# 2006 SURVEY OF LAKES IN SUPPORT OF ALPINE DEVELOPMENT

## Final Report

## October 2006
**(revised December 2006)**


**Prepared by:**

**MJM Research**
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**Prepared for:**

**ConocoPhillips Alaska, Inc.**
**700 G Street**
**Anchorage, AK**

**and**

**Anadarko Petroleum Corp.**
**1201 Lake Robbins Dr**
**The Woodlands, TX**

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# INTRODUCTION

ConocoPhillips Alaska, Inc. operates the Alpine Development within the Colville Delta, an operation that requires withdrawal of water from lakes 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 2006 survey was conducted to re-survey 26 lakes used as water sources by the Alpine Development. In addition, 4 lakes were sampled for the first time. Lakes in the 2006 study were initially surveyed from 1991 to 2000 using older survey methods. This study updates previous estimates using more accurate survey techniques developed in 2002. Objectives of the study were to re-survey selected lakes to obtain updated bathymetry and 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 up-dated lake bathymetry for selected lakes,

2) conduct initial surveys on lakes identified as being desirable water sources,

3) re-evaluate fish species in lakes within the project study area, and

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

The selected lakes are used, or 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

Most of the lakes in the 2006 survey had previously been sampled with gill nets or fyke nets targeting sensitive species. Where sensitive species had been previously documented, the lake was not re-sampled. For lakes where fish had not been documented, or where sampling was considered inadequate to detect resistant species, the biological survey consisted of sampling with gill nets and minnow traps combined with physical measurements. Lakes were sampled with short-duration gill net sets (typically 4 to 6 hours). 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. At lakes where bottom contours allowed, a 20 ft seine was pulled through vegetation beds along the lakeshore to detect small fishes.

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 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 1995-2005
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 2000-2005

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. Gallons of water represented by the surface area available for ice aggregate,
14. Maximum recommended winter water withdrawal, exclusive of volumes related to ice aggregate,
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

Four lakes were evaluated for fish for the first time in 2006 (Table 2). Two of the lakes (M0675 and M0677) were tapped lakes that had direct connections to river channels, so a variety of fish are likely to be abundant. Another (M0675) had a seasonal connection and contained least cisco. The fourth lake, M0678, although near a channel, had no obvious connection and appeared isolated from the river. Fish were not captured or observed, despite extensive sampling (Table 2). Two additional lakes, L9401 and M9707, had not yielded fish when previously sampled, but had active connections to river channels during the 2006 survey. Lake L9401 was sampled and found to have broad whitefish and least cisco. Lake M9707 was assumed to have fish because of the active river connection.

### Water Chemistry Measurements

Water chemistry parameters measured in the studied lakes are presented Table 3. Surface water temperature during the July 13-20 sampling in 2006 averaged 12.6$^{o}$C, ranging from 9.8$^{o}$C to 14.8$^{o}$C. During sampling from July 28-August 7, surface water averaged 14.6$^{o}$C, ranging from 9.4$^{o}$C to 17.7$^{o}$C. As expected for natural surface waters, dissolved oxygen was high, averaging around 10.1 mg/l. Specific conductance ranged from 81 to over 7,400 microSiemens/cm. Specific conductance was lowest in lakes in the upper end of the delta near Nuiqsut or remote from the river channel, and highest in tapped lakes or lakes closer to the coast. PH ranged from 7.03 to 8.62.

### 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, the 30 lakes surveyed in 2006 for the Alpine Development should provide 236 million gallons of water for under-ice withdrawal during winter. 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, 926 acres are likely to be available for ice chips from lakes surveyed for the Alpine Development during 2006, which is equivalent to 72.5 million gallons of water.

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Table 1. Summary of lakes sampled in 2006 for winter water use at the Alpine Development Area.

| Lake Name | Latitude (NAD83) | Longitude (NAD83) | Town | Range | Section | Surface Area (acres) | Maximum Depth (feet) | Lake Volume (mill. gals) |
|---|---|---|---|---|---|---|---|---|
| B8533 | N70.35186 | W151.02792 | 12N | 4E | 36 | 134.0 | 25.2 | 478.66 |
| L9108 | N70.41379 | W150.85655 | 12N | 5E | 10 | 120.0 | 18.5 | 336.42 |
| L9132 | N70.21208 | W150.53694 | 10N | 6E | 14/23 | 72.7 | 4.7 | 60.21 |
| L9281 | N70.37381 | W150.94658 | 12N | 5E | 20 | 49.6 | 17.0 | 169.71 |
| L9335 | N70.25537 | W150.80431 | 11N | 5E | 2 | 183.5 | 11.2 | 395.24 |
| L9401 | N70.39630 | W151.06438 | 12N | 4E | 14 | 110.0 | 16.3 | 191.07 |
| L9904 | N70.40243 | W150.93863 | 12N | 5E | 8 | 13.8 | 26.1 | 51.82 |
| L9905 | N70.40430 | W150.95362 | 12N | 5E | 7 | 8.1 | 12.4 | 16.36 |
| L9906 | N70.39978 | W150.91910 | 12N | 5E | 17 | 16.9 | 14.3 | 47.96 |
| L9907 | N70.40169 | W150.90036 | 12N | 5E | 9 | 10.7 | 10.1 | 18.10 |
| L9908 | N70.40278 | W150.91212 | 12N | 5E | 8 | 10.1 | 11.3 | 21.51 |
| M9321 | N70.37884 | W150.93592 | 12N | 5E | 20 | 21.6 | 15.1 | 59.24 |
| M9521 | N70.35938 | W150.88491 | 12N | 5E | 28 | 211.7 | 2.2 | -- |
| M9522 | N70.36618 | W150.91137 | 12N | 5E | 29 | 21.1 | 9.0 | 40.16 |
| M9523 | N70.36929 | W150.92471 | 12N | 5E | 29 | 30.4 | 6.9 | 20.75 |
| M9603 | N70.21041 | W150.78031 | 10N | 5E | 14/23 | 465.7 | 27.3 | 696.19 |
| M9619 | N70.24370 | W150.33120 | 10N | 7E | 3 | 91.0 | 6.6 | 88.12 |
| M9701 | N70.36288 | W151.02271 | 12N | 4E | 25 | 15.6 | 15.6 | 36.56 |
| M9702 | N70.36509 | W151.02775 | 12N | 4E | 25 | 15.7 | 18.1 | 43.78 |
| M9703 | N70.37459 | W151.03950 | 12N | 4E | 23 | 21.4 | 32.8 | 95.05 |
| M9704 | N70.38170 | W151.04195 | 12N | 4E | 23 | 13.1 | 12.4 | 30.33 |
| M9706 | N70.40664 | W151.05533 | 12N | 4E | 11 | 18.8 | 6.7 | 27.51 |
| M9707 | N70.41806 | W150.98547 | 12N | 5E | 6 | 18.5 | 3.0 | -- |
| M9708 | N70.41943 | W151.02471 | 12N | 4E | 1 | 45.9 | 12.0 | 67.17 |
| M9709 | N70.38465 | W150.90150 | 12N | 5E | 21 | 73.9 | 18.9 | 240.89 |
| M0675 | N70.40321 | W151.00847 | 12N | 4E | 12/13/14 | 187.3 | 17.1 | 339.28 |
| M0676 | N70.41131 | W151.02537 | 12N | 4E | 12 | 108.0 | 8.1 | 88.57 |
| M0677 | N70.41181 | W150.98523 | 12N | 4/5E | 12/6/7 | 43.8 | 5.9 | 21.03 |
| M0678 | N70.41363 | W150.88774 | 12N | 5E | 9 | 11.4 | 15.2 | 32.40 |
| MC7913 | N70.37555 | W150.83745 | 12N | 5E | 22 | 572.9 | 18.9 | 1,686.68 |

Table 2. Summary of fish sampling for lakes surveyed in 2006 for Alpine projects.

| | | Fyke Nets/Gill Nets | | Minnow Traps | | Seine or Other | |
|---|---|---|---|---|---|---|---|
| Lake Name | Sample Date | Set Duration (hours) | Fish Species[1] | Set Duration (hours) | Fish Species[2] | Effort | Fish Species[2] |
| B8533[3] | 1985-1996 | 59.3 | BDWF,LSCS,RDWF | 48.3 | NSSB | -- | |
| L9108 | 1992-1997 | 24.7 | LSCS | 12.7 | none | -- | |
| L9132 | Jul 18 06 | 8.8 | none | -- | -- | 3 seine hauls | none |
| L9281 | 1995 | 88.8 | LSCS,NSSB,BKFH | 42.4 | NSSB,BKFH | -- | |
| L9335 | Jul 21 95 | 23.2 | LSCS,NSSB | 46.1 | NSSB | -- | |
| L9401 | Aug 07 06 | 3.0 | BDWF,LSCS | 6.5 | none | -- | |
| L9904 | Aug 02 99 | 2.5 | BDWF,LSCS | -- | -- | -- | |
| L9905 | Aug 02 99 | 2.3 | none | -- | -- | Observed | NSSB |
| L9906 | Aug 02 99 | 2.2 | BDWF,LSCS | -- | -- | -- | |
| L9907 | Aug 02 99 | 9.7 | none | -- | -- | Observed | NSSB |
| L9908 | Aug 02 99 | 9.7 | none | -- | -- | Observed | NSSB |
| M9321 | 1995 | 44.5 | LSCS,NSSB | 44.3 | none | -- | |
| M9521 | 1995 | 641.3 | BDWF,HBWF,LSCS+ | 41.8 | none | -- | |
| M9522 | Aug 03 96 | 11.2 | none | -- | -- | -- | |
| M9523 | 1995 | 541.2 | BDWF,HBWF,LSCS+ | -- | -- | -- | |
| M9603 | July 96 | 19.0 | LSCS,GRAY | -- | -- | -- | |
| M9619 | Jul 30 96 | 11.2 | none | 6.0 | none | 3 seine hauls | none |
| M9701 | Jul 16 97 | 19.7 | BDWF,HBWF,LSCS | 12.0 | none | -- | |
| M9702 | connected to M9701, same catch applies | | | | | | |
| M9703 | Jul 18 97 | 6.6 | LSCS | 12.7 | none | -- | |
| M9704 | Jul 19 97 | 10.8 | LSCS | 16.3 | NSSB | -- | |
| M9706 | Jul 22 97 | 10.0 | none | 10.0 | none | -- | |
| M9707 | lake is tapped and connected to river channel, fish assumed present | | | | | | |
| M9708 | Jul 23 97 | 11.0 | none | 9.5 | none | Observed | NSSB |
| M9709 | Aug 02 97 | 6.5 | LSCS | 12.3 | none | -- | |
| M0675 | connected to river channel through M0677, not fished | | | | | | |
| M0676 | Aug 07 06 | 3.7 | LSCS | 2.1 | none | -- | |
| M0677 | connected to river channel, not fished | | | | | | |
| M0678 | Aug 06 06 | 11.4 | none | 17.0 | none | -- | |
| MC7913 | 1979-1991 | 64.8 | LSCS | -- | -- | -- | |

[1] BDWF = broad whitefish, HBWF = humpback whitefish, LSCS = least cisco, RDWF = round whitefish
+= additional species caught

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

[3] also sampled in 1985 by Bendock and Burr

Table 3. Water chemistry parameters measured in conjunction with 2006 lake sampling in the Alpine Development 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 (mg/l | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B8533 | Jul 29 06 | 16.1 | 10.0 | 136 | 5.78 | 7.68 | 5.95 | 3.12 | 15.0 | 25.7 | 27.7 |
| L9108 | Jul 17 06 | 11.3 | 10.2 | 776 | 1.72 | 7.52 | 16.9 | 16.1 | 111 | 221 | 108 |
| L9132 | Jul 18 06 | 13.7 | 10.0 | 387 | 1.77 | 8.10 | 53.0 | 8.42 | 11.9 | 68.1 | 167 |
| L9281 | Jul 20 06 | -- | -- | -- | -- | -- | 8.81 | 6.80 | 37.6 | 70.3 | 50 |
| L9335 | Jul 19 06 | 13.0 | 9.9 | 81.2 | 1.05 | 7.54 | 9.75 | 2.45 | 2.49 | 4.44 | 34.5 |
| L9401 | Aug 07 06 | 11.6 | 10.3 | 447 | 2.83 | 8.12 | 10.7 | 8.40 | 59.9 | 118 | 61.3 |
| L9904 | Jul 14 06 | 10.0 | 10.6 | 402 | 1.40 | 8.01 | 13.8 | 10.3 | 49.4 | 96.9 | 76.9 |
| L9905 | Jul 14 06 | 13.1 | 10.1 | 4,117 | 3.53 | 8.28 | -- | -- | -- | -- | -- |
| L9906 | Jul 16 06 | 11.6 | 10.6 | 339 | 1.78 | 7.03 | 12.1 | 8.44 | 43.6 | 76.1 | 65 |
| L9907 | Jul 28 06 | 16.6 | 9.1 | 177 | 0.69 | 8.21 | 11.5 | 6.87 | 11.2 | 24.8 | 57 |
| L9908 | Jul 29 06 | 16.9 | 9.7 | 185 | 0.95 | 7.63 | 11.1 | 6.15 | 13.5 | 38.3 | 53 |
| M9321 | Jul 13 06 | 10.1 | 11.0 | 171 | 1.21 | 7.78 | 9.3 | 6.20 | 13.8 | 30.7 | 48.7 |
| M9521 | Aug 05 06 | 9.4 | 11.0 | 1,246 | 4.74 | 8.03 | 28.5 | 25.7 | 174 | 307 | 177 |
| M9522 | Jul 13 06 | 9.8 | 11.3 | 2,215 | 2.90 | 7.72 | 29.2 | 43.2 | 381 | 663 | 251 |
| M9523 | Jul 16 06 | 13.9 | 10.2 | 1,797 | 8.91 | 7.93 | 31.2 | 29.5 | 227 | 377 | 199 |
| M9603 | Jul 18 06 | 14.8 | 9.9 | 98.2 | 4.54 | 7.95 | 14.8 | 2.24 | 1.62 | 2.65 | 46.2 |
| M9619 | Jul 29 06 | -- | -- | -- | 1.04 | 8.41 | 49.3 | 7.24 | 11.0 | 54.0 | 153 |
| M9701 | Jul 17 06 | 11.8 | 10.2 | 116 | 2.81 | 7.60 | 5.01 | 2.81 | 12.8 | 22.6 | 24.1 |
| M9702 | Jul 17 06 | 12.1 | 9.6 | 121 | 3.45 | 7.54 | 5.12 | 2.84 | 13.7 | 24.2 | 24.5 |
| M9703 | Jul 16 06 | 11.9 | 10.2 | 147 | 2.15 | 7.36 | 7.42 | 4.34 | 15.4 | 28.2 | 36.4 |
| M9704 | Jul 16 06 | 12.1 | 10.3 | 120 | 0.96 | 7.30 | 4.57 | 3.08 | 14.0 | 26.4 | 24.1 |
| M9706 | Aug 06 06 | 10.9 | 10.7 | 463 | 1.43 | 7.90 | 25.4 | 10.7 | 43.8 | 118 | 107 |
| M9707 | Jul 30 06 | 17.7 | 9.5 | 7,065 | 2.70 | 8.43 | 71.4 | 149 | 1340 | 2260 | 792 |
| M9708 | Jul 30 06 | 17.6 | 9.5 | 624 | 1.64 | 8.06 | 9.76 | 12.9 | 97.5 | 179 | 77.5 |
| M9709 | Jul 16 06 | 11.7 | 10.6 | 159 | 1.98 | 7.89 | 13.1 | 6.18 | 8.33 | 17.6 | 58.2 |
| M0675 | Jul 30 06 | 16.6 | 9.3 | 7,468 | 4.52 | 8.04 | 72.3 | 158 | 1400 | 2370 | 831 |
| M0676 | Aug 07 06 | 11.4 | 11.1 | 3,423 | 2.17 | 8.62 | 32.9 | 66.5 | 580 | 1110 | 356 |
| M0677 | Jul 30 06 | 15.8 | 9.5 | 2,936 | 7.39 | 8.22 | 36.5 | 56.7 | 523 | 874 | 325 |
| M0678 | Aug 06 06 | 11.8 | 10.5 | 267 | 0.82 | 8.07 | 14.3 | 9.16 | 22.3 | 52.9 | 73.4 |
| MC7913 | Jul 30 06 | 17.4 | 9.0 | 415 | 1.26 | 8.12 | 18.5 | 10.9 | 49.0 | 16.4 | 91.1 |

Table 4. Recommended maximum water volumes available for winter water withdrawal from lak surveyed in 2006 for Alpine project needs (does not include volume related to ice aggregate (revised Dec 1, 2006 to correct values for B8533, L9108 and M9708, indicated in bold)

(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] | Recommended Winter Withdrawal (mil. gals) |
|---|---|---|---|---|---|---|---|---|---|
| B8533 | 134.0 | 25.2 | 478.66 | 318.08 | 84.76 | 32.22 | BDWF,LSCS+ | NSSB | **32.22** |
| L9108 | 120.0 | 18.5 | 336.42 | 187.59 | 46.16 | 14.18 | LSCS | -- | **14.18** |
| L9132 | 72.7 | 4.7 | 60.21 | 0.04 | 0.00 | 0.00 | none | none | ice chips only |
| L9281 | 49.6 | 17.0 | 169.71 | 111.12 | 29.21 | 10.60 | LSCS | NSSB,BKFH | 10.60 |
| L9335 | 183.5 | 11.2 | 395.24 | 163.73 | 33.11 | 3.43 | LSCS | NSSB | 3.43 |
| L9401 | 110.0 | 16.3 | 191.07 | 80.31 | 17.18 | 3.04 | BDWF,LSCS | -- | 3.04 |
| L9904 | 13.8 | 26.1 | 51.82 | 34.39 | 9.05 | 3.29 | BDWF,LSCS | -- | 3.29 |
| L9905 | 8.1 | 12.4 | 16.36 | 8.17 | 1.95 | 0.51 | none | NSSB | 1.95 |
| L9906 | 16.9 | 14.3 | 47.96 | 27.03 | 6.63 | 1.92 | BDWF,LSCS | -- | 1.92 |
| L9907 | 10.7 | 10.1 | 18.10 | 7.08 | 1.51 | 0.25 | none | NSSB | 1.51 |
| L9908 | 10.1 | 11.3 | 21.51 | 9.90 | 2.27 | 0.53 | none | NSSB | 2.27 |
| M9321 | 21.6 | 15.1 | 59.24 | 32.47 | 7.87 | 2.18 | LSCS | NSSB | 2.18 |
| M9521 | 211.7 | 2.2 | -- | 0.00 | 0.00 | 0.00 | BDWF,LSCS+ | -- | ice chips only |
| M9522 | 21.1 | 9.0 | 40.16 | 15.17 | 2.91 | 0.21 | none | -- | 15.17 |
| M9523 | 30.4 | 6.9 | 20.75 | 0.81 | 0.06 | 0.00 | BDWF,LSCS+ | -- | ice chips only |
| M9603 | 465.7 | 27.3 | 696.19 | 200.27 | 37.62 | 8.72 | LSCS,GRAY | -- | 8.72 |
| M9619 | 91.0 | 6.6 | 88.12 | 5.70 | 0.15 | 0.00 | none | none | 5.70 |
| M9701 | 15.6 | 15.6 | 36.56 | 18.66 | 4.43 | 1.15 | BDWF,LSCS+ | -- | 1.15 |
| M9702 | 15.7 | 18.1 | 43.78 | 26.01 | 6.63 | 2.25 | BDWF,LSCS+ | -- | 2.25 |
| M9703 | 21.4 | 32.8 | 95.05 | 68.43 | 18.72 | 7.68 | LSCS | none | 7.68 |
| M9704 | 13.1 | 12.4 | 30.33 | 14.50 | 3.29 | 0.72 | LSCS | NSSB | 0.72 |
| M9706 | 18.8 | 6.7 | 27.51 | 5.54 | 0.54 | 0.00 | none | none | 5.54 |
| M9707 | 18.5 | 3.0 | -- | 0.00 | 0.00 | 0.00 | BDWF,LSCS+ | -- | ice chips only |
| M9708 | 45.9 | 12.0 | 67.17 | 15.36 | 1.85 | 0.03 | none | NSSB | **1.85** |
| M9709 | 73.9 | 18.9 | 240.89 | 149.35 | 38.47 | 13.27 | LSCS | -- | 13.27 |
| M0675 | 187.3 | 17.1 | 339.28 | 129.73 | 26.70 | 4.51 | BDWF,LSCS+ | -- | 4.51 |
| M0676 | 108.0 | 8.1 | 88.57 | 11.93 | 1.09 | 0.01 | LSCS | -- | 0.011 |
| M0677 | 43.8 | 5.9 | 21.03 | 0.25 | 0.00 | 0.00 | BDWF,LSCS+ | -- | ice chips only |
| M0678 | 11.4 | 15.2 | 32.40 | 18.85 | 4.81 | 1.61 | none | none | 18.85 |
| MC7913 | 572.9 | 18.9 | 1,686.68 | 970.60 | 240.27 | 73.91 | LSCS | -- | 73.91 |

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

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

-- = not sampled

Table 5. Estimated area available for removing ice aggregate, based on the area covered by water shallower than 4 feet, surveyed in 2006 for Alpine projects.

| Lake | Surface Area (acres) | Max. Depth (feet) | Acres covered by Water shallower than 4 feet | Gallons of Water As Chips (millions gallons) |
|---|---|---|---|---|
| B8533 | 134.0 | 25.2 | 23.4 | 1.83 |
| L9108 | 120.0 | 18.5 | 12.8 | 1.00 |
| L9132 | 72.7 | 4.7 | 72.4 | 5.67 |
| L9281 | 49.6 | 17.0 | 7.0 | 0.55 |
| L9335 | 183.5 | 11.2 | 14.6 | 1.14 |
| L9401 | 110.0 | 16.3 | 36.4 | 2.85 |
| L9904 | 13.8 | 26.1 | 0.8 | 0.06 |
| L9905 | 8.1 | 12.4 | 2.8 | 0.22 |
| L9906 | 16.9 | 14.3 | 1.5 | 0.12 |
| L9907 | 10.7 | 10.1 | 4.2 | 0.33 |
| L9908 | 10.1 | 11.3 | 2.7 | 0.21 |
| M9321 | 21.6 | 15.1 | 2.0 | 0.16 |
| M9521 | 211.7 | 2.2 | 211.7 | 16.57 |
| M9522 | 21.1 | 9.0 | 3.8 | 0.29 |
| M9523 | 30.4 | 6.9 | 27.1 | 2.12 |
| M9603 | 465.7 | 27.3 | 185.7 | 14.53 |
| M9619 | 91.0 | 6.6 | 59.3 | 4.64 |
| M9701 | 15.6 | 15.6 | 3.3 | 0.26 |
| M9702 | 15.7 | 18.1 | 3.3 | 0.26 |
| M9703 | 21.4 | 32.8 | 2.4 | 0.19 |
| M9704 | 13.1 | 12.4 | 1.9 | 0.15 |
| M9706 | 18.8 | 6.7 | 5.1 | 0.40 |
| M9707 | 18.5 | 3.0 | 18.5 | 1.44 |
| M9708 | 45.9 | 12.0 | 11.0 | 0.86 |
| M9709 | 73.9 | 18.9 | 7.7 | 0.60 |
| M0675 | 187.3 | 17.1 | 51.8 | 4.06 |
| M0676 | 108.0 | 8.1 | 72.0 | 5.63 |
| M0677 | 43.8 | 5.9 | 41.8 | 3.27 |
| M0678 | 11.4 | 15.2 | 2.6 | 0.20 |
| MC7913 | 572.9 | 18.9 | 36.4 | 2.85 |

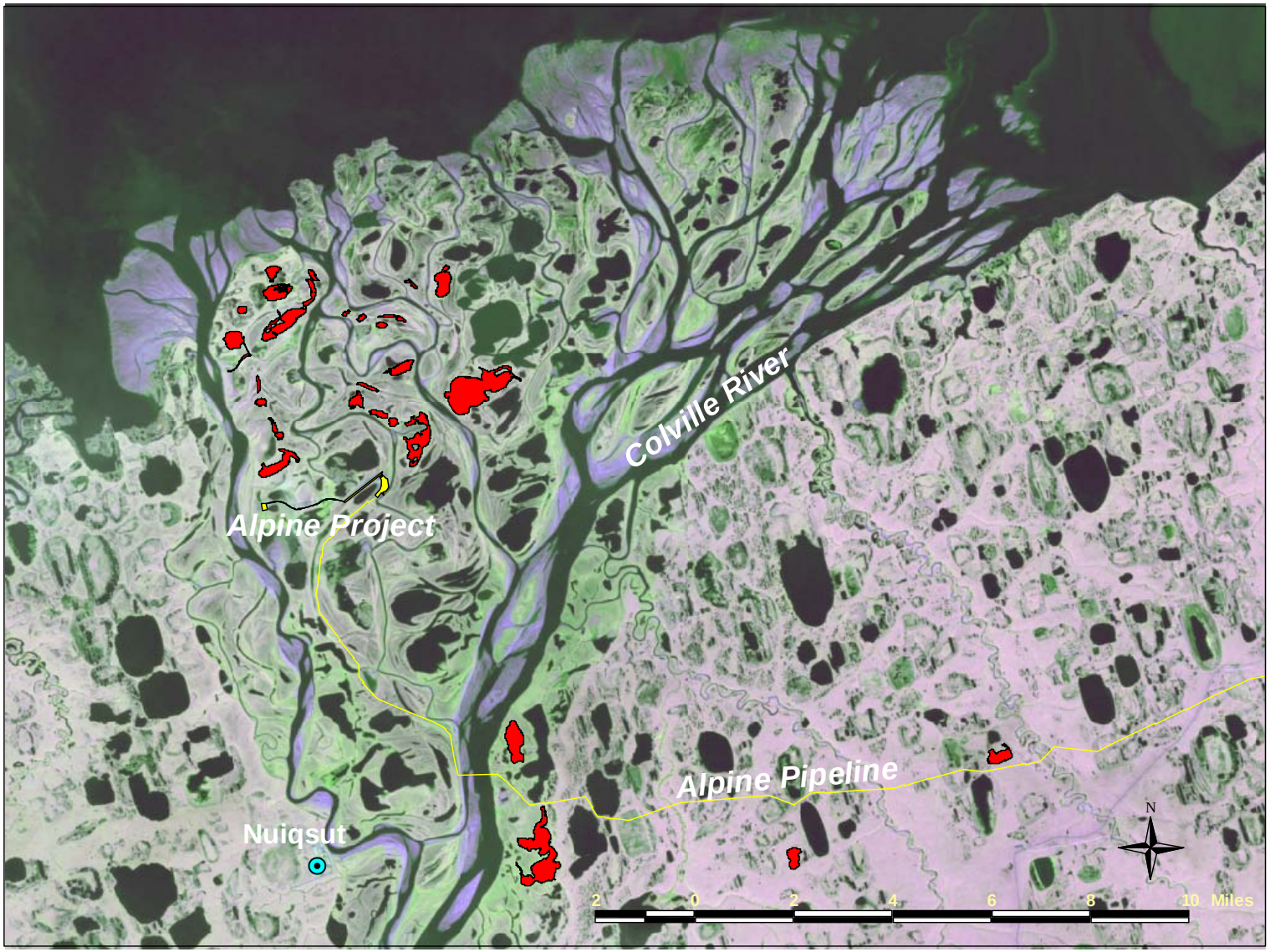



Figure 1. Lakes surveyed for the Alpine Development, 2006 (surveyed lakes in red).


Figure 2. Lakes surveyed in the northern portion of the Colville Delta for the Alpine Development, 2006.

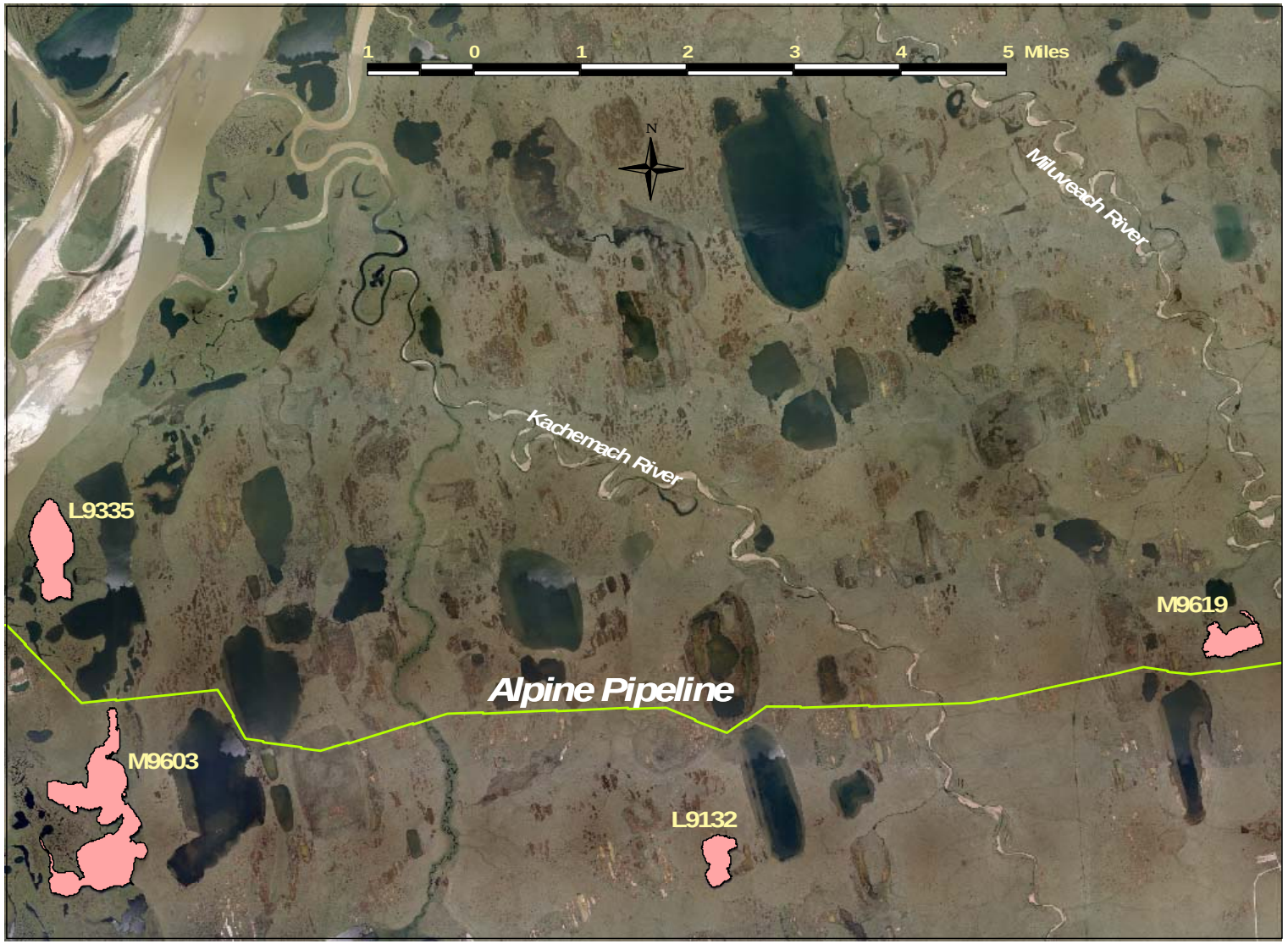
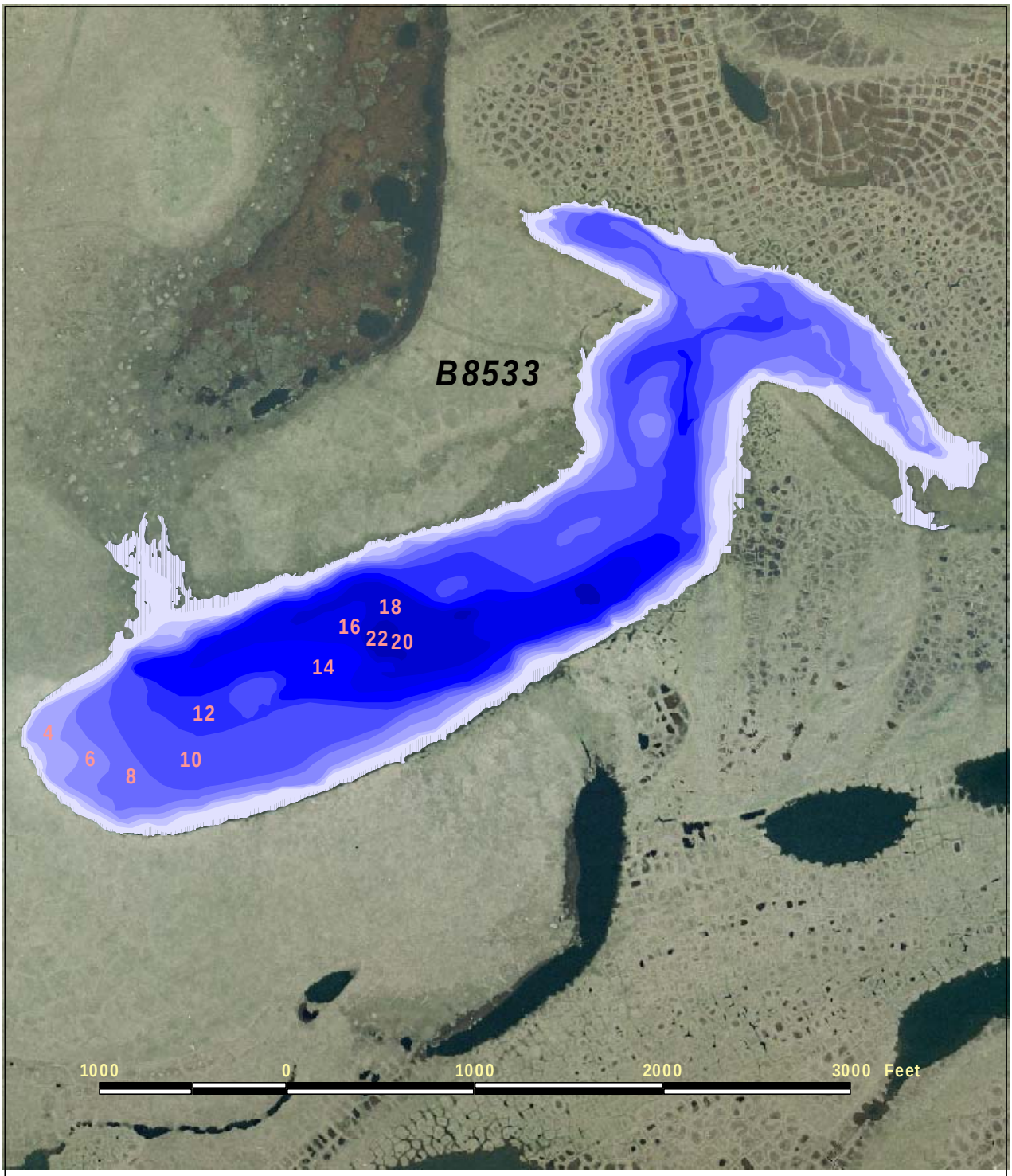



Figure 3. Lakes surveyed east of the Colville River for the Alpine Development, 2006.

