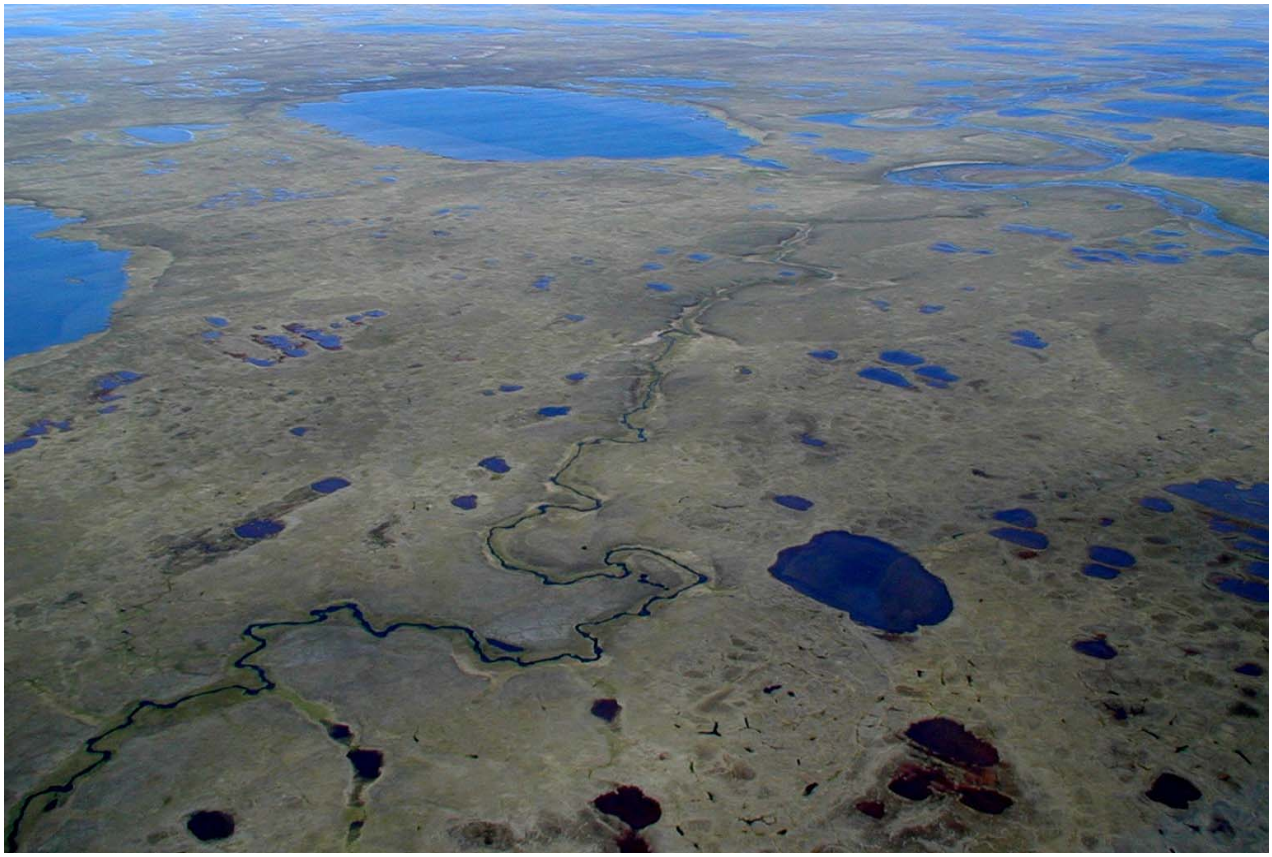
SURVEY OF LAKES IN ASSOCIATION WITH THE HORNET PROSPECT - 2005

Final Report

October 2005



Prepared by:

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Prepared for:

ConocoPhillips Alaska, Inc.
700 G Street
Anchorage, AK

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INTRODUCTION

ConocpPhillips Alasa, Inc. is planning to explore for oil and gas reserves in an area of northeastern NPRA named the Hornet Prospect. 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 lakes for lakes that may be used to support exploration activities in association with drilling operations or to support ice road construction between drill sites.

The objectives of the survey were to:

1) obtain lake bathymetry in lakes within the study area that appear suitable for water withdrawal,

2) inventory fish species in lakes within the project study area, and

3) measure water chemistry parameters to assess suitability of water for potential uses.

