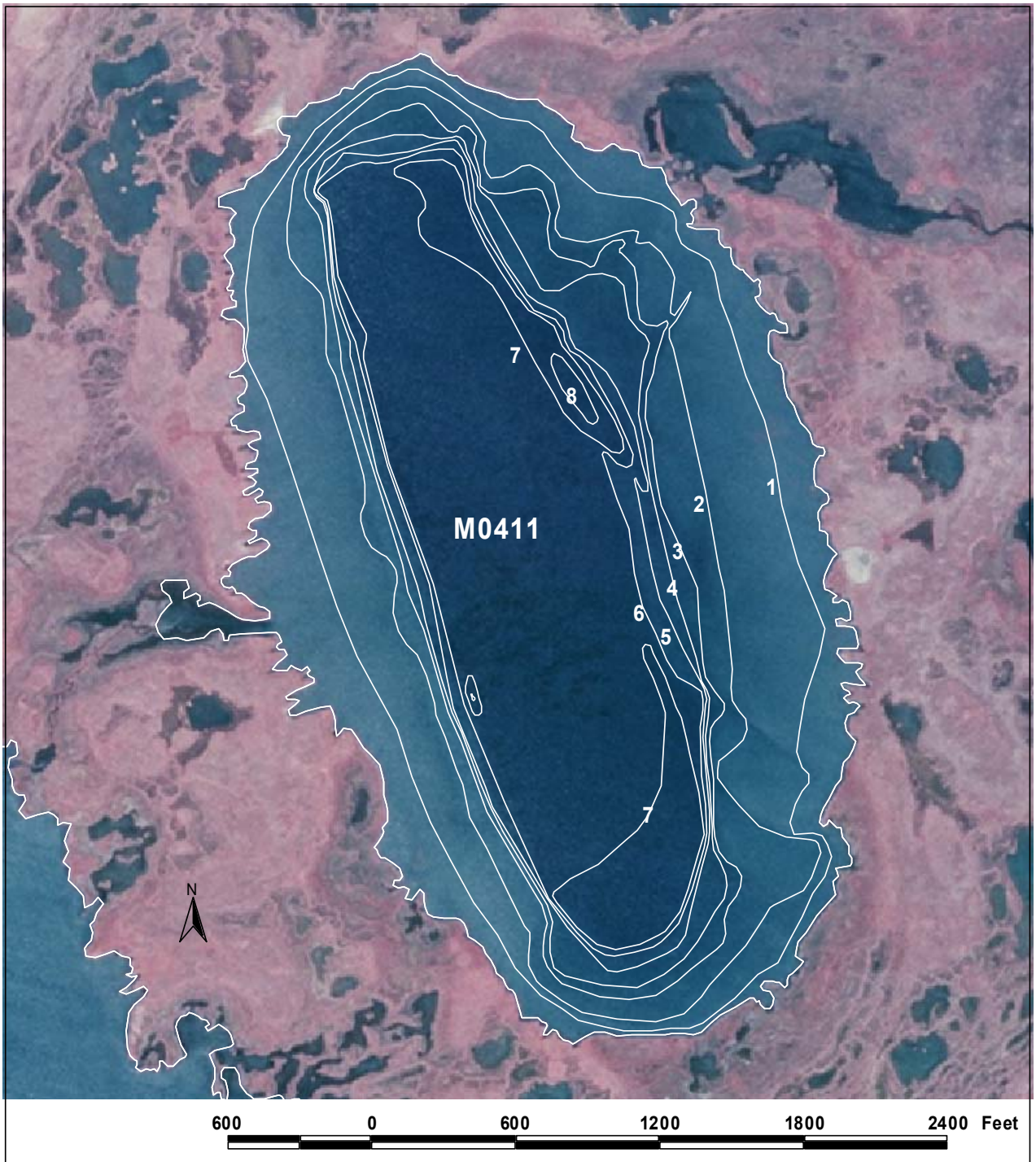


Regions of lake M0410 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 17, 2004

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



Depth transects surveyed at lake M0410 on July 17, 2004.



Depth contours of lake M0411, based on transects surveyed on July 11, 2004
(depth intervals in 1 foot increments)

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

Lake M0411

Other Names:
Location: 70.32325°N 153.19757°W
USGS Quad Sheet: Teshekpuk B-1: T11N R5W Sec. 8/9
Habitat: Drainage Lake
Area: 182.4 acres
Maximum Depth: 8.7 feet
Active Outlet: Yes
Calculated Volume: 213.49 million gallons
Permittable Volume 0.24 million gallons
Potential Aggregate 103.4 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	14.9	1.7	6.1	3.3	44	108	0.9	7.76	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 11 04	8.8	None	0
Minnow Trap	Jul 11 04	11.3	Ninespine stickleback	2

Arctic grayling assumed to be present, lake M0411 is connected to lake M0410

Regions of lake M0411 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 11, 2004

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

Depth transects surveyed at lake M0411 on July 11, 2004.

Depth contours of lake M0412, based on transects surveyed on July 26, 2004
(depth intervals in 1 foot increments)

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

Lake M0412

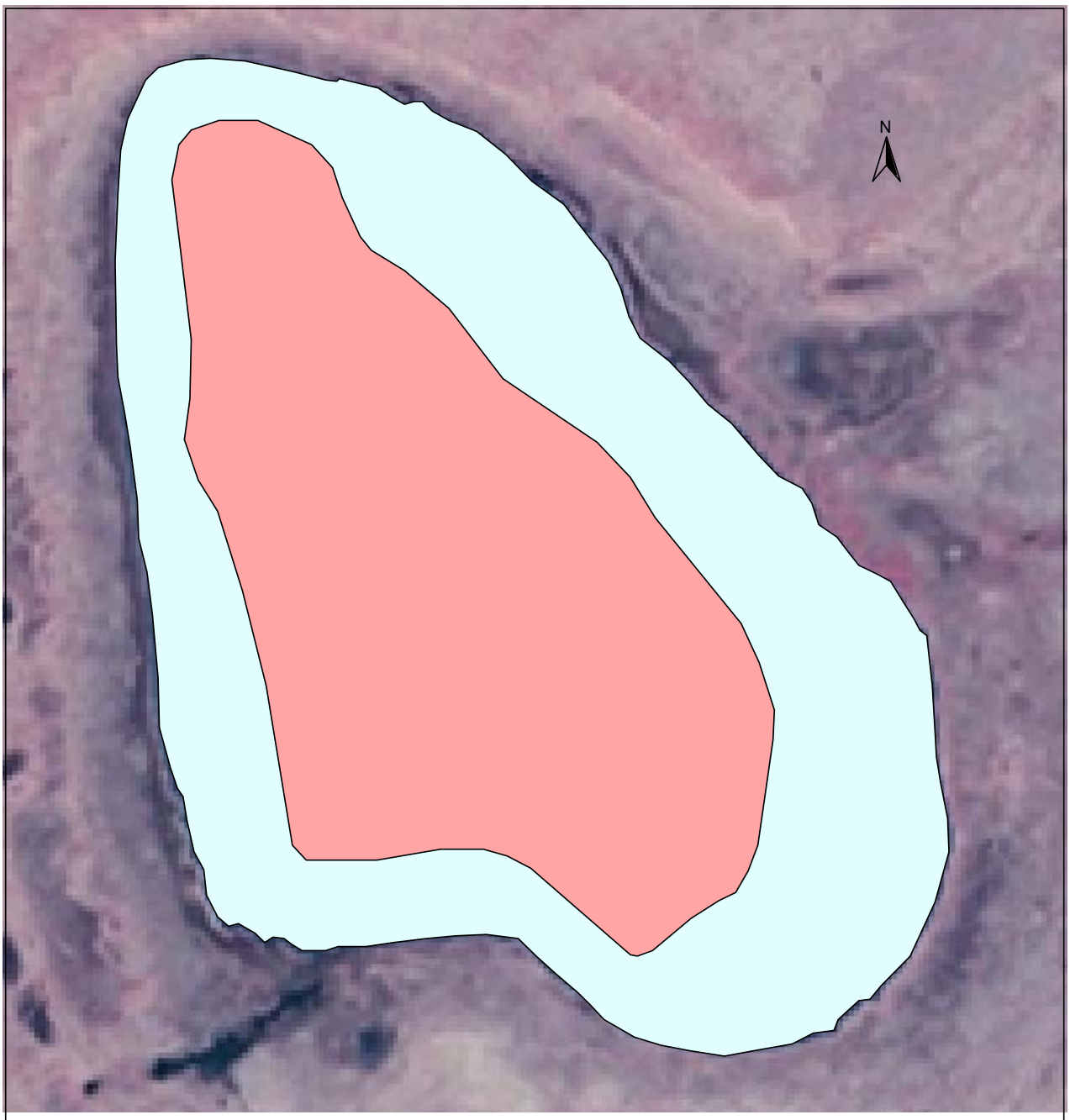
Other Names:
Location: 70.34478°N 153.17784°W
USGS Quad Sheet: Teshekpuk B-1: T12N R5W Sec. 33
Habitat: Drainage Lake
Area: 31.4 acres
Maximum Depth: 7.6 feet
Active Outlet: Yes
Calculated Volume: 36.83 million gallons
Permittable Volume 3.81 million gallons
Potential Aggregate 15.7 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	10.8	1.5	4.7	2.7	33	78	0.9	7.10	This Study

