SURVEY OF LAKES IN CONOCOPHILLIPS ALASKA INC. ACTIVITY AREAS – 2018

Final Report

January 2019

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Document Number: CPA019-18-002F0

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1. INTRODUCTION

Owl Ridge Natural Resource Consultants, Inc. sampled forty-seven lakes in the National Petroleum Reserve-Alaska (NPR-A) between July 11 and August 14, 2018. The lakes were sampled for fish, water depth, and water chemistry to support potential use by ConocoPhillips Alaska, Inc. as water sources for winter exploration (Figure 1). The lakes are located in the NPR-A in the Fish/Judy Creek and Kalikpik River drainages. For purposes of this report, lakes are grouped into five geographic areas:

1. South Willow lakes – 6 lakes (Figure 2 and Table 1)
2. North Willow lakes – 9 lakes (Figure 3 and Table 1)
3. West Willow A lakes – 9 lakes (Figure 4 and Table 1)
4. West Willow B lakes – 9 lakes (Figure 5 and Table 1)
5. Southwest Judy Creek lakes – 14 lakes (Figure 6 and Table 1)

The purpose of this study was to estimate the volume of water available for winter industrial use and to document fish presence in lakes that may be used to support operations and exploration activities.

Objectives of the study were to:

1) Identify fish species present in selected lakes within the project study area.
2) Measure water chemistry parameters to assess suitability of water for potential uses.
3) Obtain lake bathymetry and estimate water volumes for selected lakes.

The selected lakes may be used as sources of freshwater during exploration and to construct ice roads and ice pads, and for drilling support, as well as for short term potable water supplies. A limited number of lakes may be selected for long-term use if the prospect is developed. Permitting decisions on water withdrawal will consider potential impacts to fish that depend on an adequate water supply for winter survival. The inventory of fish and potential fish wintering habitat provides information to assist permitting decisions regarding water use and ice road routing.

Lakes in which fish were verified as present were divided into two categories: 1) lakes containing species sensitive to habitat changes potentially associated with water withdrawal; and 2) lakes containing species more resistant to habitat changes. Some species sensitive to potential 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 limited to Alaska blackfish and ninespine stickleback. Alaska blackfish are particularly resistant to low dissolved oxygen and are able to use 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 to the same extent as Alaska blackfish. However, ninespine stickleback can withstand higher levels of dissolved solids, and often frequent brackish nearshore waters during summer.

Regulatory agencies managing water withdrawals from surface waters on the North Slope generally adhere to similar criteria to govern maximum volumes of water and ice that may be withdrawn from fish bearing and non-fishing bearing lakes. Withdrawal of unfrozen water from lakes and the removal of ice aggregate from

grounded areas ≤ 4 feet (ft) deep may be authorized on a site-specific basis depending on water volume and depth, and the waterbody's fish community. The Alaska Department of Fish and Game (ADF&G), Alaska Department of Natural Resources (ADNR) and Bureau of Land Management (BLM) (per 2013 Record of Decision (ROD) in Best Management Practice B-2) restrict water withdrawal as follows:

Water withdrawal and ice aggregate removal criteria by agency

	ADF&G (Alaska Department of Fish and Game)	**ADNR** (Alaska Department of Natural Resources)	**BLM** (Bureau of Land Management)
No fish present	No authority	Water withdrawal: up to 20% of the total lake volume Ice aggregate: Combined ice and unfrozen water shall not exceed 20% of the total lake volume	Water withdrawal: up to 35% of the total lake volume Ice aggregate: Combined ice and unfrozen water shall not exceed 35% of the total lake volume
Resistant fish species present	Water withdrawal: up to 30% of lake volume under 5 ft. of ice Ice aggregate: Combined ice and unfrozen water shall not exceed 30% of the total lake volume under 5 ft. of ice	Water withdrawal: up to 30% of lake volume under 5 ft. of ice Ice aggregate: Combined ice and unfrozen water shall not exceed 30% of the total lake volume under 5 ft. of ice	Water withdrawal: up to 30% of lake volume under 5 ft. of ice Ice aggregate: Only ice aggregate may be removed from lakes that are ≤ 5 ft. deep, Combined ice and unfrozen water shall not exceed 30% of the total lake volume under 5 ft. of ice
Sensitive fish species present	Water withdrawal: up to 15% of lake volume under 7 ft. of ice Ice aggregate: Combined ice and unfrozen water shall not exceed 15% of the total lake volume under 7 ft. of ice	Water withdrawal: up to 15% of lake volume under 7 ft. of ice Ice aggregate: Combined ice and unfrozen water shall not exceed 15% of the total lake volume under 7 ft. of ice	Water withdrawal: up to 15% of lake volume under 7 ft. of ice Ice aggregate: Only ice aggregate may be removed from lakes that are ≤ 7 ft. deep, Combined ice and unfrozen water shall not exceed 15% of the total lake volume under 7 ft. of ice

Water withdrawal requests outside of the established criteria can be evaluated by regulators on a site-by-site basis and usually require written justification. Exceptions to the criteria can lead to additional monitoring at the requested water source.

2. METHODS

2.1. Fish Sampling

Fish sampling consisted of a combination of the following:

- gill nets (used for sensitive species)
- minnow traps
- seine nets
- visual surveys (with dip net sampling) for resistant species

When a lake had the potential to support sensitive species, or if there was doubt sensitive species were able to be supported by the lake, gill nets were used to sample for fish presence. Lakes were sampled with short-duration gill net sets (typically seven to nine hours of total soak time unless fish were captured sooner). The gill nets were multimesh, 120 ft long, with six panels of variable mesh ranging from 1.0 to 3.5 inches when stretched. These nets have been previously used to collect inventory-level data from lakes throughout the North Slope for similar surveys (Moulton 1998). Sets were closely attended and kept to a short duration to minimize the chance for entangling waterfowl and to minimize fish mortality. Since the objective of the gill netting was to document presence/absence, the nets were placed in habitats expected to be used by fish for feeding or for movement between feeding areas and were removed after fish were detected. Fish captured were measured and released. The duration of each set was recorded to allow calculation of catch rates.

Minnow traps, seining, or visual surveys were used to identify smaller fish species, such as ninespine stickleback and Alaska blackfish, which are less susceptible to capture by gill nets. Minnow traps baited with preserved salmon eggs were set at the edge of surveyed lakes in areas expected to provide cover or feeding areas for smaller fish species. The traps were set and retrieved in conjunction with other sampling.

When conditions were appropriate, a visual survey supplemented with dip net sampling and/or beach seining was conducted. Ninespine stickleback are often observed in shallow water along the lake shore and because of their affinity for nearshore vegetation, are vulnerable to hand-held dip nets. During the visual survey, frequent sweeps through vegetated areas were made with a small mesh dip net. The length of the visual/dip net survey was measured with a handheld GPS. If stickleback were observed, minnow traps and seines were not used.

2.2. Water Chemistry

Water chemistry measurements included surface measures of water temperature, specific conductance, pH, turbidity, and dissolved oxygen. Temperature, specific conductance, dissolved oxygen, and pH were in situ surface measurements recorded from approximately the middle of each lake with a calibrated YSI ProPlus water quality meter. A surface water sample was collected from the same location described above at each lake and returned to a field lab for determination of turbidity with a Lamotte 2020 turbidity meter. Two water samples were collected at each lake and sent to Pollen Environmental Inc. for laboratory determination of chloride, sodium, calcium, magnesium, and hardness (as $CaCO_3$).

2.3. Bathymetric Survey and Volume Calculations

Bathymetric data obtained during the surveys allowed lake volume to be estimated. Location and depth were recorded at approximately one- to two-second intervals on a Lowrance Model HDS-7 Gen 2 integrated

GPS/depth sounder with a goal to record at least eight depth transects on each lake. Lake volume was estimated by contour mapping of depth intervals. Contour maps were prepared by plotting the position and depth data obtained by GPS on GIS base maps and plotting the contours in one-ft intervals on maps of the surveyed lakes. Where maximum lake depth was 10 ft or less, 1-ft intervals were plotted; 2-ft intervals were used on lakes deeper than 10 ft. The surface area of each contour was obtained, then 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 ADF&G and ADNR standard criteria for winter water withdrawal when sensitive fish species are present is currently set at 15 percent of the volume of a lake deeper than 7 ft. When resistant fish species (e.g., ninespine stickleback and Alaska blackfish) are present, water withdrawal is limited to 30 percent of the volume deeper than 5 ft. In 2007, ADNR initiated a withdrawal limit of 20 percent of the total lake volume if fish are not present. The amounts may or may not be present at the time of withdrawal, depending on ice thickness at the time water is needed.

The area of a lake potentially available for ice aggregate was estimated by calculating the area of each lake that is 4 ft or less in depth, assuming ice will attain thickness of at least 4 ft prior to the need for ice aggregate and thus will be grounded. If the ice is thinner than 4 ft at the time of ice removal, then the area available for ice removal will be less.

The procedure for estimating the gallons available as ice aggregate is as follows:

1. The area of the 4 ft depth contour is subtracted from the lake outline (0 ft contour) to provide the area (in acres) less than 4 ft deep.
2. The upper one foot of the acreage less than 4 ft deep is converted to cubic yards.
3. The cubic yards are reduced by 9 percent to account for ice expansion as the water freezes.
4. The remaining volume is multiplied by 202 gallons per cubic yard to arrive at the final estimate of gallons available for use.

2.4. Water Surface Elevations

A vertical elevation benchmark (VEBM) using a 3 ft section of 5/8 inch diameter rebar and aluminum rebar caps was established at each lake with potential for water withdrawal from under the ice. The average of three water surface elevations relative to the VEBM was recorded at each site and will be used for future comparisons.

2.5. Lake Summaries

The lake numbering protocol used for the survey is based on a researcher and year code combination. The lake number contains several pieces of information, including the code of the sampler and the initial year of sampling as noted below.

Sampler Code:

MC = McElderry and Craig (1981); fish sampling 1979
B = Bendock fish sampling 1977-1986
L = Lobdell; water chemistry sampling 1991-1999
M = Moulton; fish sampling 1995-2014
M = Moulton and Morris, fish sampling 2015
MM = Morris and Moulton, fish and bathymetric sampling 2016-2018
MB = Michael Baker Jr., Inc. water chemistry and bathymetry sampling 2002-2012
N = Netsch et al. (1977); NPRA fish sampling 1977
R = Reanier depth sampling 2000-2007

First Two Numerals:

Year of Initial Sampling (if Moulton sampled a lake previously sampled by McElderry and Craig, then the McElderry and Craig lake number is used)

Last Two Numerals:

Numbers 01 through 99 are used to identify the individual lake sampled within a given year.

For each lake in the survey, the following information is accounted for and provided as applicable:

1. A diagram of the lake bathymetry.
2. Other names used for the same lake.
3. Lake location – latitude and longitude .
4. The U.S. Geological Survey (USGS) quadrangle sheet and the township and range in which the lake is situated.
5. Surface area in acres.
6. Maximum depth in feet.
7. Presence or absence of an outlet.
8. Calculated total lake volume at the time of survey.
9. Water volume under 4 ft of ice.
10. Water volume under 5 ft of ice.
11. Water volume under 7 ft of ice.
12. Acres of potential ice aggregate for ice road construction.
13. Gallons of water represented by the upper 1 ft of ice available for ice aggregate.
14. Maximum recommended under-ice water withdrawal.
15. Water chemistry measurements.
16. Catch record, including gear used, date sampled, species caught and size range
17. Water surface elevation temporary benchmark location and water surface elevation data.
18. Map depicting potential ice aggregate removal areas.
19. Map depicting measured depth transects.

3. RESULTS

3.1. Biological Observations

All 47 lakes selected for evaluation in NPR-A during 2018 that could be used as freshwater sources for ice road construction, drilling support, and/or potable water during winter are depicted in Figure 1. Water use may be in the form of either direct withdrawal of water from below the ice or by collecting ice aggregate from the lake surface.

3.1.1. South Willow Lakes

Surveys within the South Willow area included six lakes (Figure 2 and Table 1). Lake M0015 was surveyed in 2000, 2004, 2017, and again in 2018. Three lakes (Lake M0017, Lake M0029, and Lake M0030) had been previously surveyed in 2000, 2004, and again in 2018 (Table 2). Lake MM1801 and MM1803 were surveyed for the first time in 2018. Surveyed lakes varied in depth, with maximum depths exceeding 10 ft in two of the lakes (Table 1). Sensitive fish species were not captured in any of the six lakes during any of the years surveyed, however resistant fish species, including ninespine stickleback and/or Alaska blackfish, were captured in all lakes (Table 2).

3.1.2. North Willow Lakes

Surveys within the North Willow area included nine lakes (Figure 3 and Table 1). Lake Z06001 was previously surveyed in 2006 and again in 2018, while the other eight lakes had not been surveyed prior to 2018. The lakes varied in depth and ranged from 6.0 ft to 13.3 ft (Table 1). Sensitive fish species, including Arctic grayling and least cisco were captured in four of the nine lakes (Table 2). Although fishing gear was not deployed, sensitive fish use was determined because Lake MM1824 has a direct connection to the Kalikpik River where sensitive species were seen during the bathymetric survey. Resistant fish species, including ninespine stickleback, were captured in eight of the nine lakes (Table 2). No fish were captured in Lake MM1818 (Table 2).

3.1.3. West Willow A Lakes

Surveys within the West Willow A area included nine lakes (Figure 4 and Table 1). None of these lakes had been surveyed prior to 2018. Eight of the nine lakes ranged in depth from 6.6 ft to 12.6 ft, while Lake MM1815 exceeded 25 ft (Table 1). Sensitive fish species, including least cisco, were only captured in Lake MM1813 (Table 2). Sensitive fish species were also determined to use Lake MM1816 due to a direct connection to the Kalikpik River (Table 2). Resistant fish species, including ninespine stickleback, were captured in four of the nine lakes, while no fish were captured in three of the nine lakes (Table 2).

3.1.4. West Willow B Lakes

Surveys within the West Willow B area included nine lakes (Figure 5 and Table 1). Lake B84065 was previously surveyed in 2002 and again in 2018, while the other eight lakes had not been surveyed prior to 2018. Seven of the nine surveyed lakes ranged in depth from 8.5 ft to 14.2 ft, while Lake MM1831 was 19 ft deep and Lake MM1829 was nearly 30 ft deep (Table 1). Sensitive fish species, including Arctic grayling, broad whitefish, least cisco, and slimy sculpin were captured in three lakes, while resistant fish species,

including ninespine stickleback, were captured in four lakes (Table 2). No fish were captured in two of the nine lakes (Table 2).

3.1.5. Southwest Judy Creek Lakes

Surveys within the Southwest Judy Creek area included 14 lakes, none which had been surveyed prior to 2018 (Figure 6 and Table 1). Depths in 13 of the 14 lakes ranged from 7.1 ft to 13.1 ft., while Lake MM1844 was 19 ft. deep (Table 1). Sensitive fish species were captured in five of the 14 lakes and included Arctic grayling, broad whitefish, humpback whitefish, round whitefish, and least cisco (Table 2). Sensitive fish species were also determined to use Lake R0213 because of a direct connection to Lake MM1838 which contained sensitive fish species (Table 2). Resistant fish species, including ninespine stickleback, were captured in all eight remaining lakes surveyed (Table 2).

3.2. Water Chemistry Measurements

3.2.1. South Willow Lakes

Water chemistry parameters measured in the six lakes surveyed in the South Willow area are listed in Table 3. Laboratory results of chloride, sodium, calcium, magnesium, and hardness are also presented in Table 3. Surface water temperature measurements cooled through the sampling period and ranged from 17.3 degrees Celsius (°C) on July 30 to 8.0°C on August 13 and averaged 12.7°C. Specific conductance, on average, was higher than the other areas surveyed, and averaged 206.6 µSiemens/centimeter (µS/cm). However, specific conductance varied throughout the survey area and ranged from 125.1 to 371.5 µS/cm. Turbidity was higher in South Willow lakes than other areas and was generally highest in shallow lakes and lowest in deep lakes. Turbidity averaged 2.16 nephelometric turbidity units (NTU) and ranged from 0.69 to 8.09 NTU. Potential hydrogen (pH) ranged from 7.5 to 8.38 units.

3.2.2. North Willow Lakes

Water chemistry parameters measured in the nine lakes surveyed in the North Willow area are listed in Table 3. Laboratory results of chloride, sodium, calcium, magnesium, and hardness are also presented in Table 3. Surface water temperature measurements varied over the sampling period and ranged from 17.3°C on July 30 to 6.6°C on August 14 and averaged 10.5°C. Specific conductance measured relatively similar throughout the area and ranged from 104.4 to 181.3 µS/cm and averaged 152.3 µS/cm. Turbidity measurements were relatively similar throughout the area and ranged from 0.53 to 0.1.42 NTU and averaged 0.85 NTU. Potential hydrogen measured slightly higher than the other areas surveyed and ranged from 7.76 to 8.40 units.

3.2.3. West Willow A Lakes

Water chemistry parameters measured in the nine lakes surveyed in the West Willow A area are listed in Table 3. Laboratory results of chloride, sodium, calcium, magnesium, and hardness are also presented in Table 3. Surface water temperature measurements, on average, were cooler than the other areas surveyed. Temperatures ranged from 16.0°C on July 15 to 7.5°C on August 10 and averaged 10.0°C. Specific conductance was also lower than the other sites surveyed, varying from 61.9 to 220.5 µS/cm and averaging 146.3 µS/cm. Turbidity ranged from 0.55 to 1.34 NTU and averaged 0.88 NTU. Potential hydrogen ranged from 8.36 to 8.22 units.

3.2.4. West Willow B Lakes

Water chemistry parameters measured in the nine lakes surveyed in the West Willow B area are listed in Table 3. Laboratory results of chloride, sodium, calcium, magnesium, and hardness are also presented in Table 3. Surface water temperature measurements cooled over the sampling period and ranged from 16.7°C on July 31 to 7.8°C on August 11 and averaged 11.4°C. Specific conductance varied from 138.7 to 248.6 µS/cm and averaged 183.3 µS/cm. Turbidity measured lower than the other areas surveyed and ranged from 0.54 to 0.89 NTU and averaged 0.75 NTU. Potential hydrogen ranged from 7.75 to 8.24 units.

3.2.5. Southwest Judy Creek Lakes

Water chemistry parameters measured in the 14 lakes surveyed in the Southwest Judy Creek area are listed in Table 3. Laboratory results of chloride, sodium, calcium, magnesium, and hardness are also presented in Table 3. Surface water temperature measurements, on average, were warmer than the other areas surveyed. Temperatures cooled over the sampling period and ranged from 17.6°C on July 26 to 8.7°C on August 13 and averaged 13.6°C. Specific conductance ranged from 62.4 to 268.6 µS/cm and averaged 111.01 µS/cm. Turbidity ranged from 0.63 to 1.52 NTU and averaged 1.07 NTU. Potential hydrogen measured lower than other areas and ranged from 6.91 to 8.23 units.

3.3. Water Surface Elevations

VEBMs were established at each of the 47 lakes surveyed with potential for under ice water withdrawal. The locations of each VEBM was recorded using a handheld GPS unit and flagged to aid in future locating. VEBM coordinates, dates of measurements and relative elevations are presented in Table 4.

4. DISCUSSION

4.1. Evaluation of Fish Concerns

Fish sampling and depth measurements were used to evaluate the potential of each of the 47 lakes surveyed to support fish. If fish were captured during sampling, the lake was classified as fish-bearing. Gill net set duration was relatively short at all lakes where sensitive fish species were present, because fish were captured almost immediately after net deployment. The absence of catch does not necessarily indicate a lake does not support fish, however, based on sampling results over the past 20 years by Moulton (1998), in conjunction with established multimethod fish species detection probabilities developed by Haynes et al. (2013), the methods employed have a high probability of detecting fish species.

Lakes deeper than seven feet are likely to retain unfrozen water during winter and have higher potential to overwinter fish. Maximum volumes of water and ice that may be withdrawn from fish-bearing and non-fish-bearing lakes, per agency requirements outlined in Section 1 above, are described below.

4.2. Available Water and Ice Chips

4.2.1. South Willow Lakes

The six surveyed waterbodies in the South Willow study area contained 17.024 million gallons of available under-ice water (Table 5). The majority of available under-ice water was distributed between Lake M0015, Lake M0029, and Lake M0030 (Table 5). An additional 189.487 million gallons is potentially harvestable as ice aggregate, mostly from Lake MM1801 and Lake M0015 (Table 6). However, use of combined water and ice aggregate volume above the 17.024 million gallons available in the South Willow lakes area would require justification and could result in monitoring conditions.

4.2.2. North Willow Lakes

The nine surveyed waterbodies in the North Willow study area contained 20.289 million gallons of available under-ice water distributed primarily between five lakes, while availability in the four remaining lakes ranged from 0.0 million gallons to less than 0.5 million gallons in each (Table 5). An additional 256.825 million gallons is potentially harvestable as ice aggregate, mostly from Lake Z06001, Lake MM1808, and Lake MM1809 (Table 6). However, use of combined water and ice aggregate volume above the 20.289 million gallons available in the North Willow lakes area would require justification and could result in monitoring conditions.

4.2.3. West Willow A Lakes

The nine surveyed waterbodies in the West Willow A study area contained 94.178 million gallons of available under-ice water, mostly from Lake MM1815, Lake MM1816 and Lake MM1817 (Table 5). An additional 142.928 million gallons is potentially harvestable as ice aggregate, mostly from Lake MM1816 and Lake MM1815 (Table 6). However, use of combined water and ice aggregate volume above the 94.178 million gallons available in the West Willow A lakes area would require justification and could result in monitoring conditions.

4.2.4. West Willow B Lakes

The nine surveyed waterbodies in the West Willow B study area contained 191.593 million gallons of available under-ice water, mostly from Lake B84065 and Lake MM1830 (Table 5). An additional 206.690 million gallons is potentially harvestable as ice aggregate, mostly from Lake B84065 and Lake MM1829 (Table 6). However, use of combined water and ice aggregate volume above the 191.593 million gallons available in the West Willow B lakes area would require justification and could result in monitoring conditions.

4.2.5. Southwest Judy Creek Lakes

The 14 surveyed waterbodies in the Southwest Judy Creek study area contained 159.565 million gallons of available under-ice water, mostly from lakes MM18141, R0205, R0206, MM1834, and MM1836 (Table 5). Four of the 14 lakes had less than 0.5 million gallons of available under-water ice (Table 5). An additional 340.923 million gallons is potentially harvestable as ice aggregate, distributed relatively evenly across all lakes (Table 6). However, use of combined water and ice aggregate volume above the 159.565 million gallons available in the Southwest Judy Creek lakes area would require justification and could result in monitoring conditions.

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TABLES

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Table 1. Summary of lakes sampled in 2018 for winter water use in ConocoPhillips, Alaska Inc. exploration areas.

Region	Lake Name	Latitude[1] (NAD83)	Longitude[1] (NAD83)	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Lake Volume (M gals.)
South Willow									
	M0015	70.10864	-152.05727	9N	1W	23,24,25,26	482.4	6.7	614.718
	M0017	70.10072	-152.13347	9N	1W	27,28,33,34	38.7	4.2	23.931
	M0029	70.11843	-152.21087	9N	1W	19,20	46.6	13.4	95.037
	M0030	70.12209	-152.19826	9N	1W	20	27.4	10.3	42.504
	MM1801	70.04075	-152.04840	8N	1W	13,14,23,24	491.4	5.4	434.431
	MM1803	70.04907	-152.07370	8N	1W	14	28.3	7.3	26.005
North Willow									
	MM1808	70.34485	-152.34634	11N	2W	2,3	288.6	10.7	480.006
				12N	2W	34,35			
	MM1809	70.32891	-152.33586	11N	2W	2,11	81.3	7.7	60.088
	MM1810	70.32217	-152.31841	11N	2W	11	142.6	10.7	258.699
	MM1818	70.29401	-152.22464	11N	1W	19	20.4	9.9	22.221
	MM1819	70.29154	-152.25359	11N	1W	19	36.7	13.3	46.964
				11N	2W	24			
	MM1820	70.28723	-152.29747	11N	2W	23,24	18.4	7.5	22.690
	MM1821	70.28273	-152.31317	11N	2W	26	40.8	10.9	50.972
	MM1824	70.29606	-152.26884	11N	2W	24	55.7	6	38.640
	Z06001	70.35017	-152.29354	11N	2W	1,2	743.3	10.2	634.873
				12N	2W	25,26,35,36			
West Willow A									
	MM1811	70.27123	-152.47050	11N	2W	29,30,31,32	37.9	8.1	32.614
	MM1812	70.26382	-152.50734	10N	2W	6	60.9	12.6	70.633
				11N	2W	31			
				11N	3W	36			
	MM1813	70.27140	-152.53353	11N	3W	25,36	37.3	10.2	64.749
	MM1814	70.28146	-152.55020	11N	3W	25,26	66.6	11.1	79.728
	MM1815	70.27861	-152.57829	11N	3W	23,26	185.2	25.2	387.185
	MM1816	70.27453	-152.62081	11N	3W	27,34	435.5	10.6	681.247
	MM1817	70.27871	-152.50863	11N	2W	30	30.6	8.1	41.586
				11N	3W	25			
	MM1822	70.28781	-152.41623	11N	2W	21	30.5	6.6	37.043
	MM1823	70.28398	-152.43166	11N	2W	20,21,28,29	16.8	8	22.699
West Willow B									
	B84065	70.17195	-152.38202	9N	2W	3,4,9,10	1514.2	14.2	3,208.525
				10N	2W	27,28,33,34			
	MM1825	70.21728	-152.32160	10N	2W	14	84.0	8.5	92.678
	MM1826	70.21289	-152.40923	10N	2W	16,21	38.7	13.6	73.561
	MM1827	70.21416	-152.42575	10N	2W	16,17,20,21	103.7	11.4	141.427
	MM1828	70.22364	-152.38011	10N	2W	15,16	70.7	8.7	74.002

Region	Lake Name	Latitude[1] (NAD83)	Longitude[1] (NAD83)	Town	Range	Section	Surface Area (acres)	Maximum Depth (feet)	Lake Volume (M gals.)
	MM1829	70.20874	-152.53277	10N	3W	24	240.9	29.9	375.330
	MM1830	70.19224	-152.47490	10N	2W	29,30	138.9	12.4	235.612
	MM1831	70.19810	-152.52115	10N	3W	24,25	88.7	19	139.162
	MM1832	70.19254	-152.49539	10N	2W	30	73.2	9.4	101.657
Southwest Judy Creek									
	MM1834	70.08038	-152.45636	8N	2W	5,6	327.8	7.2	507.223
				9N	2W	31,32			
	MM1835	70.07792	-152.49293	8N	2W	6,7	501.0	8.2	853.361
				8N	3W	1			
				9N	2W	31			
	MM1836	70.05987	-152.46674	8N	2W	7,8	187.7	7.5	318.273
	MM1838	70.04601	-152.60651	8N	3W	9,10,15,16,22	406.7	7.4	691.364
	MM1839	70.04943	-152.63884	8N	3W	9,10,15,16,22	319.0	7.9	521.258
	MM1841	70.06556	-152.60440	8N	3W	3,10,11	428.3	12.9	728.700
	MM1844	70.08232	-152.42876	8N	2W	4,5	47.6	19	69.355
	MM1846	70.08936	-152.36415	9N	2W	34	36.0	13.1	67.588
	MM1847	70.08962	-152.34749	9N	2W	34,35	28.0	11	50.682
	R0205	70.04945	-152.55842	8N	3W	11,12,13,14	663.9	7.2	924.941
	R0206	70.09937	-152.46224	9N	2W	29,30,31,32	391.1	11.9	863.589
	R0212	70.06062	-152.70638	8N	3W	5,6,7,8,17,18	551.5	11.2	1,047.748
	R0213	70.04534	-152.66957	8N	3W	8,9,16,17,20,21	770.0	7.1	1,221.466
	R0214	70.08917	-152.39186	9N	2W	33,34	43.8	11.1	66.639

[1] Lake coordinates were derived from the centroid of each lake using GIS aerial imagery.

Table 2. Summary of fish sampling for lakes surveyed in 2018 at ConocoPhillips, Alaska Inc. exploration areas.

			Gill Nets		Minnow Traps		Seine		Visual Survey	
Region	**Lake Name**	**Sample Date**	**Set Duration (hours)**	**Fish Species[1]**	**Set Duration (hours)**	**Fish Species[1]**	**Effort (hauls)**	**Fish Species[2]**	**Distance (yards)**	**Fish Species[2]**
South Willow										
	M0015	***7/21/2000***	12.2	none	10.5	none	--	--	--	--
		NSSB were caught by fyke net on July 24-26, 2004, July 22-24, 2017, and July 18-20, 2018								
	M0017	***7/24/2000***	2.2	none	5.7	none	--	--	--	--
		NSSB were caught by fyke net on July 24-26, 2004								
		8/13/2018	9.1	none	11.8	none	--	--	5	NSSB
	M0029	***8/3/2000***	10.9	none	12.0	NSSB	--	--	--	--
		NSSB were caught by fyke net on July 26-28, 2004								
		8/1/2018	9.1	none	8.0	NSSB	--	--	--	--
	M0030	***8/3/2000***	11.0	none	12.0	none	--	--	--	--
		NSSB and BKFH were caught by fyke net on July 27-29, 2004								
		8/1/2018	9.0	none	16.5	NSSB	--	--	--	--
	MM1801	8/7/2018	10.0	none	16.5	none	--	--	50	NSSB
	MM1803	8/7/2018	9.1	none	2.3	NSSB	--	--	5	NSSB
North Willow										
	MM1808	8/6/2018	9.9	LSCS	19.0	NSSB	--	--	20	NSSB
	MM1809	7/30/2018	7.0	none	8.7	NSSB	--	--	5	GRAY
	MM1810	7/30/2018	6.7	GRAY	11.8	NSSB	--	--	--	--
	MM1818	7/17/2018	9.2	none	11.7	none	3	none	--	--
	MM1819	8/14/2018	9.0	none	4.1	NSSB	--	--	5	NSSB
	MM1820	8/14/2018	9.2	none	14.3	NSSB	--	--	5	NSSB
	MM1821	7/11/2018	9.7	none	--	--	--	--	120	NSSB
	MM1824	7/17/2018	gear not used, connected to the Kalikpik River, multiple fish observed while transecting							
	Z06001	***8/10/2006***	8.9	GRAY	21.6	NSSB			--	--
		8/6/2018	--	--	--	--	--	--	5	GRAY

			Gill Nets		Minnow Traps		Seine		Visual Survey	
Region	Lake Name	Sample Date	Set Duration (hours)	Fish Species[1]	Set Duration (hours)	Fish Species[1]	Effort (hauls)	Fish Species[2]	Distance (yards)	Fish Species[2]
West Willow A										
	MM1811	8/5/2018	9.6	none	12.0	none	1	NSSB	50	none
	MM1812	8/12/2018	9.0	none	8.5	NSSB	--	--	7	NSSB
	MM1813	7/15/2018	7.1	LSCS	5.8	NSSB	--	--	--	--
	MM1814	8/10/2018	9.5	none	12.9	none	--	--	45	NSSB
	MM1815	8/10/2018	9.1	none	4.3	NSSB	--	--	--	--
	MM1816	7/15/2018	gear not used, connected to the Kalikpik River							
	MM1817	8/12/2018	9.2	none	14.6	none	4	none	250	none
	MM1822	8/4/2018	9.5	none	15.0	none	4	none	100	none
	MM1823	8/5/2018	9.1	none	12.0	none	4	none	180	none
West Willow B										
	B84065	***8/17/2002***	5.5	GRAY	6.3	None	--	--	--	--
		7/29/2018	4.4	BDWF, LSCS	21.3	NSSB	--	--	--	--
	MM1825	8/11/2018	9.1	none	15.1	none	6	none	370	none
	MM1826	8/8/2018	9.1	none	8.5	NSSB	--	--	5	NSSB
	MM1827	8/8/2018	9.1	none	14.6	NSSB	--	--	5	NSSB
	MM1828	8/11/2018	9.1	none	15.6	none	4	NSSB	250	none
	MM1829	7/31/2018	4.2	LSCS	11.4	NSSB	--	--	--	--
	MM1830	8/3/2018	10.6	none	14.3	none	3	none	--	--
	MM1831	7/31/2018	0.6	LSCS	10.3	NSSB,SLSC	--	--	--	--
	MM1832	8/3/2018	8.4	none	9.5	none	3	NSSB	--	--
Southwest Judy Creek										
	MM1834	7/27/2018	6.3	none	17.0	none	--	--	50	NSSB
	MM1835	7/26/2018	9.2	BDWF, LSCS	11.6	NSSB	--	--	15	NSSB
	MM1836	7/26/2018	9.0	none	15.2	NSSB	--	--	25	NSSB
	MM1838	7/13/2018	1.1	BDWF,HBWF, GRAY	19.8	NSSB	--	--	--	--
	MM1839	7/13/2018	1.1	BDWF,HBWF, GRAY	19.8	NSSB	--	--	--	--

			Gill Nets		Minnow Traps		Seine		Visual Survey	
Region	Lake Name	Sample Date	Set Duration (hours)	Fish Species[1]	Set Duration (hours)	Fish Species[1]	Effort (hauls)	Fish Species[2]	Distance (yards)	Fish Species[2]
	MM1841	7/14/2018	9.4	none	8.5	NSSB	--	--	--	--
	MM1844	8/13/2018	9.0	none	12.8	NSSB	--	--	5	NSSB
	MM1846	7/28/2018	9.3	none	11.6	NSSB	--	--	--	--
	MM1847	7/28/2018	9.2	none	14.0	none	--	--	60	NSSB
	R0205	8/9/2018	9.9	none	19.0	none	4	NSSB	160	NSSB
	R0206	7/27/2018	6.0	BDWF, RDWF, LSCS	12.2	NSSB	--	--	--	--
	R0212	7/12/2018	3.0	HBWF	16.6	none	--	--	--	--
	R0213	7/14/2018	gear not used, connected to MM1838		--	--	--	--	--	--
	R0214	7/16/2018	10.0	none	16.9	NSSB	2	NSSB	--	--

[1] Sensitive species include grayling, whitefishes, char, burbot, slimy sculpin, etc.

BDWF = broad whitefish, HBWF = humpback whitefish, RDWF = round whitefish, LSCS = least cisco, GRAY = Arctic grayling

SLSC = slimy sculpin

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

Table 3. Water chemistry parameters measured in conjunction with 2018 lake sampling at ConocoPhillips, Alaska Inc. exploration areas.

Region / Lake	Date	Water Temp. (°C)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCo3] (mg/l)
South Willow										
M0015	7/30/2018	17.3	164	8.1	8.02	18.0	3.3	8.7	19.0	59.0
M0017	8/13/2018	8.0	202	0.7	8.06	27.9	5.1	6.6	13.8	90.7
M0029	8/1/2018	16.5	372	1.0	8.38	35.0	9.3	25.0	51.0	120.0
M0030	8/1/2018	16.1	234	0.74	8.13	25.0	5.3	13.0	26.0	85.0
MM1801	8/7/2018	9.1	125	1.06	7.50	16.4	2.6	5.3	10.0	51.6
MM1803	8/7/2018	9.4	143	1.4	7.69	18.9	3.6	4.9	9.1	62.0
North Willow										
MM1808	8/6/2018	9.4	118	1.2	7.81	16.7	2.1	3.8	8.6	50.2
MM1809	7/30/2018	17.3	161	0.9	8.15	23.0	2.5	4.5	9.4	68.0
MM1810	7/30/2018	15.2	154	0.8	7.78	22.0	2.6	4.8	10.0	65.0
MM1818	7/17/2018	11.1	104	0.6	7.76	14.9	2.3	3.8	8.2	46.5
MM1819	8/14/2018	6.6	149	0.8	7.89	21.2	2.8	5.3	10.8	64.3
MM1820	8/14/2018	7.3	162	0.5	8.09	22.5	3.4	6.0	13.0	70.4
MM1821	7/11/2018	7.9	181	1.4	8.08	27.1	3.4	5.4	11.8	81.6
MM1824	7/17/2018	11.6	163	0.8	7.90	24.5	2.9	4.6	10.3	73.4
Z06001	8/6/2018	8.4	179	0.8	8.40	23.2	3.4	7.4	17.1	71.7
West Willow A										
MM1811	8/5/2018	8.8	221	1.3	8.22	33.5	3.8	6.2	12.8	99.2
MM1812	8/12/2018	7.9	116	0.7	7.73	17.4	2.3	3.5	7.2	53.1
MM1813	7/15/2018	16.0	92	1.1	7.59	13.0	1.7	32.4	7.5	39.3
MM1814	8/10/2018	7.5	167	0.8	8.14	26.8	2.5	4.3	9.1	77.3
MM1815	8/10/2018	8.9	217	0.6	8.20	33.0	3.4	6.4	15.3	96.5
MM1816	7/15/2018	15.1	125	1.0	7.88	18.4	1.9	3.6	8.2	54.0
MM1817	8/12/2018	8.5	185	0.7	8.07	28.5	2.8	4.9	10.8	82.9
MM1822	8/4/2018	8.6	132	0.9	7.75	21.0	2.5	4.2	8.4	61.0

Region / Lake	Date	Water Temp. (°C)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCo3] (mg/l)
MM1823	8/5/2018	9.0	62	0.8	7.36	8.8	1.2	2.1	4.1	26.9
West Willow B										
B84065	7/29/2018	14.2	188	0.8	7.75	24.0	3.4	7.5	18.0	73.0
MM1825	8/11/2018	7.8	249	0.8	8.16	32.8	5.0	10.0	26.4	102.0
MM1826	8/8/2018	9.6	164	0.8	7.75	23.5	3.4	4.8	11.4	72.9
MM1827	8/8/2018	9.0	173	0.7	7.94	25.1	3.4	5.1	12.0	76.6
MM1828	8/11/2018	7.9	165	0.8	7.87	22.1	3.5	6.0	14.7	69.4
MM1829	7/31/2018	15.6	213	0.5	8.24	30.0	3.6	6.9	14.0	90.0
MM1830	8/3/2018	11.2	206	0.8	8.19	31.0	3.4	7.2	16.0	91.0
MM1831	7/31/2018	16.7	139	0.7	8.01	18.0	2.5	4.9	10.0	55.0
MM1832	8/3/2018	10.5	154	0.9	7.88	21.0	3.2	5.9	12.0	66.0
Southwest Judy Creek										
MM1834	7/27/2018	14.9	62	1.1	7.21	7.0	1.4	2.8	6.0	24.0
MM1835	7/26/2018	17.6	70	1.5	7.00	7.8	1.6	3.1	6.7	27.0
MM1836	7/26/2018	16.9	77	1.5	7.19	9.5	1.5	3.1	5.9	30.0
MM1838	7/13/2018	12.3	117	1.1	7.79	17.8	2.0	3.5	7.7	52.7
MM1839	7/13/2018	12.3	117	1.1	7.79	17.8	2.0	3.5	7.7	52.7
MM1841	7/14/2018	14.0	153	1.3	7.92	19.7	3.2	7.0	17.5	62.3
MM1844	8/13/2018	8.7	150	0.8	8.23	22.2	3.1	3.6	7.8	68.1
MM1846	7/28/2018	14.4	79	0.7	7.65	11.0	1.5	2.2	4.9	33.0
MM1847	7/28/2018	14.5	65	0.8	7.72	10.0	1.2	1.1	2.3	30.0
R0205	8/9/2018	8.8	269	1.4	8.21	29.8	6.9	14.5	35.7	103.0
R0206	7/27/2018	15.1	94	1.2	6.91	11.0	2.0	4.1	9.1	36.0
R0212	7/12/2018	10.3	115	0.8	7.87	11.3	1.7	2.3	5.2	35.1
R0213	7/14/2018	15.1	106	1.0	7.72	16.4	1.8	3.0	6.4	48.5
R0214	7/16/2018	15.1	81	0.6	7.70	17.9	2.0	2.5	5.6	52.8

Table 4. Water surface elevations at selected lakes surveyed for ConocoPhillips, Inc.

Note: Water surface elevations are relative to a temporary vertical elevation benchmark, or VEBM.

		Location of VEBM				
Region	Lake Name	Latitude	Longitude	Date of Measurement	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
South Willow						
	M0015	70.11086	-152.07848	7/30/18	4.95	-1.98
	M0017	70.10414	-152.13551	8/13/18	4.62	-0.51
	M0029	70.12033	-152.20535	8/1/18	5.05	-0.33
	M0030	70.12084	-152.20457	8/1/18	5.81	-0.48
	MM1801	70.04545	-152.06554	8/7/18	3.85	-2.09
	MM1803	70.04787	-152.07204	8/7/18	5.03	-5.79
North Willow						
	MM1808	70.34711	-152.33405	8/6/18	4.37	-0.98
	MM1809	70.32496	-152.33267	7/30/18	4.35	-1.17
	MM1810	70.32384	-152.33203	7/30/18	5.63	-0.33
	MM1818	70.29295	-152.22277	7/17/18	4.36	-1.78
	MM1819	70.29012	-152.25060	8/14/18	4.19	-0.58
	MM1820	70.28738	-152.29243	8/14/18	5.425	-1.51
	MM1821	70.28137	-152.31624	7/11/18	4.25	-3.55
	MM1824	70.29439	-152.26682	7/17/18	4.53	-1.81
	Z06001	70.35665	-152.31113	8/6/18	4.83	-1.79
West Willow A						
	MM1811	70.26994	-152.46613	8/5/18	4.5	-1.39
	MM1812	70.26617	-152.50667	8/12/18	4.01	-1.62
	MM1813	70.27180	-152.54038	7/15/18	4.29	-2.19
	MM1814	70.28162	-152.55942	8/10/18	5.52	-0.94
	MM1815	70.27989	-152.56935	8/10/18	4.74	-2.10
	MM1816	70.07108	-152.61864	7/15/18	4.92	-2.16
	MM1817	70.27728	-152.50490	8/12/18	6.13	-2.51
	MM1822	70.28639	-152.41890	8/4/18	4.81	-2.94
	MM1823	70.28307	-152.43333	8/5/18	3.94	-2.80
West Willow B						
	B84065	70.15498	-152.37833	7/29/18	5.26	-0.66
	MM1825	70.21412	-152.31880	8/11/18	5.135	-3.21
	MM1826	70.21129	-152.41246	8/8/18	5.5	-5.69
	MM1827	70.21380	-152.42010	8/8/18	4.97	-2.96
	MM1828	70.22195	-152.37819	8/11/18	4.61	-3.05
	MM1829	70.20263	-152.52725	7/31/18	5.33	-0.52
	MM1830	70.19210	-152.48531	8/3/18	4.1	-2.44
	MM1831	70.20162	-152.52650	7/31/18	4.29	-0.74
	MM1832	70.19164	-152.48810	8/3/18	3.55	-1.81

Region	Lake Name	Location of VEBM		Date of Measurement	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
		Latitude	Longitude			
Southwest Judy Creek						
	MM1834	70.08836	-152.45261	7/27/18	4.3	-1.70
	MM1835	70.08796	-152.49940	7/26/18	4.68	-2.29
	MM1836	70.06386	-152.45859	7/26/18	4.67	-0.48
	MM1838	70.05297	-152.64883	7/13/18	3.43	-0.98
	MM1839	70.05297	-152.64883	7/13/18	3.43	-0.98
	MM1841	70.07108	-152.61864	7/14/18	3.83	-1.18
	MM1844	70.07877	-152.42407	8/13/18	4.63	-1.39
	MM1846	70.08973	-152.35516	7/28/18	5.1	-0.79
	MM1847	70.08920	-152.35333	7/28/18	5.38	-0.66
	R0205	70.04219	-152.55040	8/9/18	4.31	-7.31
	R0206	70.08870	-152.45186	7/27/18	4.86	-1.31
	R0212	70.05479	-152.69516	7/12/18	5.13	-4.09
	R0213	70.03311	-152.66329	7/14/18	3.61	-6.24
	R0214	70.08899	-152.38533	7/16/18	5.71	-3.50

Table 5. Recommended maximum water volumes available for under-ice water withdrawal from lakes surveyed in 2018 for ConocoPhillips, Inc. (does not include volume related to ice aggregate).

NOTE: Requested water based on 20% of total lake volume when no fish are present, 30% of winter volume deeper than 5 ft when resistant fish are likely to be present, and 15% of winter volume deeper than 7 ft when sensitive species are present.

Region	Lake	Surface Area (acres)	Max. Depth in 2018 (feet)	Calculated Volume (M gals.)	20% Total Lake Volume (M gals.)	30% of Water Under 5ft of Ice (M gals.)	15% of Water Under 7 ft of Ice (M gals.)	Sensitive Fish Species Present[1]	Resistant Fish Species Present[2]	Recommended Maximum Under-Ice Withdrawal (M gals.)
South Willow										
	M0015	482.4	6.7	614.718	122.944	5.641	0.000	none	NSSB	5.641
	M0017	38.7	4.2	23.931	4.786	0.000	0.000	none	NSSB	0.000
	M0029	46.6	13.4	95.037	19.007	8.911	1.795	none	NSSB	8.911
	M0030	27.4	10.3	42.504	8.501	2.241	0.152	none	NSSB	2.241
	MM1801	491.4	5.4	434.431	86.886	0.017	0.000	none	NSSB	0.017
	MM1803	28.3	7.3	26.005	5.201	0.215	0.000	none	NSSB	0.215
North Willow										
	MM1808	288.6	10.7	480.006	96.001	38.138	5.066	LSCS	NSSB	5.066
	MM1809	81.3	7.7	60.088	12.018	1.746	0.012	GRAY	NSSB	0.012
	MM1810	142.6	10.7	258.699	51.740	24.111	4.363	GRAY	NSSB	4.363
	MM1818	20.4	9.9	22.221	4.444	0.851	0.114	none	none	4.444
	MM1819	36.7	13.3	46.964	9.393	2.790	0.641	none	NSSB	2.790
	MM1820	18.4	7.5	22.690	4.538	0.373	0.006	none	NSSB	0.373
	MM1821	40.8	10.9	50.972	10.194	2.783	0.413	none	NSSB	2.783
	MM1824	55.7	6.0	38.640	7.728	0.150	0.000	Assumed		0.000
	Z06001	743.3	10.2	634.873	126.975	24.204	0.458	GRAY	NSSB	0.458
West Willow A										
	MM1811	37.9	8.1	32.614	6.523	0.295	0.007	none	NSSB	0.295
	MM1812	60.9	12.6	70.633	14.127	2.413	0.420	none	NSSB	2.413
	MM1813	37.3	10.2	64.749	12.950	4.098	0.523	LSCS	NSSB	0.523
	MM1814	66.6	11.1	79.728	15.946	4.104	0.650	none	NSSB	4.104

Region	Lake	Surface Area (acres)	Max. Depth in 2018 (feet)	Calculated Volume (M gals.)	20% Total Lake Volume (M gals.)	30% of Water Under 5ft of Ice (M gals.)	15% of Water Under 7 ft of Ice (M gals.)	Sensitive Fish Species Present[1]	Resistant Fish Species Present[2]	Recommended Maximum Under-Ice Withdrawal (M gals.)
	MM1815	185.2	25.2	387.185	77.437	55.966	21.362	none	NSSB	55.966
	MM1816	435.5	10.6	681.247	136.249	54.311	10.611	Assumed		10.611
	MM1817	30.6	8.1	41.586	8.317	1.379	0.057	none	none	8.317
	MM1822	30.5	6.6	37.043	7.409	0.867	0.000	none	none	7.409
	MM1823	16.8	8.0	22.699	4.540	0.582	0.020	none	none	4.540
West Willow B										
	B84065	1514.2	14.2	3208.525	641.705	306.794	76.548	BDWF,LSCS, GRAY	NSSB	76.548
	MM1825	84.0	8.5	92.678	18.536	5.488	0.300	none	none	18.536
	MM1826	38.7	13.6	73.561	14.712	7.340	1.884	none	NSSB	7.340
	MM1827	103.7	11.4	141.427	28.285	7.846	0.798	none	NSSB	7.846
	MM1828	70.7	8.7	74.002	14.800	2.394	0.148	none	NSSB	2.394
	MM1829	240.9	29.9	375.330	75.066	52.600	19.675	LSCS	NSSB	19.675
	MM1830	138.9	12.4	235.612	47.122	18.453	2.650	none	none	47.122
	MM1831	88.7	19.0	139.162	27.832	15.576	4.678	LSCS,SLSC	NSSB	4.678
	MM1832	73.2	9.4	101.657	20.331	7.454	0.896	none	NSSB	7.454
Southwest Judy Creek										
	MM1834	327.8	7.2	507.223	101.445	17.313	0.000	none	NSSB	17.313
	MM1835	501.0	8.2	853.361	170.672	35.961	0.099	BDWF, LSCS	NSSB	0.099
	MM1836	187.7	7.5	318.273	63.655	14.878	0.277	none	NSSB	14.878
	MM1838	406.7	7.4	691.364	138.273	37.830	0.284	BDWF,HBWF, GRAY	NSSB	0.284
	MM1839	319.0	7.9	521.258	104.252	27.526	0.447	BDWF,HBWF, GRAY	NSSB	0.447
	MM1841	428.3	12.9	728.700	145.740	46.803	4.360	none	NSSB	46.803
	MM1844	47.6	19.0	69.355	13.871	4.910	1.022	none	NSSB	4.910
	MM1846	36.0	13.1	67.588	13.518	5.673	0.997	none	NSSB	5.673
	MM1847	28.0	11.0	50.682	10.136	3.696	0.515	none	NSSB	3.696

Region	Lake	Surface Area (acres)	Max. Depth in 2018 (feet)	Calculated Volume (M gals.)	20% Total Lake Volume (M gals.)	30% of Water Under 5ft of Ice (M gals.)	15% of Water Under 7 ft of Ice (M gals.)	Sensitive Fish Species Present[1]	Resistant Fish Species Present[2]	Recommended Maximum Under-Ice Withdrawal (M gals.)
	R0205	663.9	7.2	924.941	184.988	22.294	0.073	none	NSSB	22.294
	R0206	391.1	11.9	863.589	172.718	88.185	19.343	BDWF,RDWF, LSCS, HBWF	NSSB	19.343
	R0212	551.5	11.2	1047.748	209.550	94.727	19.974	Assumed none	none	19.974
	R0213	770.0	7.1	1221.466	244.293	43.515	0.000			0.000
	R0214	43.8	11.1	66.639	13.328	3.850	0.539		NSSB	3.850

[1] Sensitive species include grayling, whitefishes, char, burbot, slimy sculpin, etc.
BDWF = broad whitefish, HBWF = humpback whitefish, RDWF = round whitefish, LSCS = least cisco, GRAY = Arctic grayling
SLSC = slimy sculpin

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

Table 6. Estimated area available for removing ice aggregate, based on the area covered by water shallower than 4 feet.

NOTE: Surveyed in 2018 at ConocoPhillips, Inc. exploration areas.

Region	Lake	Surface Area (acres)	Max. Depth in 2018 (feet)	Acres Covered by Water Shallower than 4 feet[1]	Gallons of Water as Chips[2] (M gals.)
South Willow					
	M0015	482.394	6.7	140.52	41.674
	M0017	38.724	4.2	38.72	11.484
	M0029	46.633	13.4	10.89	3.230
	M0030	27.437	10.3	9.52	2.824
	MM1801	491.404	5.4	421.34	124.952
	MM1803	28.323	7.3	17.95	5.324
North Willow					
	MM1808	288.641	10.7	106.86	31.691
	MM1809	81.349	7.7	61.11	18.121
	MM1810	142.580	10.7	48.70	14.441
	MM1818	20.381	9.9	13.62	4.040
	MM1819	36.738	13.3	21.39	6.343
	MM1820	18.379	7.5	8.15	2.418
	MM1821	40.842	10.9	20.84	6.181
	MM1824	55.726	6.0	45.51	13.497
	Z06001	743.265	10.2	539.84	160.093
West Willow A					
	MM1811	37.856	8.1	32.11	9.521
	MM1812	60.905	12.6	32.62	9.674
	MM1813	37.291	10.2	10.03	2.973
	MM1814	66.564	11.1	37.24	11.043
	MM1815	185.197	25.2	93.30	27.668
	MM1816	435.481	10.6	240.68	71.377
	MM1817	30.607	8.1	14.50	4.300
	MM1822	30.541	6.6	14.64	4.341
	MM1823	16.821	8.0	6.85	2.031
West Willow B					
	B84065	1514.196	14.2	258.17	76.563
	MM1825	83.955	8.5	50.61	15.009
	MM1826	38.662	13.6	13.47	3.994
	MM1827	103.690	11.4	46.31	13.733
	MM1828	70.681	8.7	42.00	12.454
	MM1829	240.859	29.9	150.32	44.578
	MM1830	138.934	12.4	51.03	15.134
	MM1831	88.717	19.0	49.94	14.810
	MM1832	73.226	9.4	35.12	10.414

Region	Lake	Surface Area (acres)	Max. Depth in 2018 (feet)	Acres Covered by Water Shallower than 4 feet[1]	Gallons of Water as Chips[2] (M gals.)
Southwest Judy Creek					
	MM1834	327.838	7.2	68.28	20.248
	MM1835	501.038	8.2	81.86	24.276
	MM1836	187.700	7.5	32.93	9.764
	MM1838	406.690	7.4	99.07	29.379
	MM1839	318.954	7.9	86.71	25.714
	MM1841	428.253	12.9	123.97	36.765
	MM1844	47.585	19.0	24.01	7.119
	MM1846	36.007	13.1	8.82	2.617
	MM1847	27.964	11.0	7.31	2.166
	R0205	663.929	7.2	196.83	58.371
	R0206	391.096	11.9	68.14	20.208
	R0212	551.482	11.2	182.23	54.043
	R0213	769.964	7.1	153.05	45.387
	R0214	43.829	11.1	16.41	4.866

1 Ice thickness is typically 4 ft by early January.
2 Gallons of water available as chips is the water content of the top 1 ft of ice.