This survey in 2005 was conducted to add two additional lakes to the list of those previously surveyed in this region. Lakes in the region were surveyed from 2002 to 2004 in association with the Kokoda and other nearby exploration sites (Moulton 2003, 2004), however there was a need to add additional lakes to provide adequate access to the Hornet Prospect. Previous surveys in this region were conducted by Netsch et al. (1977) and Bendock and Burr (1984).

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 on August 18, 2005, supplemented with minnow trap sets 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 and minnow traps combined with physical measurements on August 18, 2005. Lakes were sampled with short-duration gill net sets (typically 4 to 6 hours). 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 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 pairs at the edge of surveyed lakes. The traps were set and retrieved in concert with the gill net sampling.

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 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 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 1995-2005
MB = Michael Baker Jr., Inc. water chemistry sampling in 2002-2004
N = Netsch et al. (1977) NPRA sampling in 1977
R = Reanier sampling in 2000-2005

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. Maximum recommended winter water withdrawal, exclusive of volumes related to ice aggregate,
14. Water chemistry measurements,
15. Catch record, including gear used, date sampled, species caught and size range,
16. Where appropriate data exist, the length frequency of dominant species is plotted,
17. Map of potential ice aggregate removal areas, and
18. Map showing measured depth transects.

RESULTS AND DISCUSSION

Biological Observations

Two lakes were sampled in 2005 in connection with potential exploration activities in the Hornet study region (Table 1, Figure 2). Both lakes contained fish species sensitive to habitat changes likely to be associated with winter water withdrawal. One lake (M0536) had a maximum depth exceeding 40 feet and contained lake trout. These results are consistent with previous sampling in nearby areas, where many lakes associated with the Inigok Creek drainage system support fish if the lakes are deep enough and are seasonally connected to the streams (Netsch et al. 1977, Bendock and Burr 1985).

Water Chemistry Measurements

Water chemistry parameters measured in the studied lakes are presented Table 3. Surface water temperature during the August 18 sampling in 2005 averaged 6.8^{o}C, ranging from 5.1^{o}C in the deeper lake (M0536) to 8.5^{o}C in the shallower lake (M0535). As expected for natural surface waters, dissolved oxygen was high, averaging around 11.8 mg/l. Specific conductance ranged from 132 to 202 microSiemens/cm, while pH was 8.1 in each lake.

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, both lakes were confirmed to contain sensitive fish species, thus 102.2 million gallons of water are likely to be available for under-ice withdrawal during winter from lakes surveyed during 2005 in association with the Hornet prospect. This estimate does not include volumes associated with ice aggregate removal.

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, 835 acres are likely to be available for ice chips from lakes surveyed during 2005 in association with the Hornet prospect.

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Netsch, N., E. Crateau, G. Love and N. Swanton. 1977. Freshwater fisheries reconnaissance of the coastal plain of National Petroleum Reserve-Alaska (NPR-A), July and August 1977. Preliminary report. USDI: US Fish and Wildlife Service. Anchorage, AK. 214p.

Table 1. Summary of lakes sampled in or near the Hornet prospect in 2005.

Lake Name	Latitude (NAD83)	Longitude (NAD83)	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Lake Volume (mill. gals)
M0535	N70.23076	W152.90247	10N	4W	9/10/15/16	498.3	11.8	870.89
M0536	N70.20618	W152.84907	10N	4W	14/15/22/23/26/27	1,096.8	42.8	2,371.09

Table 2. Catches of fish from lakes sampled in or near the Hornet prospect in 2005.

		Gill Nets		Minnow Traps	
Lake Name	Sample Date	Set Duration (hours)	Fish Species[1]	Set Duration (hours)	Fish Species[2]
M0535	Aug 18 05	4.5	LSCS	8.0	none
M0536	Aug 18 05	8.5	LKTR	14.5	NSSB

[1] LKTR = lake trout, LSCS = least cisco

[2] NSSB = ninespine stickleback

Table 3. Water chemistry parameters measured in conjunction with lake sampling in or near the Hornet prospect in 2005.

Lake	Date	Water Temp (^{o}C)	Dissolved Oxygen (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)
M0535	Aug 18 05	8.5	11.3	132	0.8	8.11	22.0	2.2	4.1	7.7	64
M0536	Aug 18 05	5.1	12.2	202	1.8	8.10	34.0	3.8	7.3	13.9	100

Table 4. Recommended maximum water volumes available for winter withdrawal from surveyed lakes in or near the Hornet prospect in 2005 (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 or no fish are likely to be present).