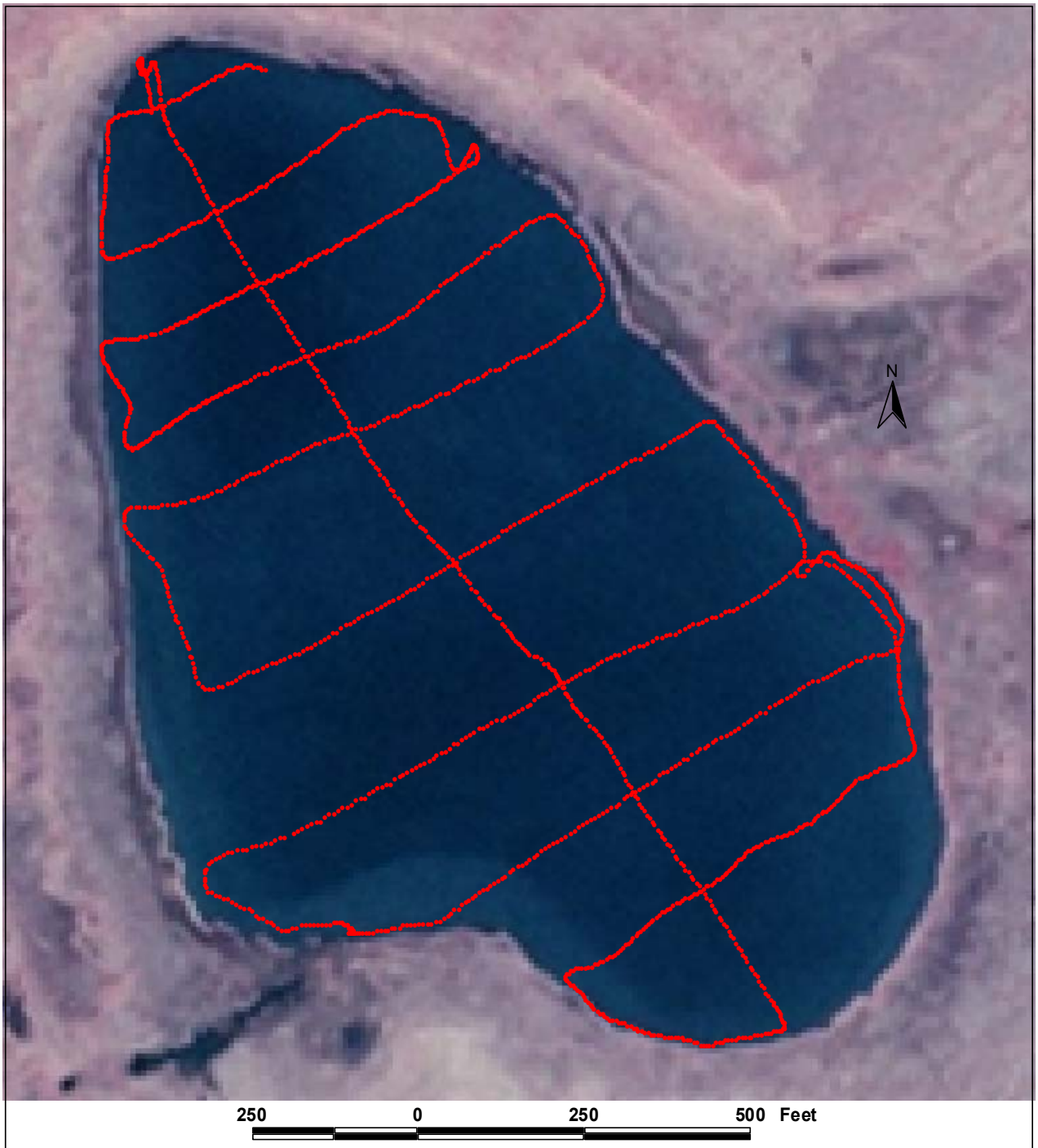
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 26 04	9.1	None	0
Minnow Trap	Jul 26 04	11.9	None	0
Seine	Jul 26 04	3 hauls	None	0

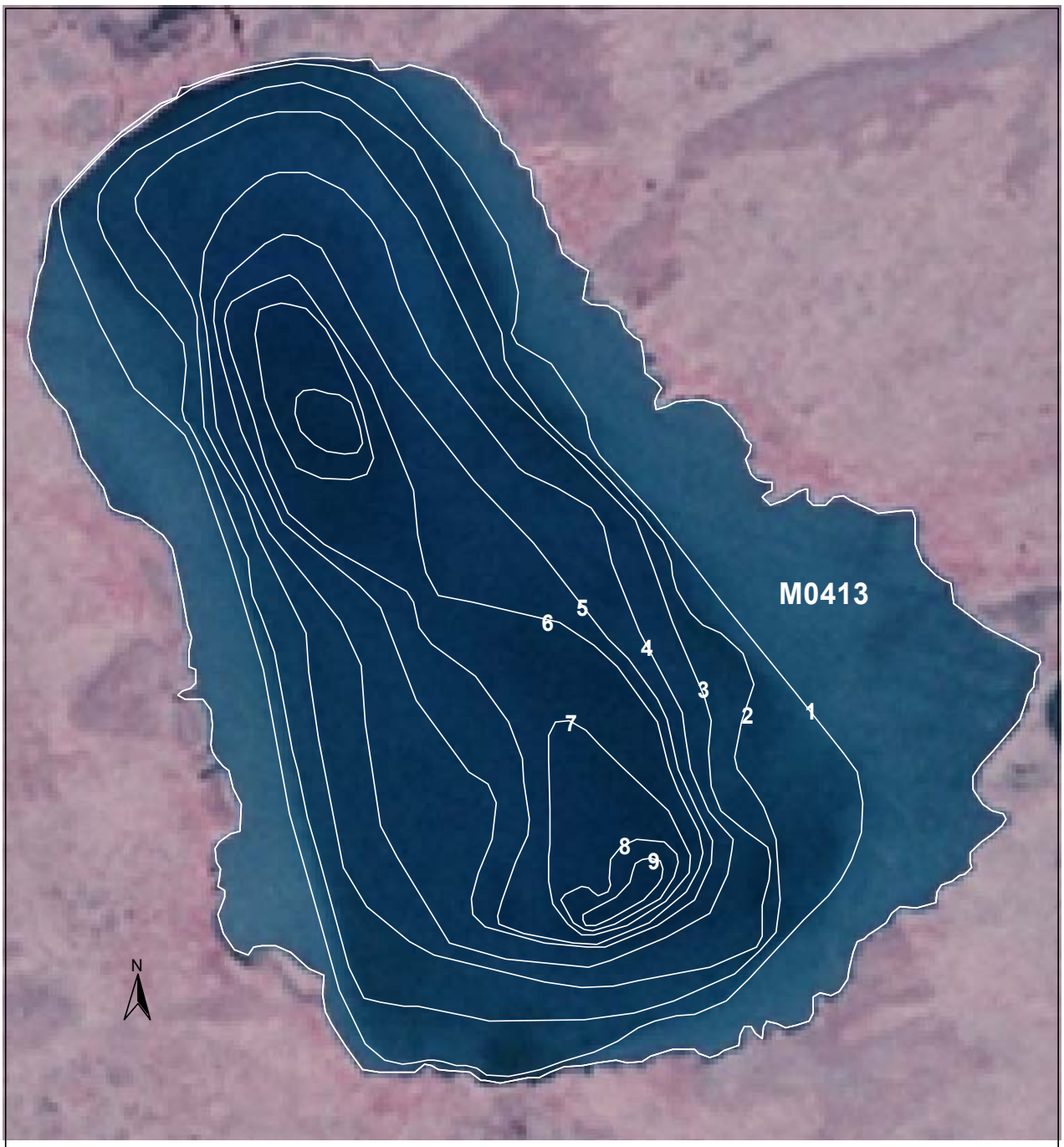


Regions of lake M0412 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 26, 2004

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



Depth transects surveyed at lake M0412 on July 26, 2004.



Depth contours of lake M0413, based on transects surveyed on July 26, 2004
(depth intervals in 1 foot increments)

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

Lake M0413

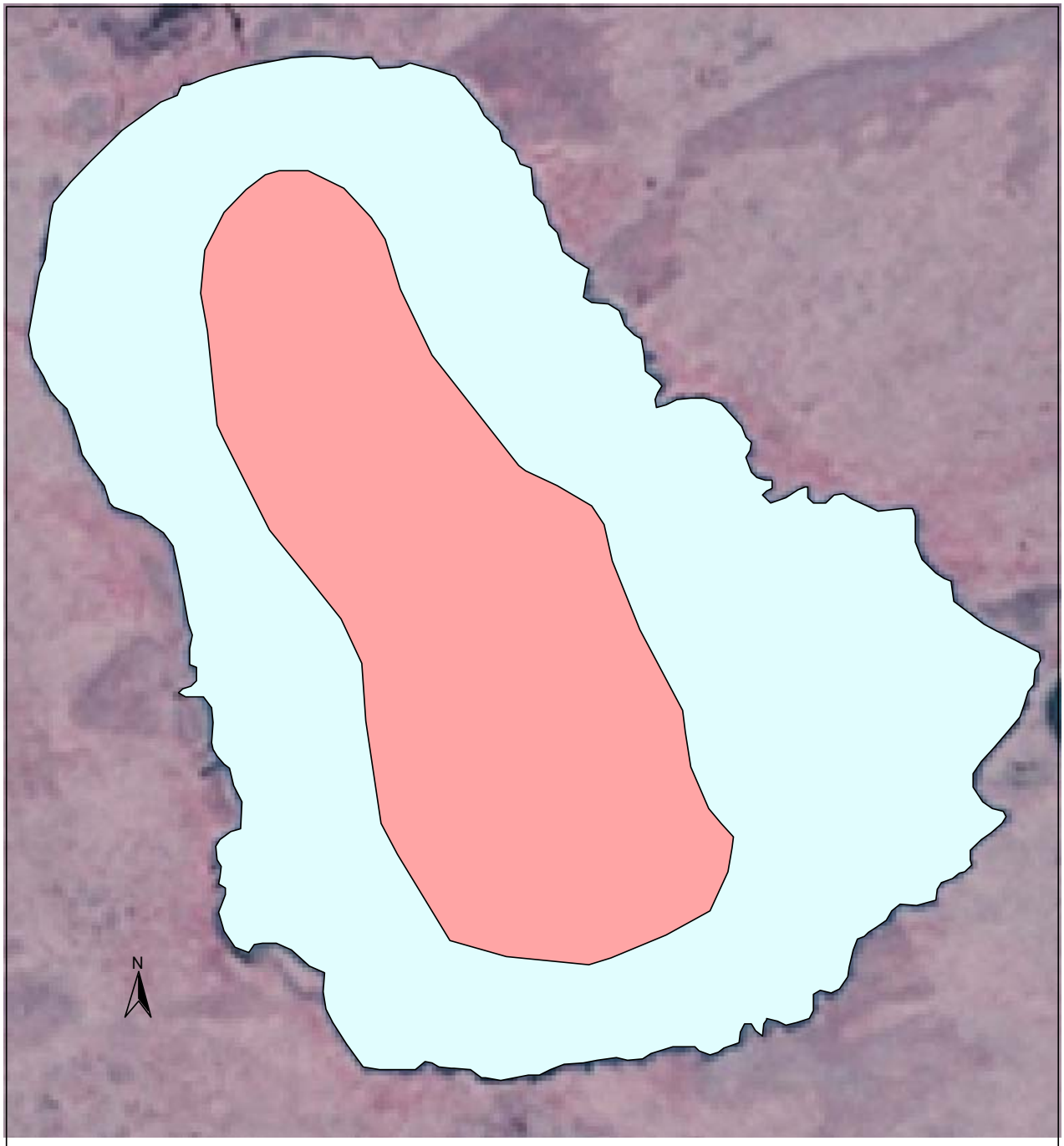
Other Names:
Location: 70.36272°N 153.16085°W
USGS Quad Sheet: Teshekpuk B-1: T12N R5W Sec. 28
Habitat: Tundra Lake
Area: 43.2 acres
Maximum Depth: 9.5 feet
Active Outlet: No
Calculated Volume: 41.78 million gallons
Permittable Volume 8.25 million gallons
Potential Aggregate 28.6 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	27.6	3.0	7.6	4.2	81	169	0.6	7.72	This Study