# Lake Summaries




Depth contours of lake B8533 based on transects surveyed on July 29, 2006.
(depths in 2 foot intervals)

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

## Lake B8533

**Other Names:** S4.1; L9315
**Location:** 70.35186°N 151.02792°W
**USGS Quad Shee** Harrison Bay B-2: T12N R4E, Sec. 36
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 134 acres
**Maximum Depth:** 25.2 feet
**Active Outlet:** No
**Total Lake Volume:** 478.7 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 318.1 million gallons
**Water Volume Under 5 ft of ice:** 282.5 million gallons
**Water Volume Under 7 ft of ice:** 214.8 million gallons

**Potential Ice Aggregate:** 23.4 acres (water depth 4 ft or less)
1.83 million gallons

**Maximum Recommended Winter Removal:** **32.22 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| 2004-2005 | 5.22 |
| 2005-2006 | 29.94 |

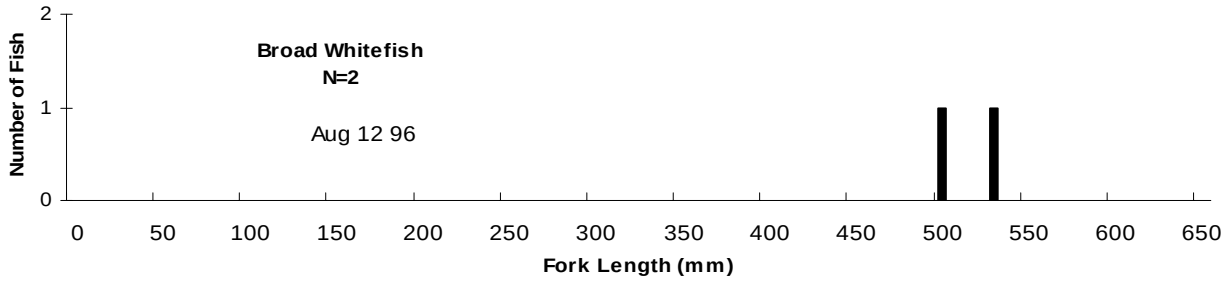
**Water Chemistry:**

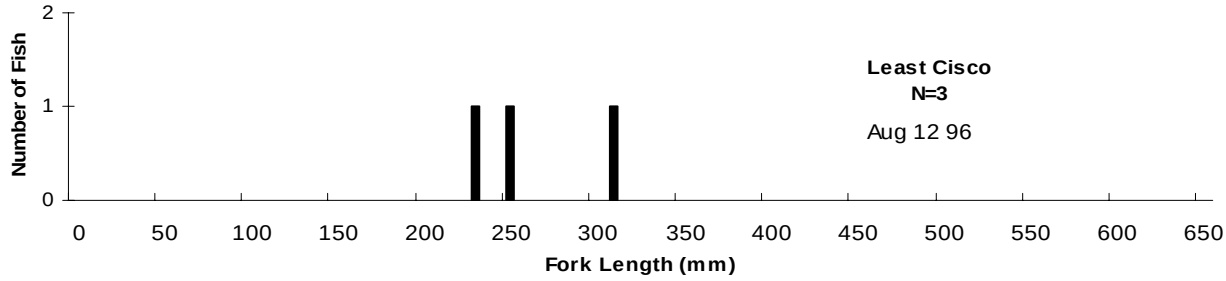
| Year of Test | Calcium (mg/l) | Magnesium (mg/l) | Sodium (mg/l) | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) | Specific Conductance (microS/cm) | Turbidity (NTU) | pH | Source |
|---|---|---|---|---|---|---|---|---|---|
| 1985 | -- | -- | -- | -- | 51 | 230 | -- | 7.50 | Bendock & Burr 1986 |
| 1993 | 2.40 | 4.70 | 11.0 | 19.0 | 22 | -- | -- | -- | J. Lobdell |
| 1995 | -- | -- | -- | -- | -- | 166 | -- | -- | Moulton 98 |
| 2006 | 5.95 | 3.12 | 15.0 | 25.7 | 28 | 136 | 5.8 | 7.68 | this study |

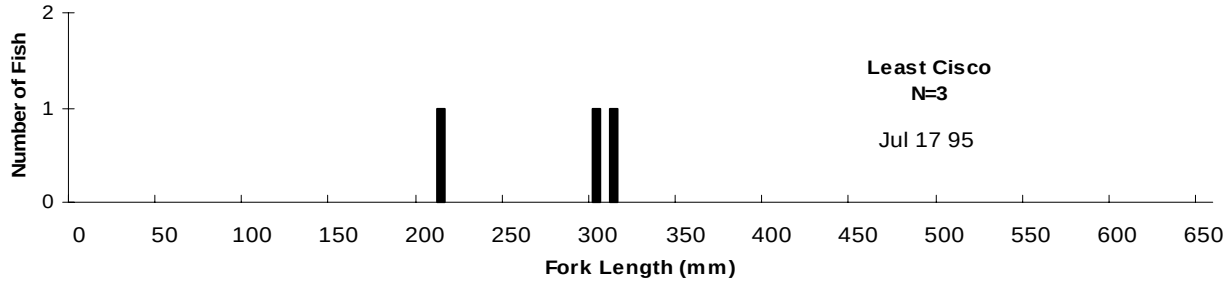
**Catch Record:**

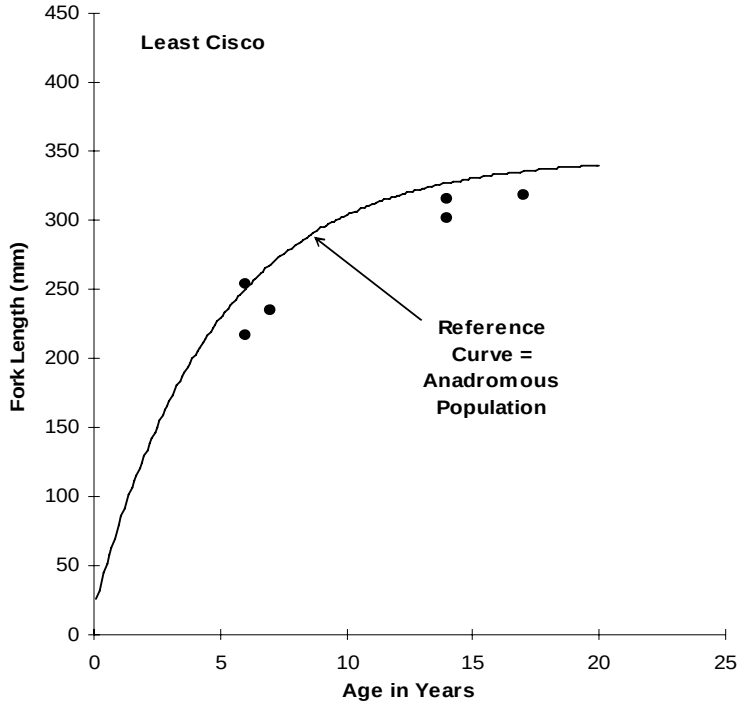
| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gill Net | Jul 16-19, 1985 | ~24 | Broad whitefish | ? | |
| | | | Least cisco | ? | |
| Fyke Net | Jul 17 95 | 23.7 | Least cisco | 3 | 217-318 |
| | | | Ninespine stickleback | 1,680 | |
| Minnow Trap | Jul 17 95 | 48.3 | Ninespine stickleback | 1 | |
| Set Line | Jul 17 95 | 23.8 | None | 0 | |
| Gill Net | Aug 12 96 | 11.7 | Broad whitefish | 2 | 507-534 |
| | | | Least cisco | 3 | 235-316 |
| | | | Round whitefish | 4 | 304-421 |

Source of 1985 data: Bendock and Burr 1986


Broad Whitefish
N=2
Aug 12 96
Number of Fish
Fork Length (mm)


Least Cisco
N=3
Aug 12 96
Number of Fish
Fork Length (mm)

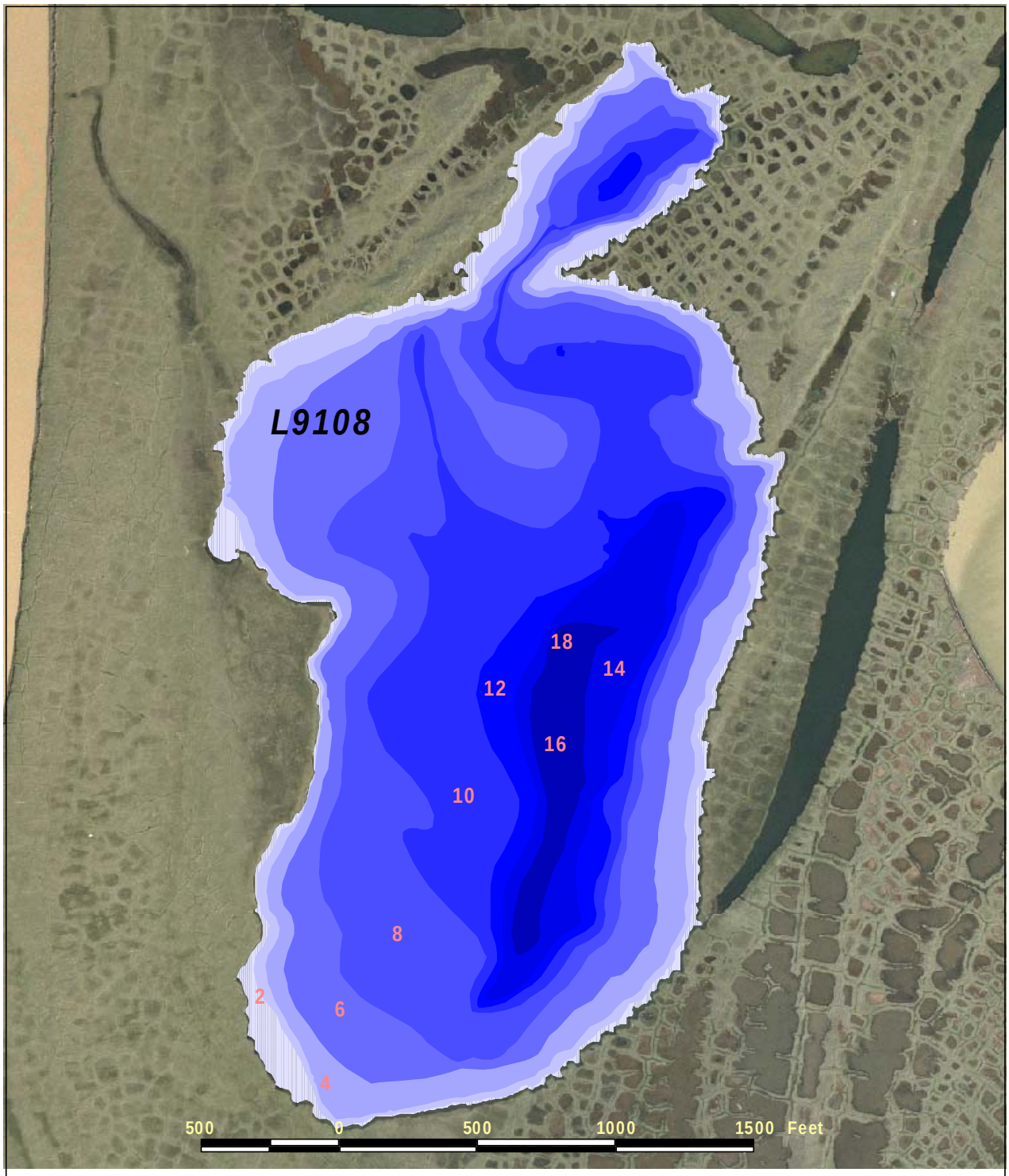

Least Cisco
N=3
Jul 17 95
Number of Fish
Fork Length (mm)


Least Cisco
Reference Curve = Anadromous Population
Fork Length (mm)
Age in Years


Regions of lake B8533 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 29, 2006.

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


Depth transects measured on lake B8533 on July 29, 2006.




Depth contours of lake L9108 based on transects surveyed on July 17, 2006
(depths in 2 foot intervals)

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

## Lake L9108

**Other Names:** P7.1; M9212
**Location:** 70.41379°N 150.85655°W
**USGS Quad Sheet** Harrison Bay B-2: T12N R5E, Sec. 10
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 120 acres
**Maximum Depth:** 18.5 feet
**Active Outlet:** No

| | | | |
|---|---|---|---|
| **Total Lake Volume:** | 336.4 | million gallons | (2006 data) |
| **Water Volume Under 4 ft of ice:** | 187.6 | million gallons | |
| **Water Volume Under 5 ft of ice:** | 153.9 | million gallons | |
| **Water Volume Under 7 ft of ice:** | 94.5 | million gallons | |
| **Potential Ice Aggregate:** | 12.8 | acres (water depth 4 ft or less) | |
| | 1.00 | million gallons | |

**Maximum Recommended Winter Removal:** **14.18 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

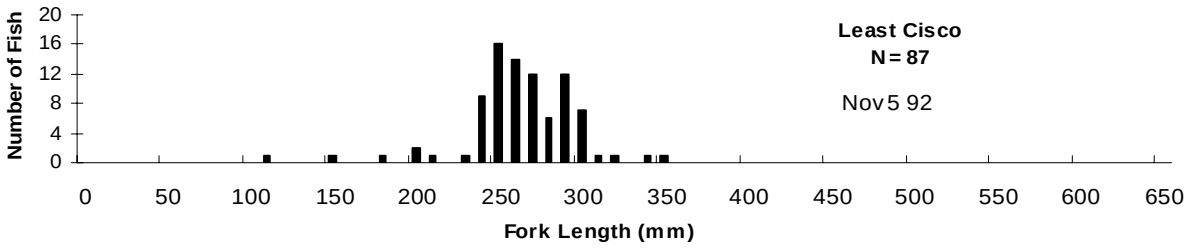
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| 1999-2000 | 5.13 |

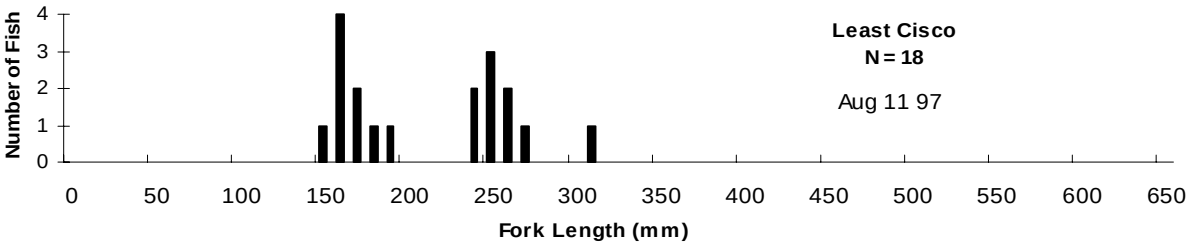
**Water Chemistry:**

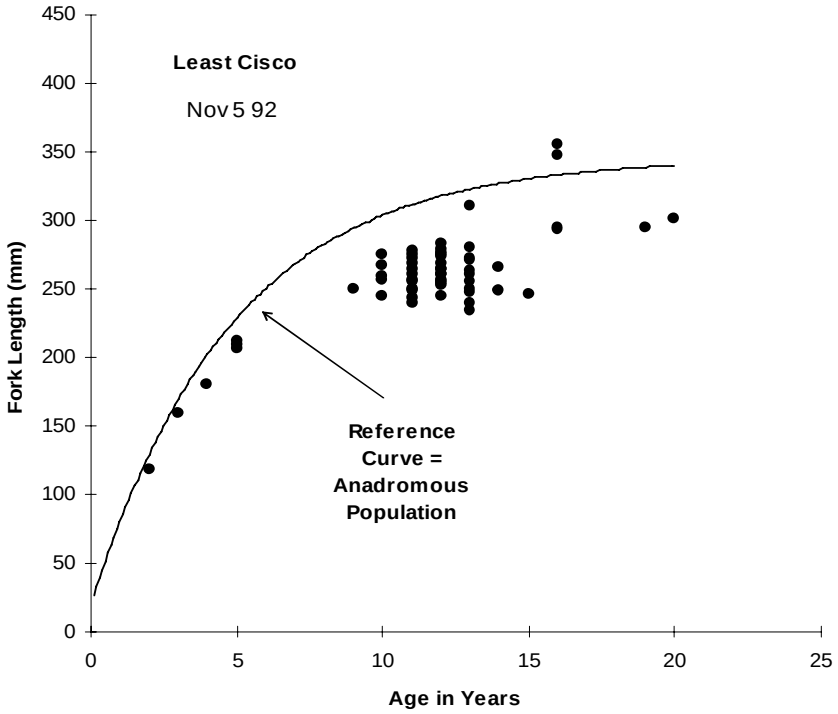
| Year of Test | Calcium (mg/l) | Magnesium (mg/l | Sodium (mg/l) | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) | Specific Conductance (microS/cm) | Turbidity (NTU) | pH | Source |
|---|---|---|---|---|---|---|---|---|---|
| 1991 | 23 | 26 | 200.0 | 360 | 164 | 1,867 | -- | 8.13 | J. Lobdell |
| 1997 | -- | -- | -- | -- | -- | 1,405 | -- | 8.07 | Moulton 98 |
| 1998 | 29.2 | 31.1 | 218.0 | 427 | 201 | -- | -- | -- | Moulton 98 |
| 2006 | 16.9 | 16.1 | 111 | 221 | 108 | 776 | 1.72 | 7.52 | this study |

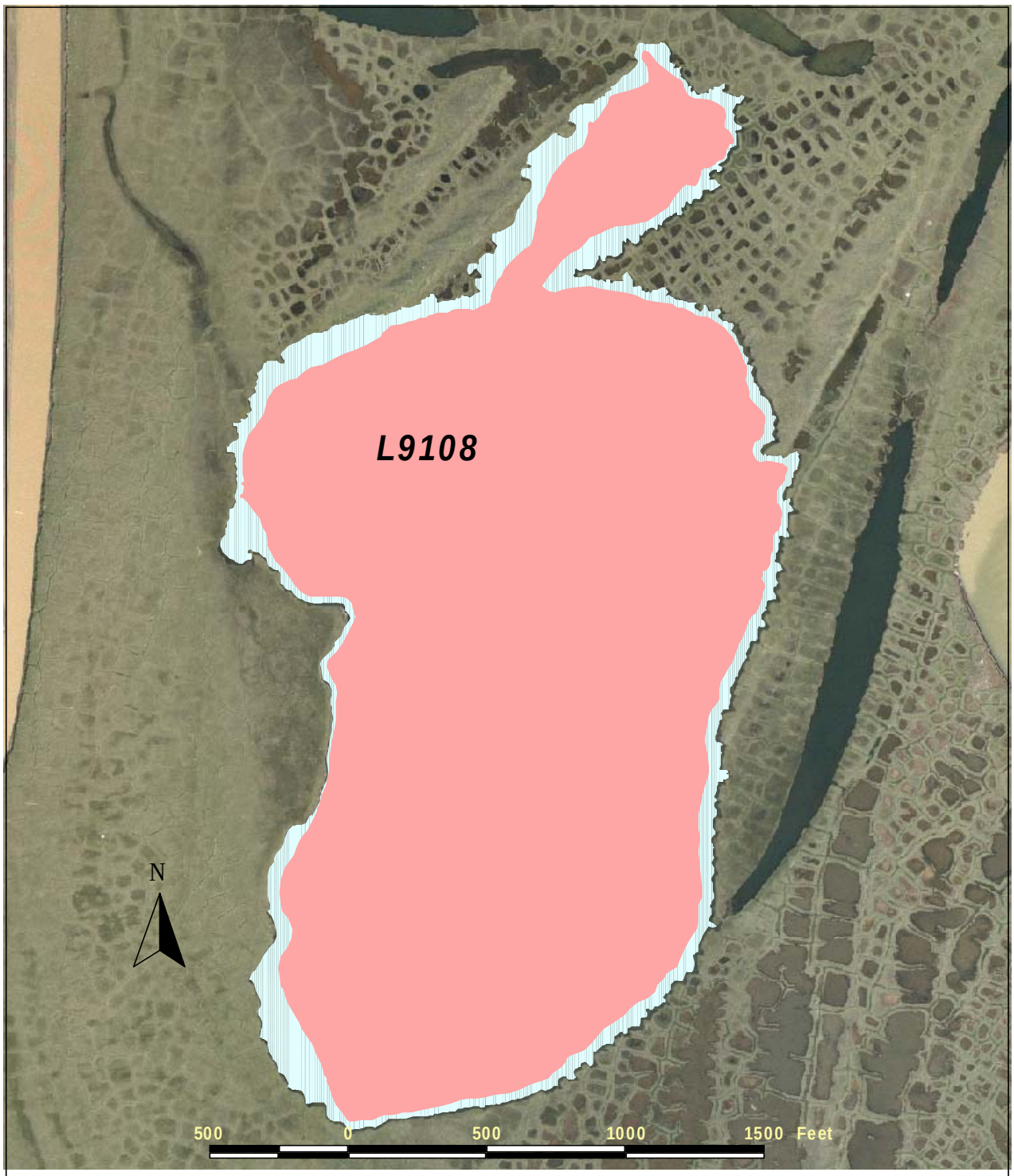
**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gill Net | Nov 5 92 | 20.0 | Least cisco | 87 | 119-355 |
| Gill Net | Aug 11 97 | 4.7 | Least cisco | 18 | 158-316 |
| Minnow Trap | Aug 11 97 | 12.7 | None | 0 | |


Number of Fish
20
16
12
8
4
0
Least Cisco
N = 87
Nov 5 92
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Fork Length (mm)

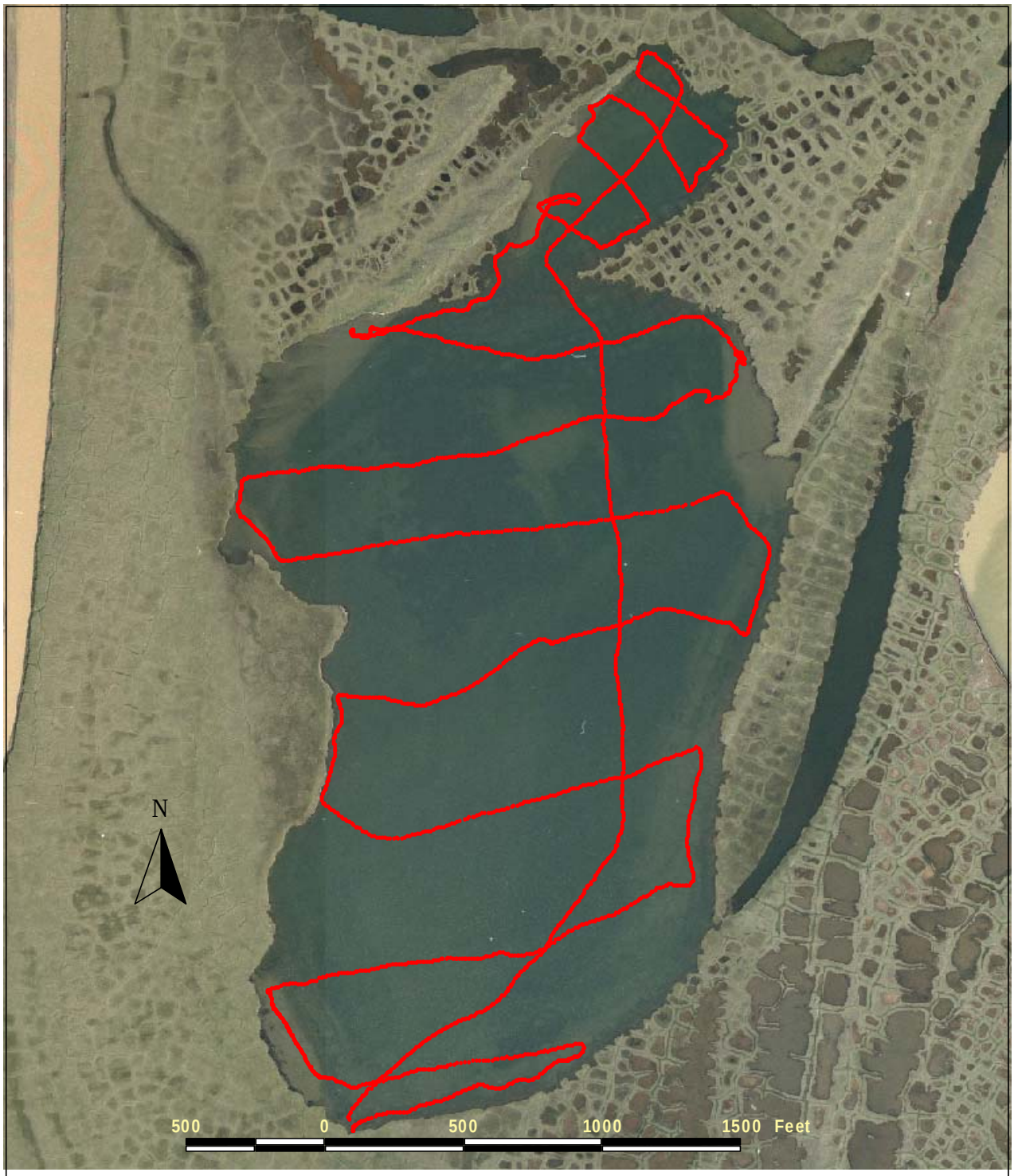

Number of Fish
4
3
2
1
0
Least Cisco
N = 18
Aug 11 97
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Fork Length (mm)


Fork Length (mm)
450
400
350
300
250
200
150
100
50
0
Least Cisco
Nov 5 92
Reference
Curve =
Anadromous
Population
0
5
10
15
20
25
Age in Years

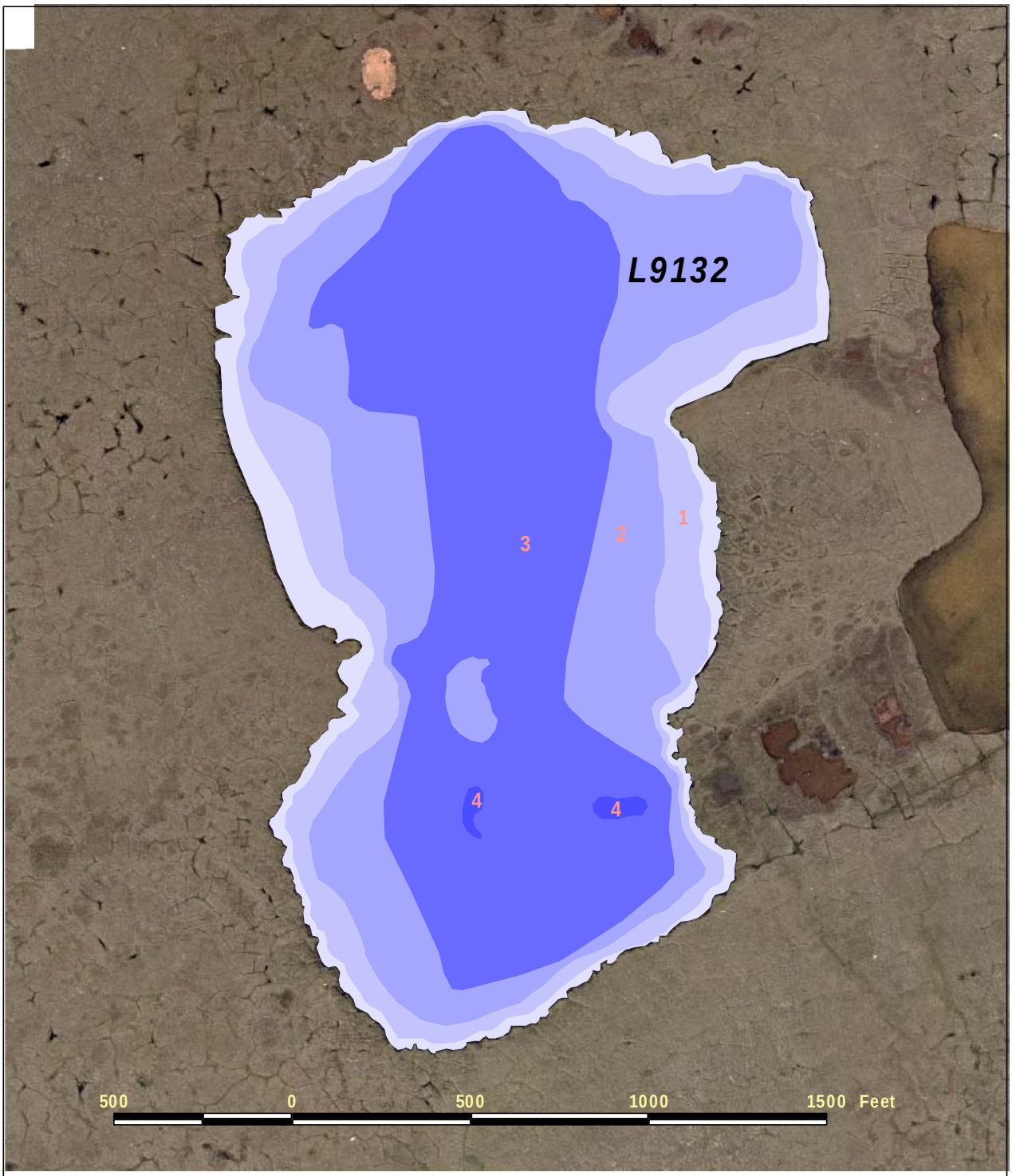



Regions of lake L9108 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 17, 2006.

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




Depth transects measured on Lake L9108 on July 17, 2006.




Depth contours of lake L9132 based on transects surveyed on July 18, 2006.
(depths in 1 foot intervals)

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

## Lake L9132

**Other Names:** BB14.1
**Location:** 70.21208°N 150.53694°W
**USGS Quad Sheet:** Harrison Bay A-1: T10N R6E Sec. 14/23
**Habitat:** Tundra
**Area:** 73 acres
**Maximum Depth:** 4.7 feet
**Active Outlet:** No
**Total Lake Volume:** 60.2 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 0.04 million gallons
**Water Volume Under 5 ft of ice:** 0.00 million gallons
**Water Volume Under 7 ft of ice:** 0.00 million gallons

**Potential Ice Aggregate:** 72.4 acres (water depth 4 ft or less)
5.67 million gallons

**Maximum Recommended Winter Removal:** **0.04 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

**Water Use History:**

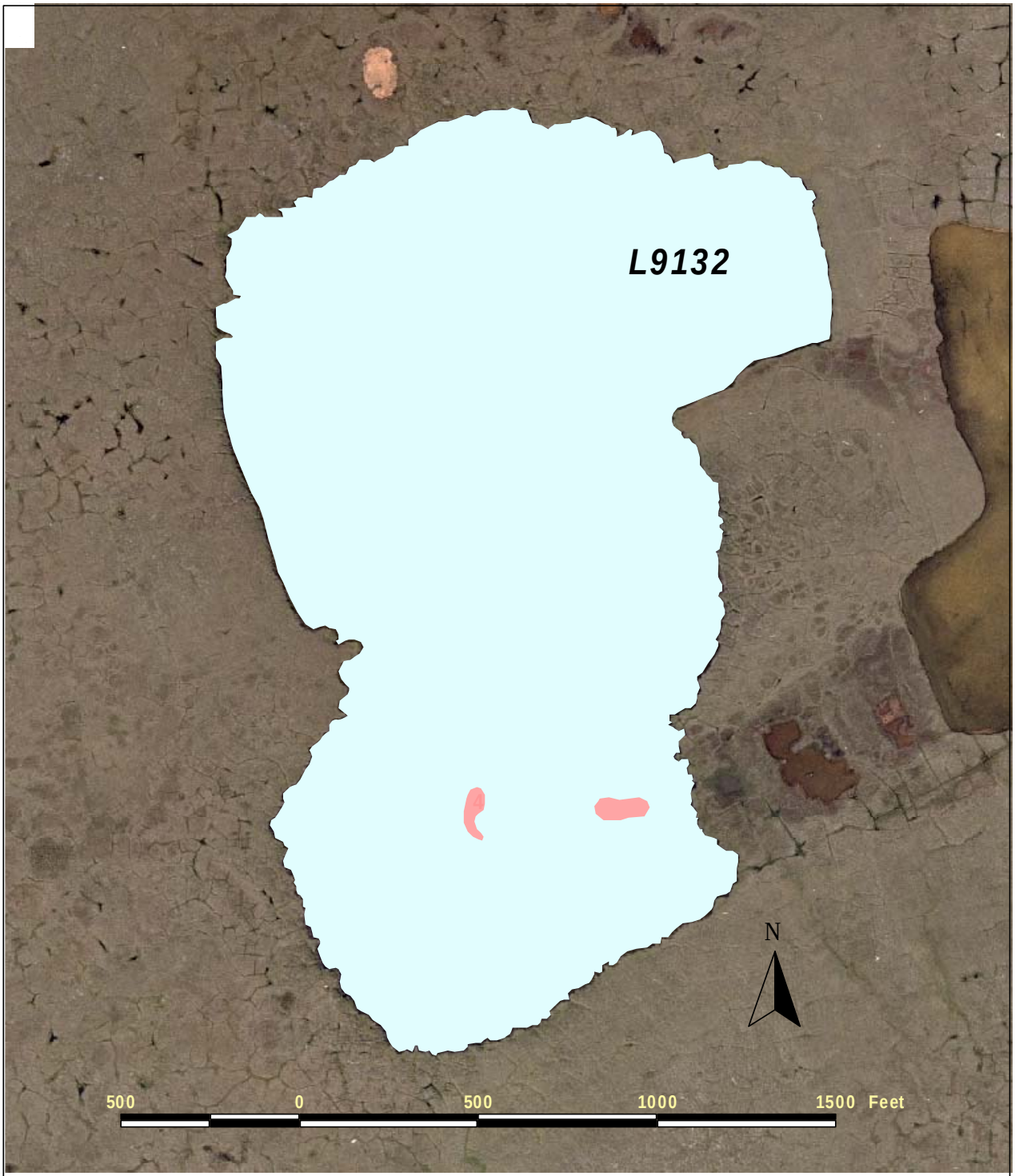
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 53.0 | 8.42 | 11.9 | 68.1 | 167 | 387 | 1.8 | 8.10 | this study |

**Catch Record:**

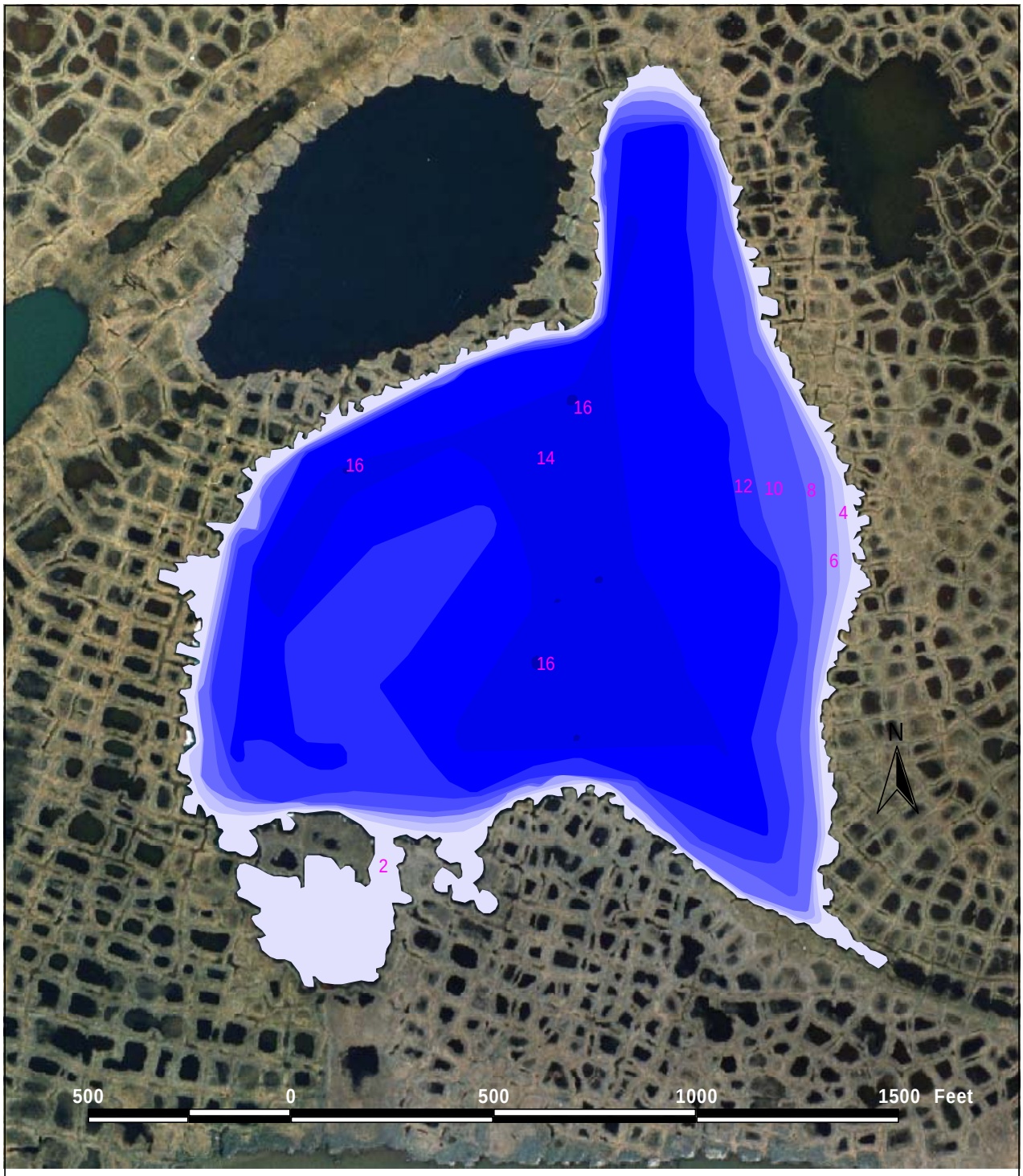
| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gill Net | Jul 18 06 | 8.80 | None | 0 |
| Seine | Jul 18 06 | 3 hauls | None | 0 |




Regions of lake L9132 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 18, 2006.

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


Depth transects measured on lake L9132 on July 18, 2006.




Depth contours of lake L9281 based on transects surveyed on July 19, 2005.
(depths in 2 foot intervals)

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

## Lake L9281

**Other Names:** R6.3
**Location:** 70.37381°N 150.94658°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E, Sec. 20
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 50 acres
**Maximum Depth:** 17.0 feet
**Active Outlet:** No

| | | | |
|---|---|---|---|
| **Total Lake Volume:** | 169.7 | million gallons | (2006 data) |
| **Water Volume Under 4 ft of ice:** | 111.1 | million gallons | |
| **Water Volume Under 5 ft of ice:** | 97.4 | million gallons | |
| **Water Volume Under 7 ft of ice:** | 70.7 | million gallons | |

**Potential Ice Aggregate:** 7.0 acres (water depth 4 ft or less)
0.55 million gallons

**Maximum Recommended Winter Removal:** **10.60 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

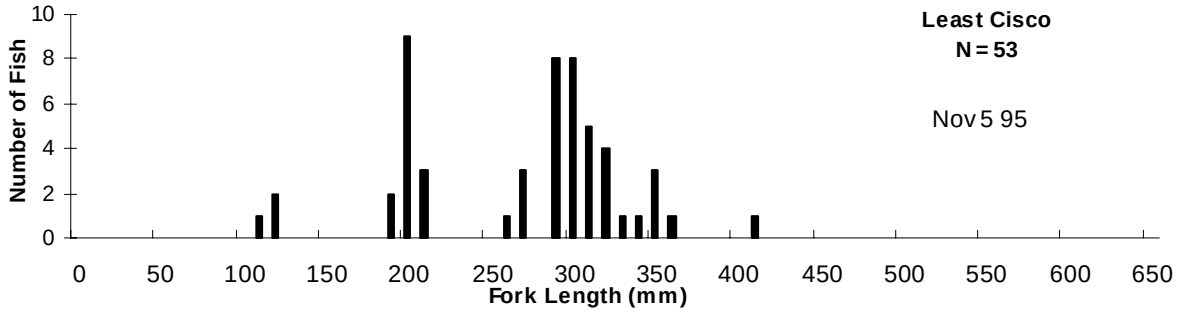
**Water Chemistry:**

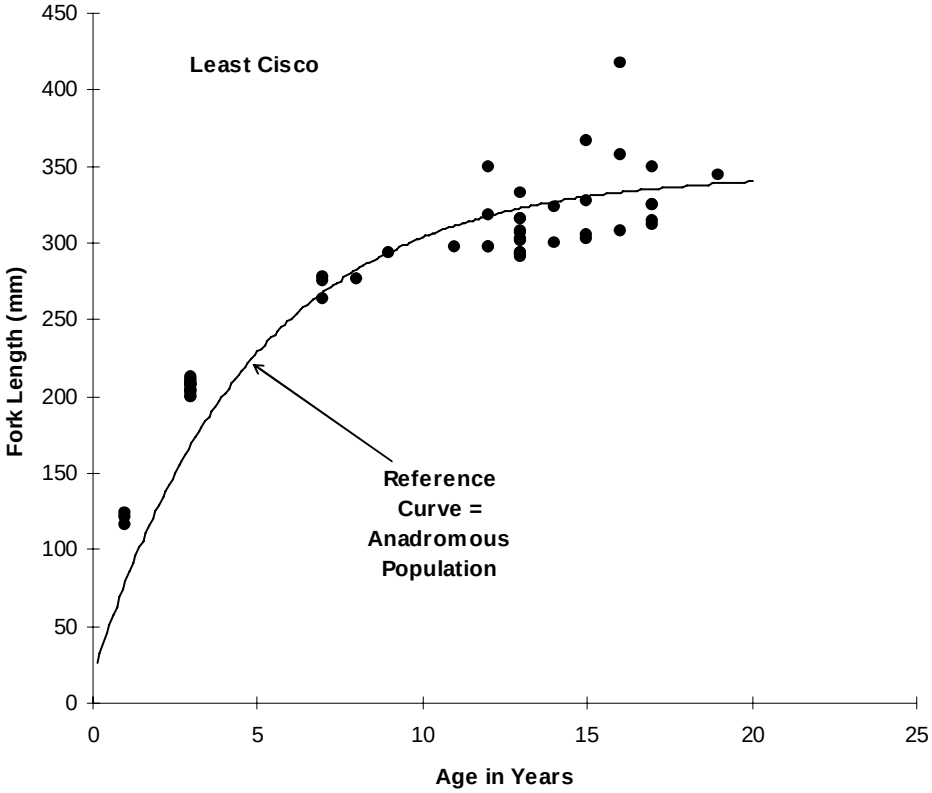
| Year of Test | Calcium (mg/l) | Magnesium (mg/l | Sodium (mg/l) | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) | Specific Conductance (microS/cm) | Turbidity (NTU) | pH | Source |
|---|---|---|---|---|---|---|---|---|---|
| 1992 | 11 | 8.5 | 3.6 | 90.0 | 62 | -- | -- | -- | J. Lobdell |
| 1995 | -- | -- | -- | -- | -- | 346 | -- | -- | Moulton 98 |
| 2006 | 8.81 | 6.8 | 37.6 | 70.3 | 50 | -- | -- | -- | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Fyke Net | Jul 11 95 | 25.6 | Ninespine stickleback | 560 | |
| Fyke Net | Jul 27 95 | 21.0 | Ninespine stickleback | 4 | |
| Fyke Net | Jul 28 95 | 21.1 | Ninespine stickleback | 5 | |
| Minnow Trap | Jul 11 95 | 42.4 | Alaska blackfish | 1 | |
| | | | Ninespine stickleback | 1 | |
| Set Line | Jul 11 95 | 26.3 | None | 0 | |
| Gill Net | Nov 5 95 | 21.0 | Least cisco | 53 | 116-417 |
| | | | Alaska blackfish | 2 | 100, 100 |

Mar 28 00

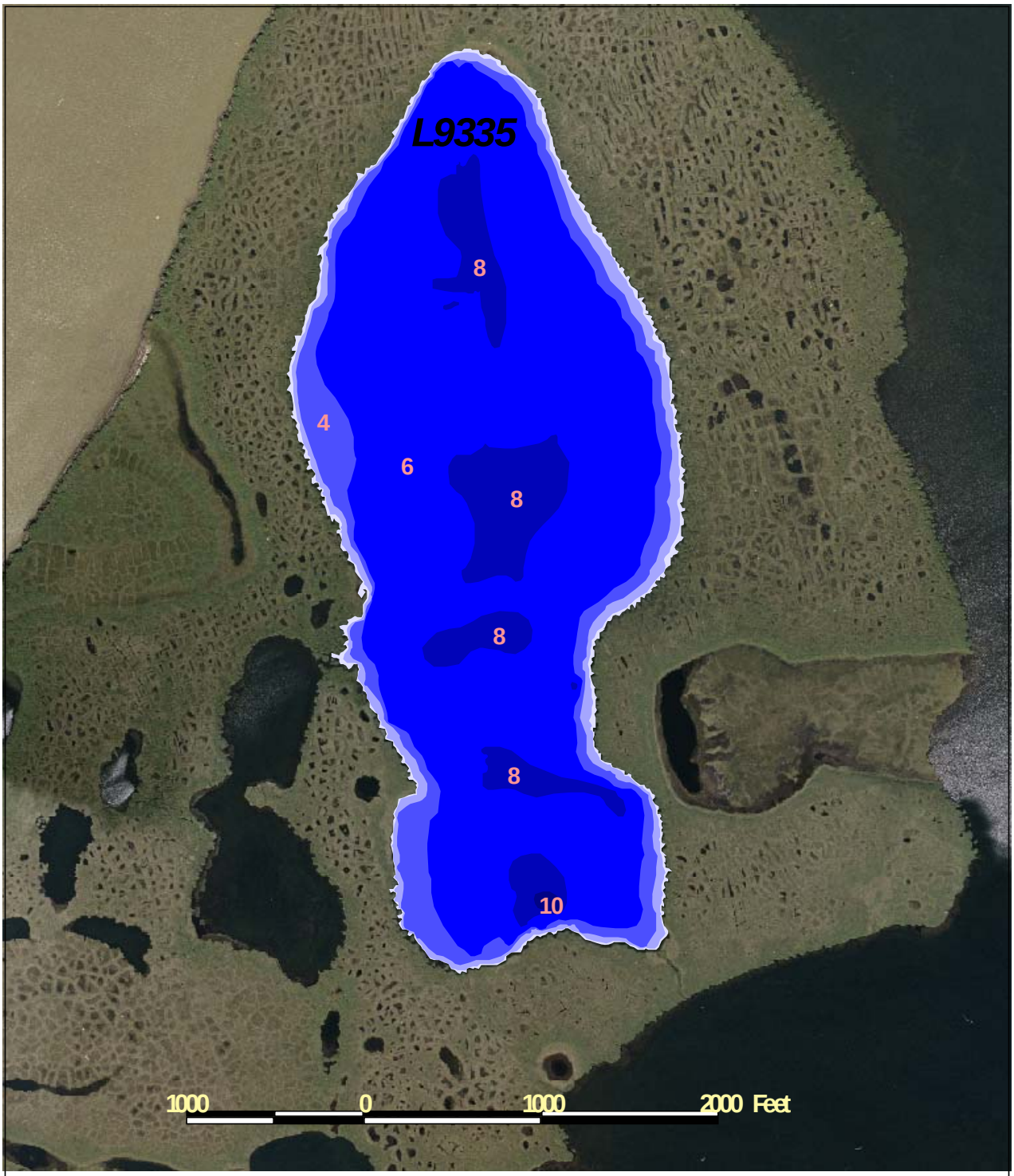

Least Cisco
N = 53
Nov 5 95
Number of Fish
Fork Length (mm)
0
2
4
6
8
10
0
50
100
150
200
250
300
350
400
450
500
550
600
650


Least Cisco
Reference Curve = Anadromous Population
Fork Length (mm)
Age in Years
0
50
100
150
200
250
300
350
400
450
0
5
10
15
20
25


Regions of lake L9281 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 19, 2005.