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]	Maximum Winter Withdrawal (mil. gals)
M0535	498.3	11.8	870.89	384.05	91.29	24.00	LSCS	none	24.00
M0536	1,096.8	42.8	2,371.09	1,482.24	397.85	158.17	LKTR	NSSB	158.17

[1] LKTR = lake trout, LSCS = least cisco

[2] NSSB = ninespine stickleback

Table 5. Estimated area available for removing ice aggregate, based on the area covered by water shallower than 4 feet, in or near the Hornet prospect in 2005.

Lake	Surface Area (acres)	Max. Depth (feet)	Acres covered by Water shallower 4 feet
M0535	498.3	11.8	236.5
M0536	1,096.8	42.8	598.6

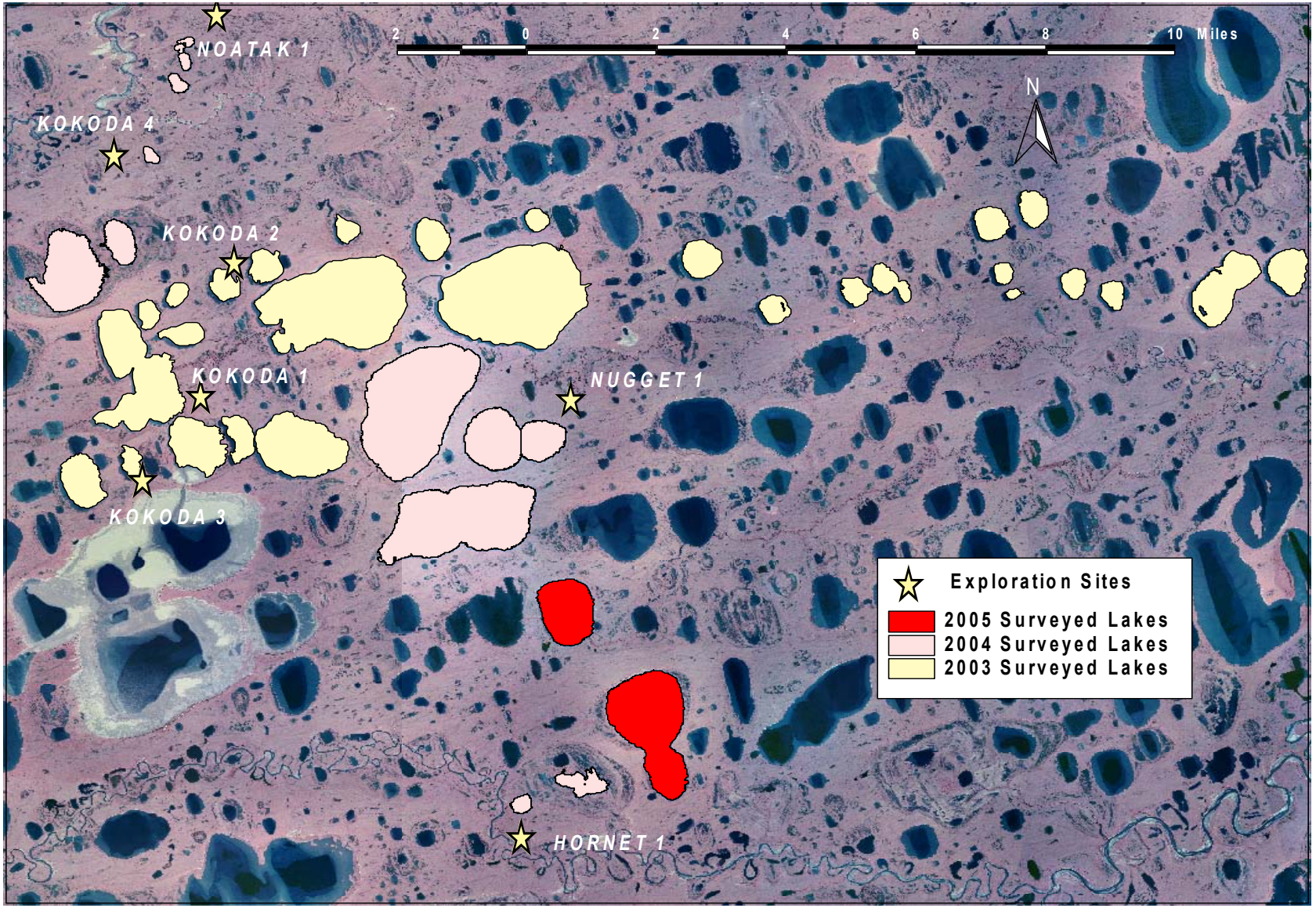


Figure 1. Study area of northeastern NPRA, showing location of lakes sampled in summer 2005 in relation to those sampled in 2003 and 2004.