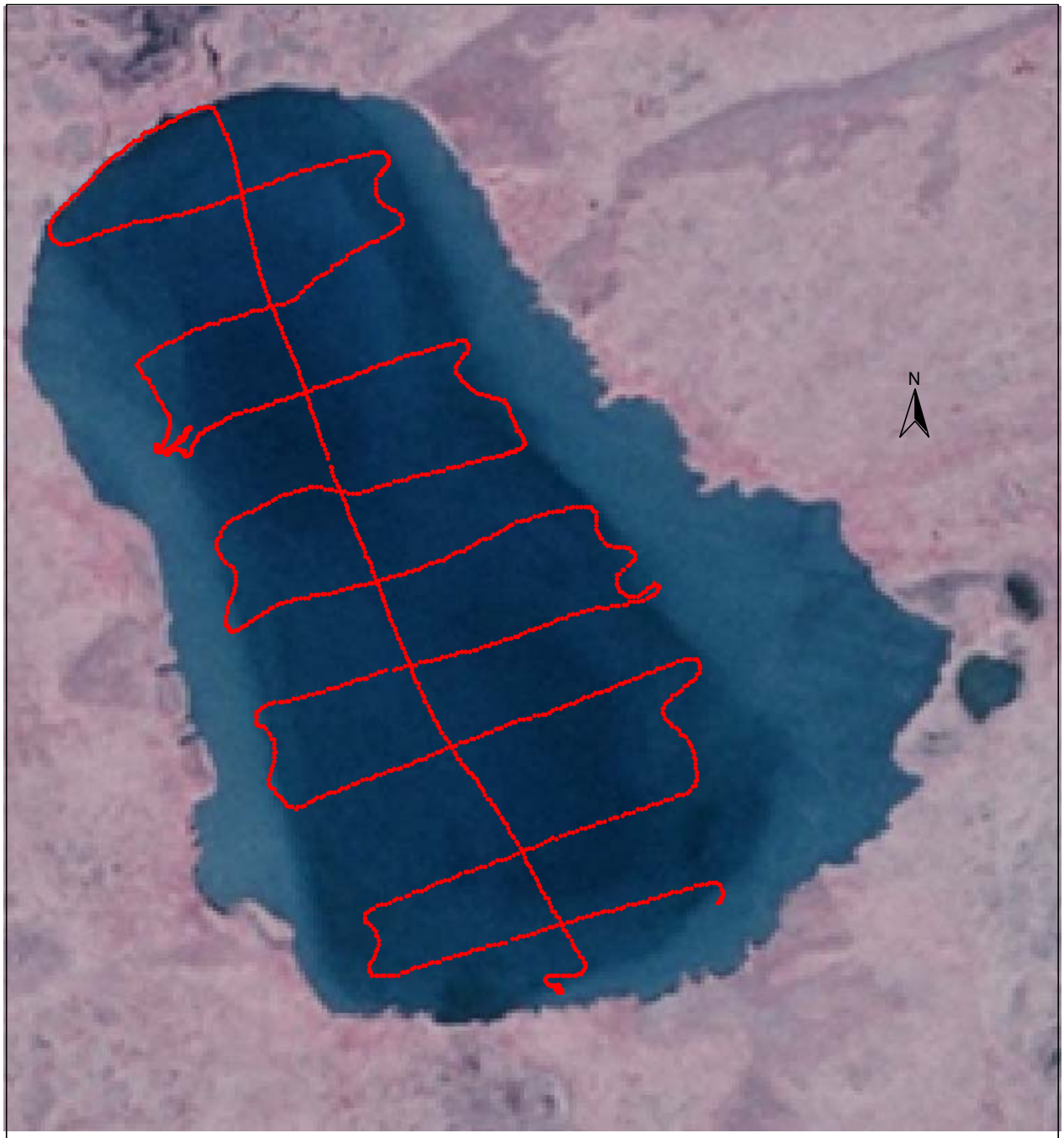
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 26 04	8.2	None	0
Minnow Trap	Jul 26 04	10.9	None	0
Seine	Jul 26 04	3 hauls	None	0

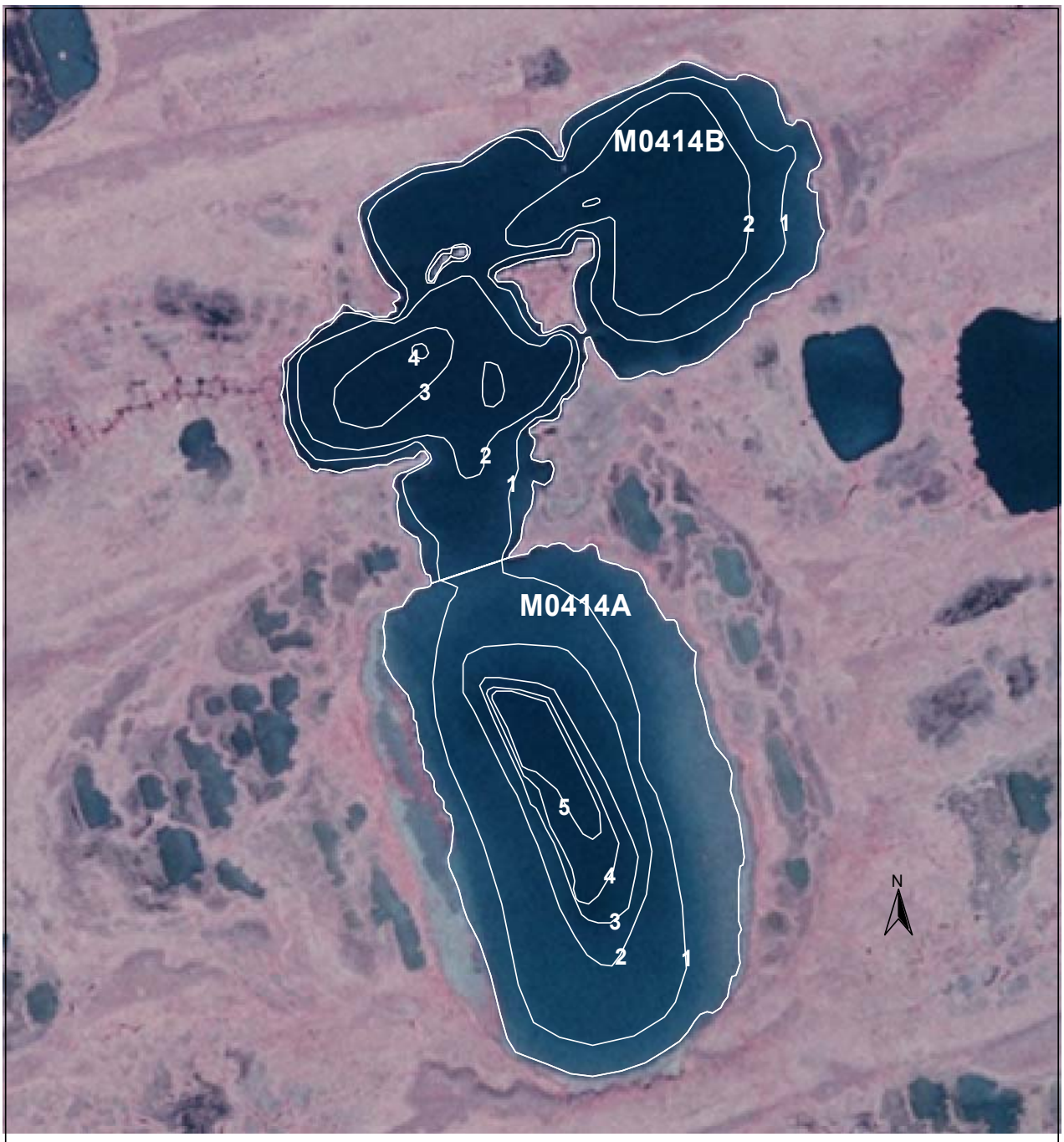


Regions of lake M0413 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 26, 2004

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



Depth transects surveyed at lake M0413 on July 26, 2004.



Depth contours of lake M0414, based on transects surveyed on July 23, 2004
(depth intervals in 1 foot increments)

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

Lake M0414

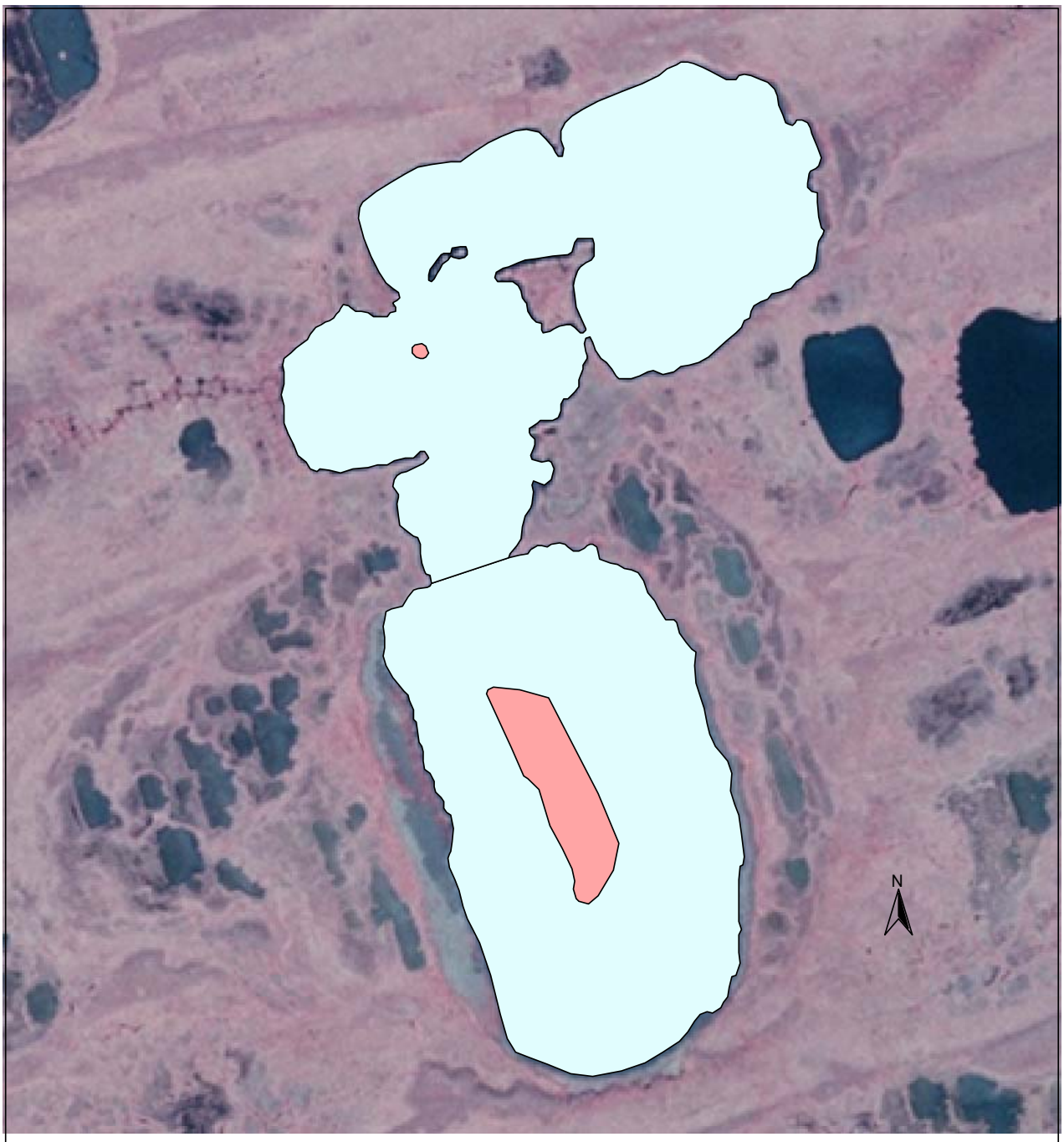
	Basin A	Basin B
Other Names:		
Location:	70.36841°N 153.15570°W	70.37354°N 153.15347°W
USGS Quad Sheet:	Teshekpuk B-1: T12N R5W Sec. 28	Teshekpuk B-1: T12N R5W Sec. 21/28
Habitat:	Drainage Lake	Drainage Lake
Area:	27.7 acres	29.3 acres
Maximum Depth:	5.8 feet	4.1 (shallow)
Active Outlet:	Yes	Yes
Calculated Volume:	14.34 million gallons	16.5 million gallons
Permittable Volume	0.72 million gallons	0.00 million gallons
Potential Aggregate	25.3 acres (water 4 ft or less)	29.2 acres (water 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	12.6	9.1	11.0	5.7	69	105	1.2	7.80	This Study