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


Depth transects measured on lake L9281 on July 19, 2006.




Depth contours of lake L9335 based on transects surveyed on July 19, 2006.
(depths in 2 foot intervals)

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

## Lake L9335

**Other Names:** Y8.2
**Location:** 70.25537°N 150.80431°W
**USGS Quad Sheet:** Harrison Bay B-2: T10N R5E, Sec. 2
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 183 acres
**Maximum Depth:** 11.2 feet
**Active Outlet:** No

| | | | |
|---|---|---|---|
| **Total Lake Volume:** | 395.2 | million gallons | (2006 data) |
| **Water Volume Under 4 ft of ice:** | 163.7 | million gallons | |
| **Water Volume Under 5 ft of ice:** | 110.4 | million gallons | |
| **Water Volume Under 7 ft of ice:** | 22.9 | million gallons | |
| **Potential Ice Aggregate:** | 14.6 | acres (water depth 4 ft or less) | |
| | 1.14 | million gallons | |

**Maximum Recommended Winter Removal:** **3.43 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

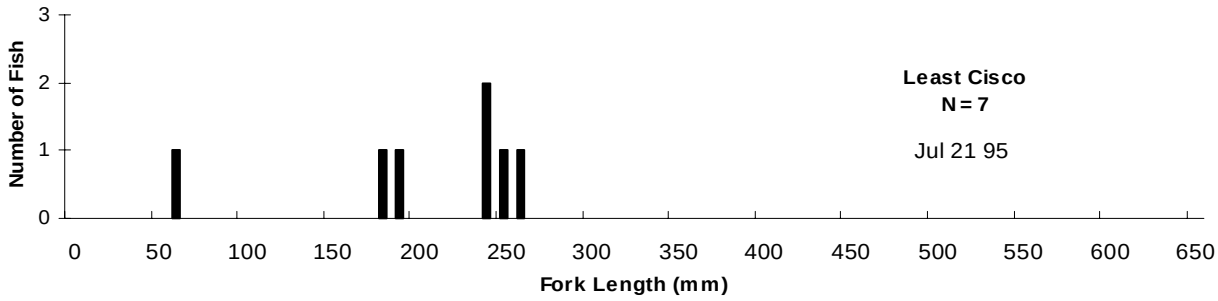
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

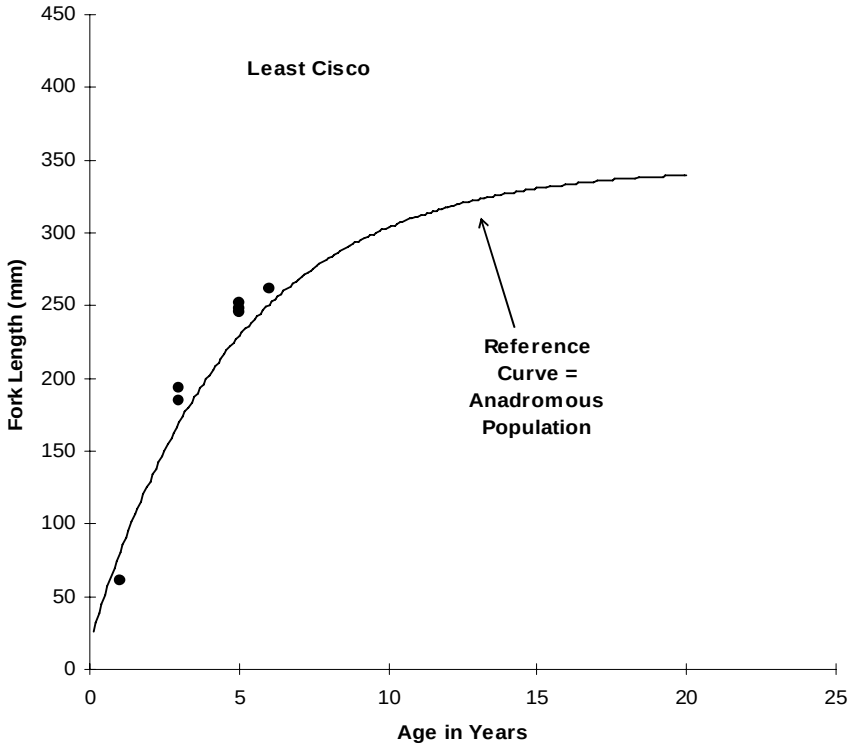
**Water Chemistry:**

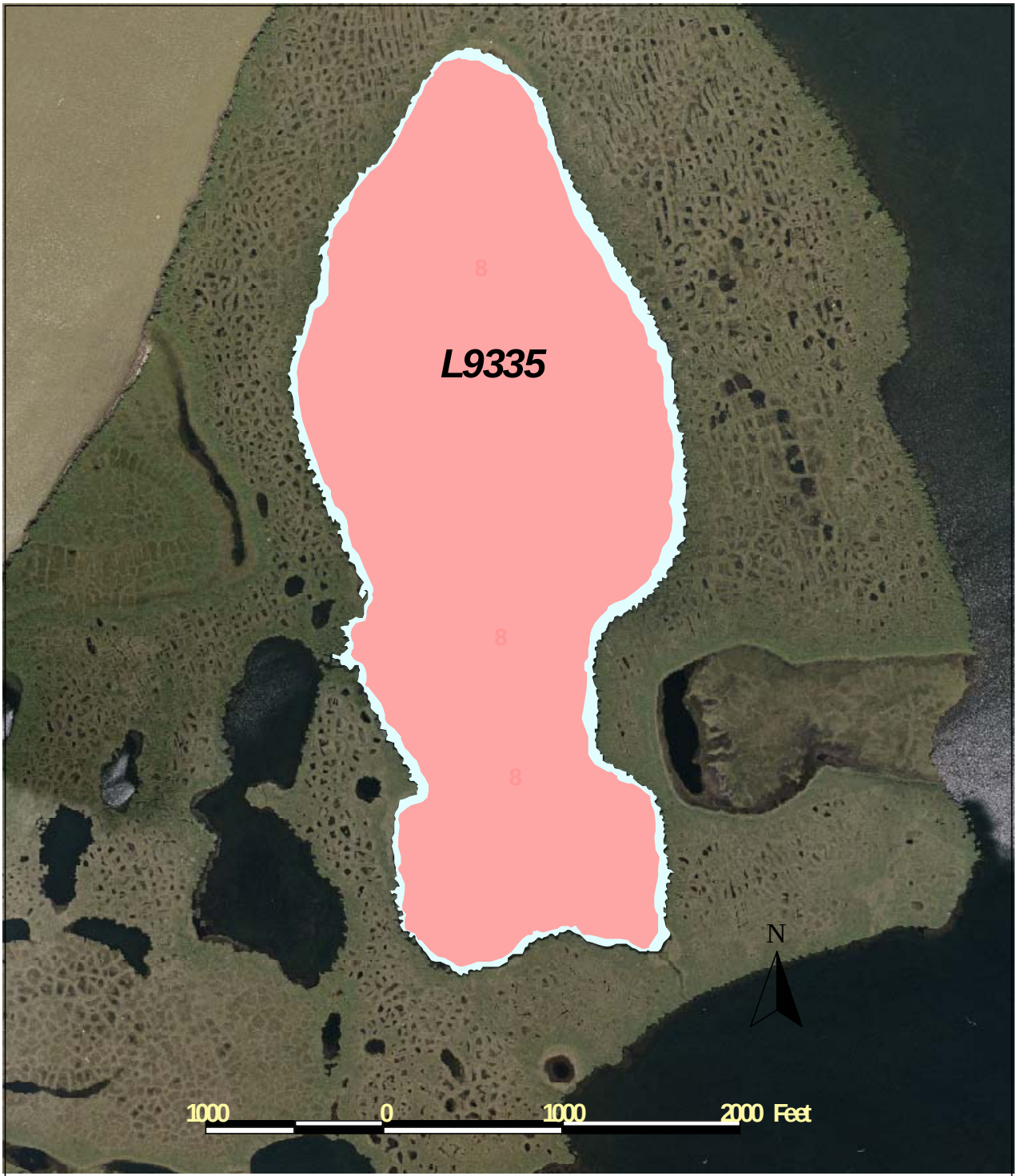
| Year of Test | Calcium (mg/l | Magnesium (mg/l) | Sodium (mg/l) | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) | Specific Conductance (microS/cm) | Turbidity (NTU) | pH | Source |
|---|---|---|---|---|---|---|---|---|---|
| 1993 | 7.6 | 1.6 | 4.1 | 2.0 | 26 | -- | -- | | J. Lobdell |
| 2006 | 9.8 | 2.5 | 2.5 | 4.4 | 34.5 | 81 | 1.1 | 7.54 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Fyke Net | Jul 21 95 | 23.2 | Least cisco | 7 | 61-261 |
| | | | Ninespine stickleback | 33 | |
| Minnow Trap | Jul 21 95 | 46.1 | Ninespine stickleback | 3 | |
| Set Line | Jul 21 95 | 23.0 | None | 0 | |

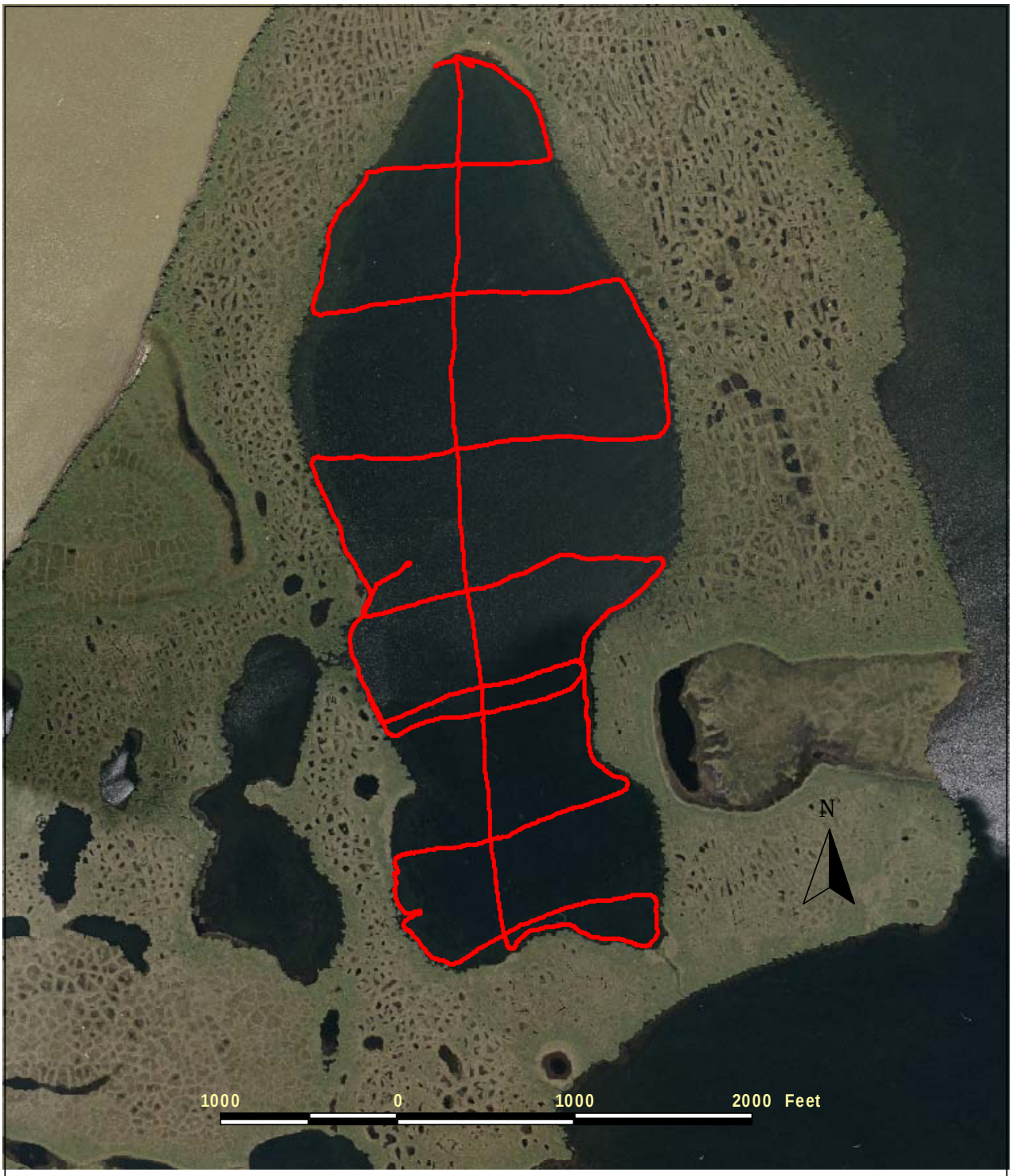

Number of Fish
3
2
1
0
Least Cisco
N = 7
Jul 21 95
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Fork Length (mm)


Least Cisco
Fork Length (mm)
450
400
350
300
250
200
150
100
50
0
Reference
Curve =
Anadromous
Population
0
5
10
15
20
25
Age in Years

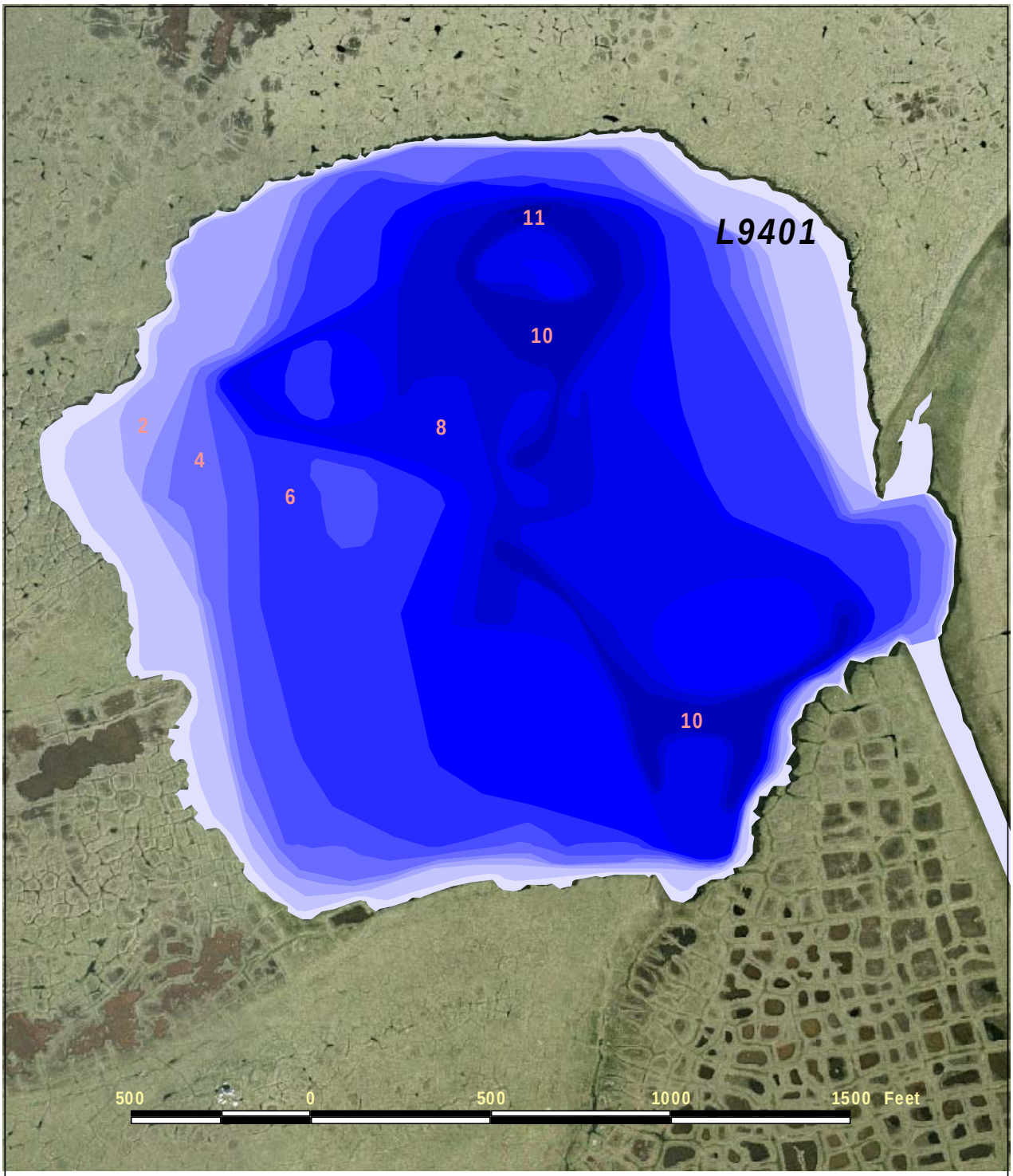



Regions of lake L9335 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 29, 2006.

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




Depth transects measured on lake L9335 on July 29, 2006.




Depth contours of lake L9401 based on transects surveyed on August 7, 2006.
(depths in 1 foot intervals)

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

## Lake L9401

**Other Names:** Q3.1
**Location:** 70.39630°N 151.06438°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4E, Sec. 14
**Habitat:** Perched Lake (Frequent Flooding)
**Area:** 110 acres
**Maximum Depth:** 16.3 feet
**Active Outlet:** Yes
**Total Lake Volume:** 191.1 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 80.3 million gallons
**Water Volume Under 5 ft of ice:** 57.3 million gallons
**Water Volume Under 7 ft of ice:** 20.2 million gallons

**Potential Ice Aggregate:** 36.4 acres (water depth 4 ft or less)
2.85 million gallons

**Maximum Recommended Winter Removal:** **3.04 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

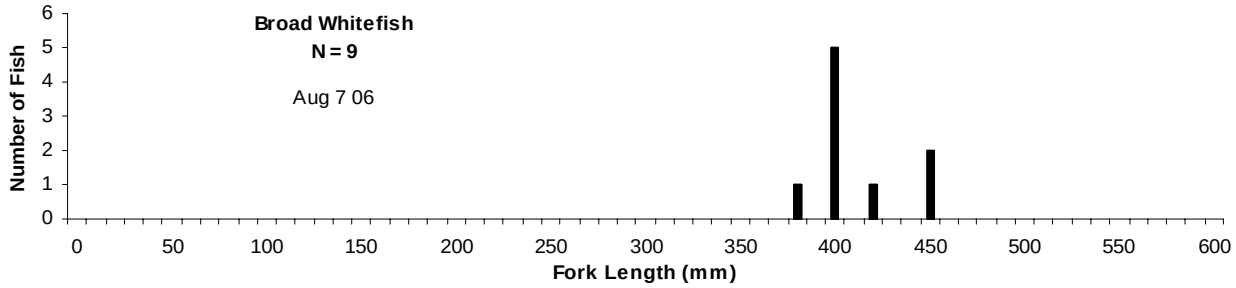
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

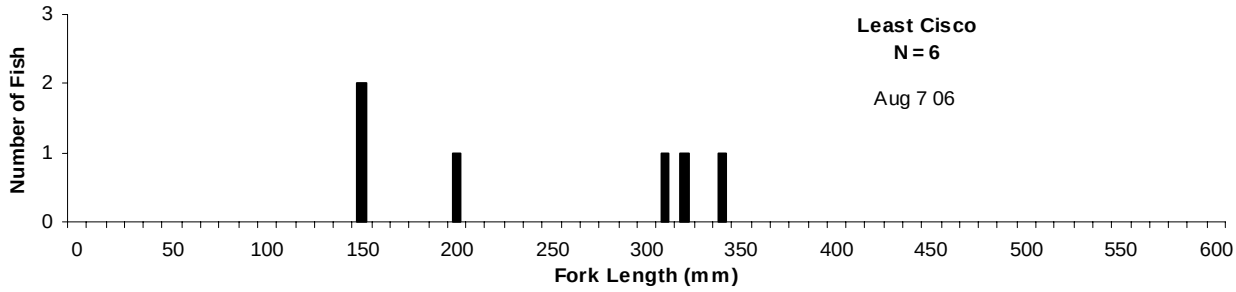
**Water Chemistry:**

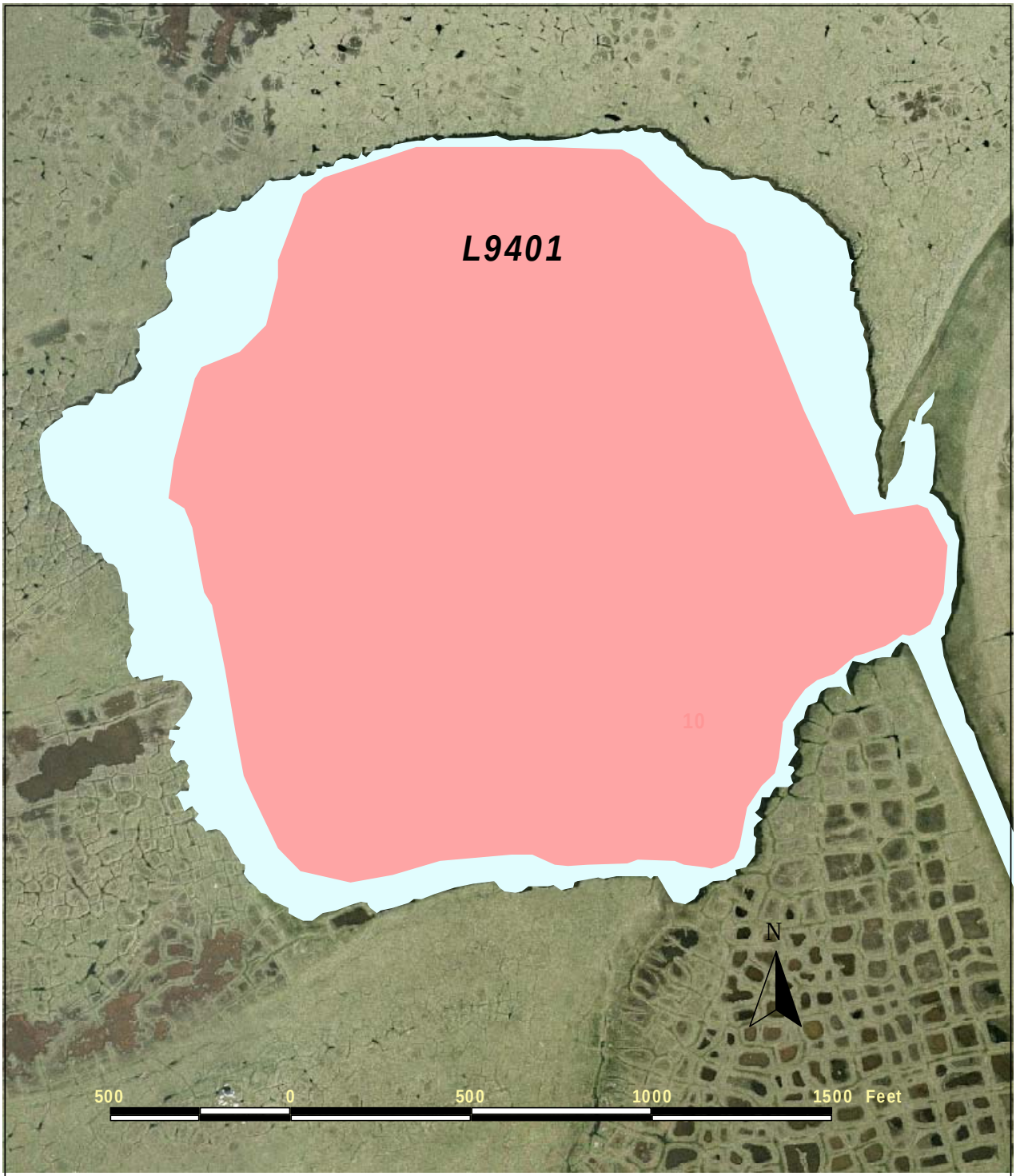
| Year of Test | Calcium (mg/l | Magnesium (mg/l) | Sodium (mg/l) | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) | Specific Conductance (microS/cm) | Turbidity (NTU) | pH | Source |
|---|---|---|---|---|---|---|---|---|---|
| 1994 | 22.7 | 26.9 | 381 | 462 | 167 | -- | -- | -- | J. Lobdell |
| 1997 | -- | -- | -- | -- | -- | 1257 | -- | -- | Moulton 1998 |
| 1999 | 23.3 | 23.6 | 164 | 311 | 155 | -- | -- | -- | Moulton 1999 |
| 2006 | 10.7 | 8.4 | 59.9 | 118 | 61.3 | 447 | 2.83 | 8.12 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gillnet | Jul 21 97 | 9.9 | None | 0 | 61-261 |
| | Aug 3 97 | 10.8 | None | 0 | |
| | Aug 7 06 | 3.0 | Broad whitefish | 12 | 328-452 |
| | | | Least cisco | 6 | 153-343 |
| Minnow Trap | Jul 21 97 | 21.0 | Ninespine stickleback | 308 | |
| | Aug 7 06 | 6.5 | None | 0 | |


Broad Whitefish
N = 9
Aug 7 06
Number of Fish
0
1
2
3
4
5
6
0
50
100
150
200
250
300
350
400
450
500
550
600
Fork Length (mm)

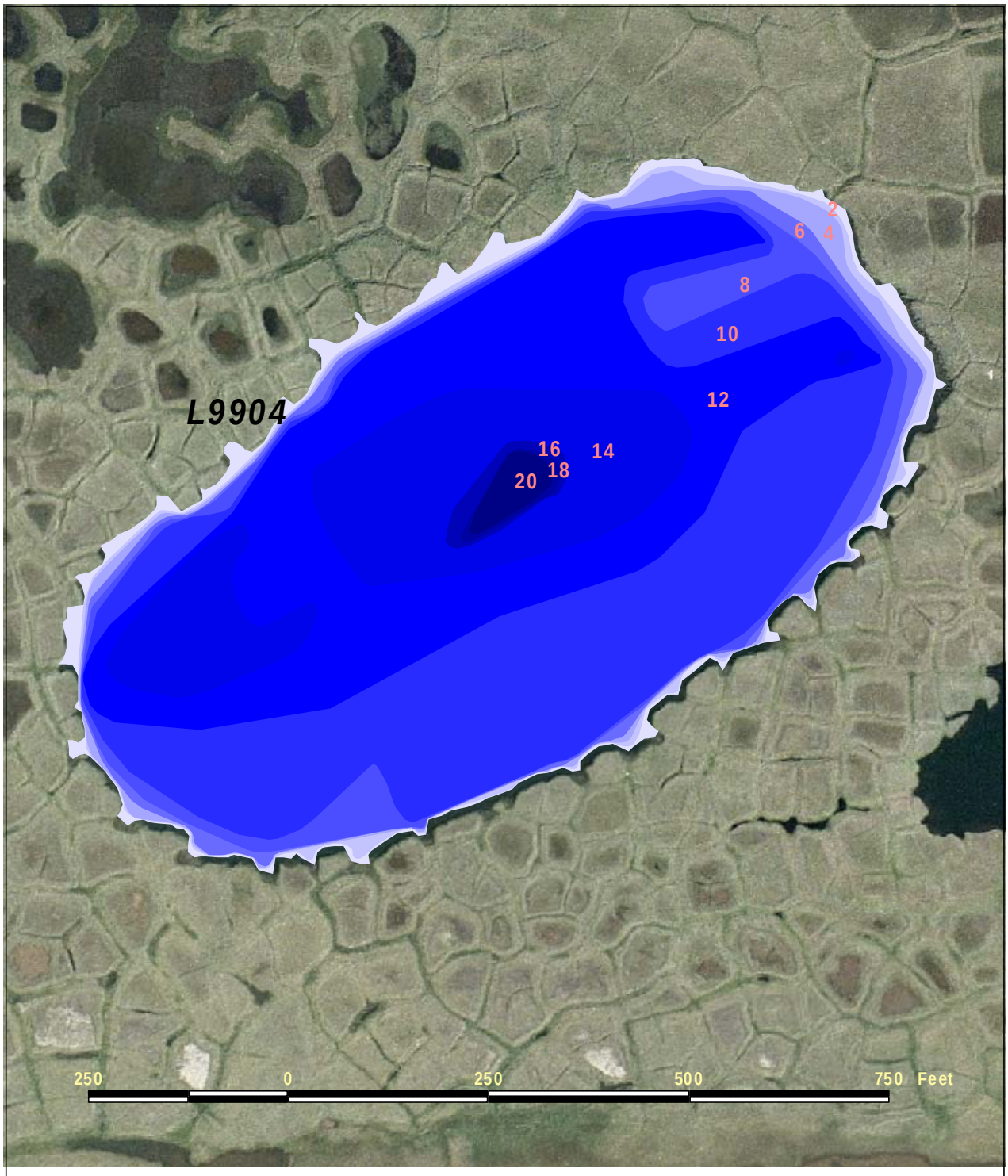

Least Cisco
N = 6
Aug 7 06
Number of Fish
0
1
2
3
0
50
100
150
200
250
300
350
400
450
500
550
600
Fork Length (mm)




Regions of lake L9401 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 7, 2006.

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


Depth transects measured on lake L9401 on August 7, 2006.




Depth contours of lake L9904 based on transects surveyed on July 14, 2006
(depths in 2 foot intervals)
(not to be used for navigation or to direct operation of heavy equipment)

## Lake L9904

**Other Names:** P6.2
**Location:** 70.40243°N 150.93863°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E Sec. 8
**Habitat:** Perched Lake (Frequent Flooding)
**Area:** 14 acres
**Maximum Depth:** 26.1 feet
**Active Outlet:** No
**Total Lake Volume:** 51.8 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 34.4 million gallons
**Water Volume Under 5 ft of ice:** 30.2 million gallons
**Water Volume Under 7 ft of ice:** 21.9 million gallons

**Potential Ice Aggregate:** 0.8 acres (water depth 4 ft or less)
0.06 million gallons

**Maximum Recommended Winter Removal:** **3.29 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

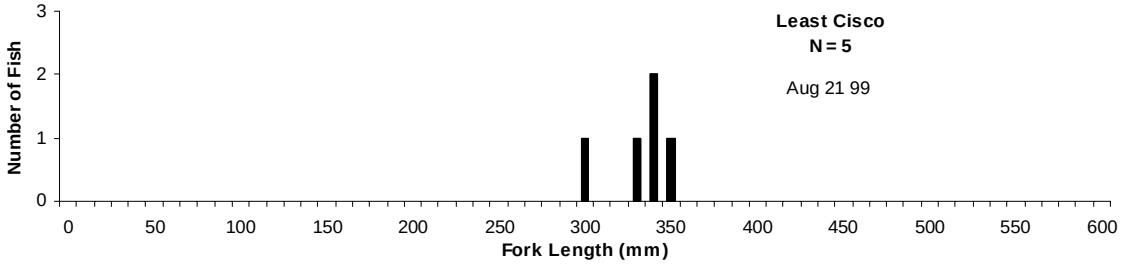
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 1999 | 18.4 | 16.2 | 78.6 | 161 | 112 | 622 | -- | 8.09 | J. Lobdell |
| 2006 | 13.8 | 10.3 | 49.4 | 96.9 | 76.9 | 402 | 1.4 | 8.01 | this study |

**Catch Record:**

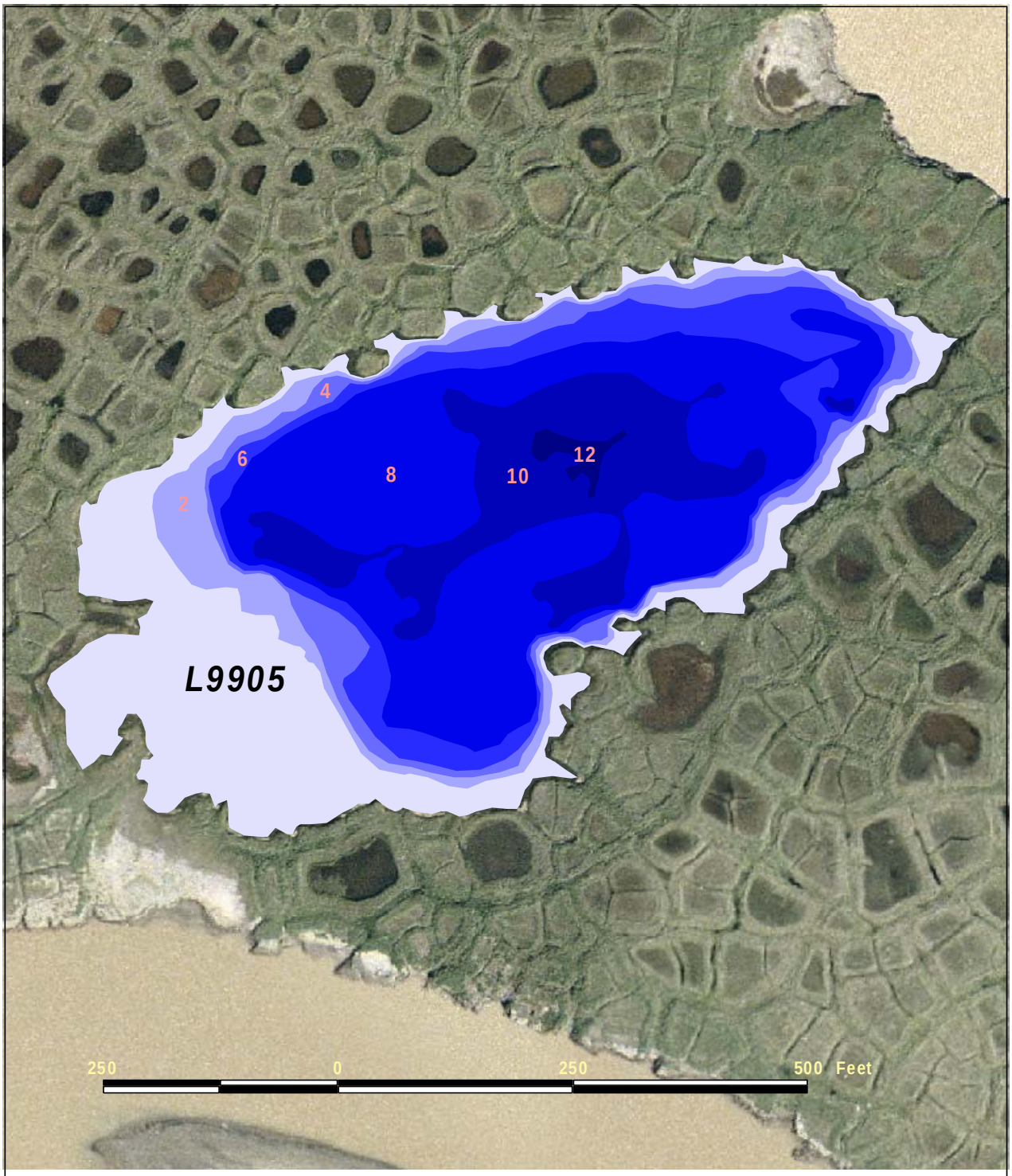
| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gill Net | Aug 2 99 | 2.5 | Broad whitefish | 1 | 505 |
| | | | Least cisco | 5 | 307-353 |




Regions of lake L9904 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 14, 2006.

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


Depth transects measured on lake L9904 on July 14, 2006.




Depth contours of lake L9905 based on transects surveyed on August 5, 2006.
(depths in 2 foot intervals)

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

## Lake L9905

**Other Names:** P6.1
**Location:** 70.40430°N 150.95362°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E Sec. 7
**Habitat:** Perched Lake (Frequent Flooding)
**Area:** 8 acres
**Maximum Depth:** 12.4 feet
**Active Outlet:** Yes

| | | |
|---|---|---|
| **Total Lake Volume:** | 16.4 million gallons | (2006 data) |
| **Water Volume Under 4 ft of ice:** | 8.17 million gallons | |
| **Water Volume Under 5 ft of ice:** | 6.49 million gallons | |
| **Water Volume Under 7 ft of ice:** | 3.41 million gallons | |
| **Potential Ice Aggregate:** | 2.8 acres (water depth 4 ft or less) | |
| | 0.22 million gallons | |

**Maximum Recommended Winter Removal:** **1.95 million gallons**
(30% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

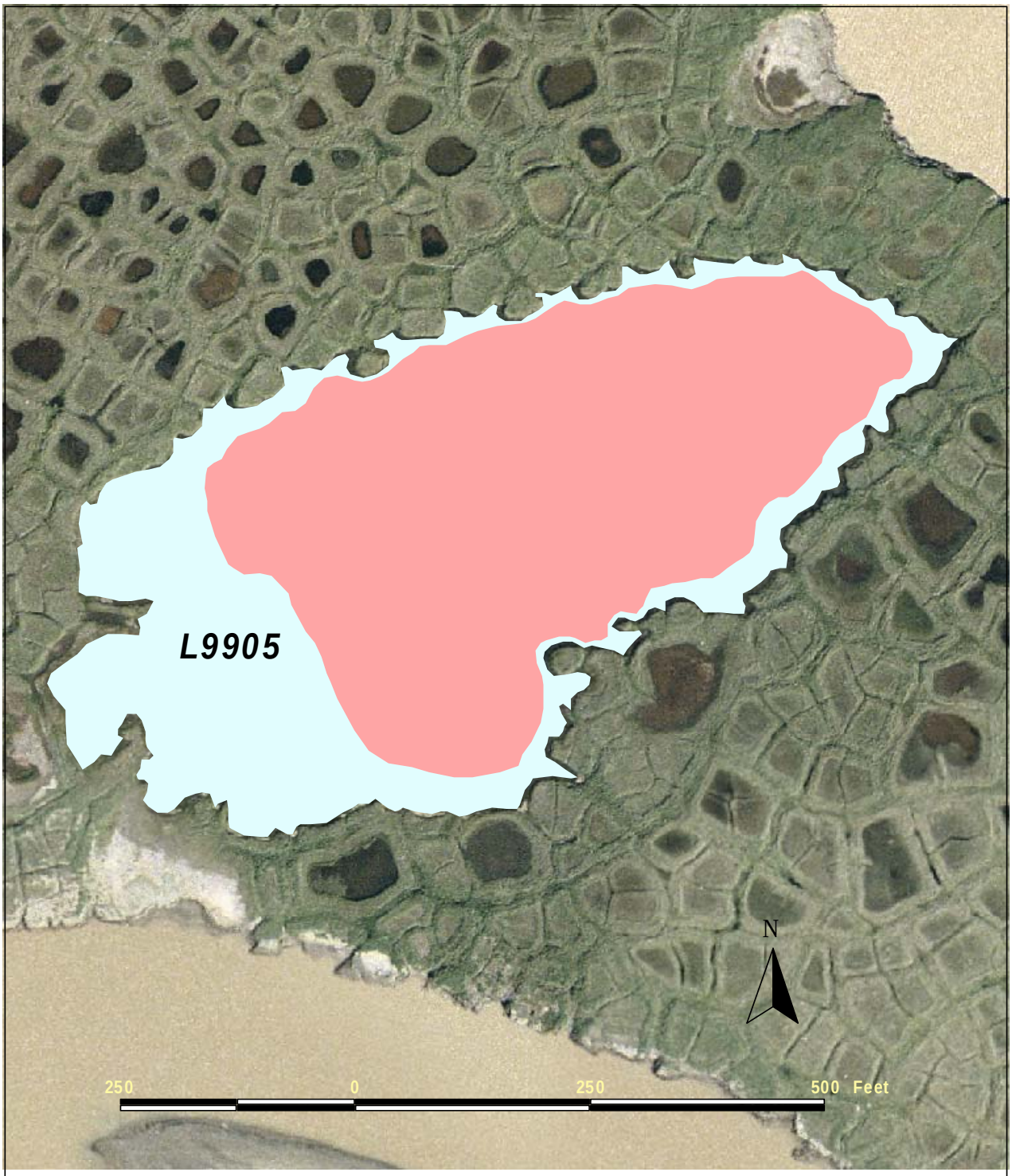
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 1999 | 68.8 | 135.0 | 991 | 1880 | 737 | 5860 | -- | 8.42 | J. Lobdell |
| 2006 | -- | -- | -- | -- | -- | 4117 | 3.5 | 8.28 | this study |

**Catch Record:**

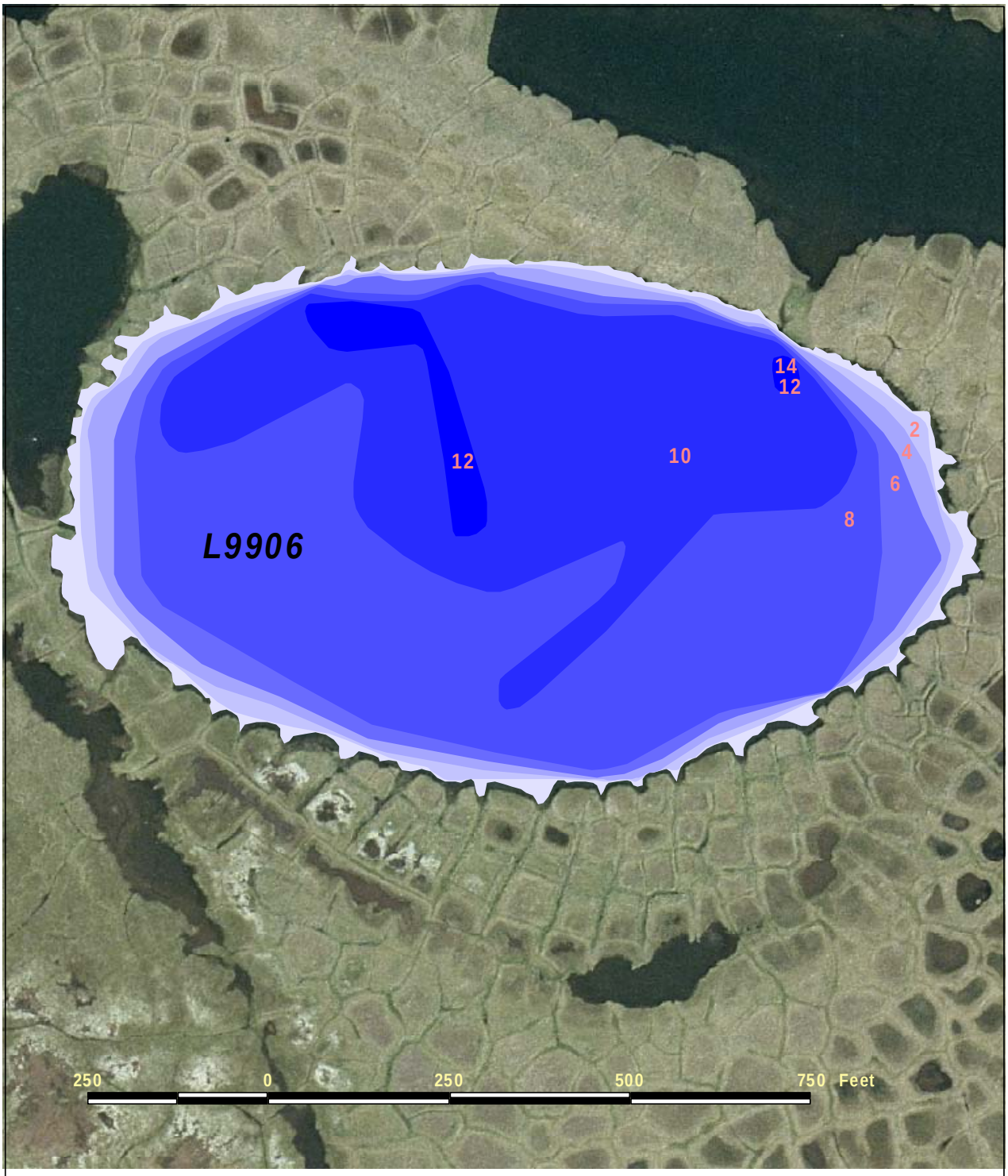
| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gill Net | Aug 2 99 | 2.3 | None | 0 |
| Observed | Aug 5 06 | | Ninespine stickleback | 1 |




Regions of lake L9905 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on August 5, 2006.