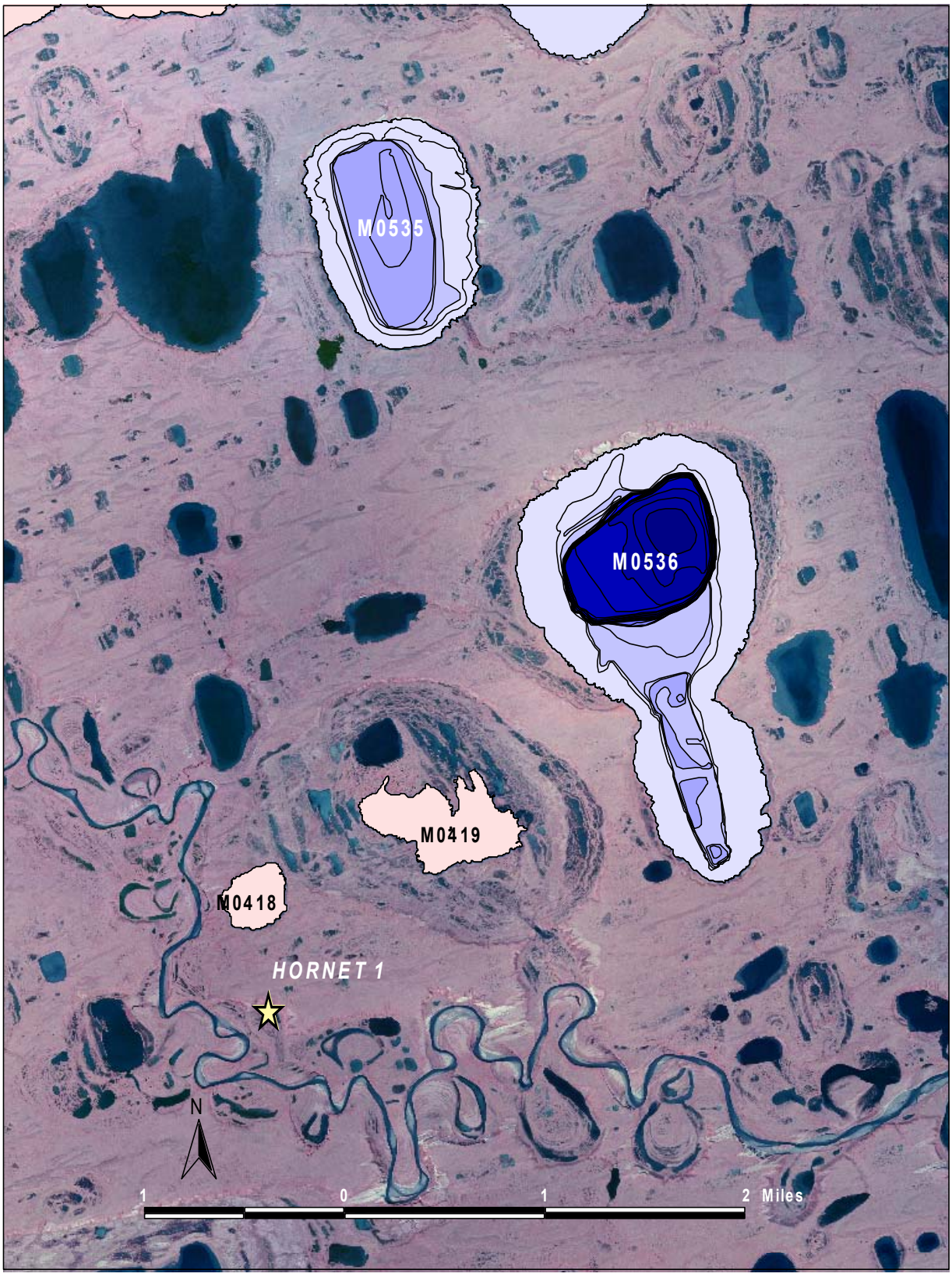


Figure 2. Lakes surveyed in the Hornet study area during summer 2005 for potential use during exploration.