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FIGURES

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North Willow
Z06001
MM1808
MM1809
MM1810
MM1824
MM1819
MM1818
MM1820
MM1821
West Willow A
MM1814
MM1815
MM1816
MM1813
MM1812
MM1822
MM1823
MM1811
MM1817
Kalikpik River
Fish Creek
West Willow B
MM1825
MM1828
MM1829
MM1831
MM1832
MM1826
MM1827
MM1830
B84065
Inicok Creek
Judy Creek
South Willow
M0030
M0029
M0015
M0017
MM1803
MM1801
Southwest Judy Creek
R0206
MM1847
MM1834
MM1846
MM1835
MM1841
MM1836
R0212
R0214
MM1844
R0205
R0213
MM1838
MM1839
Ublutuoch River

Legend

Bathymetric Survey Location

Imagery Source: 2002 BLM NPRA Aerial

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

2018 FIELD STUDY AREA

LAKES SURVEYED

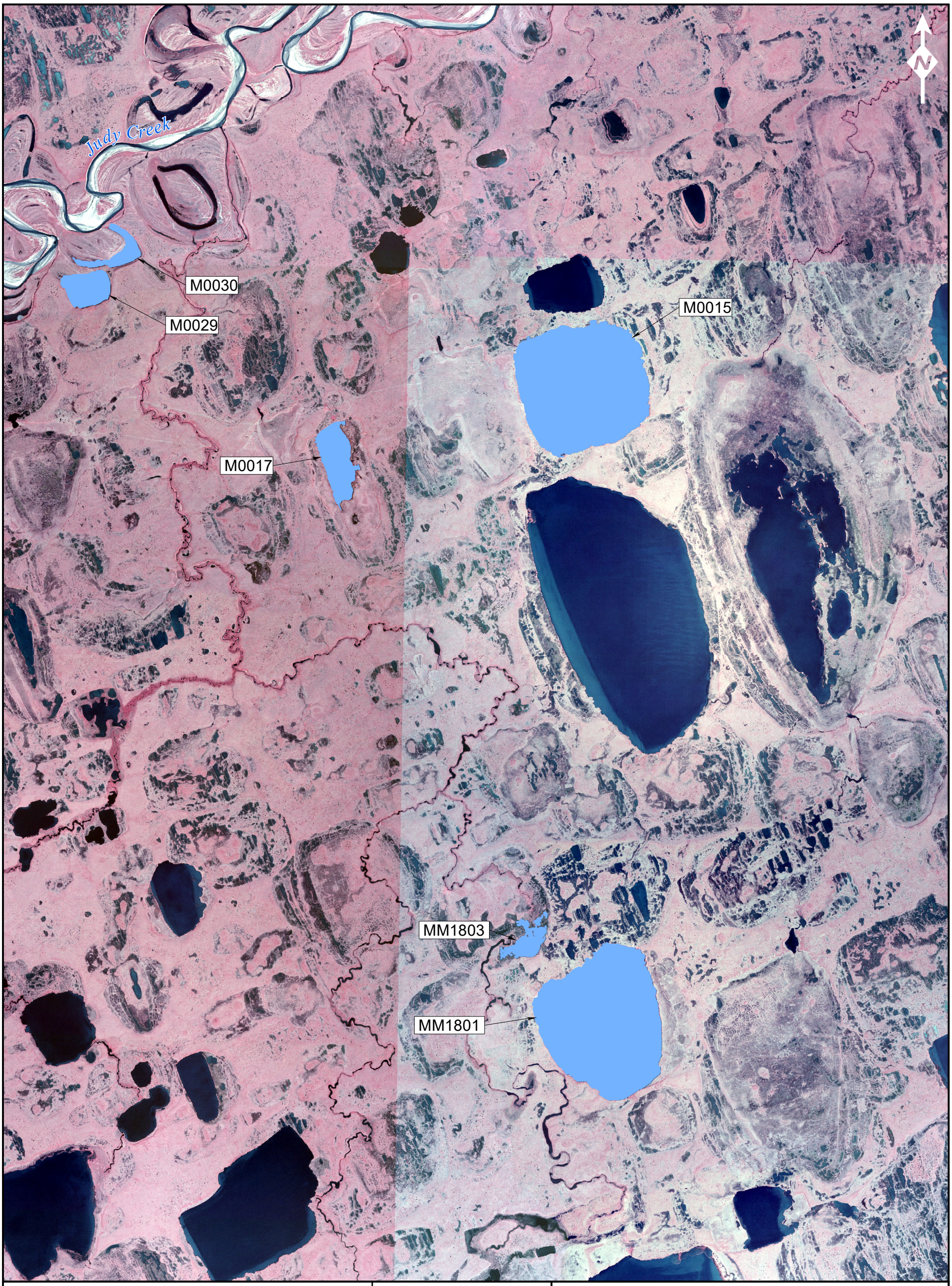
Scale

0 10 20 mi.

Figure

1

CPAI_011.mxd 20190116 ORNRC R07



Legend

Bathymetric Survey Location

Imagery Source: 2002 BLM NPRA Aerial

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

SOUTH WILLOW LAKES

6 Lakes

Scale

0 2.5 5 mi.

Figure

2

CPAI_021.mxd 20190116 ORNRC R05

Legend

Bathymetric Survey Location

Imagery Source: 2002 BLM NPRA Aerial

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

NORTH WILLOW LAKES

9 Lakes

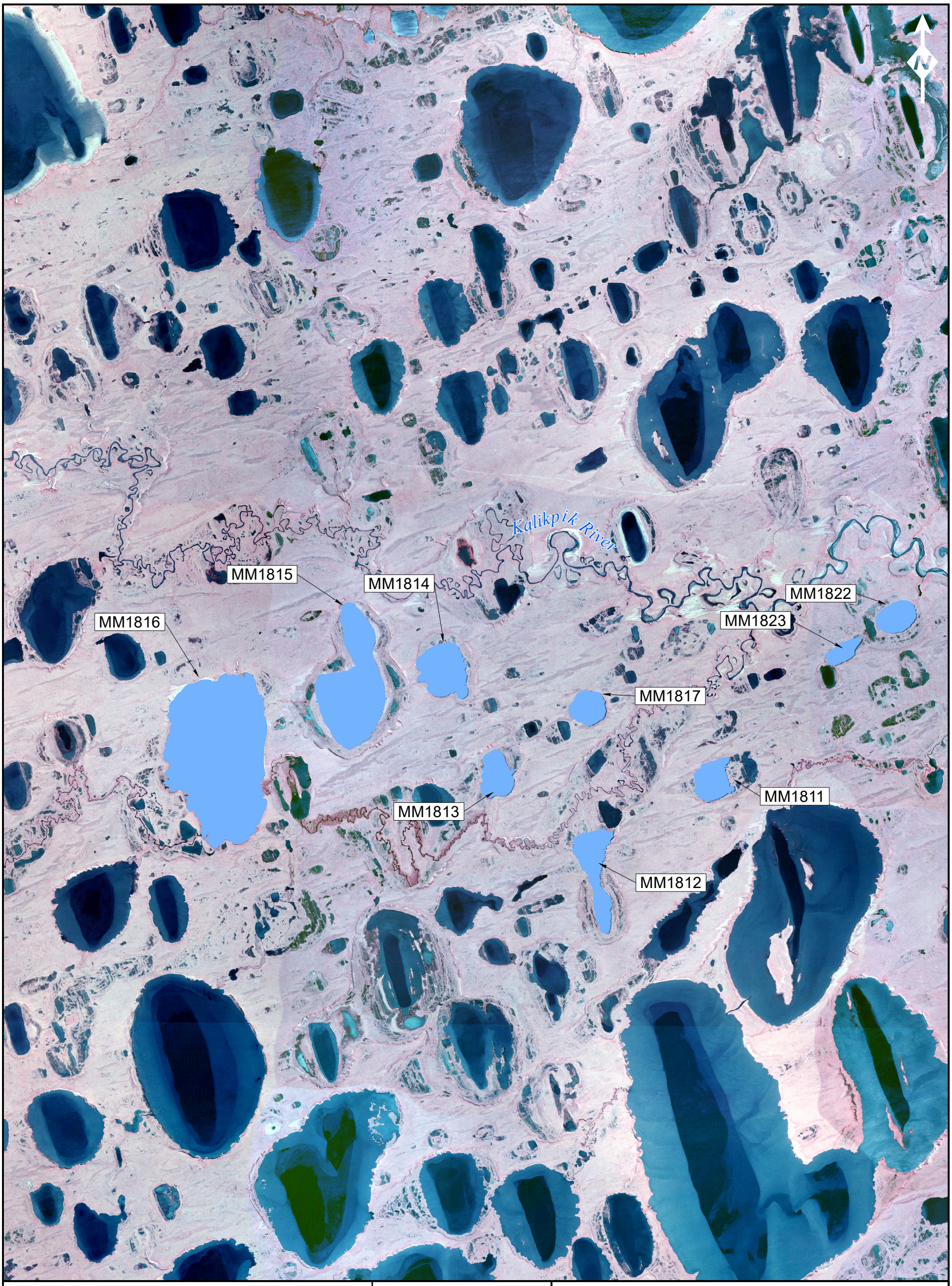
Scale

0 2 4 mi.

Figure

3

CPAI_018.mxd 20190116 ORNRC R04



Legend

Bathymetric Survey Location

Imagery Source: 2002 BLM NPRA Aerial

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

WEST WILLOW A LAKES

9 Lakes

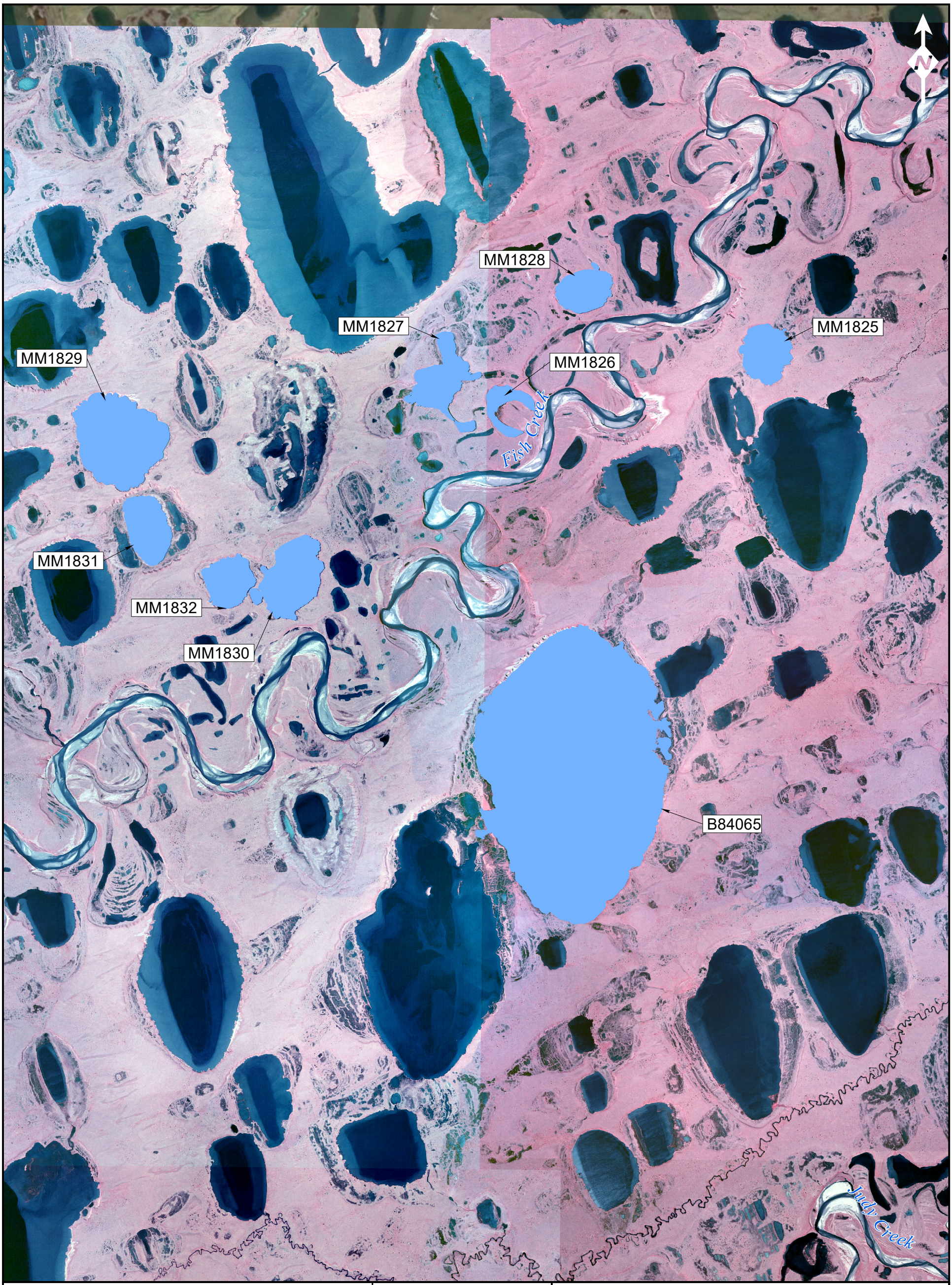
Scale

0 2.5 5 mi.

Figure

4

CPAI_019.mxd 20190116 ORNRC R04



Legend

Bathymetric Survey Location

Imagery Source: 2002 BLM NPRA Aerial

ConocoPhillips Alaska

Prepared by:

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WEST WILLOW B LAKES

9 Lakes

Scale

0 3 6 mi.

Figure

5

CPAI_020.mxd 20190116 ORNRC R04

Fish Creek

R0206

MM1835

R0214

MM1846

R0212

MM1841

MM1847

MM1844

MM1834

Judy Creek

MM1836

R0205

R0213

MM1839

MM1838

Judy Creek

Legend

Bathymetric Survey Location

Imagery Source: 2002 BLM NPRA Aerial

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

SOUTHWEST JUDY CREEK LAKES

14 Lakes

Scale

0 4 8 mi.

Figure

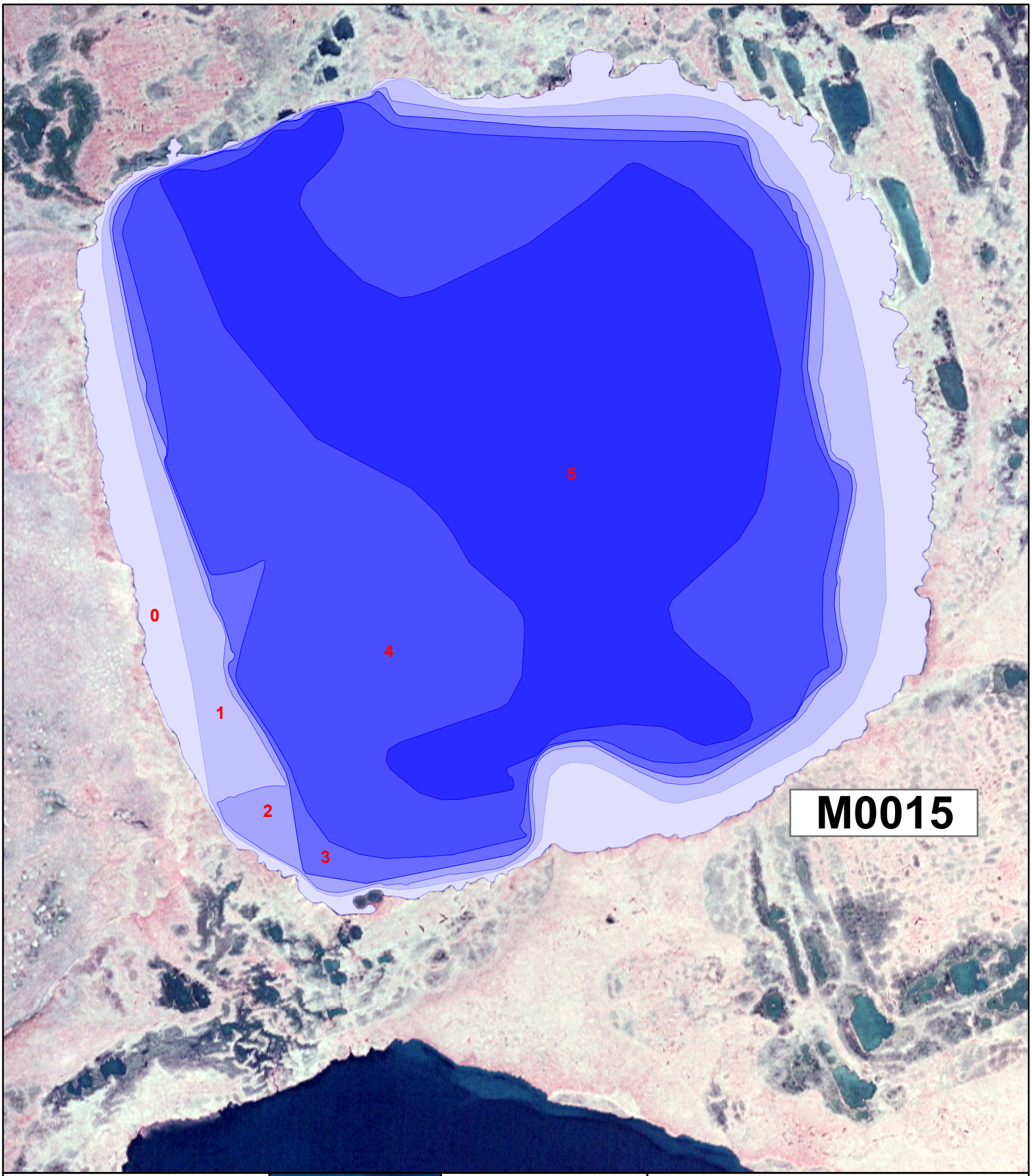
6

CPAI_022.mxd 20190116 ORNRC R06

6. LAKE SUMMARIES

Contents:

6.1. Lake Summaries for Lakes Sampled in the South Willow Area, 2018.



Depth in Feet

0 1 2 3 4 5

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake M0015

based on transects surveyed on July 30, 2018

SCALE:

500 250 0 500 1,000 Feet

N

Lake M0015

Other Names: R0056, W17301
Location: 70.10864°N 152.05727°W
USGS Quad Sheet: Harrison Bay A-4: T9N R1W Sec. 23-26
Habitat: Tundra Lake
Area: 482 acres
Maximum Depth: 6.7 feet in 2018 (7.5 ft in 2004)
Active Outlet: Yes
Total Lake Volume: 614.718 million gallons (July 30, 2018 data)
Water Volume Under 4 ft of ice: 101.163 million gallons
Water Volume Under 5 ft of ice: 18.803 million gallons
Water Volume Under 7 ft of ice: 0.000 million gallons

Potential Aggregate: 140.5 acres (water depth 4 ft or less)
41.674 million gallons

Maximum Recommended Winter Removal: **5.641 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

Water Chemistry:

Date of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2000	21.2	3.9	10.1	23.5	69	--	--	--	2000 survey
Jul 13 04	--	--	--	--	--	179	3.9	7.82	Moulton 2004
Jul 23 04	--	--	--	--	--	188	0.8	7.88	Moulton 2004
Jul 24 04	--	--	--	--	--	190	0.8	8.10	Moulton 2004
Jul 25 04	--	--	--	--	--	191	1.6	8.00	Moulton 2004
Jul 26 04	--	--	--	--	--	193	1.7	7.76	Moulton 2004
Jul 21 17	--	--	--	--	--	189	1.3	8.19	Morris 2017
Jul 22 17	--	--	--	--	--	190	3.0	8.07	Morris 2017
Jul 23 17	--	--	--	--	--	192	4.3	8.03	Morris 2017
Jul 24 17	--	--	--	--	--	188	3.5	8.15	Morris 2017
Jul 18 18	--	--	--	--	--	158	4.5	7.91	Morris 2018
Jul 19 18	--	--	--	--	--	156	33.3	7.66	Morris 2018
Jul 20 18	--	--	--	--	--	140	8.4	7.86	Morris 2018
Jul 21 18	--	--	--	--	--	157	6.9	7.95	Morris 2018
Jul 30 18	18.0	3.3	8.7	19.0	59	164	8.1	8.02	Morris 2018

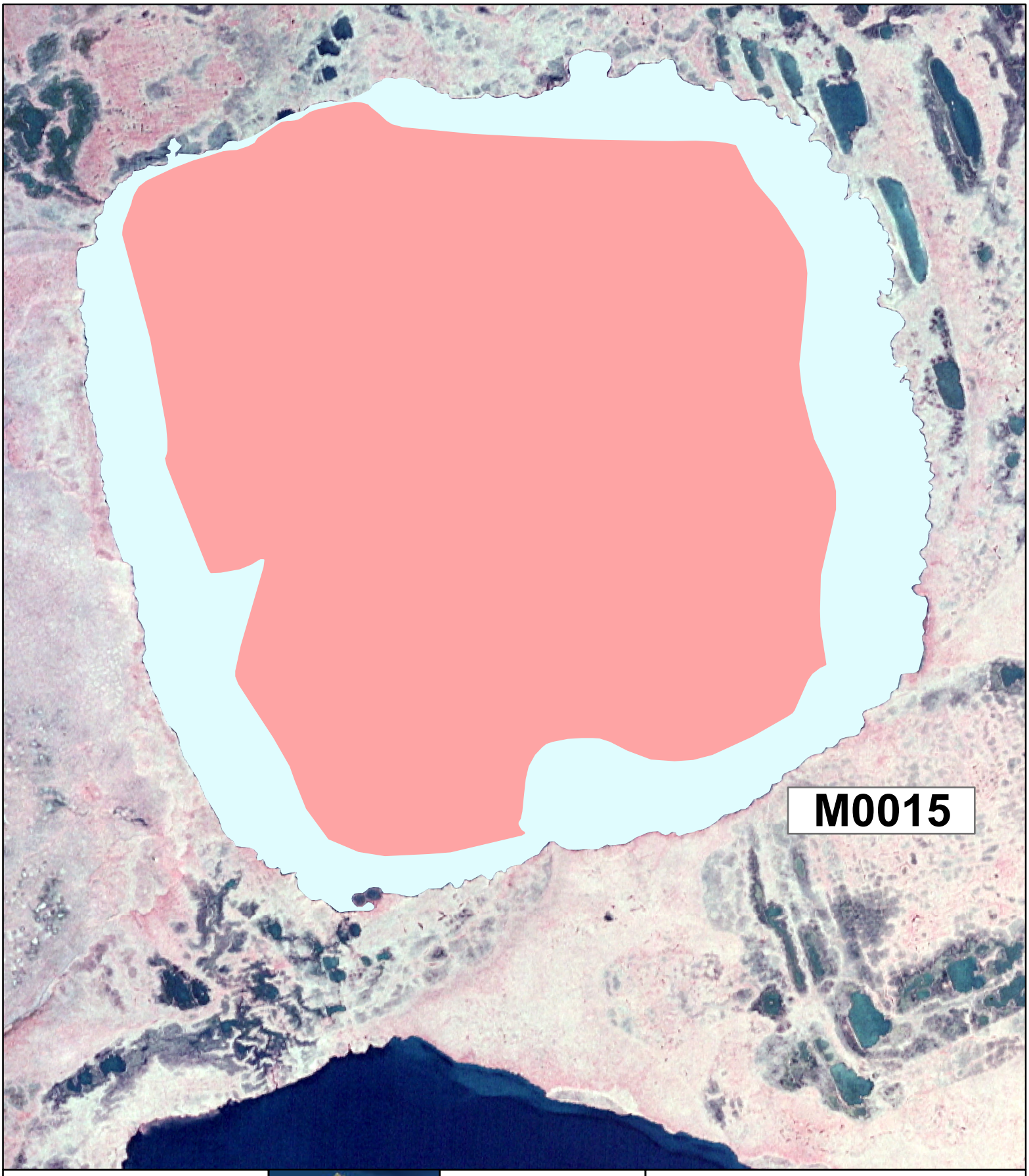
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 21 00	12.2	None	0	
Minnow Traps	Jul 21 00	10.5	None	0	
Fyke Net	Jul 24-26, 04	72.6	Ninespine stickleback	3,258	
	Jul 22-24, 17	70.5	Ninespine stickleback	24,104	
	Jul 18-21, 18	70.1	Alaska blackfish	1	71
			Ninespine stickleback	204	

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.11086	-152.07848	7/30/2018	4.95	-1.98

Last Revised: December 6, 2018



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

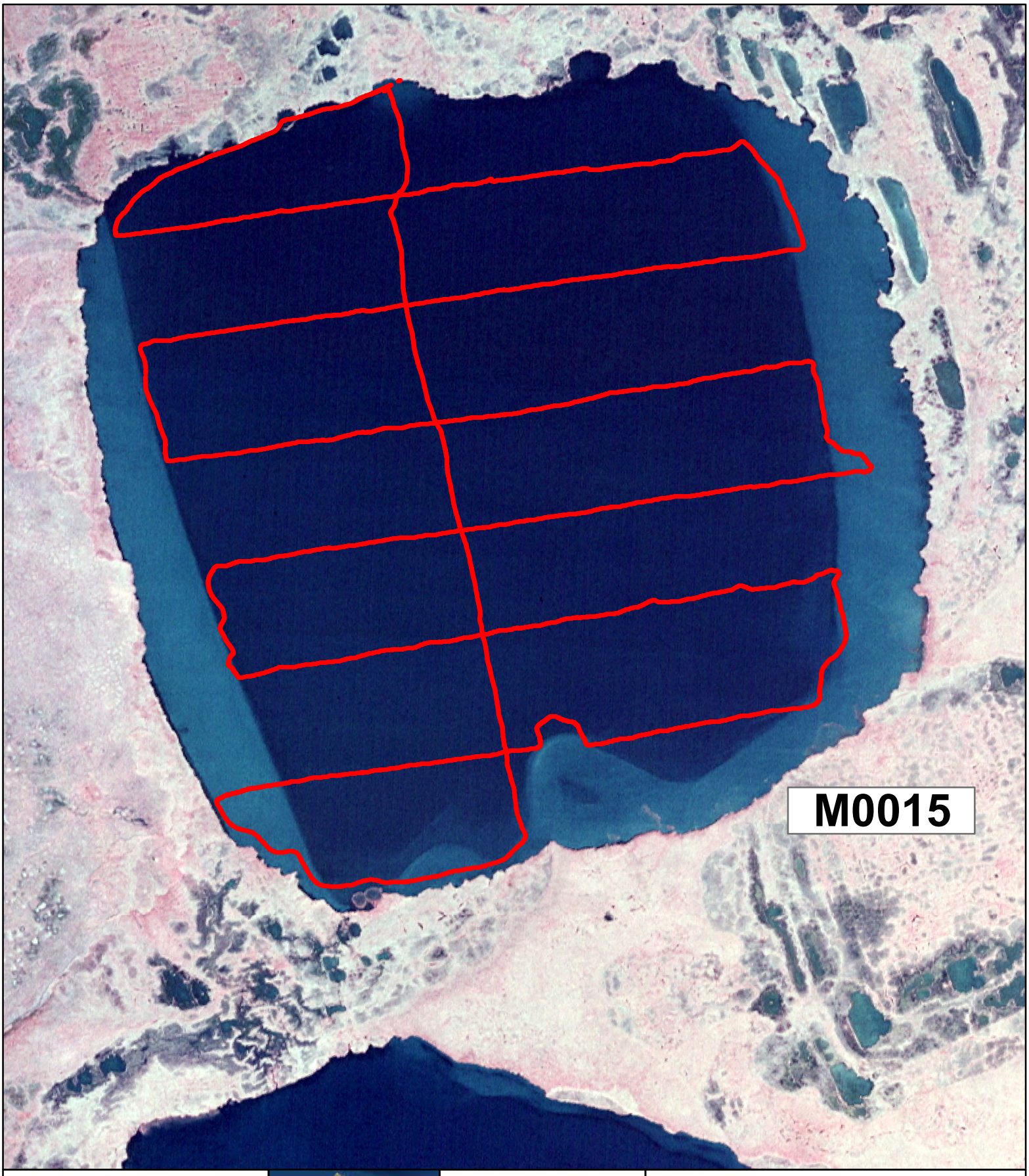
Area Available for Ice Chip Collection at Lake M0015

based on transects surveyed on July 30, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

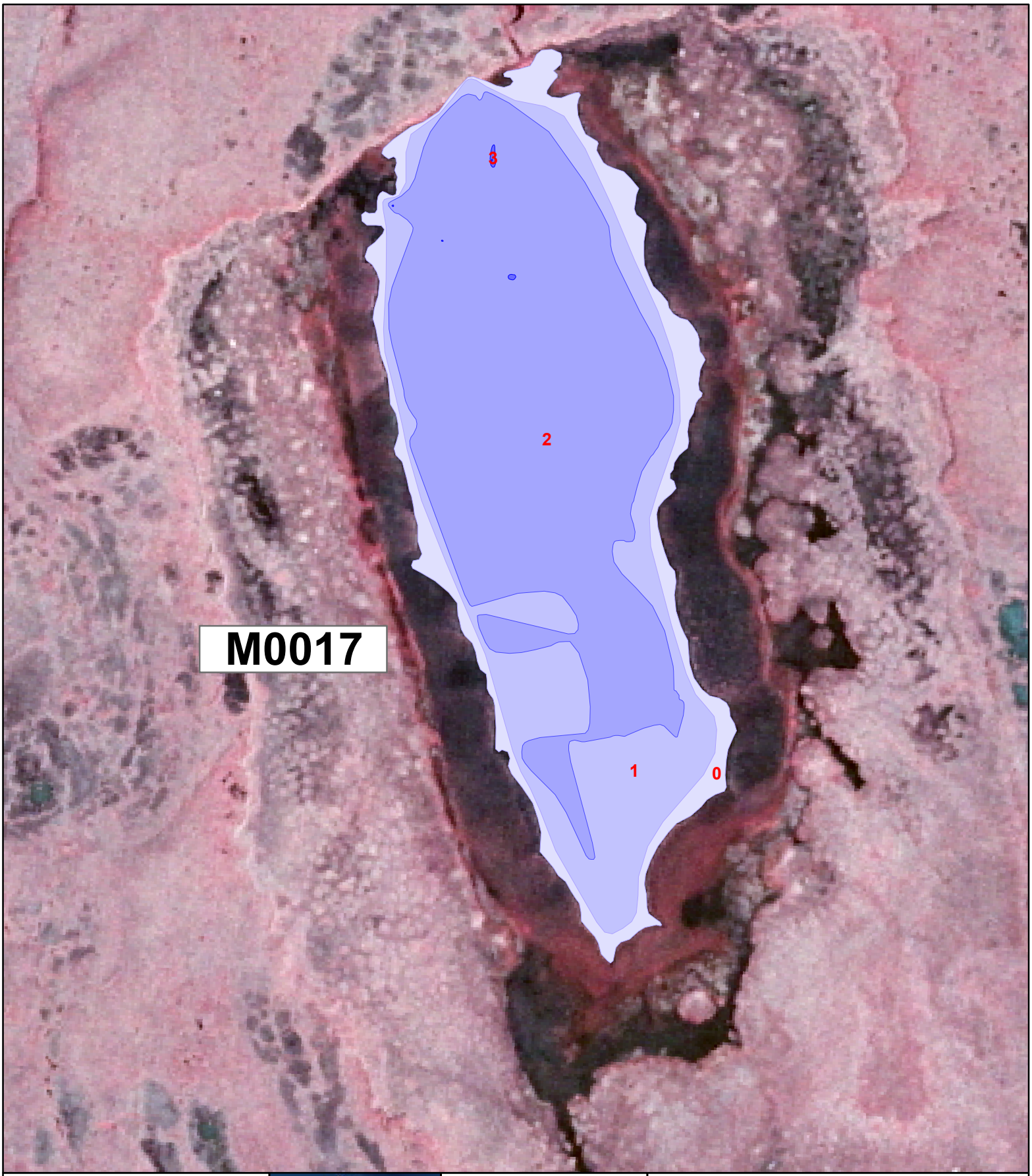
Depth Transects Surveyed at Lake M0015

surveyed on July 30, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth in Feet

0 1 2 3 4

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake M0017

based on transects surveyed on August 13, 2018

SCALE:

250 125 0 250 500 Feet

N

Lake M0017

Other Names: R0054
Location: 70.10083°N 152.13332°W
USGS Quad Sheet: Harrison Bay A-4: T9N R1W Sec. 27,28,33,34
Habitat: Tundra Lake
Area: 39 acres
Maximum Depth: 4.2 feet in 2018 (3.3 feet in 2004)
Active Outlet: No
Total Lake Volume: 23.931 million gallons (2018 data)
Water Volume Under 4 ft of ice: 0.000 million gallons
Water Volume Under 5 ft of ice: 0.000 million gallons
Water Volume Under 7 ft of ice: 0.000 million gallons

Potential Aggregate: 38.7 acres (water depth 4 ft or less)
11.484 million gallons

Maximum Recommended Winter Removal: **0.000 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

Water Chemistry:

Date of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2000	34.2	6.8	8.9	16.3	133	--	--	--	L. Moulton
Jul 13 04	--	--	--	--	--	187	2.6	7.66	L. Moulton
Jul 23 04	--	--	--	--	--	212	2.1	7.77	L. Moulton
Jul 24 04	--	--	--	--	--	218	1.6	7.96	L. Moulton
Jul 25 04	--	--	--	--	--	217	2.6	7.89	L. Moulton
Jul 26 04	--	--	--	--	--	220	2.6	7.85	L. Moulton
2018	27.9	5.1	6.6	13.8	91	202	0.7	8.06	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Jul 24 00	2.2	none	0
	Aug 13 18	9.1	none	0
Minnow Traps	Jul 24 00	5.7	none	0
	Aug 13 18	11.8	none	0
Fyke Net	Jul 24-26, 04	72.6	Ninespine stickleback	240
Visual +Dipnet	Aug 13 18	5 yards	Ninespine stickleback	7

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.10414	-152.13551	8/13/2018	4.62	-0.51

Last Revised: November 7, 2018

Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

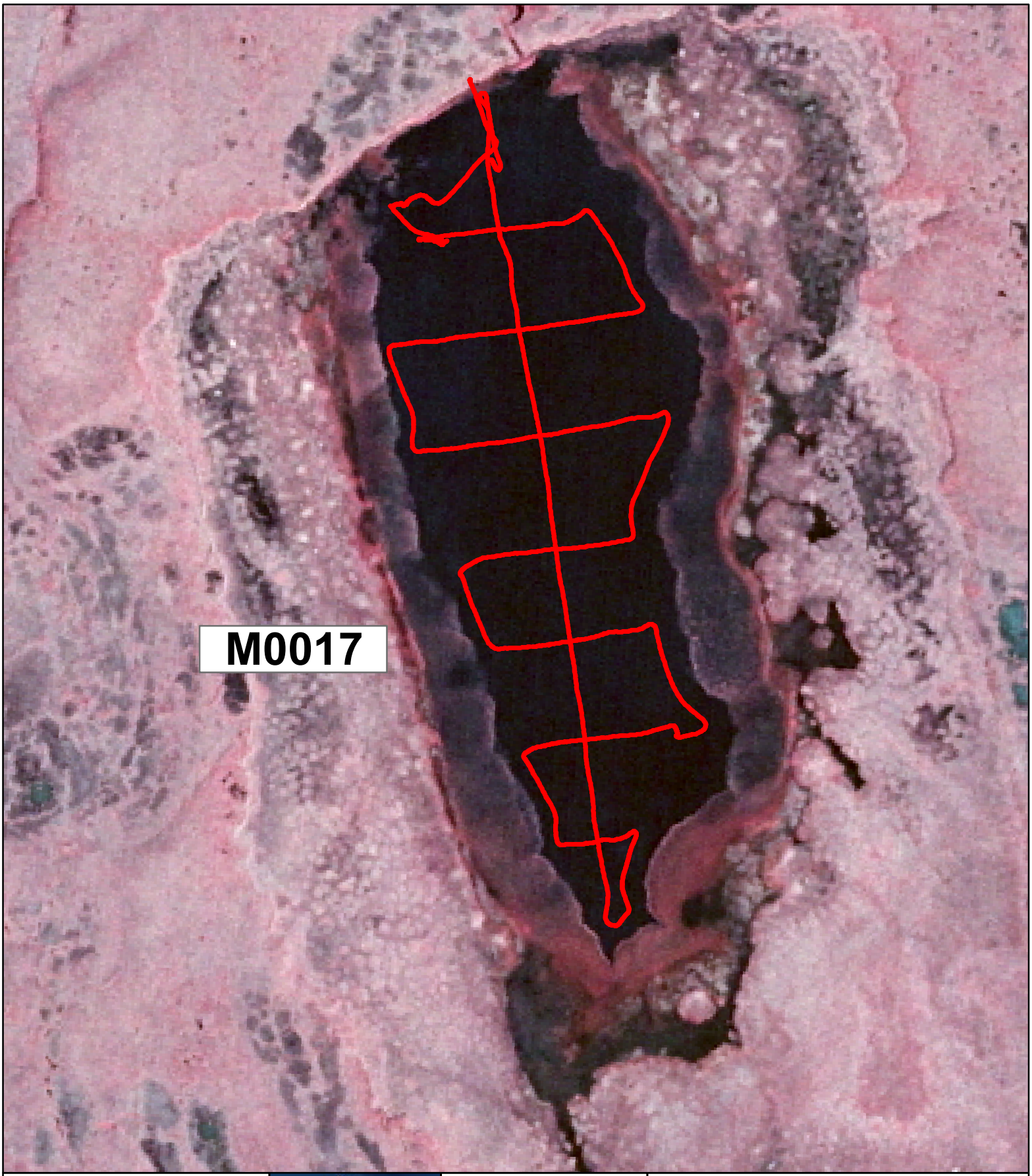
Area Available for Ice Chip Collection at Lake M0017

based on transects surveyed on August 13, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

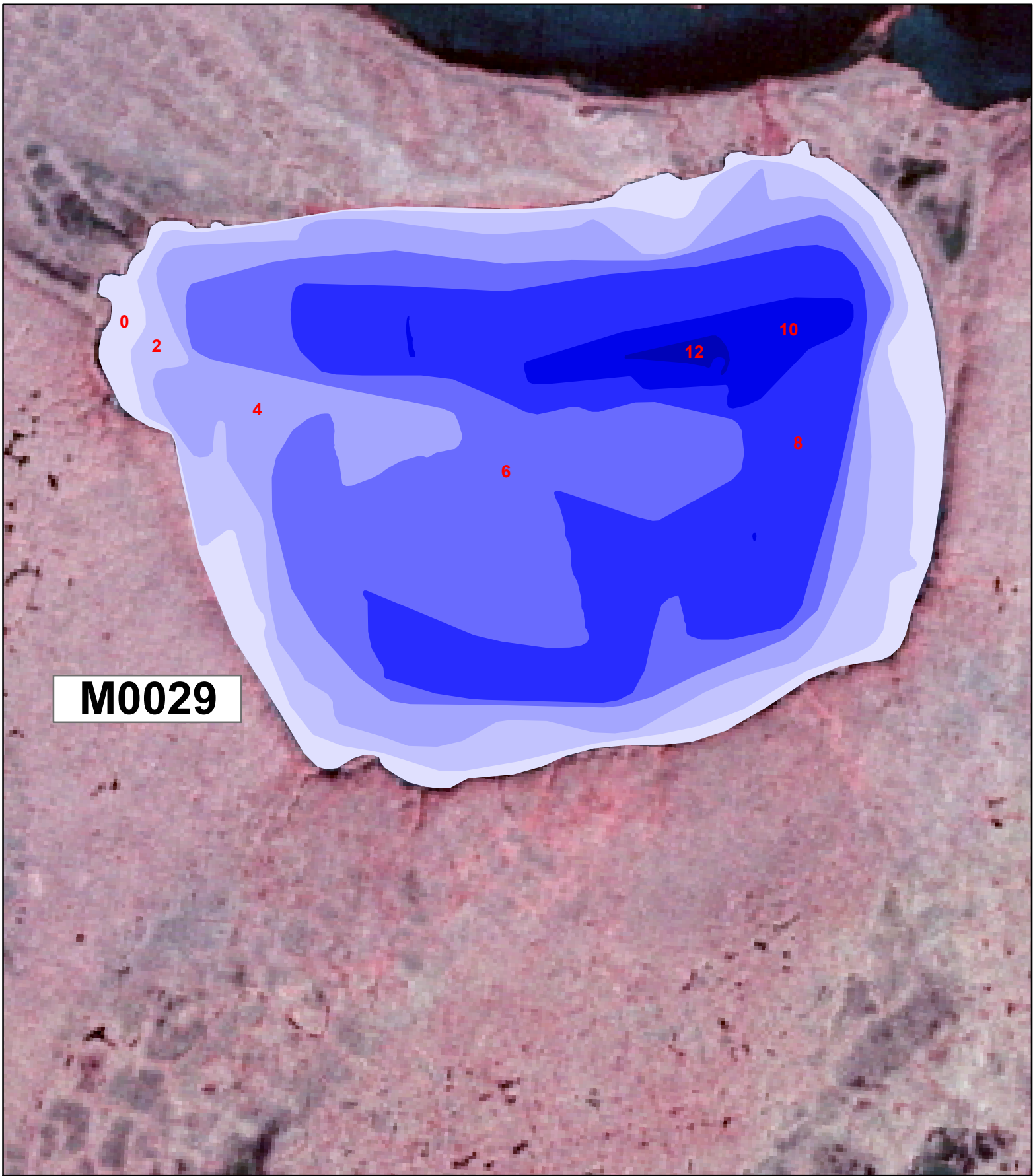
Depth Transects Surveyed at Lake M0017

surveyed on August 13, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth in Feet

0 2 4 6 8 10 12

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake M0029 (depths in 2 foot intervals)

based on transects surveyed on August 1, 2018

SCALE:

100 50 0 100 200 300 400 500 Feet

N

Lake M0029

Other Names: None Known
Location: 70.11847°N 152.21073°W
USGS Quad Sheet: Harrison Bay A-4: T9N R1W Sec. 19,20
Habitat: Perched Lake
Area: 47 acres
Maximum Depth: 13.4 feet in 2018 (12.6 feet in 2004)
Active Outlet: No
Total Lake Volume: 95.037 million gallons (2018 data)
Water Volume Under 4 ft of ice: 40.709 million gallons
Water Volume Under 5 ft of ice: 29.704 million gallons
Water Volume Under 7 ft of ice: 11.967 million gallons

Potential Ice Aggregate: 10.9 acres (water depth 4 ft or less)
3.230 million gallons

Maximum Recommended Winter Removal: **8.911 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

Water Chemistry:

Date of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2000	39.2	10.6	29.3	45.9	142	--	--	--	L. Moulton
Jul 13 04	--	--	--	--	--	410	1.1	8.21	L. Moulton
Jul 25 04	--	--	--	--	--	423	0.9	8.40	L. Moulton
Jul 26 04	--	--	--	--	--	425	0.7	8.18	L. Moulton
Jul 27 04	--	--	--	--	--	426	0.7	8.42	L. Moulton
Jul 28 04	--	--	--	--	--	428	1.3	8.41	L. Moulton
2018	35.0	9.3	25.0	51.0	120	372	1.0	8.38	B. Morris

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 3 00	10.9	none	0	
	Aug 1 18	9.1	none	0	
Minnow Traps	Aug 3 00	12.0	Ninespine stickleback	3	52-56
	Aug 1 18	8.0	Ninespine stickleback	19	
Fyke Net	Jul 26-28, 04	72.1	Ninespine stickleback	361	

Water Surface Elevation
Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.12033	-152.20535	8/1/2018	5.05	-0.33

Last Revised: November 12, 2018

Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake M0029

based on transects surveyed on August 1, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N

Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

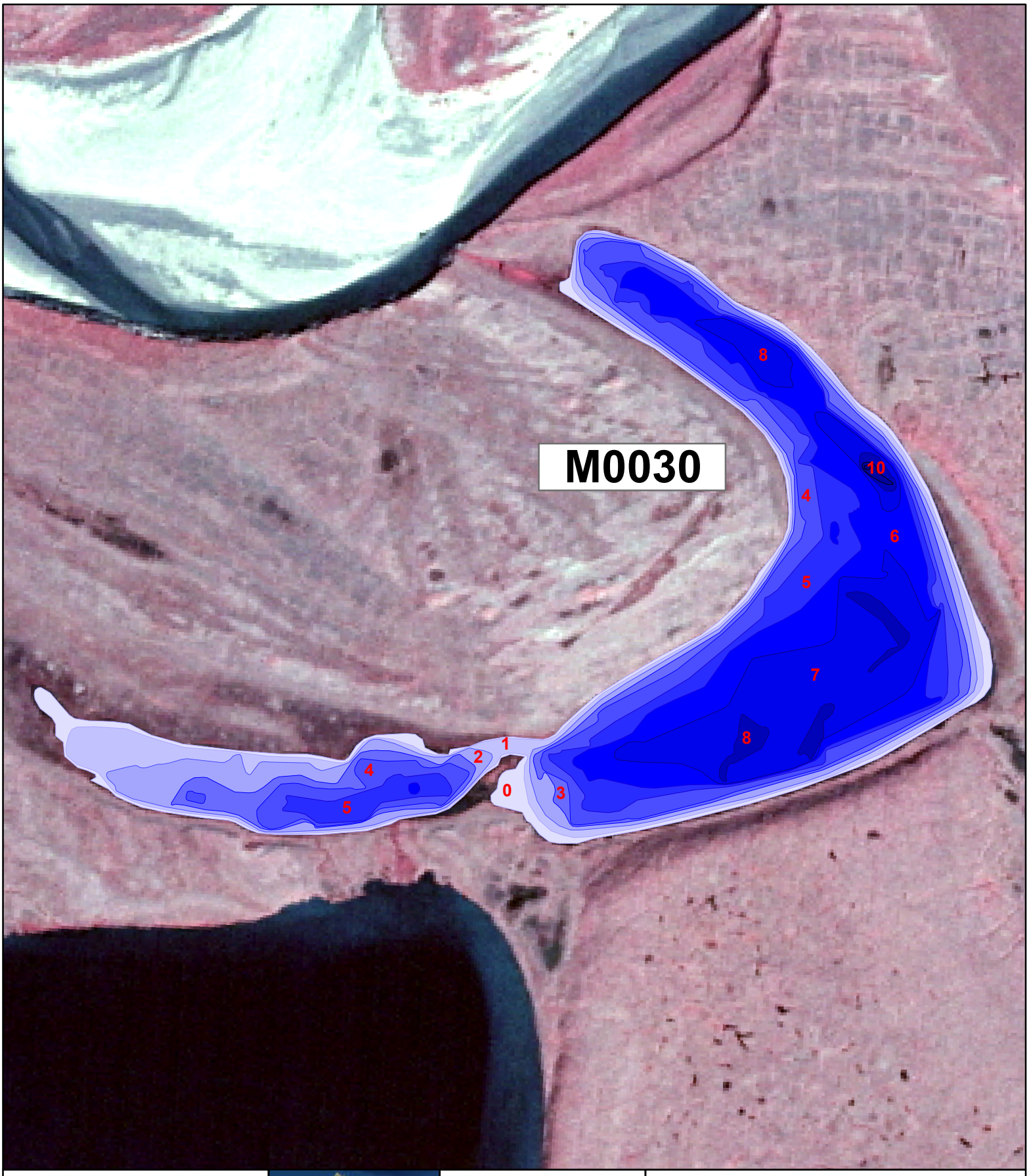
Depth Transects Surveyed at Lake M0029

surveyed on August 1, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake M0030

based on transects surveyed on August 1, 2018

SCALE:

250 125 0 250 500 Feet

N

Lake M0030

Other Names: None Known
Location: 70.12211°N 152.19899°W
USGS Quad Sheet: Harrison Bay A-4: T9N R1W Sec. 20
Habitat: Oxbow Lake
Area: 27 acres
Maximum Depth: 10.3 feet in 2018 (8.6 feet in 2004)
Active Outlet: No
Total Lake Volume: 42.504 million gallons (2018 data)
Water Volume Under 4 ft of ice: 12.622 million gallons
Water Volume Under 5 ft of ice: 7.468 million gallons
Water Volume Under 7 ft of ice: 1.010 million gallons

Potential Ice Aggregate: 9.5 acres (water depth 4 ft or less)
2.824 million gallons

Maximum Recommended Winter Removal: **2.241 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

Water Chemistry:

Date of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2000	20.1	10.0	4.4	22.6	75	--	--	--	L. Moulton
Jul 13 04	--	--	--	--	--	226	0.8	7.95	L. Moulton
Jul 26 04	--	--	--	--	--	202	0.3	8.04	L. Moulton
Jul 27 04	--	--	--	--	--	203	0.4	8.26	L. Moulton
Jul 28 04	--	--	--	--	--	204	0.5	8.15	L. Moulton
Jul 29 04	--	--	--	--	--	204	0.5	8.13	L. Moulton
2018	25.0	5.3	13.0	26.0	85	234	0.7	8.13	B. Morris

Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 3 00	11.0	none	0	
	Aug 1 18	9.0	none	0	
Minnow Traps	Aug 3 00	12.0	none	0	
	Aug 1 18	16.5	Ninespine stickleback	28	
Fyke Net	Jul 27-29, 04	72.2	Alaska blackfish	3	41-68
			Ninespine stickleback	281	

Water Surface Elevation
Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.12084	-152.20457	8/1/2018	5.81	-0.48

Last Revised: November 12, 2018

Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake M0030

based on transects surveyed on August 1, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N

Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

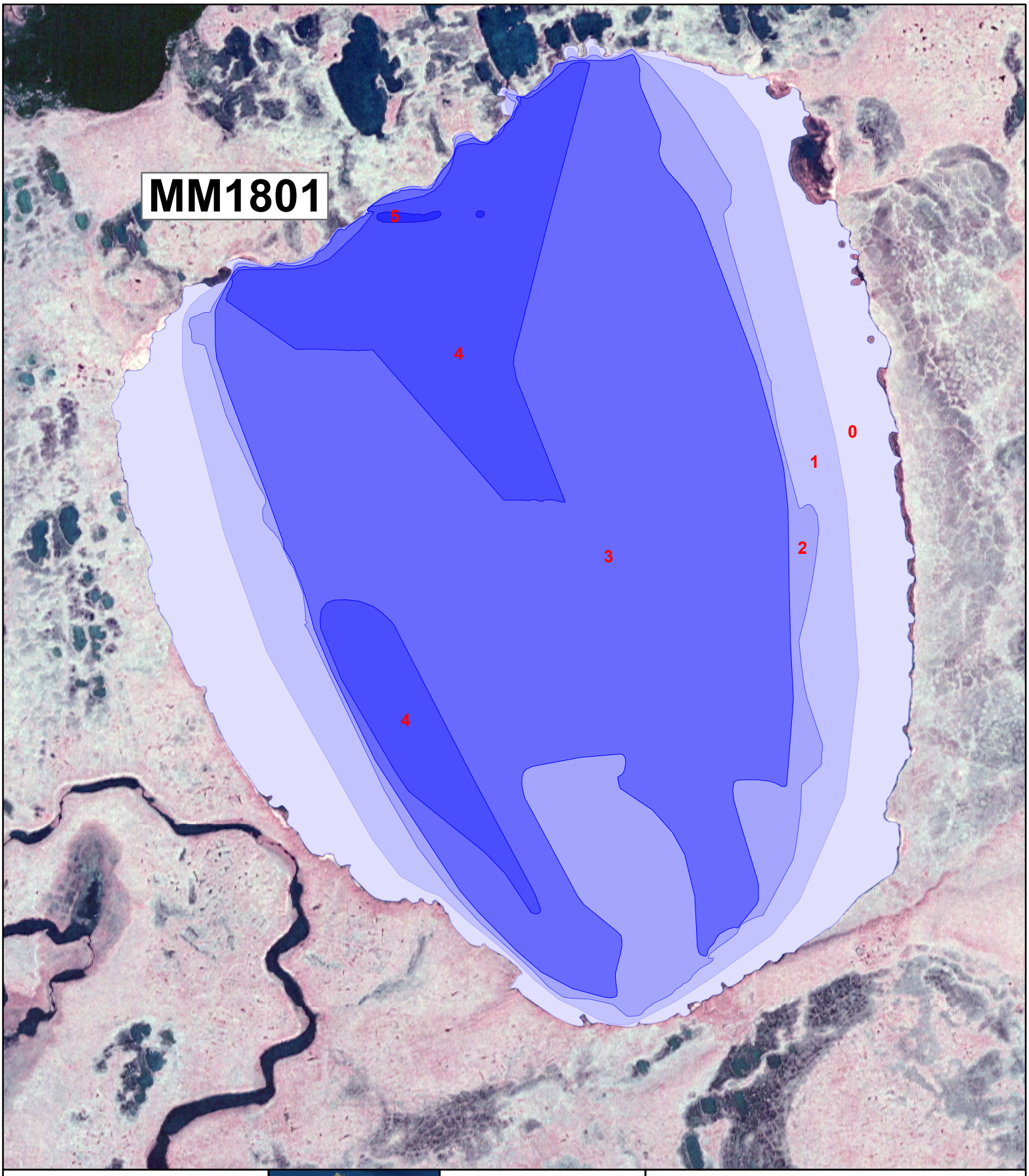
Depth Transects Surveyed at Lake M0030

surveyed on August 1, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth in Feet

0 1 2 3 4 5

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1801

based on transects surveyed on August 7, 2018

SCALE:

500 250 0 500 1,000 Feet

N

Lake MM1801

Other Names: None Known
Location: 70.04075°N 152.04840°W
USGS Quad Sheet: Harrison Bay A-4: T8N R1W Sec. 13,14,23,24
Habitat: Tundra Lake
Area: 491 acres
Maximum Depth: 5.4 feet in 2018
Active Outlet: No
Total Lake Volume: 434.431 million gallons
Volume Under 4 ft of ice: 8.369 million gallons
Volume Under 5 ft of ice: 0.055 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 421.34 acres (water depth 4 ft or less)
124.952 million gallons

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

Water Chemistry:

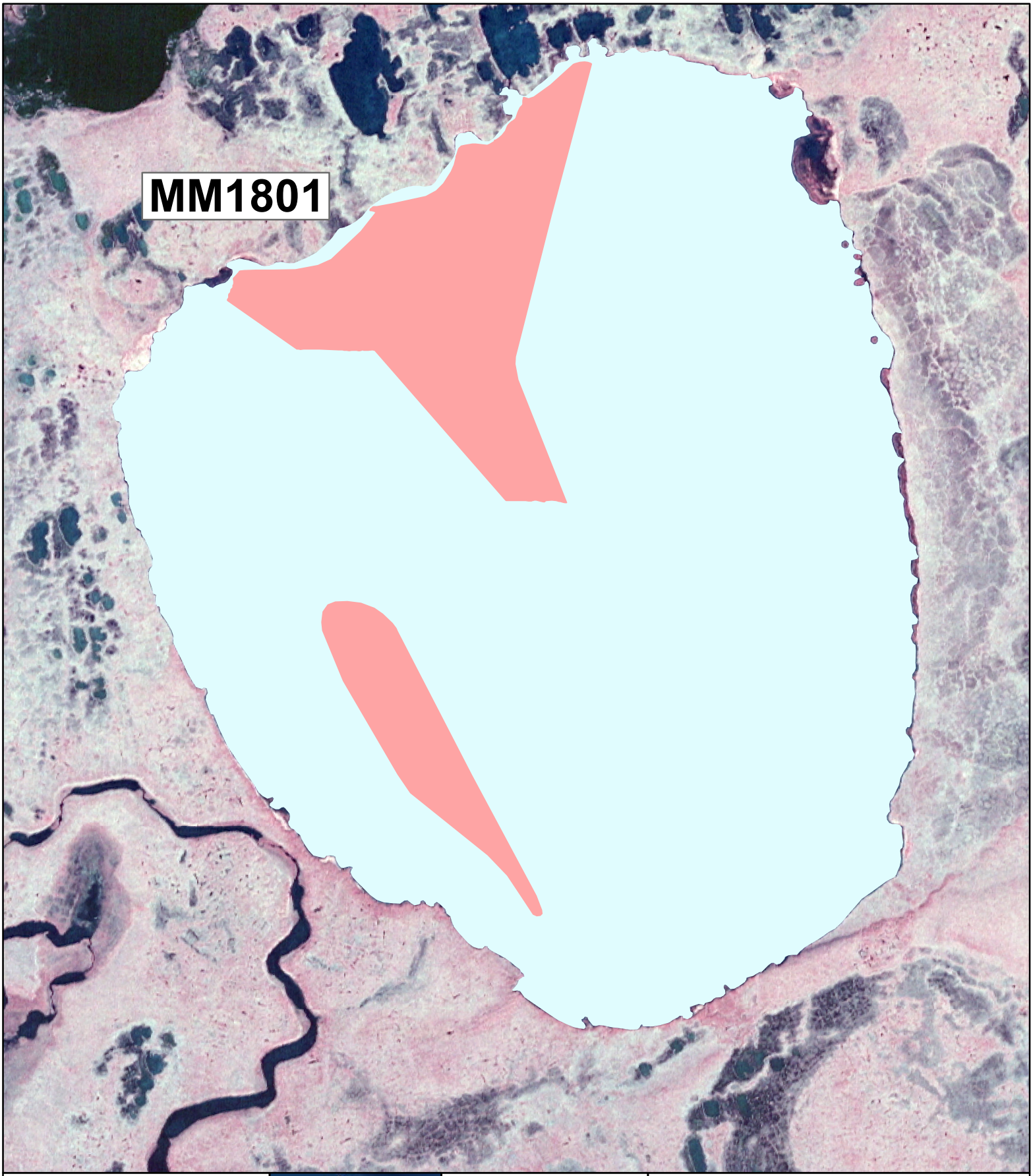
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	16.4	2.6	5.3	10.0	52	125	1.1	7.50	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 7 18	10.0	none	0
Minnow Traps	Aug 7 18	16.5	none	0
Seine	not used			
Visual +Dipnet	Aug 7 18	50 yards	Ninespine stickleback	1

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.04545	-152.06554	8/7/2018	3.85	-2.09

Last Revised: January 15, 2019



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

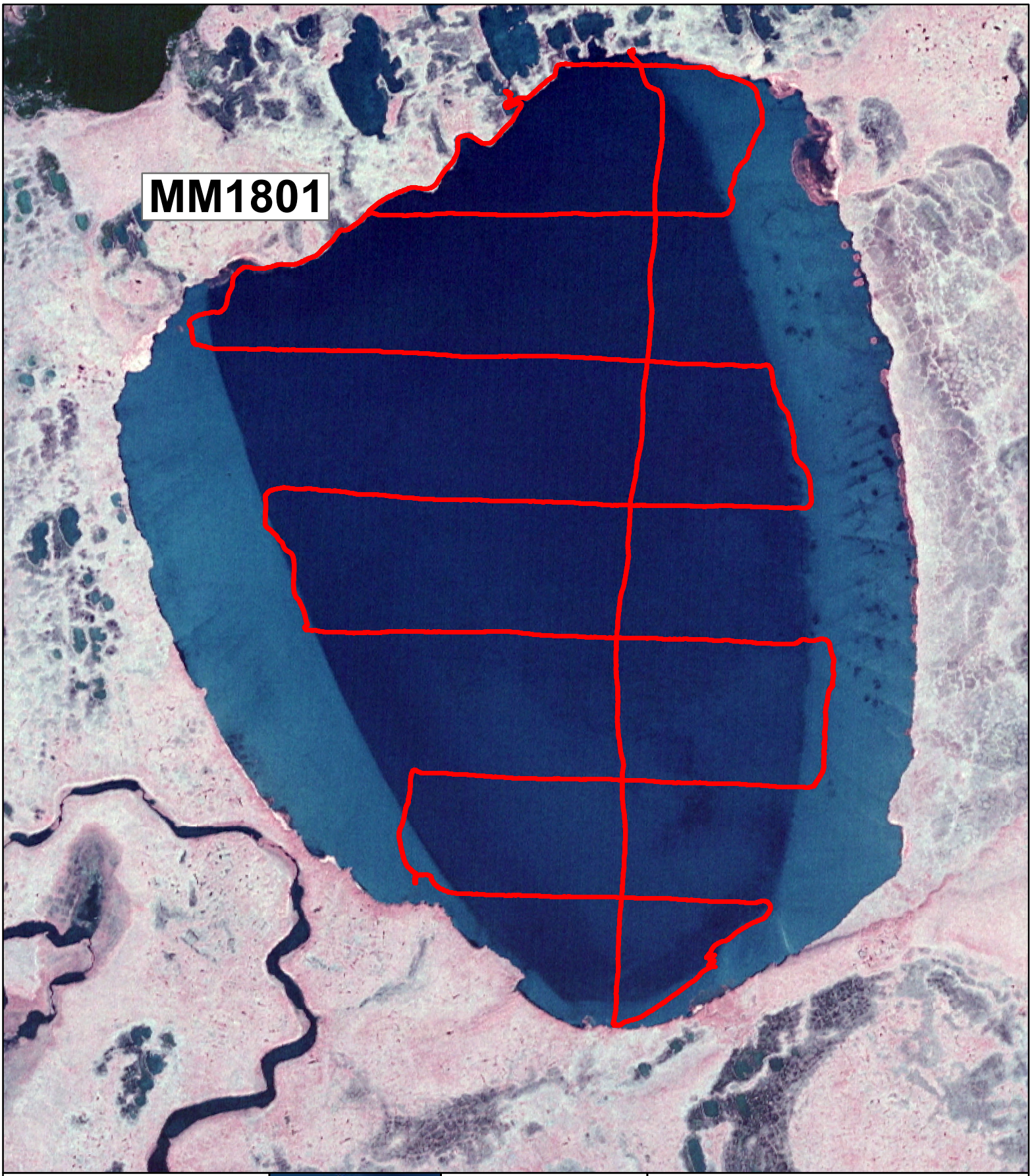
Area Available for Ice Chip Collection at Lake MM1801

based on transects surveyed on August 7, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

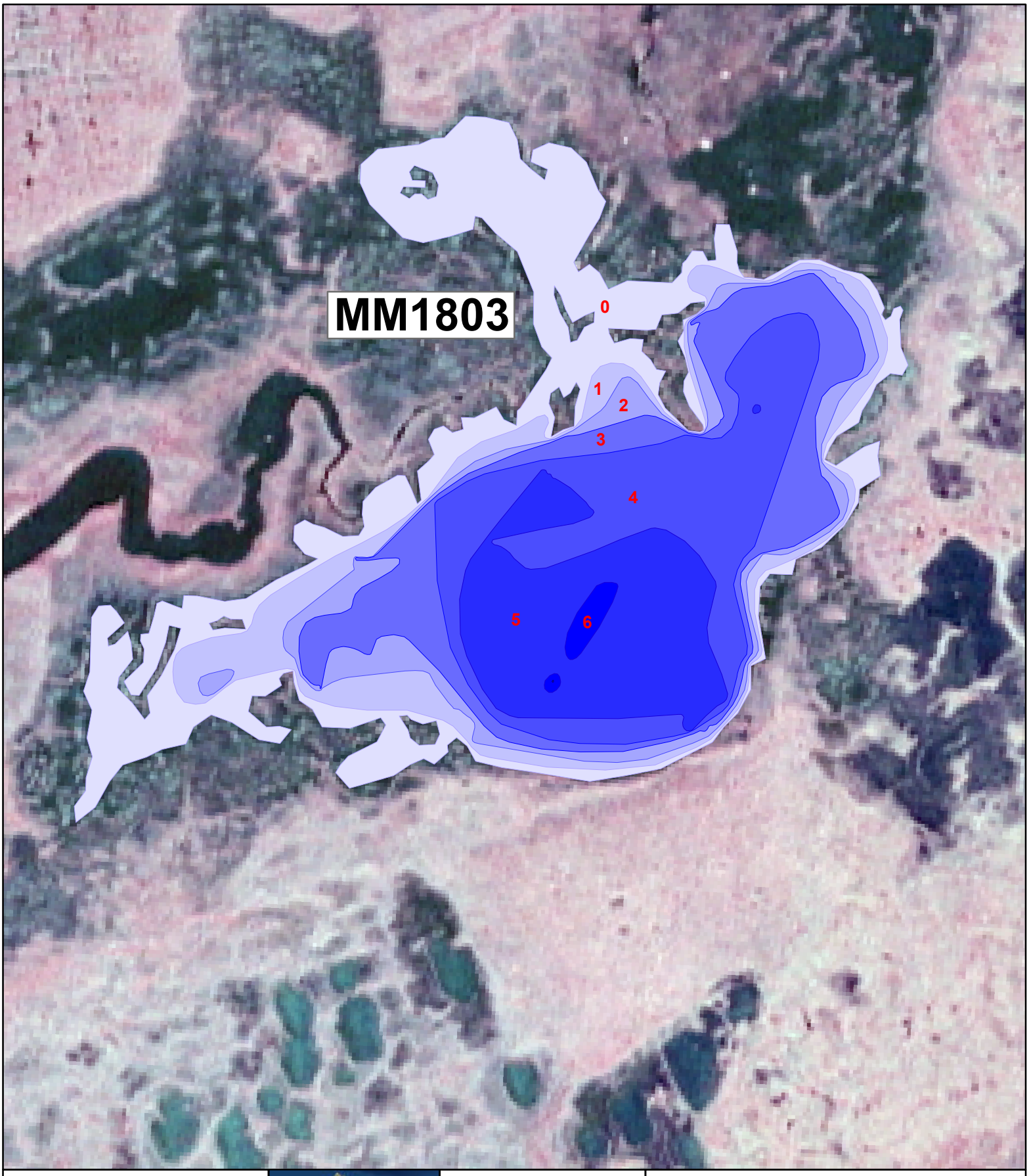
Depth Transects Surveyed at Lake MM1801

surveyed on August 7, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth in Feet

0 1 2 3 4 5 6 7

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1803

based on transects surveyed on August 7, 2018

SCALE:

100 50 0 100 200 300 400 500 Feet

N

Lake MM1803

Other Names: None Known
Location: 70.04907°N 152.07370°W
USGS Quad Sheet: Harrison Bay A-4: T8N R1W Sec. 14
Habitat: Drainage Lake
Area: 28 acres
Maximum Depth: 7.3 feet in 2018
Active Outlet: Yes
Total Lake Volume: 26.005 million gallons
Volume Under 4 ft of ice: 3.172 million gallons
Volume Under 5 ft of ice: 0.715 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 17.95 acres (water depth 4 ft or less)
5.324 million gallons

Maximum Recommended Winter Removal: **0.215 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	18.9	3.6	4.9	9.1	62	143	1.4	7.69	B. Morris

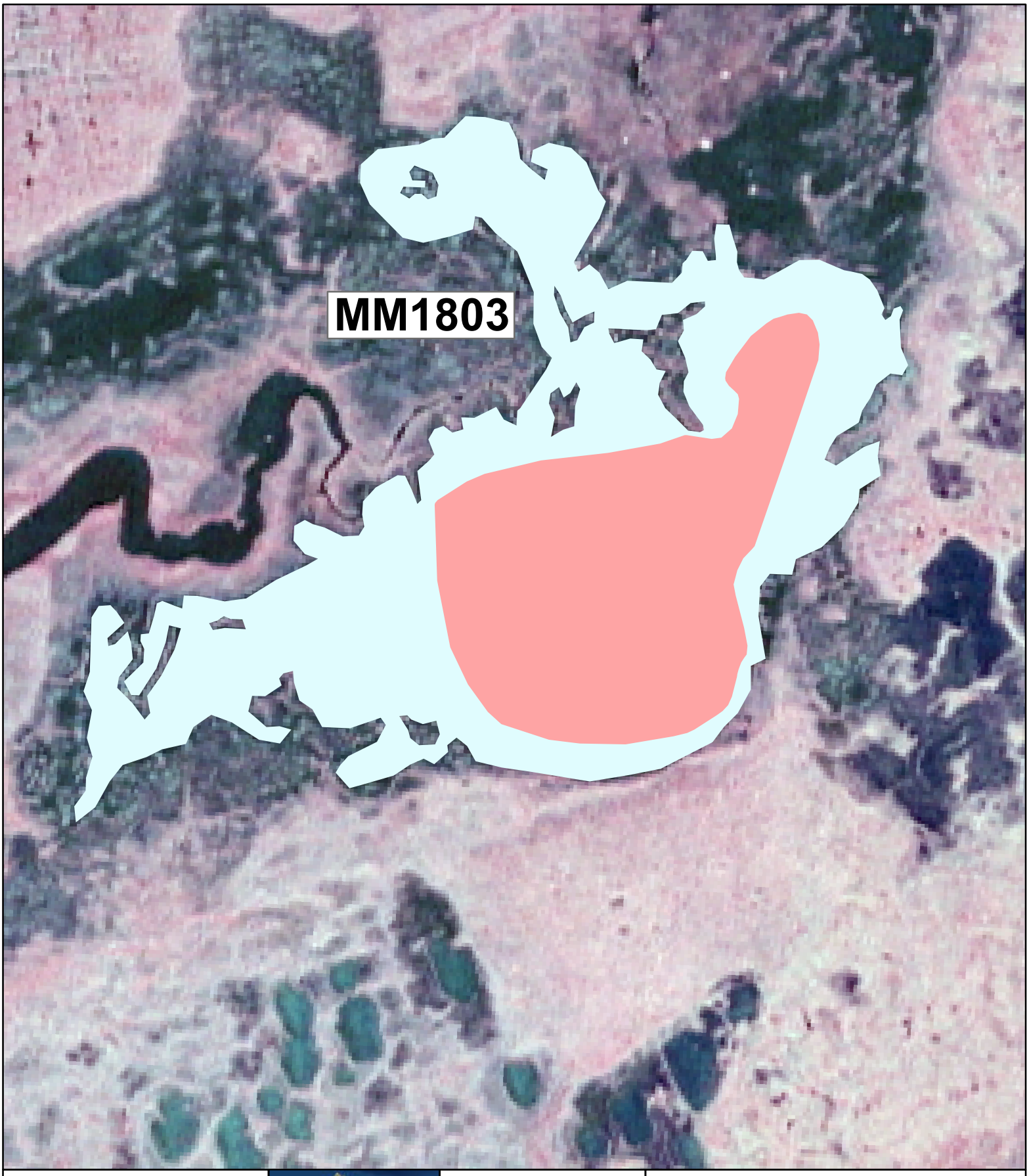
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 7 18	9.1	none	0
Minnow Traps	Aug 7 18	2.3	Ninespine stickleback	4
Seine	not used			
Visual +Dipnet	Aug 7 18	5 yards	Ninespine stickleback	+

+ denotes fish were visually observed but not caught

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.04787	-152.07204	8/7/2018	5.03	-5.79

Last Revised: January 8, 2019



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

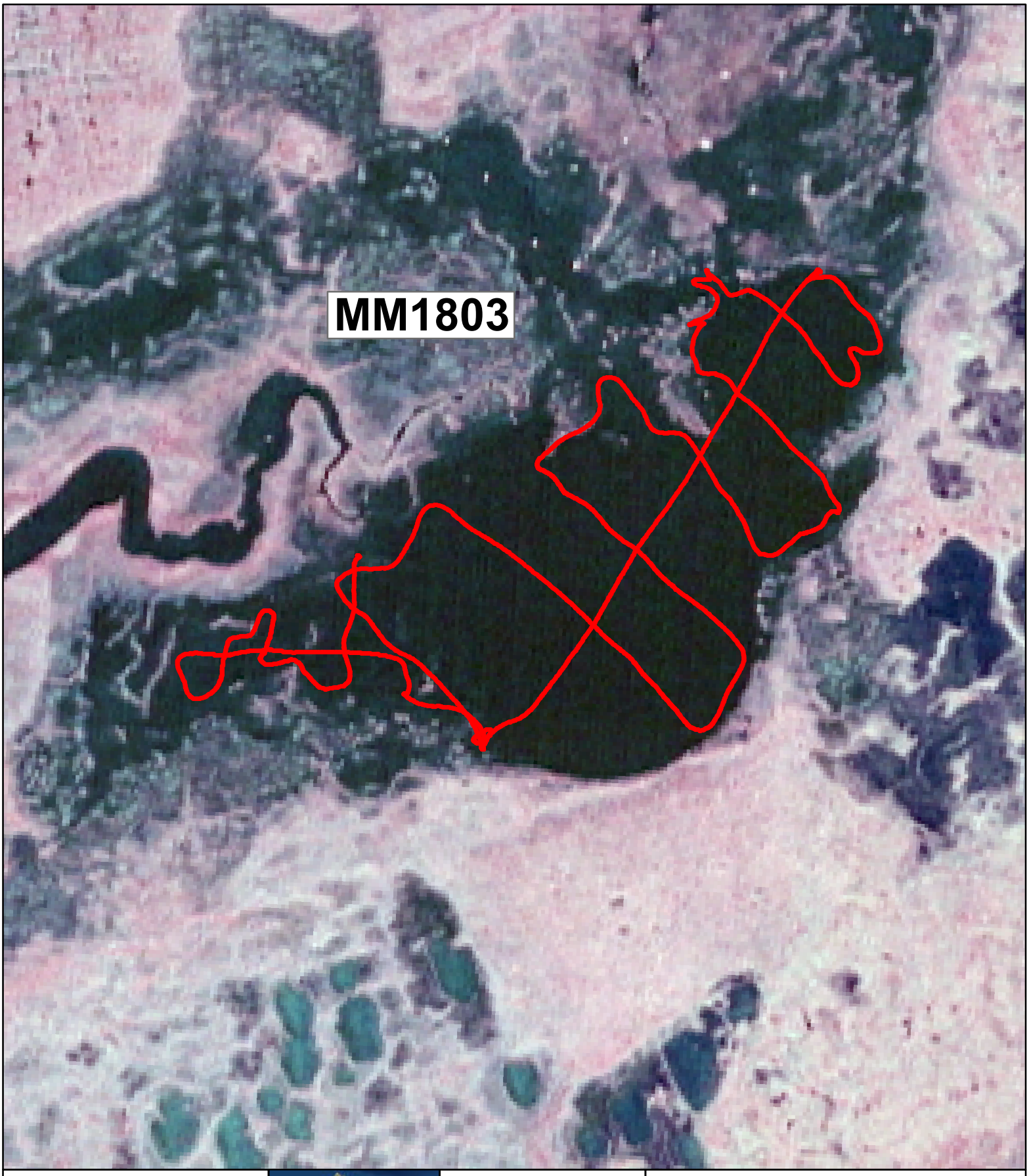
Area Available for Ice Chip Collection at Lake MM1803

based on transects surveyed on August 7, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Transects Surveyed at Lake MM1803

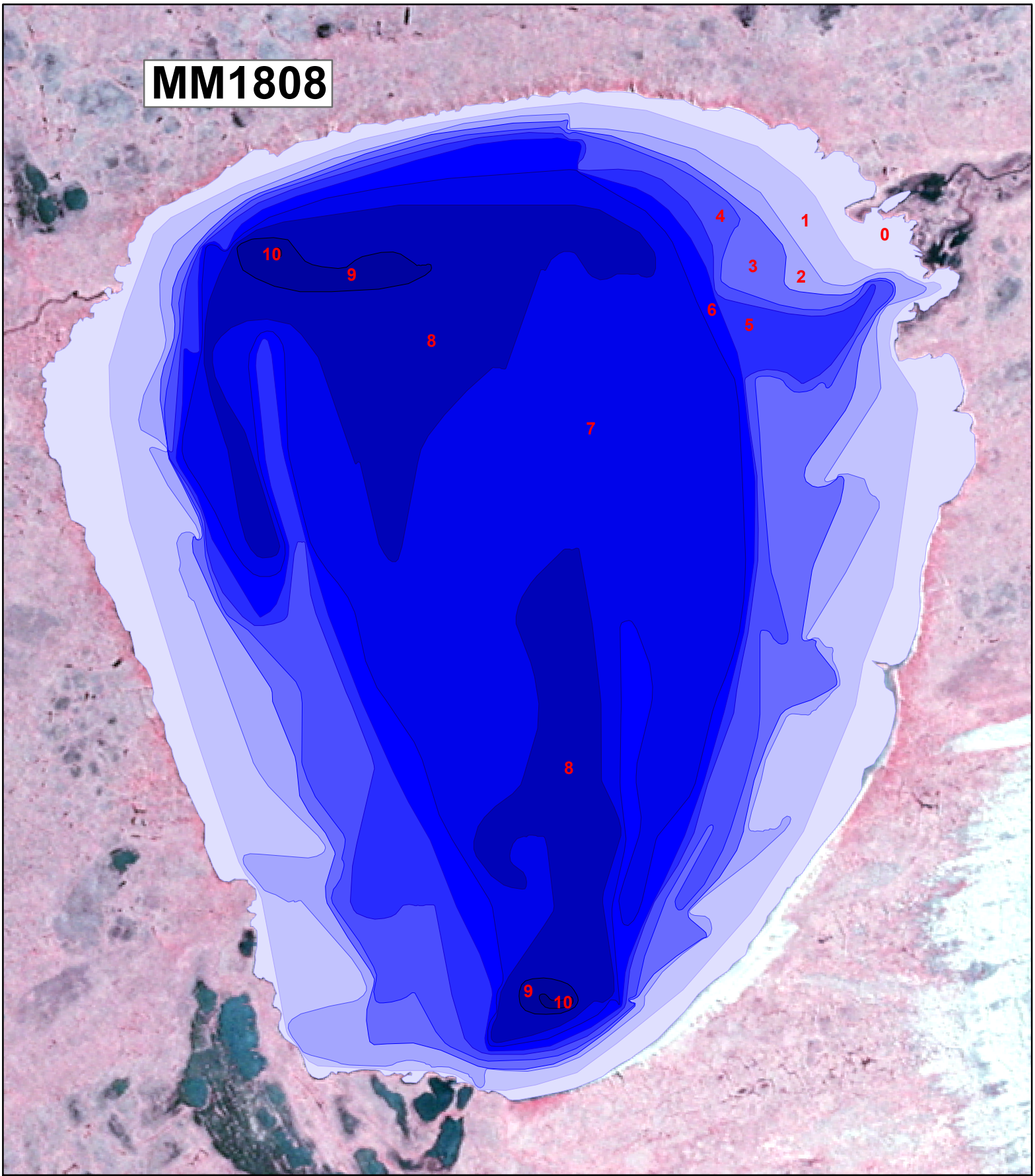
surveyed on August 7, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N

6.2. Lake Summaries for Lakes Sampled in the North Willow Area, 2018.



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1808

based on transects surveyed on August 6, 2018

SCALE:

500 250 0 500 Feet

N

Lake MM1808

Other Names: None Known
Location: 70.34485°N 152.34634°W
USGS Quad Sheet: Harrison Bay B-4: T11N R2W Sec. 2,3; T12N R2W Sec. 34,35
Habitat: Drainage Lake
Area: 289 acres
Maximum Depth: 10.7 feet in 2018
Active Outlet: Yes
Total Lake Volume: 480.006 million gallons
Volume Under 4 ft of ice: 182.981 million gallons
Volume Under 5 ft of ice: 127.126 million gallons
Volume Under 7 ft of ice: 33.772 million gallons

Potential Ice Aggregate: 106.86 acres (water depth 4 ft or less)
31.691 million gallons

Maximum Recommended Winter Removal: **5.066 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

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
2018	16.7	2.1	3.8	8.6	50	118	1.2	7.81	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 6 18	9.9	Least cisco	1	163
Minnow Traps	Aug 6 18	19.0	Ninespine stickleback	3	
Seine	not used				
Visual +Dipnet	Aug 6 18	20 yards	Ninespine stickleback	+	

+ denotes fish were visually observed but not caught

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.34711	-152.33405	8/6/2018	4.37	-0.98

Last Revised: January 8, 2019

MM1808

Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

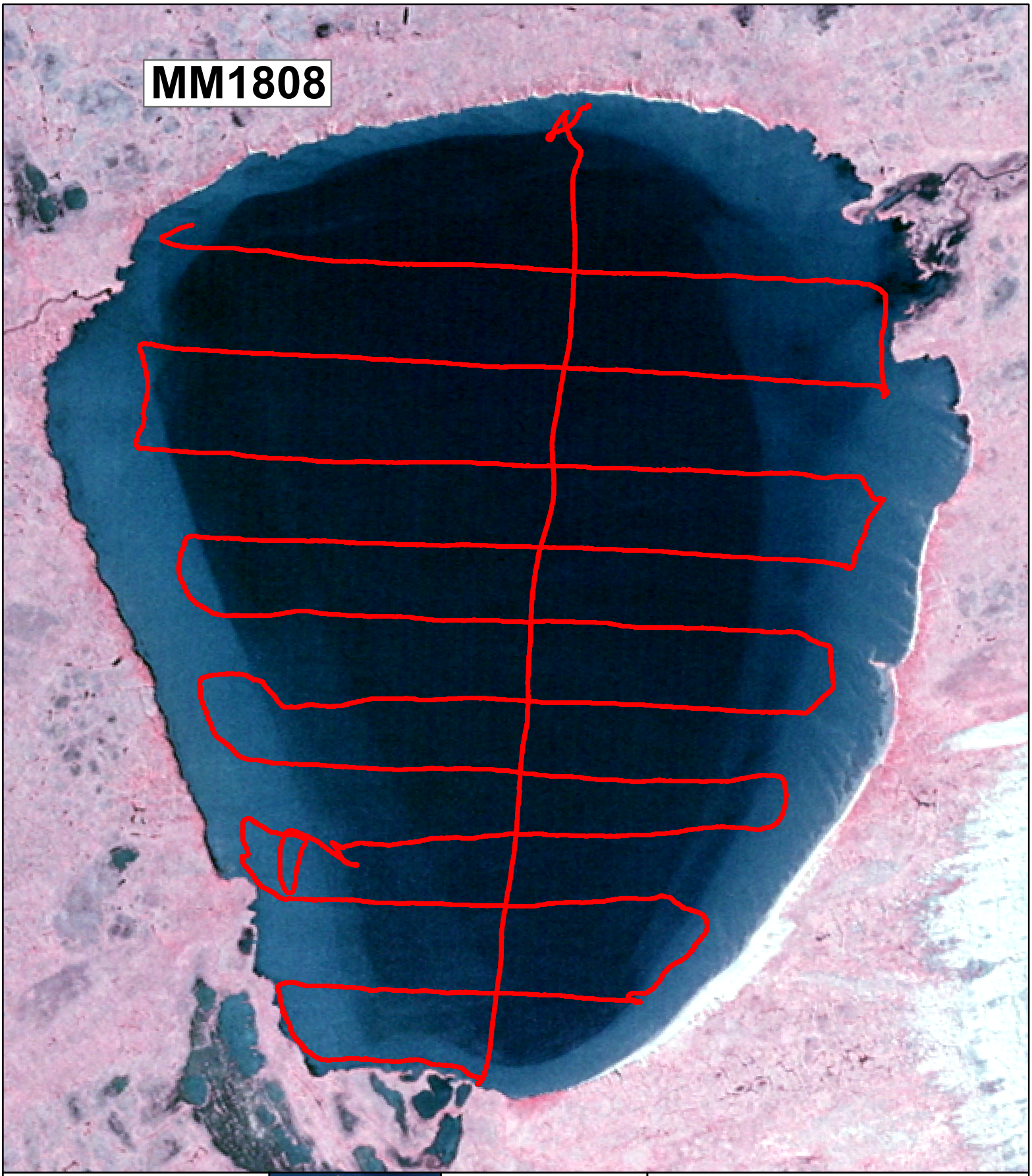
Area Available for Ice Chip Collection at Lake MM1808

based on transects surveyed on August 6, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

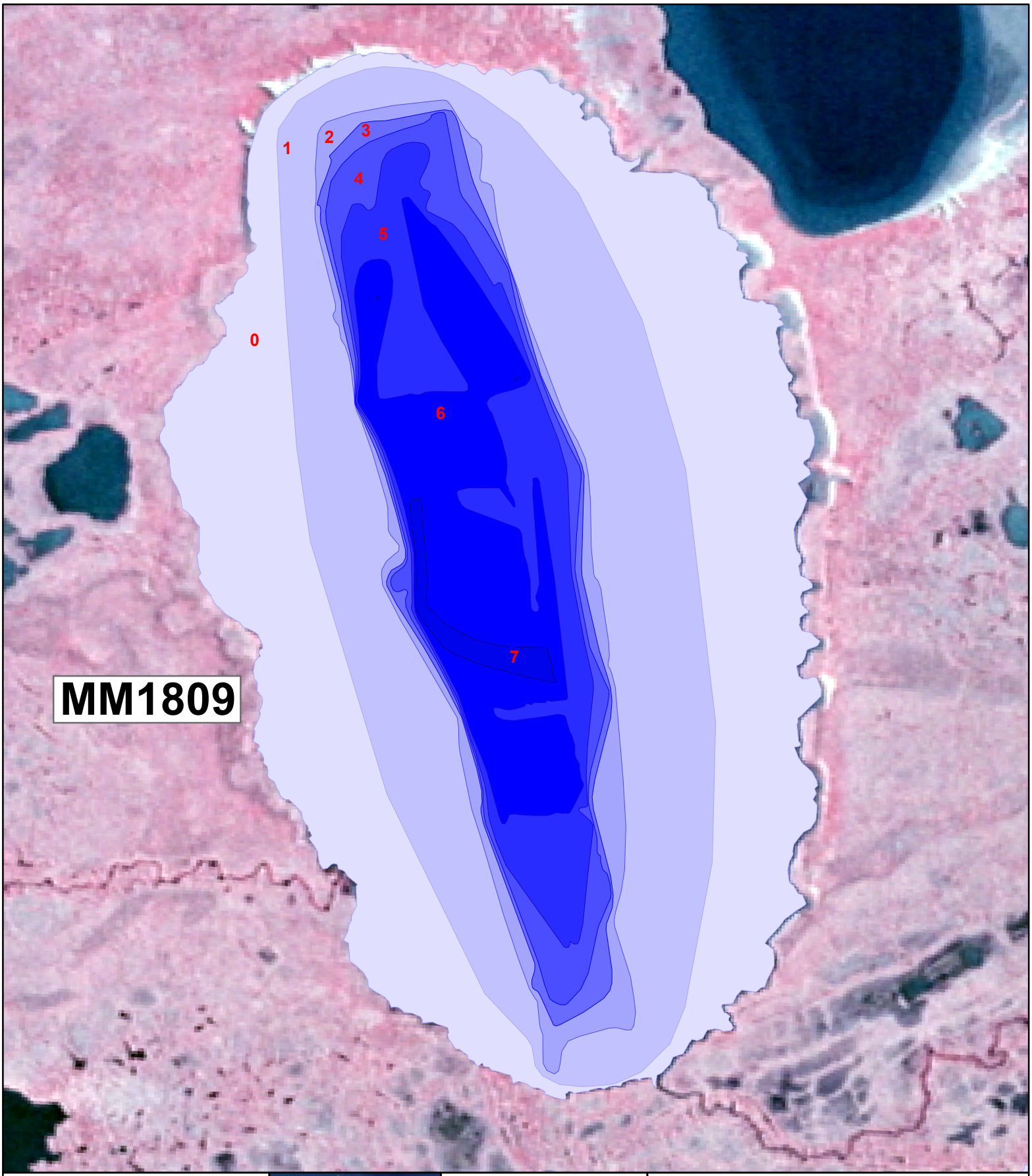
Depth Transects Surveyed at Lake MM1808

surveyed on August 6, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 Feet

N



Depth in Feet

0 1 2 3 4 5 6 7

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1809

based on transects surveyed on July 30, 2018

SCALE:

250 125 0 250 500 Feet

N

Lake MM1809

Other Names: None Known
Location: 70.32891°N 152.33586°W
USGS Quad Sheet: Harrison Bay B-4: T11N R2W Sec. 2,11
Habitat: Drainage Lake
Area: 81 acres
Maximum Depth: 7.7 feet in 2018
Active Outlet: Yes
Total Lake Volume: 60.088 million gallons
Volume Under 4 ft of ice: 11.854 million gallons
Volume Under 5 ft of ice: 5.821 million gallons
Volume Under 7 ft of ice: 0.081 million gallons

Potential Ice Aggregate: 61.11 acres (water depth 4 ft or less)
18.121 million gallons

Maximum Recommended Winter Removal: **0.012 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

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
2018	23.0	2.5	4.5	9.4	68	161	0.9	8.15	B. Morris

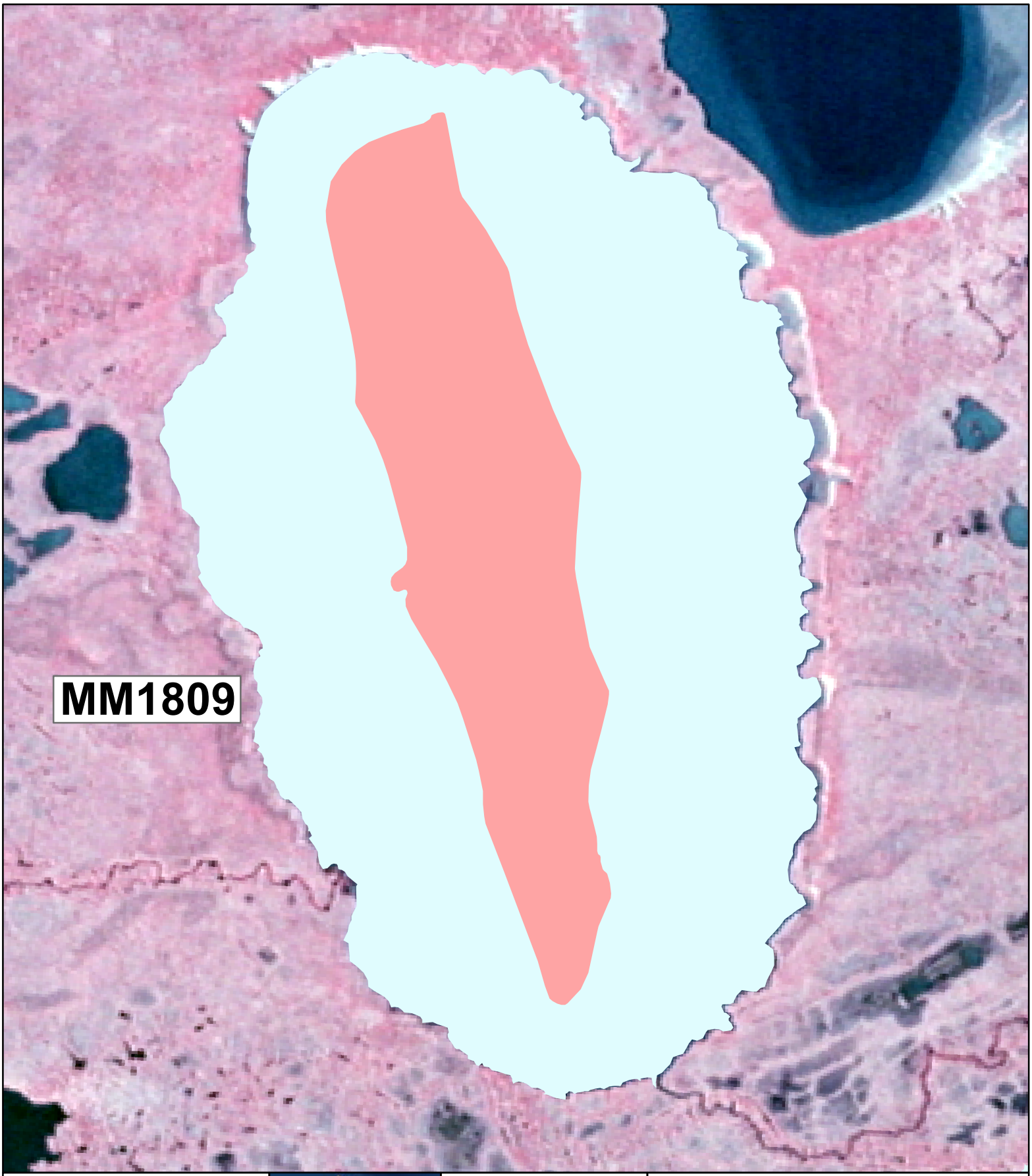
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 30 18	7.0	none	0	
Minnow Traps	Jul 30 18	8.7	Ninespine stickleback	16	
Seine	not used				
Visual +Dipnet	Jul 30 18	5 yards	Arctic grayling	8-10	adults

Water Surface Elevation

Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.32496	-152.33267	7/30/2018	4.35	-1.17

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

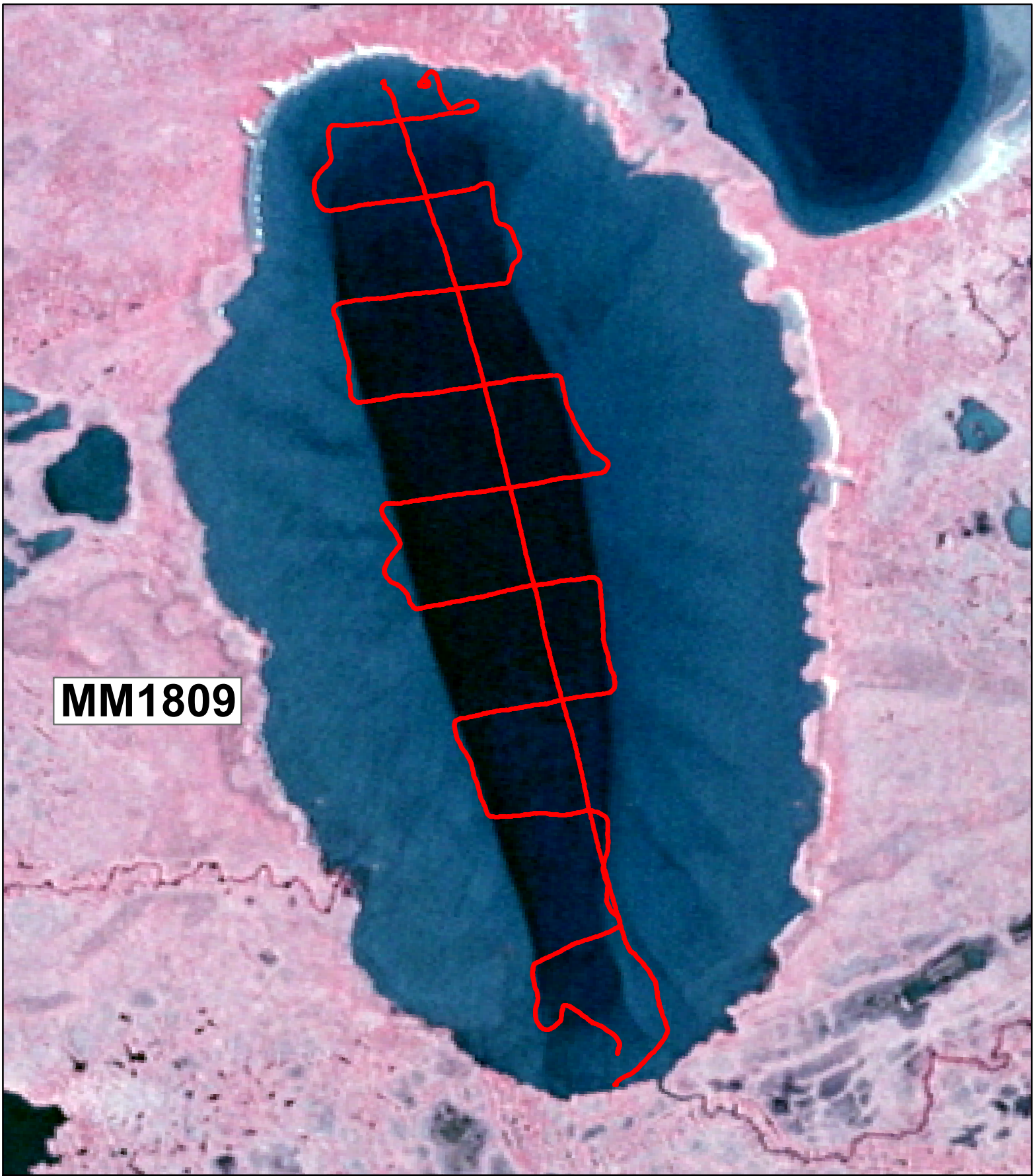
Area Available for Ice Chip Collection at Lake MM1809

based on transects surveyed on July 30, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

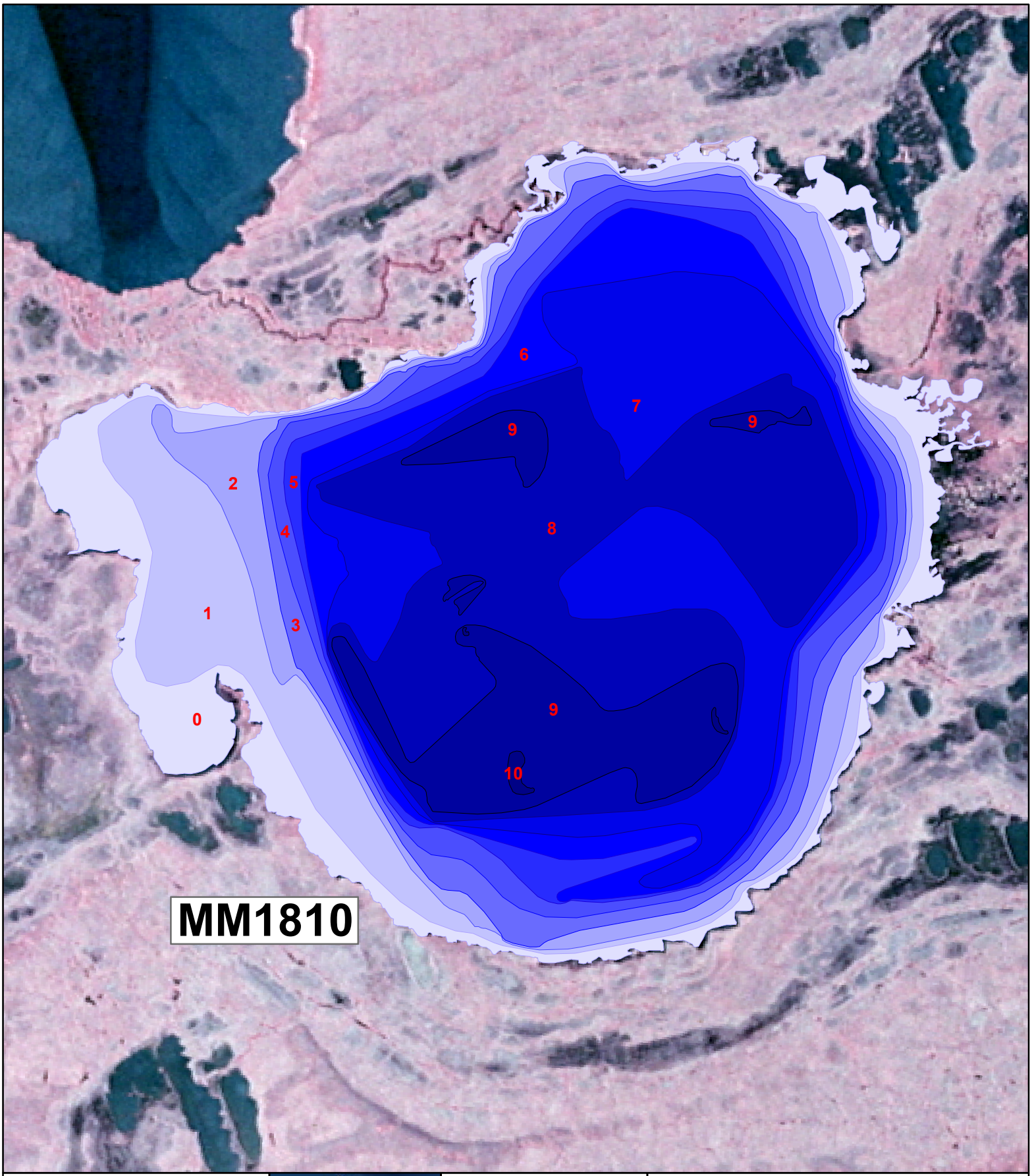
Depth Transects Surveyed at Lake MM1809

surveyed on July 30, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1810

based on transects surveyed on July 30, 2018

SCALE:

250 125 0 250 500 750 Feet

N

Lake MM1810

Other Names: None Known
Location: 70.32217°N 152.31841°W
USGS Quad Sheet: Harrison Bay B-4: T11N R2W Sec. 11
Habitat: Drainage Lake
Area: 143 acres
Maximum Depth: 10.7 feet in 2018
Active Outlet: Yes
Total Lake Volume: 258.699 million gallons
Volume Under 4 ft of ice: 109.662 million gallons
Volume Under 5 ft of ice: 80.370 million gallons
Volume Under 7 ft of ice: 29.086 million gallons

Potential Ice Aggregate: 48.70 acres (water depth 4 ft or less)
14.441 million gallons

Maximum Recommended Winter Removal: **4.363 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

Water Chemistry:

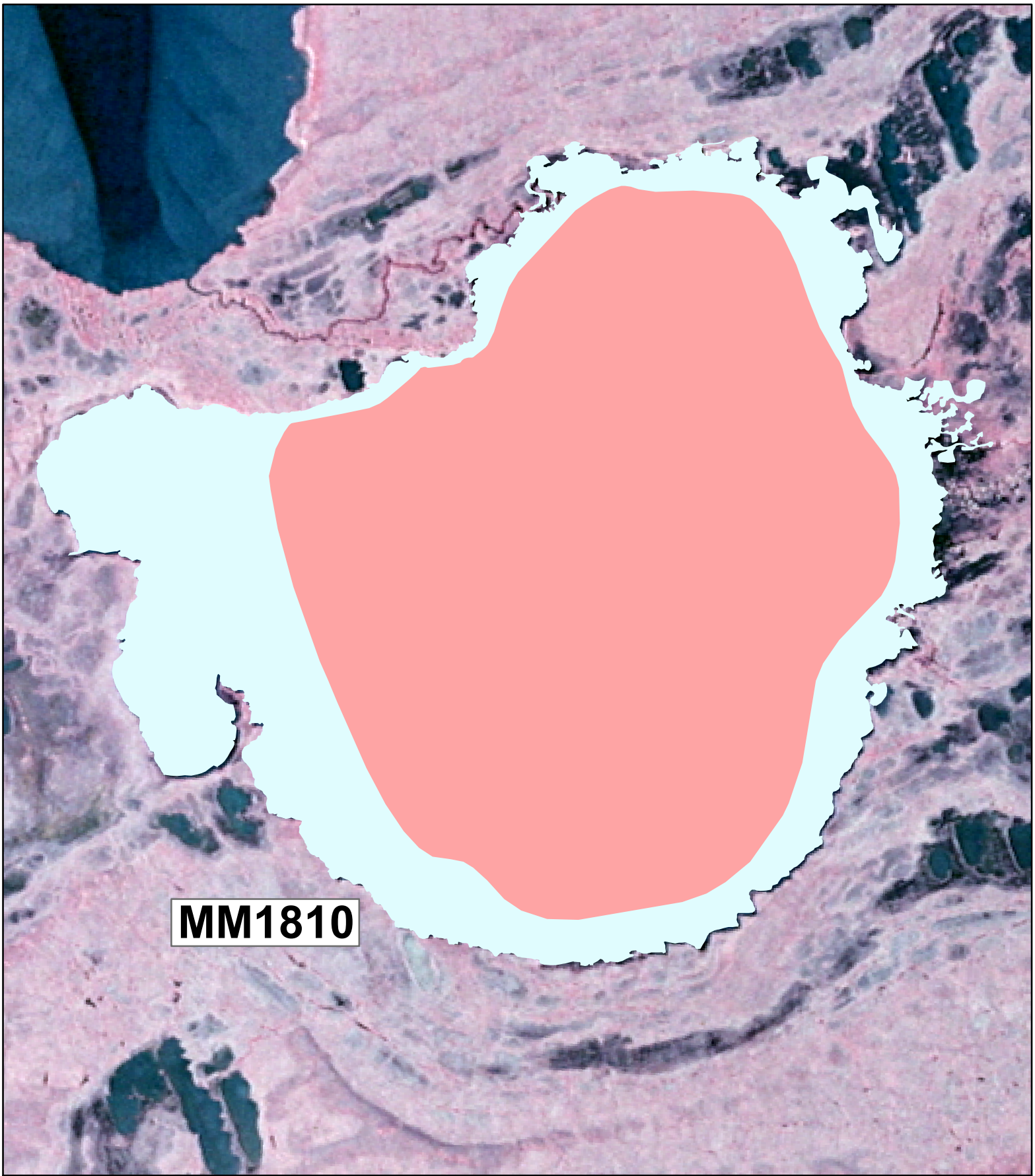
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	22.0	2.6	4.8	10.0	65	154	0.8	7.78	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 30 18	6.7	Arctic grayling	2	162-223
Minnow Traps	Jul 30 18	11.8	Ninespine stickleback	4	
Seine	not used				
Visual +Dipnet	not used				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.32384	-152.33203	7/30/2018	5.63	-0.33

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

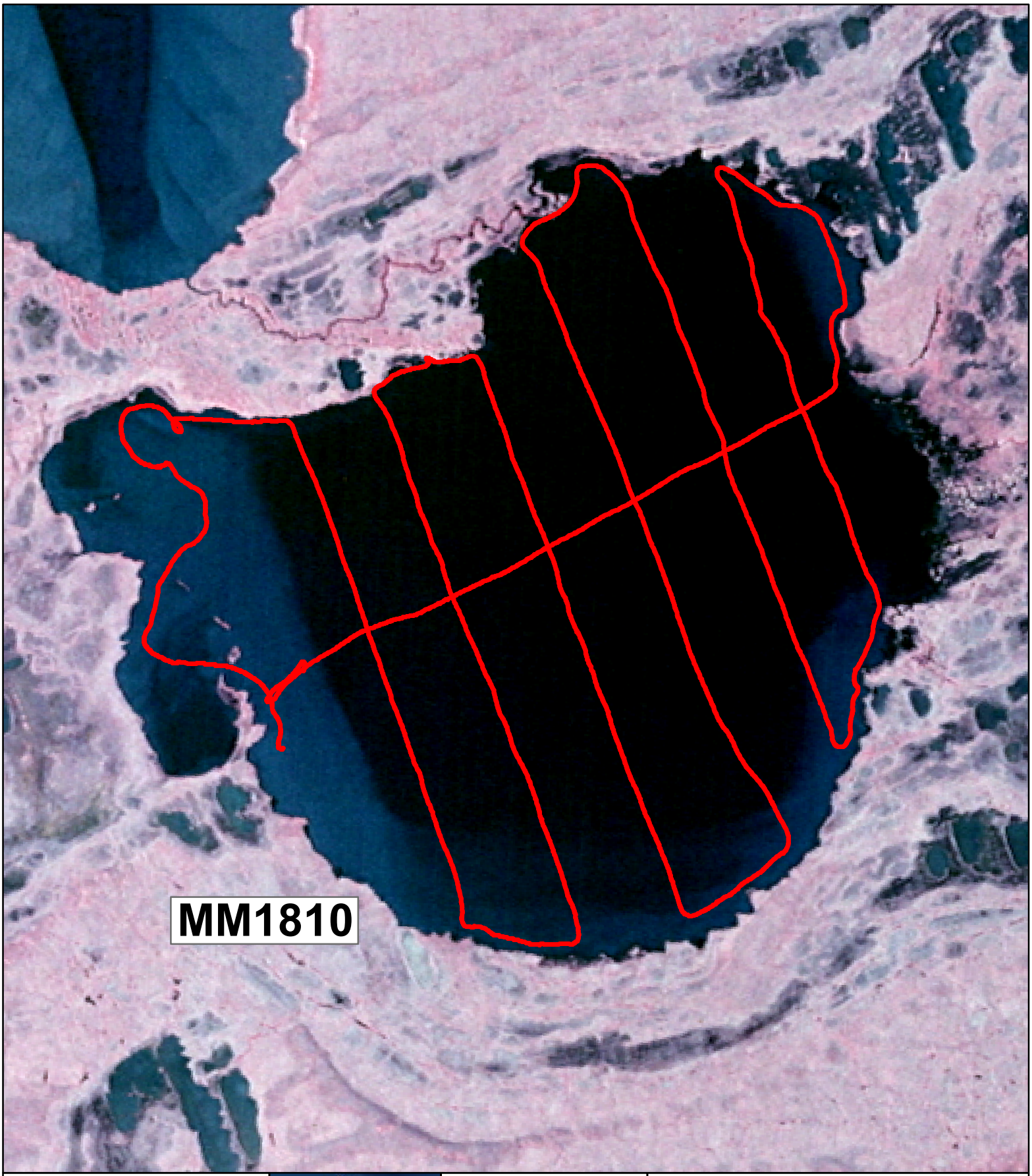
Area Available for Ice Chip Collection at Lake MM1810

based on transects surveyed on July 30, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