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


Depth transects measured on lake L9905 on August 5, 2006.




Depth contours of lake L9906 based on transects surveyed on July 16, 2006
(depths in 2 foot intervals)

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

## Lake L9906

**Other Names:** P6.5
**Location:** 70.39978°N 150.91910°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E Sec. 17
**Habitat:** Perched Lake (Frequent Flooding)
**Area:** 16.9 acres
**Maximum Depth:** 14.3 feet
**Active Outlet:** No
**Total Lake Volume:** 48.0 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 27.0 million gallons
**Water Volume Under 5 ft of ice:** 22.1 million gallons
**Water Volume Under 7 ft of ice:** 12.8 million gallons

**Potential Ice Aggregate:** 1.5 acres (water depth 4 ft or less)
0.12 million gallons

**Maximum Recommended Winter Removal:** **1.92 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

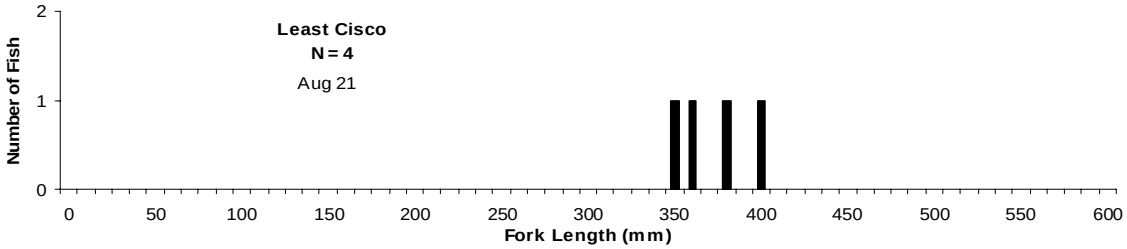
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

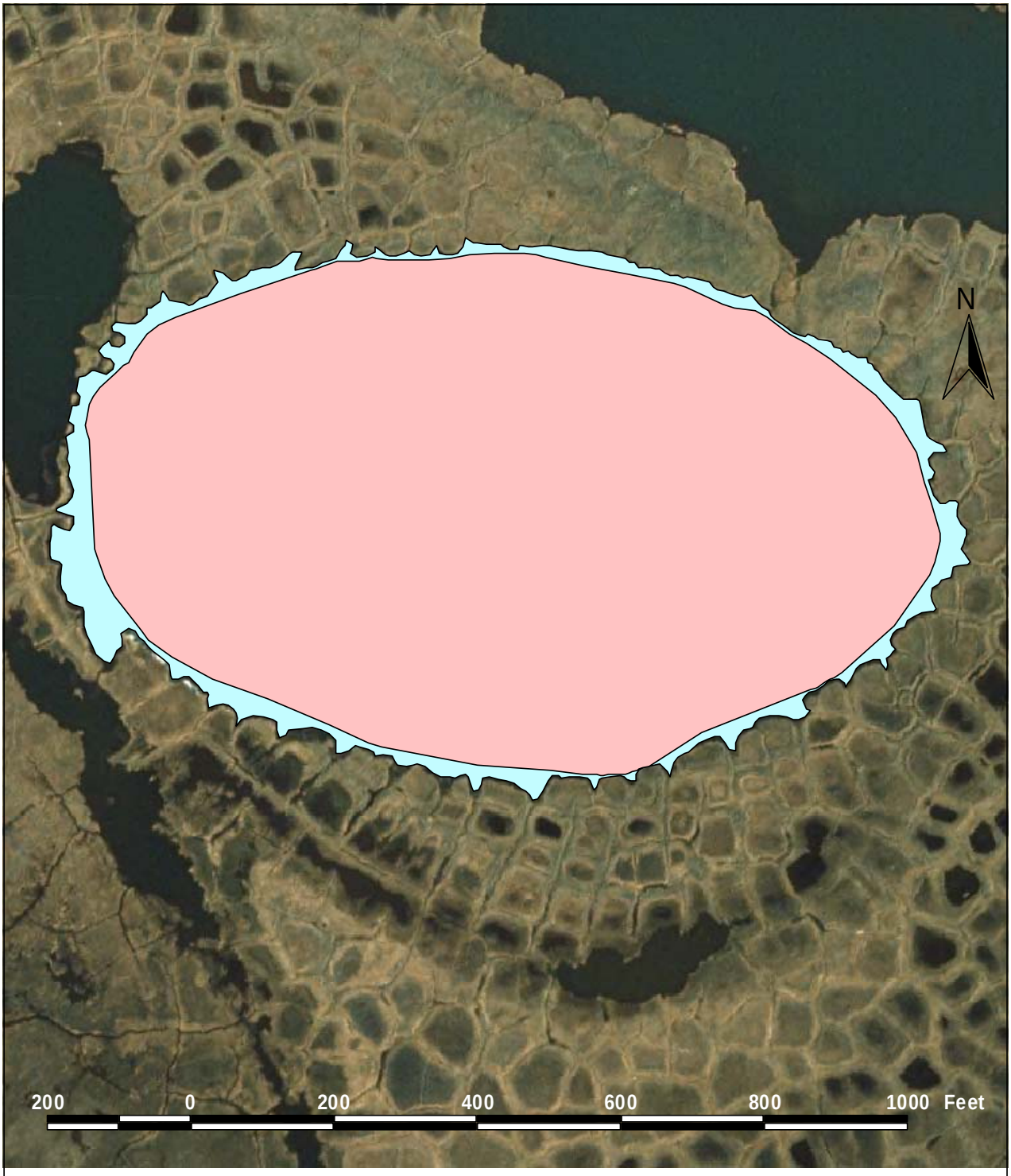
**Water Chemistry:**

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1999 | 14.5 | 12.1 | 48.8 | 97.4 | 86 | 416 | -- | 8.00 | J. Lobdell |
| 2006 | 12.1 | 8.4 | 43.6 | 76.1 | 65 | 339 | 1.8 | 7.03 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gill Net | Aug 2 99 | 2.2 | Broad whitefish | 1 | 553 |
| | | | Least cisco | 4 | 351-406 |

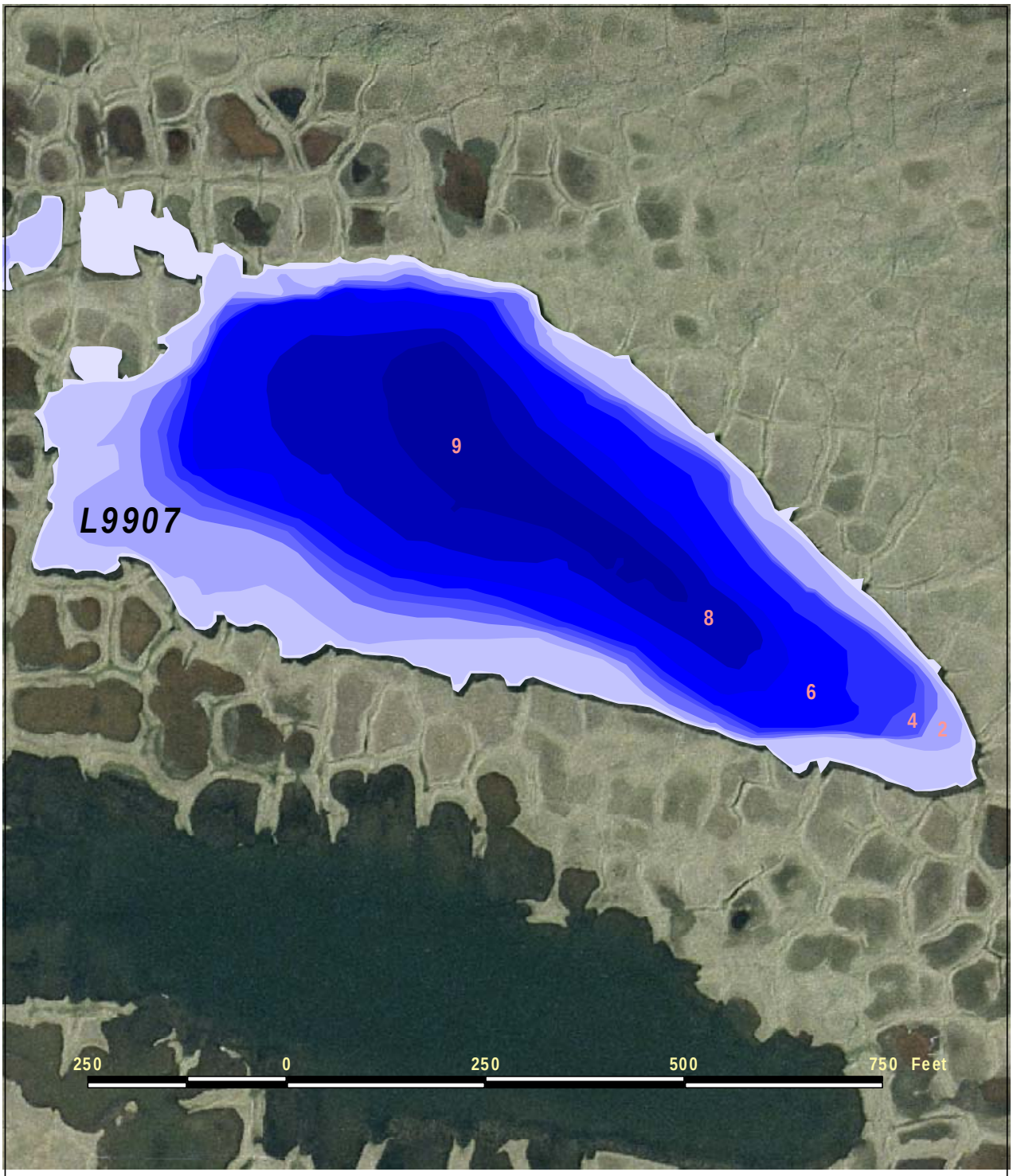





Regions of lake L9906 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 16, 2006.

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


Depth transects measured on lake L9906 on July 16, 2006.




Depth contours of lake L9907 based on transects surveyed on July 28, 2006.
(depths in 1 foot intervals)

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

## Lake L9907

**Other Names:** P7.2
**Location:** 70.40169°N 150.90036°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E Sec. 9
**Habitat:** Perched Lake (Frequent Flooding?)
**Area:** 10.7 acres
**Maximum Depth:** 10.1 feet
**Active Outlet:**
**Total Lake Volume:** 18.1 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 7.08 million gallons
**Water Volume Under 5 ft of ice:** 5.04 million gallons
**Water Volume Under 7 ft of ice:** 1.67 million gallons

**Potential Ice Aggregate:** 4.2 acres (water depth 4 ft or less)
0.33 million gallons

**Maximum Recommended Winter Removal:** **1.51 million gallons**
(30% of volume under 5 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

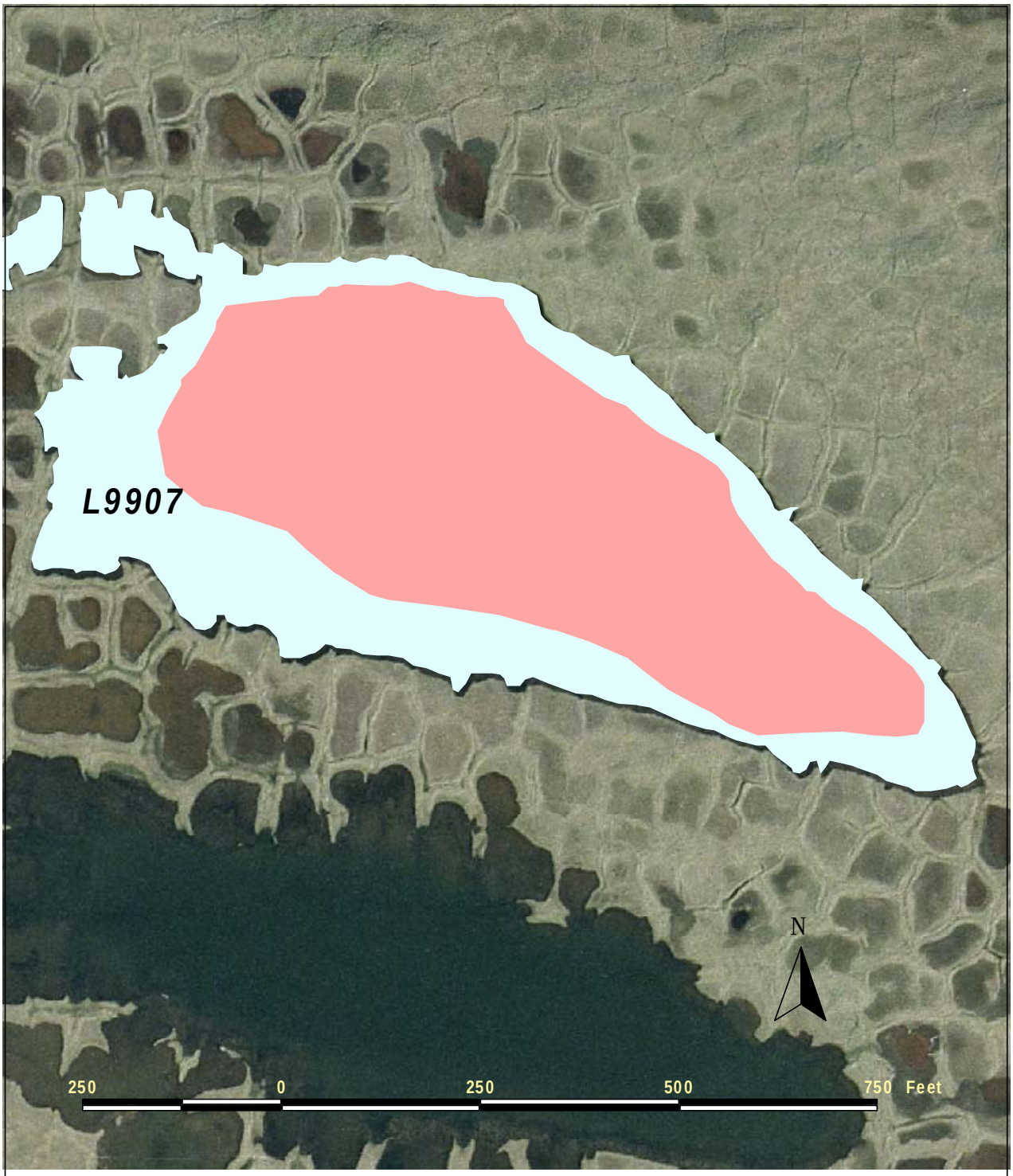
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 1999 | 16.7 | 11.5 | 16.2 | 36.2 | 89 | 264 | -- | 7.97 | J. Lobdell |
| 2006 | 11.5 | 6.9 | 11.2 | 24.8 | 57 | 177 | 0.7 | 8.21 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gill Net | Aug 1 99 | 4.7 | None | 0 |
| Gill Net | Aug 2 99 | 5.0 | None | 0 |
| Observed | Jul 28 06 | | Ninespine stickleback | 1 |




Regions of lake L9907 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 28, 2006.

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


Depth transects measured on lake L9907 on July 28, 2006.


Depth contours of lake L9908 based on transects surveyed on July 29, 2006.
(depths in 1 foot intervals)

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

## Lake L9908

**Other Names:** P6.4
**Location:** 70.40278°N 150.91212°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E Sec. 8
**Habitat:** Perched Lake (Frequent Flooding?)
**Area:** 10 acres
**Maximum Depth:** 11.3 feet
**Active Outlet:** No
**Total Lake Volume:** 21.5 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 9.90 million gallons
**Water Volume Under 5 ft of ice:** 7.58 million gallons
**Water Volume Under 7 ft of ice:** 3.53 million gallons

**Potential Ice Aggregate:** 2.7 acres (water depth 4 ft or less)
0.21 million gallons

**Maximum Recommended Winter Removal:** **9.90 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

**Water Use History:**

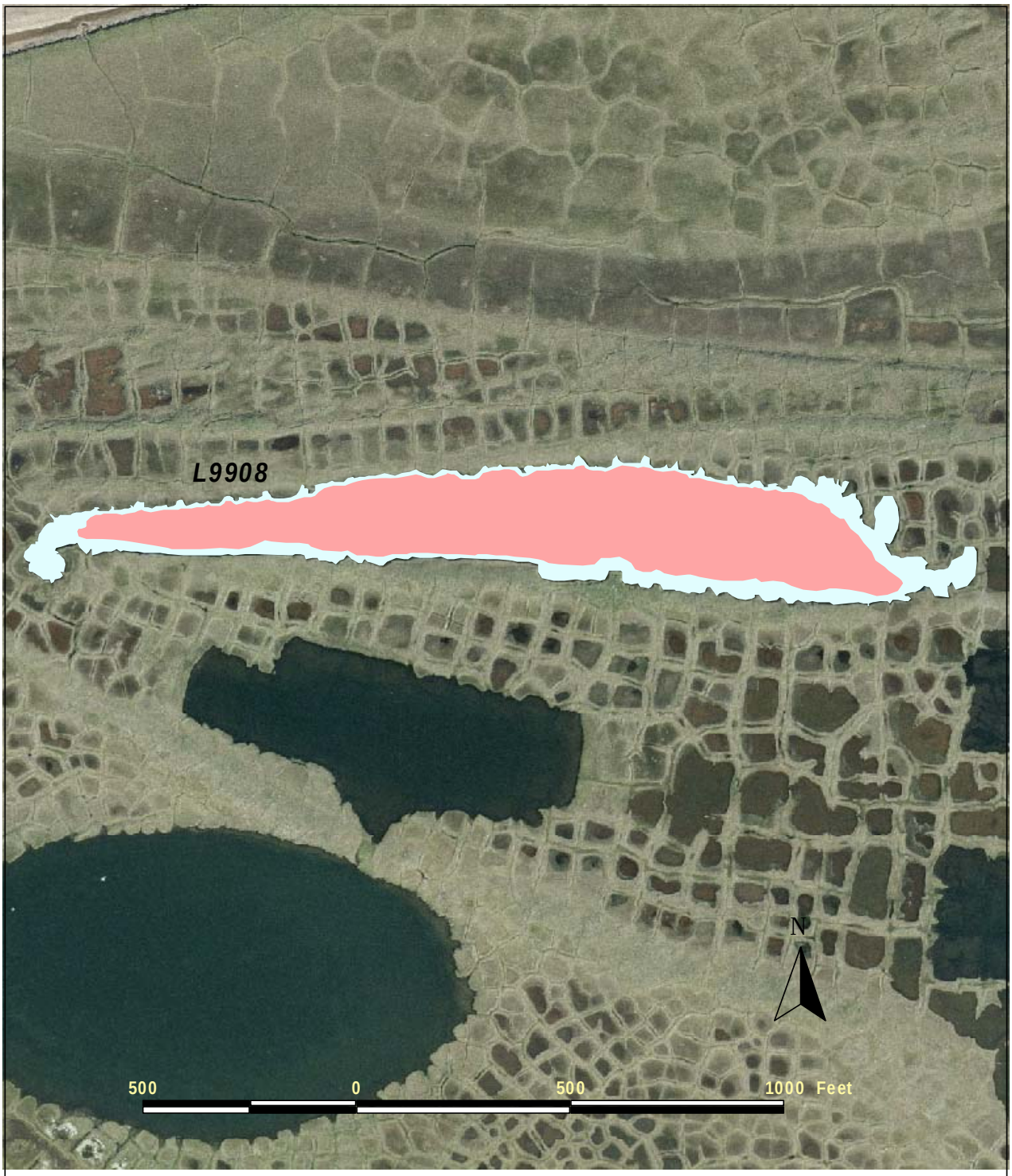
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 1999 | 15.2 | 9.6 | 18.1 | 47.7 | 77 | 251 | -- | 7.87 | J. Lobdell |
| 2006 | 11.1 | 6.2 | 13.5 | 38.3 | 53 | 185 | 1.0 | 7.63 | this study |

**Catch Record:**

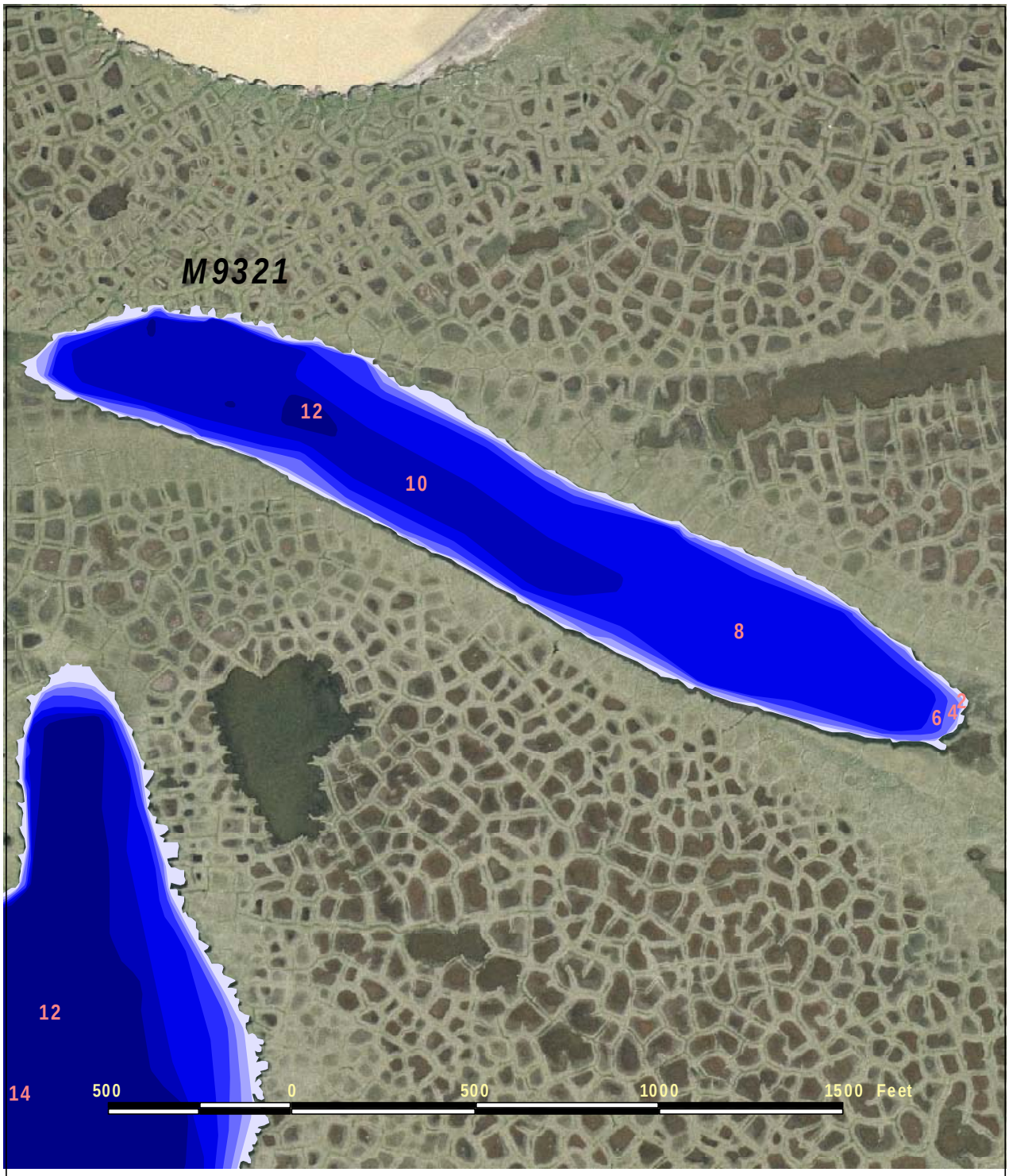
| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gill Net | Aug 1 99 | 4.5 | None | 0 |
| | Aug 2 99 | 5.0 | None | 0 |
| Observed | Jul 29 06 | | Ninespine stickleback | 1 |




Regions of lake L9908 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 29, 2006.

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


Depth transects measured on lake L9908 on July 29, 2006.




Depth contours of lake M9321 based on transects surveyed on July 14, 2006
(depths in 2 foot intervals)

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

## Lake M9321

**Other Names:** R6.4
**Location:** 70.37884°N 150.93592°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E, Sec. 20
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 21.6 acres
**Maximum Depth:** 15.1 feet
**Active Outlet:** No
**Total Lake Volume:** 59.2 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 32.5 million gallons
**Water Volume Under 5 ft of ice:** 26.2 million gallons
**Water Volume Under 7 ft of ice:** 14.6 million gallons

**Potential Ice Aggregate:** 2.0 acres (water depth 4 ft or less)
0.16 million gallons

**Maximum Recommended Winter Removal:** **2.18 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

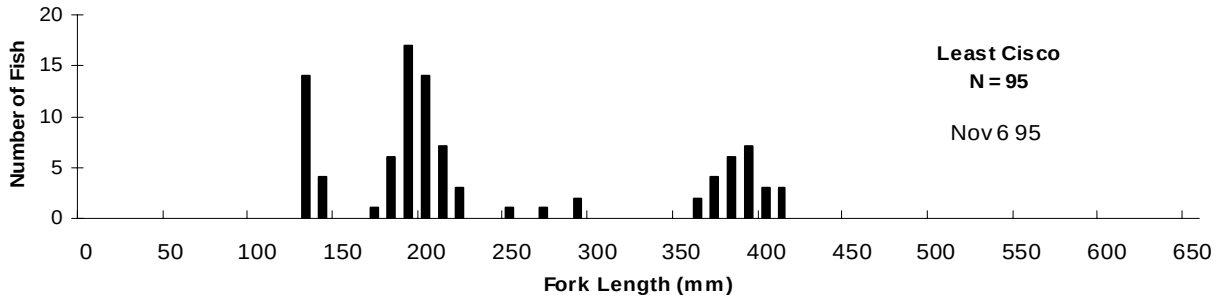
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

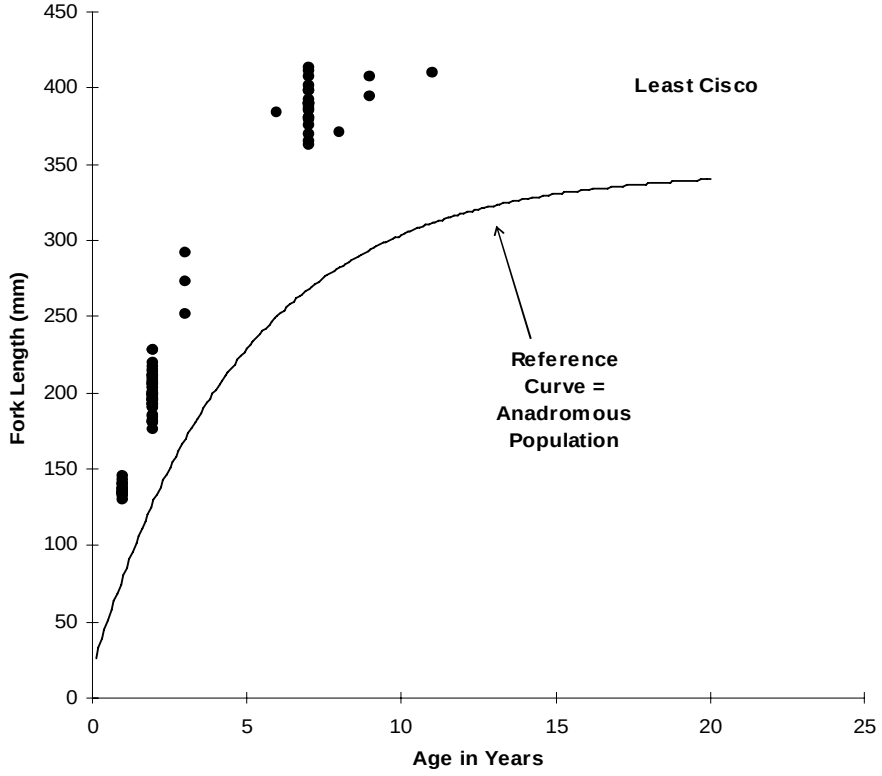
**Water Chemistry:**

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1995 | -- | -- | -- | -- | -- | 146 | -- | -- | Moulton 98 |
| 2006 | 9.3 | 6.2 | 13.8 | 30.7 | 49 | 171 | 1.2 | 7.78 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Fyke Net | Jul 17 95 | 21.4 | Ninespine stickleback | 220 | |
| Minnow Trap | Jul 17 95 | 44.3 | None | 0 | |
| Set Line | Jul 17 95 | 22.1 | None | 0 | |
| Gill Net | Nov 6 95 | 23.1 | Least cisco | 96 | 130-413 |


Number of Fish
20
15
10
5
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Fork Length (mm)
Least Cisco
N = 95
Nov 6 95


Fork Length (mm)
450
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
Age in Years
Least Cisco
Reference Curve = Anadromous Population


Regions of lake M9321 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 14, 2006.

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


Depth transects measured on lake M9321 on July 14, 2006.


Lake M9521 was less than 4 feet deep when sampled on August 5, 2006.

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

## Lake M9521

**Other Names:** S7.2
**Location:** 70.35938°N 150.88491°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E, Sec. 28
**Habitat:** Tapped Lake
**Area:** 212 acres
**Maximum Depth:** 2.2 feet
**Active Outlet:** Yes
**Total Lake Volume:** not estimated, max. depth 2.2 ft (2006 data)
**Water Volume Under 4 ft of ice:** 0.00 million gallons
**Water Volume Under 5 ft of ice:** 0.00 million gallons
**Water Volume Under 7 ft of ice:** 0.00 million gallons

**Potential Ice Aggregate:** 211.7 acres (water depth 4 ft or less)
16.57 million gallons

**Maximum Recommended Winter Removal:** **0.00 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

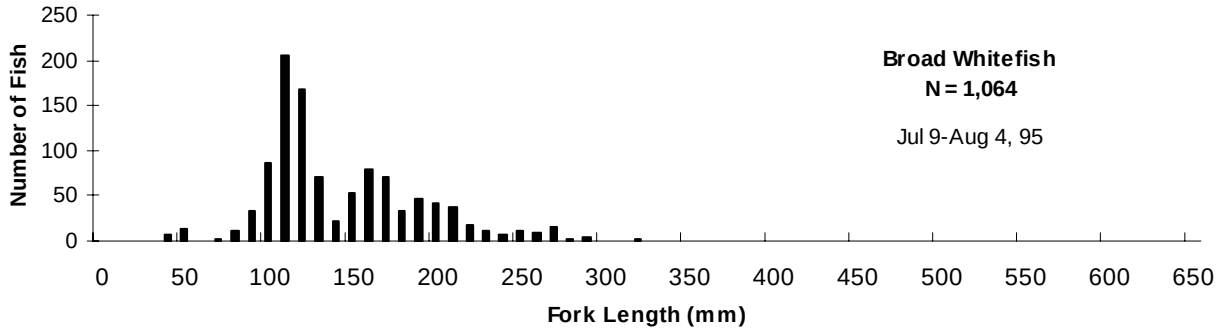
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| none | |

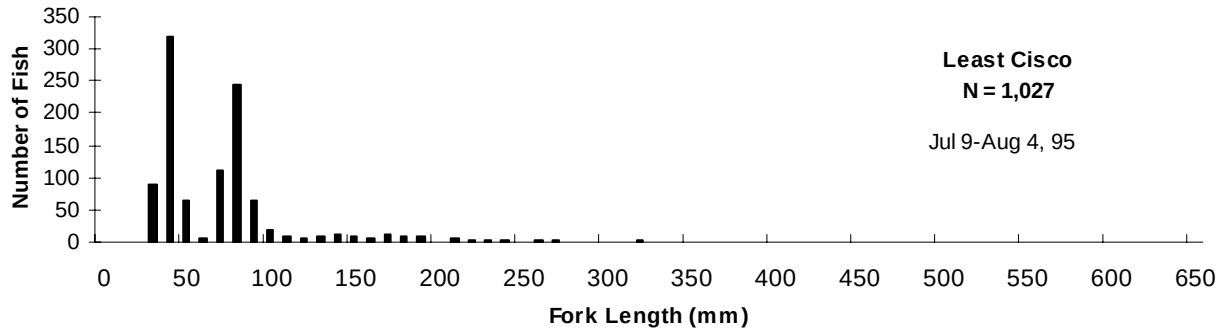
**Water Chemistry:**

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1995 | -- | -- | -- | -- | -- | 608 | -- | -- | Moulton 95 |
| 2006 | 28.5 | 25.7 | 174.0 | 307.0 | 177 | 1246 | 5 | 8.03 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Fyke Net | Jul 7- Aug 4, 95 | 641.3 | Broad whitefish | 1,071 | 37-325 |
| | | | Humpback whitefish | 152 | 31-410 |
| | | | Round whitefish | 211 | 56-267 |
| | | | Least cisco | 1,462 | 31-327 |
| | | | Arctic grayling | 10 | 71-194 |
| | | | Rainbow smelt | 130 | 24-83 |
| | | | Burbot | 2 | 179-227 |
| | | | Longnose sucker | 30 | 68-330 |
| | | | Fourhorn sculpin | 54 | |
| | | | Ninespine stickleback | 244 | |
| | | | Threespine stickleback | 1 | 83 |
| Minnow Trap | Jul 12 95 | 41.8 | None | 0 | |
| Set Line | Jul 12 95 | 21.1 | None | 0 | |

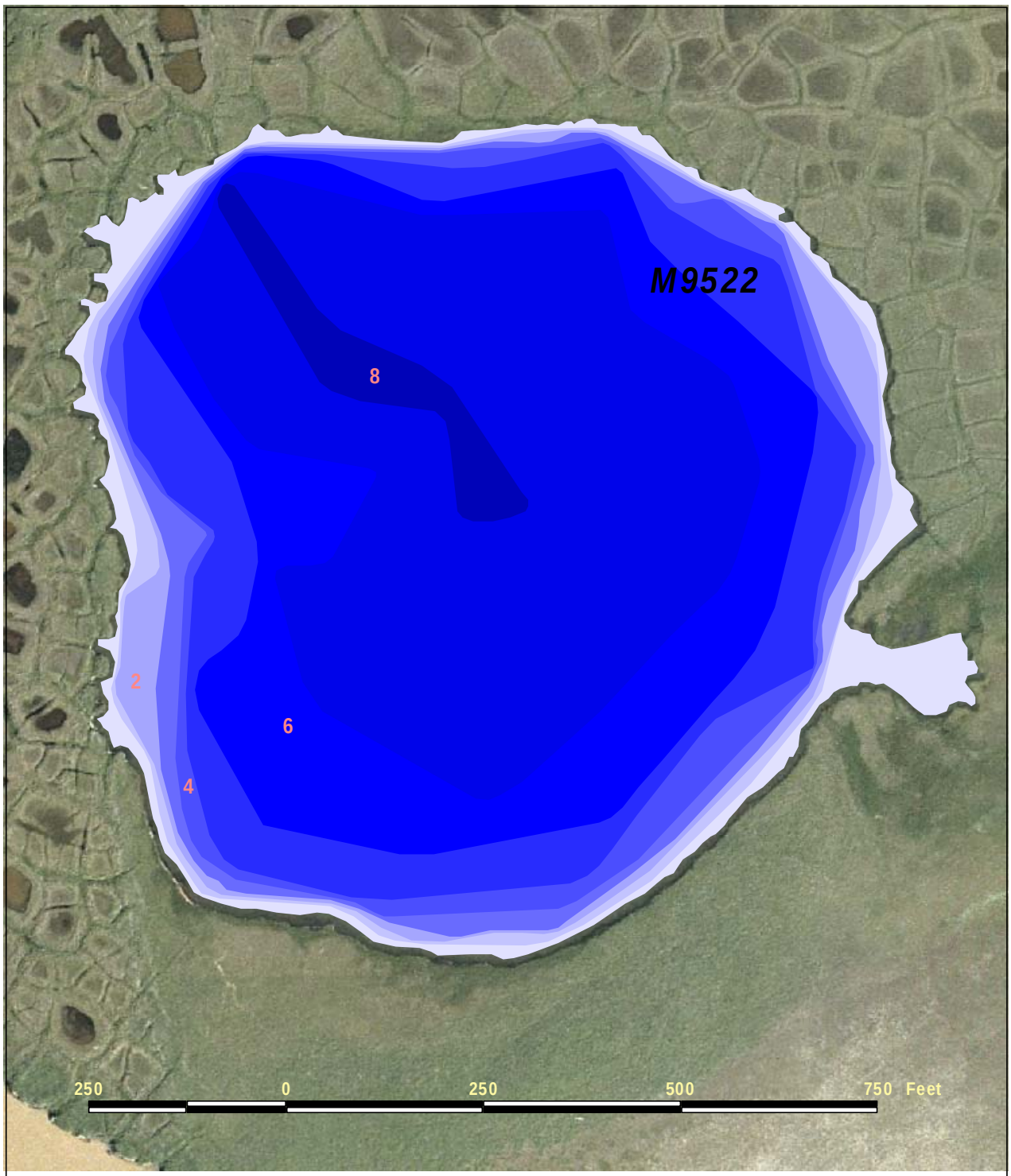

Number of Fish
250
200
150
100
50
0
Broad Whitefish
N = 1,064
Jul 9-Aug 4, 95
0 50 100 150 200 250 300 350 400 450 500 550 600 650
Fork Length (mm)


Number of Fish
350
300
250
200
150
100
50
0
Least Cisco
N = 1,027
Jul 9-Aug 4, 95
0 50 100 150 200 250 300 350 400 450 500 550 600 650
Fork Length (mm)


Lake M9521 was less than 4 feet deep and likely to be available for ice chips, based on survey of August 5, 2006.