Lake Summaries

Lake M0535

Other Names: Field identifier - CP0513
Location: 70.23076°N 152.90247°W
USGS Quad Sheet: Harrison Bay A-5: T10N R4W, Sec. 9/10/15/16
Area: 498 acres
Maximum Depth: 11.8 feet
Active Outlet: Yes
Total Lake Volume: 870.9 million gallons (Aug 18, 2005 data)
Water Volume Under 4 ft of ice: 384.1 million gallons
Water Volume Under 5 ft of ice: 304.3 million gallons
Water Volume Under 7 ft of ice: 160.0 million gallons
Potential Ice Aggregate: 236.5 acres (water depth 4 ft or less)

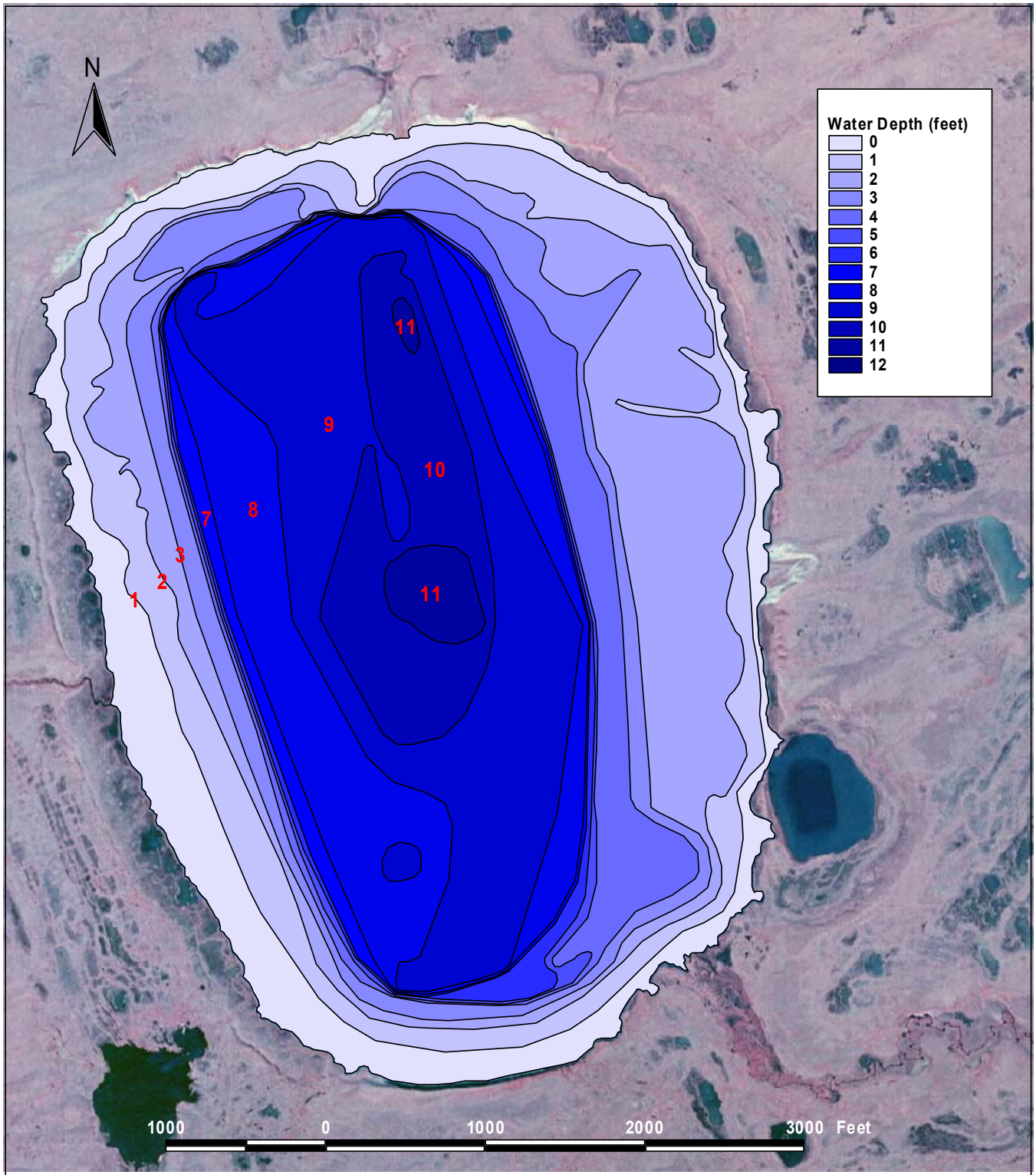
Maximum Recommended Winter Removal: **24.00 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

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
2005	22.0	2.2	7.7	4.1	64	132	0.8	8.11	This Study