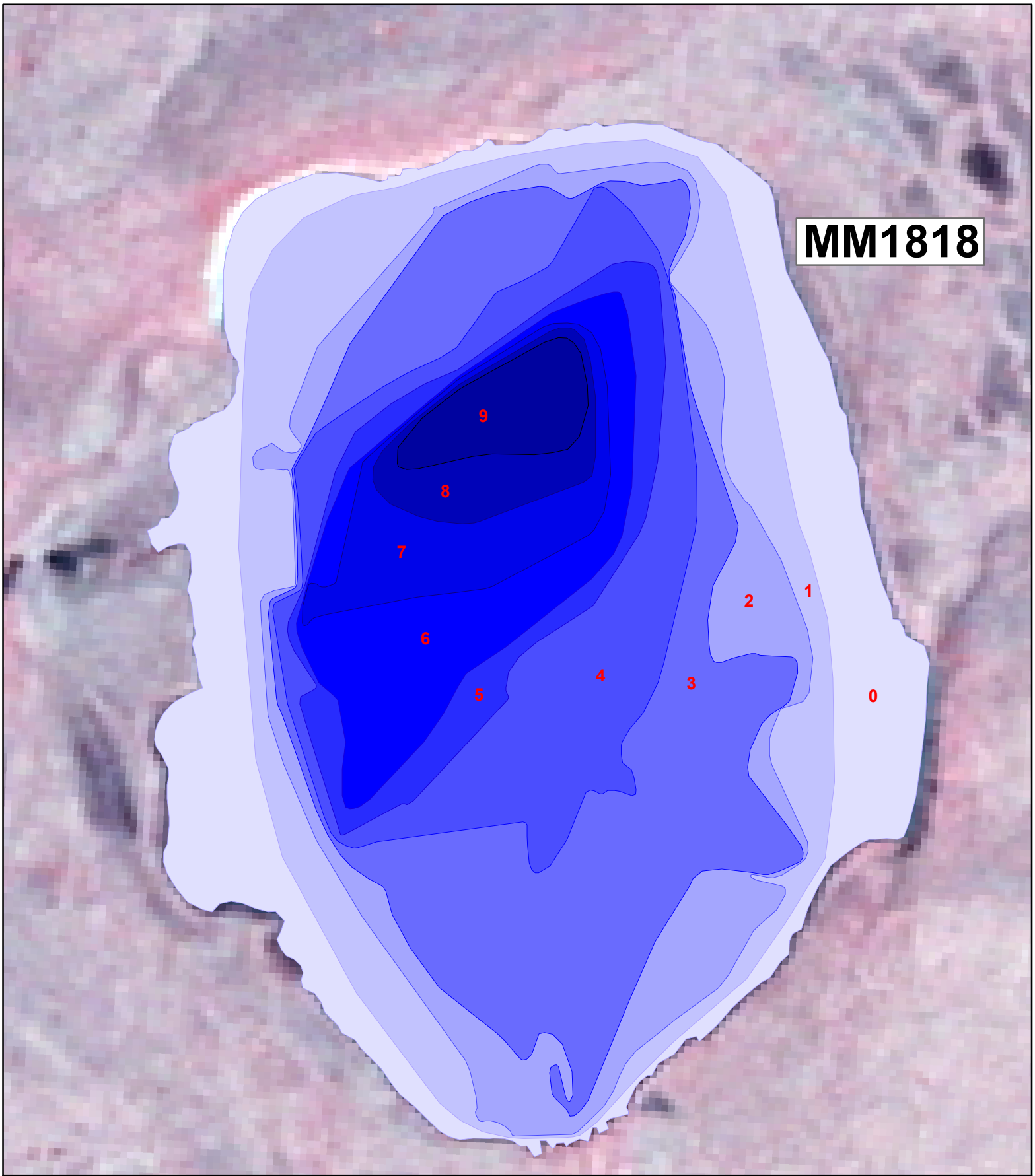
Depth Transects Surveyed at Lake MM1810

surveyed on July 30, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 Feet

N



Depth in Feet

0	3	6	9		
1	4	7			
2	5	8			

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1818

based on transects surveyed on July 17, 2018

SCALE:

100 50 0 100 200 Feet

N

Lake MM1818

Other Names: None Known
Location: 70.29401°N 152.22464°W
USGS Quad Sheet: Harrison Bay B-4: T11N R1W Sec. 19
Habitat: Tundra Lake
Area: 20 acres
Maximum Depth: 9.9 feet in 2018
Active Outlet: No
Total Lake Volume: 22.221 million gallons
Volume Under 4 ft of ice: 4.624 million gallons
Volume Under 5 ft of ice: 2.837 million gallons
Volume Under 7 ft of ice: 0.760 million gallons

Potential Ice Aggregate: 13.62 acres (water depth 4 ft or less)
4.040 million gallons

Maximum Recommended Winter Removal: **4.444 million gallons**
(20% of lake volume)
(No fish concern)

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
2018	14.9	2.3	3.8	8.2	47	104	0.6	7.76	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Jul 17 18	9.2	none	0
Minnow Traps	Jul 17 18	11.7	none	0
Seine	Jul 17 18	3 hauls	none	0
Visual +Dipnet	not used			

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.29295	-152.22277	7/17/2018	4.36	-1.78

Last Revised: December 13, 2018

MM1818

Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake MM1818

based on transects surveyed on July 17, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 Feet

N

Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

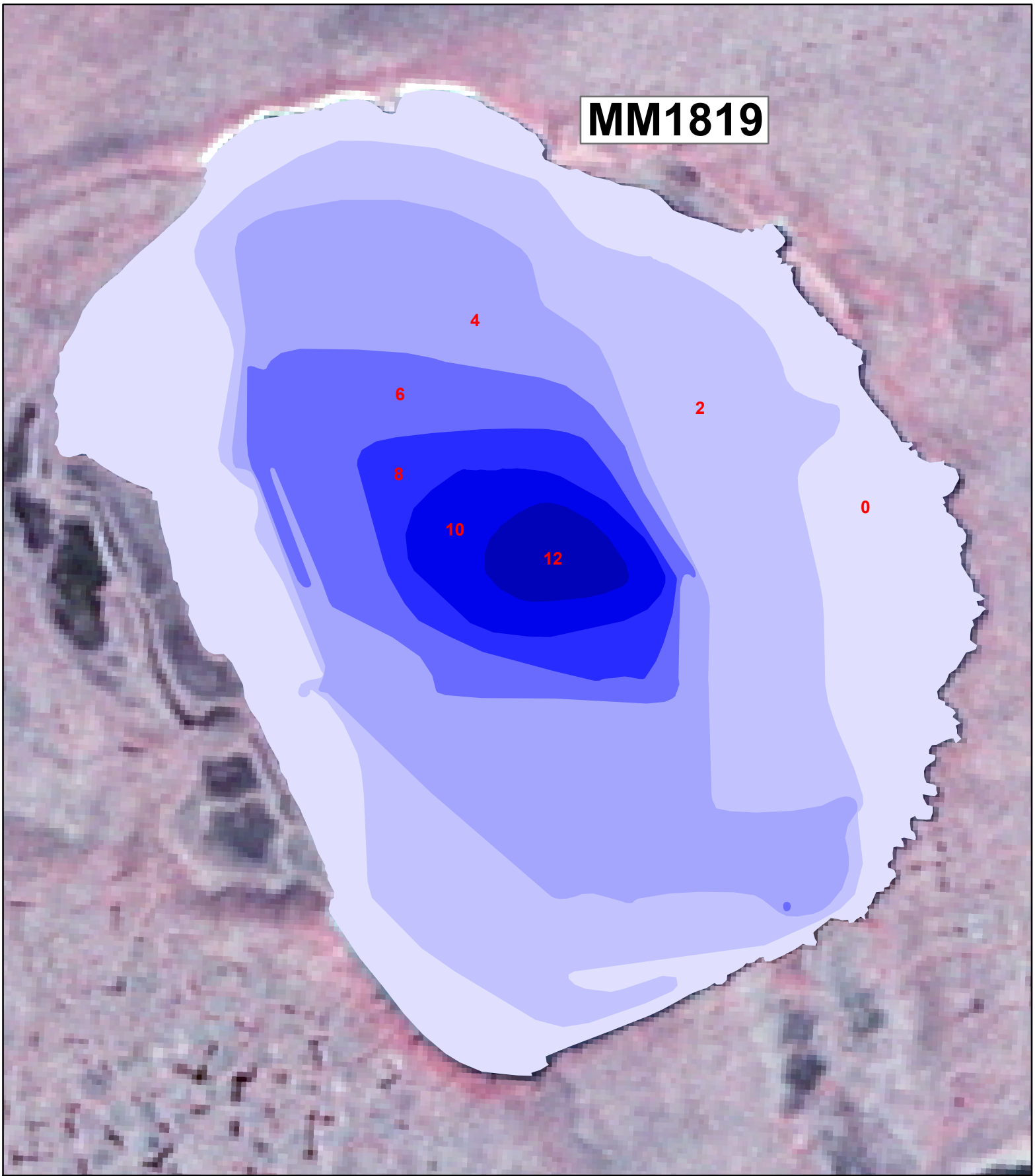
Depth Transects Surveyed at Lake MM1818

surveyed on July 17, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 Feet

N



Depth in Feet

0 2 4 6 8 10 12

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1819 (depths in 2 foot intervals)

based on transects surveyed on August 14, 2018

SCALE:

100 50 0 100 200 300 Feet

N

Lake MM1819

Other Names: None Known
Location: 70.29154°N 152.25359°W
USGS Quad Sheet: Harrison Bay B-4: T11N R1W Sec. 19; T11N R2W Sec. 24
Habitat: Tundra Lake
Area: 37 acres
Maximum Depth: 13.3 feet in 2018
Active Outlet: No
Total Lake Volume: 46.964 million gallons
Volume Under 4 ft of ice: 13.617 million gallons
Volume Under 5 ft of ice: 9.298 million gallons
Volume Under 7 ft of ice: 4.271 million gallons

Potential Ice Aggregate: 21.39 acres (water depth 4 ft or less)
6.343 million gallons

Maximum Recommended Winter Removal: **2.790 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	21.2	2.8	5.3	10.8	64	149	0.8	7.89	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 14 18	9.0	none	0
Minnow Traps	Aug 14 18	4.1	Ninespine stickleback	11
Seine	not used			
Visual +Dipnet	Aug 14 18	5 yards	Ninespine stickleback	+

+ denotes fish were visually observed but not caught

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.29012	-152.25060	8/14/2018	4.19	-0.58

Last Revised: January 8, 2019

MM1819

Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

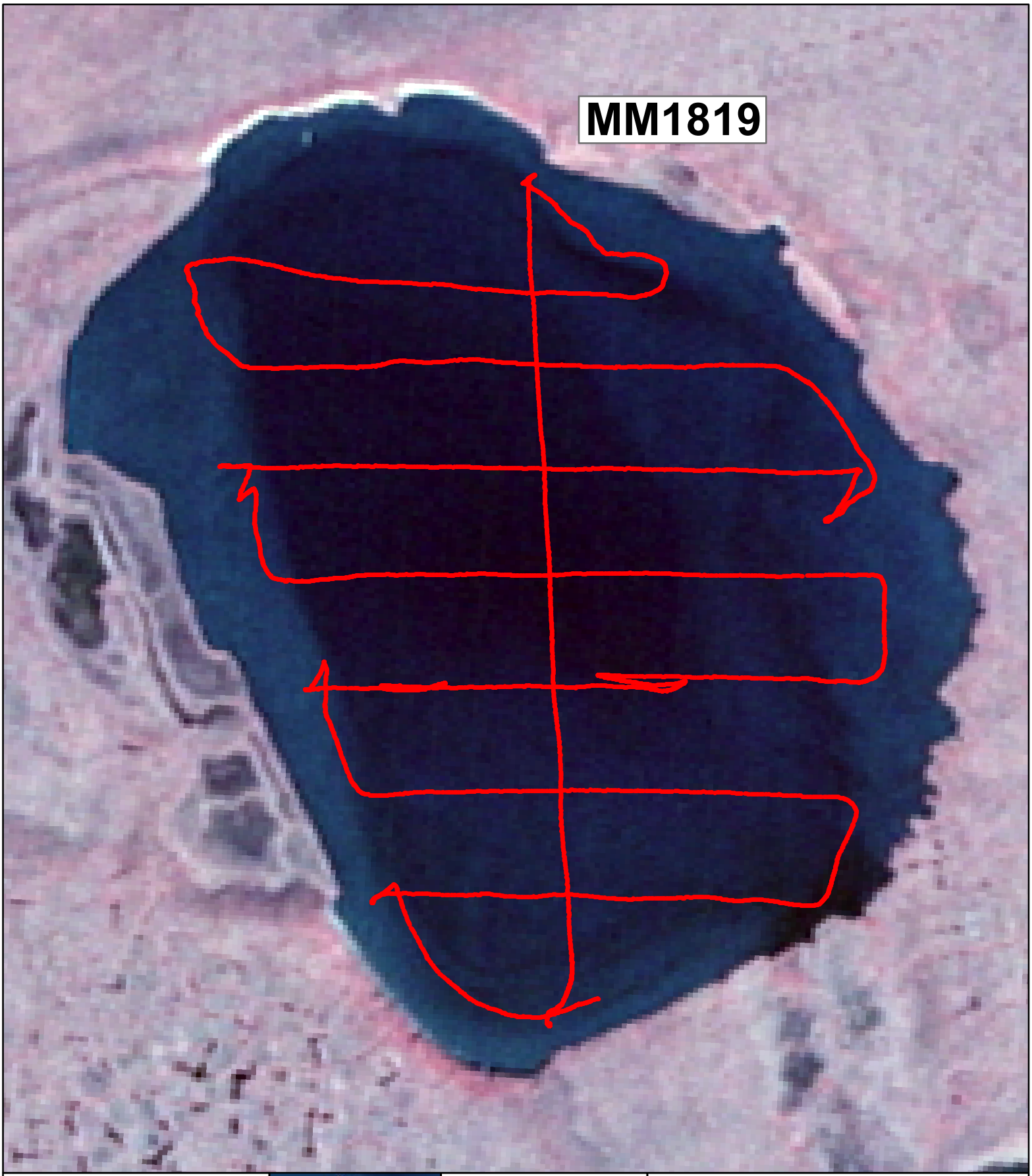
Area Available for Ice Chip Collection at Lake MM1819

based on transects surveyed on August 14, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

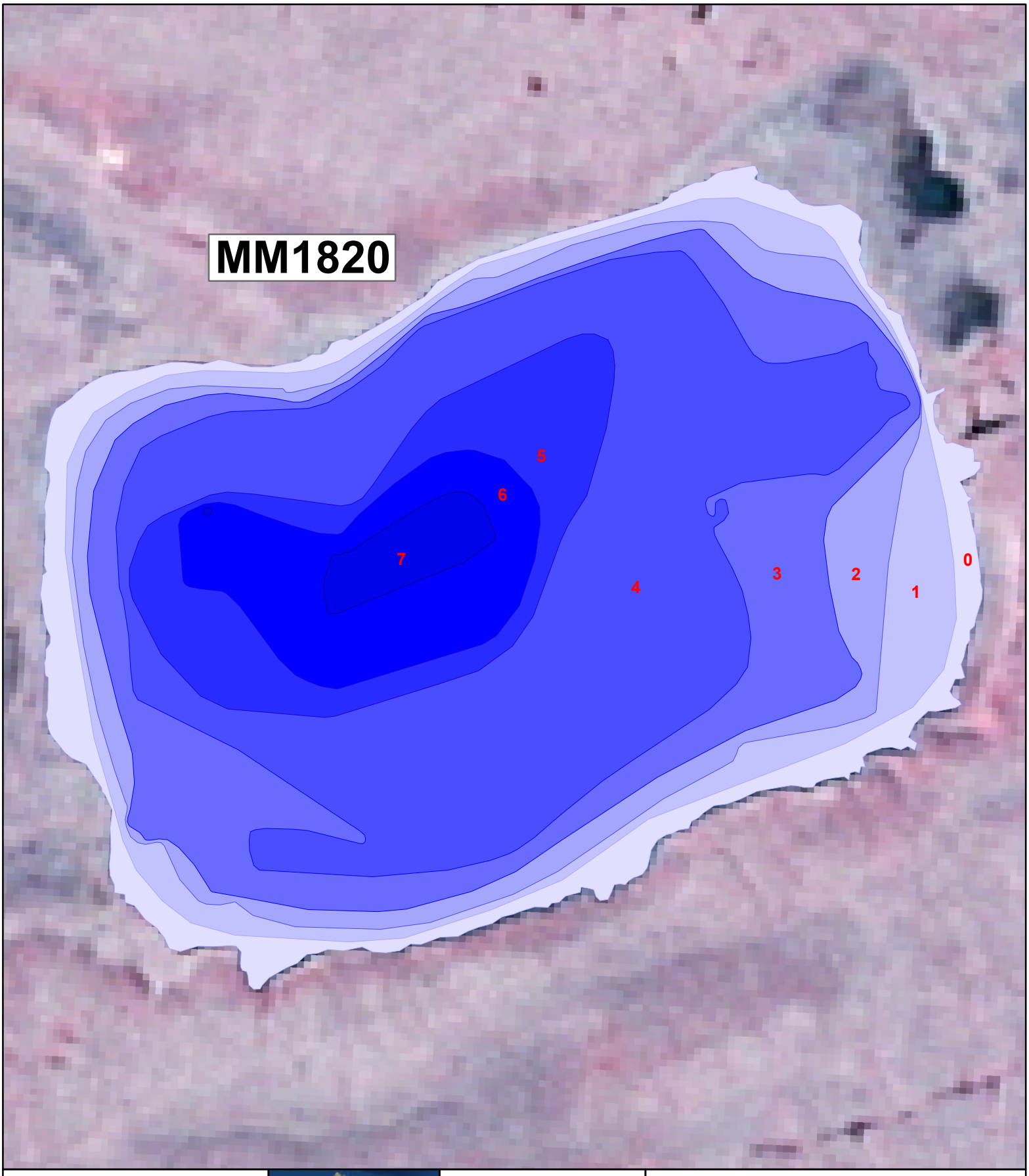
Depth Transects Surveyed at Lake MM1819

surveyed on August 14, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth in Feet

0 1 2 3 4 5 6 7

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1820

based on transects surveyed on August 14, 2018

SCALE:

100 50 0 100 200 Feet

N

Lake MM1820

Other Names: None Known
Location: 70.28723°N 152.29747°W
USGS Quad Sheet: Harrison Bay B-4: T11N R2W Sec. 23,24
Habitat: Tundra Lake
Area: 18 acres
Maximum Depth: 7.5 feet in 2018
Active Outlet: No
Total Lake Volume: 22.690 million gallons
Volume Under 4 ft of ice: 3.403 million gallons
Volume Under 5 ft of ice: 1.243 million gallons
Volume Under 7 ft of ice: 0.040 million gallons

Potential Ice Aggregate: 8.15 acres (water depth 4 ft or less)
2.418 million gallons

Maximum Recommended Winter Removal: **0.373 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	22.5	3.4	6.0	13.0	70	162	0.5	8.09	B. Morris

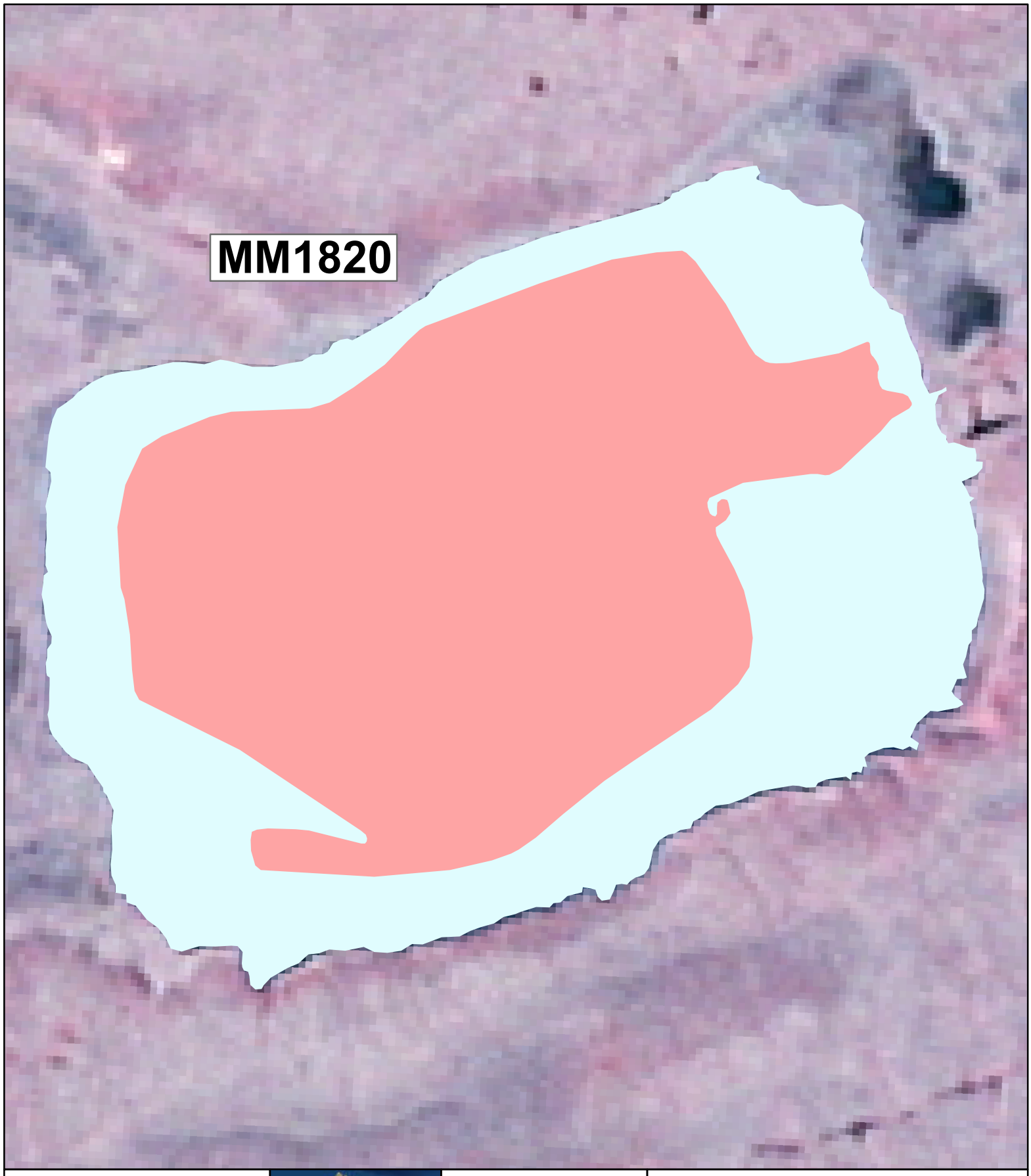
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 14 18	9.2	none	0
Minnow Traps	Aug 14 18	14.3	Ninespine stickleback	1
Seine	not used			
Visual +Dipnet	Aug 14 18	5 yards	Ninespine stickleback	1+

+ denotes additional fish were visually observed but not caught

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.28738	-152.29243	8/14/2018	5.425	-1.51

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

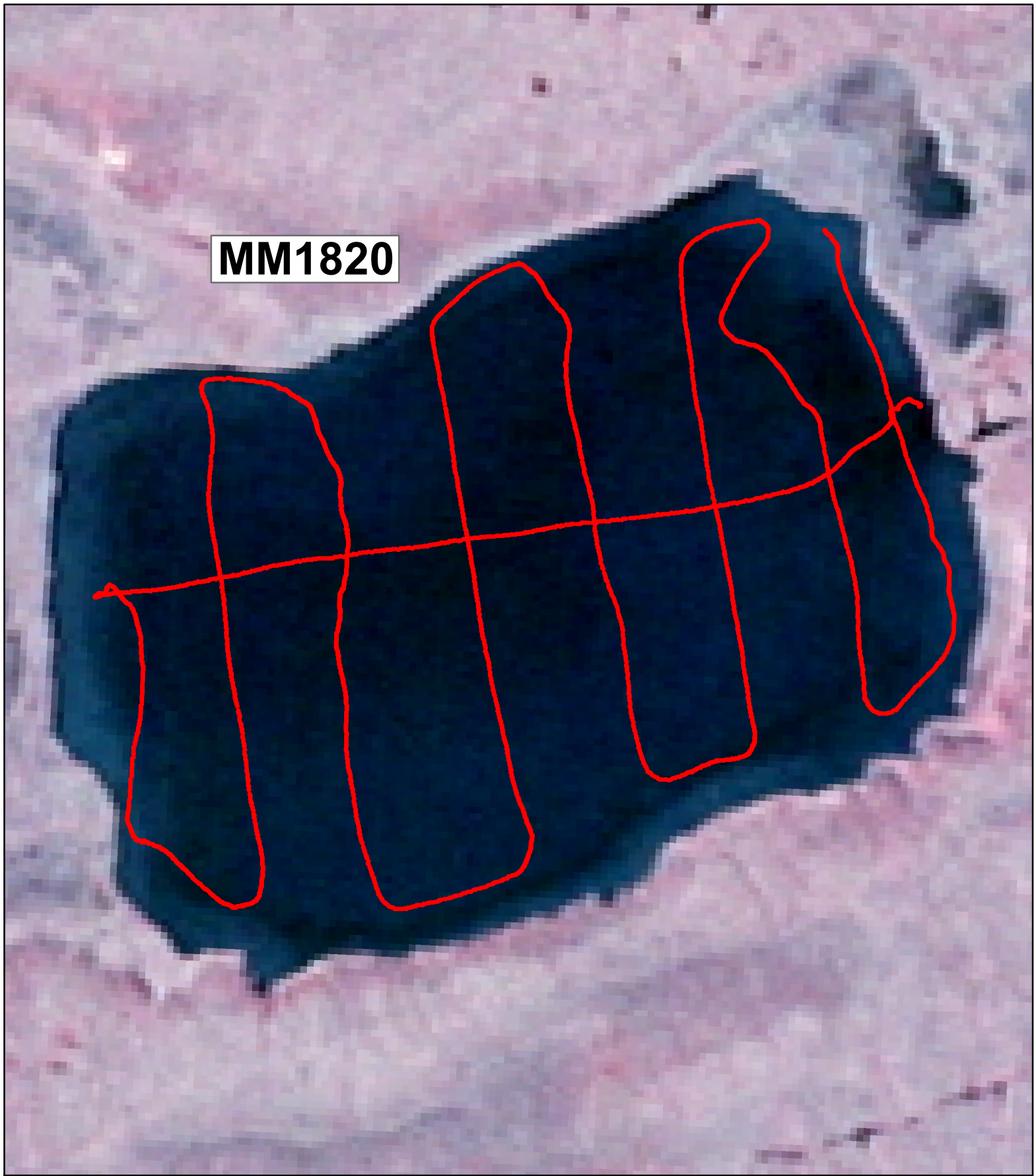
Area Available for Ice Chip Collection at Lake MM1820

based on transects surveyed on August 14, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Transects Surveyed at Lake MM1820

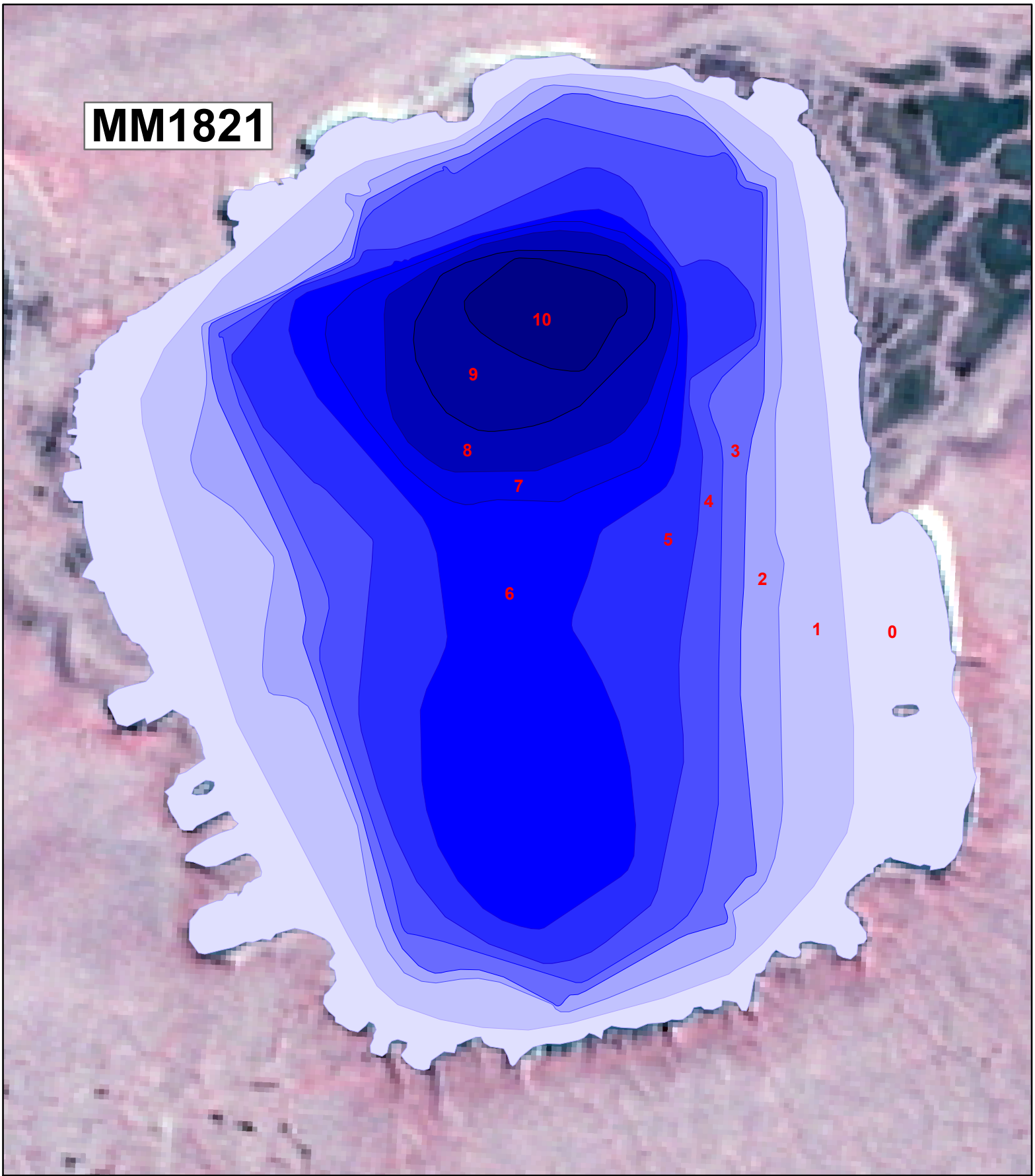
surveyed on August 14, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 Feet

N

MM1821



Depth in Feet

0	3	6	9		
1	4	7	10		
2	5	8			

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1821

based on transects surveyed on July 11, 2018

SCALE:

100 50 0 100 200 300 Feet

N

Lake MM1821

Other Names: None Known
Location: 70.28273°N 152.31317°W
USGS Quad Sheet: Harrison Bay B-4: T11N R2W Sec. 26
Habitat: Tundra Lake
Area: 41 acres
Maximum Depth: 10.9 feet in 2018
Active Outlet: Yes
Total Lake Volume: 50.972 million gallons
Volume Under 4 ft of ice: 15.071 million gallons
Volume Under 5 ft of ice: 9.278 million gallons
Volume Under 7 ft of ice: 2.756 million gallons

Potential Ice Aggregate: 20.84 acres (water depth 4 ft or less)
6.181 million gallons

Maximum Recommended Winter Removal: **2.783 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	27.1	3.4	5.4	11.8	82	181	1.4	8.08	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Jul 11 18	9.7	none	0
Minnow Traps	not used			
Seine	not used			
Visual +Dipnet	Jul 11 18	120 yards	Ninespine stickleback	2

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.28137	-152.31624	7/11/2018	4.25	-3.55

Last Revised: November 7, 2018

MM1821

Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake MM1821

based on transects surveyed on July 11, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N

MM1821

Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

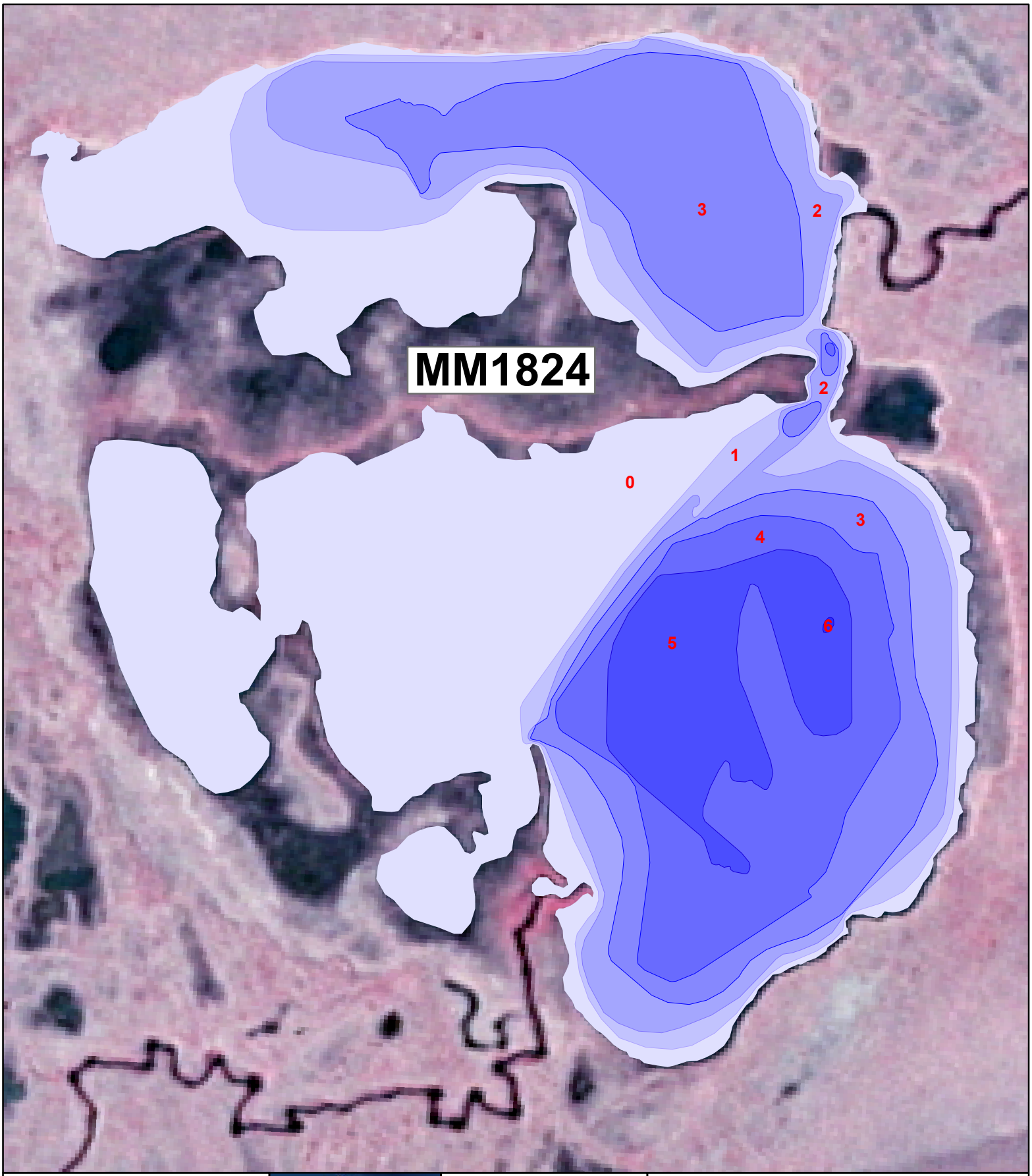
Depth Transects Surveyed at Lake MM1821

surveyed on July 11, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth in Feet

0 1 2 3 4 5 6

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1824

based on transects surveyed on July 17, 2018

SCALE:

100 50 0 100 200 300 400 Feet

N

Lake MM1824

Other Names: None Known
Location: 70.29606°N 152.26884°W
USGS Quad Sheet: Harrison Bay B-4: T11N R2W Sec. 24
Habitat: Drainage Lake
Area: 56 acres
Maximum Depth: 6.0 feet in 2018
Active Outlet: Yes
Total Lake Volume: 38.640 million gallons
Volume Under 4 ft of ice: 2.807 million gallons
Volume Under 5 ft of ice: 0.501 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 45.51 acres (water depth 4 ft or less)
13.497 million gallons

Maximum Recommended Winter Removal: **0.000 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

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
2018	24.5	2.9	4.6	10.3	73	163	0.8	7.90	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	gear not used, direct connection to the Kalikpik River			
Minnow Traps	Multiple fish observed while transecting			
Seine				
Visual +Dipnet				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.29439	-152.26682	7/17/2018	4.53	-1.81

Last Revised: December 13, 2018

Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake MM1824

based on transects surveyed on July 17, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 Feet

N

Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

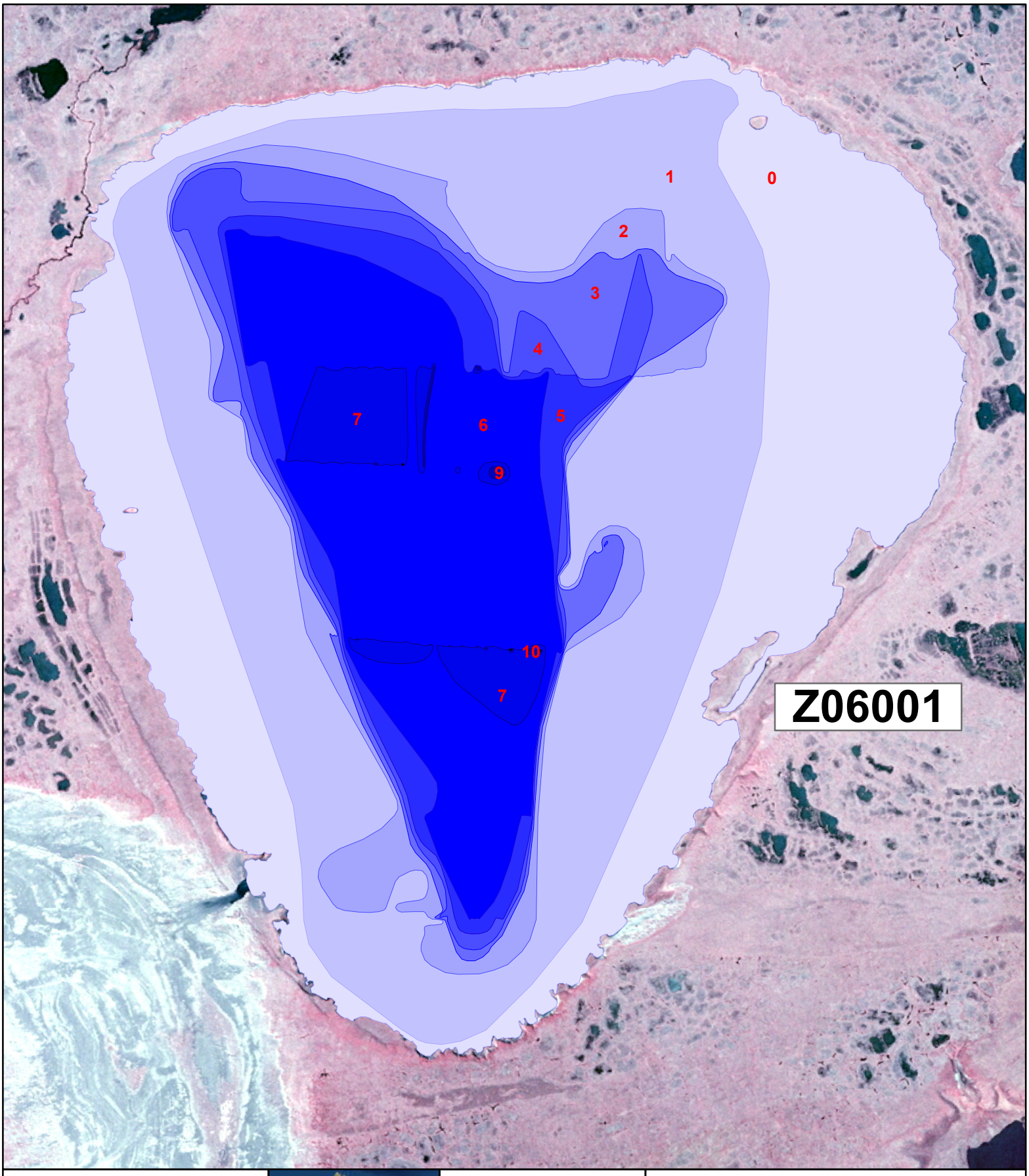
Depth Transects Surveyed at Lake MM1824

surveyed on July 17, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake Z06001

based on transects surveyed on August 6, 2018

SCALE:

500 250 0 500 1,000 1,500 Feet

N

Lake Z06001

Other Names: None Known
Location: 70.35017°N 152.29354°W
USGS Quad Sheet: Harrison Bay B-4: T11N R2W Sec. 1,2; T12N R2W Sec. 25,26,35,36
Habitat: Drainage Lake
Area: 743 acres
Maximum Depth: 10.2 feet in 2018 (6.6 feet in 2006)
Active Outlet: Yes
Total Lake Volume: 634.873 million gallons
Volume Under 4 ft of ice: 142.792 million gallons
Volume Under 5 ft of ice: 80.680 million gallons
Volume Under 7 ft of ice: 3.056 million gallons

Potential Ice Aggregate: 539.84 acres (water depth 4 ft or less)
160.093 million gallons

Maximum Recommended Winter Removal: **0.458 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

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
2018	23.2	3.4	7.4	17.1	72	179	0.8	8.40	B. Morris

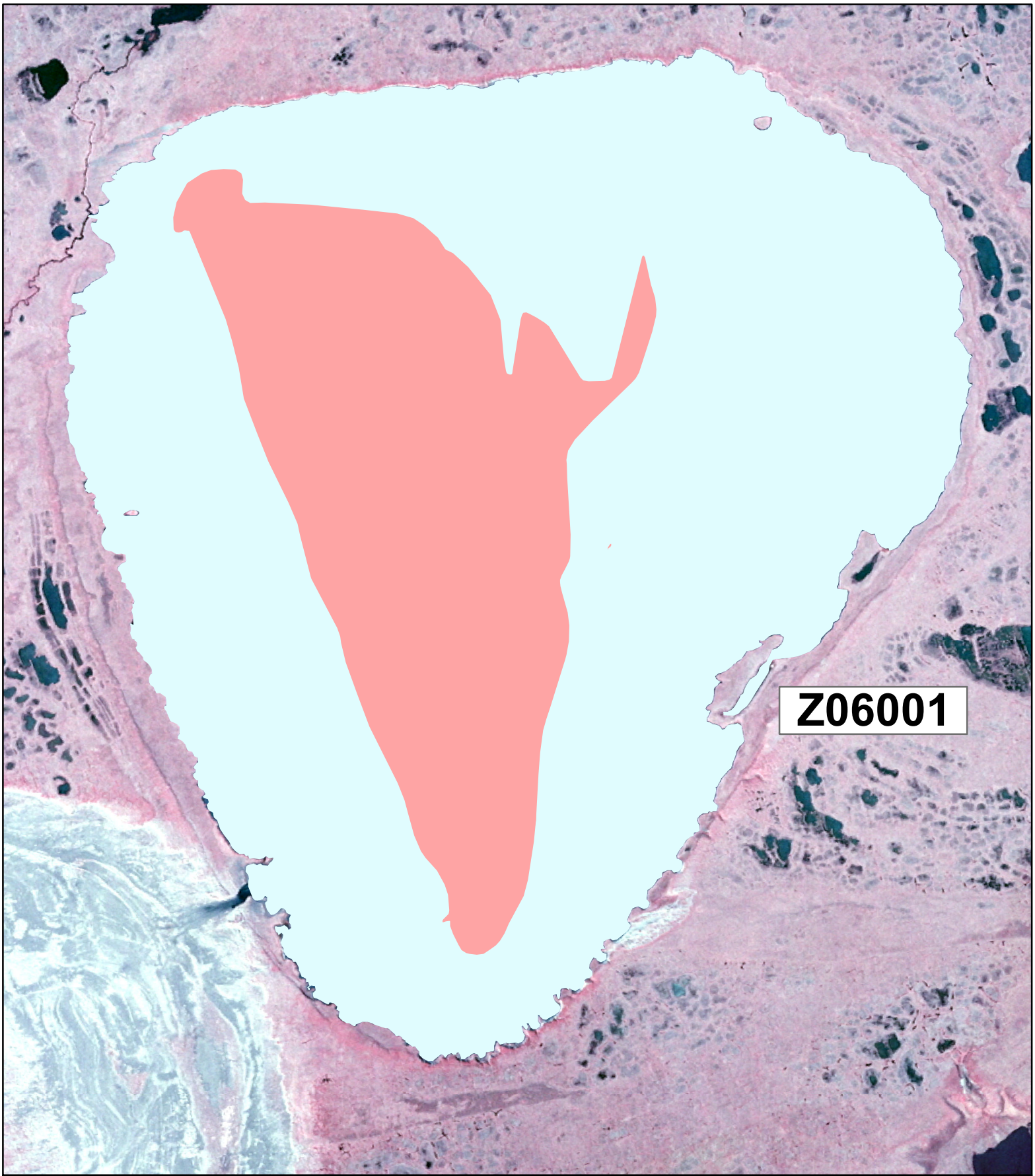
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 10 06	8.9	Arctic grayling	3	48-199
Minnow Traps	Aug 10 06	21.6	Ninespine stickleback	3	
Seine	not used				
Visual	Aug 6 18	5 yards	Arctic grayling	+	

2006 observations from Oasis (2006)
+ denotes fish were visually observed but not caught

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.35665	-152.31113	8/6/2018	4.83	-1.79

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

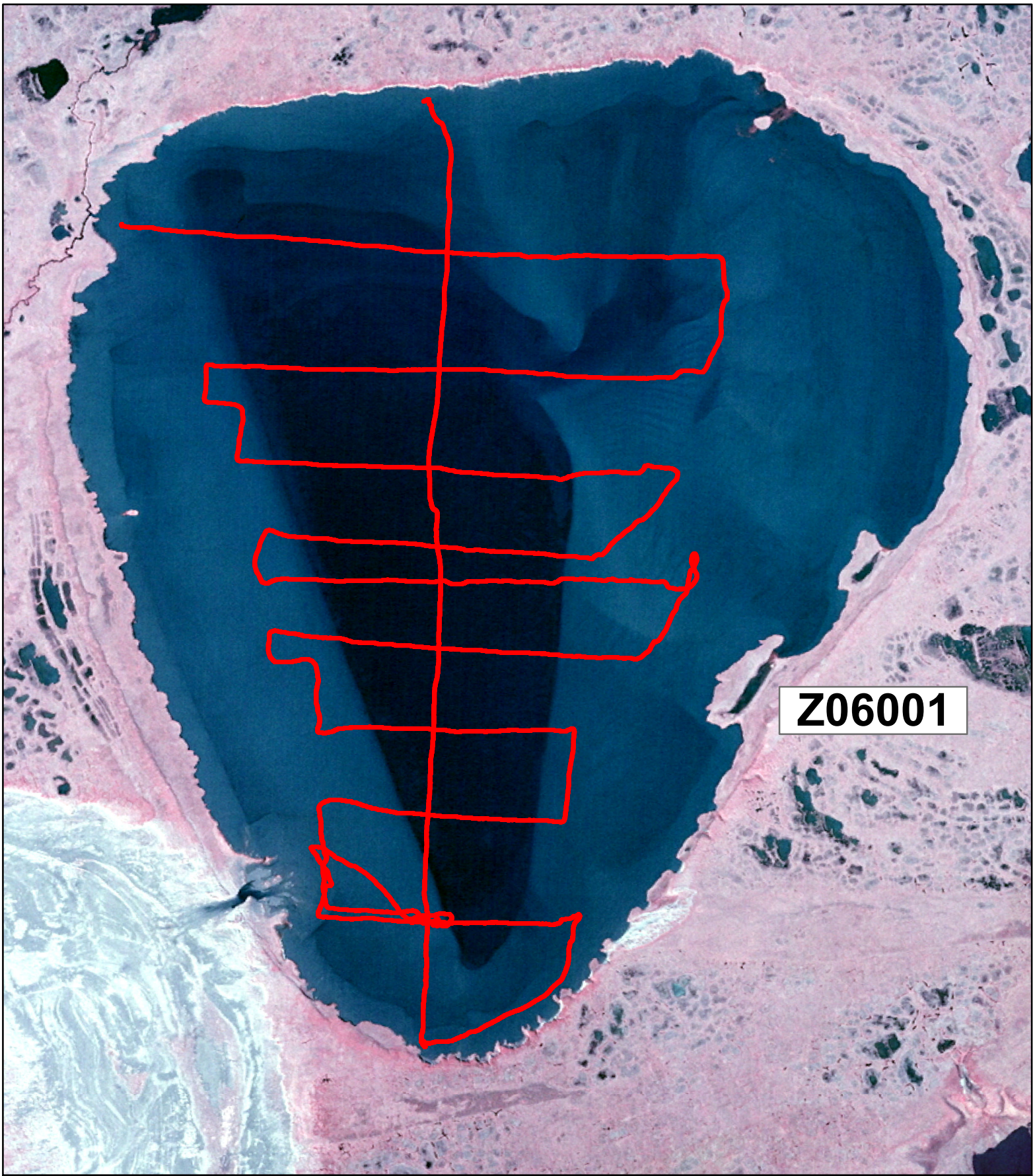
Area Available for Ice Chip Collection at Lake Z06001

based on transects surveyed on August 6, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Transects Surveyed at Lake Z06001

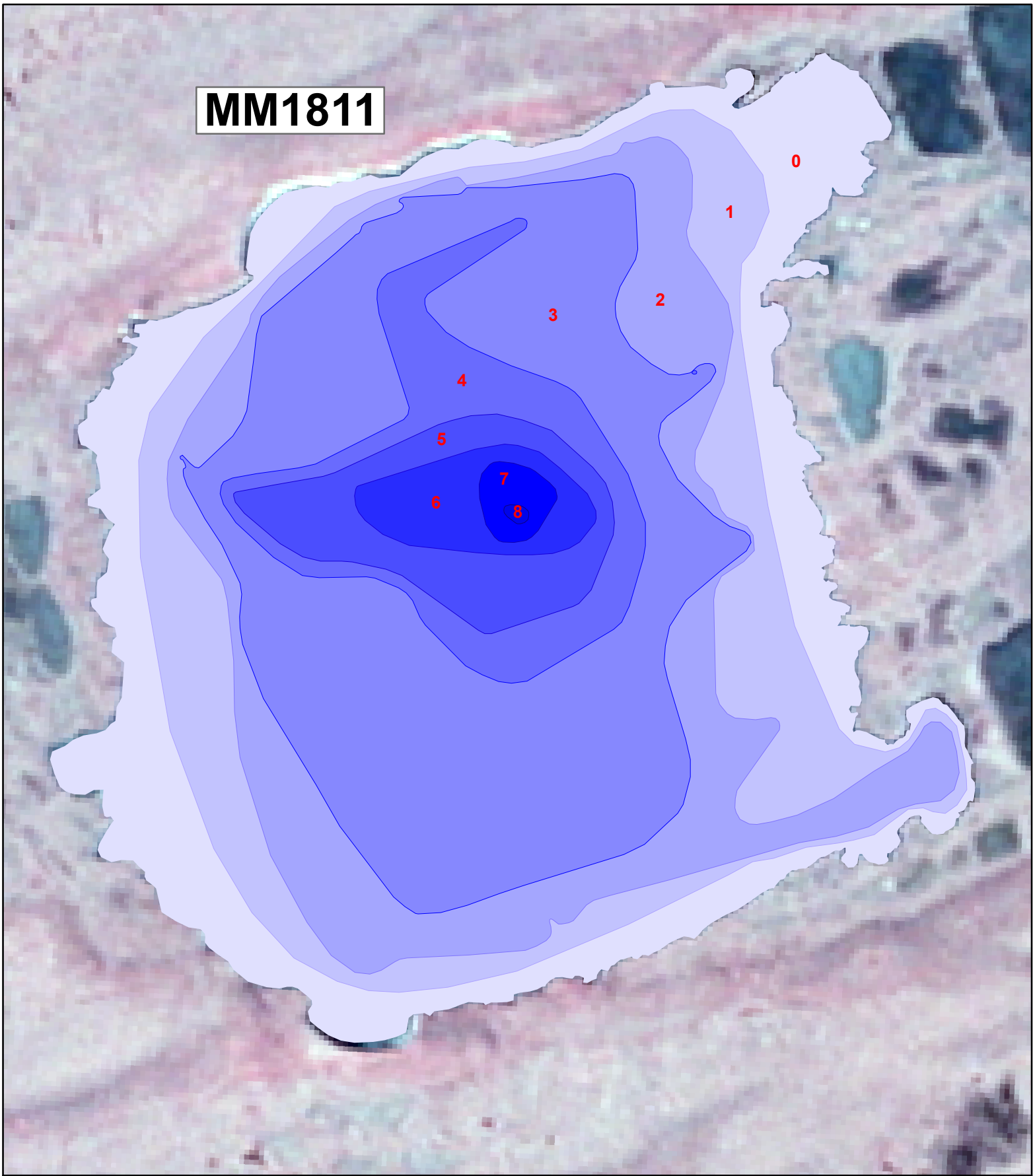
surveyed on August 6, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N