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


Lake M9521 was too shallow to transect on August 5, 2006.




Depth contours of lake M9522 based on transects surveyed on July 13, 2006
(depths in 1 foot intervals)

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

## Lake M9522

**Other Names:** R6.1
**Location:** 70.36618°N 150.91137°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E, Sec. 29
**Habitat:** Perched Lake (Frequent Flooding)
**Area:** 21.1 acres
**Maximum Depth:** 9.0 feet
**Active Outlet:** No
**Total Lake Volume:** 40.2 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 15.2 million gallons
**Water Volume Under 5 ft of ice:** 9.71 million gallons
**Water Volume Under 7 ft of ice:** 1.39 million gallons

**Potential Ice Aggregate:** 3.8 acres (water depth 4 ft or less)
0.29 million gallons

**Maximum Recommended Winter Removal:** **15.17 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

**Water Use History:**

| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**Water Chemistry:**

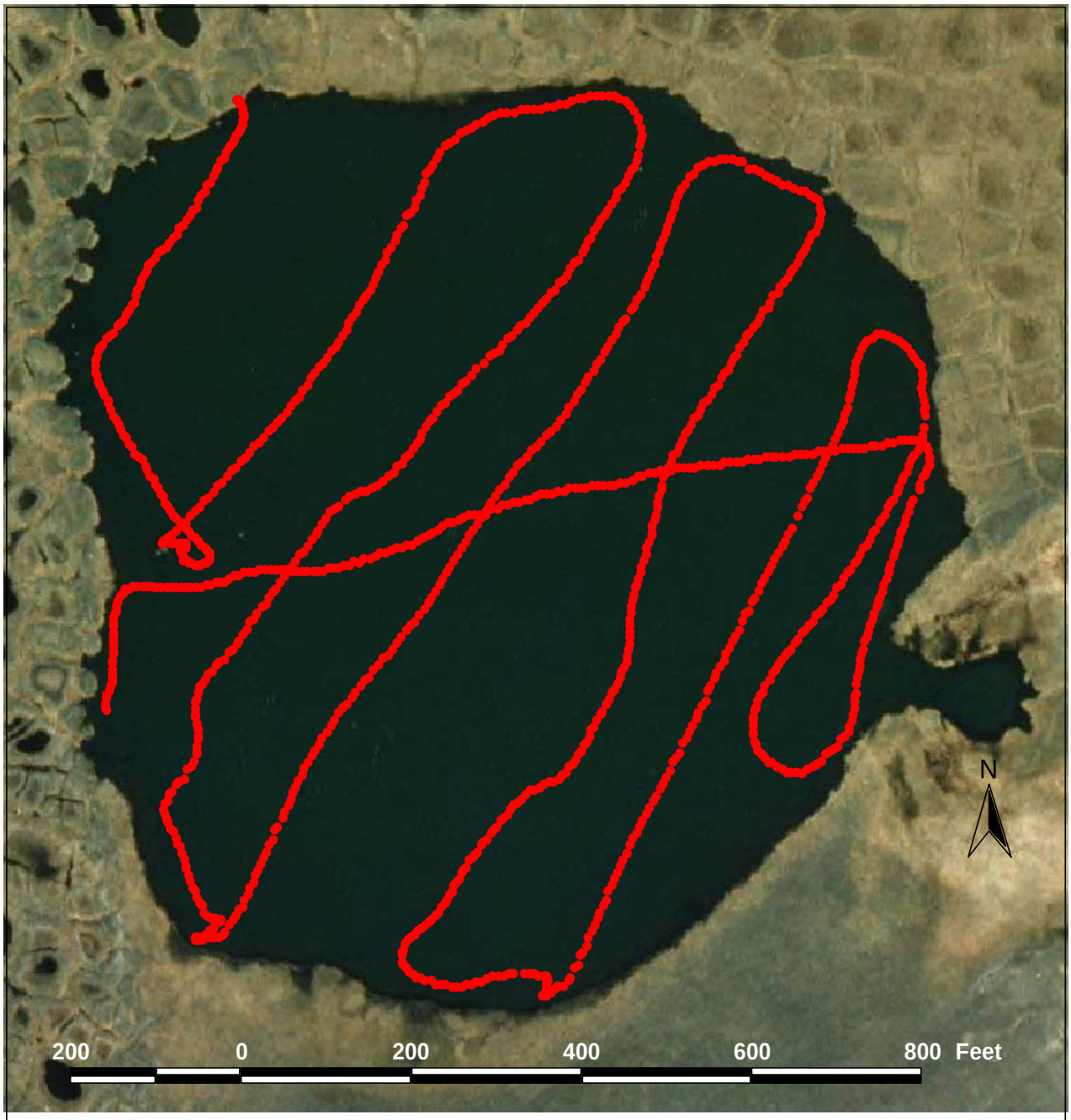
| Year of Test | Calcium (mg/l | Magnesium (mg/l) | Sodium (mg/l) | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) | Specific Conductance (microS/cm) | Turbidity (NTU) | pH | Source |
|---|---|---|---|---|---|---|---|---|---|
| 1996 | -- | -- | -- | -- | -- | 4290 | -- | -- | Moulton 98 |
| 2006 | 29.2 | 43.2 | 381 | 663 | 251 | 2215 | 2.90 | 7.72 | this study |

**Catch Record:**

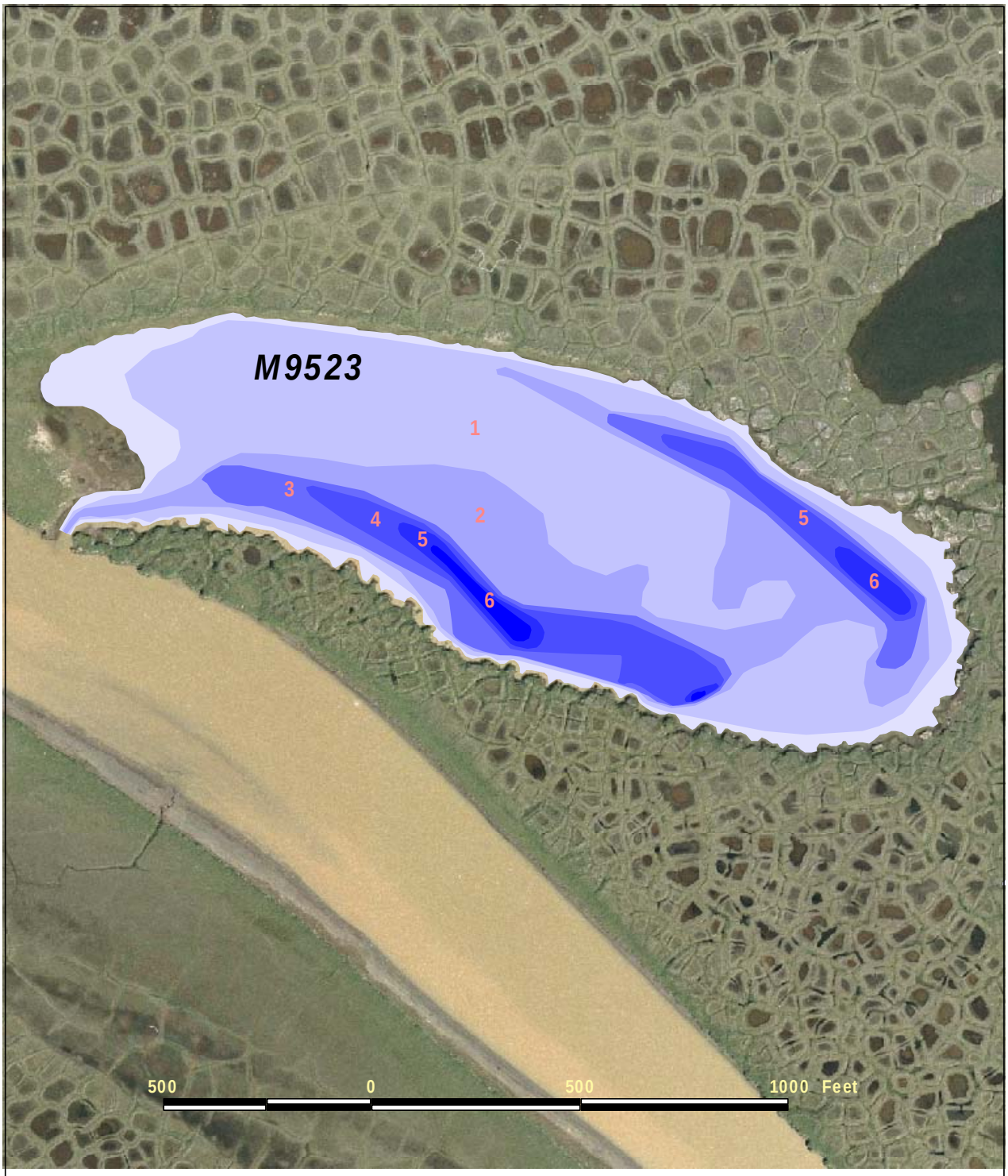
| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gill Net | Aug 3 96 | 11.2 | None | 0 |


Regions of lake M9522 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 13, 2006.

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




Depth transects measured on lake M9522 on July 13, 2006.




Depth contours of lake M9523 based on transects surveyed on July 16, 2006
(depths in 1 foot intervals)

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

## Lake M9523

**Other Names:** R6.2
**Location:** 70.36929°N 150.92471°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E, Sec. 29
**Habitat:** Tapped Lake
**Area:** 30.4 acres
**Maximum Depth:** 6.9 feet
**Active Outlet:** Yes
**Total Lake Volume:** 20.7 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 0.81 million gallons
**Water Volume Under 5 ft of ice:** 0.19 million gallons
**Water Volume Under 7 ft of ice:** 0.00 million gallons

**Potential Ice Aggregate:** 27.1 acres (water depth 4 ft or less)
2.12 million gallons

**Maximum Recommended Winter Removal:** **0.00 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

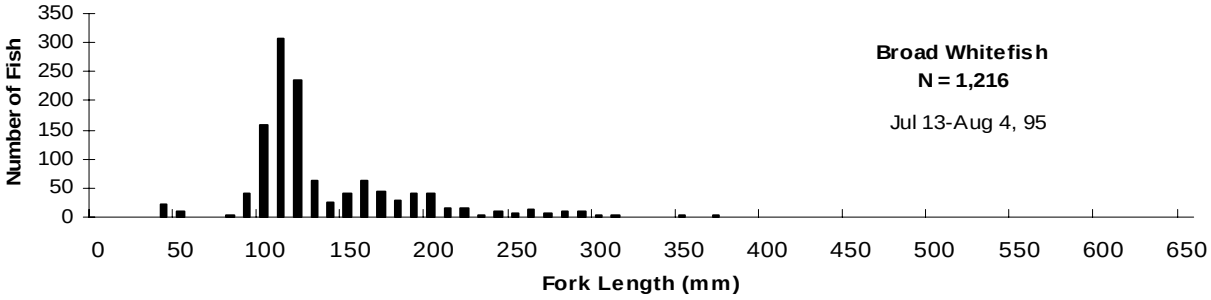
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

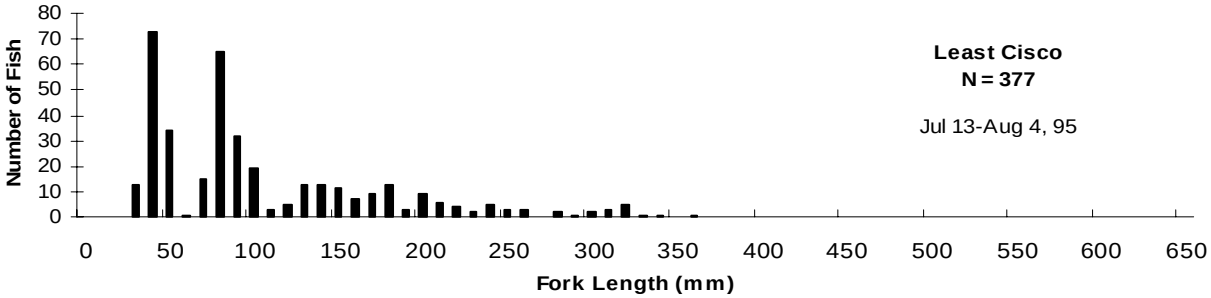
**Water Chemistry:**

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1995 | -- | -- | -- | -- | -- | 593 | -- | -- | Moulton 98 |
| 2006 | 31.2 | 29.5 | 227.0 | 377.0 | 199 | 1797 | 8.9 | 7.93 | this study |

**Catch Record:**

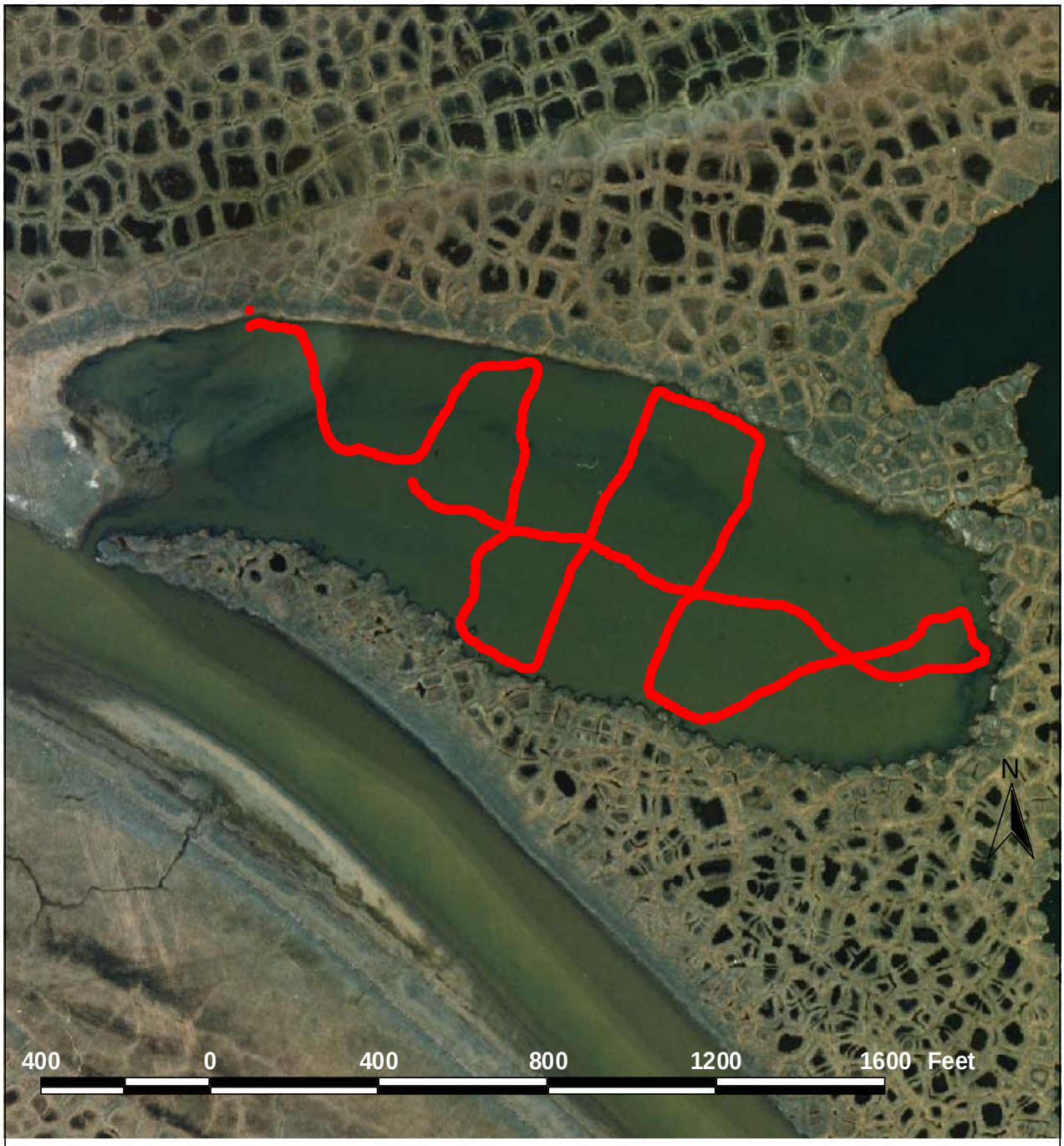
| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Fyke Net | Jul 13-Aug 4, 95 | 541.2 | Broad whitefish | 1,218 | 35-403 |
| | | | Humpback whitefish | 166 | 79-359 |
| | | | Round whitefish | 367 | 54-275 |
| | | | Least cisco | 478 | 35-365 |
| | | | Arctic grayling | 22 | 80-155 |
| | | | Rainbow smelt | 53 | 30-77 |
| | | | Burbot | 6 | 103-261 |
| | | | Longnose sucker | 22 | 59-215 |
| | | | Fourhorn sculpin | 20 | |
| | | | Ninespine stickleback | 176 | |


Number of Fish
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Fork Length (mm)
Broad Whitefish
N = 1,216
Jul 13-Aug 4, 95

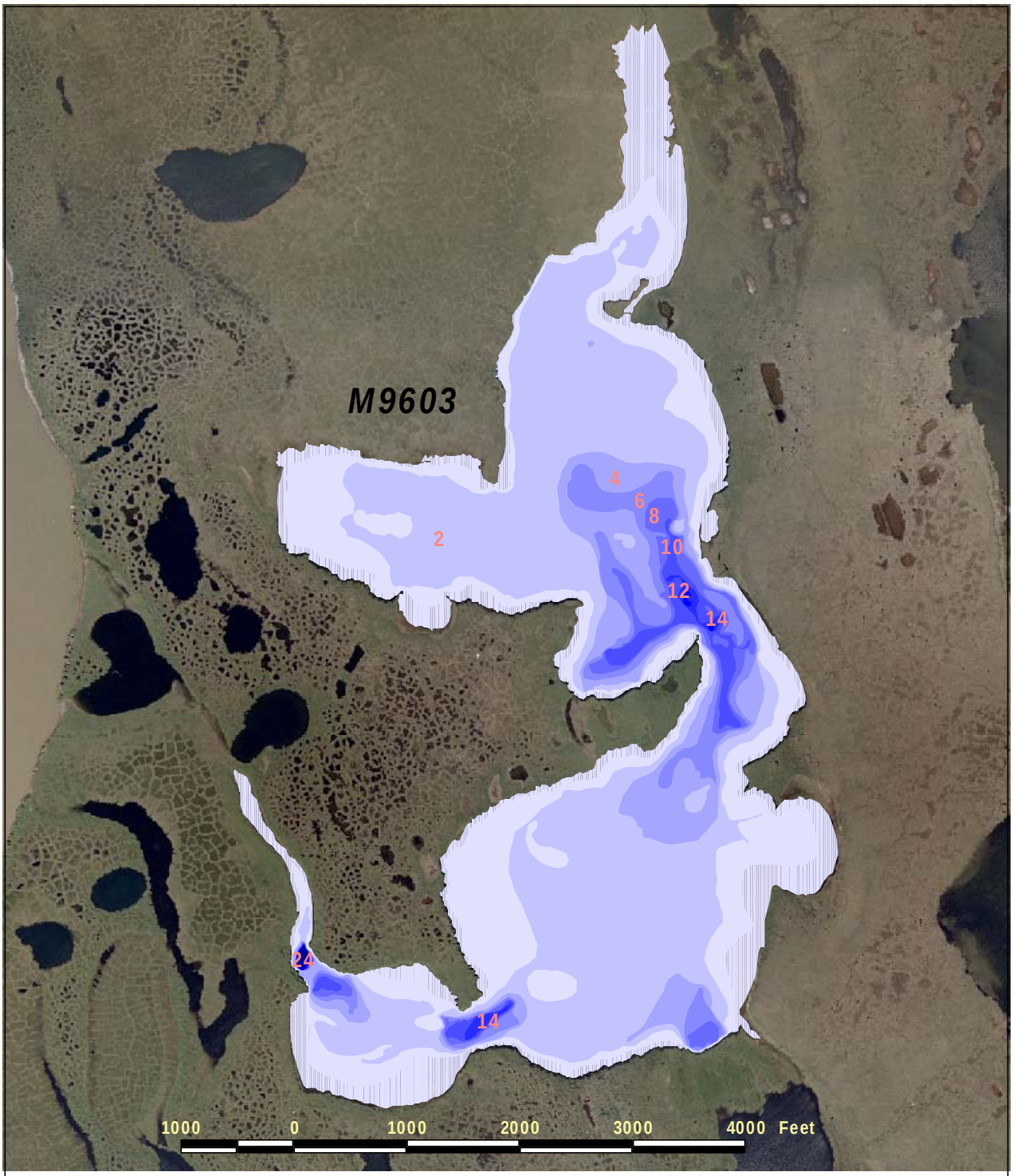

Number of Fish
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Fork Length (mm)
Least Cisco
N = 377
Jul 13-Aug 4, 95


Regions of lake M9523 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 16, 2006.

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




Depth transects on lake M9523 on July 16, 2006.




Depth contours of lake M9603 based on transects surveyed on July 19, 2006.
(depths in 2 foot intervals)

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

## Lake M9603

**Other Names:** BB9.1
**Location:** 70.21041°N 150.78031°W
**USGS Quad Sheet:** Harrison Bay A-2: T10N R5E, Sec. 14, 23
**Habitat:** Drainage Lake
**Area:** 465.7 acres
**Maximum Depth:** 27.3 feet
**Active Outlet:** Yes
**Total Lake Volume:** 696.2 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 200.3 million gallons
**Water Volume Under 5 ft of ice:** 125.4 million gallons
**Water Volume Under 7 ft of ice:** 58.1 million gallons

**Potential Ice Aggregate:** 185.7 acres (water depth 4 ft or less)
14.53 million gallons

**Maximum Recommended Winter Removal:** **8.72 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

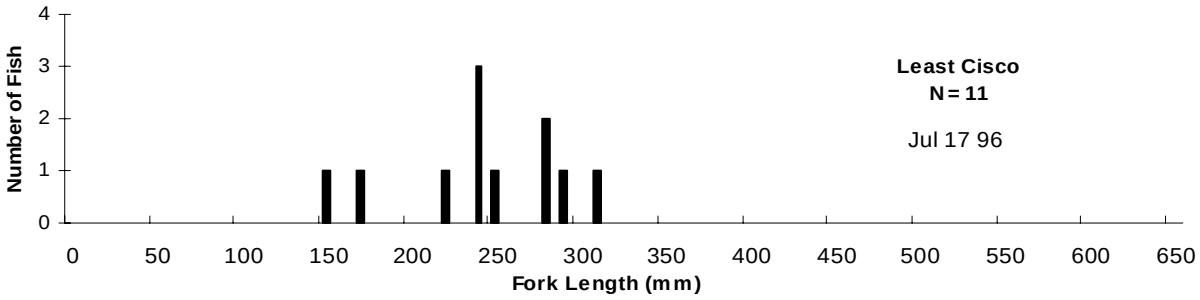
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| 2005-2006 | 1.81 |

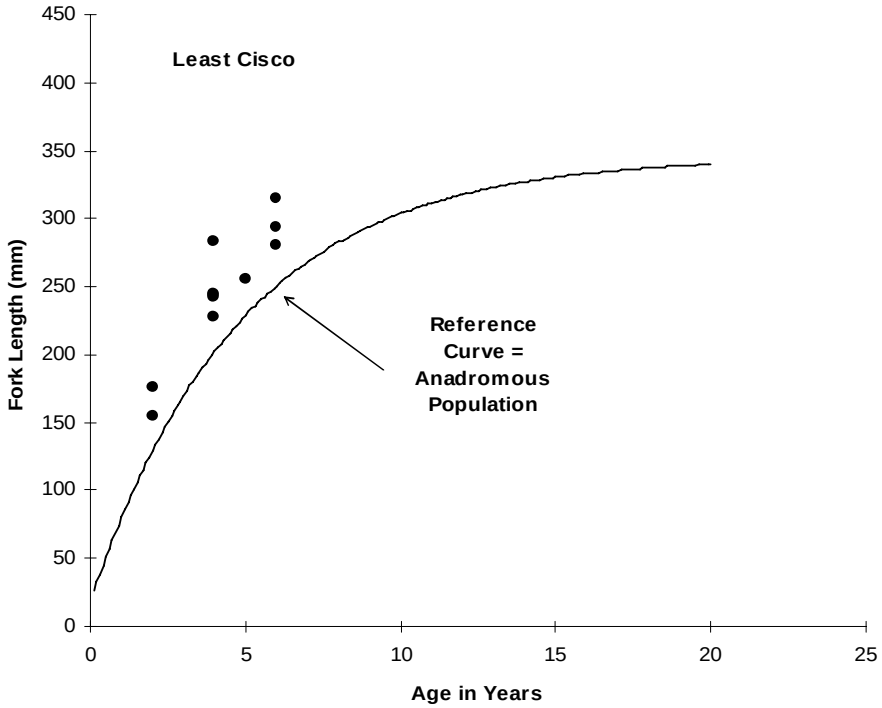
**Water Chemistry:**

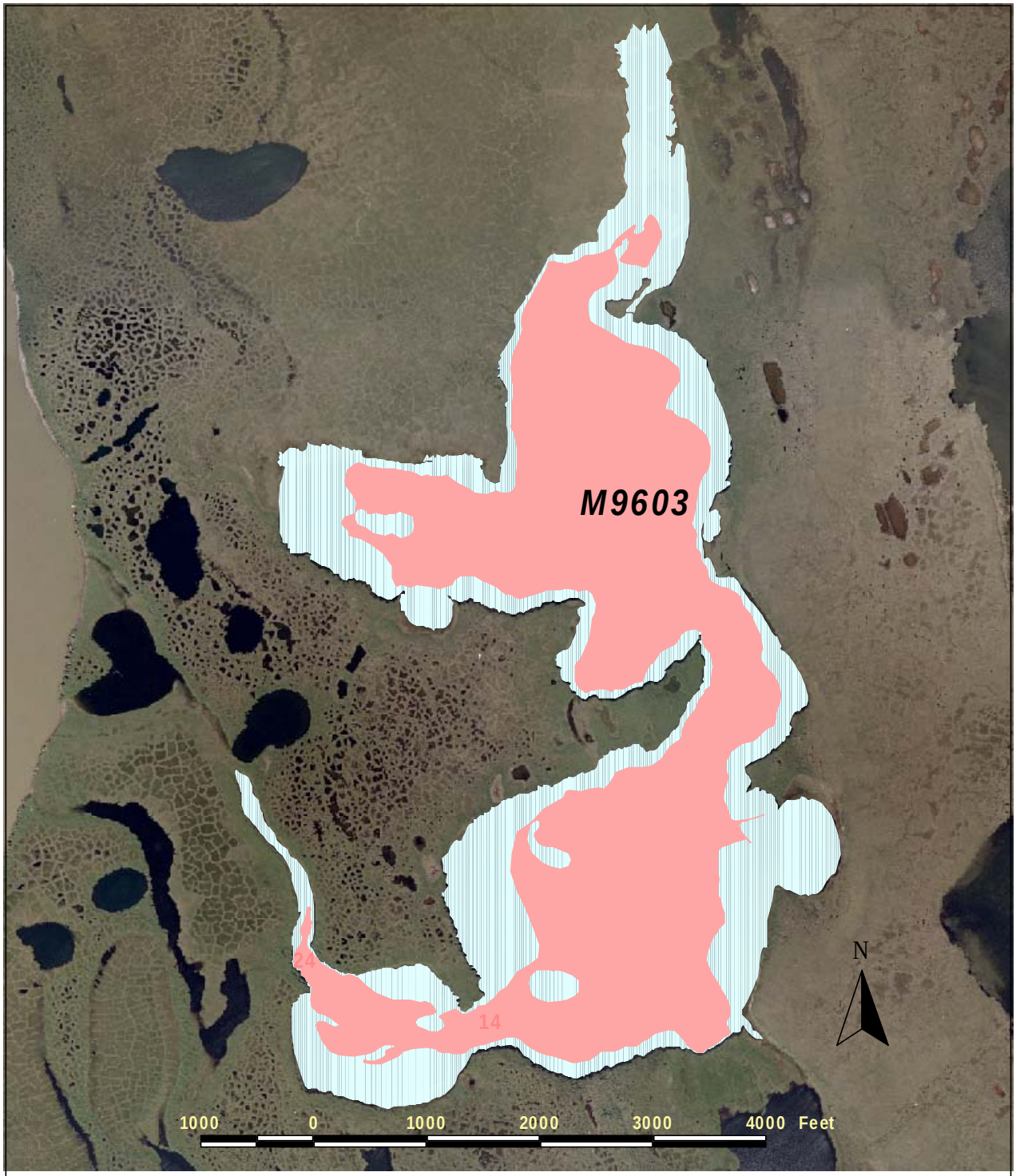
| Year of Test | Calcium (mg/l | Magnesium (mg/l) | Sodium (mg/l) | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) | Specific Conductance (microS/cm) | Turbidity (NTU) | pH | Source |
|---|---|---|---|---|---|---|---|---|---|
| 1996 | 25.4 | 3.3 | 8.3 | 11.0 | 77 | 165 | -- | 8.29 | Moulton 98 |
| 2002 | -- | -- | -- | -- | -- | 138 | 1.4 | 8.01 | |
| 2006 | 14.8 | 2.2 | 1.6 | 2.7 | 46.2 | 98 | 4.5 | 7.95 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gill Net | Jul 17 96 | 8.1 | Least cisco | 2 | 286, 318 |
| Gill Net | Jul 27 96 | 10.9 | Least cisco | 9 | 155-294 |
| | | | Arctic grayling | 1 | 237 |

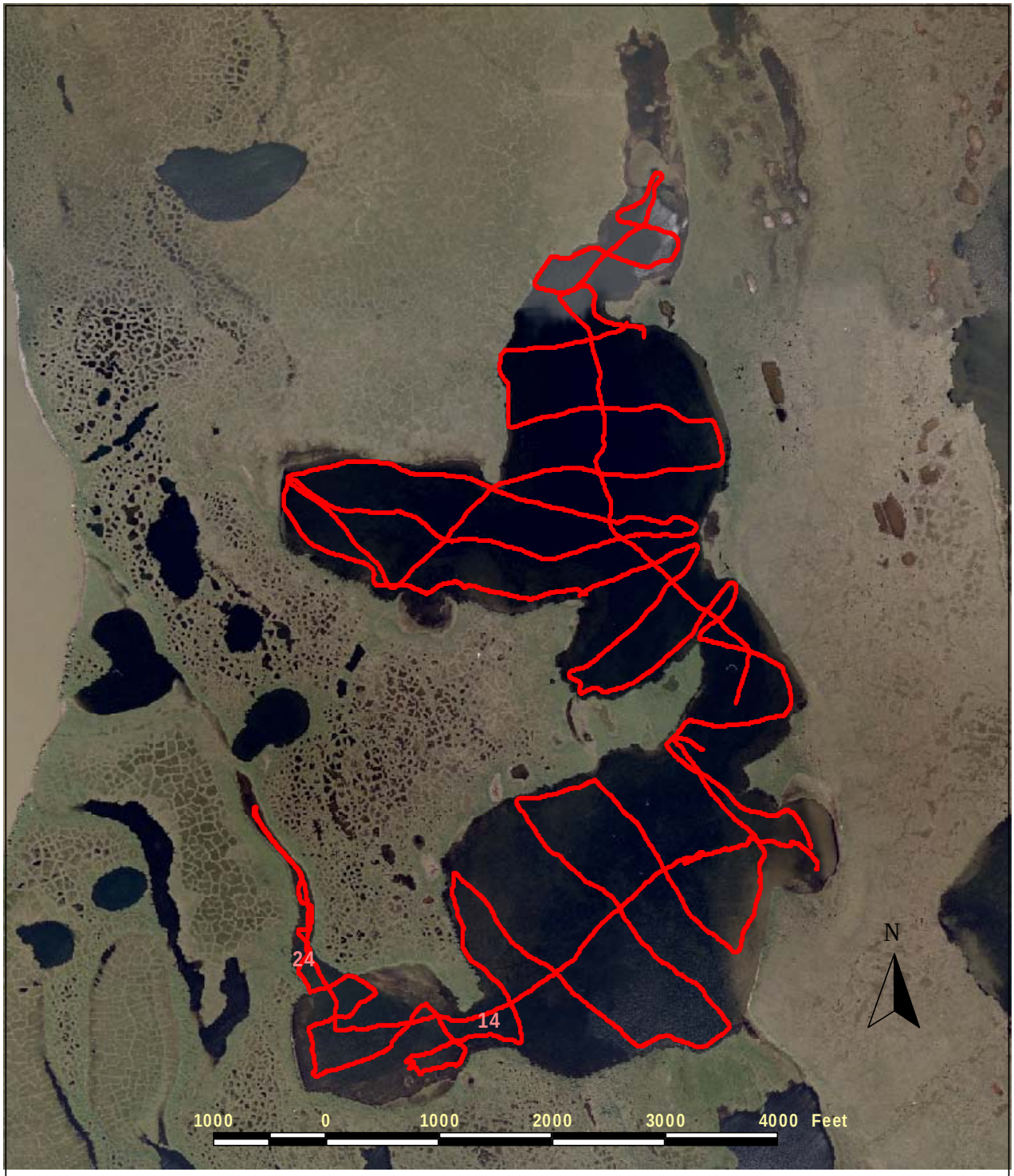

Number of Fish
Fork Length (mm)
Least Cisco
N = 11
Jul 17 96


Least Cisco
Fork Length (mm)
Age in Years
Reference Curve = Anadromous Population

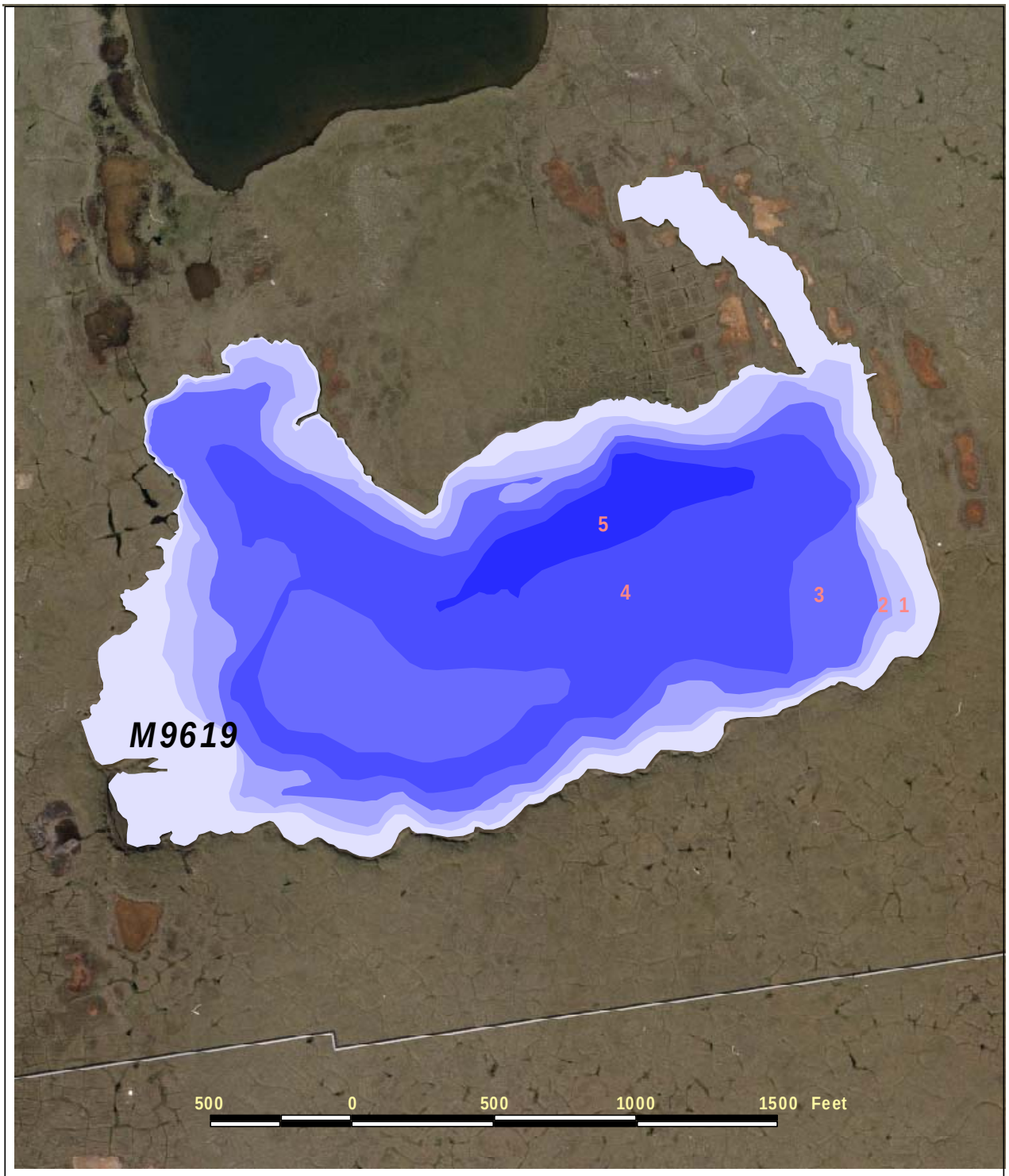



Regions of lake M9603 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on July 19, 2006.

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




Depth transects measured on lake M9603 on July 19, 2006.