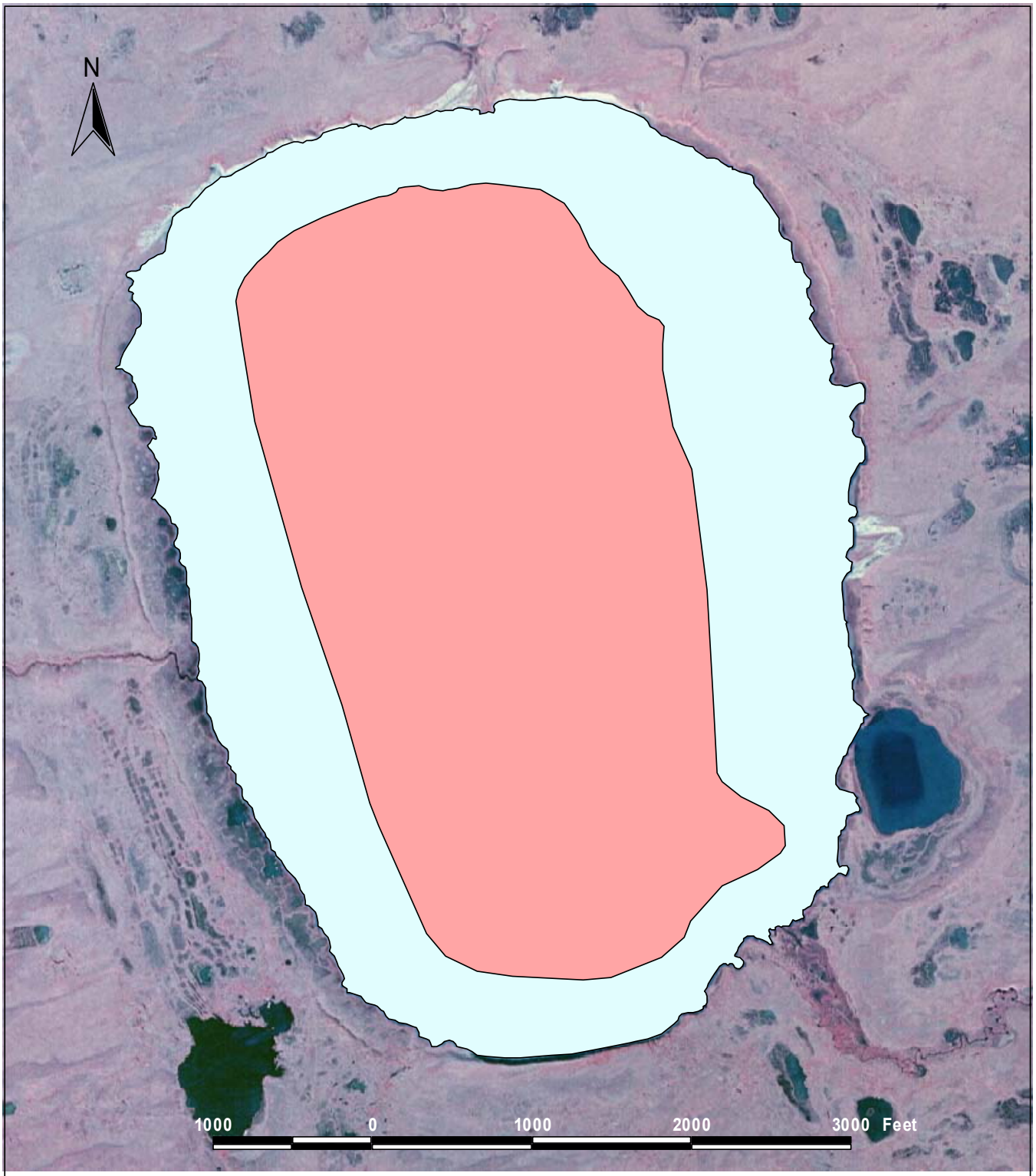
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 18 05	4.5	Least cisco	1	253
Minnow traps	Aug 18 05	8.0	None	0	