6.3. Lake Summaries for Lakes Sampled in the West Willow A Area, 2018.



Depth in Feet

0	3	6
1	4	7
2	5	8

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1811

based on transects surveyed on August 5, 2018

SCALE:

100 50 0 100 200 300 Feet

N

Lake MM1811

Other Names: None Known
Location: 70.27123°N 152.47050°W
USGS Quad Sheet: Harrison Bay B-5: T11N R2W Sec. 29-32
Habitat: Tundra Lake
Area: 38 acres
Maximum Depth: 8.1 feet in 2018
Active Outlet: No
Total Lake Volume: 32.614 million gallons
Volume Under 4 ft of ice: 2.420 million gallons
Volume Under 5 ft of ice: 0.983 million gallons
Volume Under 7 ft of ice: 0.047 million gallons

Potential Ice Aggregate: 32.11 acres (water depth 4 ft or less)
9.521 million gallons

Maximum Recommended Winter Removal: **0.295 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	33.5	3.8	6.2	12.8	99	221	1.3	8.22	B. Morris

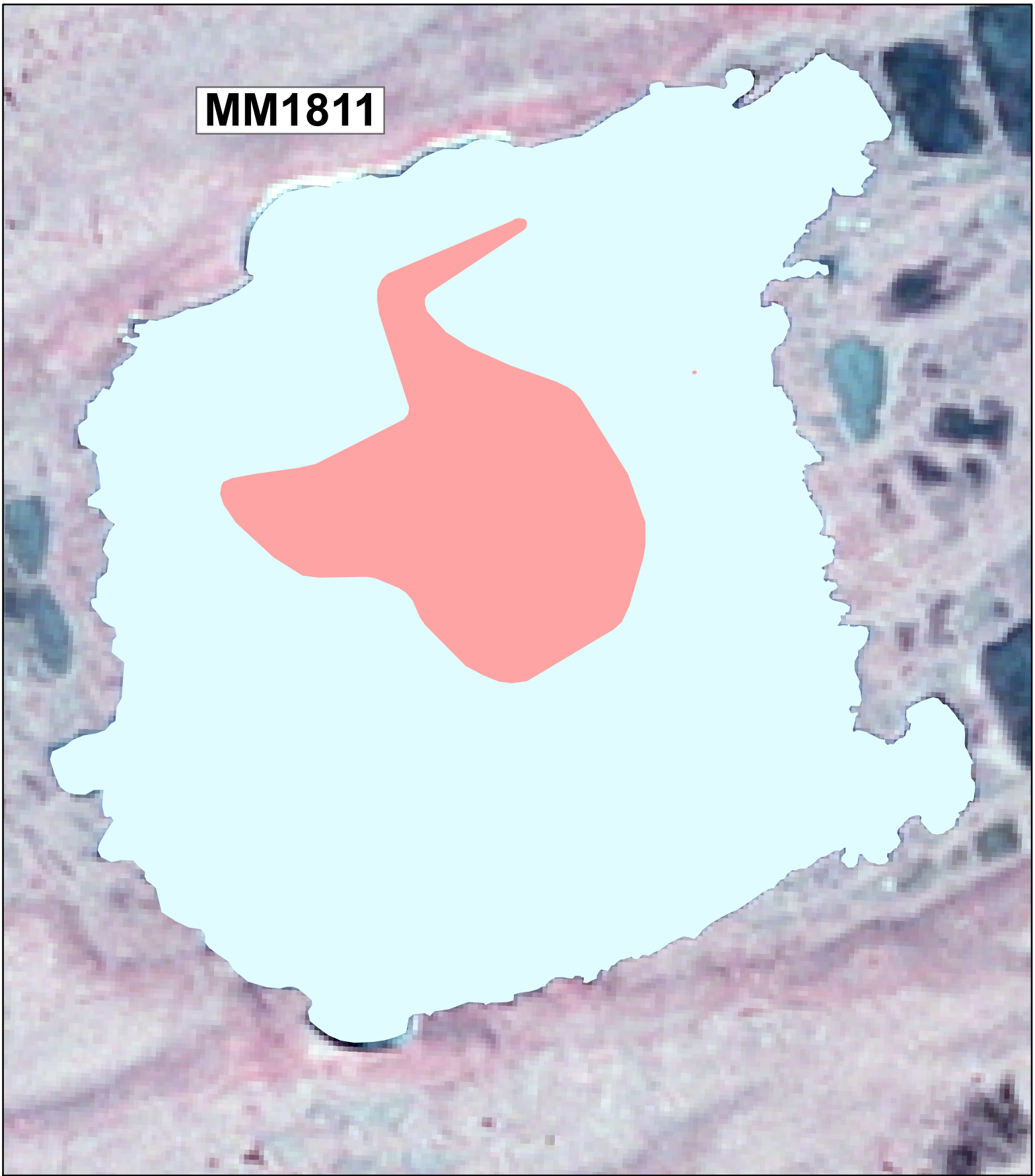
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 5 18	9.6	none	0
Minnow Traps	Aug 5 18	12.0	none	0
Seine	Aug 5 18	1 haul	Ninespine stickleback	1
Visual +Dipnet	Aug 5 18	50 yards	none	0

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.26994	-152.46613	8/5/2018	4.5	-1.39

Last Revised: January 8, 2019



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake MM1811

based on transects surveyed on August 5, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N

Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

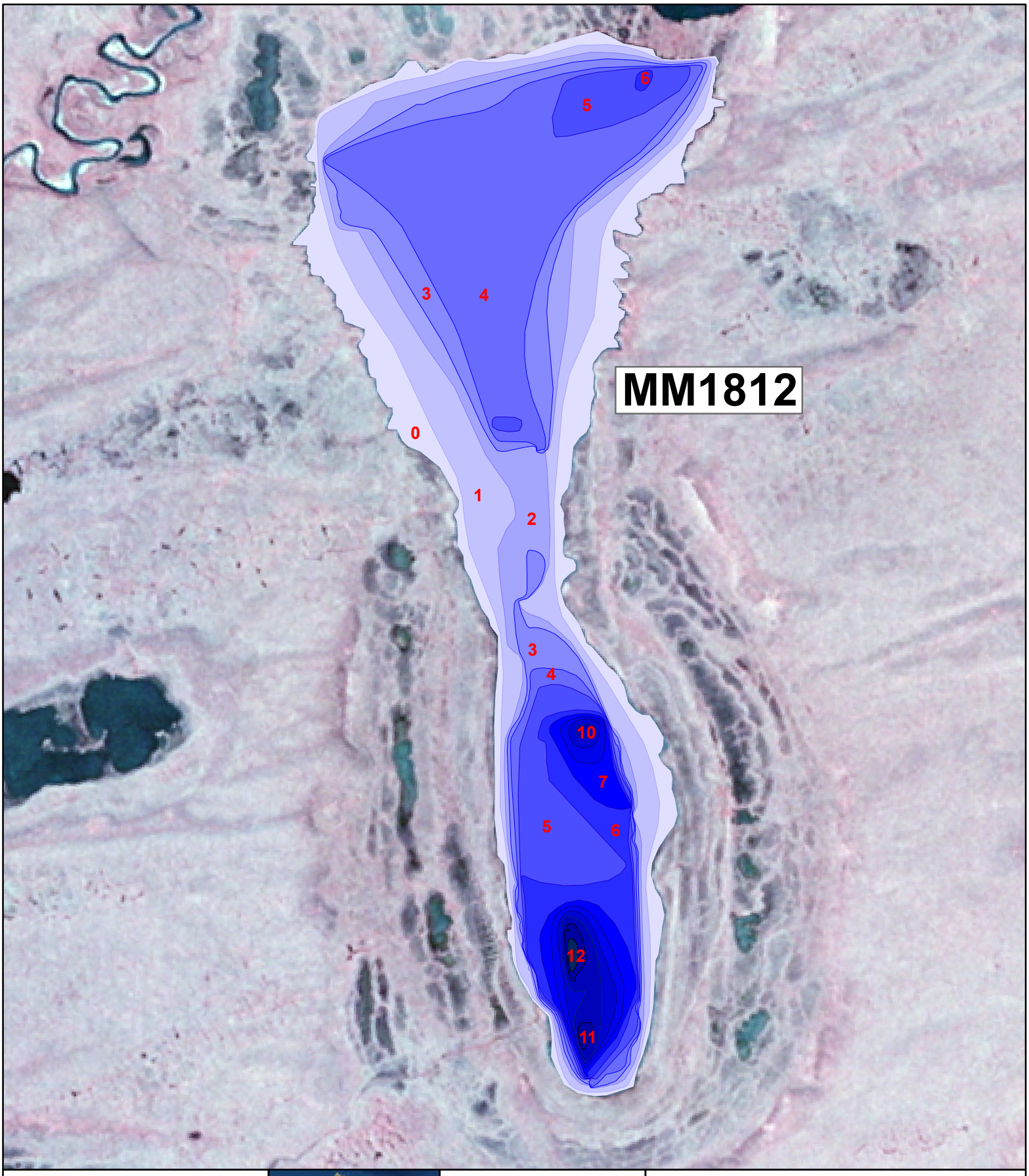
Depth Transects Surveyed at Lake MM1811

surveyed on August 5, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth in Feet

0	3	6	9	12	
1	4	7	10		
2	5	8	11		

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1812

based on transects surveyed on August 12, 2018

SCALE:

250 125 0 250 500 750 Feet

N

Lake MM1812

Other Names: None Known
Location: 70.26382°N 152.50734°W
USGS Quad Sheet: Harrison Bay B-5: T10N R2W Sec. 6; T11N R2W Sec. 31; T11N R3W Sec. 36
Habitat: Perched Lake
Area: 61 acres
Maximum Depth: 12.6 feet in 2018
Active Outlet: No
Total Lake Volume: 70.633 million gallons
Volume Under 4 ft of ice: 14.614 million gallons
Volume Under 5 ft of ice: 8.045 million gallons
Volume Under 7 ft of ice: 2.803 million gallons

Potential Ice Aggregate: 32.62 acres (water depth 4 ft or less)
9.674 million gallons

Maximum Recommended Winter Removal: **2.413 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

Water Chemistry:

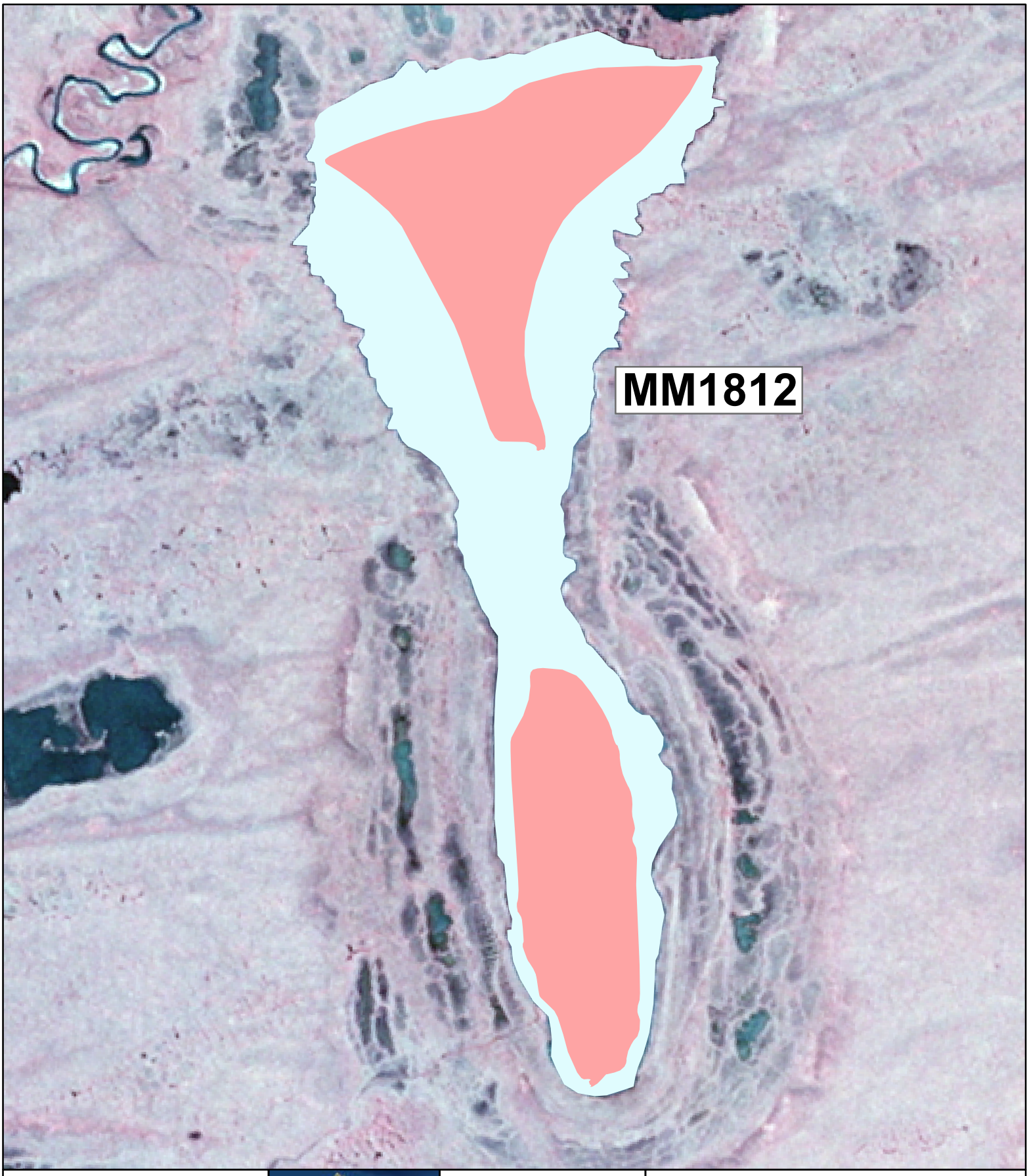
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	17.4	2.3	3.5	7.2	53	116	0.7	7.73	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 12 18	9.0	none	0
Minnow Traps	Aug 12 18	8.5	Ninespine stickleback	1
Seine	not used			
Visual +Dipnet	Aug 12 18	7 yards	Ninespine stickleback	7

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.26617	-152.50667	8/12/2018	4.01	-1.62

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

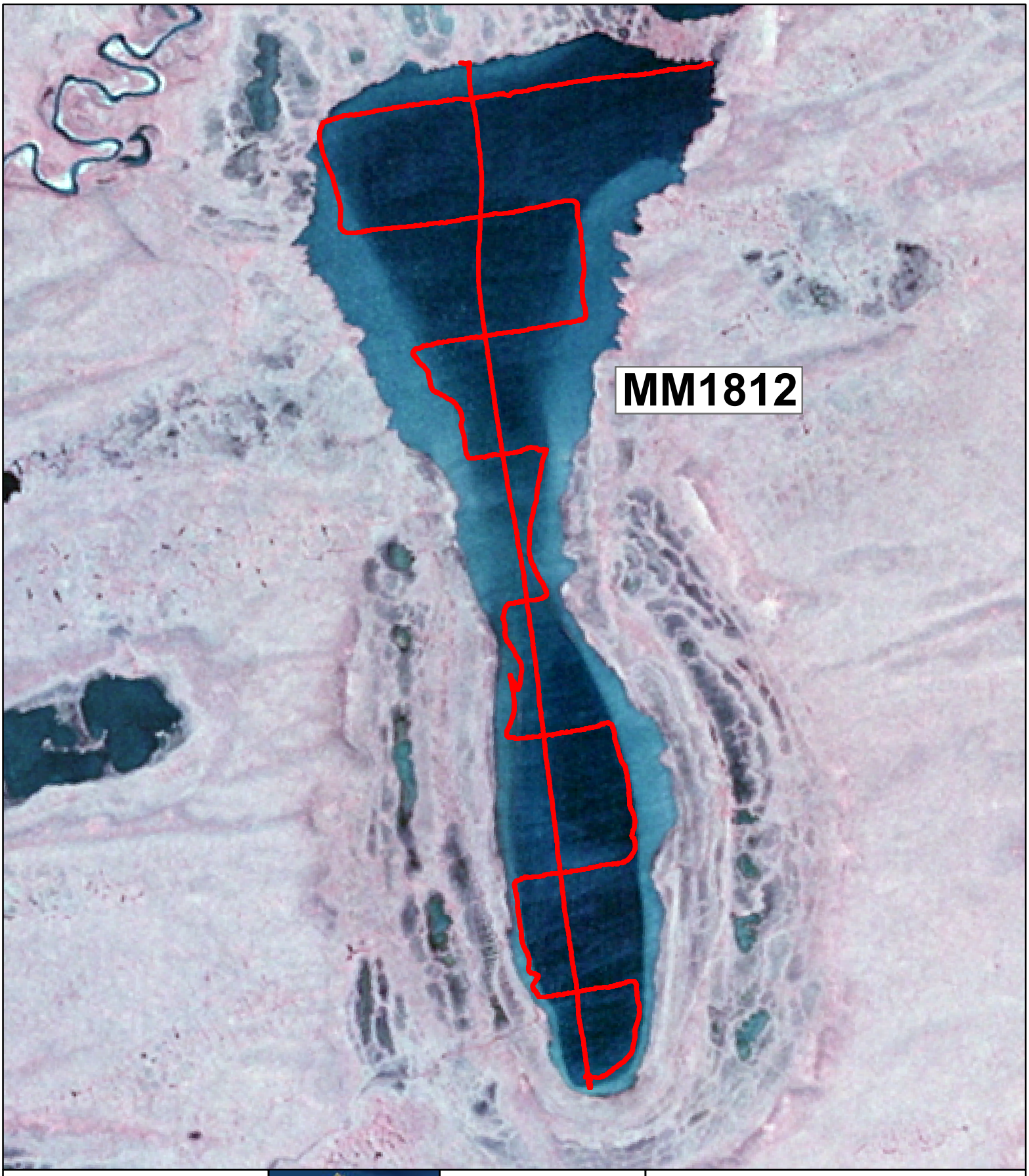
Area Available for Ice Chip Collection at Lake MM1812

based on transects surveyed on August 12, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

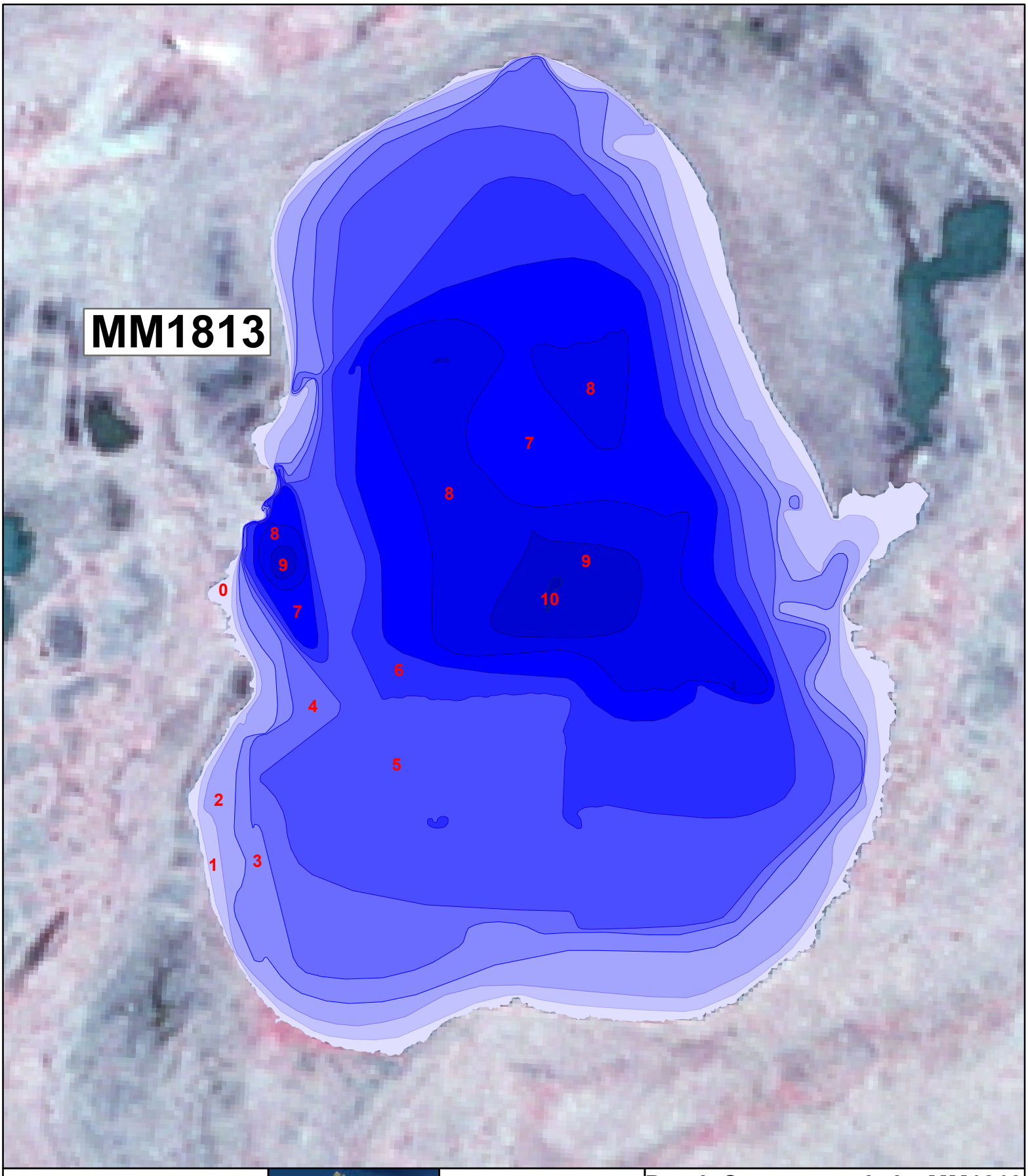
Depth Transects Surveyed at Lake MM1812

surveyed on August 12, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1813

based on transects surveyed on July 15, 2018

SCALE:

100 50 0 100 200 300 Feet

N

Lake MM1813

Other Names: None Known
Location: 70.27140°N 152.53353°W
USGS Quad Sheet: Harrison Bay B-5: T11N R3W Sec. 25,36
Habitat: Tundra Lake
Area: 37 acres
Maximum Depth: 10.2 feet in 2018
Active Outlet: No
Total Lake Volume: 64.749 million gallons
Volume Under 4 ft of ice: 21.924 million gallons
Volume Under 5 ft of ice: 13.659 million gallons
Volume Under 7 ft of ice: 3.487 million gallons

Potential Ice Aggregate: 10.03 acres (water depth 4 ft or less)
2.973 million gallons

Maximum Recommended Winter Removal: **0.523 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

Water Chemistry:

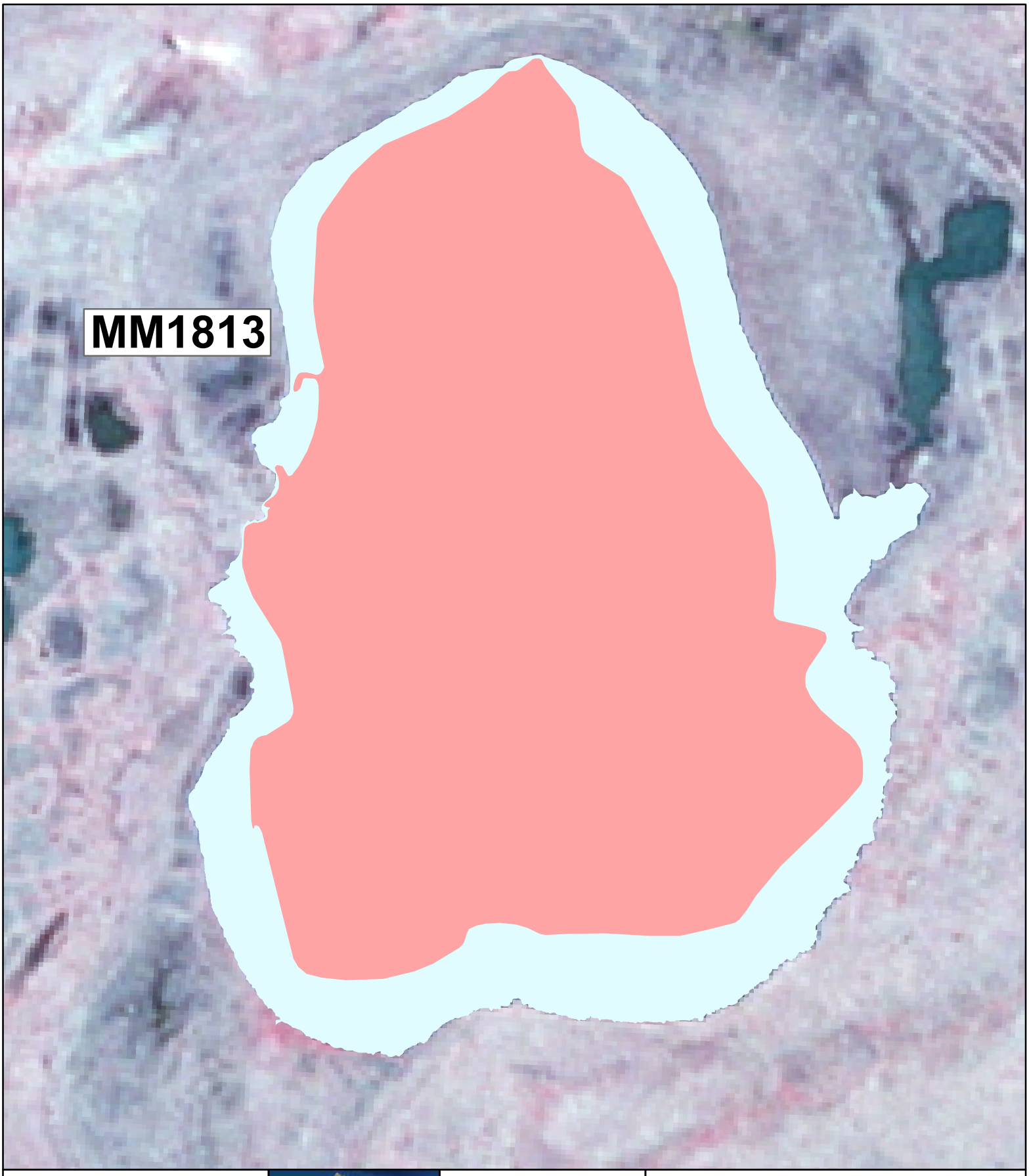
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	13.0	1.7	32.4	7.5	39	92	1.1	7.59	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 15 18	7.1	Least cisco	1	204
Minnow Traps	Jul 15 18	5.8	Ninespine stickleback	6	
Seine	not used				
Visual +Dipnet	not used				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.27180	-152.54038	7/15/2018	4.29	-2.19

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

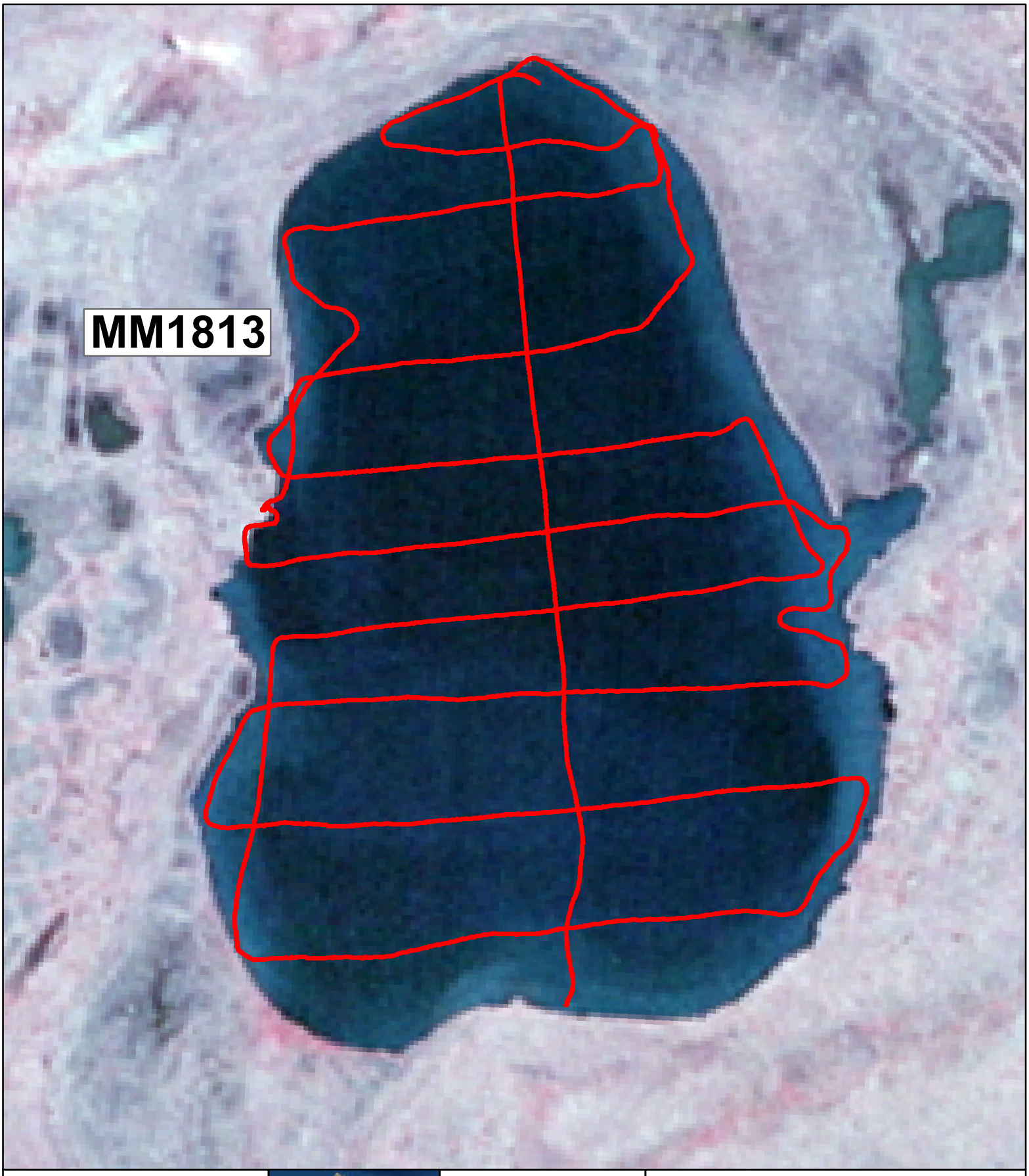
Area Available for Ice Chip Collection at Lake MM1813

based on transects surveyed on July 15, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

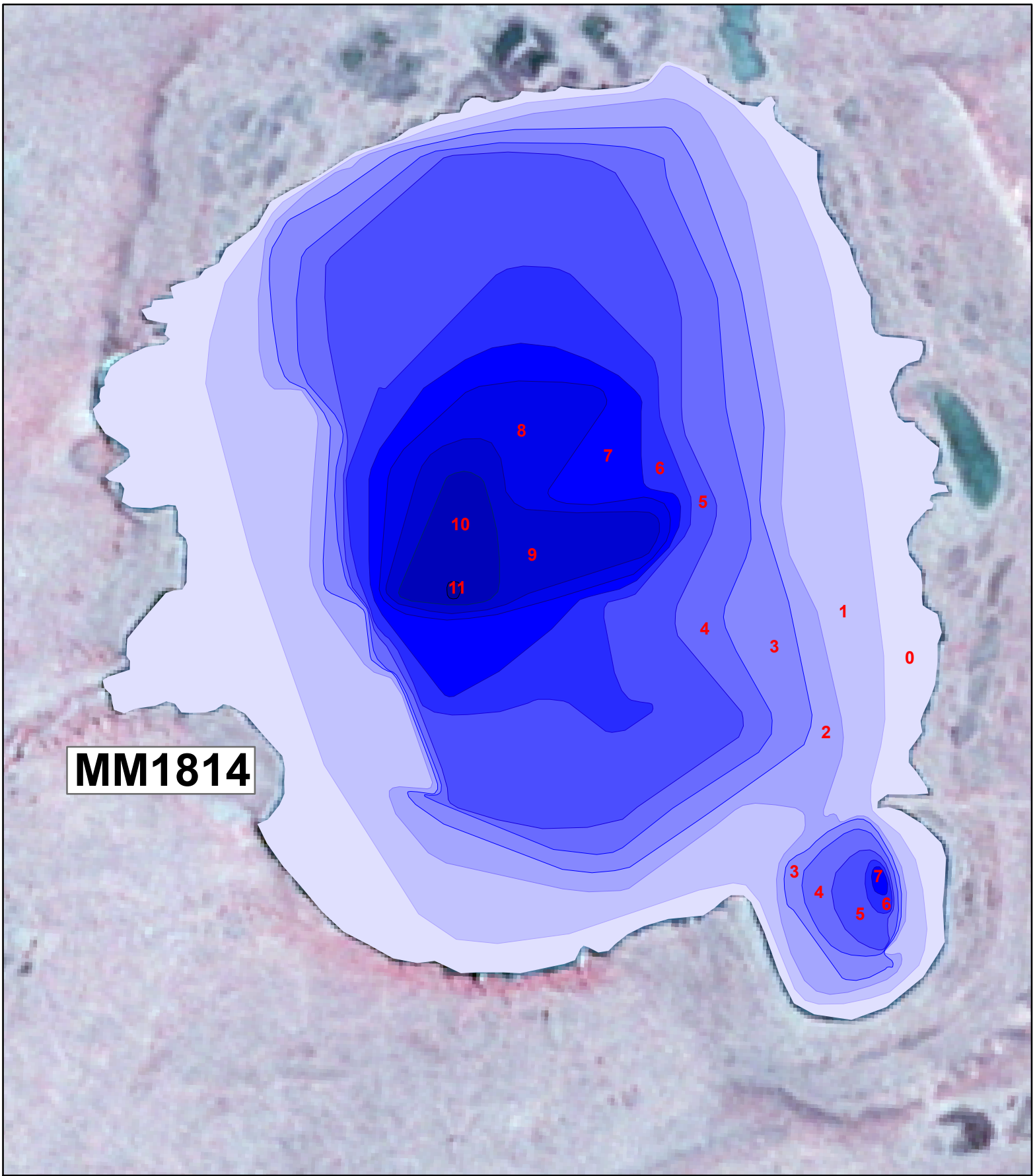
Depth Transects Surveyed at Lake MM1813

surveyed on July 15, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	11

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1814

based on transects surveyed on August 10, 2018

SCALE:

100 50 0 100 200 300 400 500 Feet

N

Lake MM1814

Other Names: None Known
Location: 70.28146°N 152.55020°W
USGS Quad Sheet: Harrison Bay B-5: T11N R3W Sec. 25,26
Habitat: Tundra Lake
Area: 67 acres
Maximum Depth: 11.1 feet in 2018
Active Outlet: No
Total Lake Volume: 79.728 million gallons
Volume Under 4 ft of ice: 22.351 million gallons
Volume Under 5 ft of ice: 13.681 million gallons
Volume Under 7 ft of ice: 4.334 million gallons

Potential Ice Aggregate: 37.24 acres (water depth 4 ft or less)
11.043 million gallons

Maximum Recommended Winter Removal: **4.104 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	26.8	2.5	4.3	9.1	77	167	0.8	8.14	B. Morris

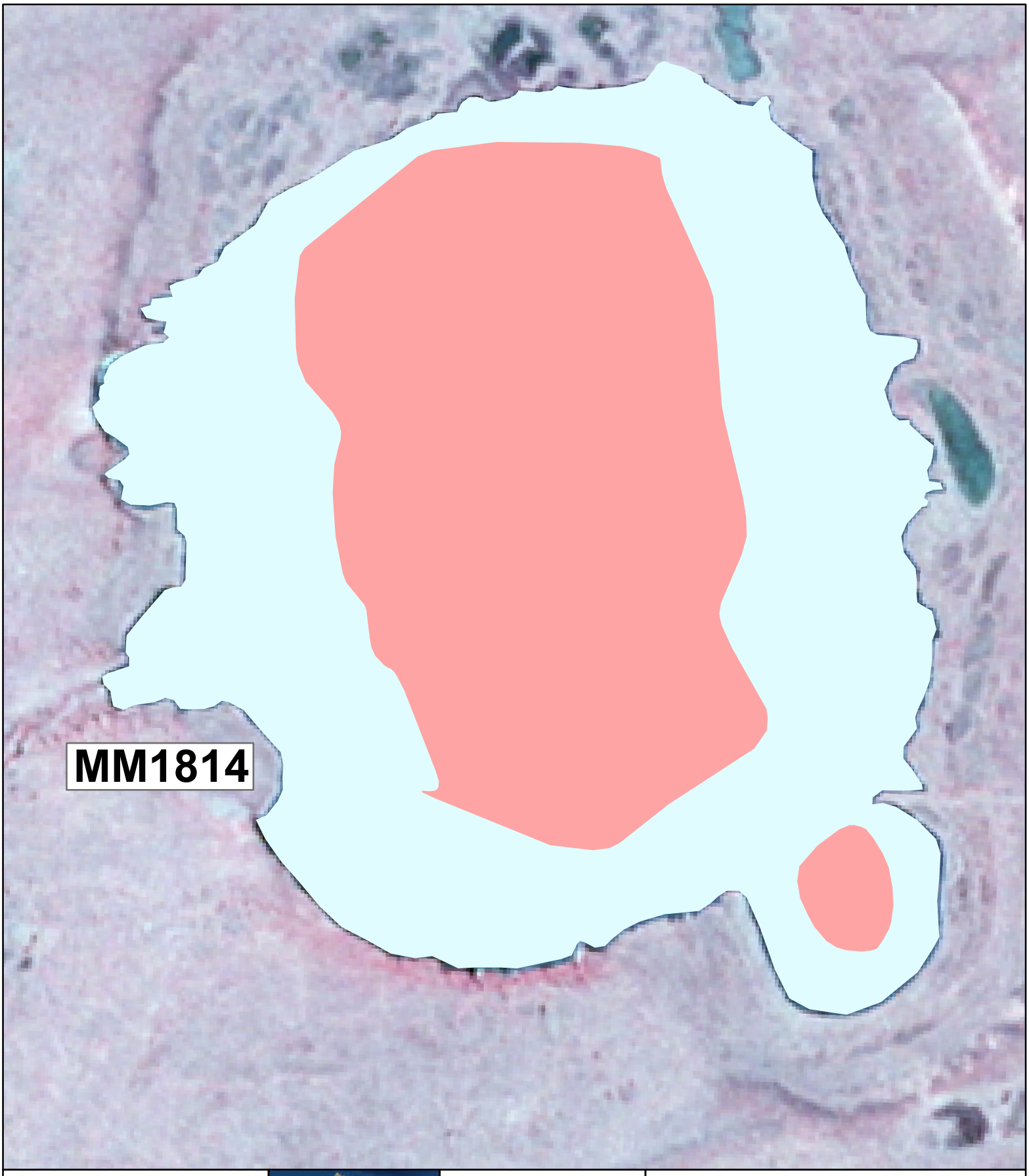
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 10 18	9.5	none	0
Minnow Traps	Aug 10 18	12.9	none	0
Seine	not used			
Visual +Dipnet	Aug 10 18	45 yards	Ninespine stickleback	1

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.28162	-152.55942	8/10/2018	5.52	-0.94

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

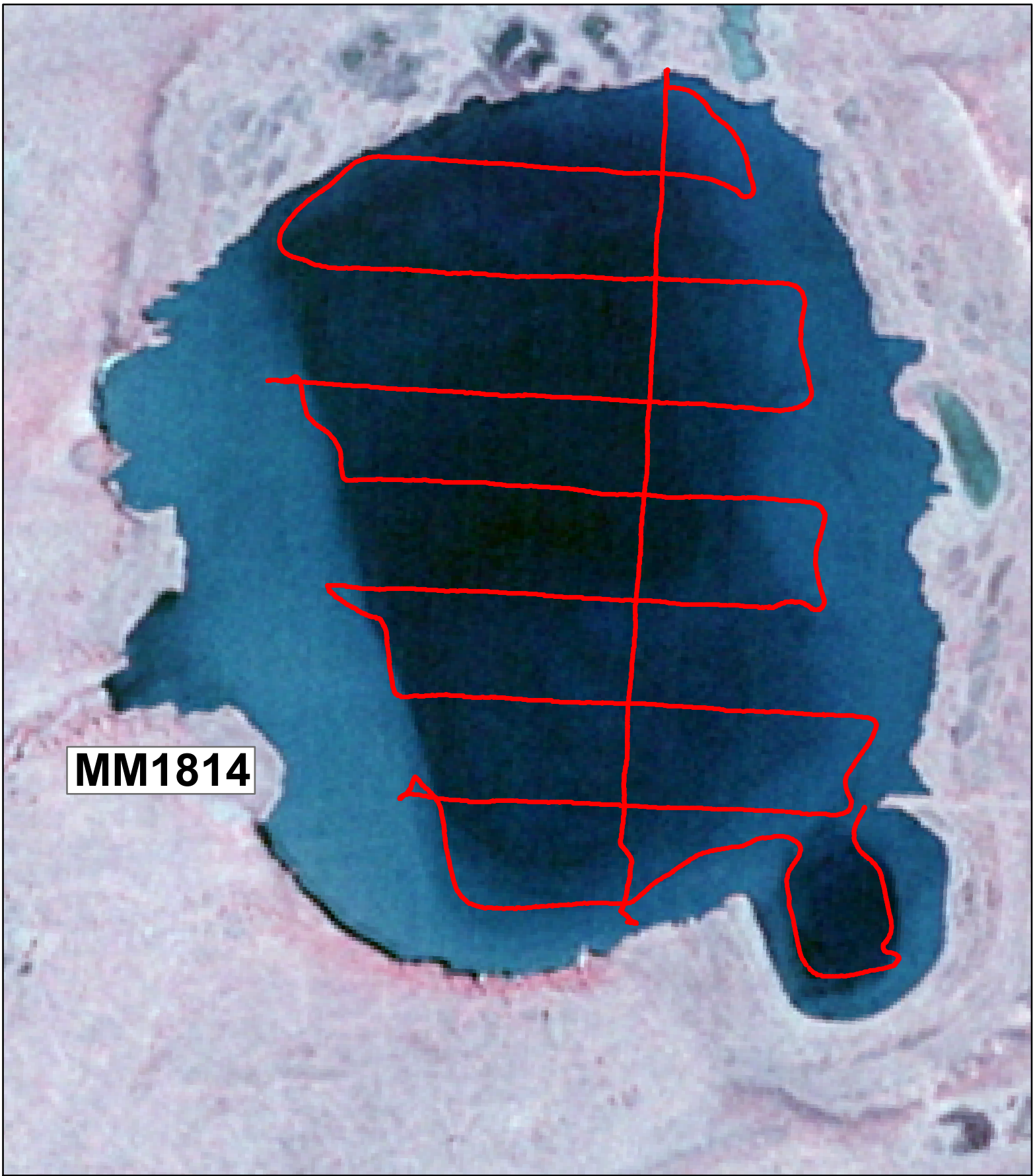
Area Available for Ice Chip Collection at Lake MM1814

based on transects surveyed on August 10, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

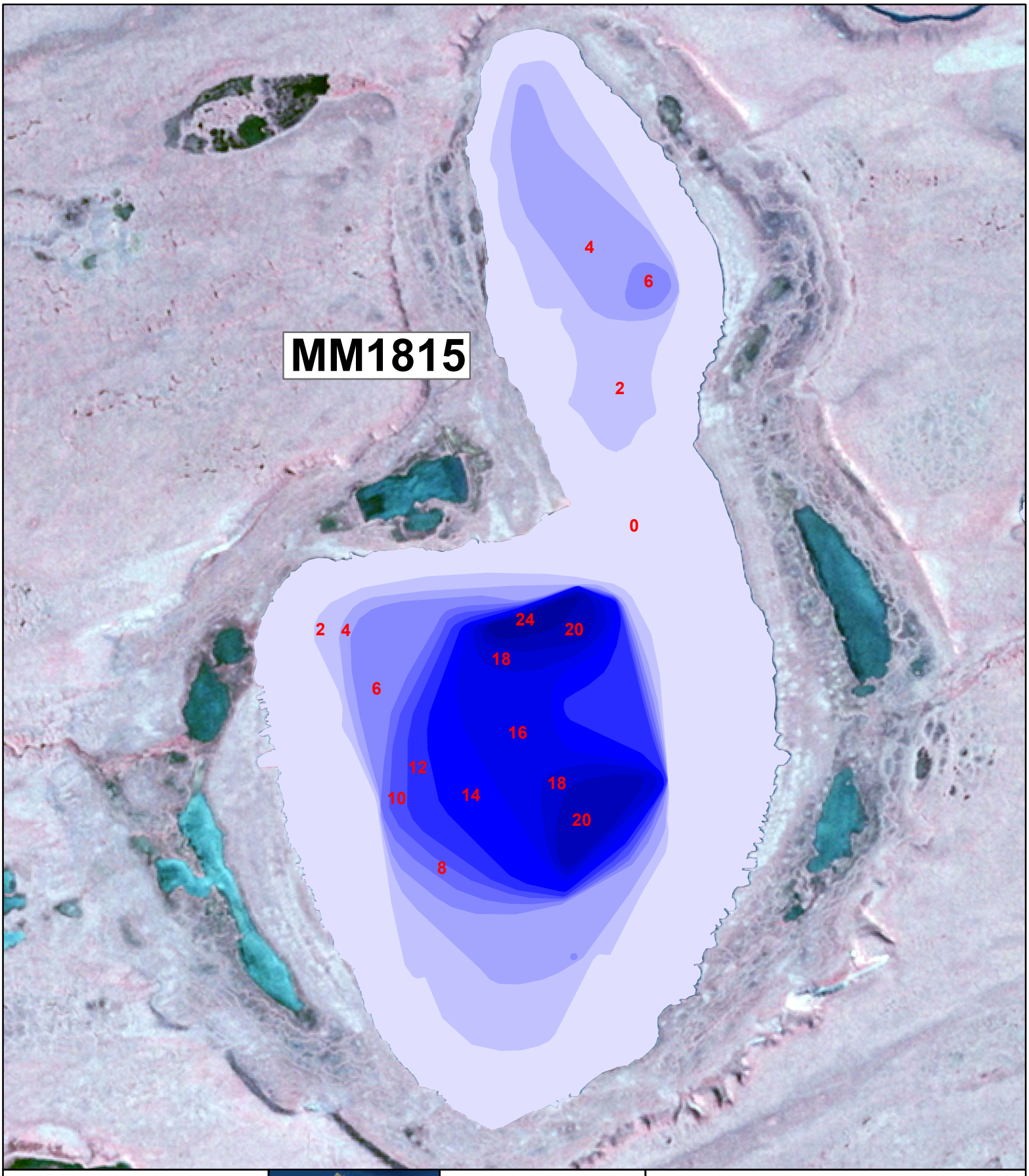
Depth Transects Surveyed at Lake MM1814

surveyed on August 10, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N



Depth in Feet

0	6	12	18	24
2	8	14	20	
4	10	16	22	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1815 (depths in 2 foot intervals)

based on transects surveyed on August 10, 2018

SCALE:

250 125 0 250 500 750 1,000 Feet

N

Lake MM1815

Other Names: None Known
Location: 70.27861°N 152.57829°W
USGS Quad Sheet: Harrison Bay B-5: T11N R3W Sec. 23,26
Habitat: Tundra Lake
Area: 185 acres
Maximum Depth: 25.2 feet in 2018
Active Outlet: No
Total Lake Volume: 387.185 million gallons
Volume Under 4 ft of ice: 214.452 million gallons
Volume Under 5 ft of ice: 186.553 million gallons
Volume Under 7 ft of ice: 142.415 million gallons

Potential Ice Aggregate: 93.30 acres (water depth 4 ft or less)
27.668 million gallons

Maximum Recommended Winter Removal: **55.966 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

Water Chemistry:

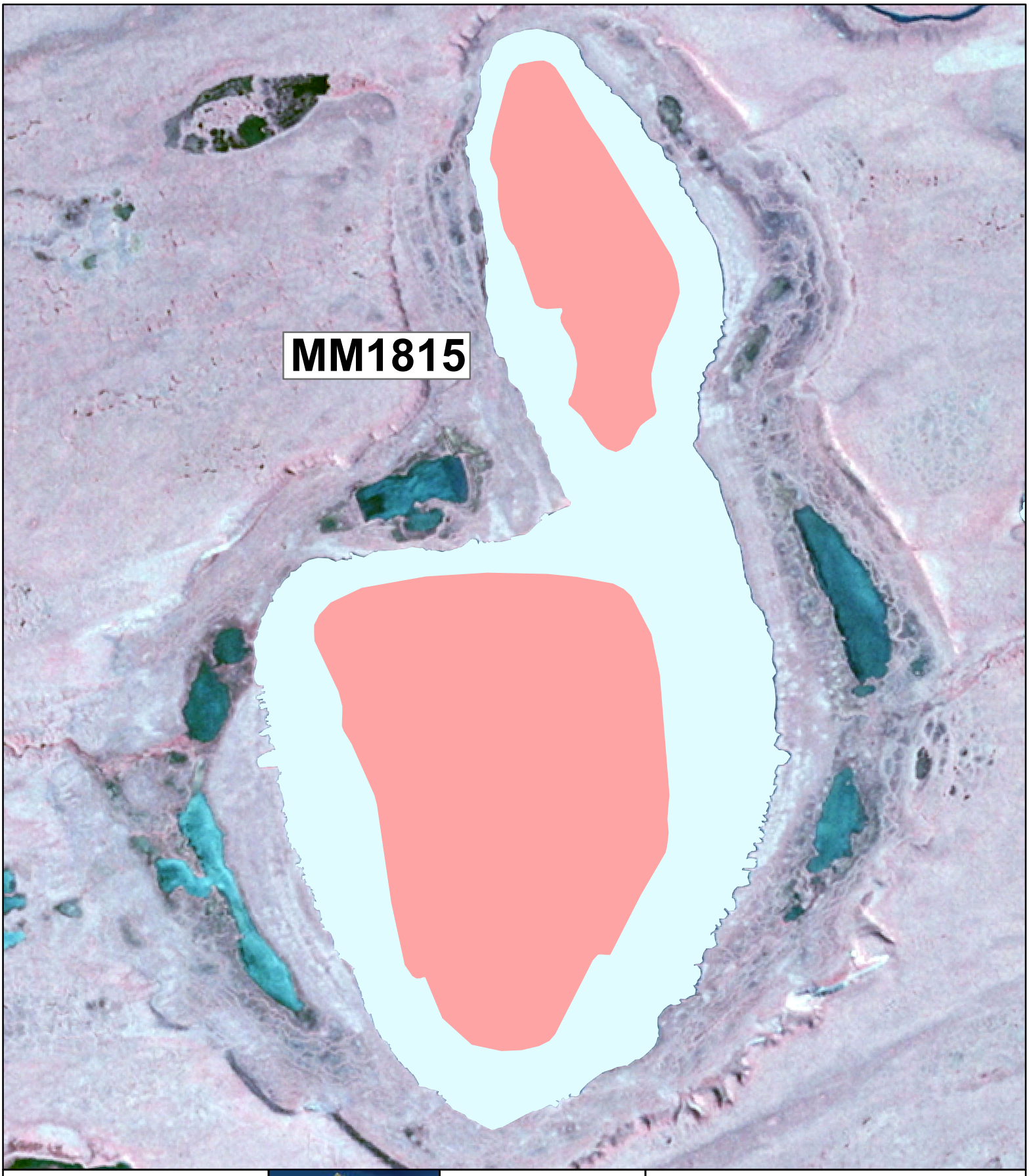
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	33.0	3.4	6.4	15.3	97	217	0.6	8.20	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 10 18	9.1	none	0
Minnow Traps	Aug 10 18	4.3	Ninespine stickleback	1
Seine	not used			
Visual +Dipnet	not used			

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.27989	-152.56935	8/10/2018	4.74	-2.10