Depth contours of lake M9619 based on transects surveyed on July 29, 2006.
(depths in 1 foot intervals)

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

## Lake M9619

**Other Names:** Z18.1
**Location:** 70.24370°N 150.33120°W
**USGS Quad Sheet:** Harrison Bay A-1: T10N R7E, Sec. 3
**Habitat:** Tundra Lake
**Area:** 91.0 acres
**Maximum Depth:** 6.6 feet
**Active Outlet:** No
**Total Lake Volume:** 88.1 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 5.70 million gallons
**Water Volume Under 5 ft of ice:** 0.49 million gallons
**Water Volume Under 7 ft of ice:** 0.00 million gallons

**Potential Ice Aggregate:** 59.3 acres (water depth 4 ft or less)
4.64 million gallons

**Maximum Recommended Winter Removal:** **5.70 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

**Water Use History:**

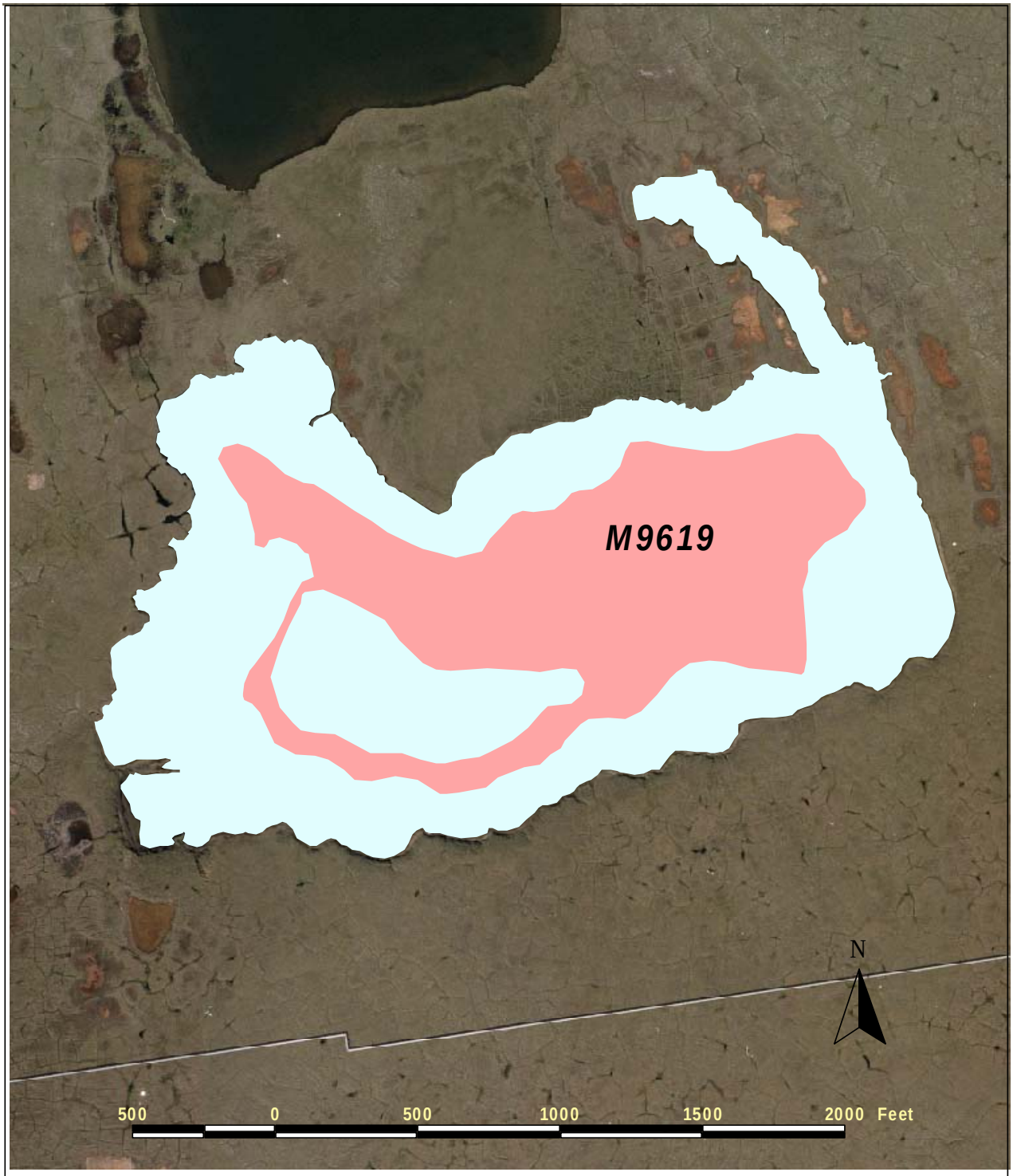
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 1996 | 39.0 | 5.7 | 21.5 | 43.0 | 121 | -- | -- | -- | Moulton 98 |
| 2006 | 49.3 | 7.2 | 11.0 | 54.0 | 153 | -- | 1.0 | 8.41 | this study |

**Catch Record:**

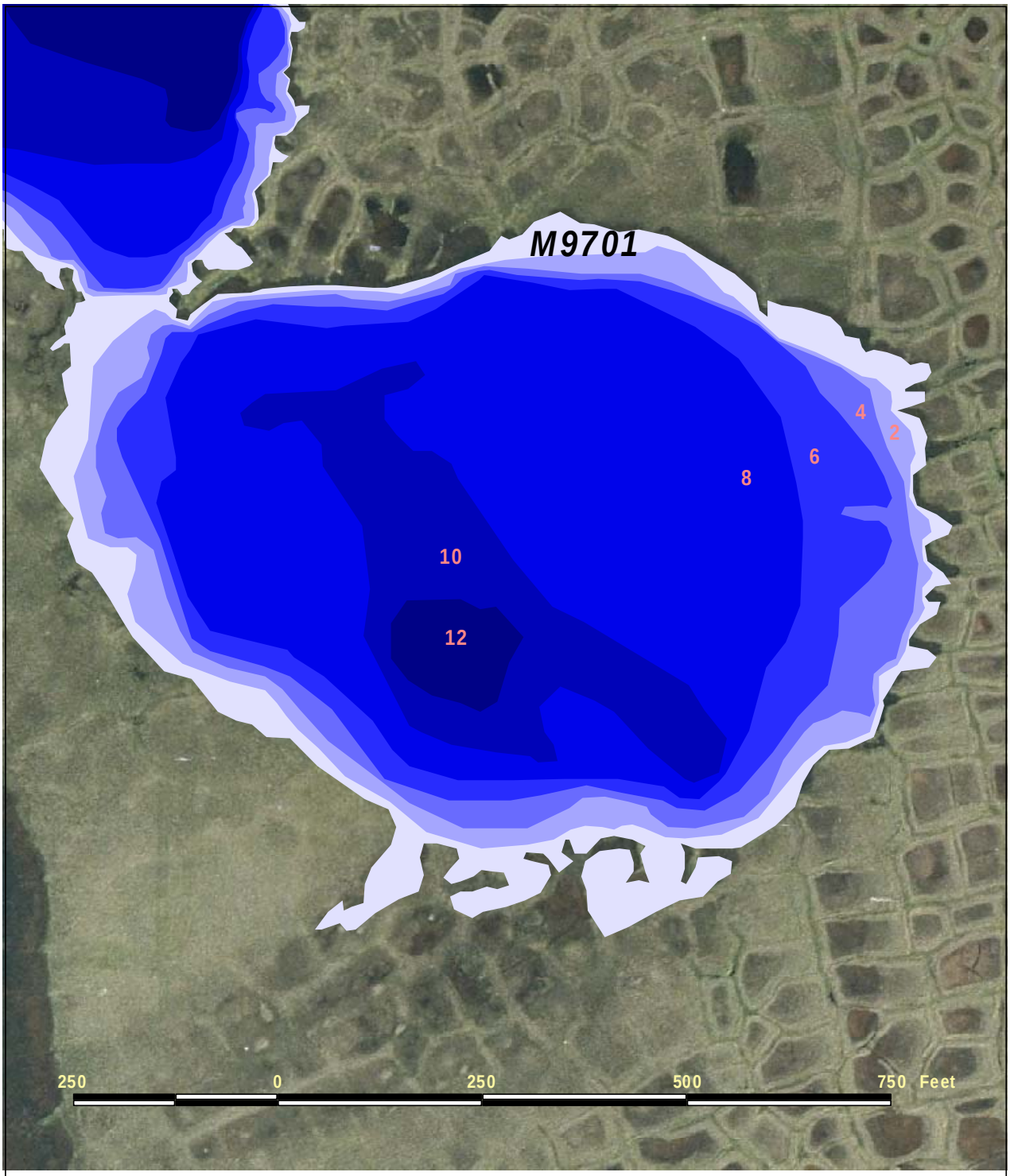
| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gill Net | Jul 30 96 | 11.2 | None | 0 |
| Minnow traps | Jul 20 06 | | None | 0 |
| Seine | Jul 29 06 | 3 hauls | None | 0 |




Regions of lake M9619 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on July 29, 2006.

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


Depth transects measured on lake M9619 on July 29, 2006.




Depth contours of lake M9701 based on transects surveyed on July 17, 2006
(depths in 2 foot intervals)

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

## Lake M9701

**Other Names:** S4.2
**Location:** 70.36288°N 151.02271°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4E, Sec. 25
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 15.6 acres
**Maximum Depth:** 15.6 feet
**Active Outlet:** No
**Total Lake Volume:** 36.6 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 18.7 million gallons
**Water Volume Under 5 ft of ice:** 14.8 million gallons
**Water Volume Under 7 ft of ice:** 7.67 million gallons

**Potential Ice Aggregate:** 3.3 acres (water depth 4 ft or less)
0.26 million gallons

**Maximum Recommended Winter Removal:** **1.15 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

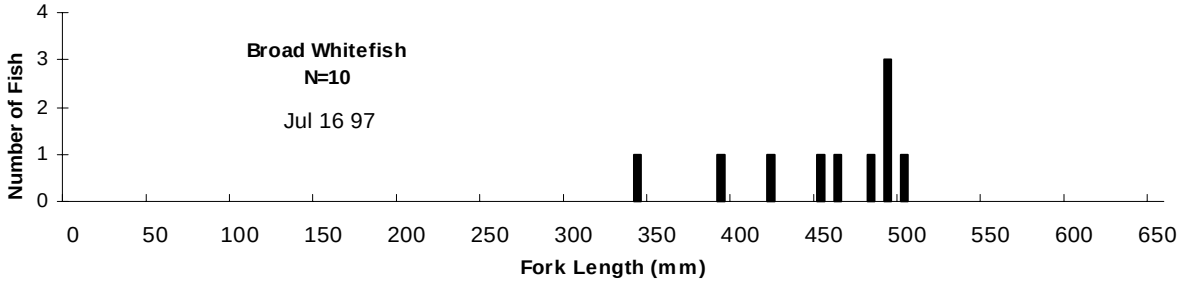
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

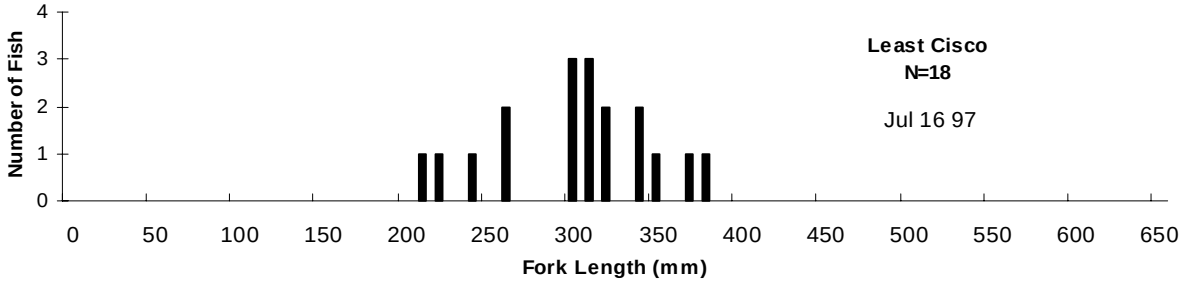
**Water Chemistry:**

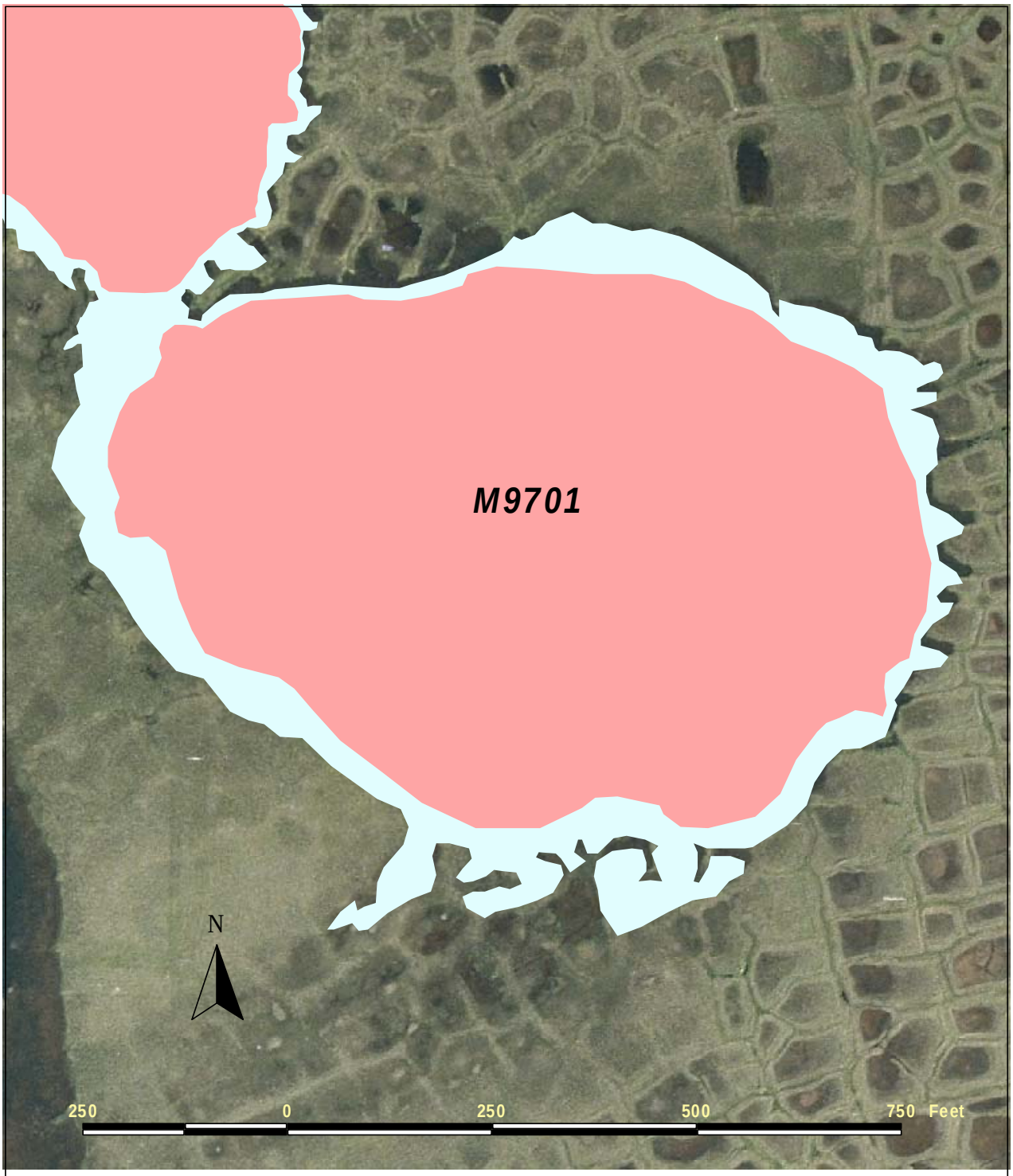
| Year of Test | Calcium (mg/l | Magnesium (mg/l) | Sodium (mg/l) | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) | Specific Conductance (microS/cm) | Turbidity (NTU) | pH | Source |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 14.5 | 4.5 | 47.8 | 45.0 | 55 | 165 | -- | -- | Moulton 98 |
| 2006 | 5.0 | 2.8 | 12.8 | 22.6 | 24 | 116 | 2.8 | 7.60 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gillnet | Jul 16 97 | 19.7 | Broad whitefish | 10 | 342-503 |
| | | | Humpback whitefish | 1 | 472 |
| | | | Least cisco | 18 | 215-381 |
| Minnow Trap | Jul 16 97 | 12.0 | None | 0 | |


Broad Whitefish
N=10
Jul 16 97
Number of Fish
Fork Length (mm)
0
1
2
3
4
0
50
100
150
200
250
300
350
400
450
500
550
600
650

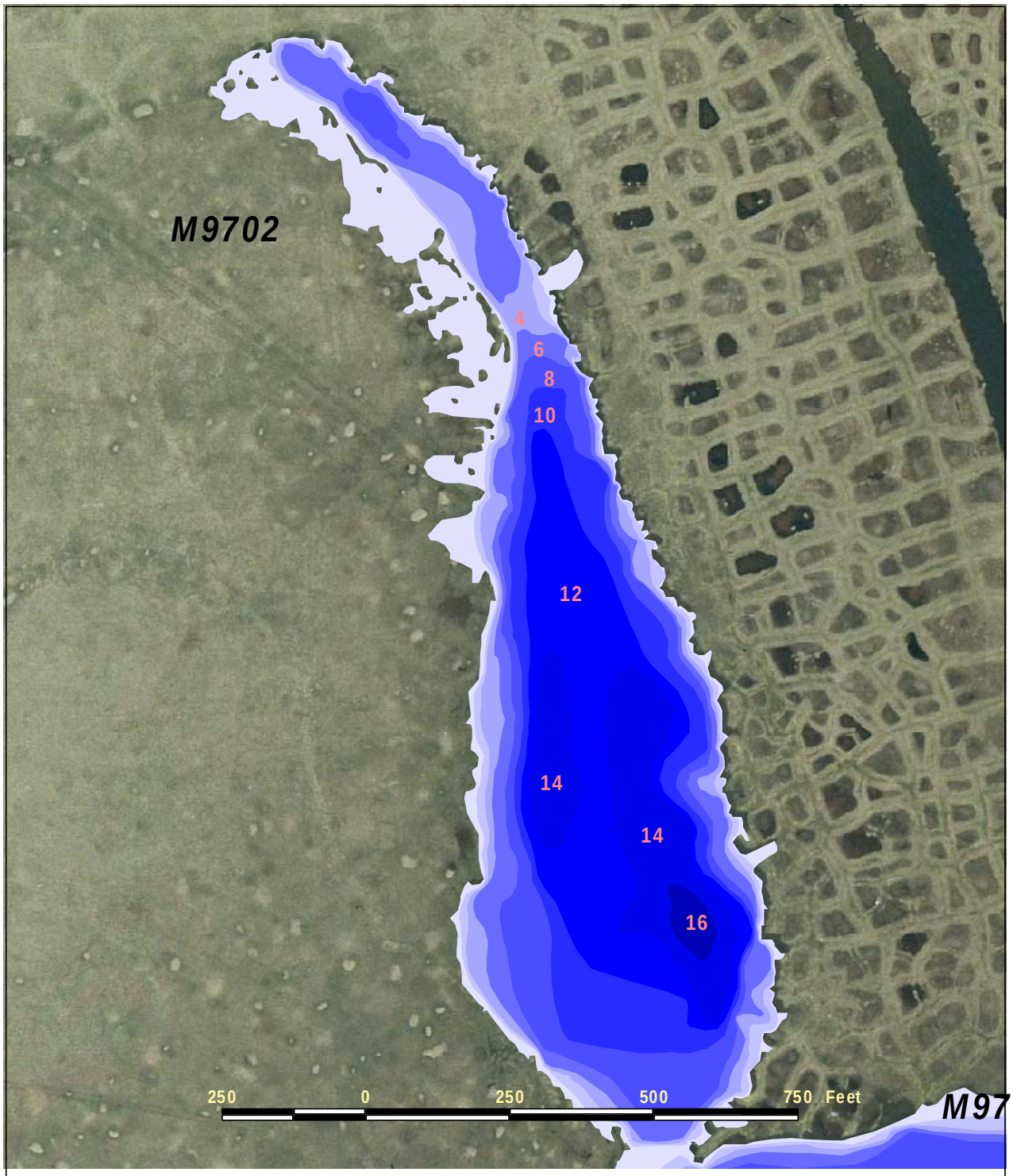

Least Cisco
N=18
Jul 16 97
Number of Fish
Fork Length (mm)
0
1
2
3
4
0
50
100
150
200
250
300
350
400
450
500
550
600
650




Regions of lake M9701 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 17, 2006.

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


Depth transects measured on lake M9701 on July 17, 2006.




Depth contours of lake M9702 based on transects surveyed on July 17, 2006
(depths in 2 foot intervals)

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

## Lake M9702

**Other Names:** S4.3
**Location:** 70.36509°N 151.02775°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4E, Sec. 25
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 16 acres
**Maximum Depth:** 18.1 feet
**Active Outlet:** No
**Total Lake Volume:** 43.8 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 26.0 million gallons
**Water Volume Under 5 ft of ice:** 22.1 million gallons
**Water Volume Under 7 ft of ice:** 15.0 million gallons

**Potential Ice Aggregate:** 3.3 acres (water depth 4 ft or less)
0.26 million gallons

**Maximum Recommended Winter Removal:** **2.25 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| 2000-2001 | 1.65 |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 14.5 | 4.5 | 47.8 | 45.0 | 55 | 165 | -- | -- | Moulton 98 |
| 2006 | 5.1 | 2.8 | 13.7 | 24.2 | 25 | 121 | 3.5 | 7.54 | this study |

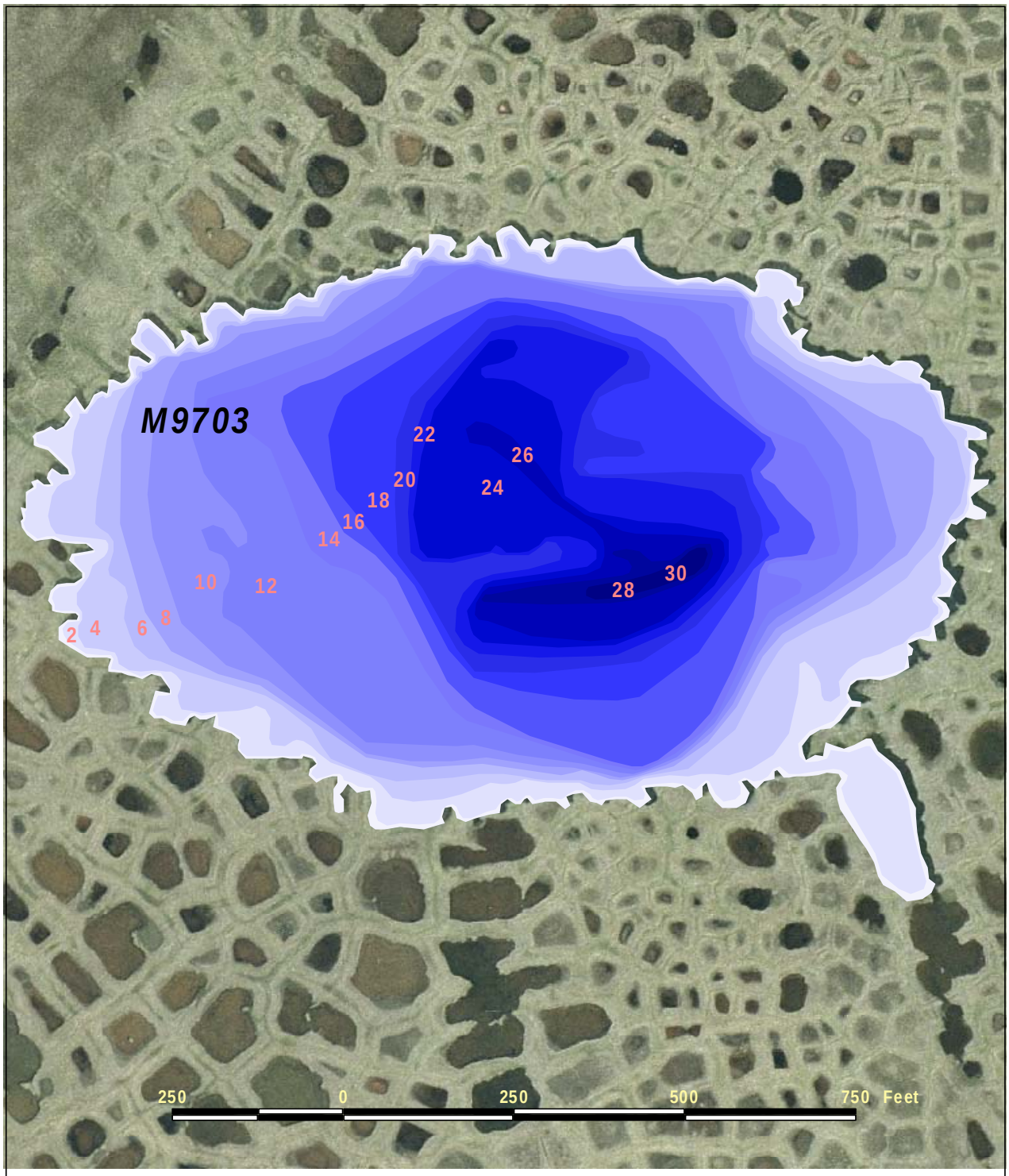
**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| connected to M9701, same catch applies | | | | | |


Regions of lake M9702 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 17, 2006.

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


Depth transects measured on lake M9702 on July 17, 2006.




Depth contours of lake M9703 based on transects surveyed on July 16, 2006
(depths in 2 foot intervals)

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

## Lake M9703

**Other Names:** R4.1
**Location:** 70.37459°N 151.03950°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4E, Sec. 23
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 21.4 acres
**Maximum Depth:** 32.8 feet
**Active Outlet:** No
**Total Lake Volume:** 95.0 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 68.4 million gallons
**Water Volume Under 5 ft of ice:** 62.4 million gallons
**Water Volume Under 7 ft of ice:** 51.2 million gallons

**Potential Ice Aggregate:** 2.4 acres (water depth 4 ft or less)
0.19 million gallons

**Maximum Recommended Winter Removal:** **7.68 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

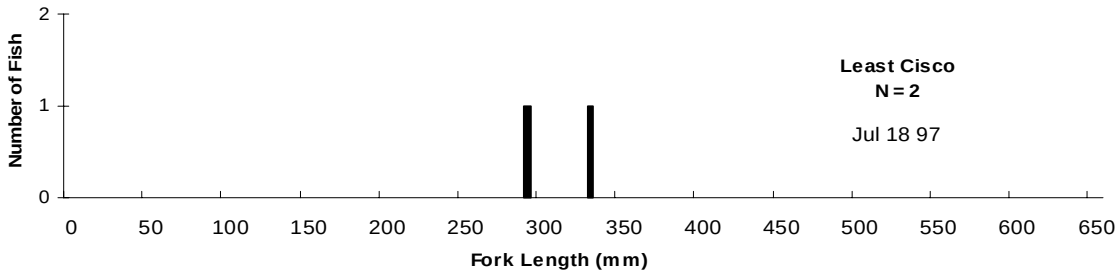
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| 2000-2001 | 5.36 |
| 2004-2005 | 6.67 |

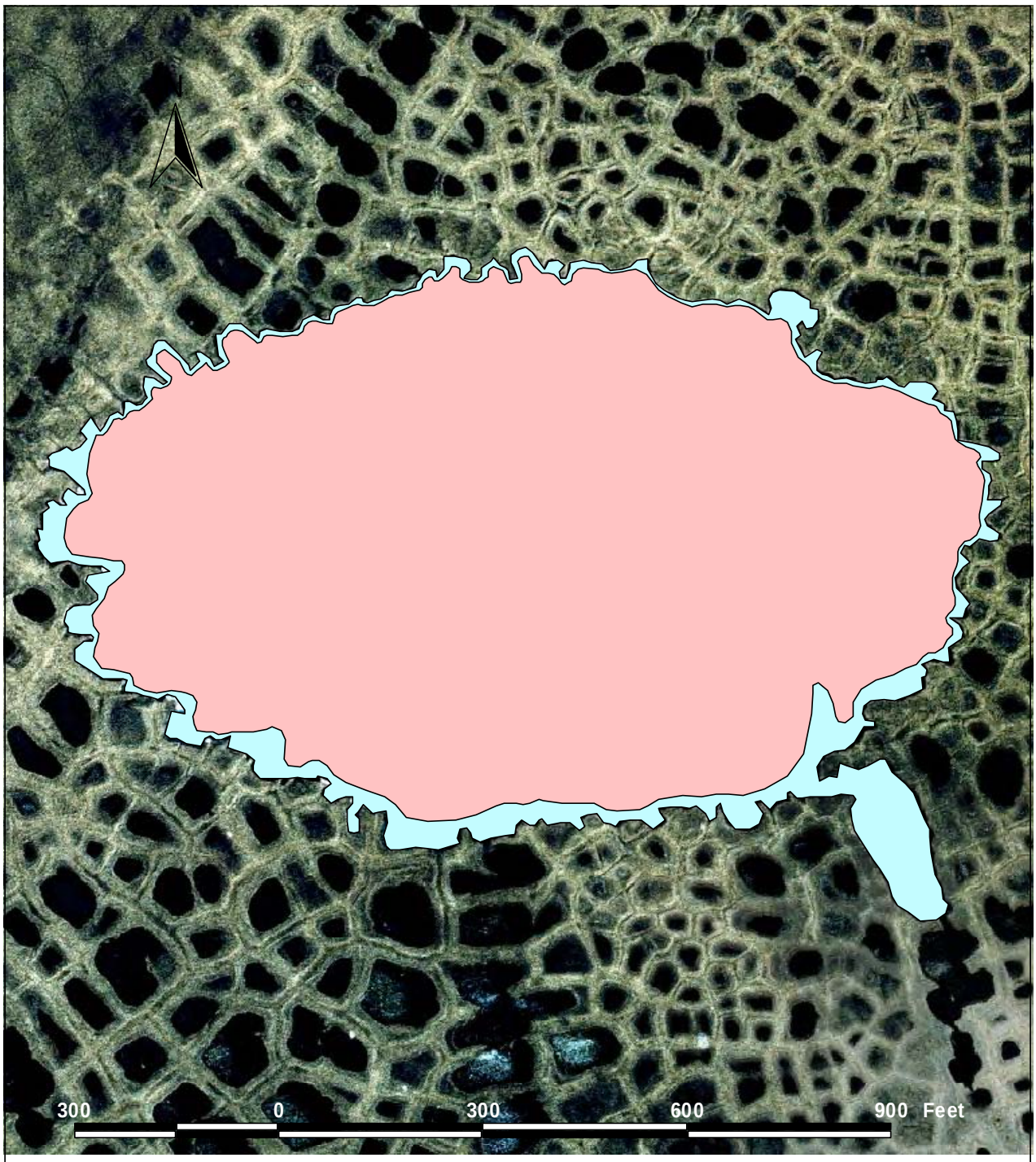
**Water Chemistry:**

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 15.6 | 5.0 | 43.9 | 42.0 | 60 | -- | -- | -- | Moulton 98 |
| 2006 | 7.4 | 4.3 | 15.4 | 28.2 | 36.4 | 147 | 2.2 | 7.36 | this study |

**Catch Record:**

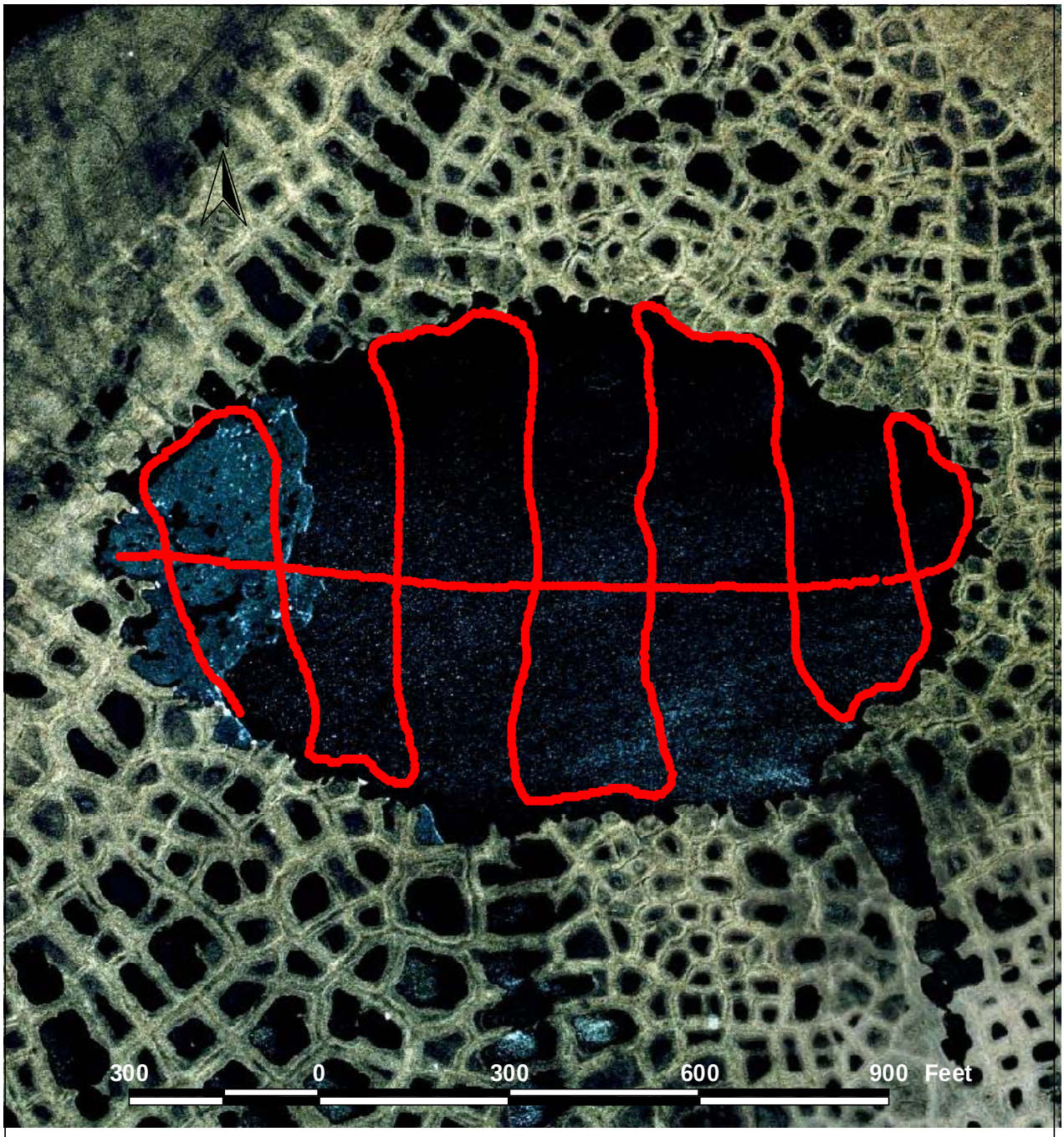
| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gillnet | Jul 18 97 | 6.6 | Least cisco | 2 | 298-330 |
| Minnow Trap | Jul 18 97 | 12.7 | None | 0 | |



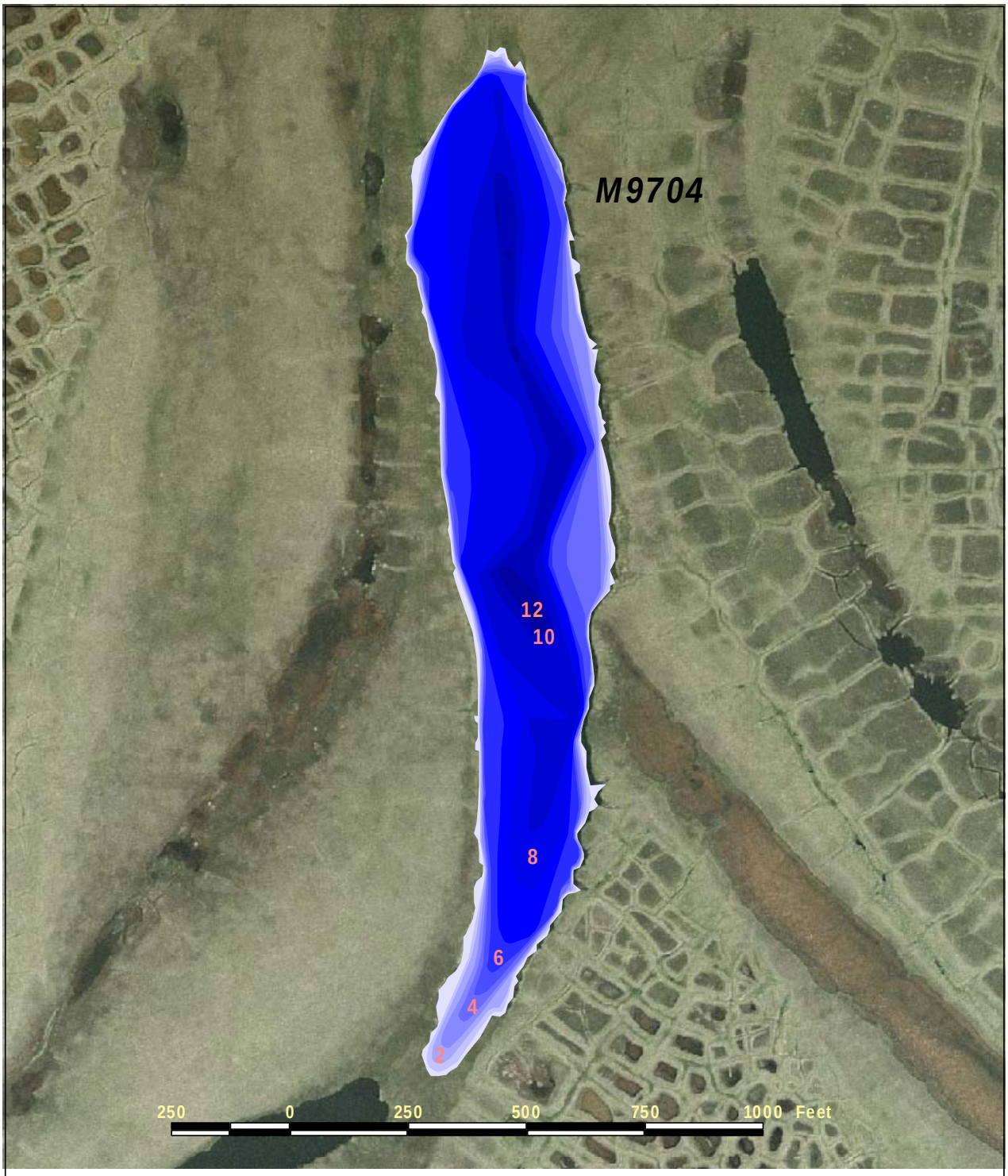



Regions of lake M9703 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 16, 2006.

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




Depth transects measured on lake M9703 on July 16, 2006.