Catch Record:

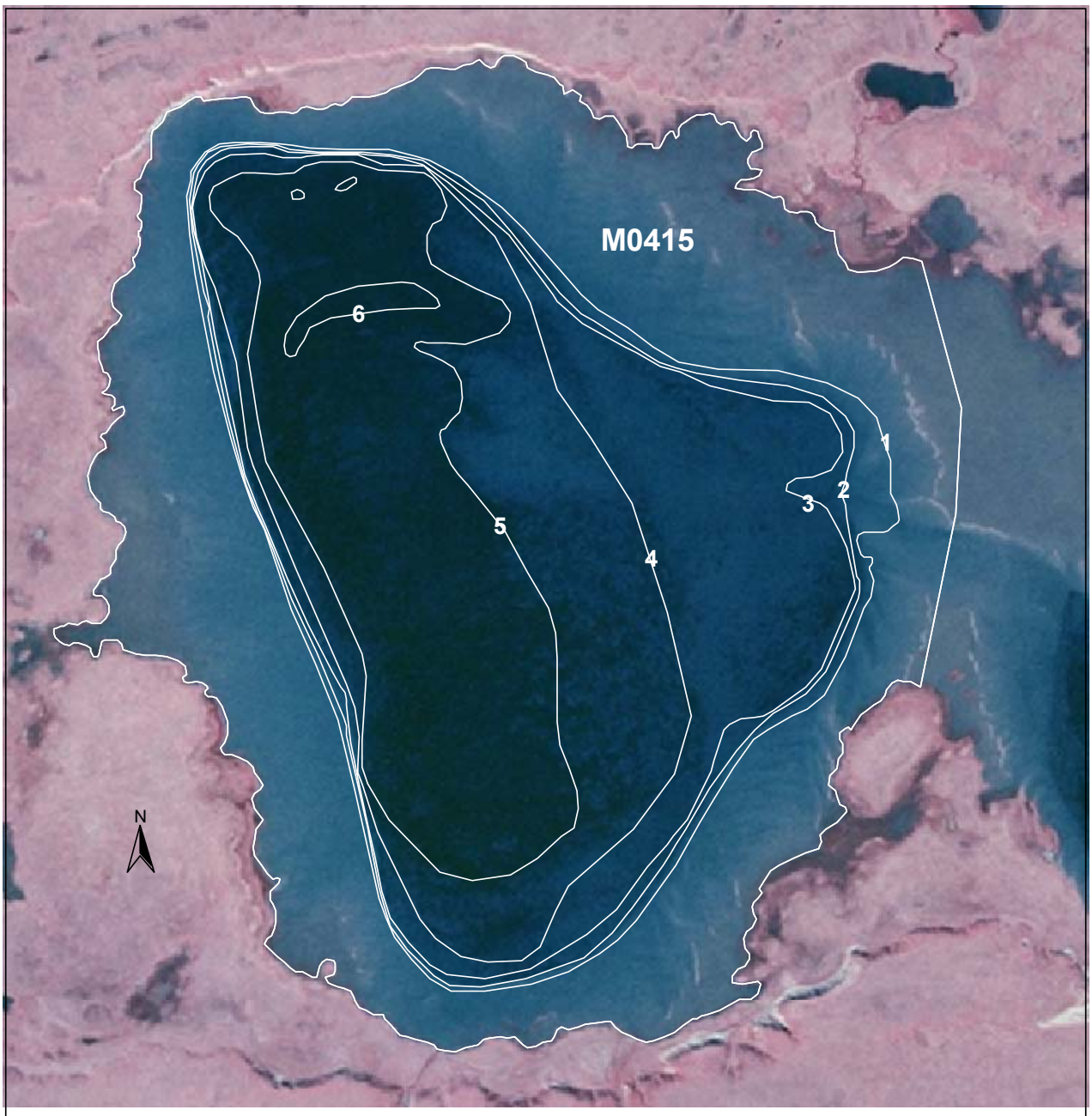
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 27 04	7.2	None	0
Minnow Trap	Jul 27 04	11.1	None	0
Seine	Jul 27 04	3 hauls	None	0



Regions of lake M0414 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 23, 2004

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

Depth transects surveyed at lake M0414 on July 27, 2004.



Depth contours of lake M0415, based on transects surveyed on July 17, 2004
(depth intervals in 1 foot increments)

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

Lake M0415

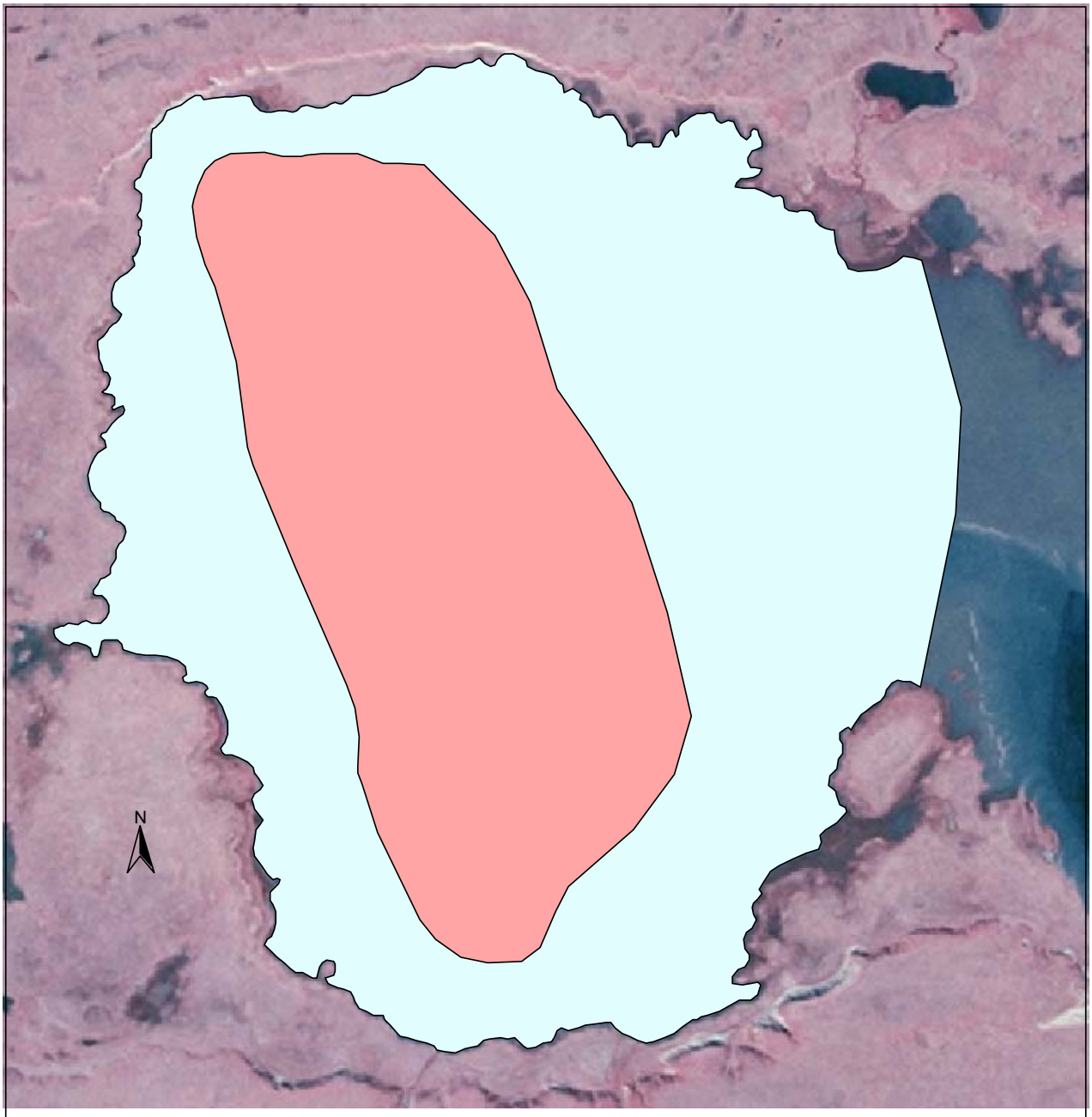
Other Names:
Location: 70.39628°N 153.09250°W
USGS Quad Sheet: Teshekpuk B-1: T12N R5W Sec. 14
Habitat: Drainage Lake
Area: 209.2 acres
Maximum Depth: 6.1 feet
Active Outlet: Yes
Calculated Volume: 183.44 million gallons
Permittable Volume 25.98 million gallons
Potential Aggregate 131.3 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	21.7	2.4	6.6	3.6	64	142	0.6	8.11	This Study