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

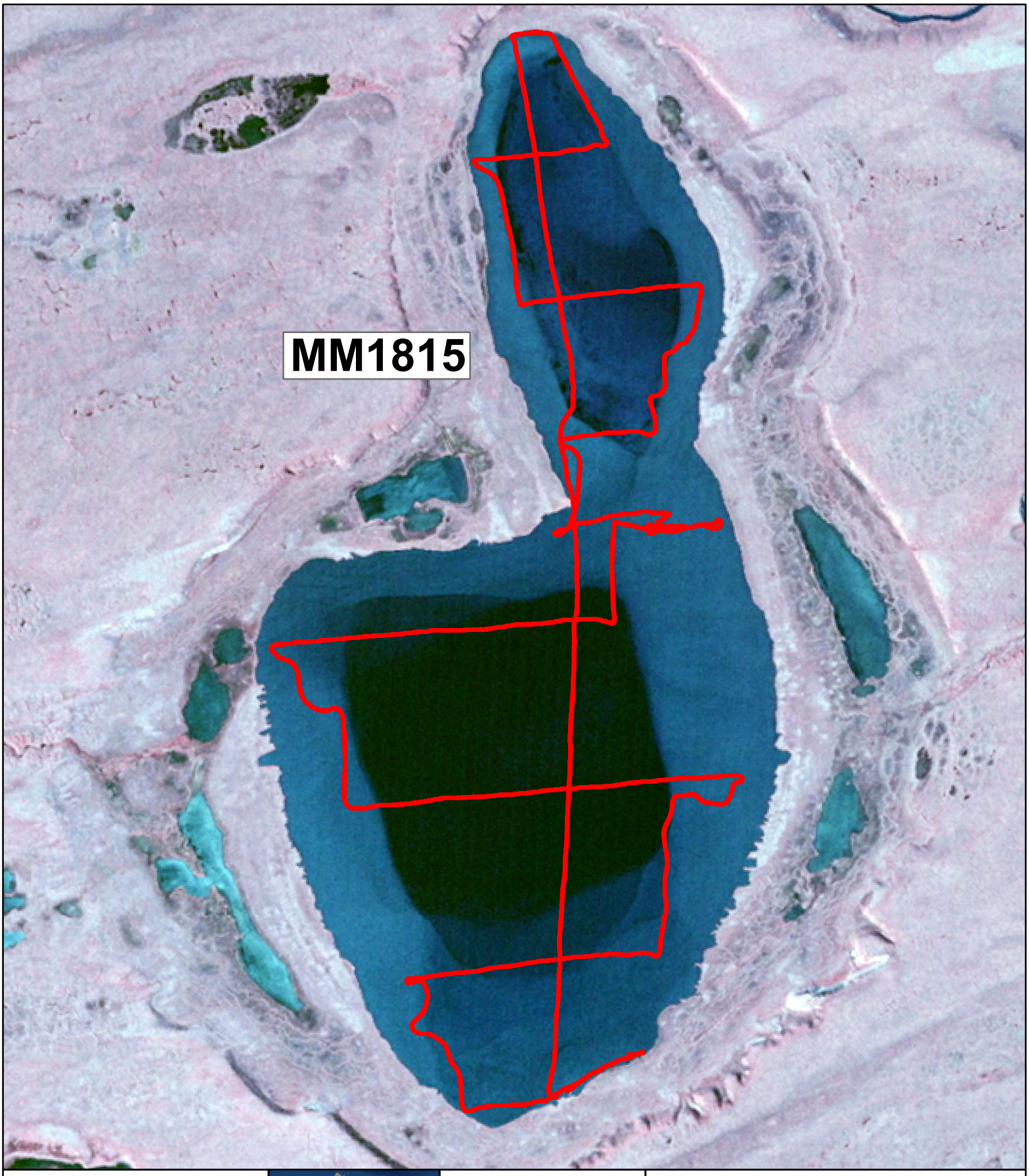
Area Available for Ice Chip Collection at Lake MM1815

based on transects surveyed on August 10, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 1,000 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

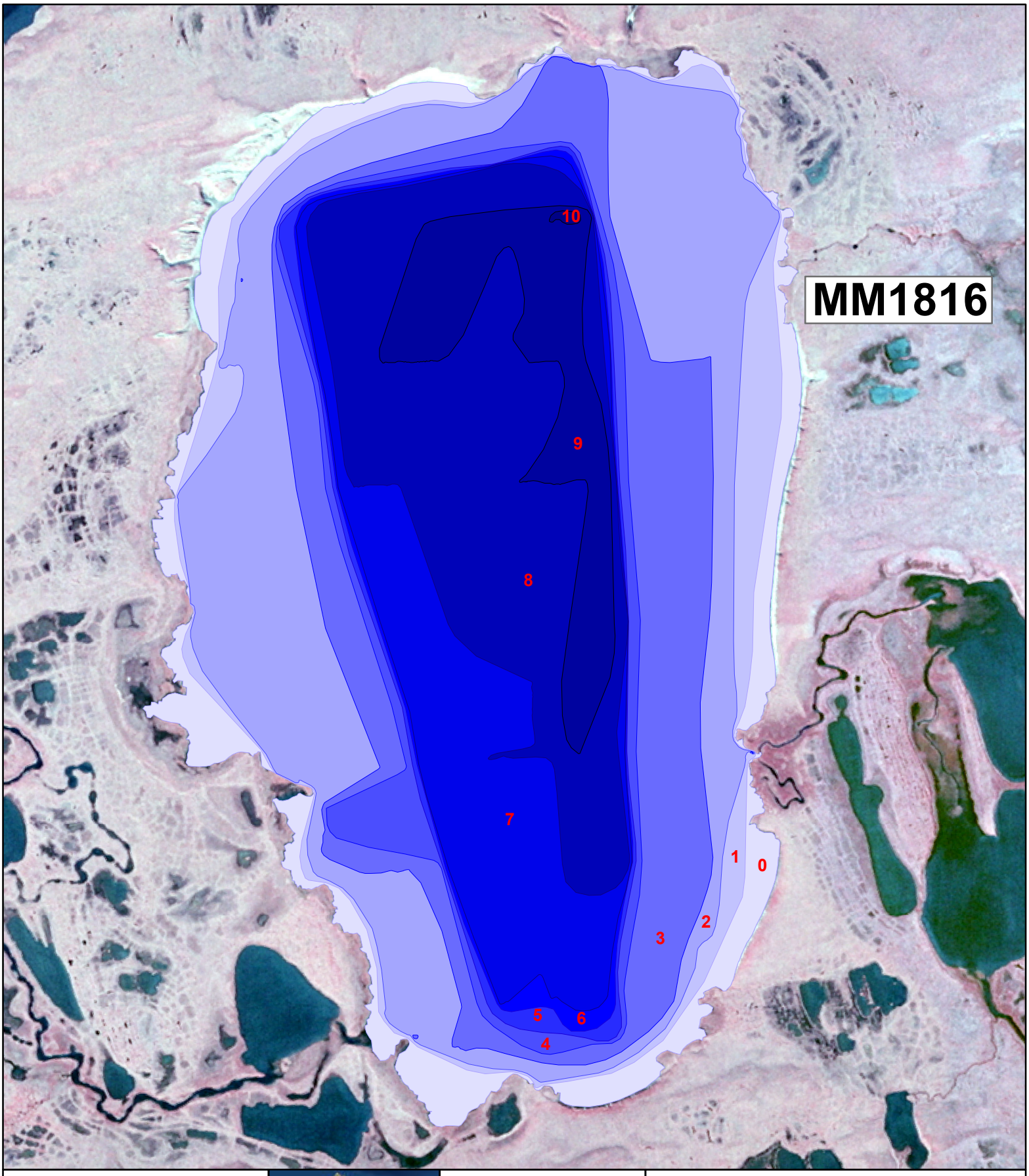
Depth Transects Surveyed at Lake MM1815

surveyed on August 10, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 1,000 Feet

N



Depth in Feet

0	3	6	9		
1	4	7	10		
2	5	8			

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1816

based on transects surveyed on July 15, 2018

SCALE:

500 250 0 500 1,000 Feet

N

Lake MM1816

Other Names: None Known
Location: 70.27453°N 152.62081°W
USGS Quad Sheet: Harrison Bay B-5: T11N R3W Sec. 27,34
Habitat: Drainage Lake
Area: 435 acres
Maximum Depth: 10.6 feet in 2018
Active Outlet: Yes
Total Lake Volume: 681.247 million gallons
Volume Under 4 ft of ice: 241.462 million gallons
Volume Under 5 ft of ice: 181.037 million gallons
Volume Under 7 ft of ice: 70.737 million gallons

Potential Ice Aggregate: 240.68 acres (water depth 4 ft or less)
71.377 million gallons

Maximum Recommended Winter Removal: **10.611 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

Water Chemistry:

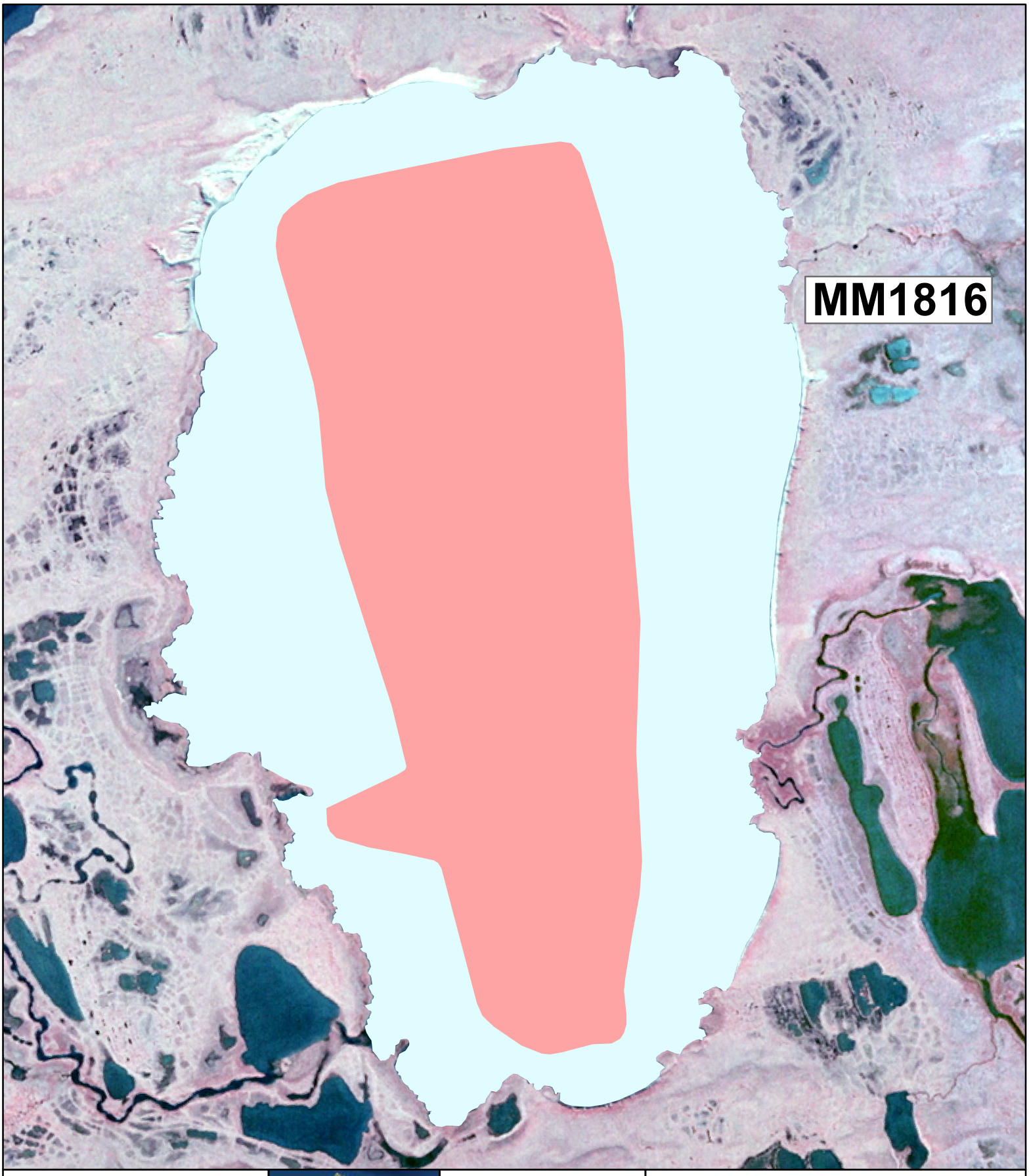
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	18.4	1.9	3.6	8.2	54	125	1.0	7.88	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	gear not used, direct connection to the Kalikpik River			
Minnow Traps				
Seine				
Visual +Dipnet				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.07108	-152.61864	7/15/2018	4.92	-2.16

Last Revised: December 13, 2018



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

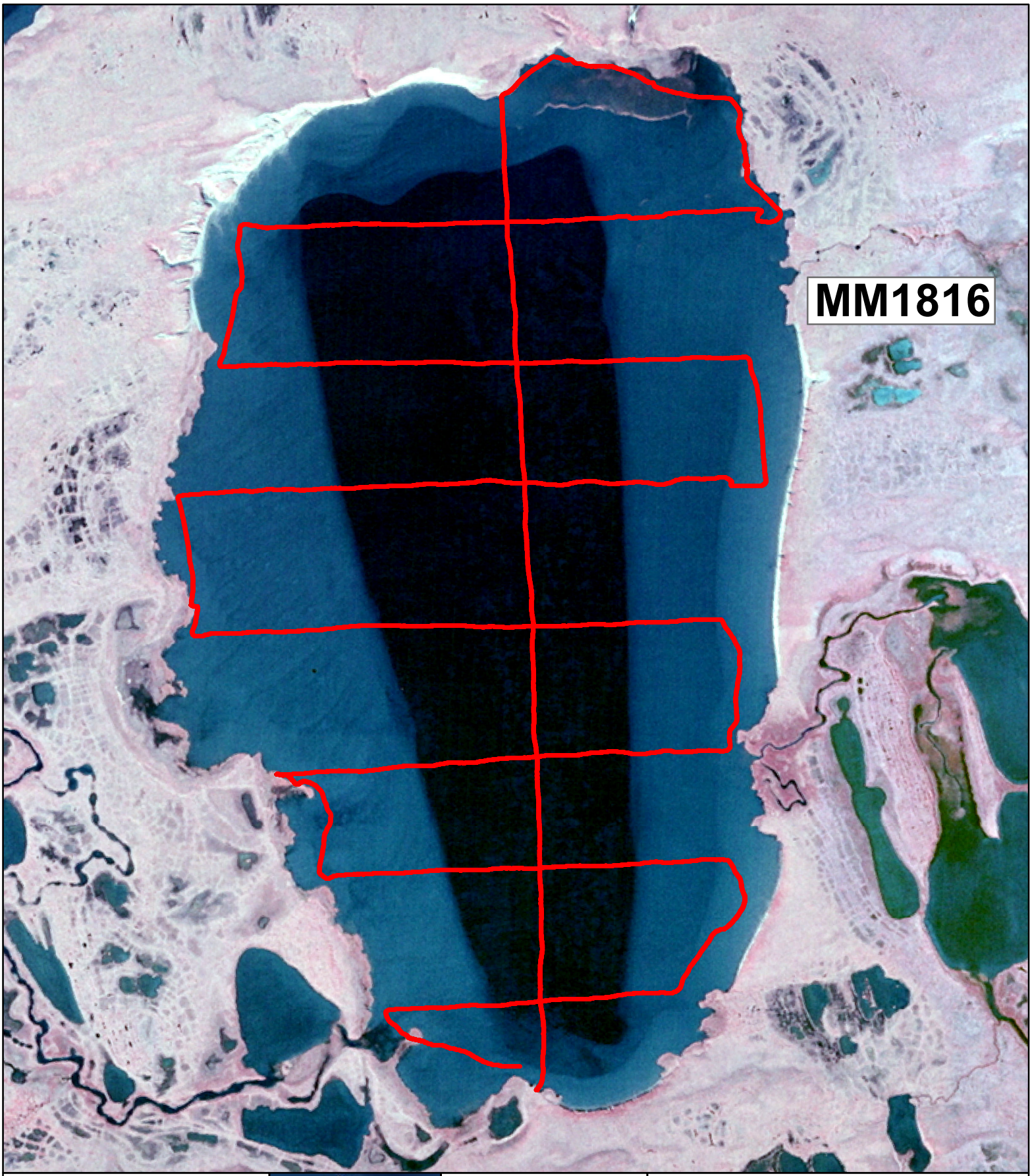
Area Available for Ice Chip Collection at Lake MM1816

based on transects surveyed on July 15, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth Transects Surveyed

MM1816 Transect Survey Line

MM1816

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

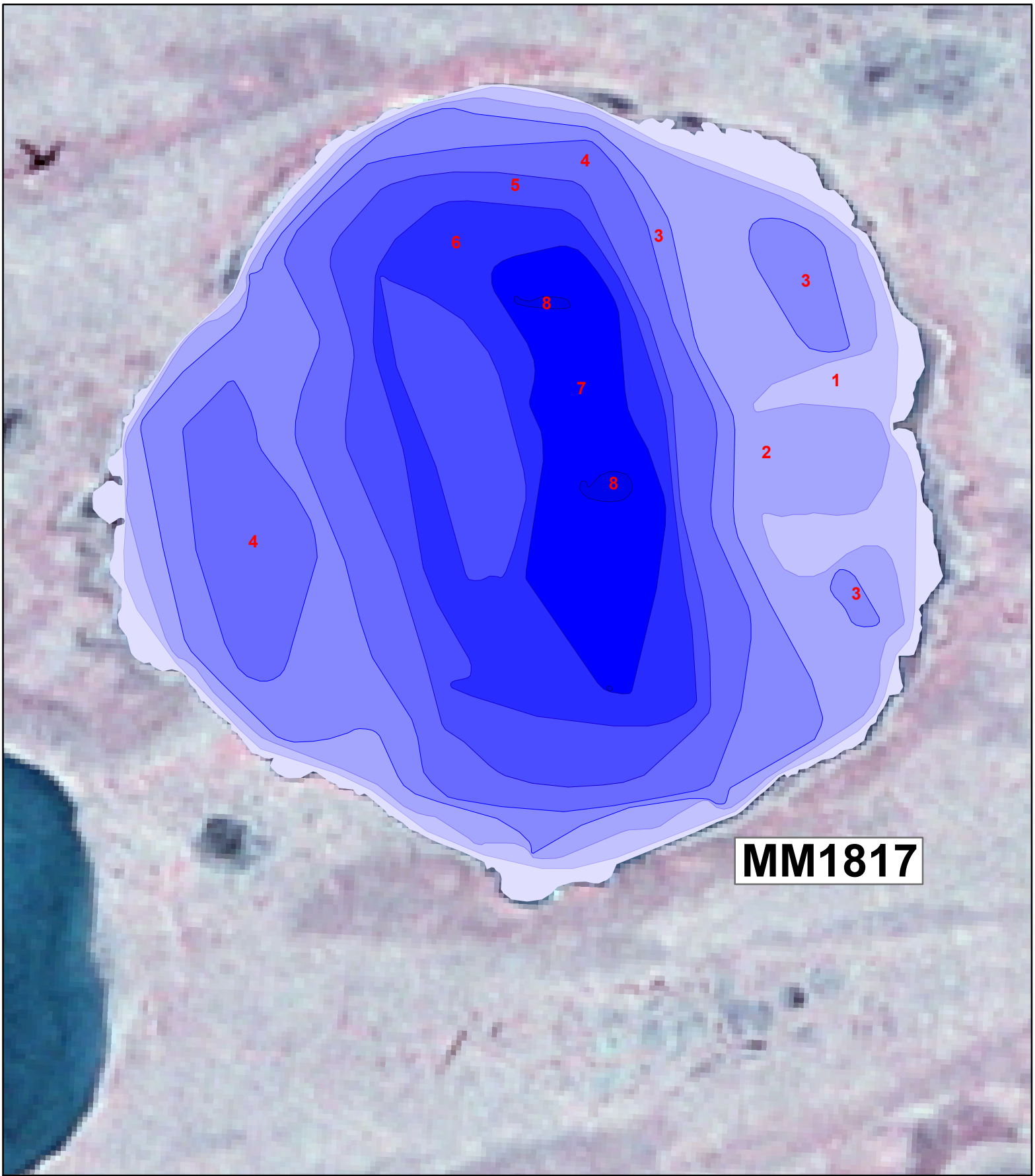
Depth Transects Surveyed at Lake MM1816

surveyed on July 15, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth in Feet

0	3	6
1	4	7
2	5	8

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1817

based on transects surveyed on August 12, 2018

SCALE:

100 50 0 100 200 300 Feet

N

Lake MM1817

Other Names: None Known
Location: 70.27871°N 152.50863°W
USGS Quad Sheet: Harrison Bay B-5: T11N R2W Sec. 30; T11N R3W Sec. 25
Habitat: Tundra Lake
Area: 31 acres
Maximum Depth: 8.1 feet in 2018
Active Outlet: No
Total Lake Volume: 41.586 million gallons
Volume Under 4 ft of ice: 8.924 million gallons
Volume Under 5 ft of ice: 4.595 million gallons
Volume Under 7 ft of ice: 0.383 million gallons

Potential Ice Aggregate: 14.50 acres (water depth 4 ft or less)
4.300 million gallons

Maximum Recommended Winter Removal: **8.317 million gallons**
(20% of lake volume)
(No fish concern)

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
2018	28.5	2.8	4.9	10.8	83	185	0.7	8.07	B. Morris

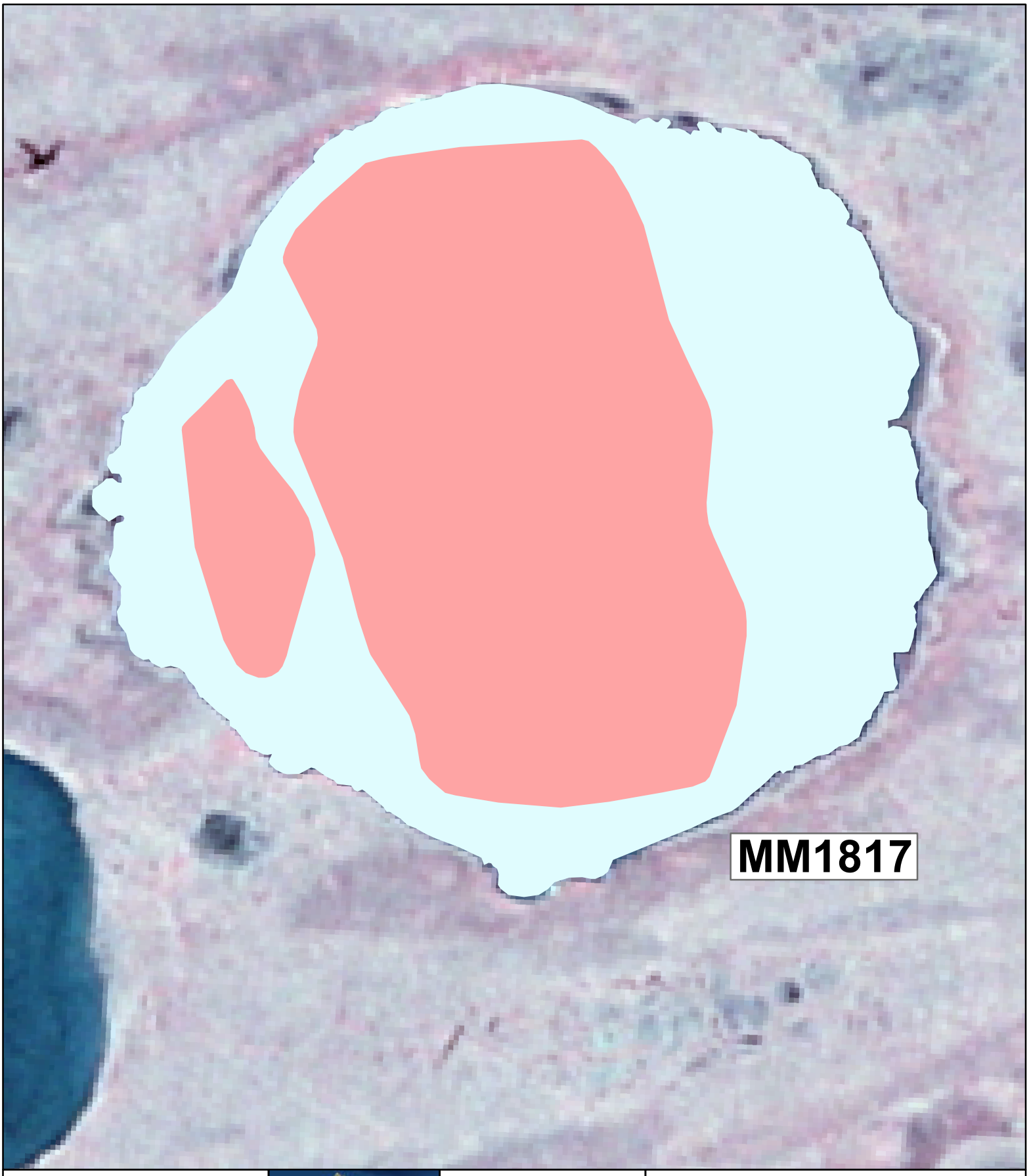
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 12 18	9.2	none	0
Minnow Traps	Aug 12 18	14.6	none	0
Seine	Aug 12 18	4 hauls	none	0
Visual +Dipnet	Aug 12 18	250 yards	none	0

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.27728	-152.50490	8/12/2018	6.13	-2.51

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

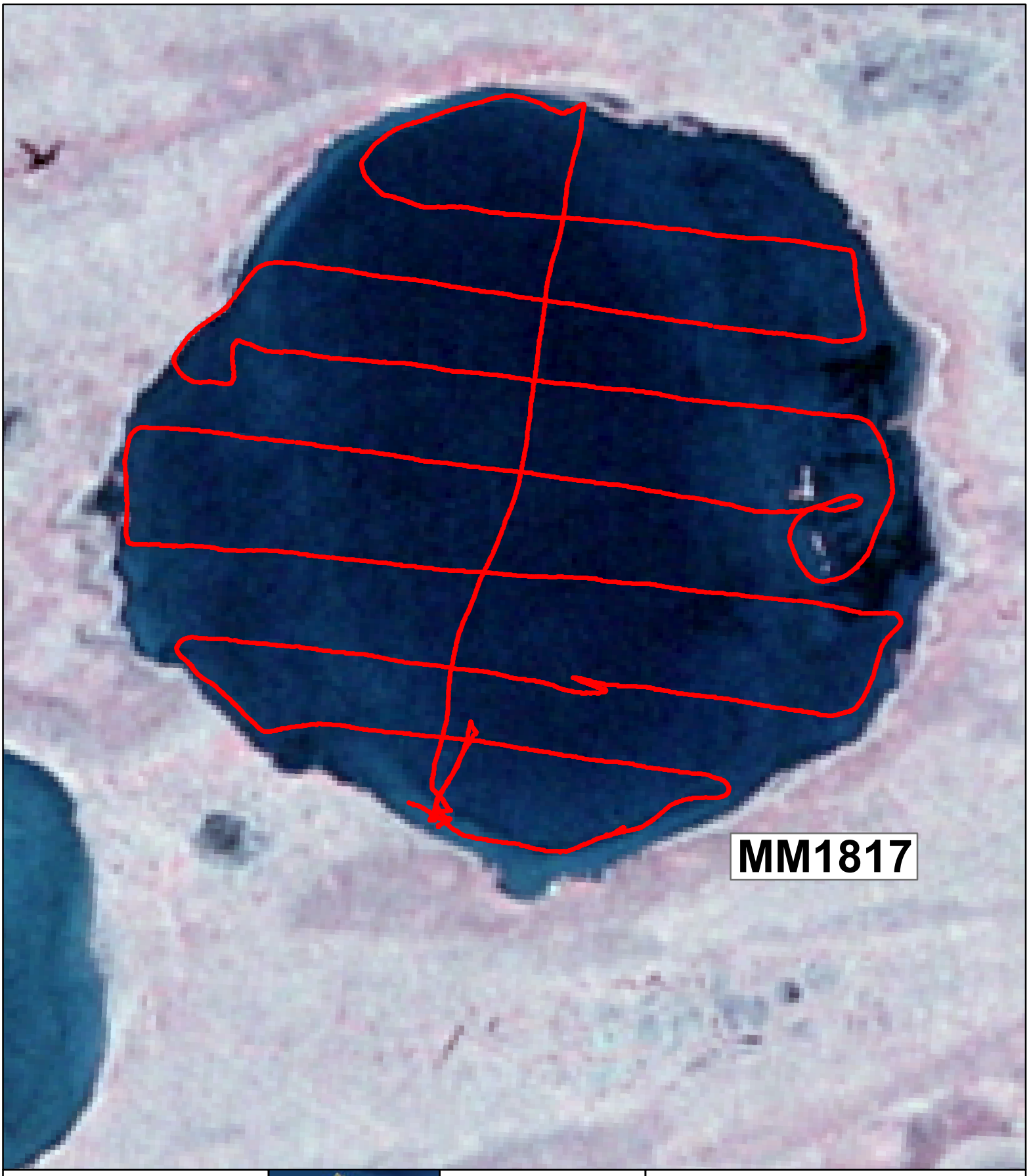
Area Available for Ice Chip Collection at Lake MM1817

based on transects surveyed on August 12, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

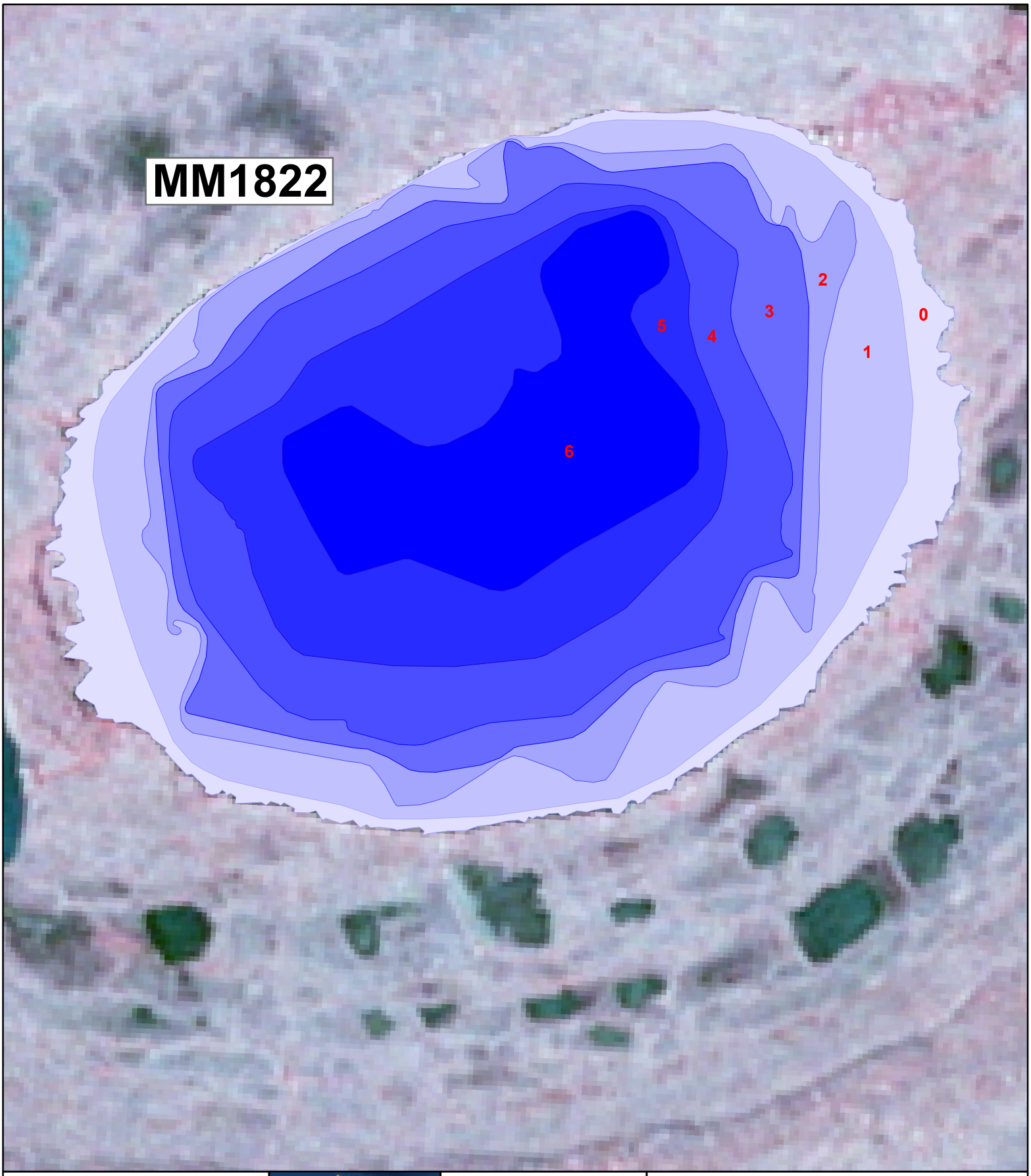
Depth Transects Surveyed at Lake MM1817

surveyed on August 12, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth in Feet

0 1 2 3 4 5 6

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1822

based on transects surveyed on August 4, 2018

SCALE:

100 50 0 100 200 300 Feet

N

Lake MM1822

Other Names: None Known
Location: 70.28781°N 152.41623°W
USGS Quad Sheet: Harrison Bay B-5: T11N R2W Sec. 21
Habitat: Drainage Lake
Area: 31 acres
Maximum Depth: 6.6 feet in 2018
Active Outlet: Yes (seasonal)
Total Lake Volume: 37.043 million gallons
Volume Under 4 ft of ice: 7.124 million gallons
Volume Under 5 ft of ice: 2.889 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 14.64 acres (water depth 4 ft or less)
4.341 million gallons

Maximum Recommended Winter Removal: **7.409 million gallons**
(20% of lake volume)
(No fish concern)

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
2018	21.0	2.5	4.2	8.4	61	132	0.9	7.75	B. Morris

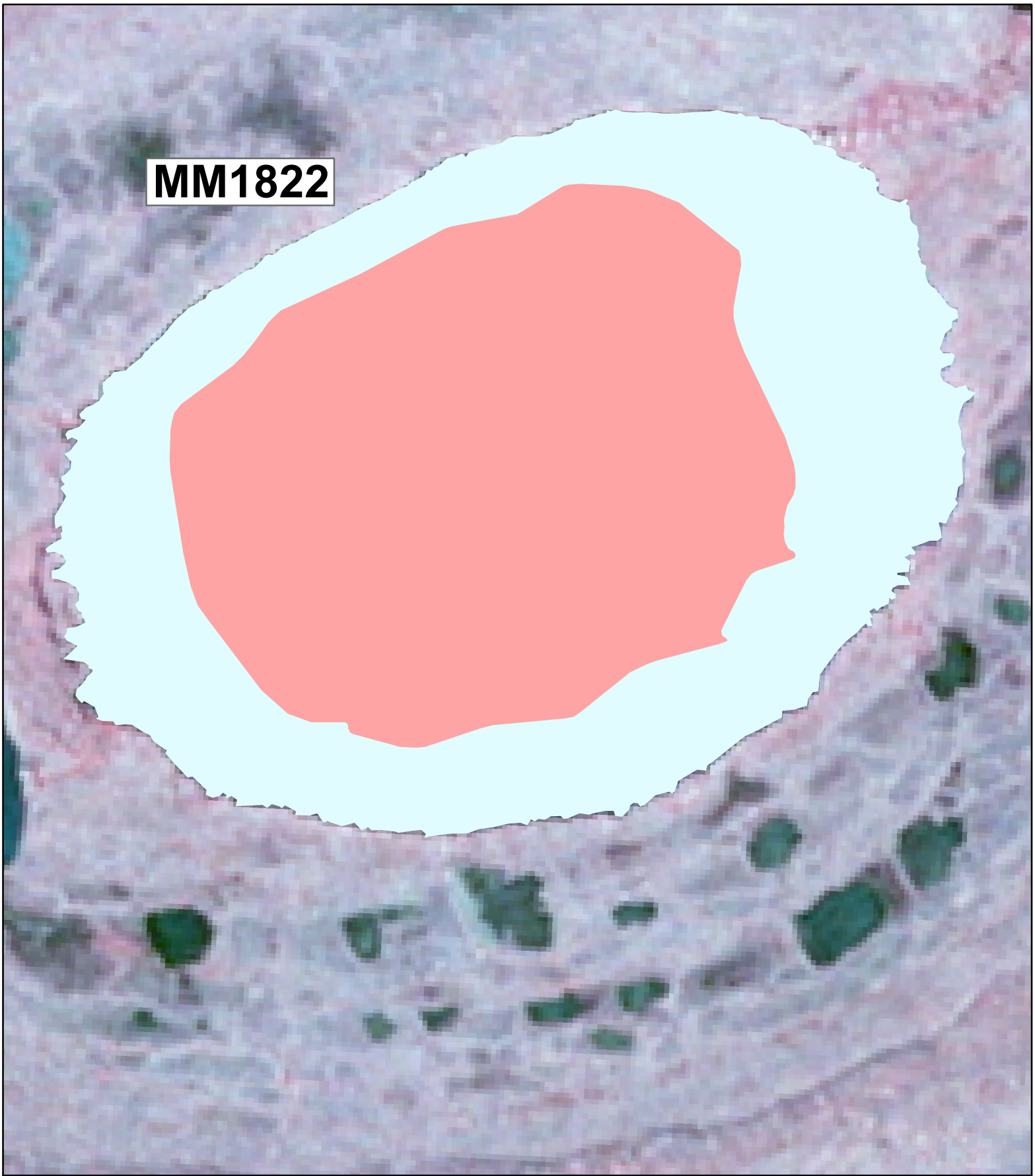
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 4 18	9.5	none	0
Minnow Traps	Aug 4 18	15.0	none	0
Seine	Aug 4 18	4 hauls	none	0
Visual +Dipnet	Aug 4 18	100 yards	none	0

Water Surface Elevation
Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.28639	-152.41890	8/4/2018	4.81	-2.94

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

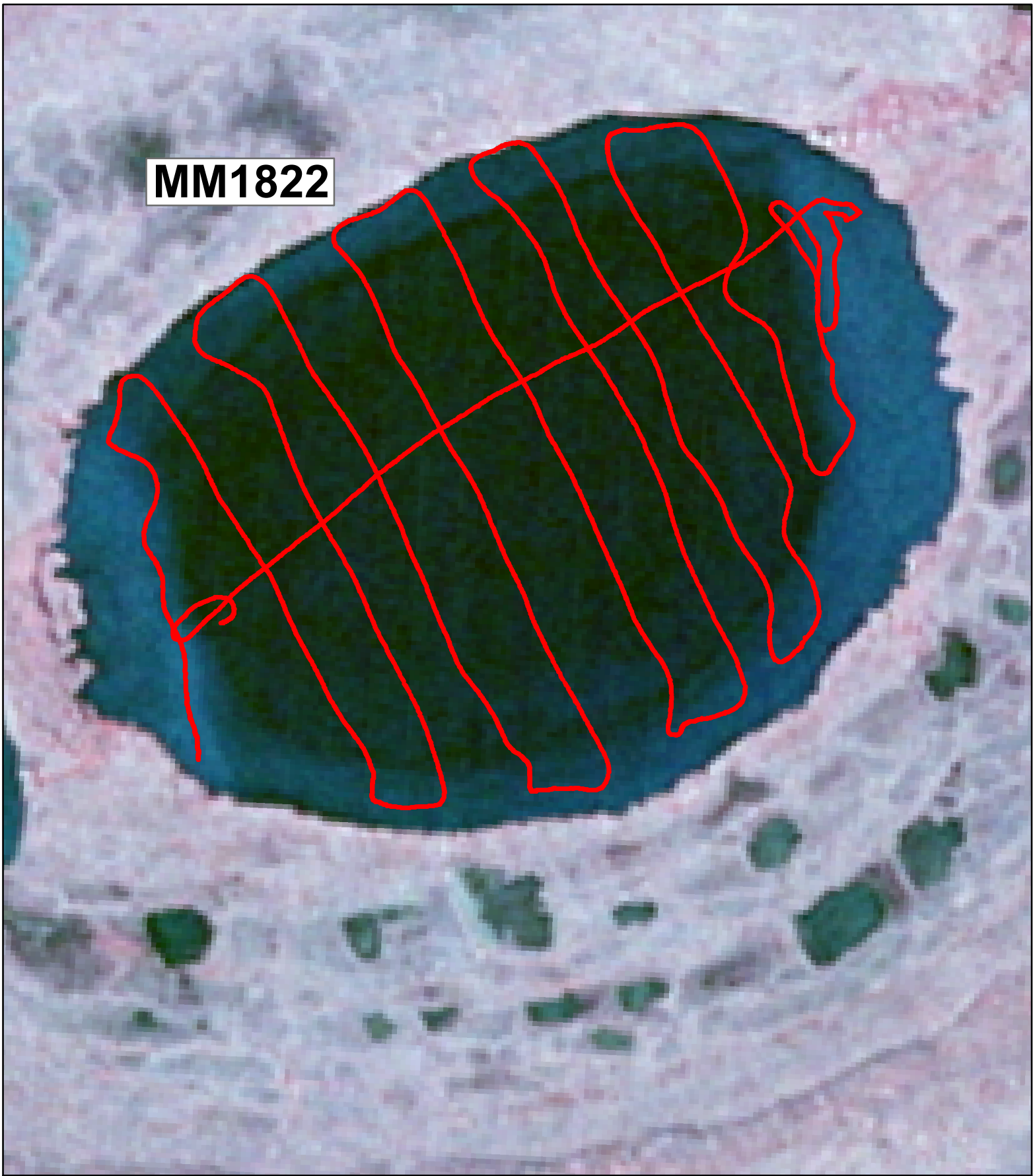
Area Available for Ice Chip Collection at Lake MM1822

based on transects surveyed on August 4, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

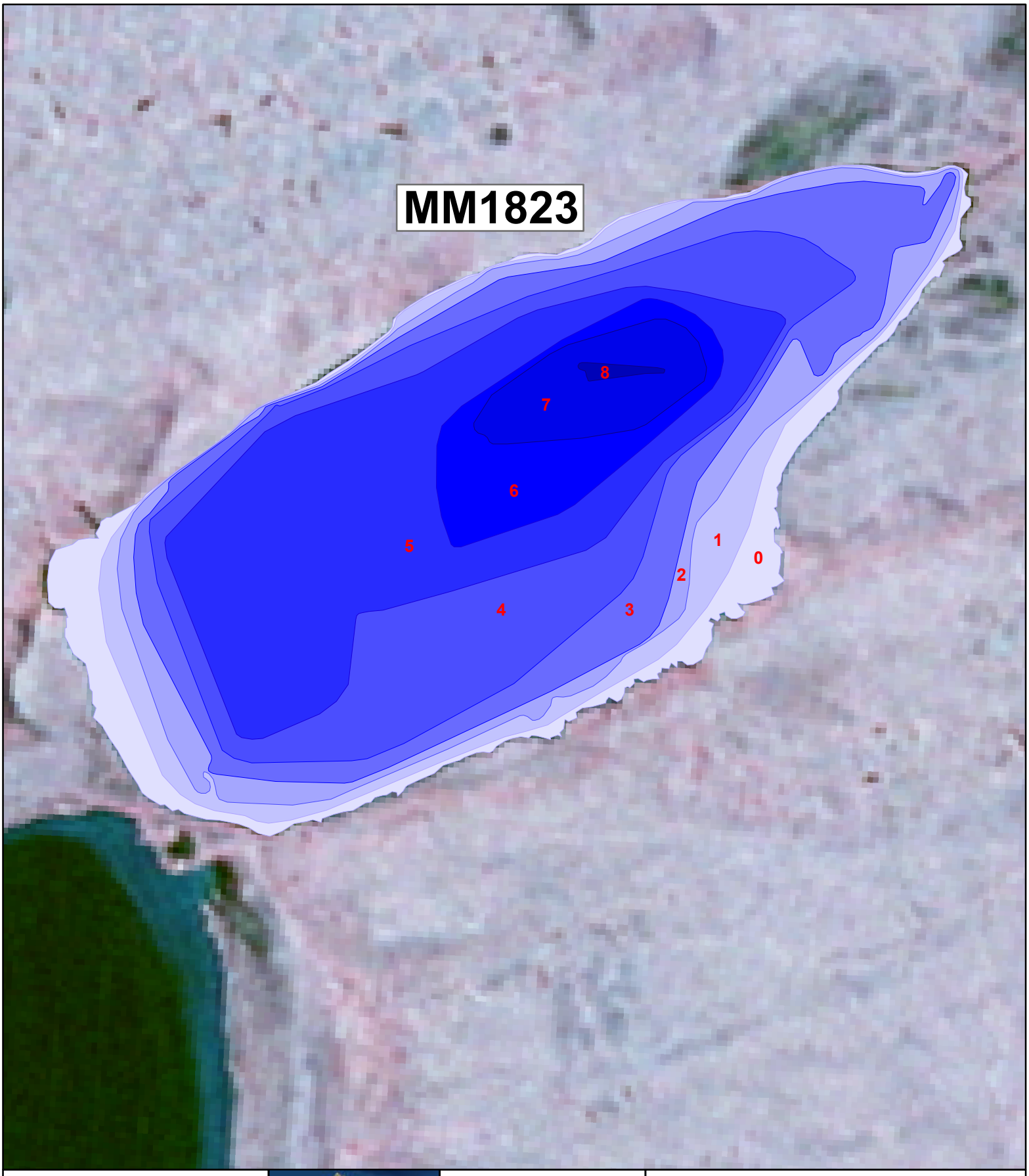
Depth Transects Surveyed at Lake MM1822

surveyed on August 4, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth in Feet

0	3	6
1	4	7
2	5	8

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1823

based on transects surveyed on August 5, 2018

SCALE:

100 50 0 100 200 300 Feet

N

Lake MM1823

Other Names: None Known
Location: 70.28398°N 152.43166°W
USGS Quad Sheet: Harrison Bay B-5: T11N R2W Sec. 20,21,28,29
Habitat: Tundra Lake
Area: 17 acres
Maximum Depth: 8.0 feet in 2018
Active Outlet: No
Total Lake Volume: 22.699 million gallons
Volume Under 4 ft of ice: 4.629 million gallons
Volume Under 5 ft of ice: 1.940 million gallons
Volume Under 7 ft of ice: 0.134 million gallons

Potential Ice Aggregate: 6.85 acres (water depth 4 ft or less)
2.031 million gallons

Maximum Recommended Winter Removal: **4.540 million gallons**
(20% of lake volume)
(No fish concern)

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
2018	8.8	1.2	2.1	4.1	27	62	0.8	7.36	B. Morris

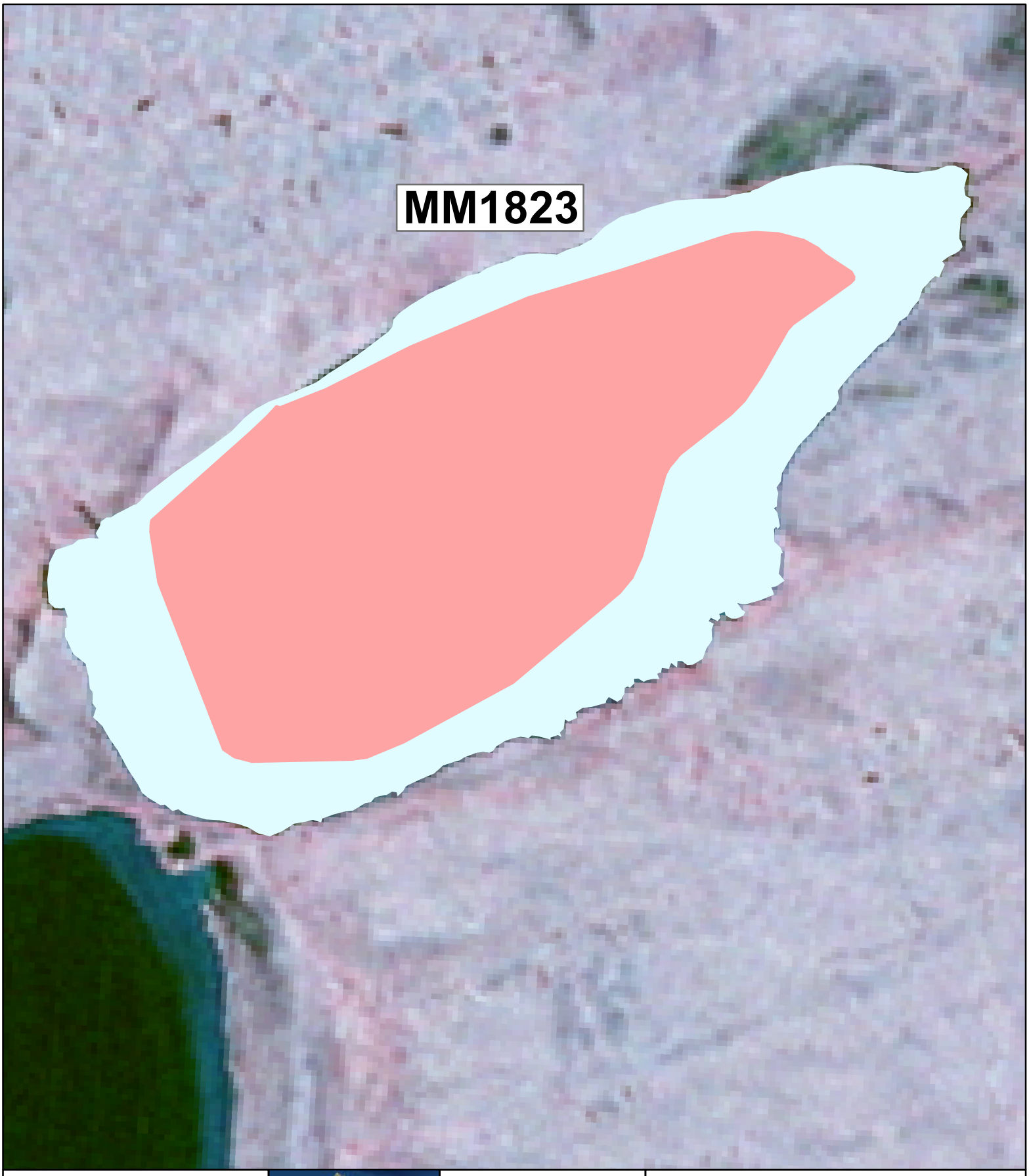
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 5 18	9.1	none	0
Minnow Traps	Aug 5 18	12.0	none	0
Seine	Aug 5 18	4 hauls	none	0
Visual +Dipnet	Aug 5 18	180 yards	none	0

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.28307	-152.43333	8/5/2018	3.94	-2.80

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

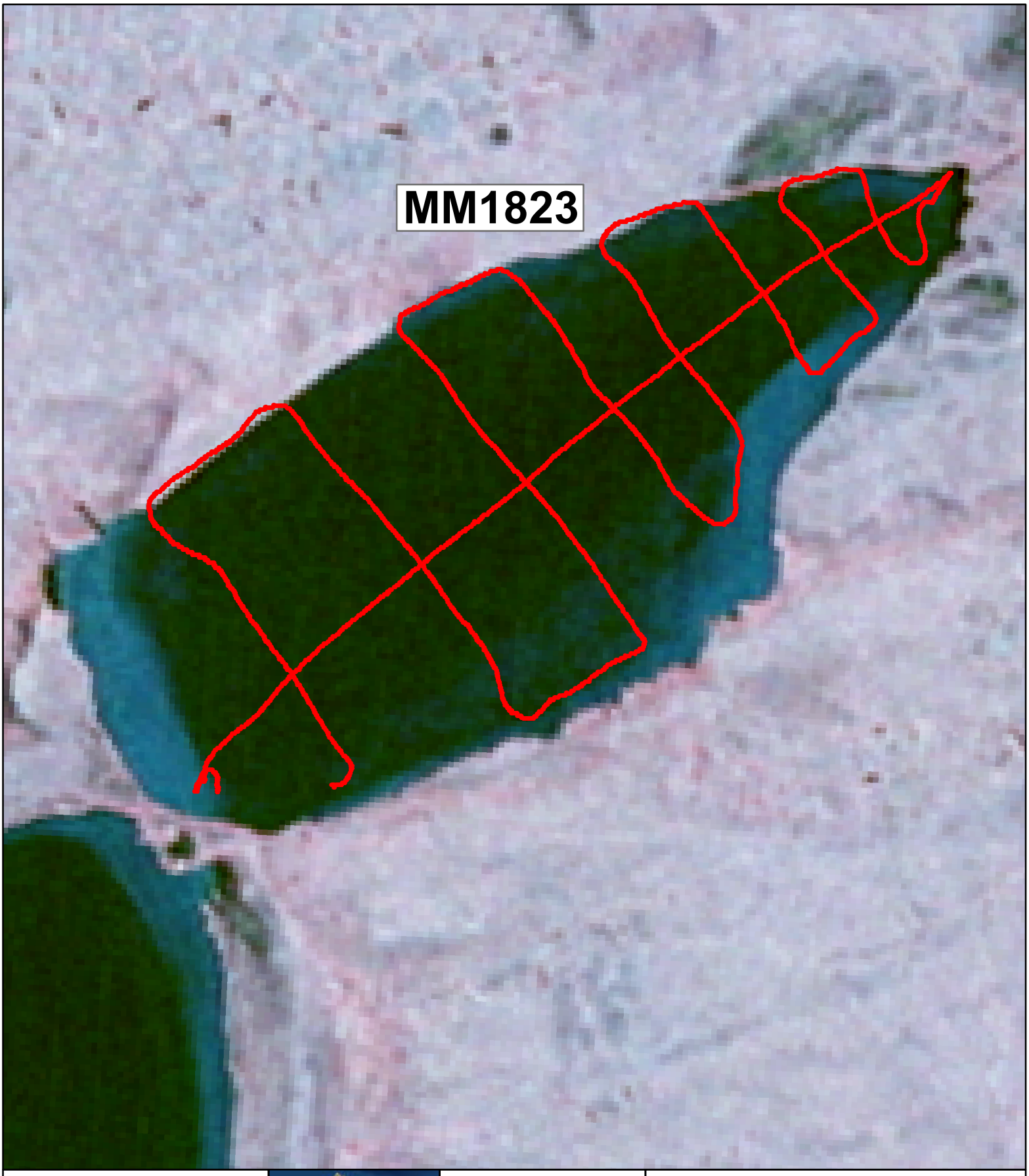
Area Available for Ice Chip Collection at Lake MM1823

based on transects surveyed on August 5, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Transects Surveyed at Lake MM1823