Depth contours of lake M9704 based on transects surveyed on July 16, 2006
(depths in 1 foot intervals)

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

## Lake M9704

**Other Names:** R4.2
**Location:** 70.38170°N 151.04195°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4E, Sec. 23
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 13.1 acres
**Maximum Depth:** 12.4 feet
**Active Outlet:** No

| | | | |
|---|---|---|---|
| **Total Lake Volume:** | 30.3 | million gallons | (2006 data) |
| **Water Volume Under 4 ft of ice:** | 14.5 | million gallons | |
| **Water Volume Under 5 ft of ice:** | 11.0 | million gallons | |
| **Water Volume Under 7 ft of ice:** | 4.79 | million gallons | |
| **Potential Ice Aggregate:** | 1.9 | acres (water depth 4 ft or less) | |
| | 0.15 | million gallons | |

**Maximum Recommended Winter Removal:** **0.72 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

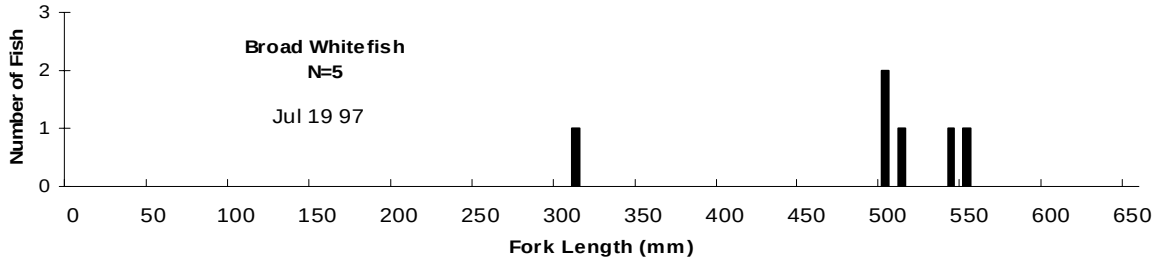
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

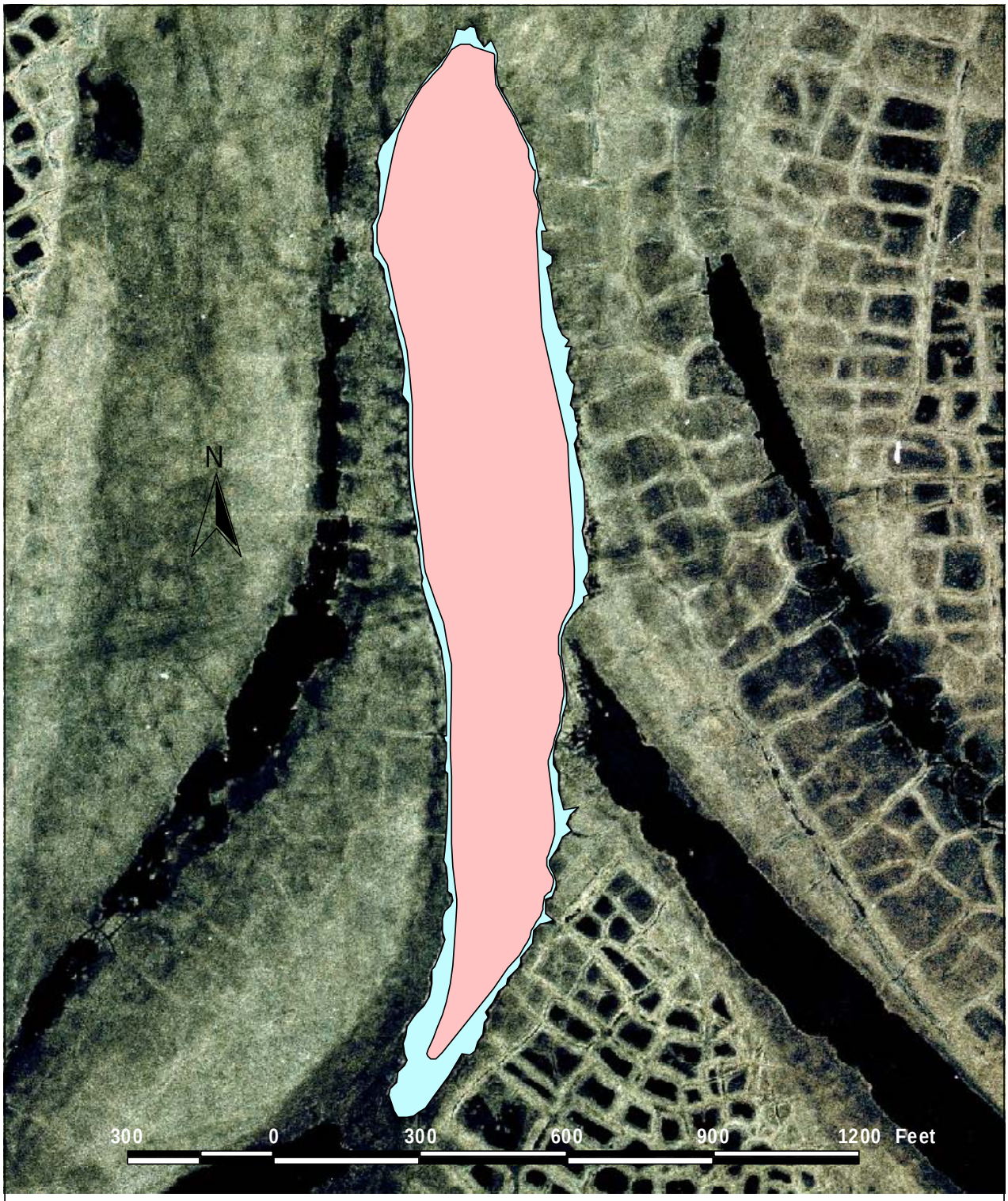
**Water Chemistry:**

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 21.6 | 5.4 | 52.3 | 58.0 | 76 | -- | -- | -- | Moulton 98 |
| 2006 | 4.6 | 3.1 | 14.0 | 26.4 | 24.1 | 120 | 1.0 | 7.30 | this study |

**Catch Record:**

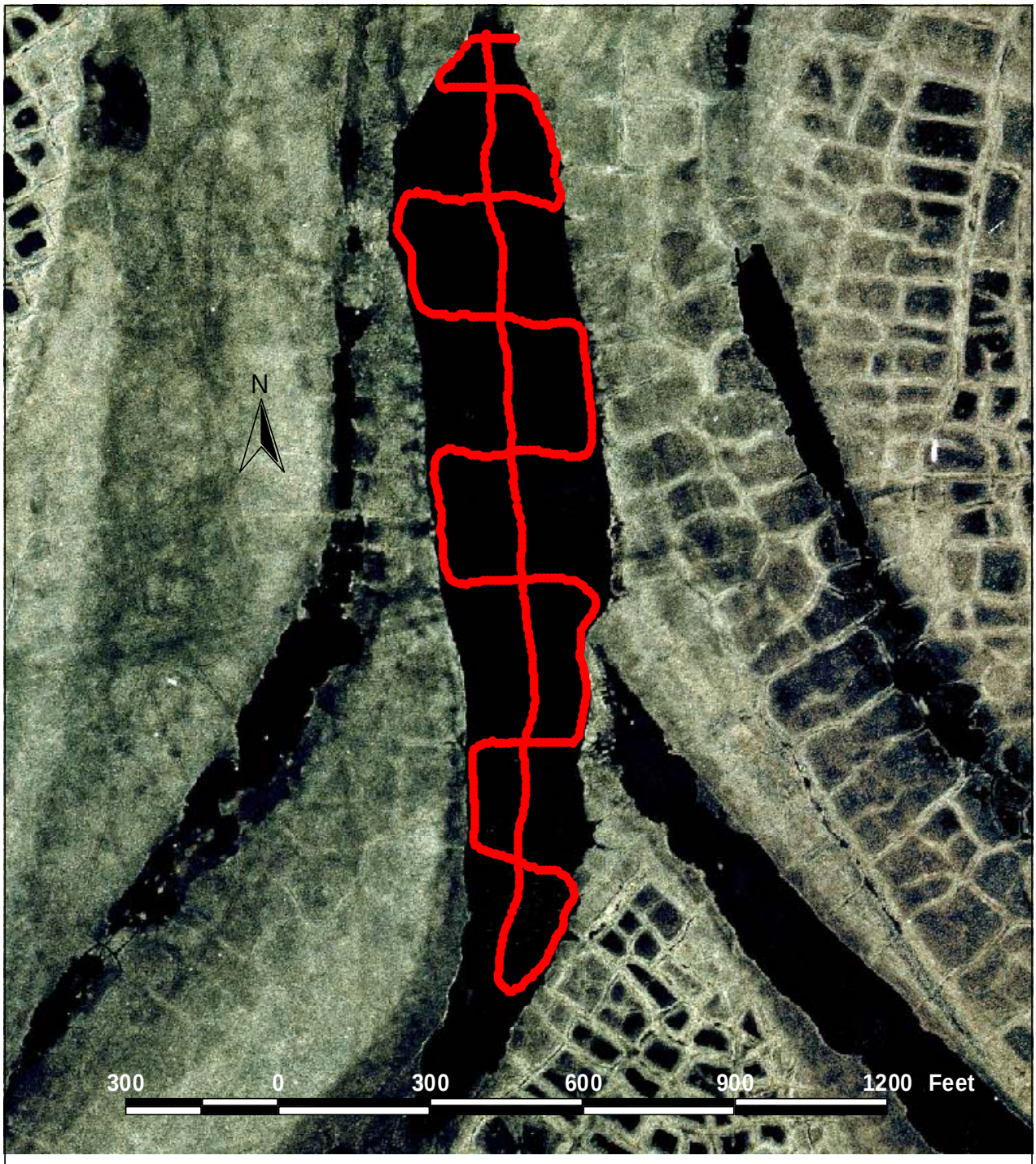
| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gillnet | Jul 19 97 | 10.8 | Broad whitefish | 5 | 535-573 |
| Minnow Trap | Jul 19 97 | 16.3 | Ninespine stickleback | 173 | |



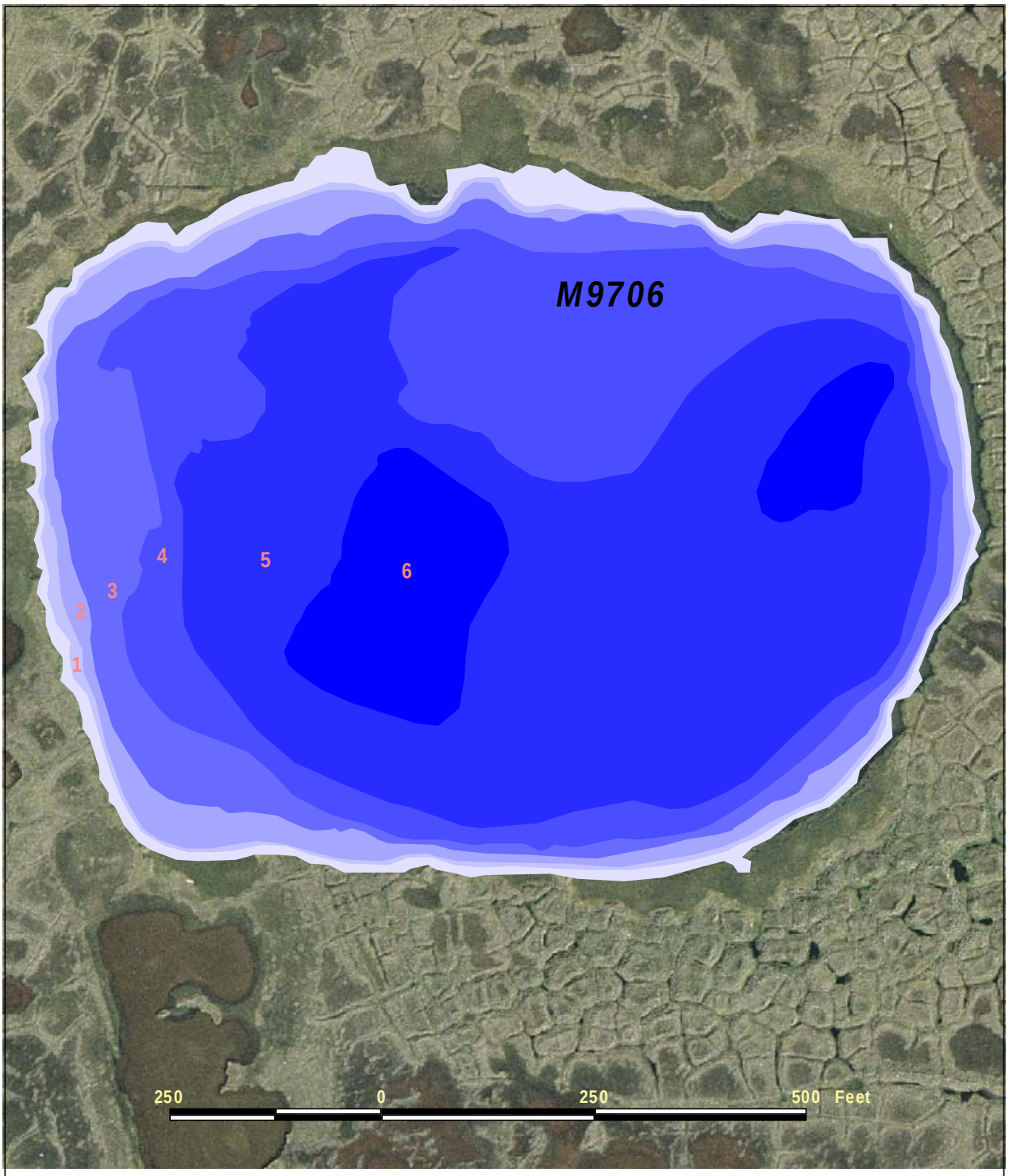



Regions of lake M9704 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 16, 2006.

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




Depth transects measured on lake M9704 on July 16, 2006.




Depth contours of lake M9706 based on transects surveyed on August 6, 2006.
(depths in 1 foot intervals)

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

## Lake M9706

**Other Names:** P3.1
**Location:** 70.40664°N 151.05533°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4E, Sec. 11
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 18.8 acres
**Maximum Depth:** 6.7 feet
**Active Outlet:** No
**Total Lake Volume:** 27.5 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 5.54 million gallons
**Water Volume Under 5 ft of ice:** 1.81 million gallons
**Water Volume Under 7 ft of ice:** 0.00 million gallons

**Potential Ice Aggregate:** 5.1 acres (water depth 4 ft or less)
0.40 million gallons

**Maximum Recommended Winter Removal:** **5.54 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

**Water Use History:**

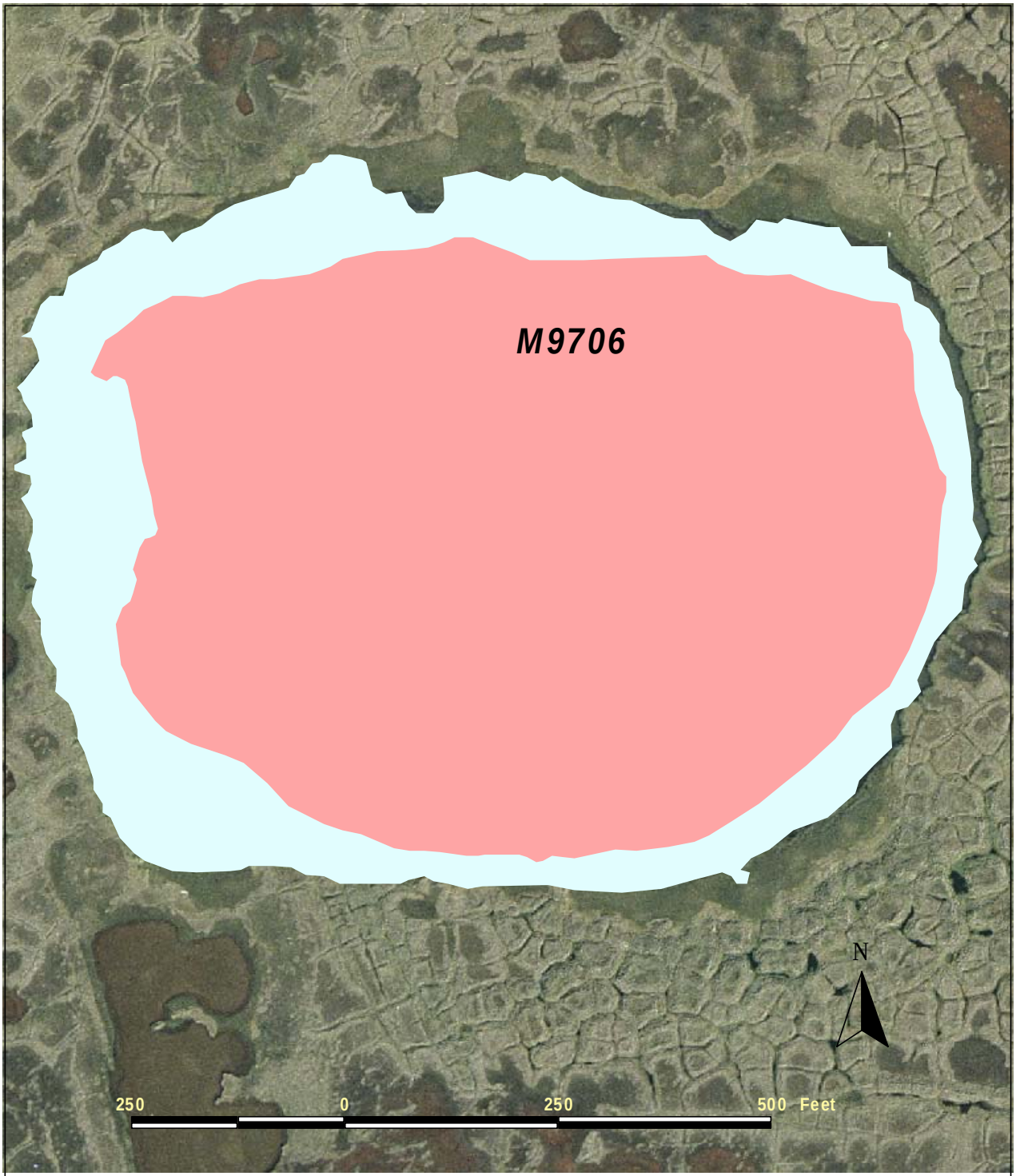
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 27.8 | 9.4 | 84.7 | 112.0 | 108 | 434 | -- | -- | Moulton 98 |
| 2006 | 25.4 | 10.7 | 43.8 | 118.0 | 107 | 463 | 1.4 | 7.90 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gillnet | Jul 22 97 | 10.0 | None | 0 |
| Minnow Trap | Jul 22 97 | 10.0 | None | 0 |




Regions of lake M9706 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on August 6, 2006.

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


Depth transects measured on lake M9706 on August 6, 2006.


Lake M9707 was less than 3 feet deep when surveyed on July 30, 2006, consequently a contour map was not developed.

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

## Lake M9707

**Other Names:** O5.1
**Location:** 70.41806°N 150.98547°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E, Sec. 6
**Habitat:** Tapped Lake
**Area:** 18.5 acres
**Maximum Depth:** 3.0 feet
**Active Outlet:** Yes
**Total Lake Volume:** -- million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 0.00 million gallons
**Water Volume Under 5 ft of ice:** 0.00 million gallons
**Water Volume Under 7 ft of ice:** 0.00 million gallons

**Potential Ice Aggregate:** 18.5 acres (water depth 4 ft or less)
1.44 million gallons

**Maximum Recommended Winter Removal:** **0.00 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

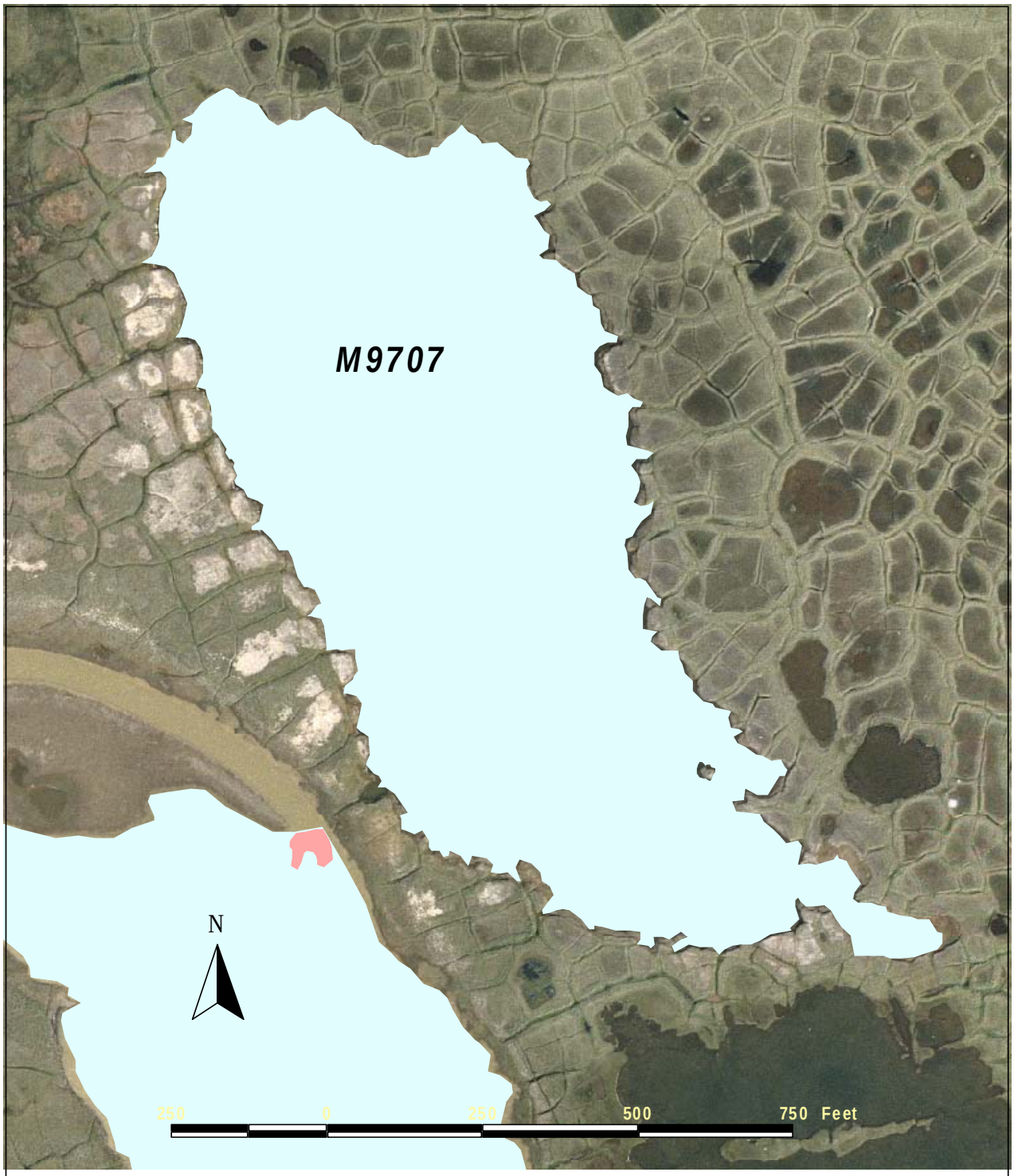
**Water Chemistry:**

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1999 | 166 | 258 | 3230 | 2390 | 1480 | 4254 | -- | -- | Moulton 98 |
| 2006 | 71.4 | 149.0 | 1340.0 | 2260.0 | 792 | 7065 | 2.7 | 8.43 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gillnet | Jul 22 97 | 10.5 | None | 0 |
| Minnow Trap | Jul 22 97 | 10.1 | None | 0 |

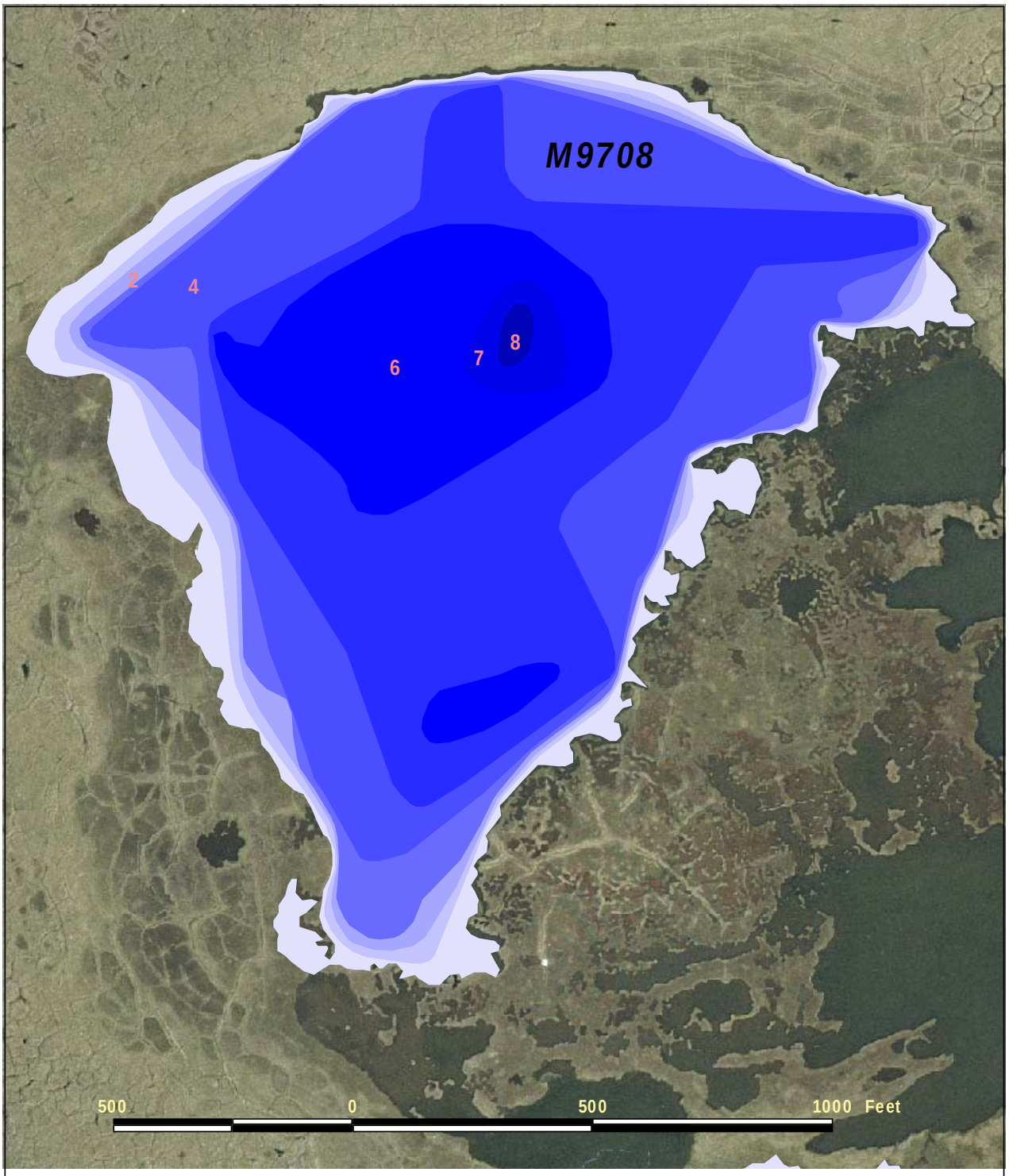
lake is now tapped and connected to river channel, fish assumed present




Lake M9707 was less than 4 feet deep when surveyed on July 30, 2006 and likely to be available for ice chips.

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


Lake M9707 was less than 3 feet deep on July 30, 2006, depth transects were not conducted.




Depth contours of lake M9708 based on transects surveyed on July 30, 2006.
(depths in 1 foot intervals)

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

## Lake M9708

**Other Names:** O4.1
**Location:** 70.41943°N 151.02471°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4E, Sec. 1
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 45.9 acres
**Maximum Depth:** 12.0 feet
**Active Outlet:** No
**Total Lake Volume:** 67.2 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 15.4 million gallons
**Water Volume Under 5 ft of ice:** 6.16 million gallons
**Water Volume Under 7 ft of ice:** 0.18 million gallons

**Potential Ice Aggregate:** 11.0 acres (water depth 4 ft or less)
0.86 million gallons

**Maximum Recommended Winter Removal:** **1.85 million gallons**
(30% of volume under 5 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| 2004-2005 | 0.76 |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 27.0 | 29.9 | 419.0 | 248.0 | 191 | 643 | -- | -- | Moulton 98 |
| 1999 | 14.5 | 22.2 | 137.0 | 201.0 | 127 | -- | -- | -- | this study |
| 2006 | 9.8 | 12.9 | 97.5 | 179.0 | 78 | 624 | 1.6 | 8.06 | this study |

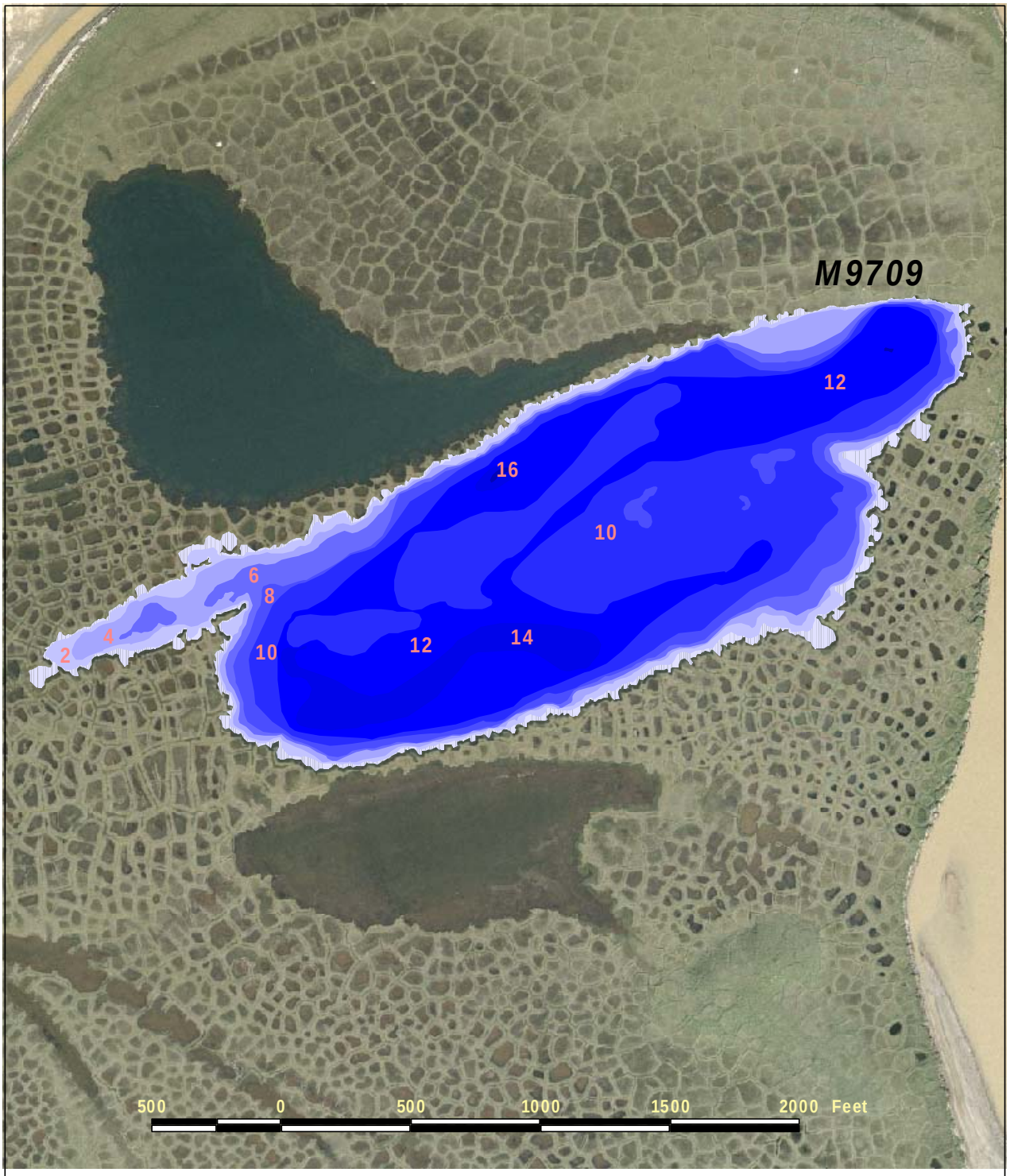
**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gillnet | Jul 23 97 | 11.0 | None | 0 |
| Minnow Trap | Jul 23 97 | 9.5 | None | 0 |
| Observed | Jul 30 06 | | Ninespine stickleback | 1 |


Regions of lake M9708 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on July 30, 2006.

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


Depth transects measured on lake M9708 on July 30, 2006.




Depth contours of lake M9709 based on transects surveyed on July 16-17, 2006.
(depths in 2 foot intervals)

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

## Lake M9709

**Other Names:** Q7.1
**Location:** 70.38465°N 150.90150°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E, Sec. 21
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 74 acres
**Maximum Depth:** 18.9 feet
**Active Outlet:** No
**Total Lake Volume:** 240.9 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 149.5 million gallons
**Water Volume Under 5 ft of ice:** 128.4 million gallons
**Water Volume Under 7 ft of ice:** 88.7 million gallons

**Potential Ice Aggregate:** 7.7 acres (water depth 4 ft or less)
0.60 million gallons

**Maximum Recommended Winter Removal:** **13.30 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

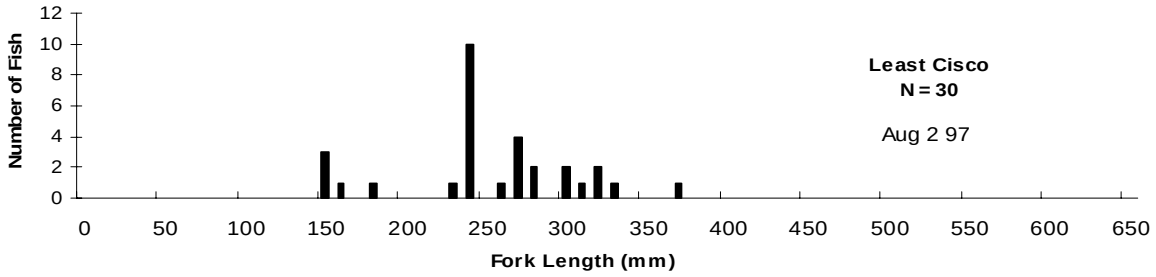
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| 2004-2005 | 3.52 |
| 2005-2006 | 4.69 |

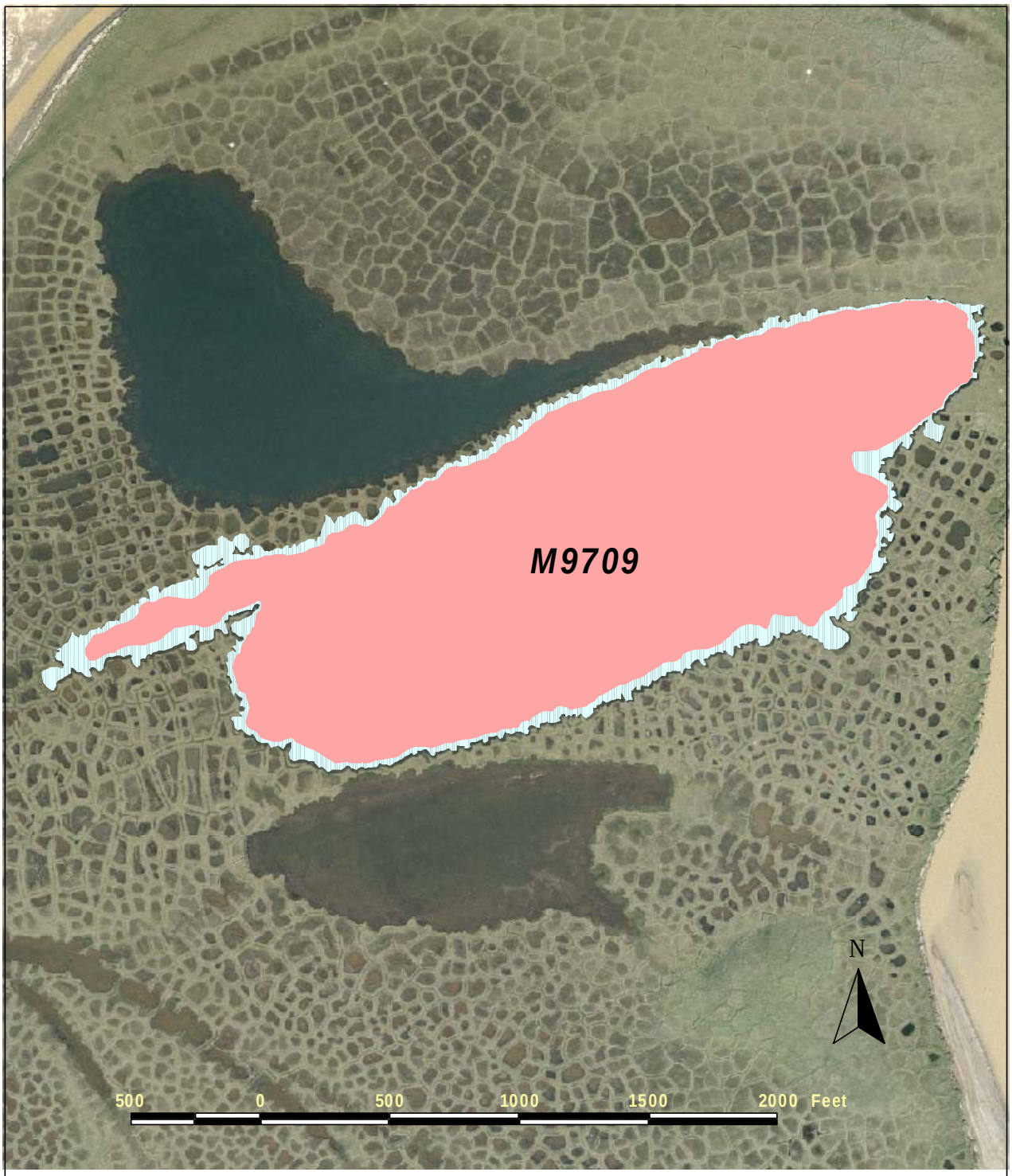
**Water Chemistry:**

| 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | -- | -- | -- | -- | -- | 302 | -- | 7.75 | Moulton 98 |
| 2006 | 13.1 | 6.2 | 8.3 | 17.6 | 58 | 159 | 2.0 | 7.89 | this study |

**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gillnet | Aug 2 97 | 6.5 | Least cisco | 30 | 153-371 |
| Minnow Trap | Aug 2 97 | 12.3 | None | 0 | |

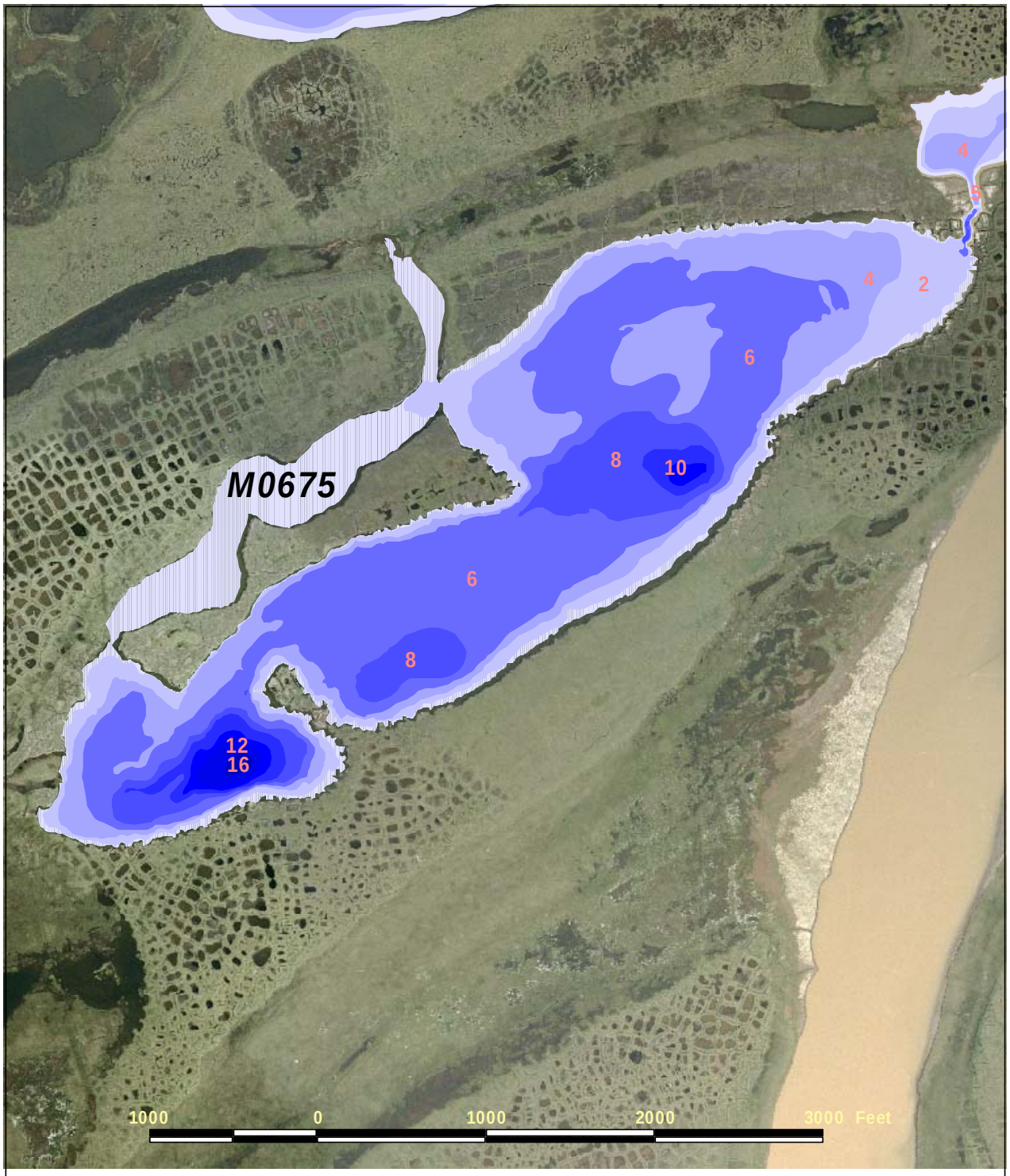





Regions of lake M9709 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on July 16-17, 2006.

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


Depth transects measured on lake M9709 on July 16-17, 2006.