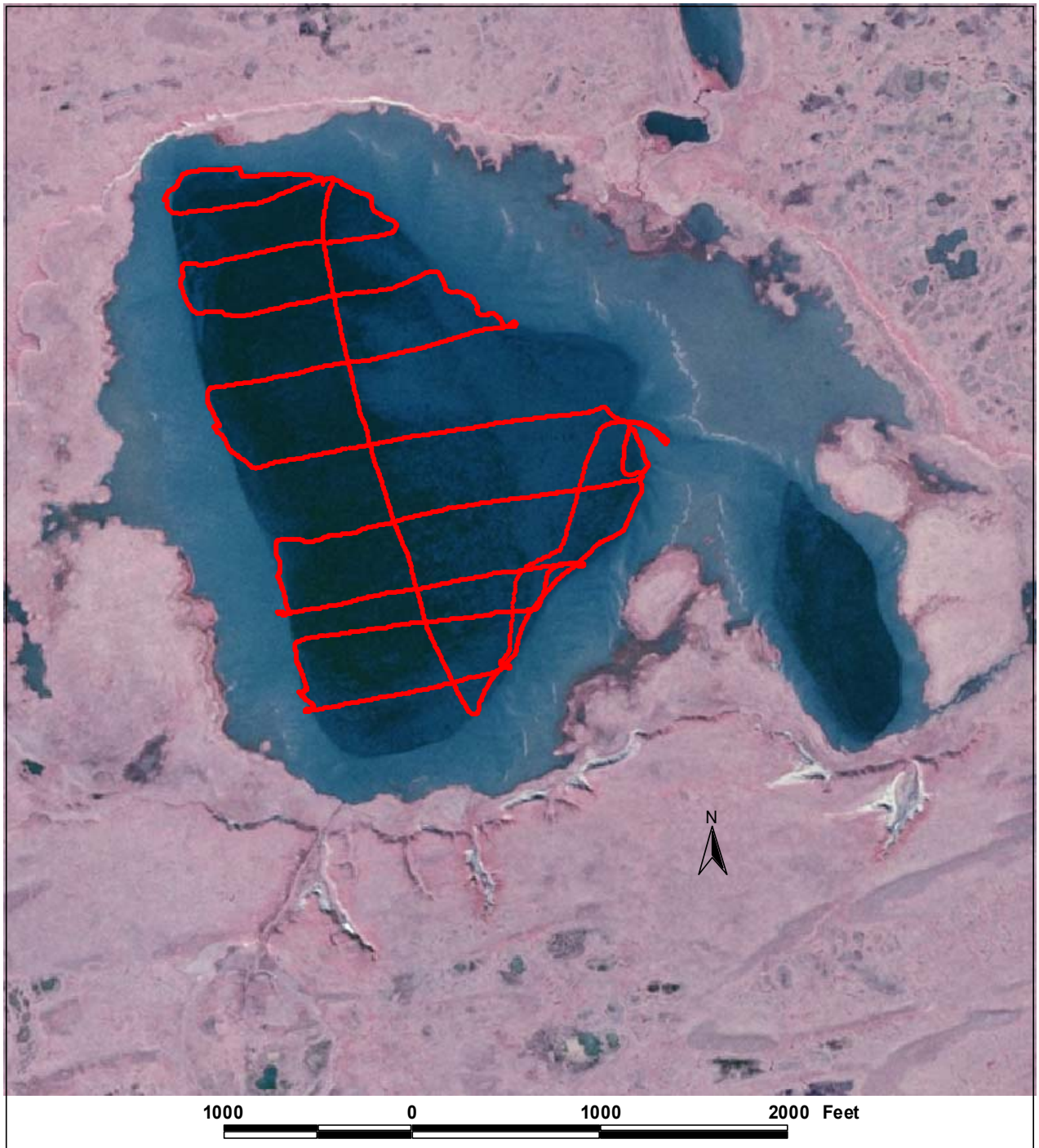
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 17 04	7.2	None	0
Minnow Trap		0.0		
Seine	Jul 17 04	5 hauls	None	0

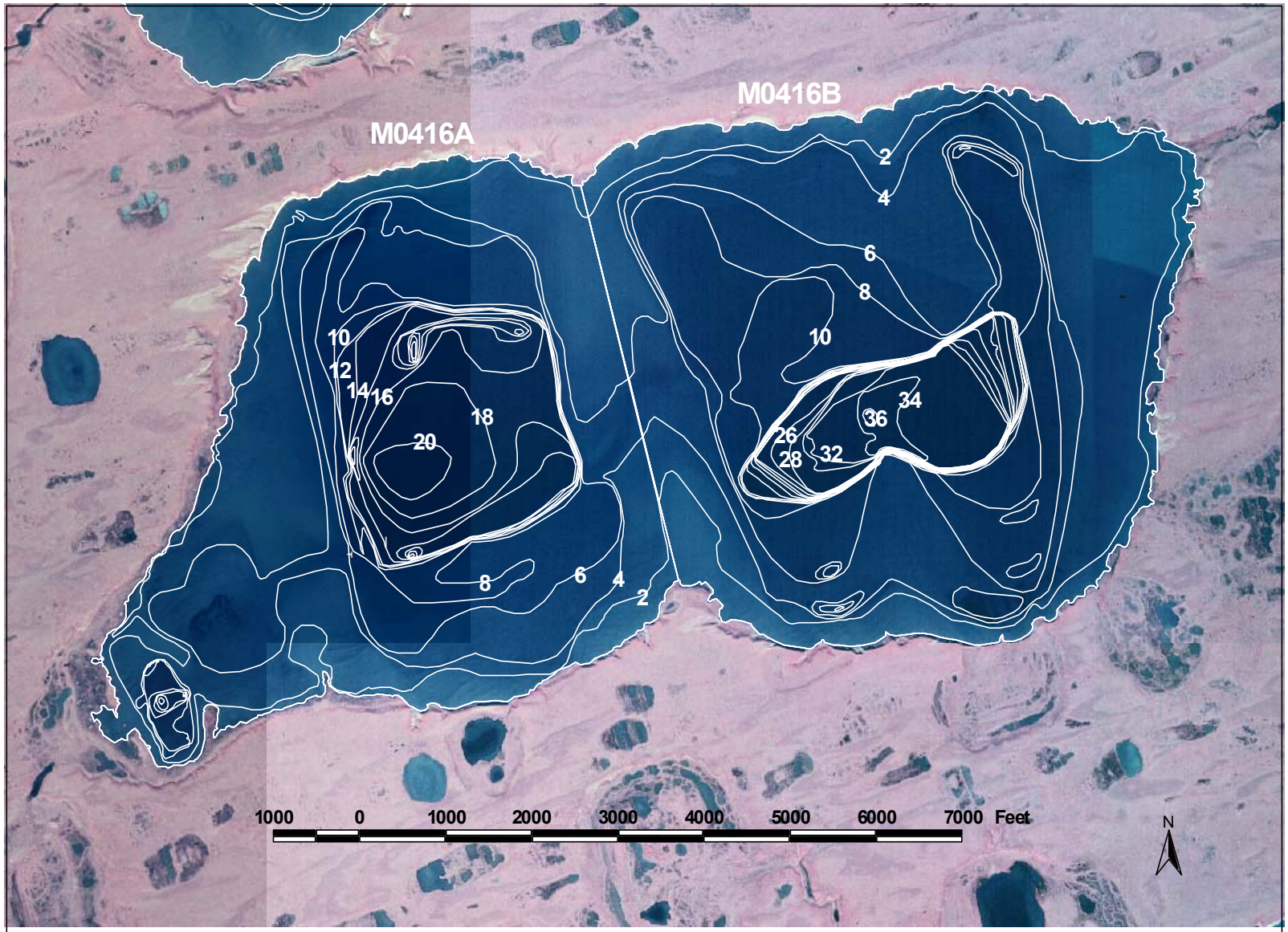


Regions of lake M0415 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 17, 2004

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



Depth transects surveyed at lake M0415 on July 17, 2004.



Depth contours of lake M0417, based on transects surveyed on July 25, 2004
(depth intervals in 2 foot increments)

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

Lake M0416

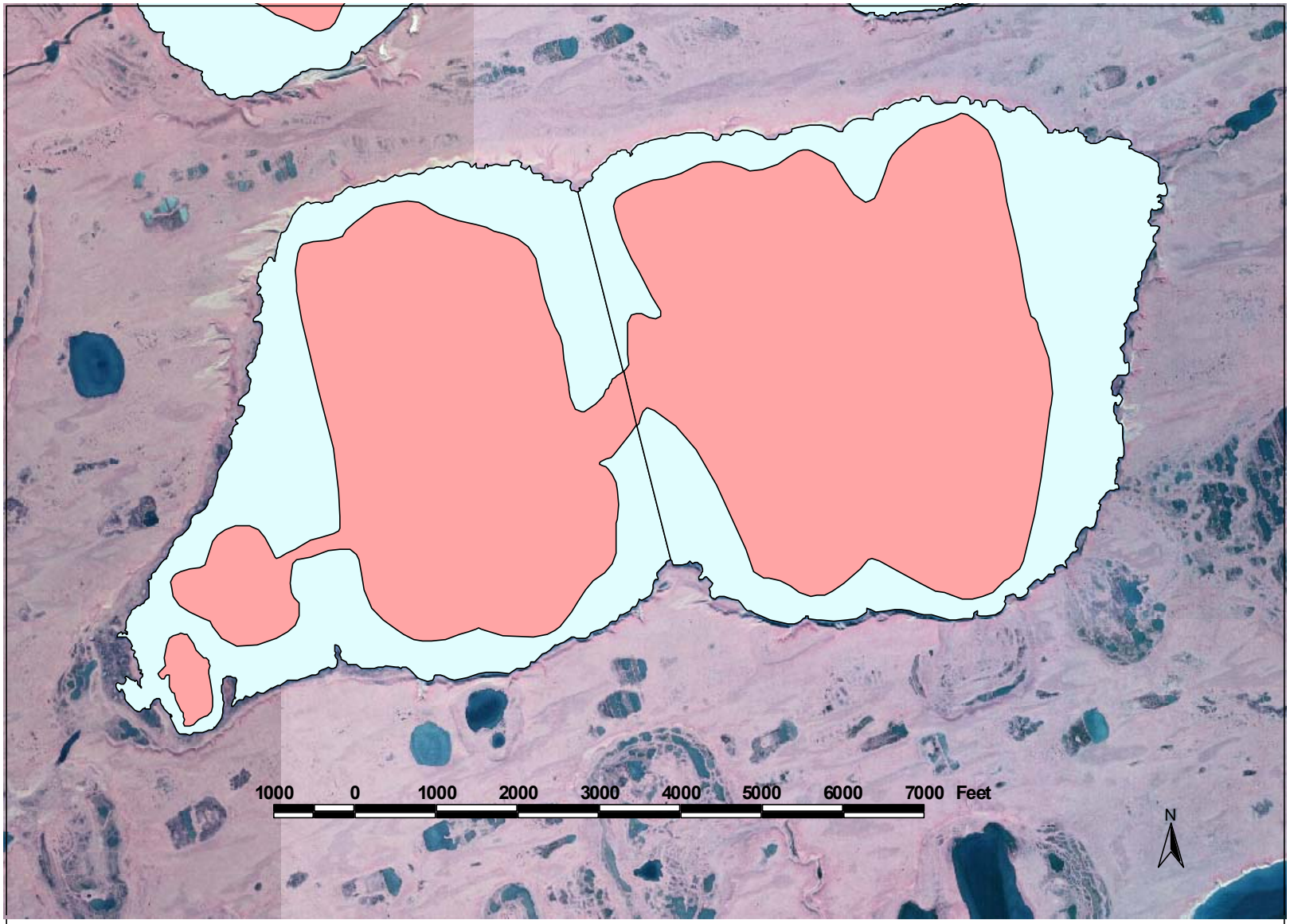
	Basin A	Basin B
Other Names:		
Location:	70.25355°N 152.99526°W	70.25581°N 152.95238°W
USGS Quad Sheet:	Harrison Bay B-5: T10/11N R4/5W Sec. 1/6/31	Harrison Bay B-5: T10/11N R4W Sec. 4/5/32/33
Habitat:	Drainage Lake	Drainage Lake
Area:	683.2 acres	803.0 acres
Maximum Depth:	27.9 feet	37.1 feet
Active Outlet:	Yes	Yes
Calculated Volume:	1,495.20 million gallons	2,040.86 million gallons
Permittable Volume	65.40 million gallons	115.38 million gallons
Potential Aggregate	281.7 acres (water 4 ft or less)	280.9 acres (water 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	34.0	3.3	9.8	4.2	98	198	0.7	8.20	This Study