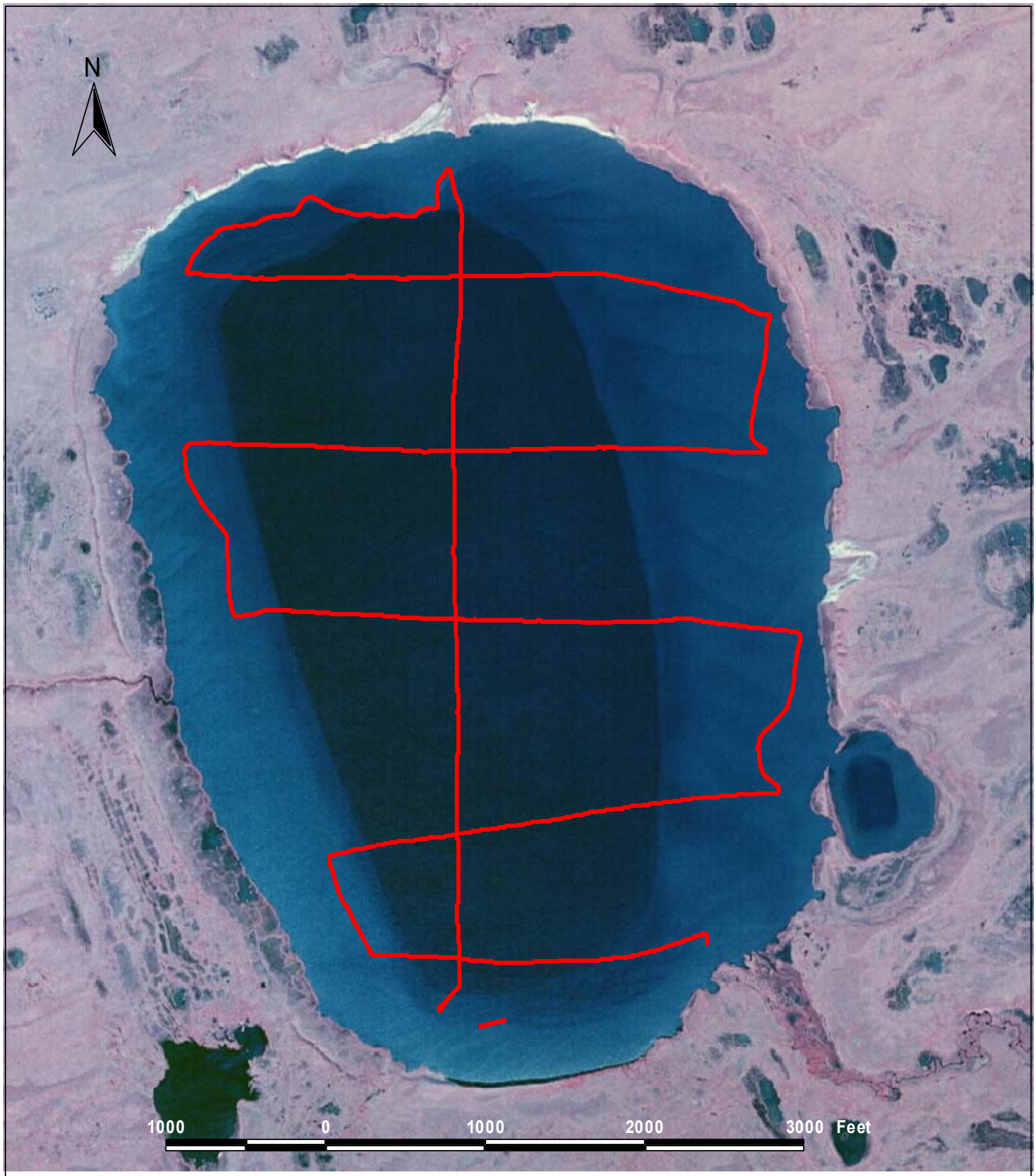
Depth contours of lake M0535 based on transects surveyed on August 18, 2005.
(depths in 1 foot intervals)

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



Regions of lake M0535 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 18, 2005.

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



Depth transects surveyed at lake M0535 on August 18, 2005.

Lake M0536

Other Names: Field identifier - CP0514
Location: 70.20618°N 152.84907°W
USGS Quad Sheet: Harrison Bay A-5: T10N R4W, Sec. 14/15/22/23/26/27
Area: 1,097 acres
Maximum Depth: 42.8 feet
Active Outlet: Yes
Total Lake Volume: 2,371.1 million gallons (Aug 18, 2005 data)
Water Volume Under 4 ft of ice: 1,482.2 million gallons
Water Volume Under 5 ft of ice: 1,326.2 million gallons
Water Volume Under 7 ft of ice: 1,054.5 million gallons
Potential Ice Aggregate: 598.6 acres (water depth 4 ft or less)