Depth contours of lake M0675 based on transects surveyed on July 30, 2006.
(depths in 2 foot intervals)

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

## Lake M0675

**Other Names:**
**Location:** 70.41131°N 151.02537°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4E, Sec. 12/13/14
**Habitat:** Tapped Lake
**Area:** 187.3 acres
**Maximum Depth:** 17.1 feet
**Active Outlet:** Yes
**Total Lake Volume:** 339.3 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 129.7 million gallons
**Water Volume Under 5 ft of ice:** 89.0 million gallons
**Water Volume Under 7 ft of ice:** 30.1 million gallons

**Potential Ice Aggregate:** 51.8 acres (water depth 4 ft or less)
4.06 million gallons

**Maximum Recommended Winter Removal:** **4.51 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

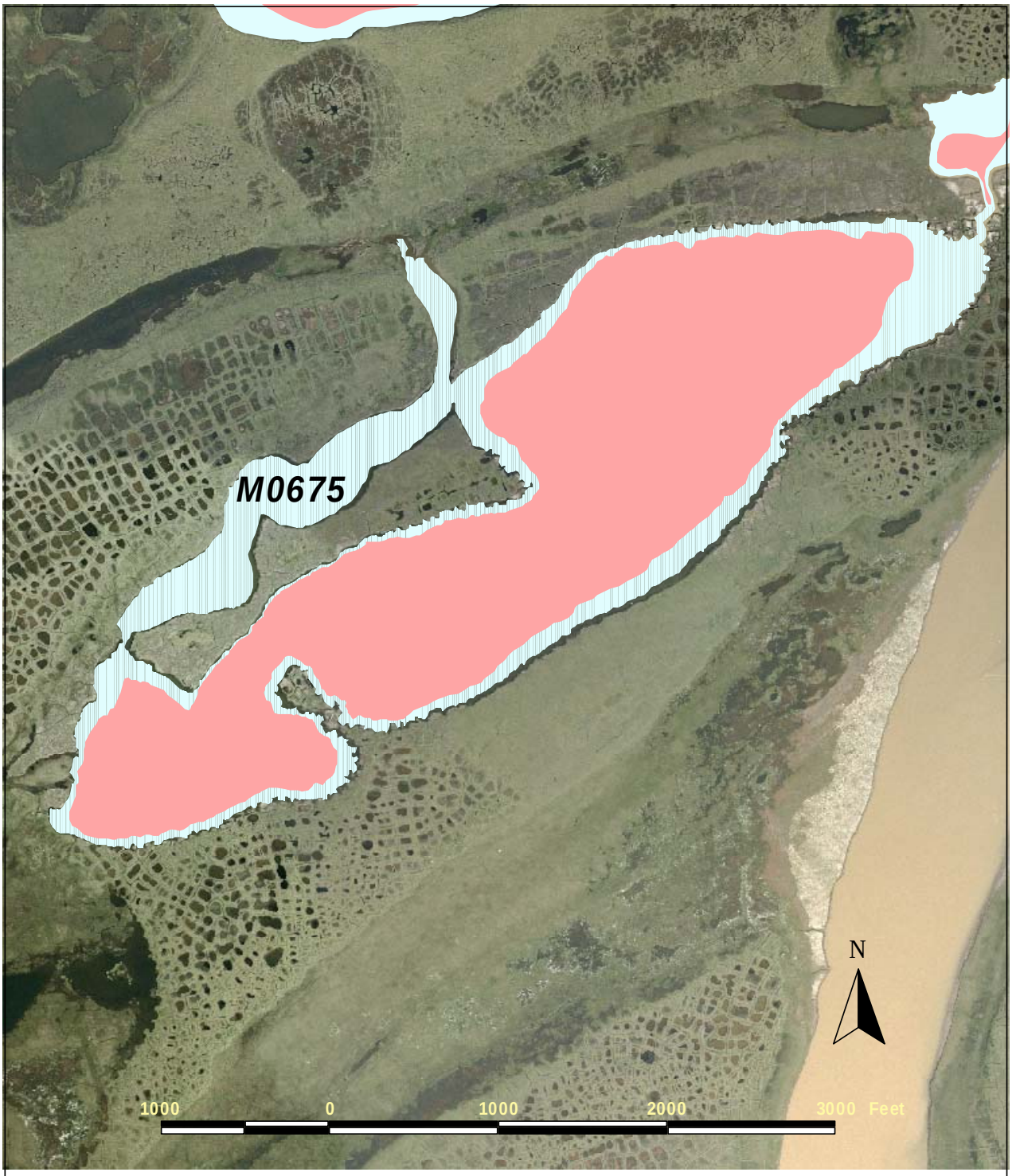
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| none | |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 72.3 | 158 | 1400 | 2370 | 831 | 7468 | 4.5 | 8.04 | this study |

**Catch Record:**

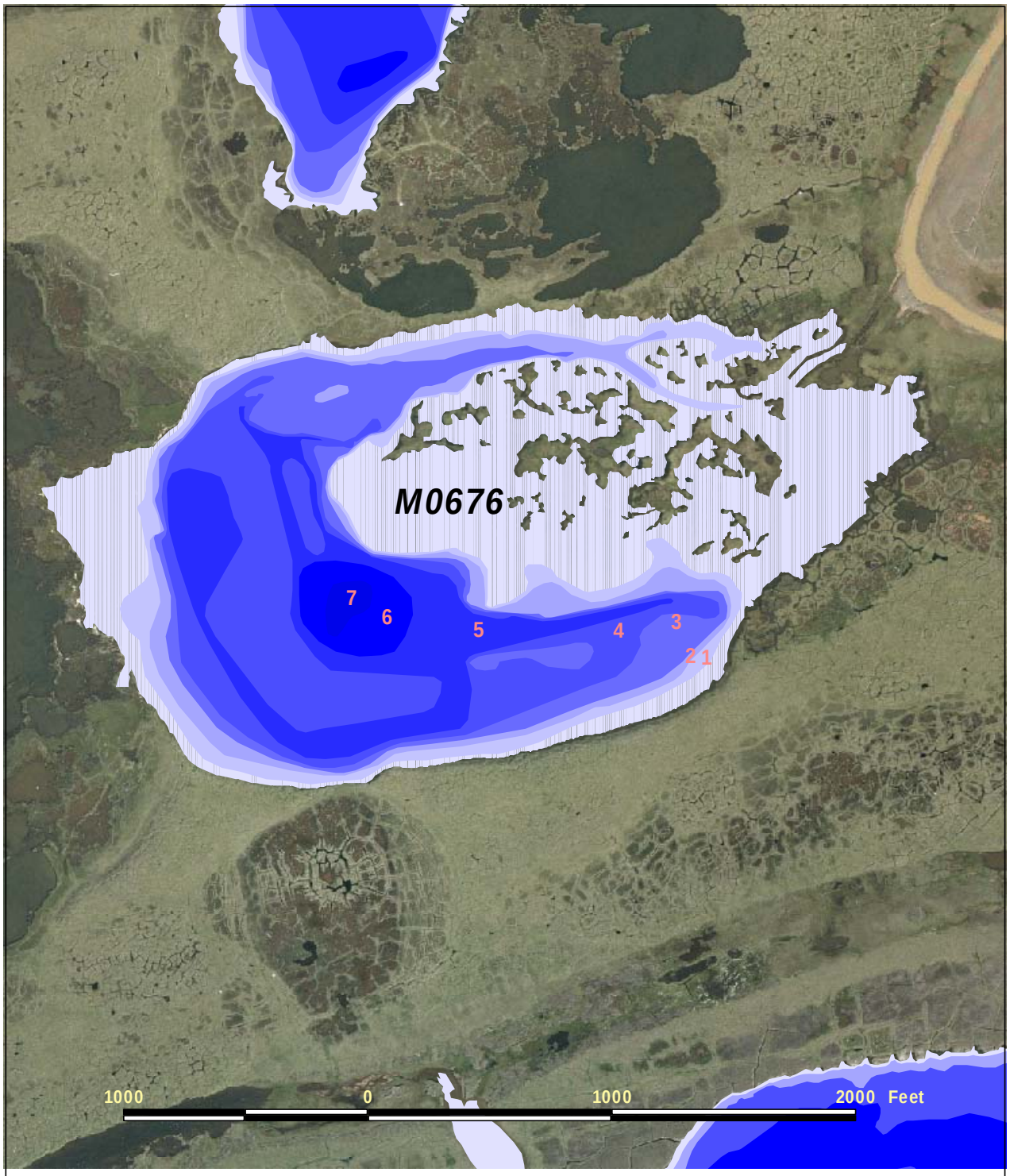
| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| connected to river channel through M0677, no fishing | | | | |




Regions of lake M0675 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on July 30, 2006.

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


Depth transects measured on lake M0675 on July 30, 2006.




Depth contours of lake M0676 based on transects surveyed on August 7, 2006.
(depths in 1 foot intervals)

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

## Lake M0676

**Other Names:**
**Location:** 70.40321°N 151.00847°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4E, Sec. 12
**Habitat:** Tapped Lake
**Area:** 108.0 acres
**Maximum Depth:** 8.1 feet
**Active Outlet:** Yes
**Total Lake Volume:** 88.6 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 11.9 million gallons
**Water Volume Under 5 ft of ice:** 3.64 million gallons
**Water Volume Under 7 ft of ice:** 0.08 million gallons

**Potential Ice Aggregate:** 72.0 acres (water depth 4 ft or less)
5.63 million gallons

**Maximum Recommended Winter Removal:** **0.01 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

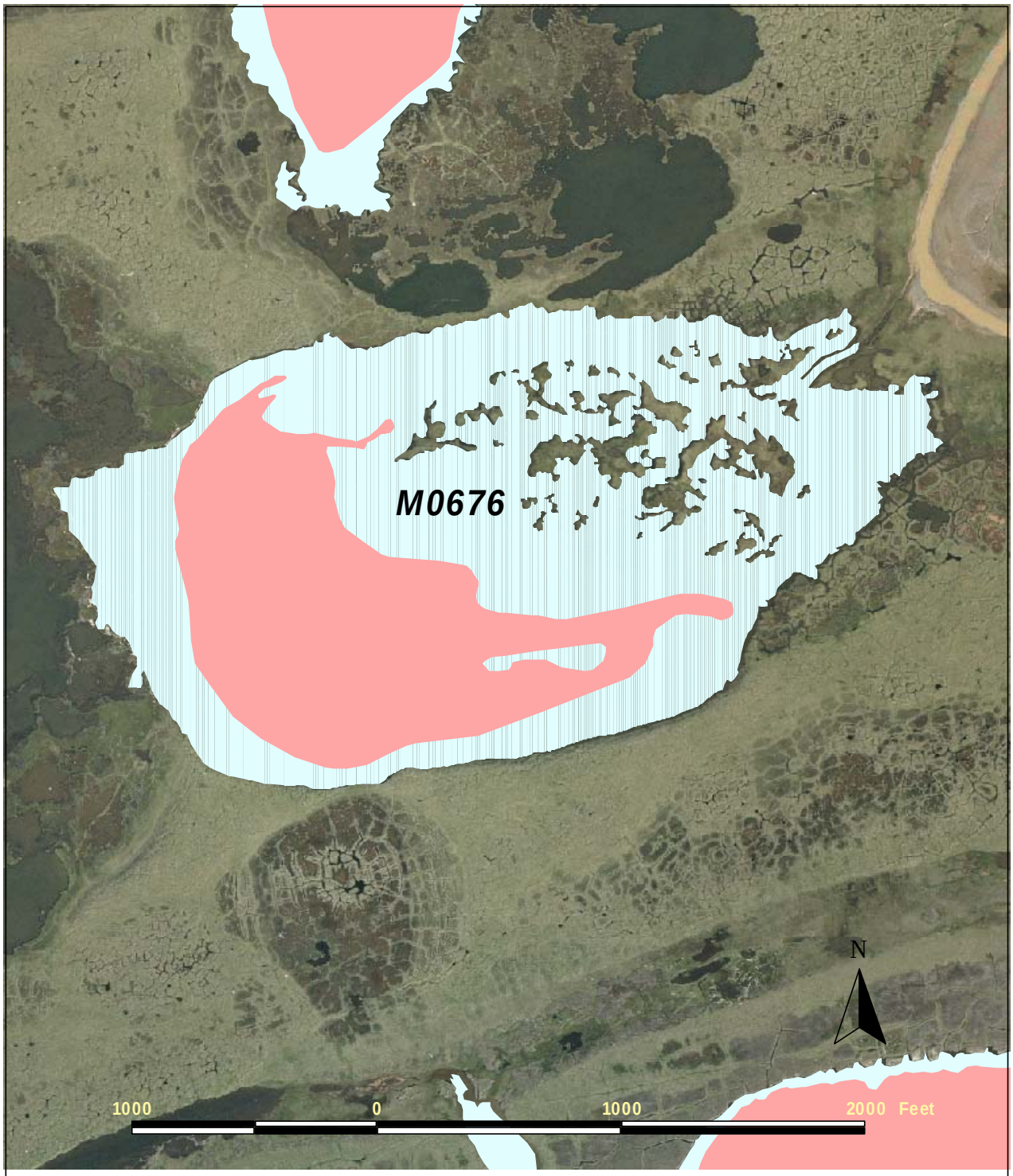
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 32.9 | 67 | 580 | 1110 | 356 | 3423 | 2.2 | 8.62 | this study |

**Catch Record:**

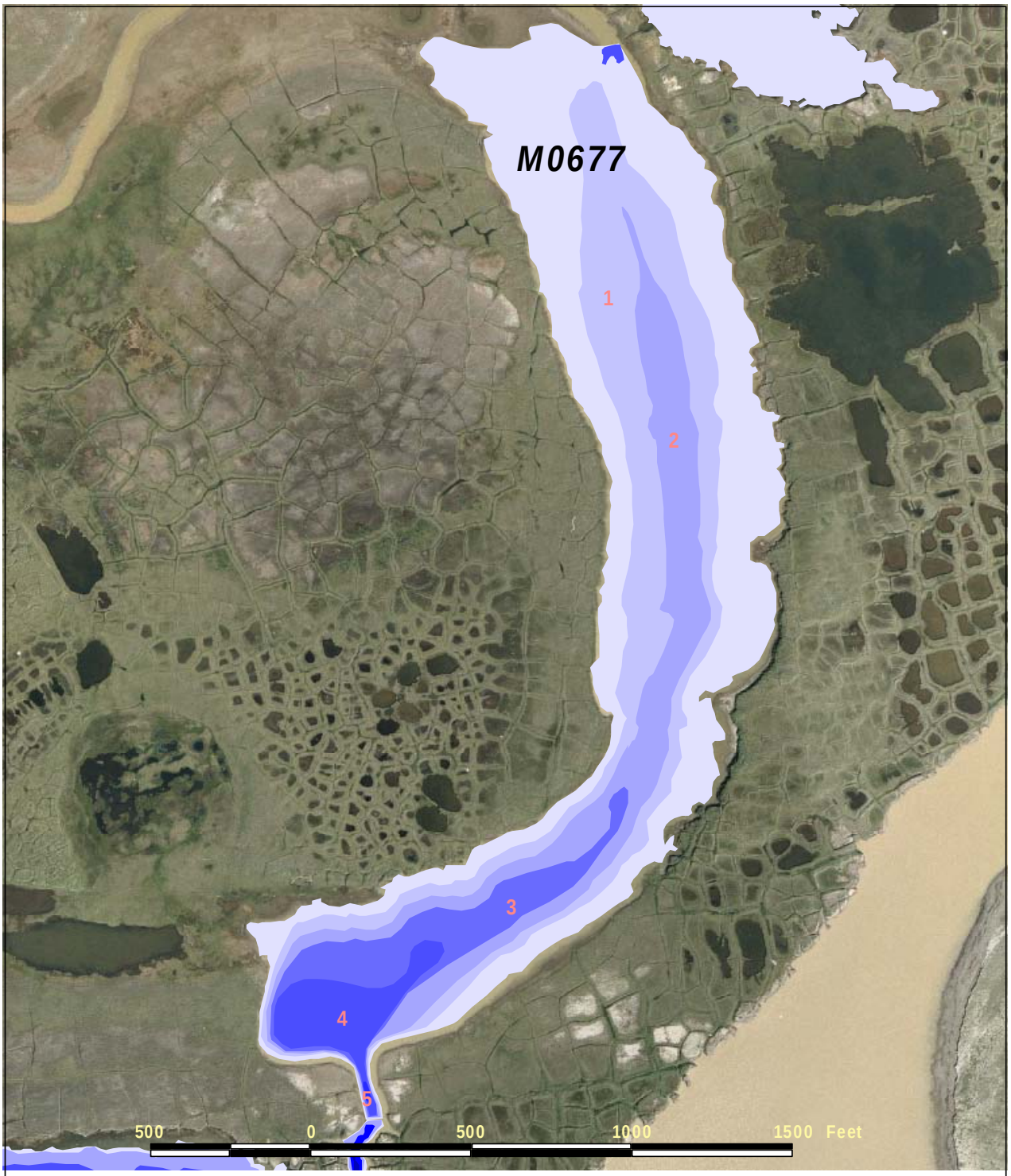
| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gill Net | Aug 7 06 | 3.7 | Least cisco | 4 | 222-286 |
| Minnow Trap | Aug 7 06 | 2.1 | None | 0 | |




Regions of lake M0676 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on August 7, 2006.

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


Depth transects measured on lake M0676 on August 7, 2006.




Depth contours of lake M0677 based on transects surveyed on July 30, 2006.
(depths in 1 foot intervals)

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

## Lake M0677

**Other Names:**
**Location:** 70.41181°N 150.98523°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R4/5E, Sec. 12/6/7
**Habitat:** Tapped Lake
**Area:** 43.8 acres
**Maximum Depth:** 5.9 feet
**Active Outlet:** Yes
**Total Lake Volume:** 21.0 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 0.25 million gallons
**Water Volume Under 5 ft of ice:** 0.00 million gallons
**Water Volume Under 7 ft of ice:** 0.00 million gallons

**Potential Ice Aggregate:** 41.8 acres (water depth 4 ft or less)
3.27 million gallons

**Maximum Recommended Winter Removal:** **0.00 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

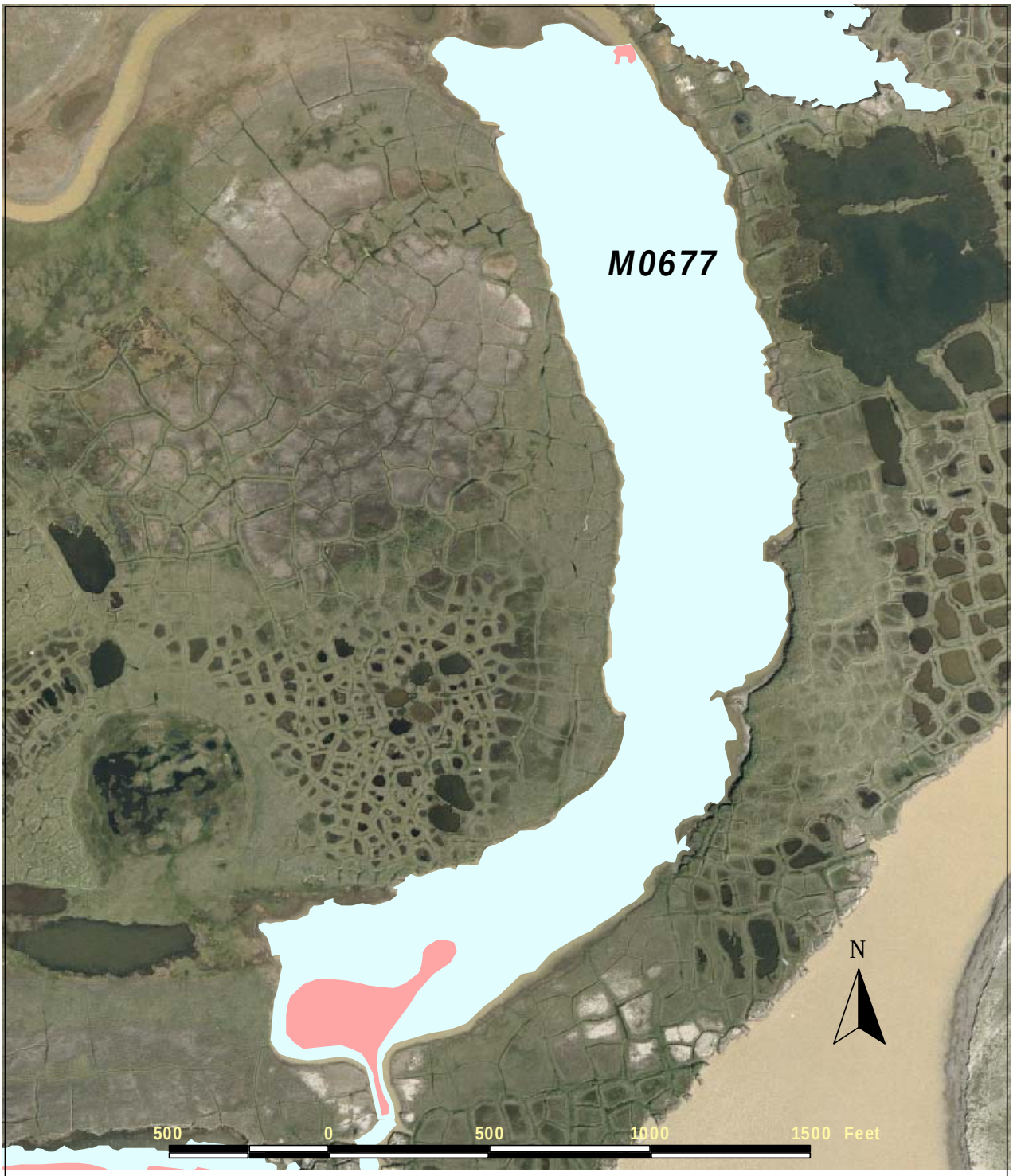
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 36.5 | 57 | 523 | 874 | 325 | 2936 | 7.4 | 8.22 | this study |

**Catch Record:**

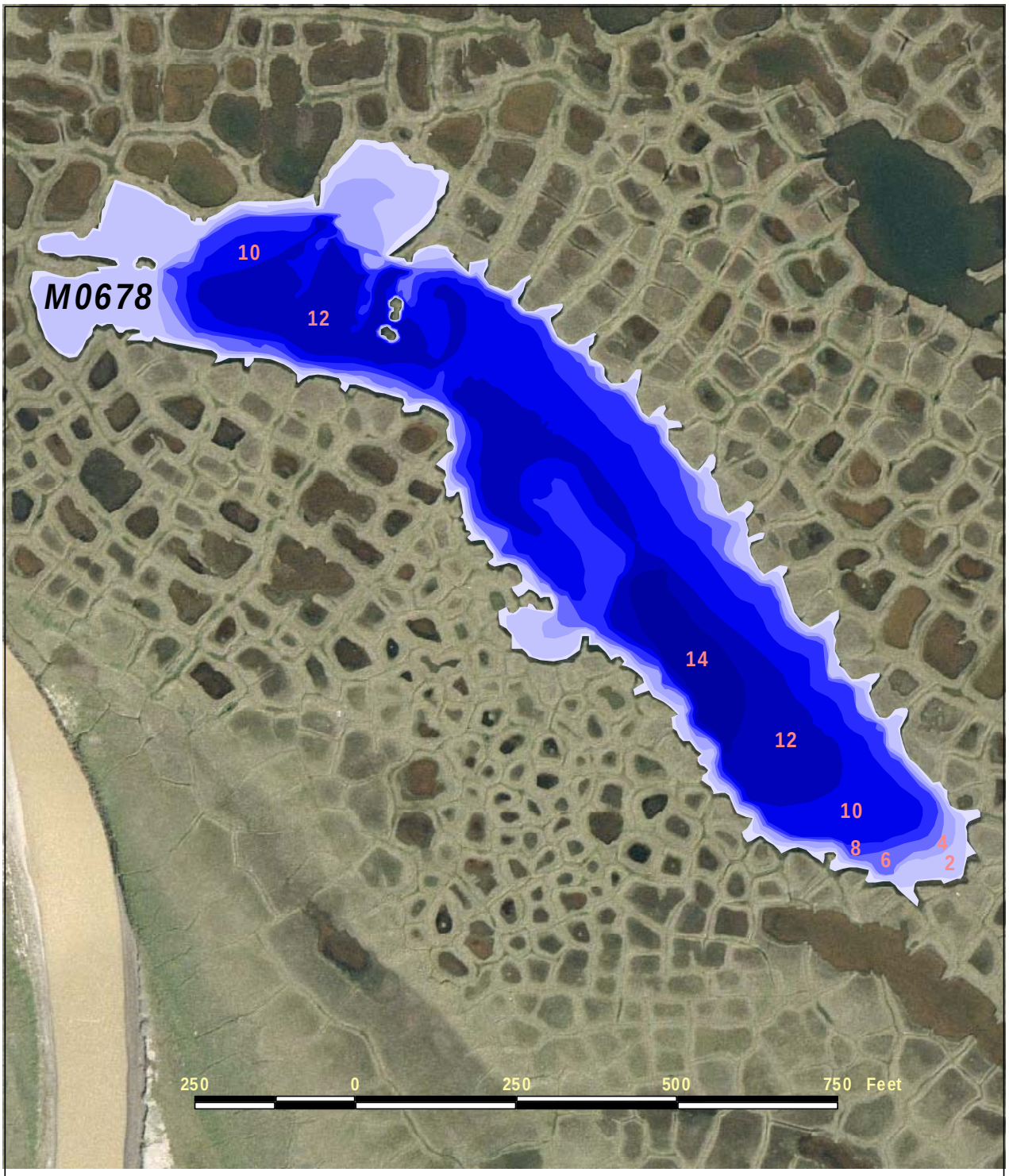
| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| connected to river channel, no fishing | | | | |




Regions of lake M0677 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on July 30, 2006.

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


Depth transects measured on lake M0677 on July 30, 2006.




Depth contours of lake M0678 based on transects surveyed on August 6, 2006.
(depths in 2 foot intervals)

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

## Lake M0678

**Other Names:**
**Location:** 70.41363°N 150.88774°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E, Sec. 9
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 11.4 acres
**Maximum Depth:** 15.2 feet
**Active Outlet:** No
**Total Lake Volume:** 32.4 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 18.9 million gallons
**Water Volume Under 5 ft of ice:** 16.0 million gallons
**Water Volume Under 7 ft of ice:** 10.8 million gallons

**Potential Ice Aggregate:** 2.6 acres (water depth 4 ft or less)
0.20 million gallons

**Maximum Recommended Winter Removal:** **18.85 million gallons**
(water volume under 4 ft of ice, no fish concern)
(does not include volume associated with ice aggregate)

**Water Use History:**

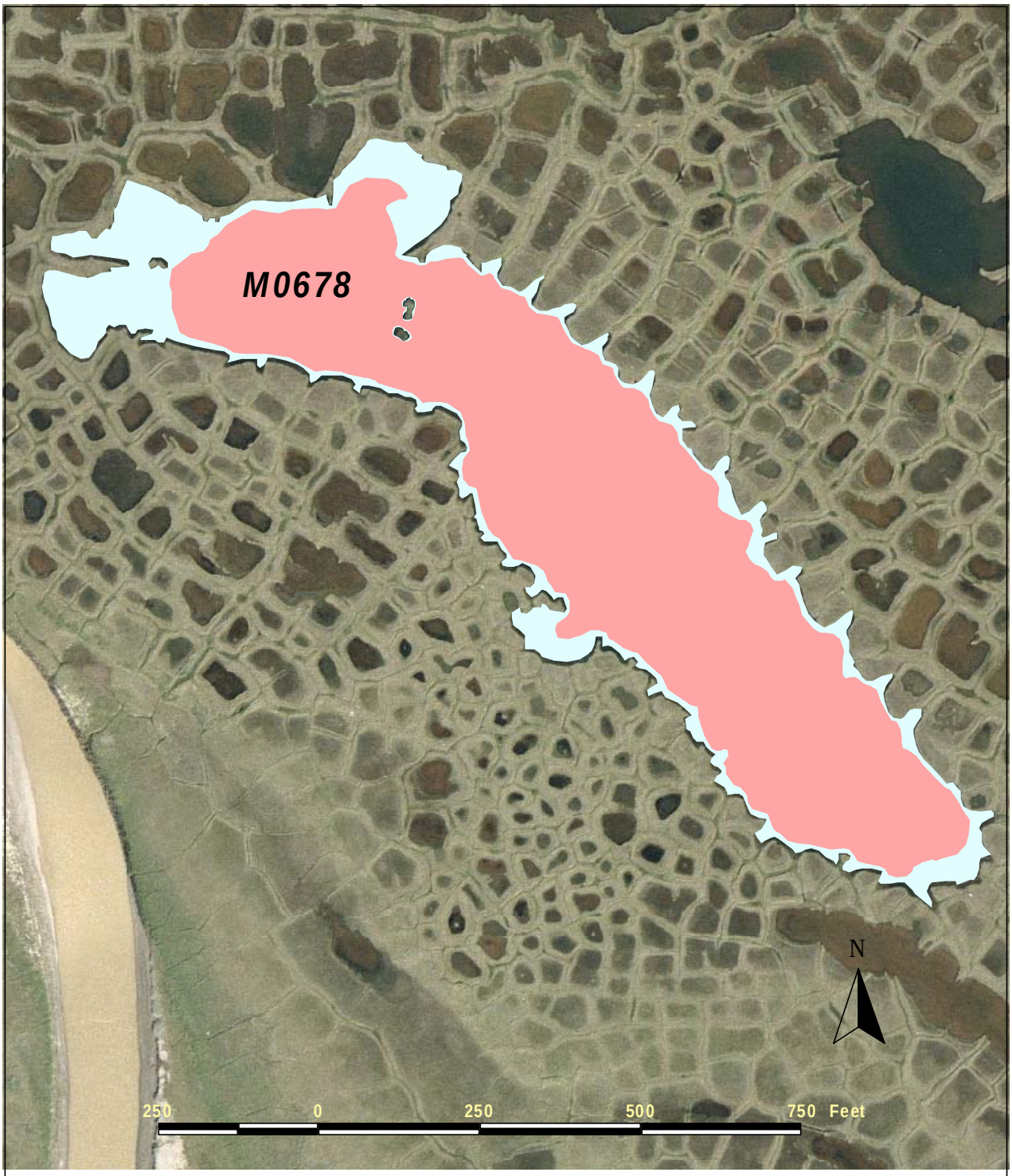
| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| | none |

**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 |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 14.3 | 9.2 | 22.3 | 52.9 | 73 | 267 | 0.8 | 8.07 | this study |

**Catch Record:**

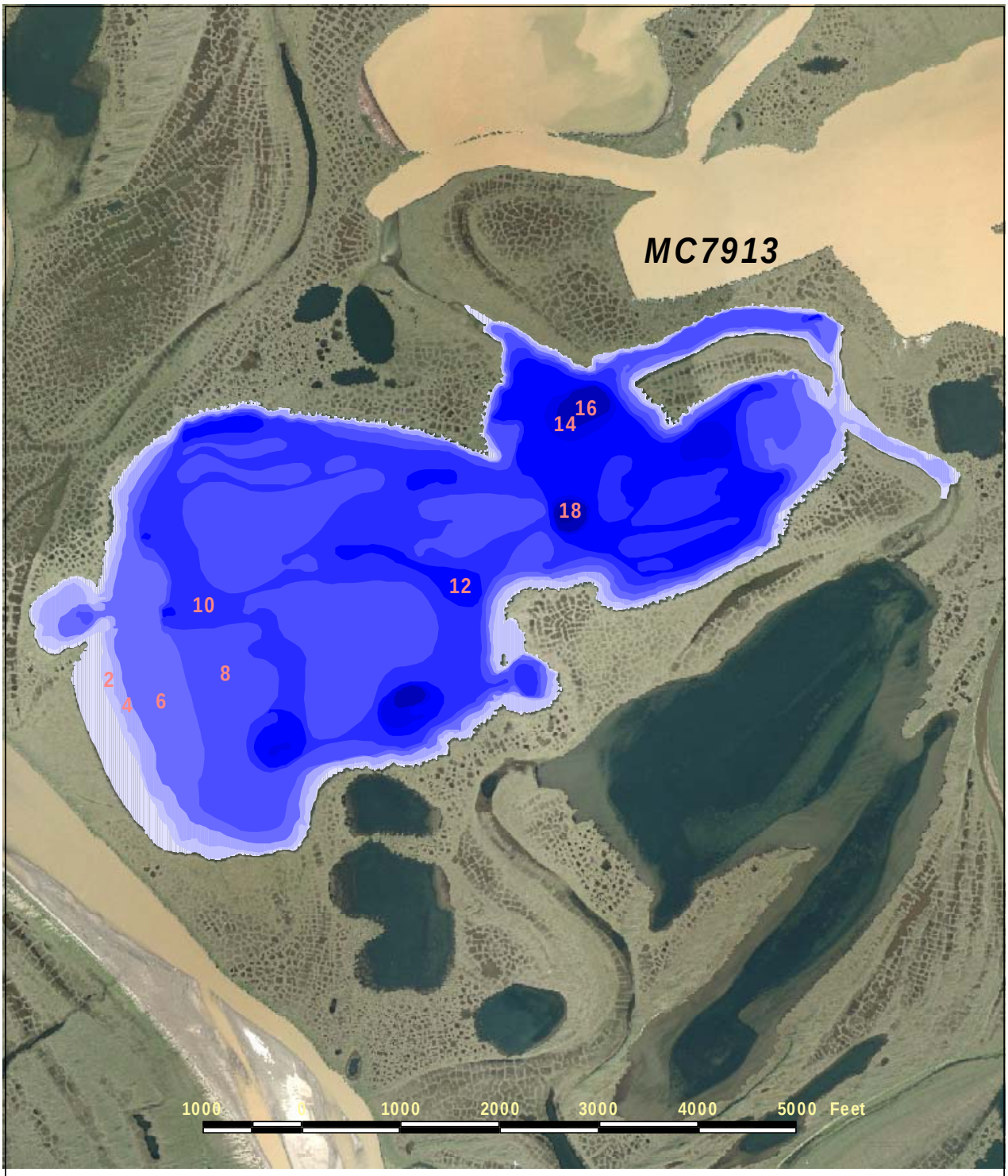
| Gear | Date | Effort (hours) | Species | Number Caught |
|---|---|---|---|---|
| Gill Net | Aug 6 06 | 11.4 | None | 0 |
| Minnow Trap | Aug 6 06 | 17.0 | None | 0 |




Regions of lake M0678 less than 4 feet deep (light shaded) and likely to be available for ice chips, based transects surveyed on August 6, 2006.

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


Depth transects measured on lake M0678 on August 6, 2006.




Depth contours of lake MC7913 based on transects surveyed on July 30 2006
(depths in 2 foot intervals)

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

## Lake MC7913

**Other Names:** R8.3; M9111
**Location:** 70.37555°N 150.83745°W
**USGS Quad Sheet:** Harrison Bay B-2: T12N R5E, Sec. 22
**Habitat:** Perched Lake (Infrequent Flooding)
**Area:** 572.9 acres
**Maximum Depth:** 18.9 feet
**Active Outlet:** Yes
**Total Lake Volume:** 1,686.7 million gallons (2006 data)
**Water Volume Under 4 ft of ice:** 970.6 million gallons
**Water Volume Under 5 ft of ice:** 800.9 million gallons
**Water Volume Under 7 ft of ice:** 492.7 million gallons

**Potential Ice Aggregate:** 36.4 acres (water depth 4 ft or less)
2.85 million gallons

**Maximum Recommended Winter Removal:** **73.91 million gallons**
(15% of volume under 7 feet of ice)
(does not include volume associated with ice aggregate)

**Water Use History:**

| Year | Water Removed (all sources) (mill. Gals) |
|---|---|
| 1998-1999 | 18.02 |
| 1999-2000 | 25.45 |

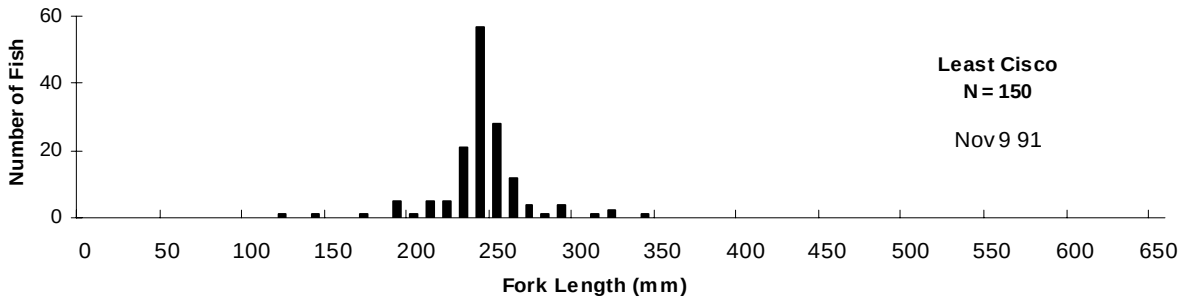
**Water Chemistry:**

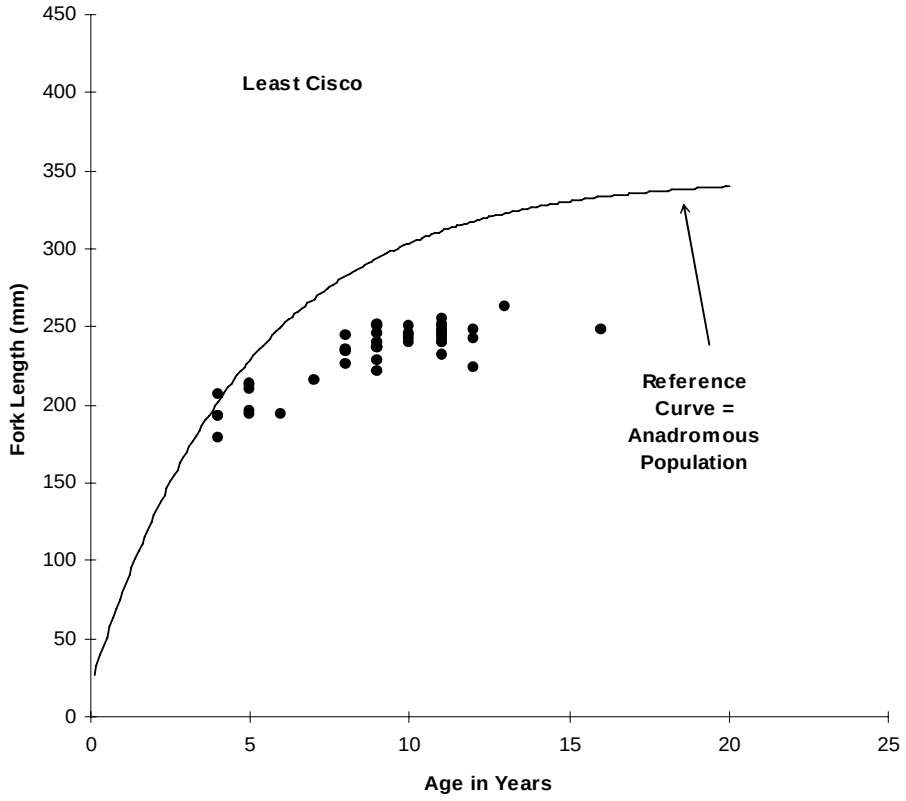
| Year of Test | Calcium (mg/l | Magnesium (mg/l) | Sodium (mg/l) | Chloride (mg/l) | Total Hardness [CaCO3] (mg/l) | Specific Conductance (microS/cm) | Turbidity (NTU) | pH | Source |
|---|---|---|---|---|---|---|---|---|---|
| 1998 | 24.0 | 14.9 | 63.5 | 133.0 | 121 | -- | -- | -- | Moulton 98 |
| 2006 | 18.5 | 10.9 | 49.0 | 16.4 | 91 | 415 | 1.3 | 8.12 | this study |

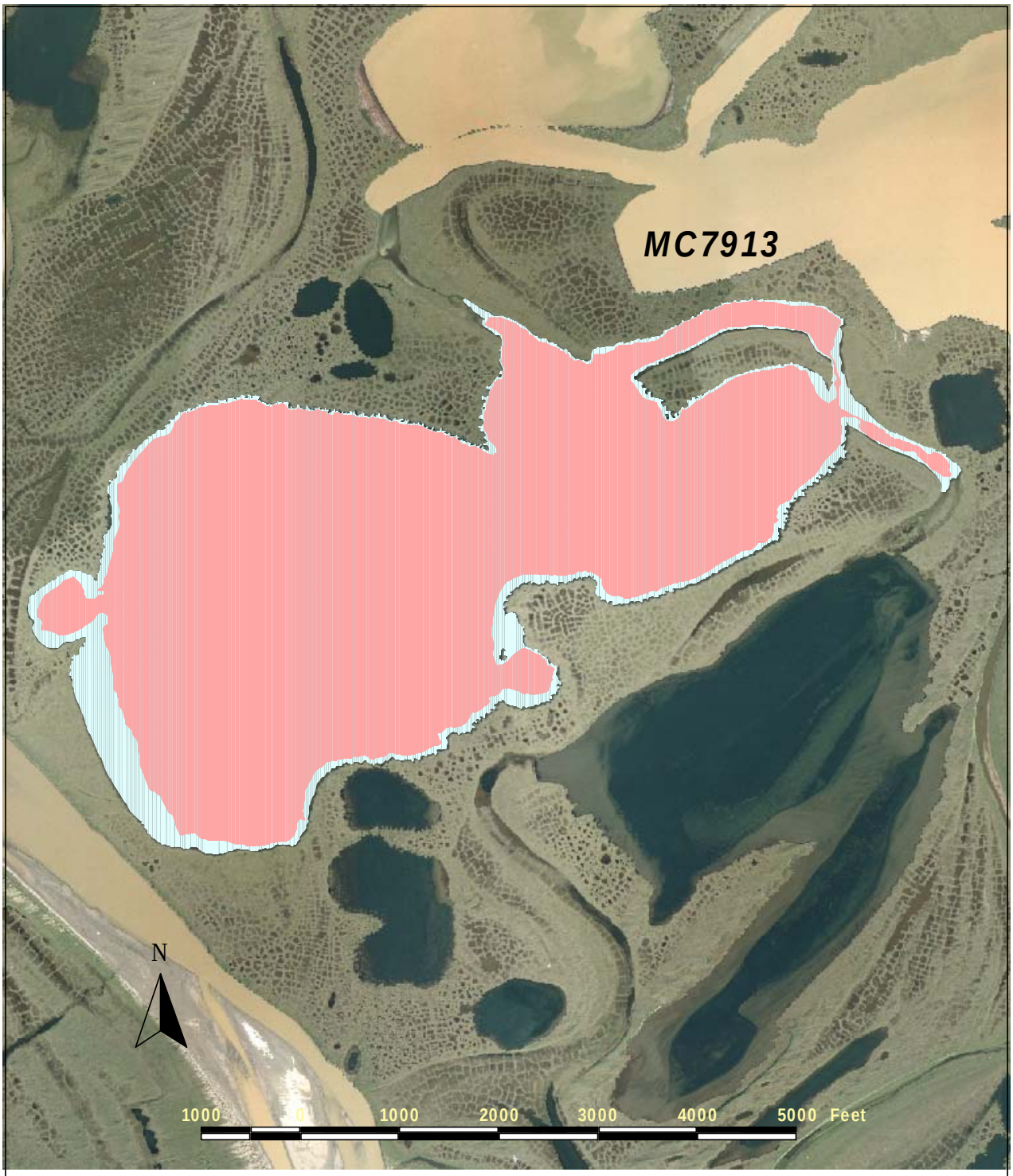
**Catch Record:**

| Gear | Date | Effort (hours) | Species | Number Caught | Fork Length (mm) |
|---|---|---|---|---|---|
| Gill Net | Sep 8 79 | 20.8 | Least cisco | 83 | 130-367 |
| | Nov 9 91 | 44.0 | Least cisco | 150 | 125-340 |

Source of 1979 data: McElderry & Craig 1981


Number of Fish
60
40
20
0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Fork Length (mm)
Least Cisco
N = 150
Nov 9 91


Fork Length (mm)
450
400
350
300
250
200
150
100
50
0
0
5
10
15
20
25
Age in Years
Least Cisco
Reference Curve = Anadromous Population




Regions of lake MC7913 less than 4 feet deep (light shaded) and likely to be available for ice chips, based on transects surveyed on July 30, 2006.

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


Depth transects measured on lake MC7913 on July 30, 2006.