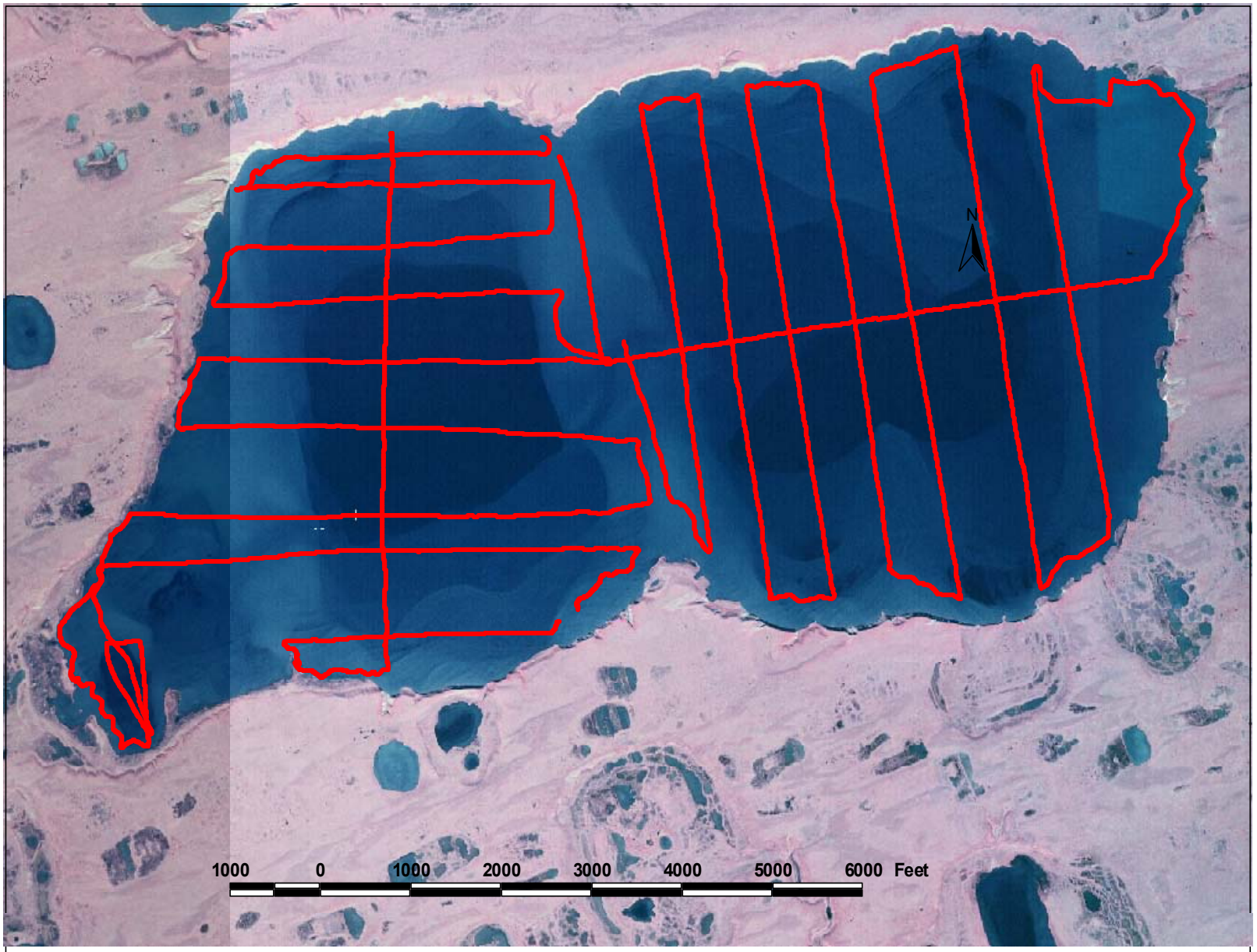
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 25 04	16.1	Lake trout	1	550
			Least cisco	3	187-206
Minnow Trap		0.0			
Observed	Jul 25 04		Ninespine stickleback	many	

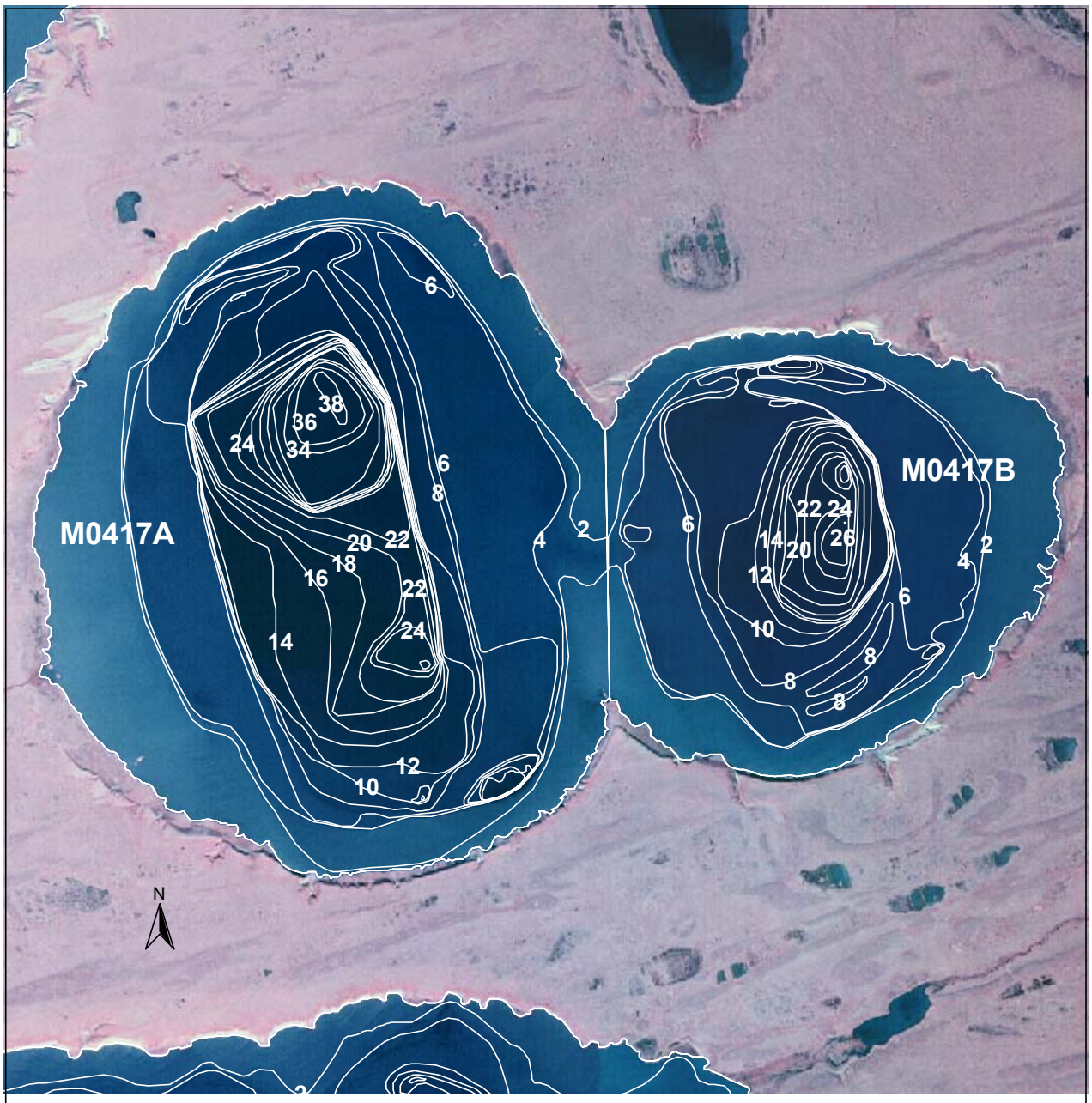


Regions of lake M0416 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 25, 2004

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



Depth transects surveyed at lake M0416 on July 25, 2004.



Depth contours of lake M0417, based on transects surveyed on July 15, 2004
(depth intervals in 2 foot increments)

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

Lake M0417

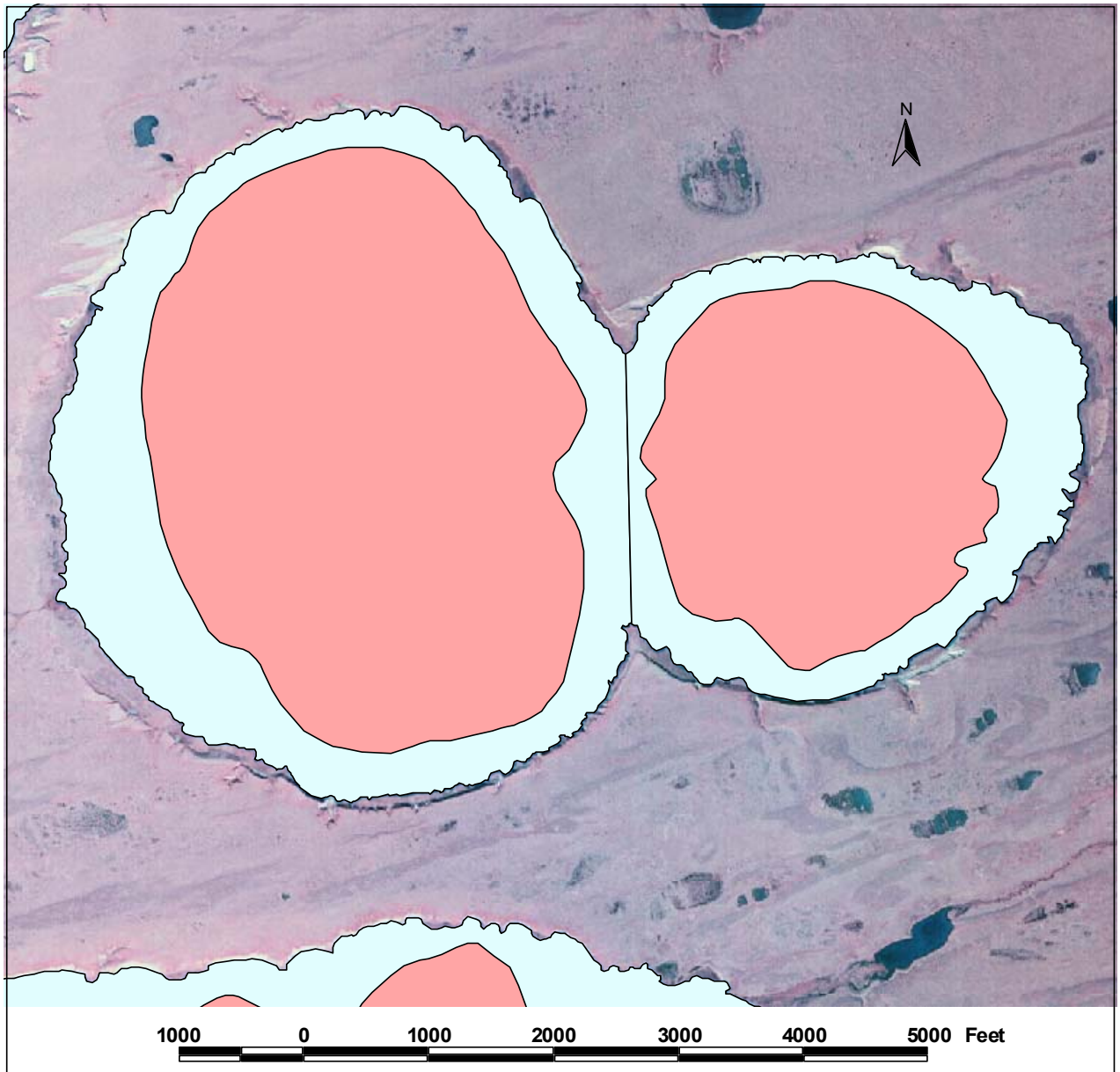
	Basin A	Basin B
Other Names:		
Location:	70.27446°N 152.95056°W	70.27388°N 152.92015°W
USGS Quad Sheet:	Harrison Bay B-5: T11N R4W Sec. 29/32	Harrison Bay B-5: T11N R4W Sec. 28/33
Habitat:	Drainage Lake	Drainage Lake
Area:	475.3 acres	250.1 acres
Maximum Depth:	38.4 feet	28.5 feet
Active Outlet:	Yes	Yes
Calculated Volume:	1,342.75 million gallons	533.18 million gallons
Permittable Volume	93.16 million gallons	26.00 million gallons
Potential Aggregate	162.1 acres (water 4 ft or less)	90.4 acres (water 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	29.7	2.8	9.7	4.4	86	202	1.0	8.18	This Study