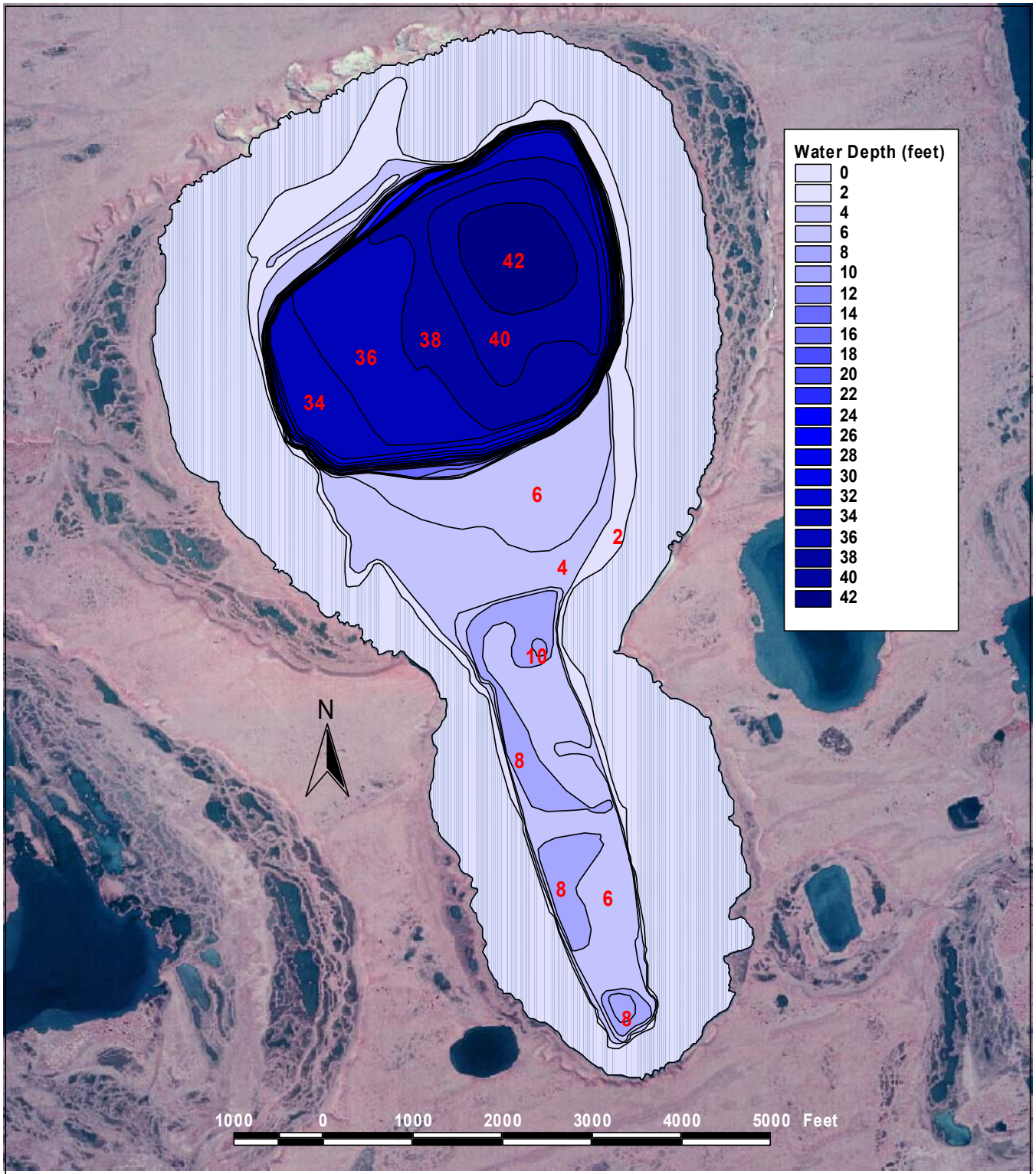
Maximum Recommended Winter Removal: **158.17 million gallons**
(15% of water volume under 7 ft of ice)
(does not include volumes related to ice chips)

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
2005	34.0	3.8	13.9	7.3	100	202	1.8	8.10	This Study

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 18 05	8.5	Lake trout	1	724
Minnow traps	Aug 18 05	14.5	Ninespine stickleback	1	



Depth contours of lake M0536 based on transects surveyed on August 18, 2005.
(depths in 2 foot intervals)

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

Regions of lake M0536 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 18, 2005.

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

Depth transects surveyed at lake M0536 on August 18, 2005.