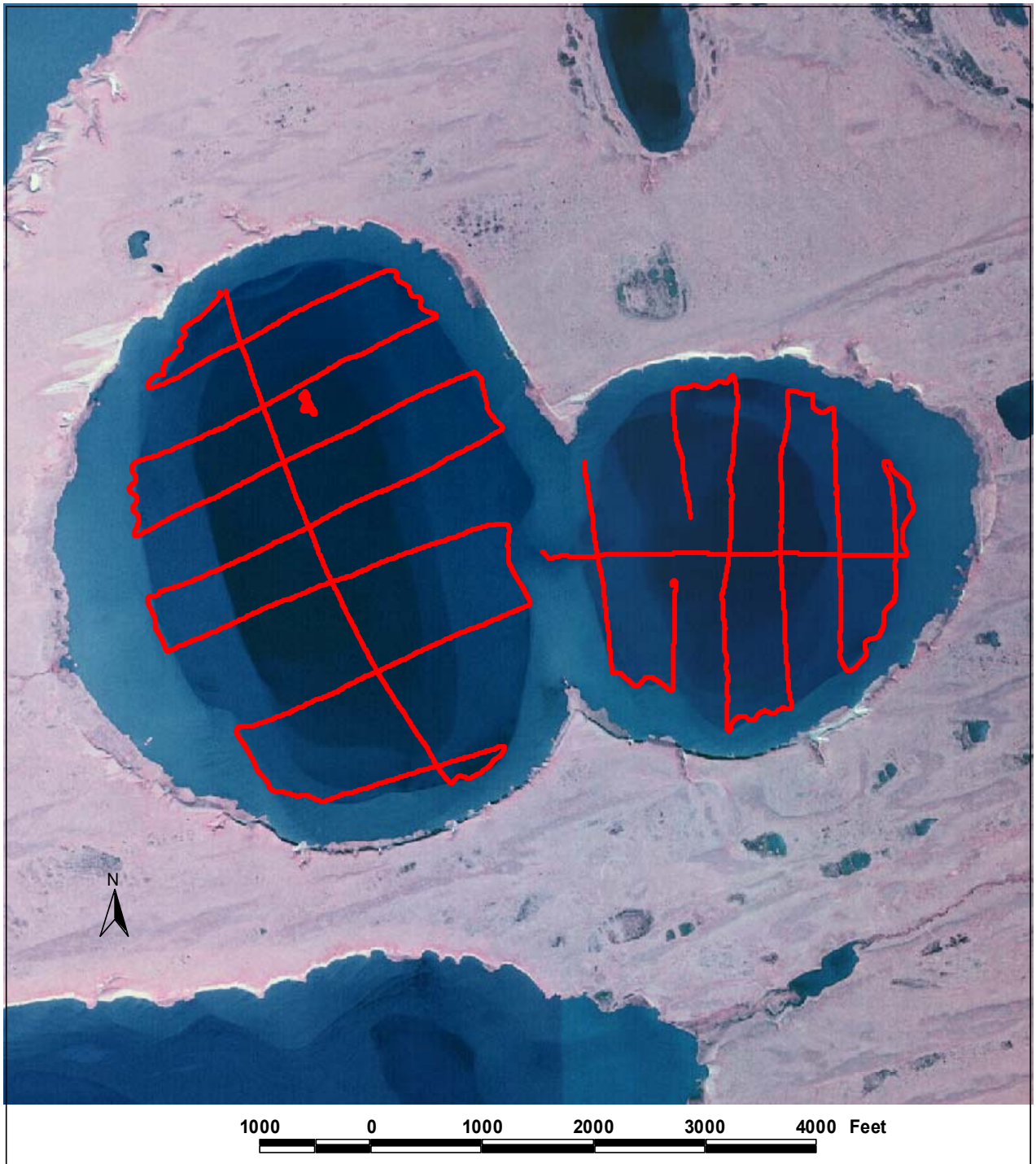
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 15 04	7.1	Lake trout (plus 1 observed)	1	675
Minnow Trap		0.0			
Observed			Ninespine stickleback		many

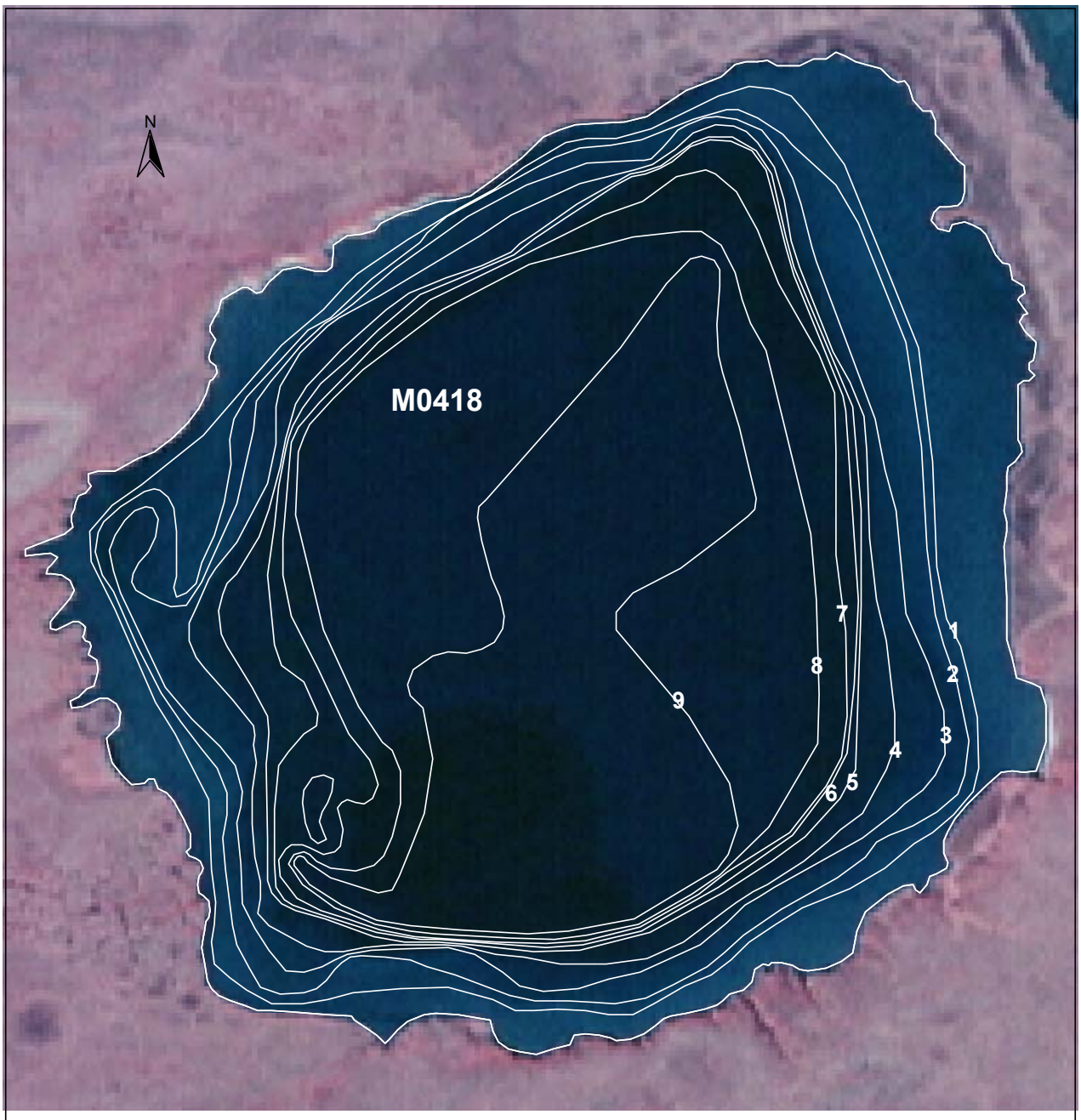


Regions of lake M0417 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 15, 2004

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



Depth transects surveyed at lake M0417 on July 15, 2004.



Depth contours of lake M0418, based on transects surveyed on July 16, 2004
(depth intervals in 1 foot increments)

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

Lake M0418

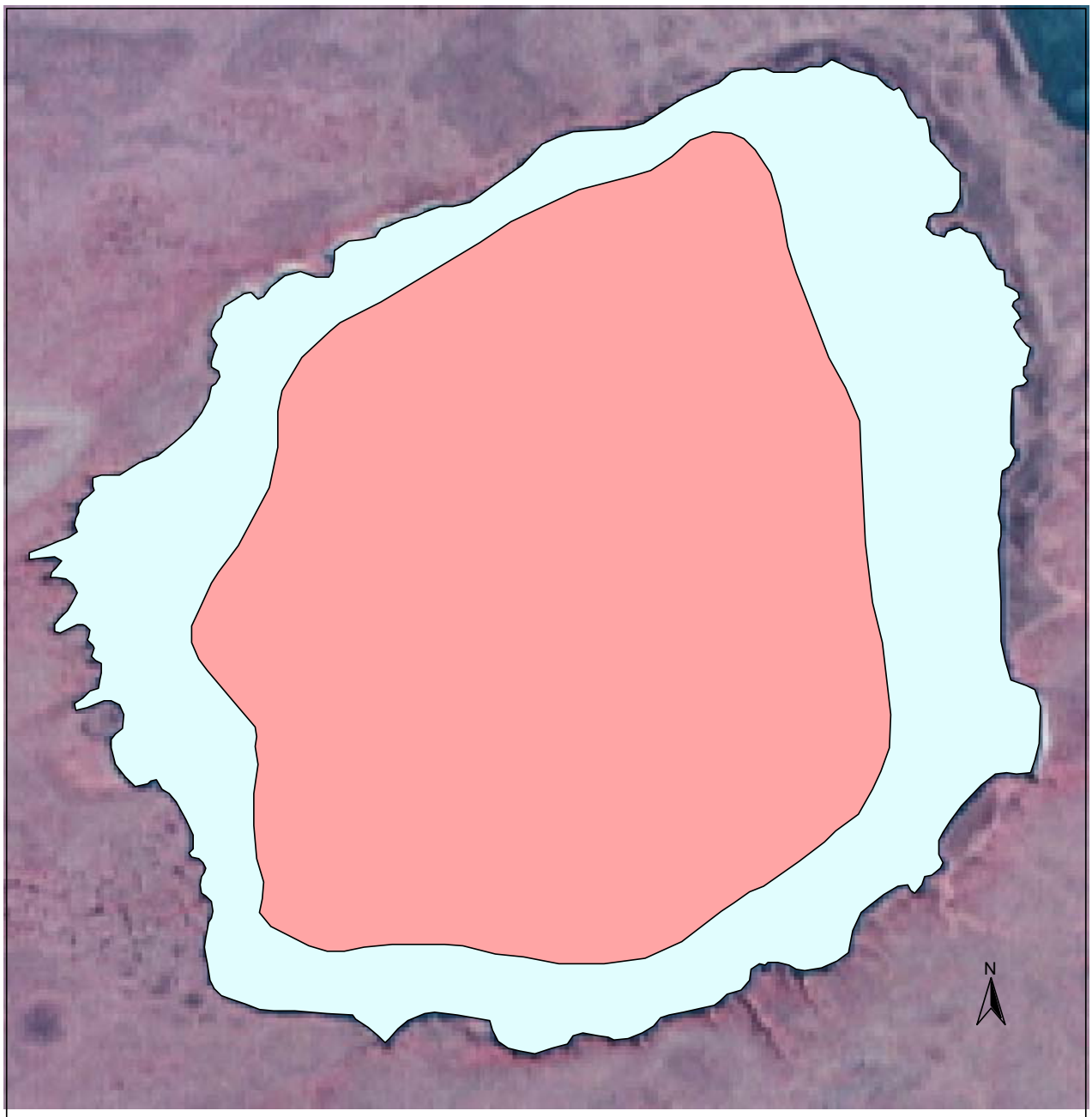
Other Names:
Location: 70.18332°N 152.93221°W
USGS Quad Sheet: Harrison Bay A-5: T10N R4W Sec. 28/32/33
Habitat: Tundra Lake
Area: 49.8 acres
Maximum Depth: 9.7 feet
Active Outlet: No
Calculated Volume: 88.92 million gallons
Permittable Volume 8.95 million gallons
Potential Aggregate 19.5 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	26.8	2.9	14.9	7.9	79	181	0.9	7.95	This Study

Catch Record:

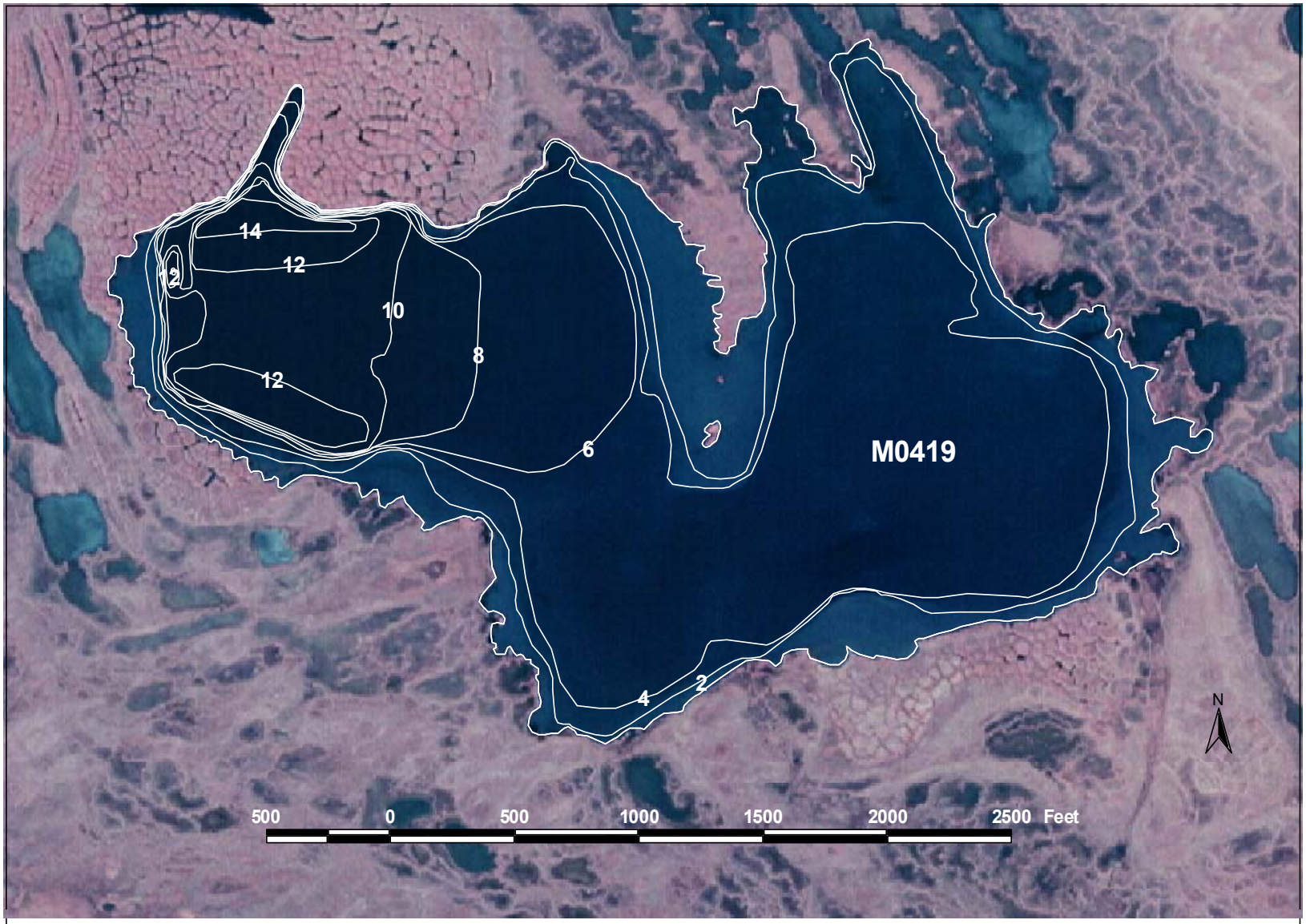
Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 16 04	9.2	None	0
Minnow Trap		0.0		
Seine	Jul 16 04	1 haul	Ninespine stickleback	5



Regions of lake M0418 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 16, 2004

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

Depth transects surveyed at lake M0418 on July 16, 2004.



Depth contours of lake M0419, based on transects surveyed on July 16, 2004
(depth intervals in 2 foot increments)

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

Lake M0419

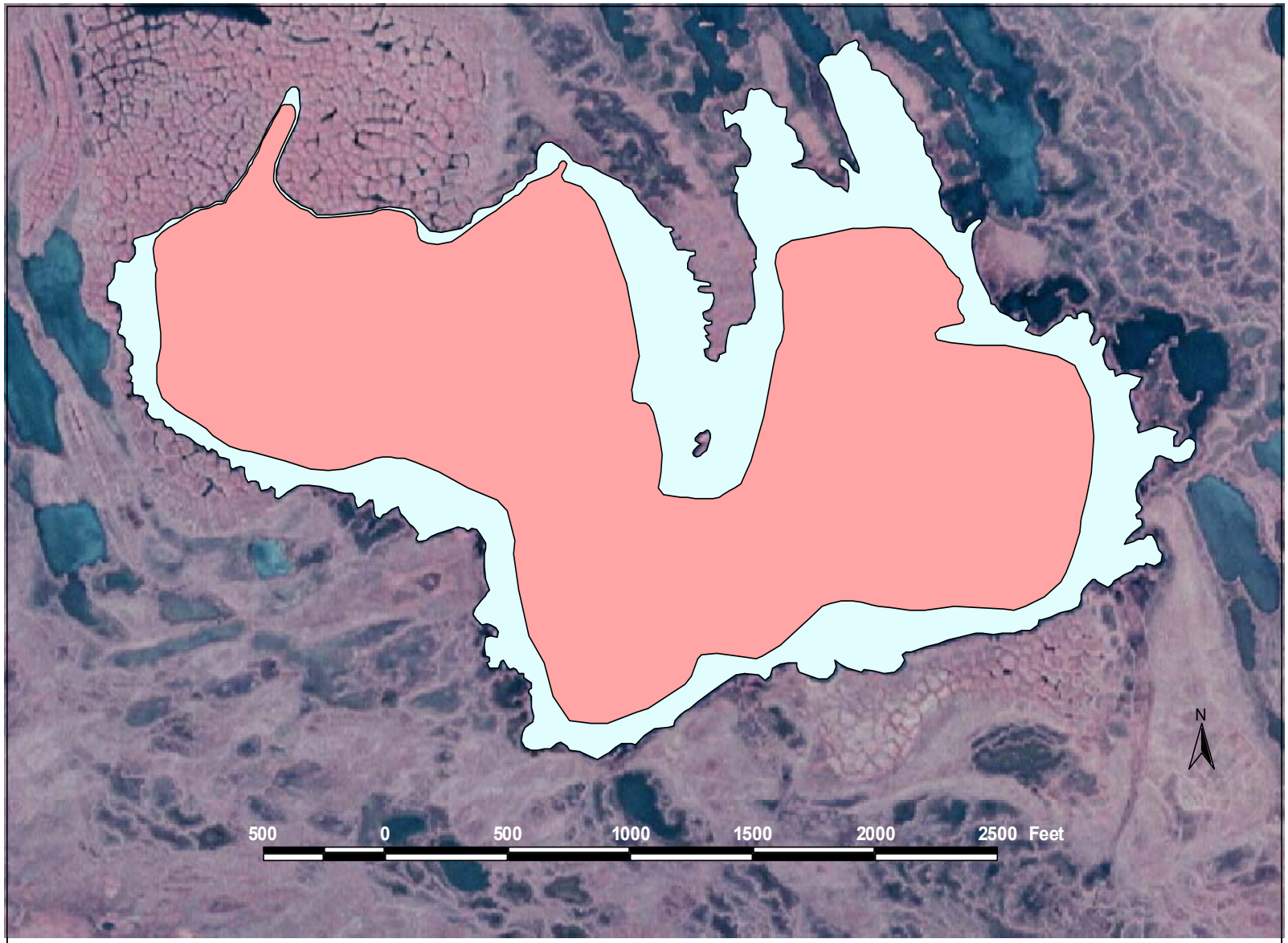
Other Names:
Location: 70.18778°N 152.89309°W
USGS Quad Sheet: Harrison Bay A-5: T10N R4W Sec. 27/28
Habitat: Tundra Lake
Area: 144.7 acres
Maximum Depth: 15.8 feet
Active Outlet: No
Calculated Volume: 246.48 million gallons
Permittable Volume 18.53 million gallons
Potential Aggregate 44.8 acres (water depth 4 ft or less)

Water Chemistry:

Year of Test	Calcium (mg/l	Magnesium (mg/l)	Chloride (mg/l)	Sodium (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2004	29.0	3.1	13.8	6.3	85	203	0.8	8.11	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught
Gill Net	Jul 16 04	9.0	None	0
Minnow Trap		0.0		
Observed	Jul 16 04		Ninespine stickleback	1



Regions of lake M0419 less than 4 ft deep (light shaded), and likely to be available for ice chips, based on transects surveyed on July 16, 2004

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

Depth transects surveyed at lake M0419 on July 16, 2004.