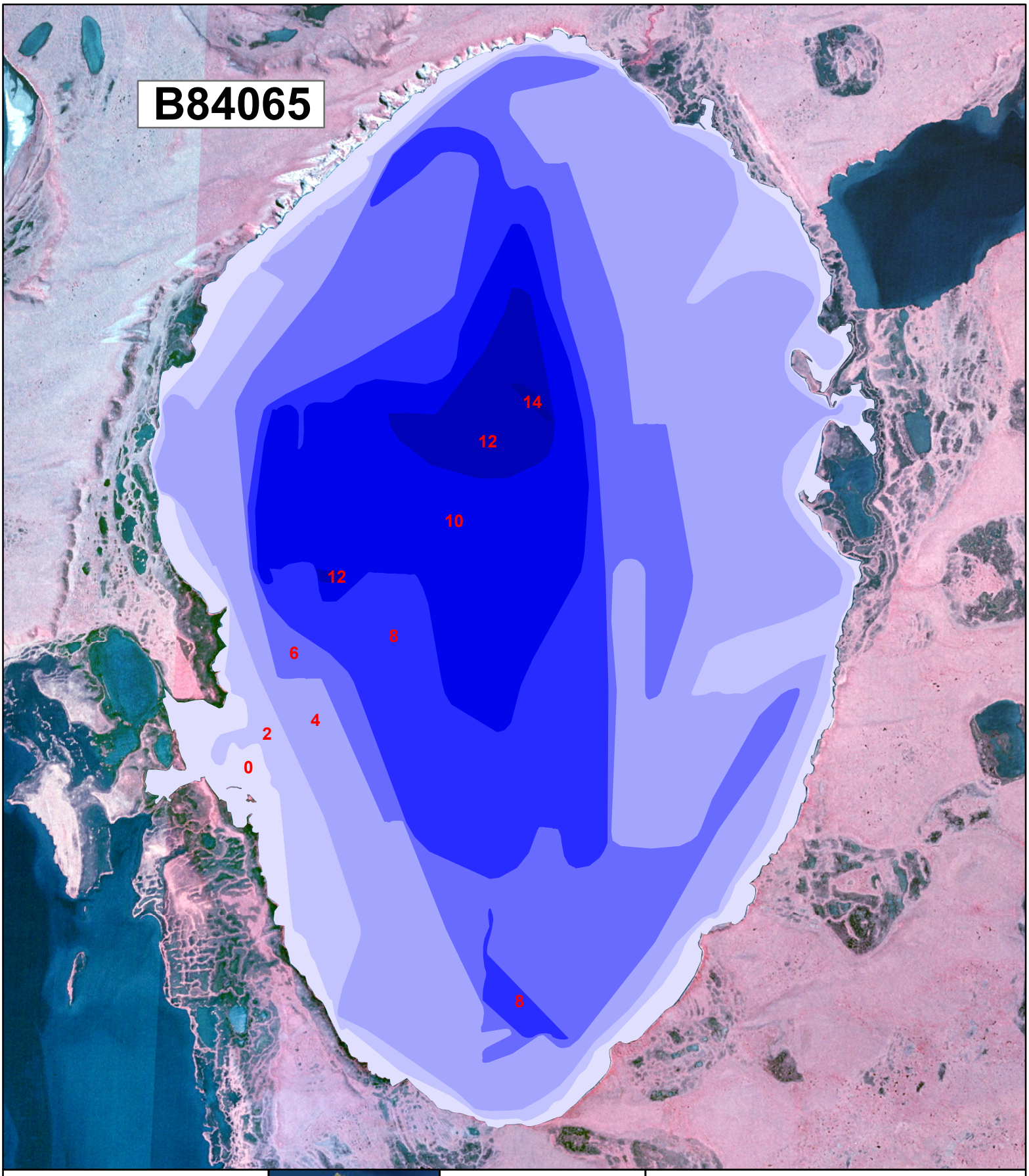
surveyed on August 5, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 Feet

N

6.4. Lake Summaries for Lakes Sampled in the West Willow B Area, 2018.



Depth in Feet

0	6	12
2	8	14
4	10	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake B84065 (depths in 2 foot intervals)

based on transects surveyed on July 29, 2018

SCALE:

1,000 500 0 1,000 2,000 Feet

N

Lake B84065

Other Names: M0241
Location: 70.17198°N 152.38337°W
USGS Quad Sheet: Harrison Bay A-4: T9N R2W, Sec. 3,4,9,10; T10N R2W, Sec. 27,28,33,34
Habitat: Drainage Lake
Area: 1,514 acres
Maximum Depth: 14.2 feet in 2018 (13.8 ft in 2002)
Active Outlet: Yes
Total Lake Volume: 3208.525 million gallons (2018 data)
Water Volume Under 4 ft of ice: 1391.097 million gallons
Water Volume Under 5 ft of ice: 1022.645 million gallons
Water Volume Under 7 ft of ice: 510.320 million gallons

Potential Ice Aggregate: 258.2 acres (water depth 4 ft or less)
76.563 million gallons

Maximum Recommended Winter Removal: **76.548 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

Water Chemistry:

Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2002	--	--	--	--	--	195	--	7.86	L. Moulton
2018	24.0	3.4	7.5	18.0	73	188	0.8	7.75	B. Morris

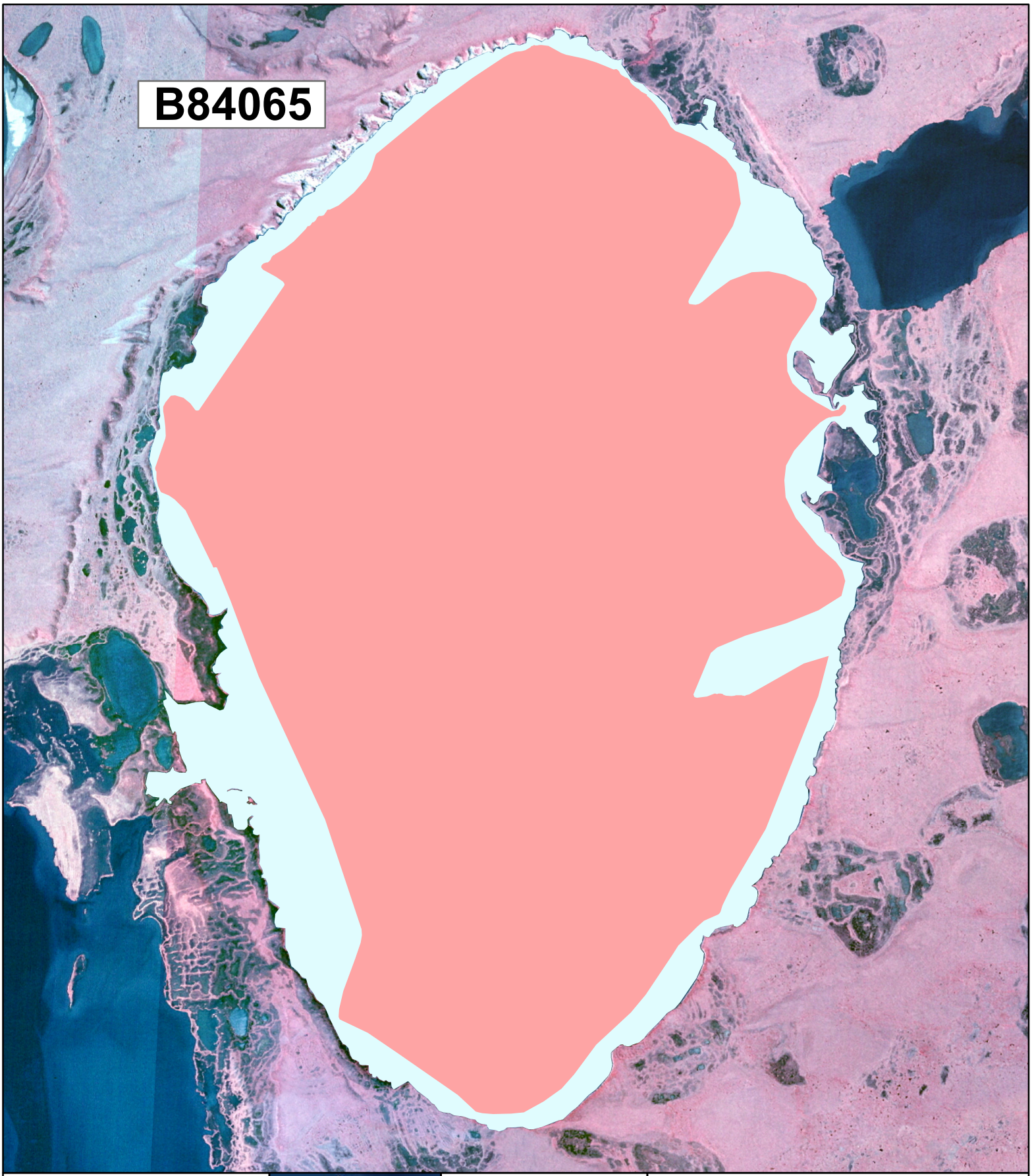
Catch Record:

Gear	Date	Effort (hours)	Species	Number Caught	Fork Length (mm)
Gill Net	Aug 17 02	5.5	Arctic grayling	1	131
	Jul 29 18	4.4	Broad whitefish	1	510
			Least cisco	6	175-203
Minnow Trap	Aug 17 02	6.3	None	0	
	Jul 29 18	21.3	Ninespine stickleback	5	

Water Surface Elevation
Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.15498	-152.37833	7/29/2018	5.26	-0.66

Last Revised: December 13, 2018



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

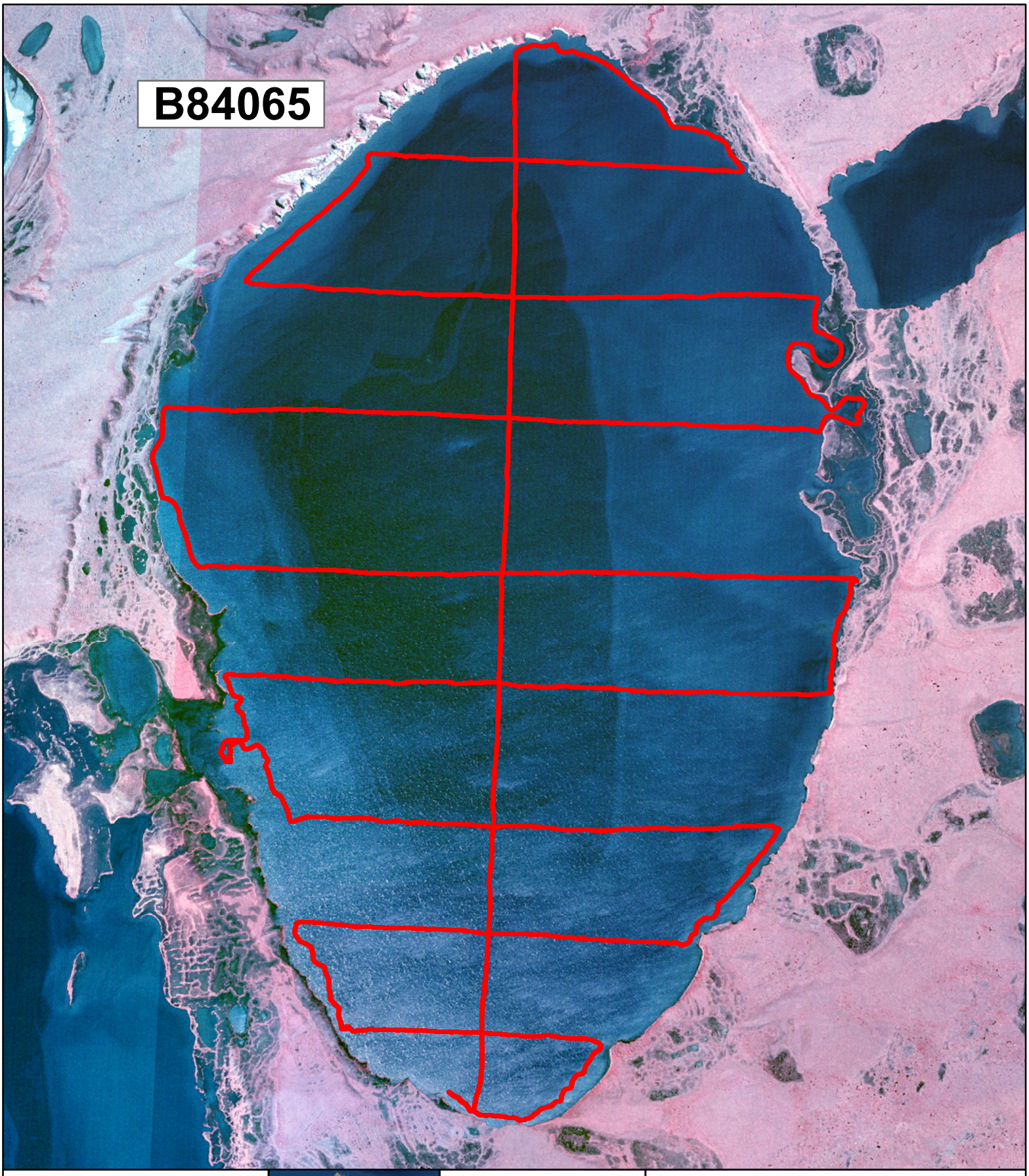
Area Available for Ice Chip Collection at Lake B84065

based on transects surveyed on July 29, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

1,000 500 0 1,000 2,000 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

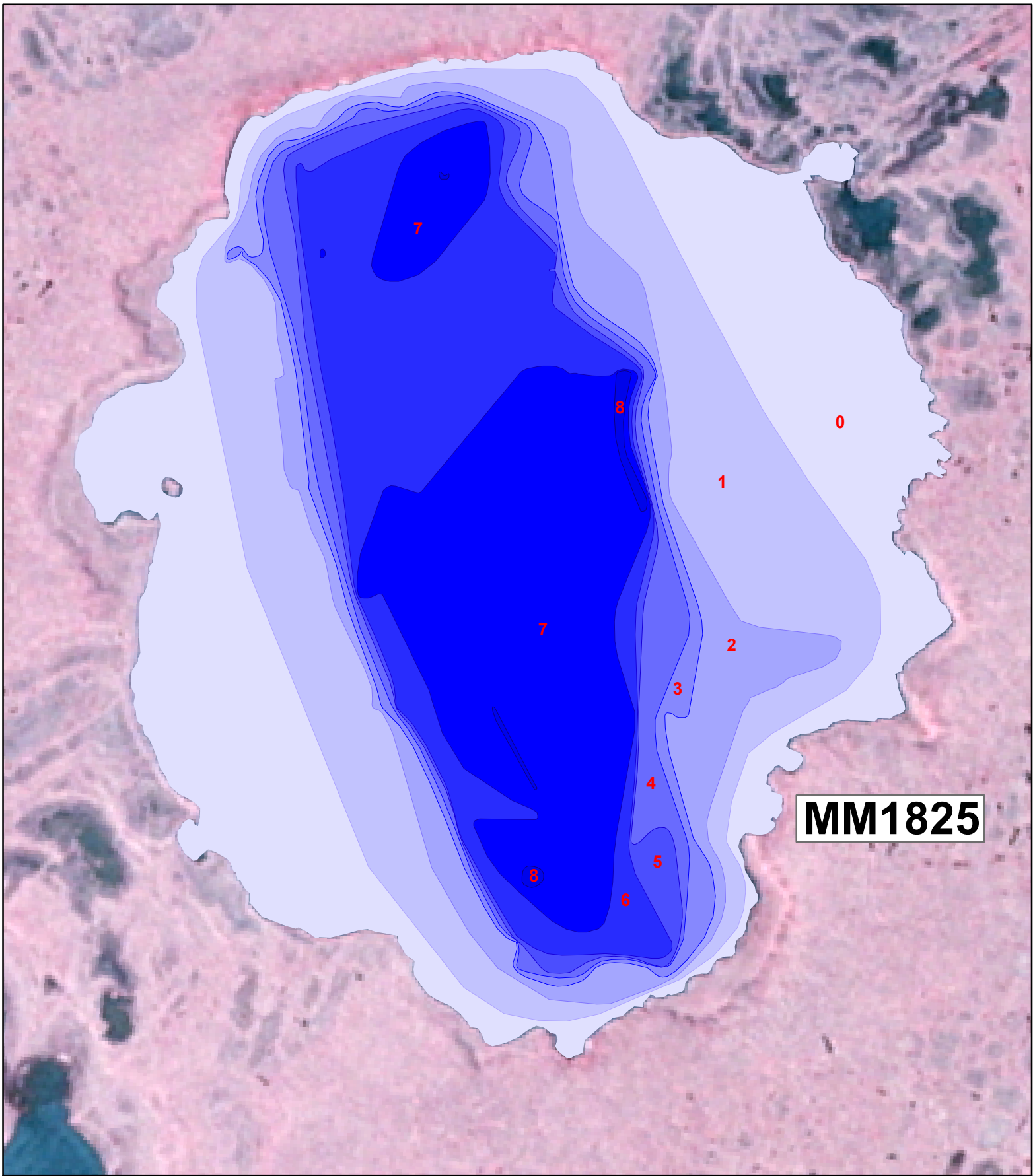
Depth Transects Surveyed at Lake B84065

surveyed on July 29, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

1,000 500 0 1,000 2,000 Feet

N



Depth in Feet

0	3	6
1	4	7
2	5	8

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1825

based on transects surveyed on August 11, 2018

SCALE:

100 50 0 100 200 300 400 500 Feet

N

Lake MM1825

Other Names: None Known
Location: 70.21728°N 152.32160°W
USGS Quad Sheet: Harrison Bay A-4: T10N R2W Sec. 14
Habitat: Tundra Lake
Area: 84 acres
Maximum Depth: 8.5 feet in 2018
Active Outlet: No
Total Lake Volume: 92.678 million gallons
Volume Under 4 ft of ice: 28.590 million gallons
Volume Under 5 ft of ice: 18.293 million gallons
Volume Under 7 ft of ice: 2.002 million gallons

Potential Ice Aggregate: 50.61 acres (water depth 4 ft or less)
15.009 million gallons

Maximum Recommended Winter Removal: **18.536 million gallons**
(20% of lake volume)
(No fish concern)

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
2018	32.8	5.0	10.0	26.4	102	249	0.8	8.16	B. Morris

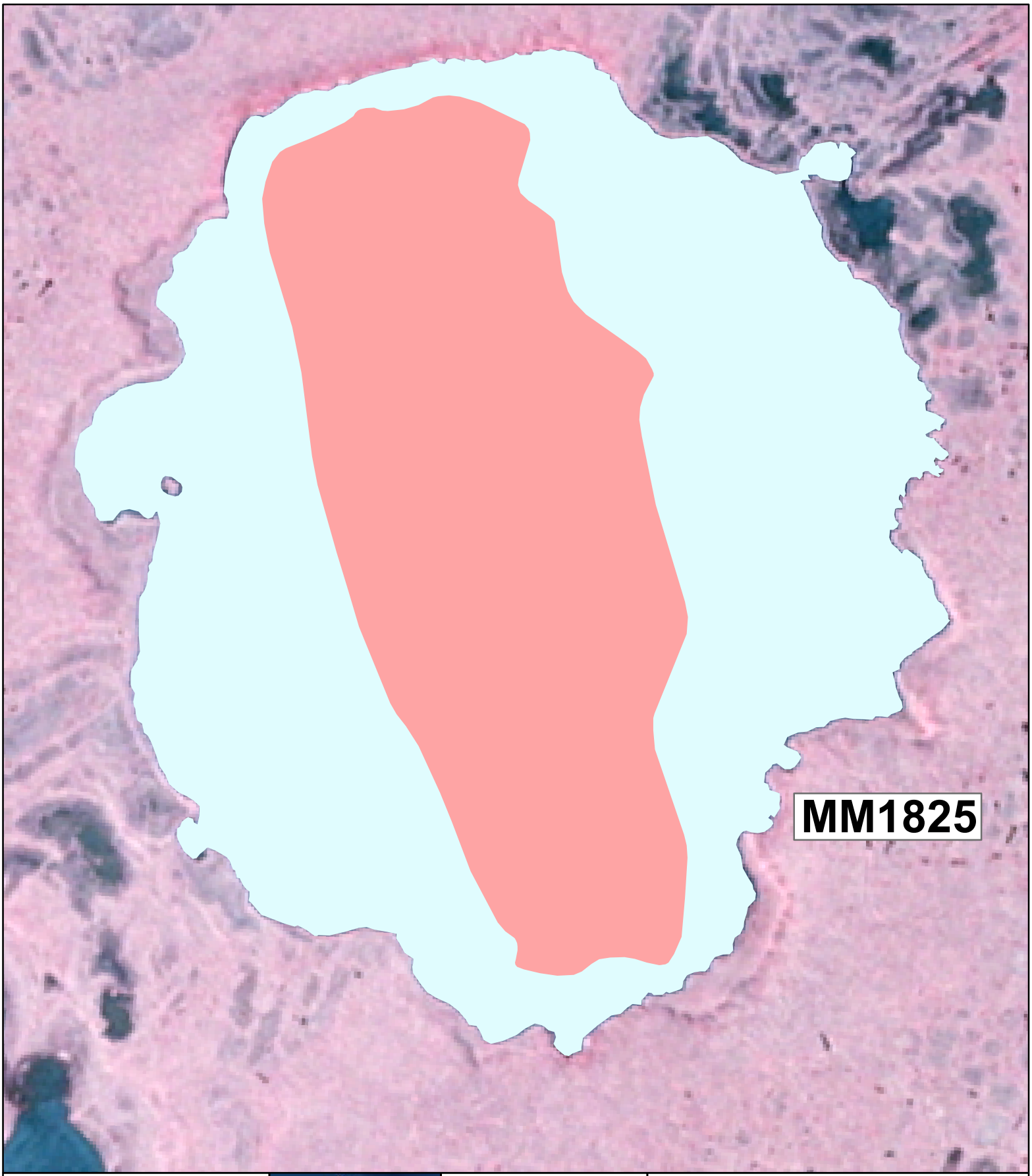
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 11 18	9.1	none	0
Minnow Traps	Aug 11 18	15.1	none	0
Seine	Aug 11 18	6 hauls	none	0
Visual +Dipnet	Aug 11 18	370 yards	none	0

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.21412	-152.31880	8/11/2018	5.14	-3.21

Last Revised: January 8, 2019



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

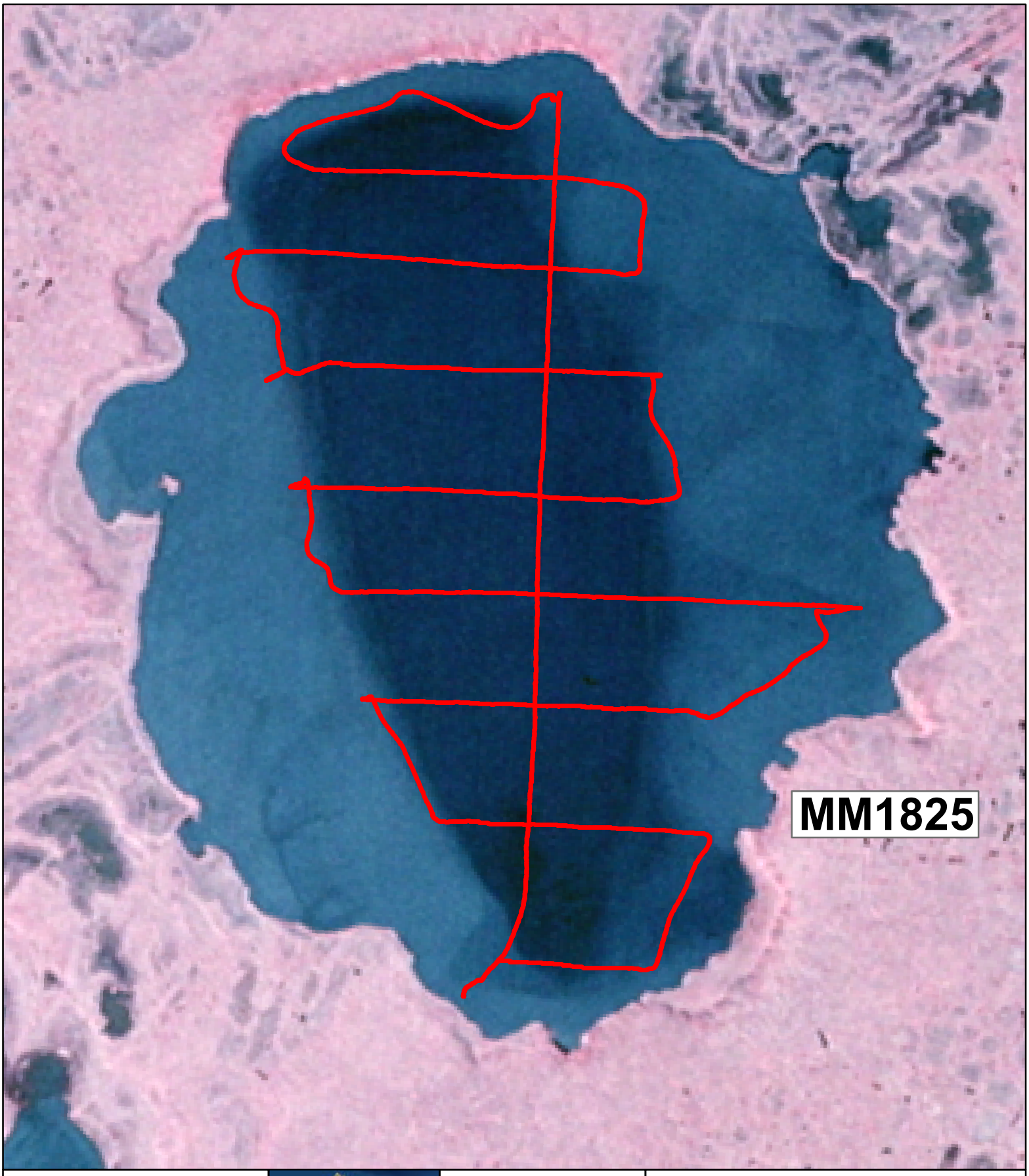
Area Available for Ice Chip Collection at Lake MM1825

based on transects surveyed on August 11, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

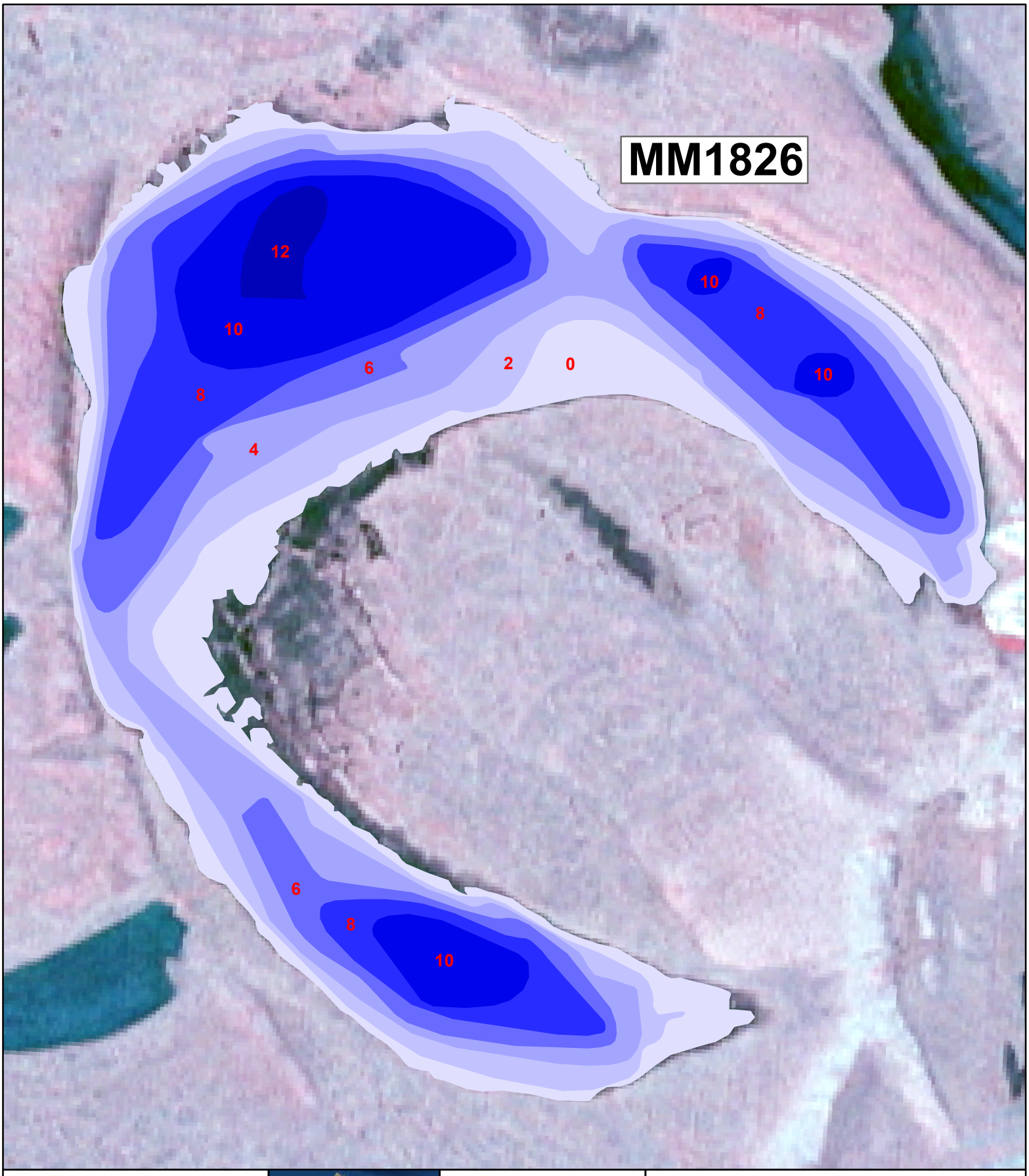
Depth Transects Surveyed at Lake MM1825

surveyed on August 11, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N



Depth in Feet

0 2 4 6 8 10 12

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1826 (depths in 2 foot intervals)

based on transects surveyed on August 8, 2018

SCALE:

100 50 0 100 200 300 400 Feet

N

Lake MM1826

Other Names: None Known
Location: 70.21289°N 152.40923°W
USGS Quad Sheet: Harrison Bay A-4/5: T10N R2W Sec. 16,21
Habitat: Oxbow Lake
Area: 39 acres
Maximum Depth: 13.6 feet in 2018
Active Outlet: Yes (seasonal)
Total Lake Volume: 73.561 million gallons
Volume Under 4 ft of ice: 32.096 million gallons
Volume Under 5 ft of ice: 24.468 million gallons
Volume Under 7 ft of ice: 12.558 million gallons

Potential Ice Aggregate: 13.47 acres (water depth 4 ft or less)
3.994 million gallons

Maximum Recommended Winter Removal: **7.340 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	23.5	3.4	4.8	11.4	73	164	0.8	7.75	B. Morris

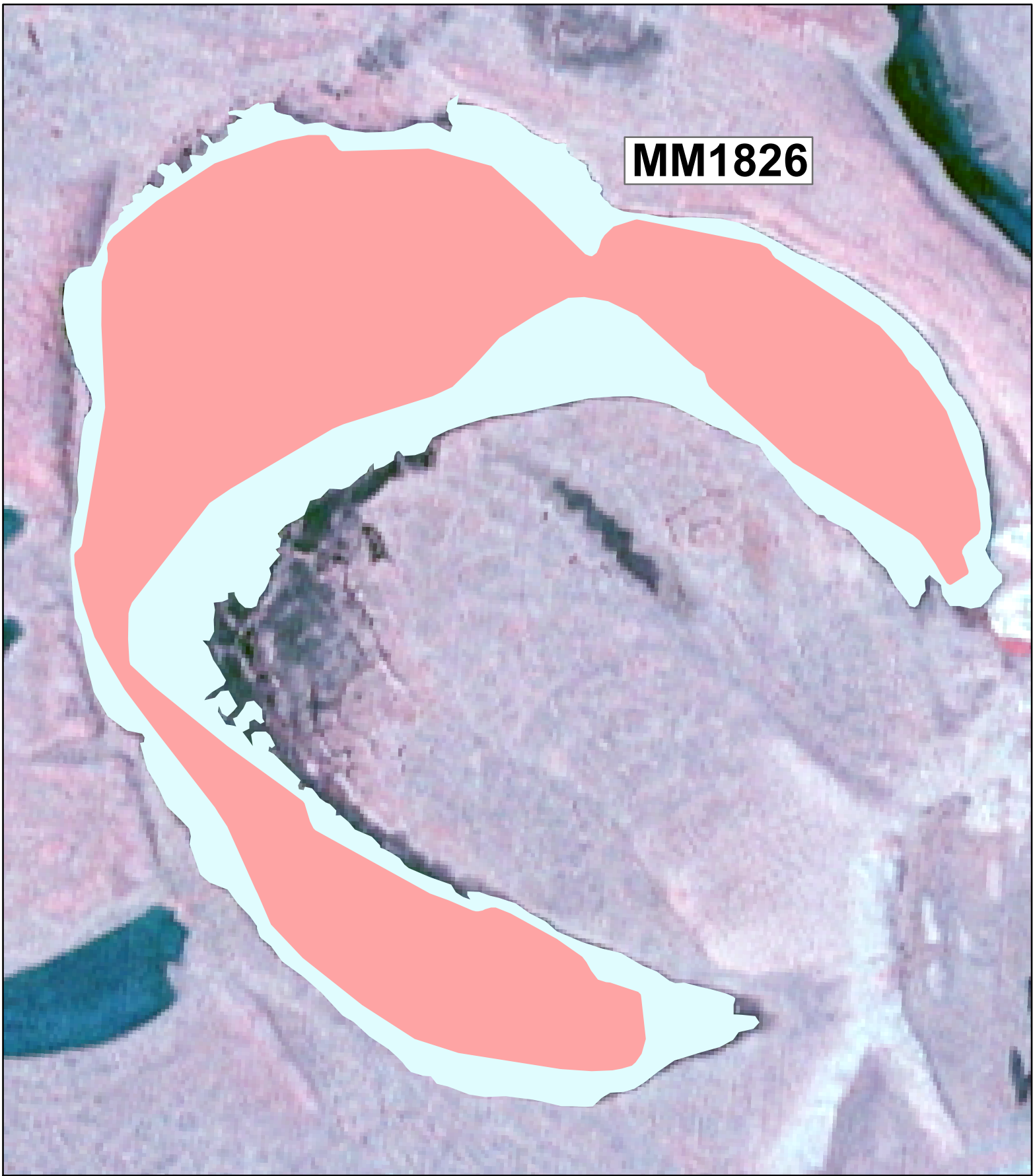
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 8 18	9.1	none	0
Minnow Traps	Aug 8 18	8.5	Ninespine stickleback	2
Seine	not used			
Visual +Dipnet	Aug 8 18	5 yards	Ninespine stickleback	+

+ denotes fish were visually observed but not caught

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.21129	-152.41246	8/8/2018	5.50	-5.69

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

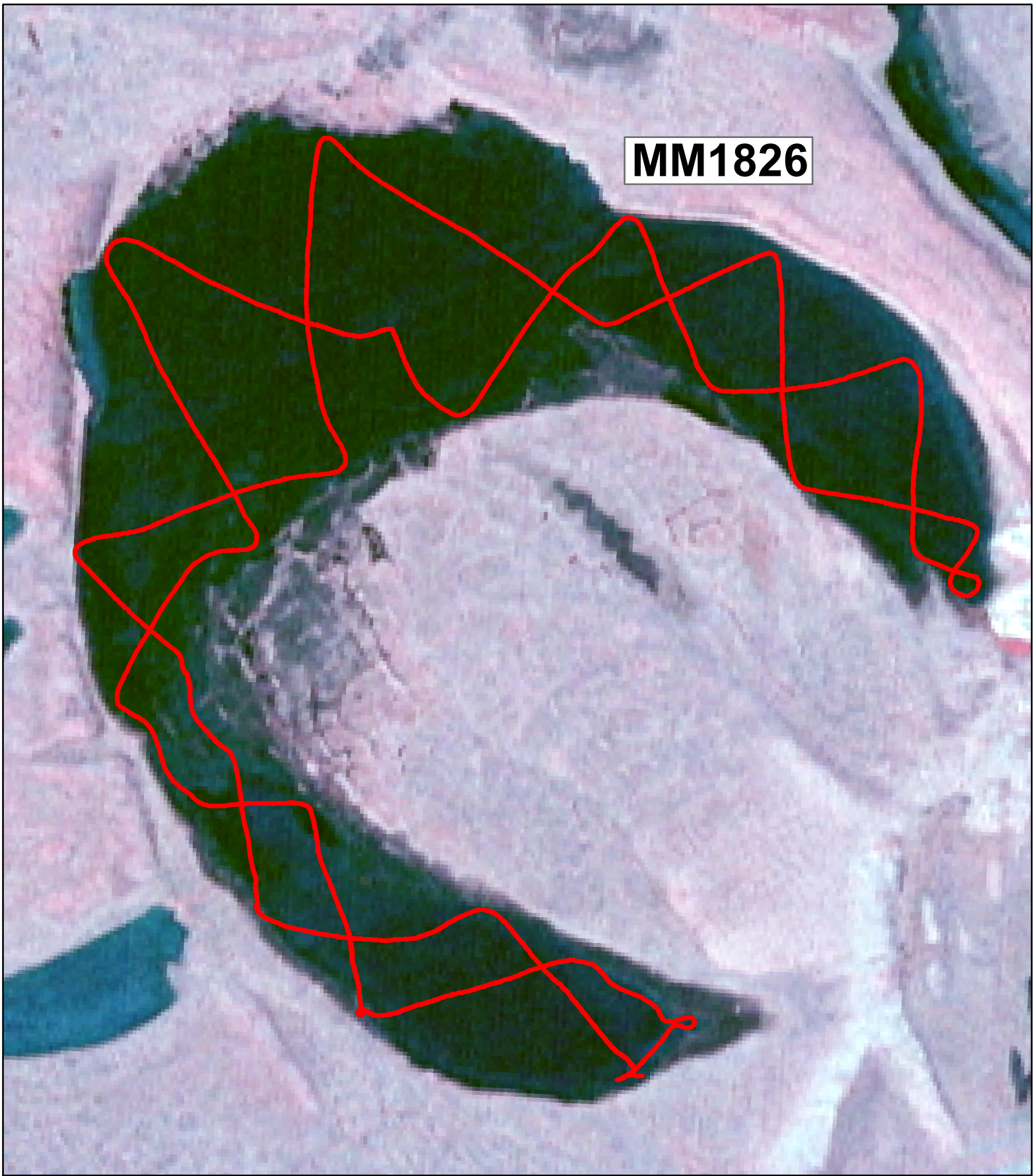
Area Available for Ice Chip Collection at Lake MM1826

based on transects surveyed on August 8, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

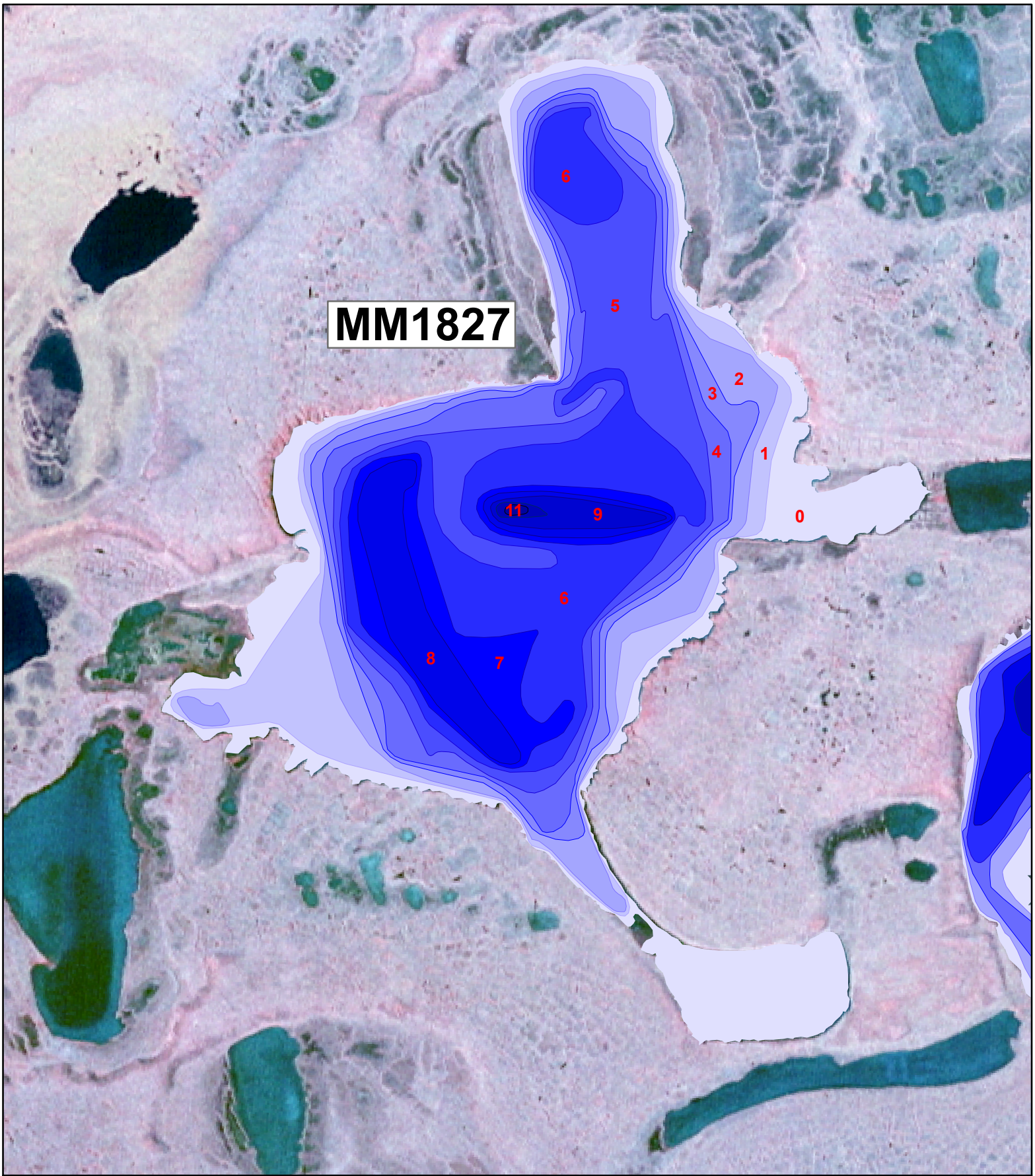
Depth Transects Surveyed at Lake MM1826

surveyed on August 8, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	11

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1827

based on transects surveyed on August 8, 2018

SCALE:

250 125 0 250 500 750 Feet

N

Lake MM1827

Other Names: None Known
Location: 70.21416°N 152.42575°W
USGS Quad Sheet: Harrison Bay A-5: T10N R2W Sec. 16,17,20,21
Habitat: Tundra Lake
Area: 104 acres
Maximum Depth: 11.4 feet in 2018
Active Outlet: No
Total Lake Volume: 141.427 million gallons
Volume Under 4 ft of ice: 43.420 million gallons
Volume Under 5 ft of ice: 26.153 million gallons
Volume Under 7 ft of ice: 5.319 million gallons

Potential Ice Aggregate: 46.31 acres (water depth 4 ft or less)
13.733 million gallons

Maximum Recommended Winter Removal: **7.846 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	25.1	3.4	5.1	12.0	77	173	0.7	7.94	B. Morris

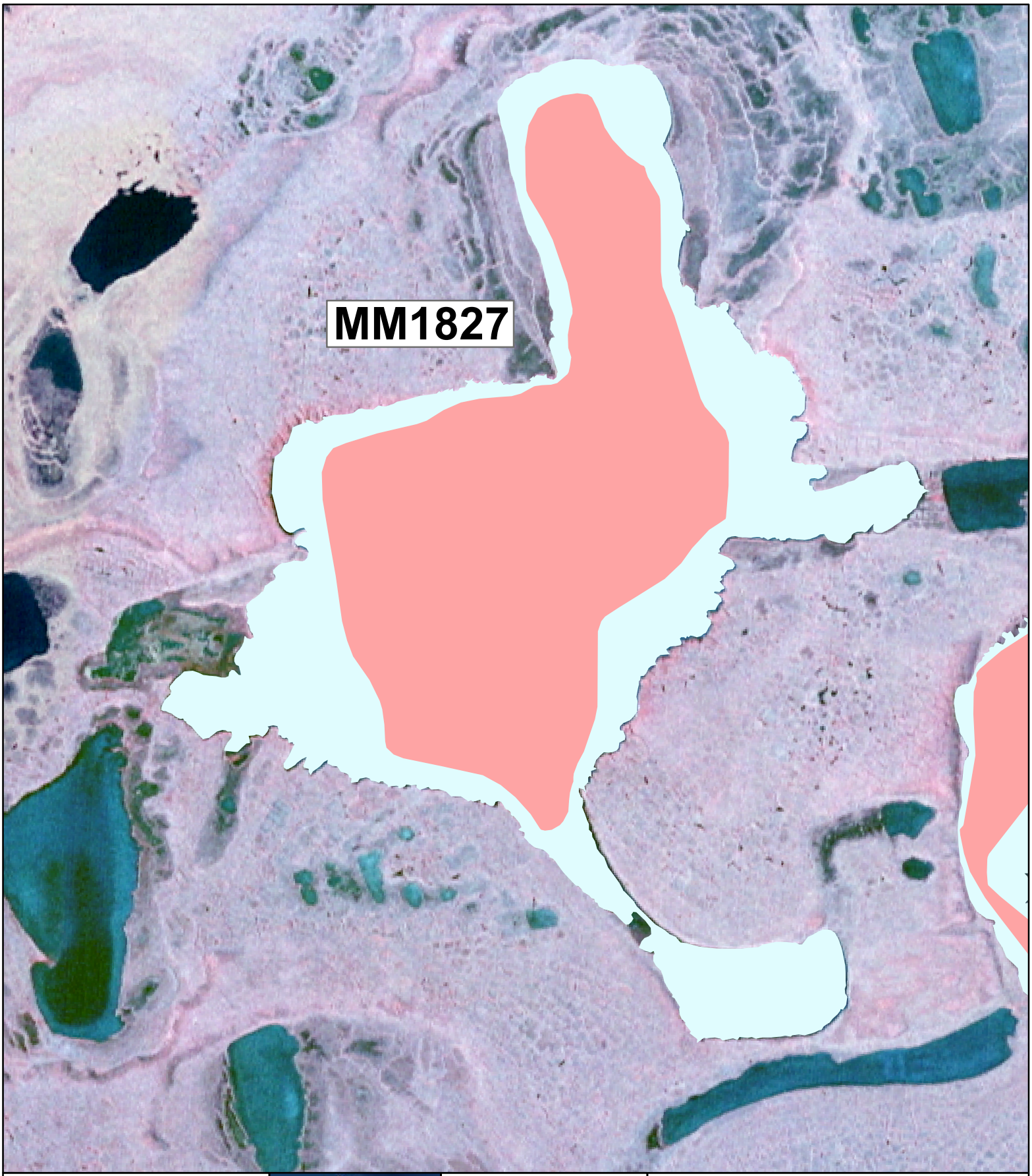
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 8 18	9.1	none	0
Minnow Traps	Aug 8 18	14.6	Ninespine stickleback	1
Seine	not used			
Visual +Dipnet	Aug 8 18	5 yards	Ninespine stickleback	2

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.21380	-152.42010	8/8/2018	4.97	-2.96

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

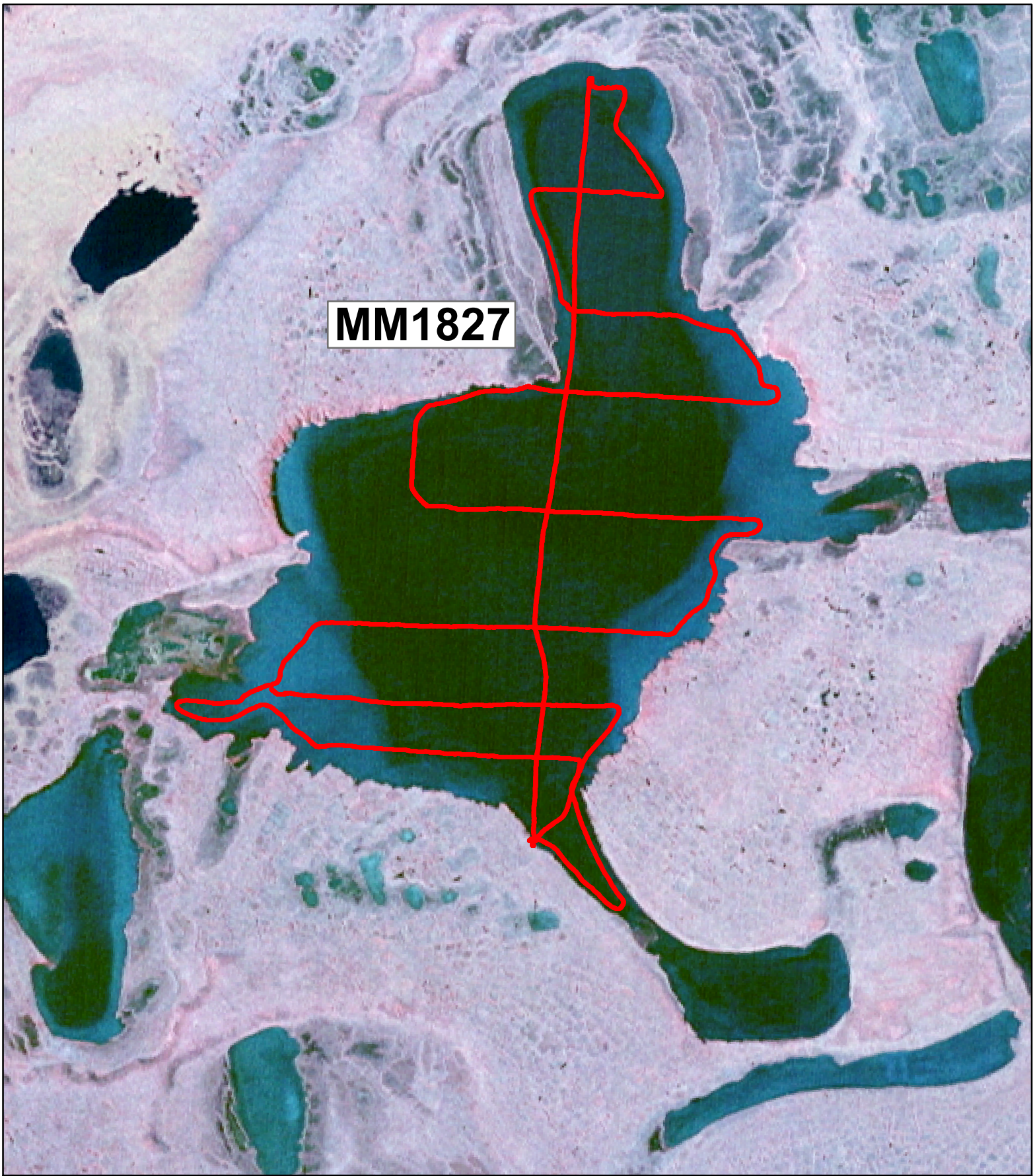
Area Available for Ice Chip Collection at Lake MM1827

based on transects surveyed on August 8, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

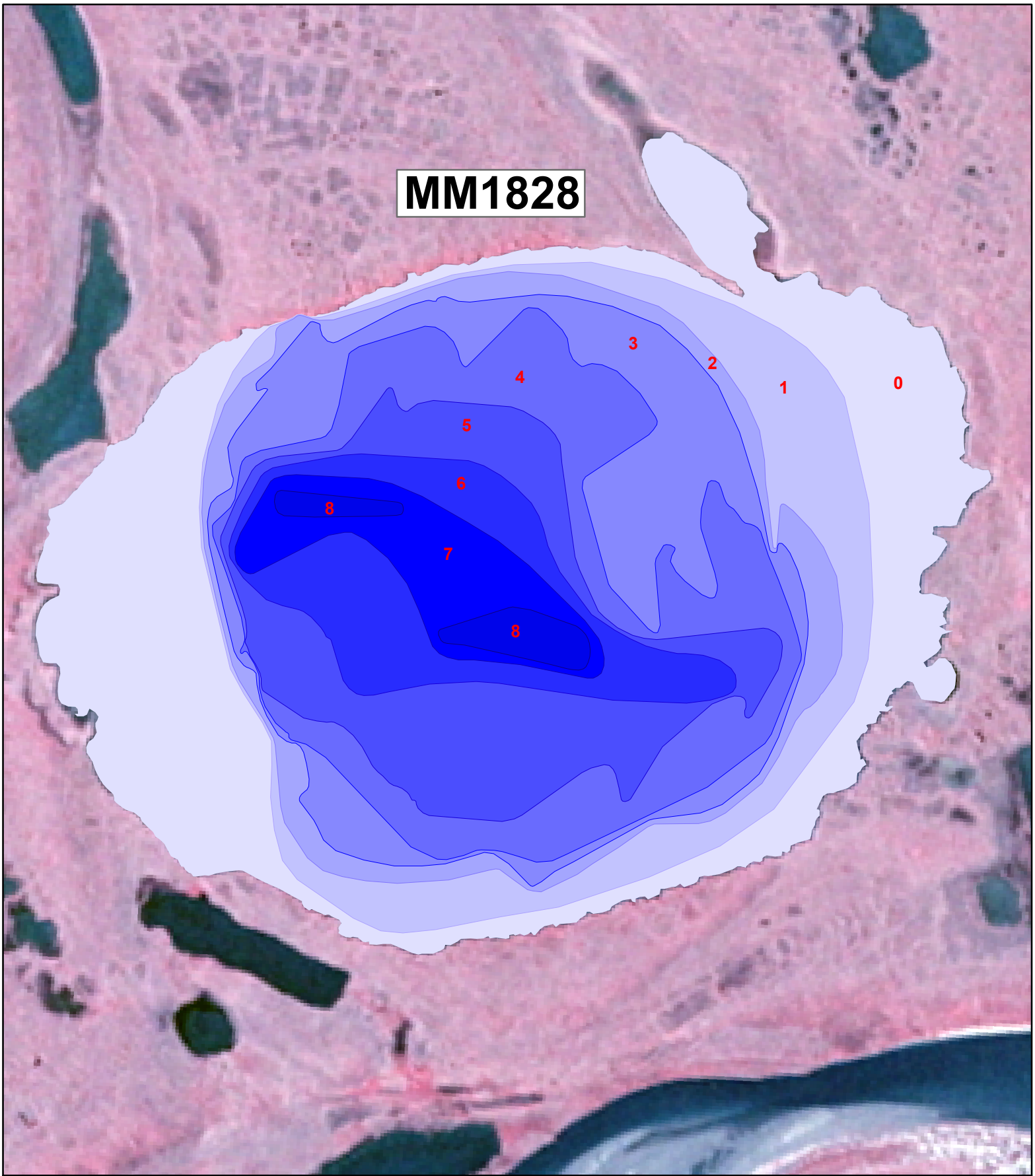
Depth Transects Surveyed at Lake MM1827

surveyed on August 8, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 Feet

N



Depth in Feet

0	3	6
1	4	7
2	5	8

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1828

based on transects surveyed on August 11, 2018

SCALE:

100 50 0 100 200 300 400 500 Feet

N

Lake MM1828

Other Names: None Known
Location: 70.22364°N 152.38011°W
USGS Quad Sheet: Harrison Bay A-4: T10N R2W Sec. 15,16
Habitat: Perched Lake
Area: 71 acres
Maximum Depth: 8.7 feet in 2018
Active Outlet: No
Total Lake Volume: 74.002 million gallons
Volume Under 4 ft of ice: 15.707 million gallons
Volume Under 5 ft of ice: 7.978 million gallons
Volume Under 7 ft of ice: 0.984 million gallons

Potential Ice Aggregate: 42.00 acres (water depth 4 ft or less)
12.454 million gallons

Maximum Recommended Winter Removal: **2.394 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	22.1	3.5	6.0	14.7	69	165	0.8	7.87	B. Morris

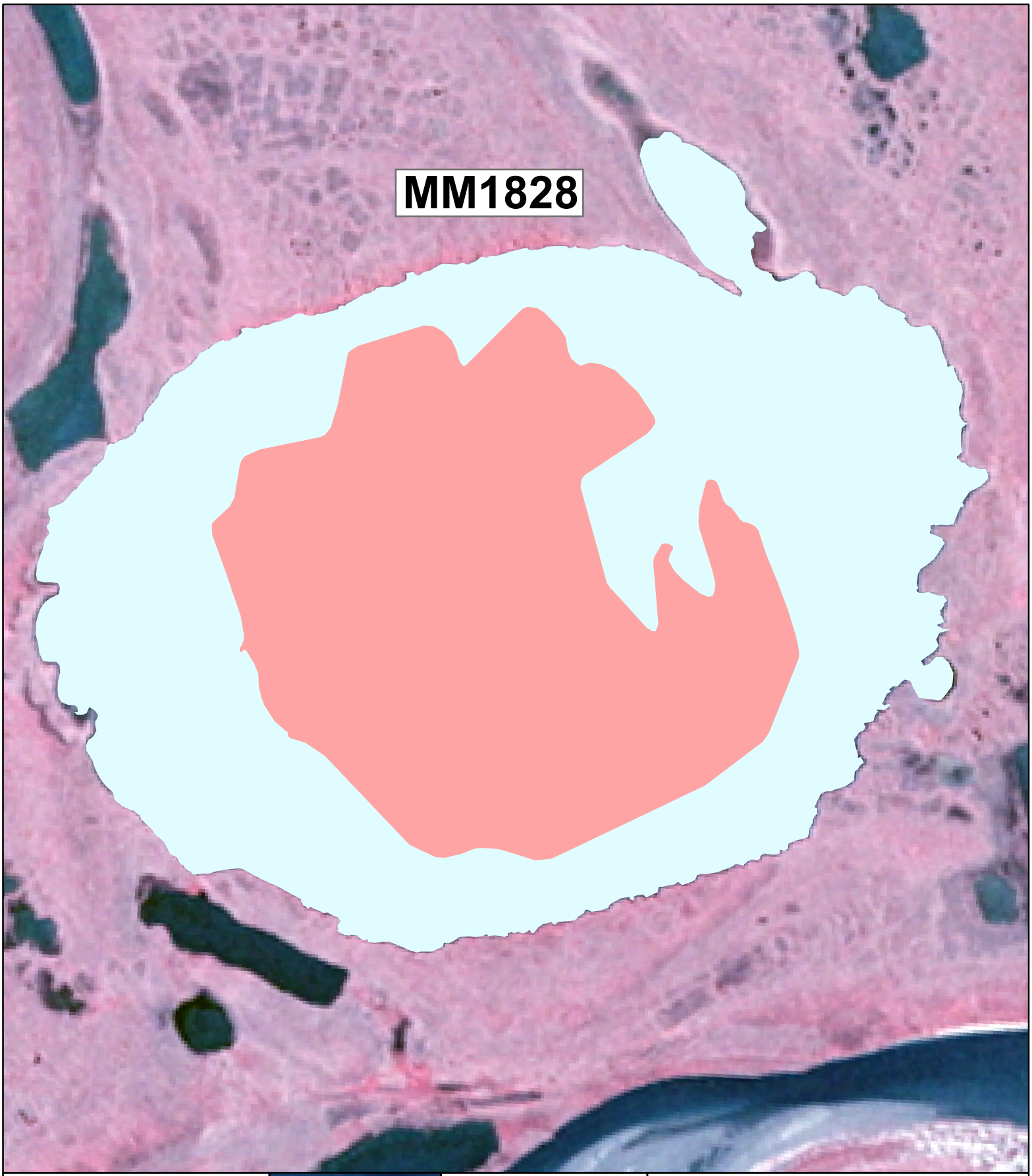
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 11 18	9.1	none	0
Minnow Traps	Aug 11 18	15.6	none	0
Seine	Aug 11 18	4 hauls	Ninespine stickleback	4
Visual +Dipnet	Aug 11 18	250 yards	none	0

Water Surface Elevation
Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.22195	-152.37819	8/11/2018	4.61	-3.05

Last Revised: January 8, 2019



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

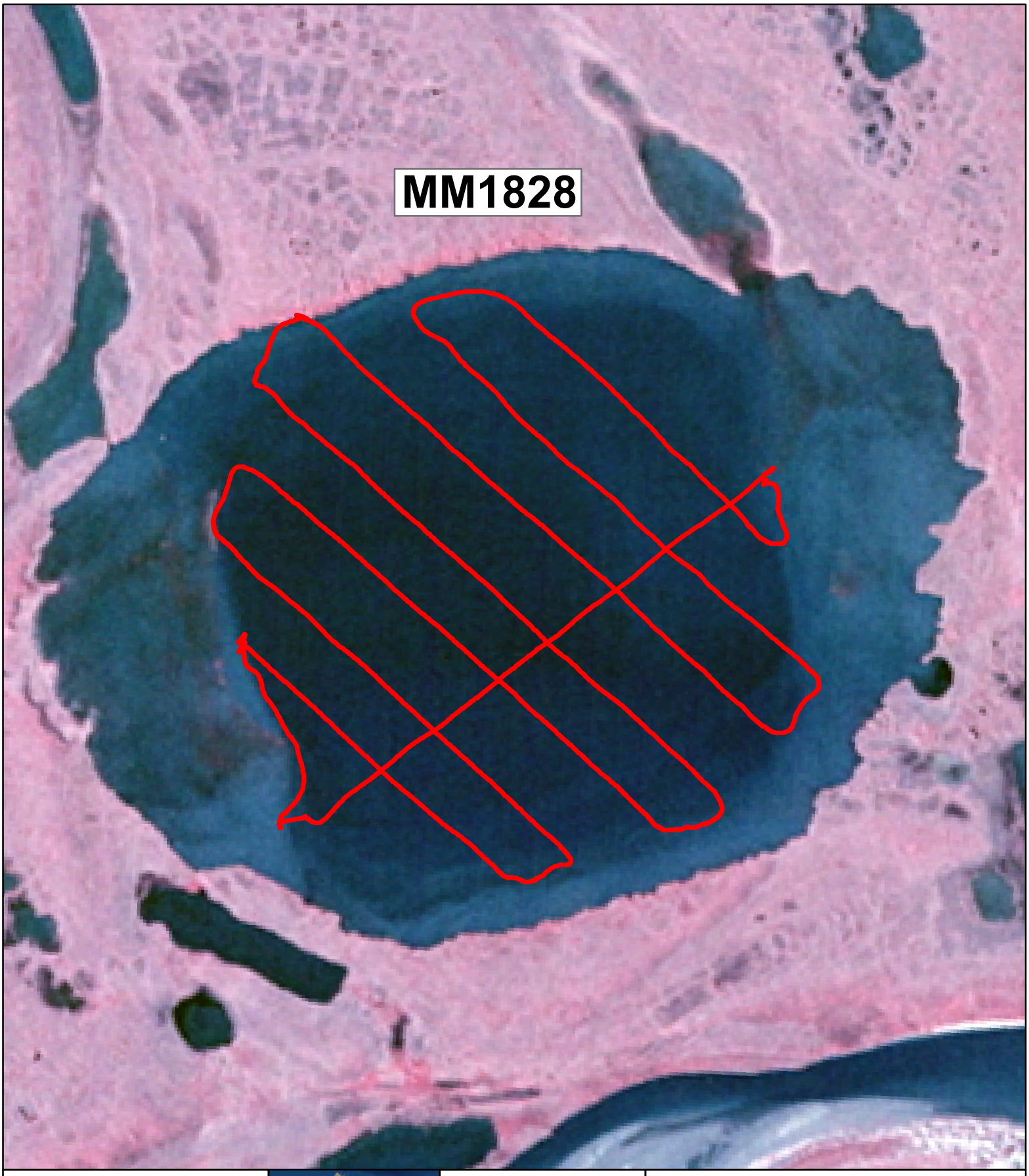
Area Available for Ice Chip Collection at Lake MM1828

based on transects surveyed on August 11, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

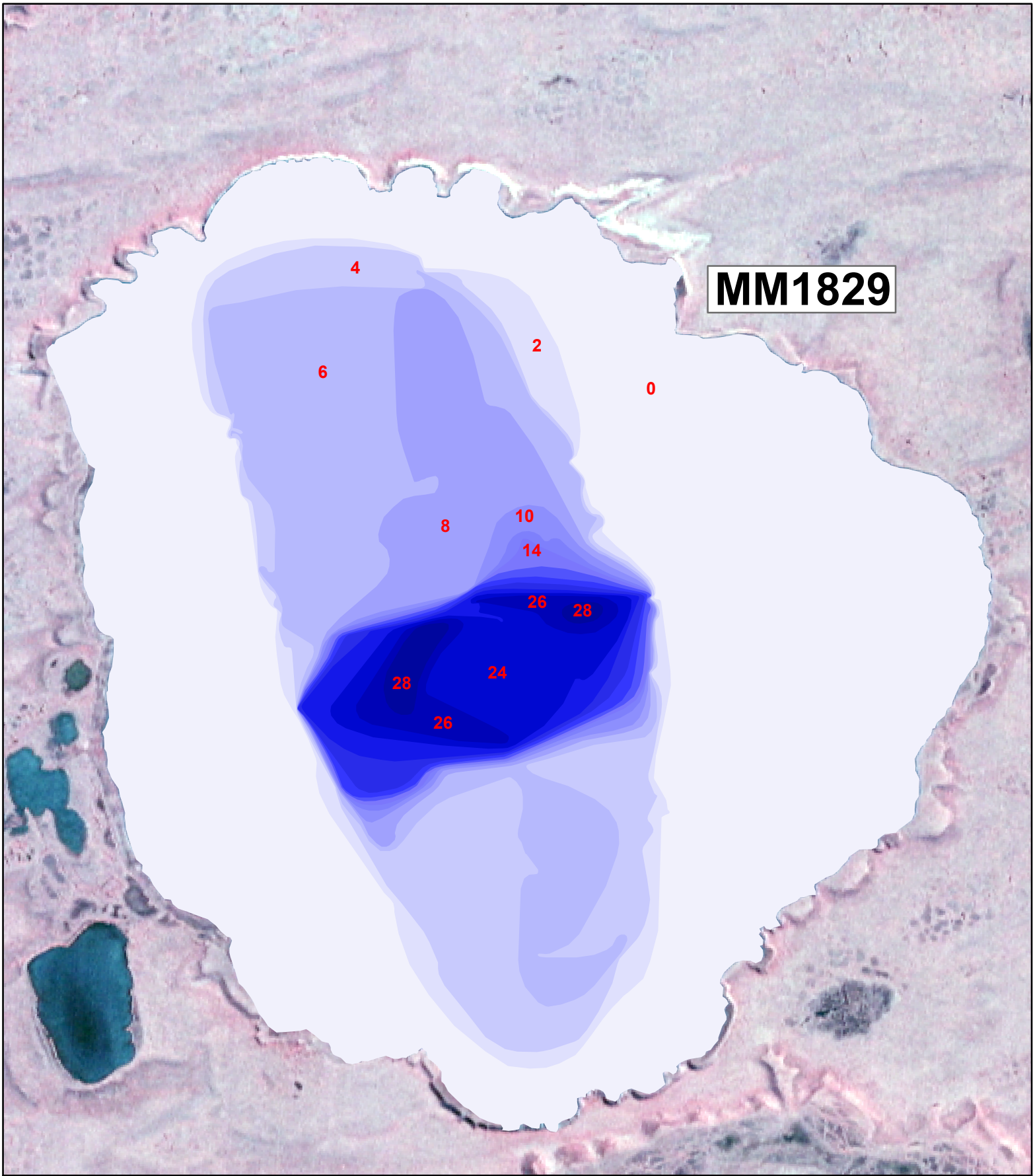
Depth Transects Surveyed at Lake MM1828

surveyed on August 11, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N



Depth in Feet

0	6	12	18	24	
2	8	14	20	26	
4	10	16	22	28	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1829 (depths in 2 foot intervals)

based on transects surveyed on July 31, 2018

SCALE:

250 125 0 250 500 750 Feet

N

Lake MM1829

Other Names: None Known
Location: 70.20874°N 152.53277°W
USGS Quad Sheet: Harrison Bay A-5: T10N R3W Sec. 24
Habitat: Tundra Lake
Area: 241 acres
Maximum Depth: 29.9 feet in 2018
Active Outlet: No
Total Lake Volume: 375.330 million gallons
Volume Under 4 ft of ice: 203.062 million gallons
Volume Under 5 ft of ice: 175.334 million gallons
Volume Under 7 ft of ice: 131.169 million gallons

Potential Ice Aggregate: 150.32 acres (water depth 4 ft or less)
44.578 million gallons

Maximum Recommended Winter Removal: **19.675 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

Water Chemistry:

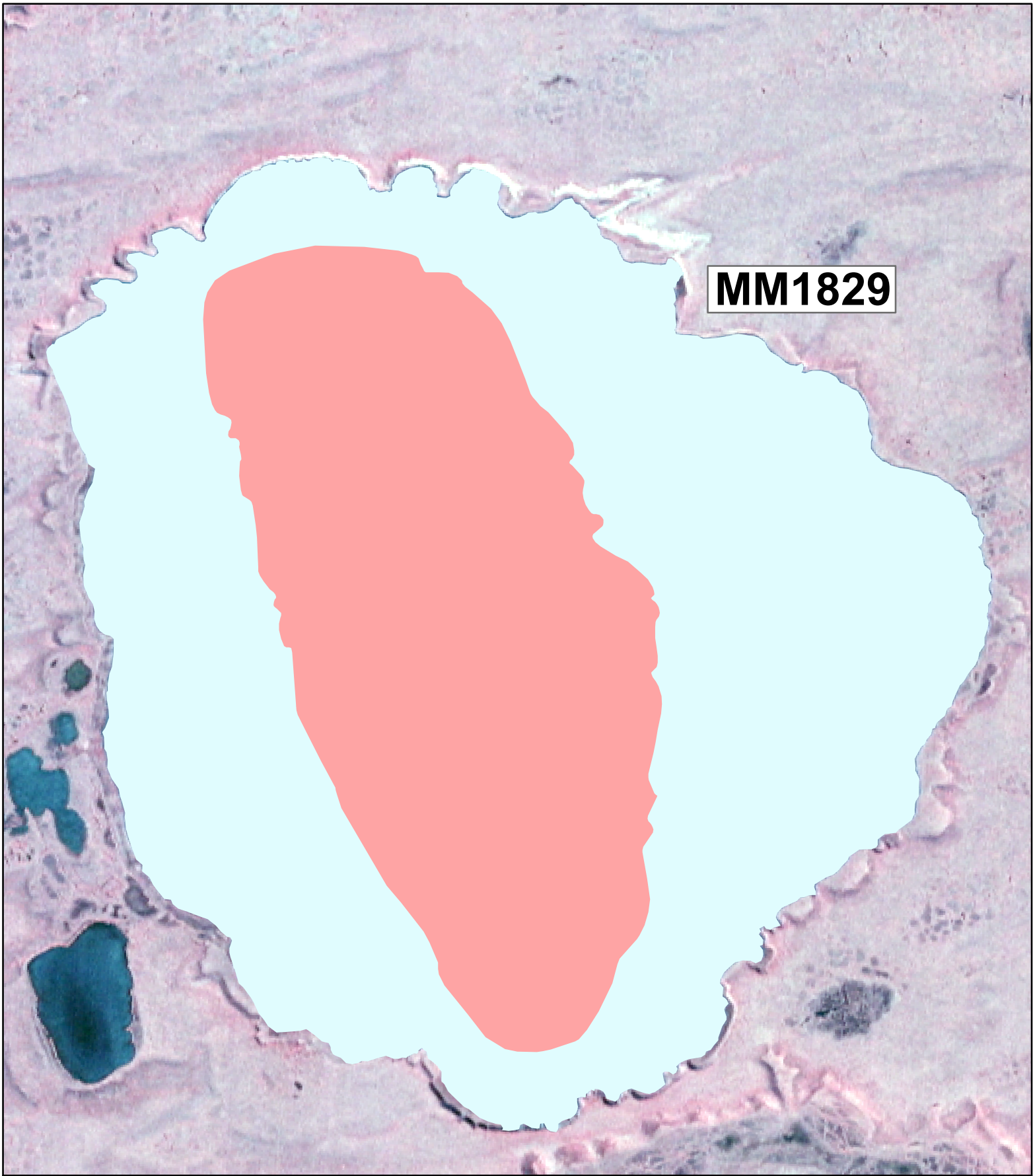
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	30.0	3.6	6.9	14.0	90	213	0.5	8.24	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 31 18	4.2	Least cisco	36	136-438
Minnow Traps	Jul 31 18	11.4	Ninespine stickleback	5	
Seine	not used				
Visual +Dipnet	not used				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.20263	-152.52725	7/31/2018	5.33	-0.52

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

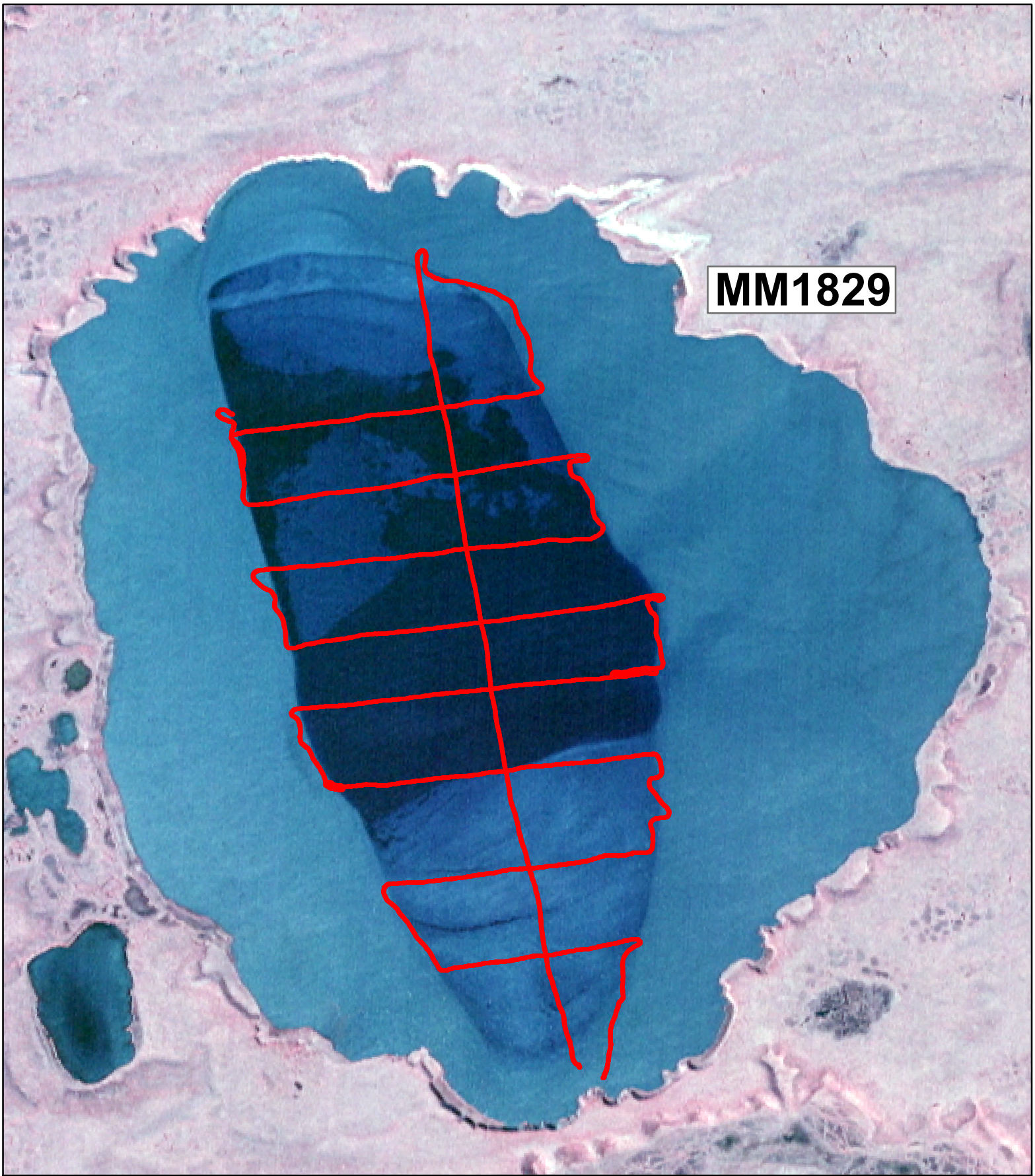
Area Available for Ice Chip Collection at Lake MM1829

based on transects surveyed on July 31, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

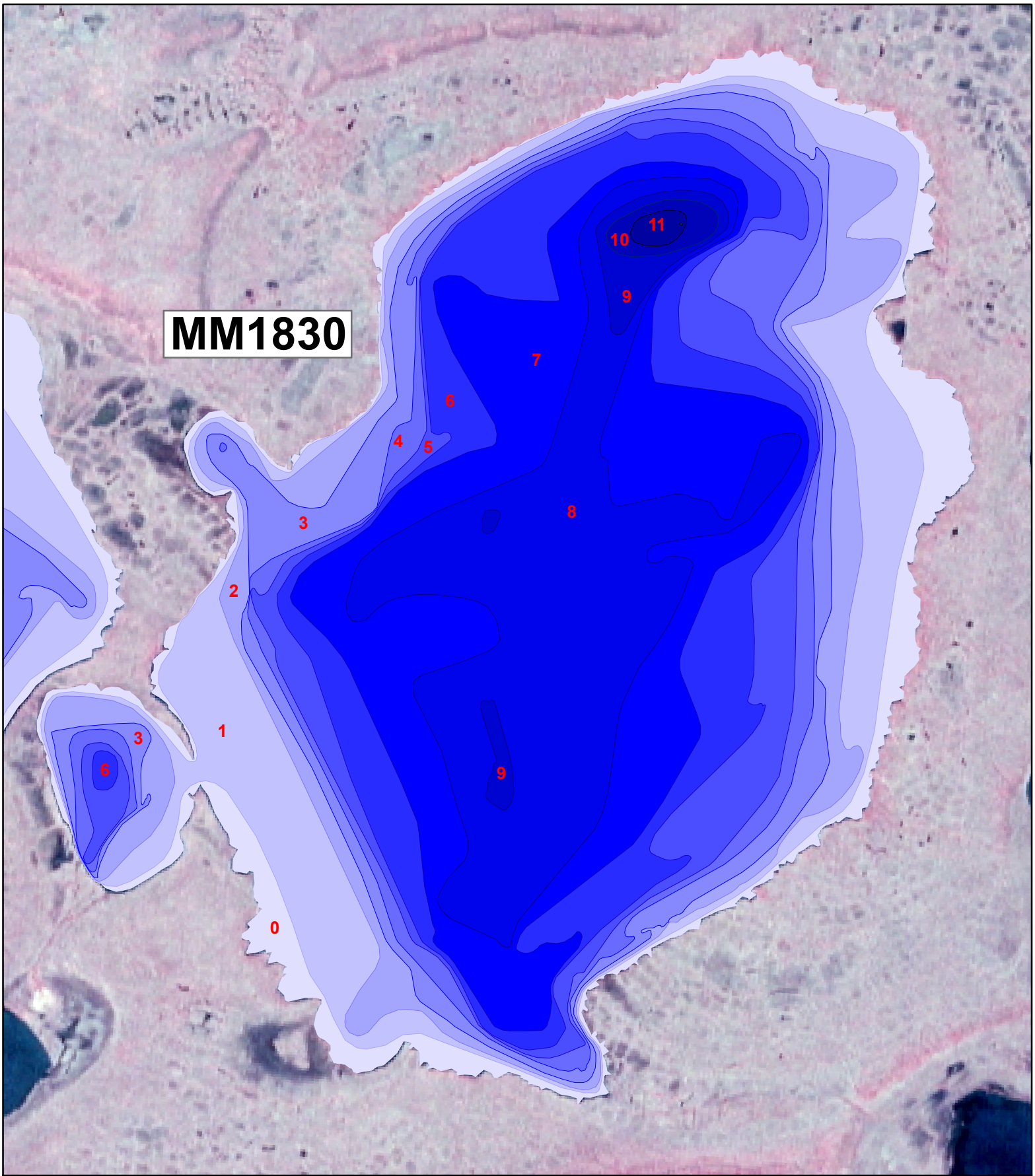
Depth Transects Surveyed at Lake MM1829

surveyed on July 31, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 Feet

N



Depth in Feet

0	3	6	9	12
1	4	7	10	
2	5	8	11	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1830

based on transects surveyed on August 3, 2018

SCALE:

250 125 0 250 500 Feet

N

Lake MM1830

Other Names: None Known
Location: 70.19224°N 152.47490°W
USGS Quad Sheet: Harrison Bay A-5: T10N R2W Sec. 29,30
Habitat: Perched Lake
Area: 139 acres
Maximum Depth: 12.4 feet in 2018
Active Outlet: No
Total Lake Volume: 235.612 million gallons
Volume Under 4 ft of ice: 88.819 million gallons
Volume Under 5 ft of ice: 61.511 million gallons
Volume Under 7 ft of ice: 17.663 million gallons

Potential Ice Aggregate: 51.03 acres (water depth 4 ft or less)
15.134 million gallons

Maximum Recommended Winter Removal: **47.122 million gallons**
(20% of lake volume)
(No fish concern)

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
2018	31.0	3.4	7.2	16.0	91	206	0.8	8.19	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 3 18	10.6	none	0
Minnow Traps	Aug 3 18	14.3	none	0
Seine	Aug 3 18	3 hauls	none	0
Visual +Dipnet	not used			

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.19210	-152.48531	8/3/2018	4.10	-2.44

Last Revised: January 8, 2019

MM1830

Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

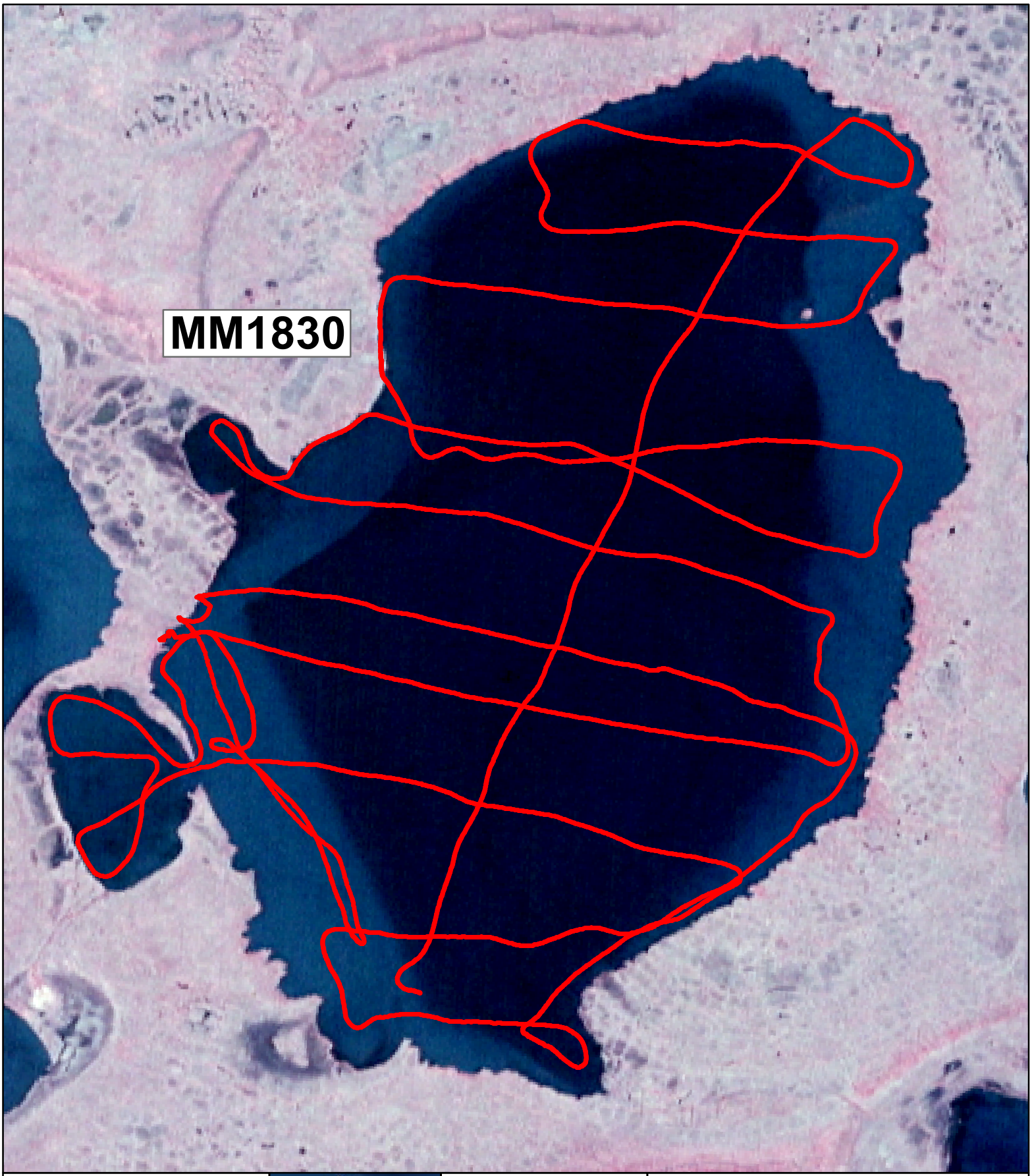
Area Available for Ice Chip Collection at Lake MM1830

based on transects surveyed on August 3, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

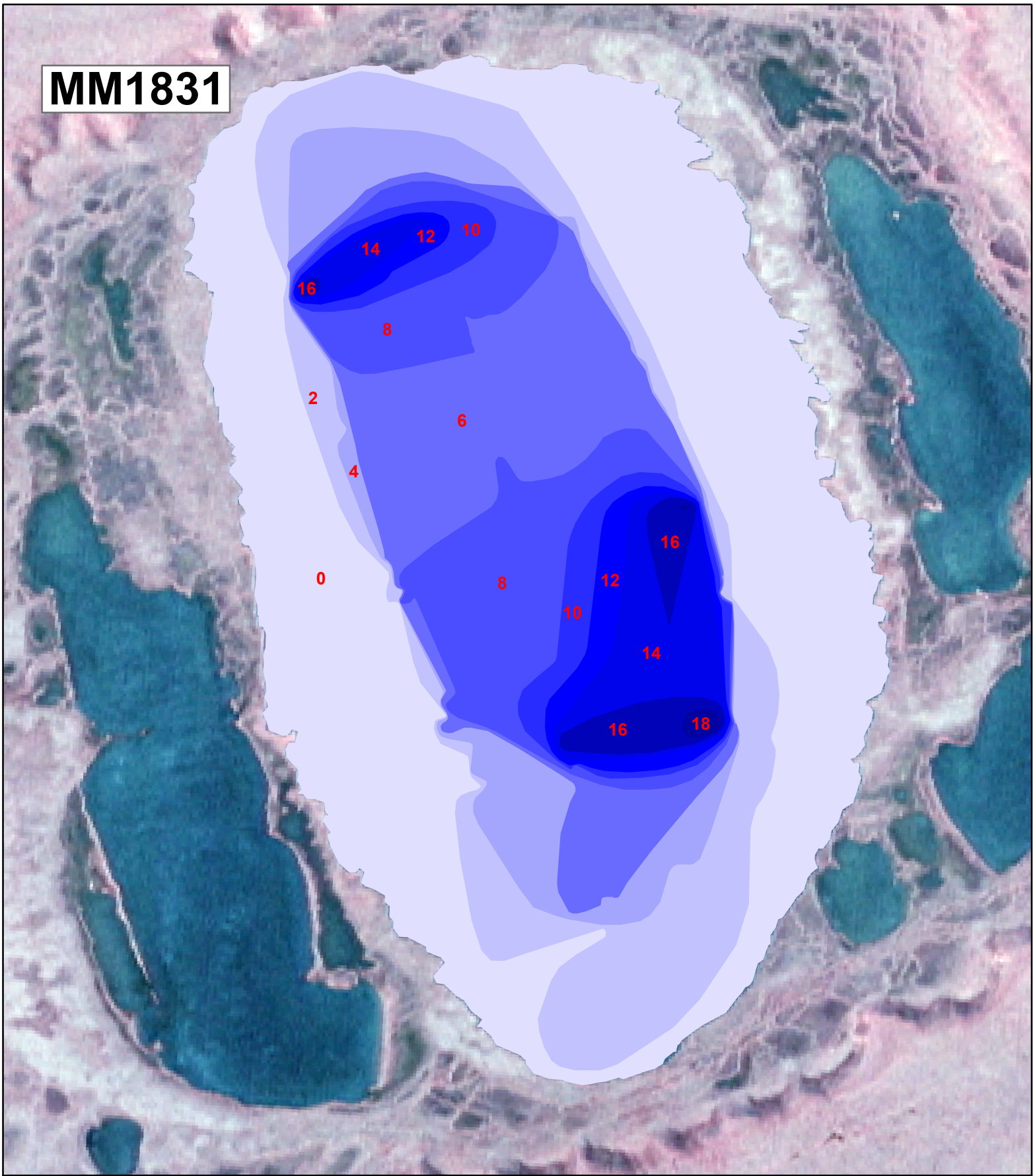
Depth Transects Surveyed at Lake MM1830

surveyed on August 3, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth in Feet

0	6	12	18
2	8	14	
4	10	16	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1831 (depths in 2 foot intervals)

based on transects surveyed on July 31, 2018

SCALE:

250 125 0 250 500 Feet

N

Lake MM1831

Other Names: None Known
Location: 70.19810°N 152.52115°W
USGS Quad Sheet: Harrison Bay A-5: T10N R3W Sec. 24,25
Habitat: Tundra Lake
Area: 89 acres
Maximum Depth: 19.0 feet in 2018
Active Outlet: No
Total Lake Volume: 139.162 million gallons
Volume Under 4 ft of ice: 64.047 million gallons
Volume Under 5 ft of ice: 51.920 million gallons
Volume Under 7 ft of ice: 31.186 million gallons

Potential Ice Aggregate: 49.94 acres (water depth 4 ft or less)
14.810 million gallons

Maximum Recommended Winter Removal: **4.678 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

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
2018	18.0	2.5	4.9	10.0	55	139	0.7	8.01	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 31 18	0.6	Least cisco	6	255-443
Minnow Traps	Jul 31 18	10.3	Ninespine stickleback	58	
			Slimy Sculpin	2	
Seine	not used				
Visual +Dipnet	not used				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.20162	-152.52650	7/31/2018	4.29	-0.74

Last Revised: January 8, 2019

MM1831

Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake MM1831

based on transects surveyed on July 31, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N

MM1831

Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

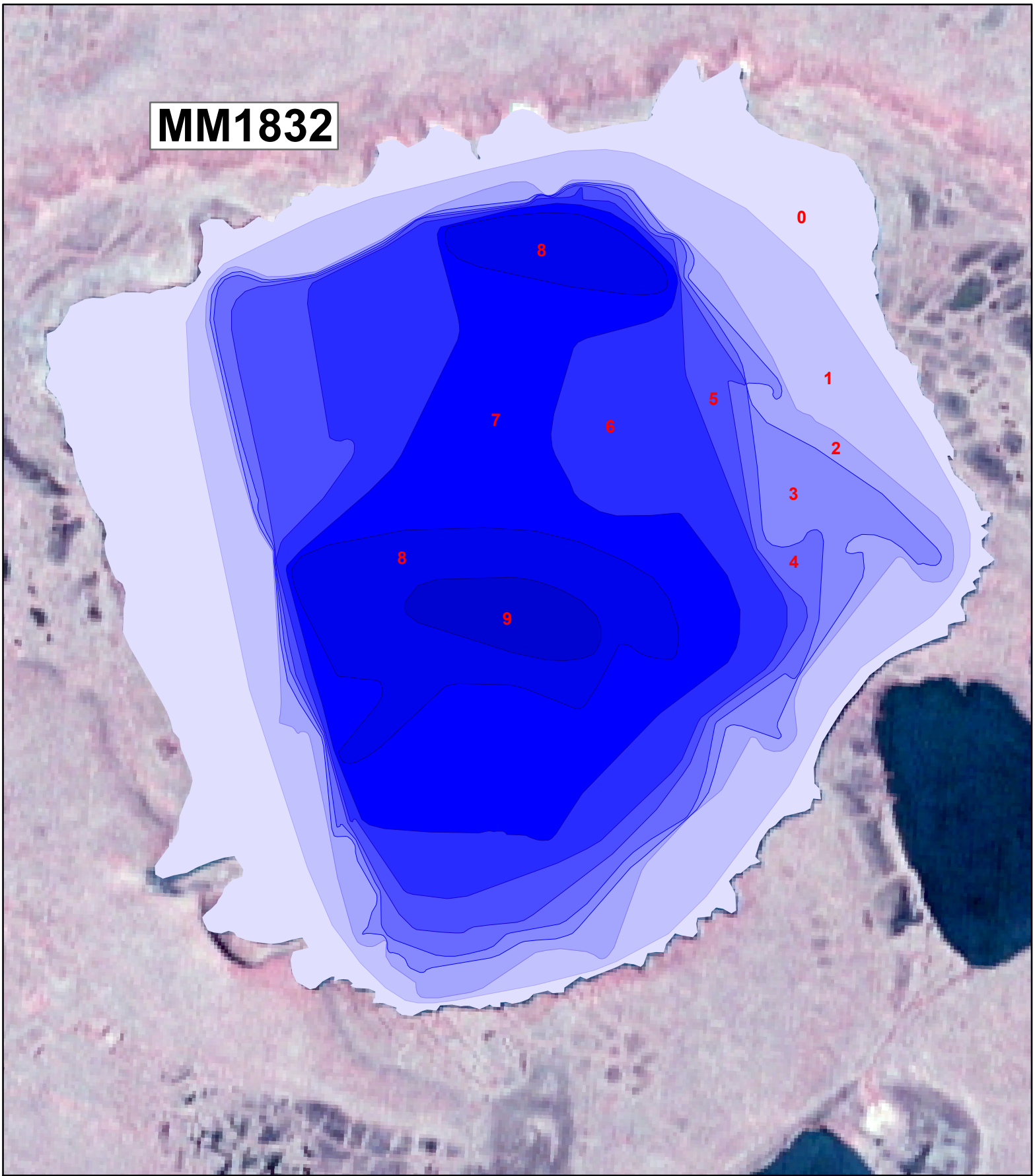
Depth Transects Surveyed at Lake MM1831

surveyed on July 31, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth in Feet

0	3	6	9
1	4	7	
2	5	8	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1832

based on transects surveyed on August 3, 2018

SCALE:

100 50 0 100 200 300 400 500 Feet

N

Lake MM1832

Other Names: None Known
Location: 70.19254°N 152.49539°W
USGS Quad Sheet: Harrison Bay A-5: T10N R2W Sec. 30
Habitat: Tundra Lake
Area: 73 acres
Maximum Depth: 9.4 feet in 2018
Active Outlet: No
Total Lake Volume: 101.657 million gallons
Volume Under 4 ft of ice: 36.804 million gallons
Volume Under 5 ft of ice: 24.847 million gallons
Volume Under 7 ft of ice: 5.974 million gallons

Potential Ice Aggregate: 35.12 acres (water depth 4 ft or less)
10.414 million gallons

Maximum Recommended Winter Removal: **7.454 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	21.0	3.2	5.9	12.0	66	154	0.9	7.88	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 3 18	8.4	none	0
Minnow Traps	Aug 3 18	9.5	none	0
Seine	Aug 3 18	3 hauls	Ninespine stickleback	1
Visual +Dipnet	not used			

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.19164	-152.48810	8/3/2018	3.55	-1.81

Last Revised: January 8, 2019

MM1832

Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

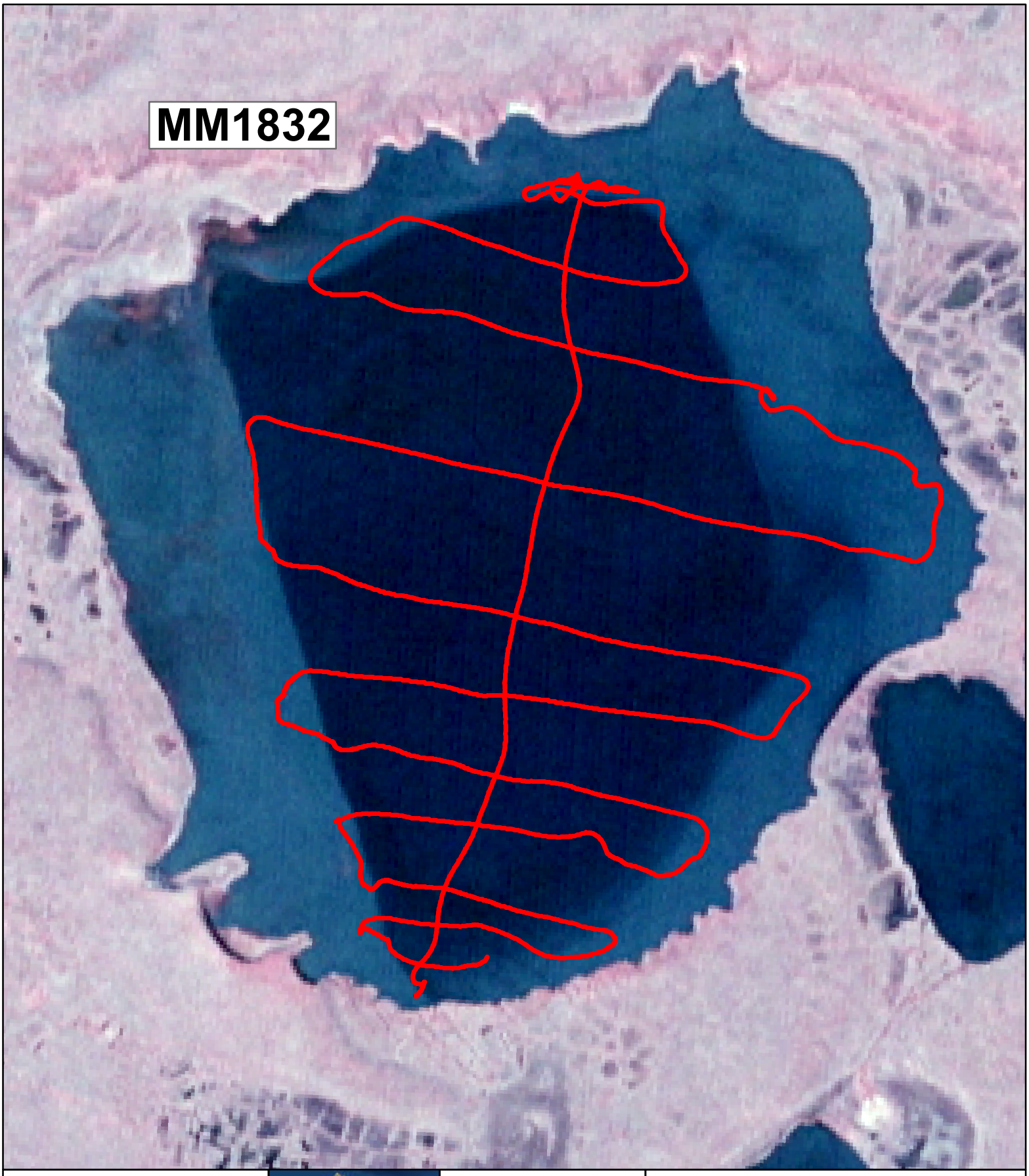
Area Available for Ice Chip Collection at Lake MM1832

based on transects surveyed on August 3, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Transects Surveyed at Lake MM1832

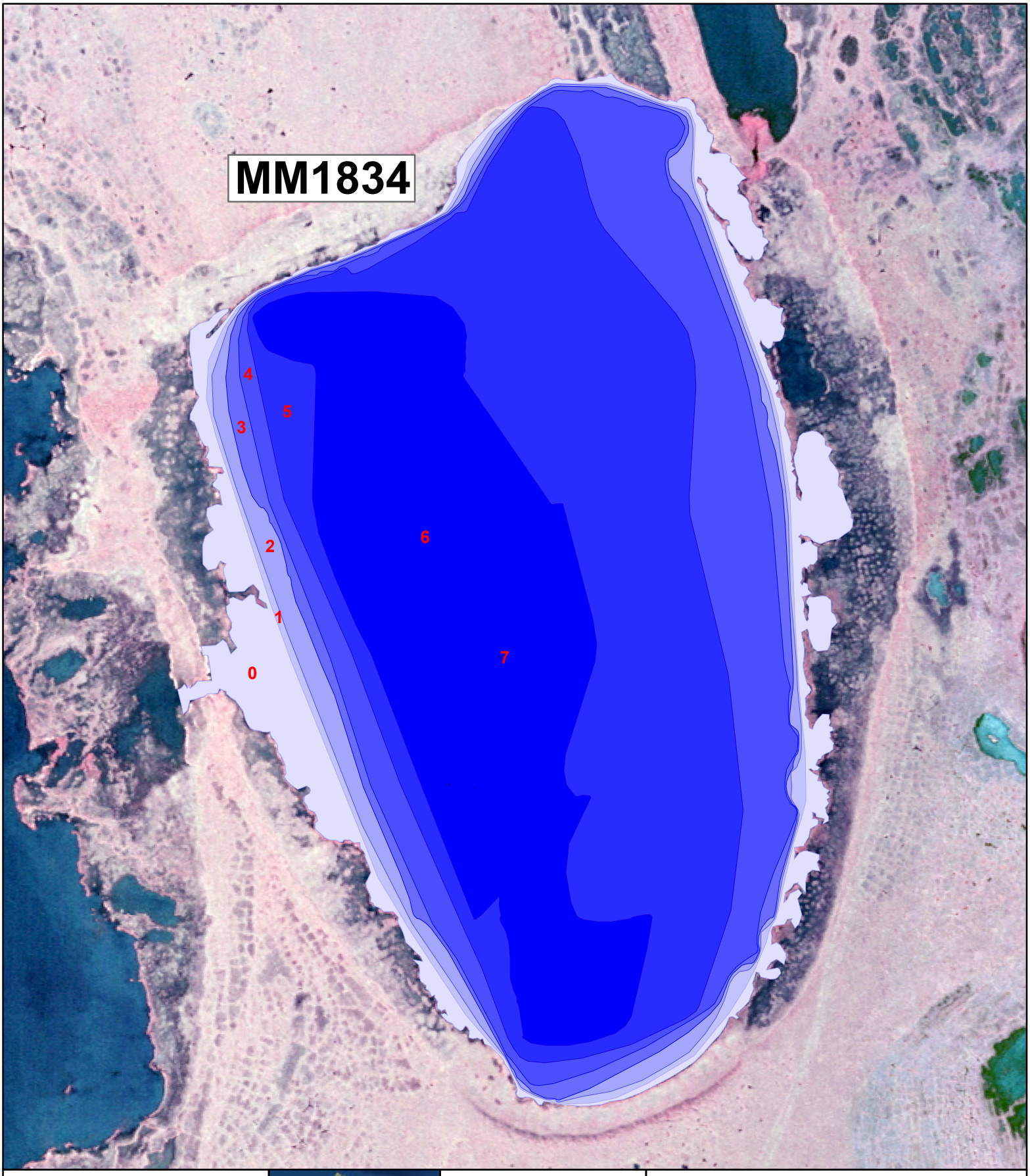
surveyed on August 3, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

100 50 0 100 200 300 400 500 Feet

N

6.5. Lake Summaries for Lakes Sampled in the Southwest Judy Creek Area, 2018.



Depth in Feet

0 1 2 3 4 5 6 7

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1834

based on transects surveyed on July 27, 2018

SCALE:

500 250 0 500 1,000 Feet

N

Lake MM1834

Other Names: None Known
Location: 70.08038°N 152.45636°W
USGS Quad Sheet: Harrison Bay A-5: T8N R2W, Sec. 5,6; T9N R2W Sec. 31,32
Habitat: Drainage Lake
Area: 328 acres
Maximum Depth: 7.2 feet in 2018
Active Outlet: Yes
Total Lake Volume: 507.223 million gallons
Volume Under 4 ft of ice: 133.355 million gallons
Volume Under 5 ft of ice: 57.710 million gallons
Volume Under 7 ft of ice: 0.001 million gallons

Potential Ice Aggregate: 68.28 acres (water depth 4 ft or less)
20.248 million gallons

Maximum Recommended Winter Removal: **17.313 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

Water Chemistry:

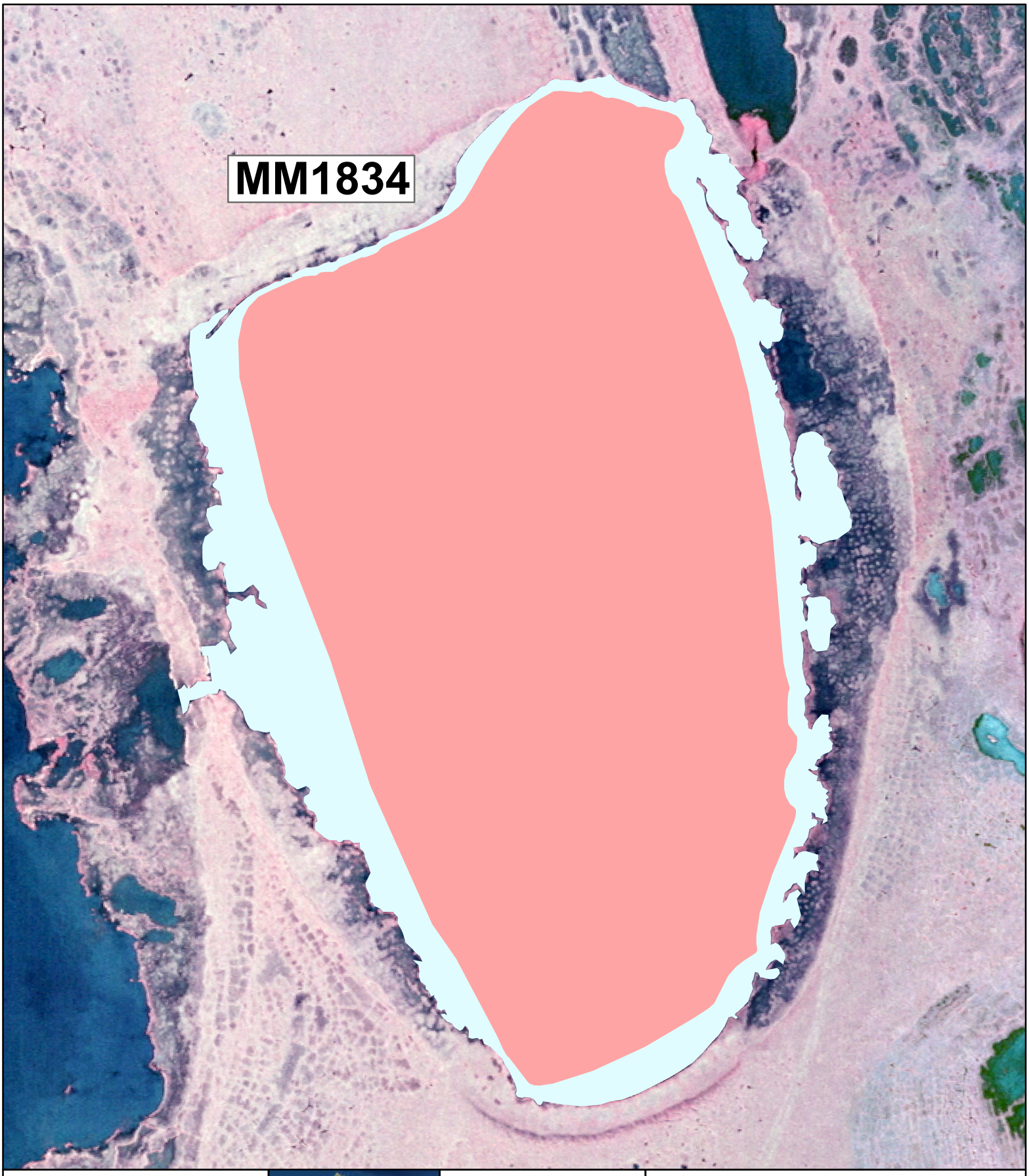
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	7.0	1.4	2.8	6.0	24	62	1.1	7.21	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Jul 27 18	6.3	none	0
Minnow Traps	Jul 27 18	17.0	none	0
Seine	not used			
Visual +Dipnet	Jul 27 18	50 yards	Ninespine stickleback	15

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.08836	-152.45261	7/27/2018	4.30	-1.70

Last Revised: January 8, 2019



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

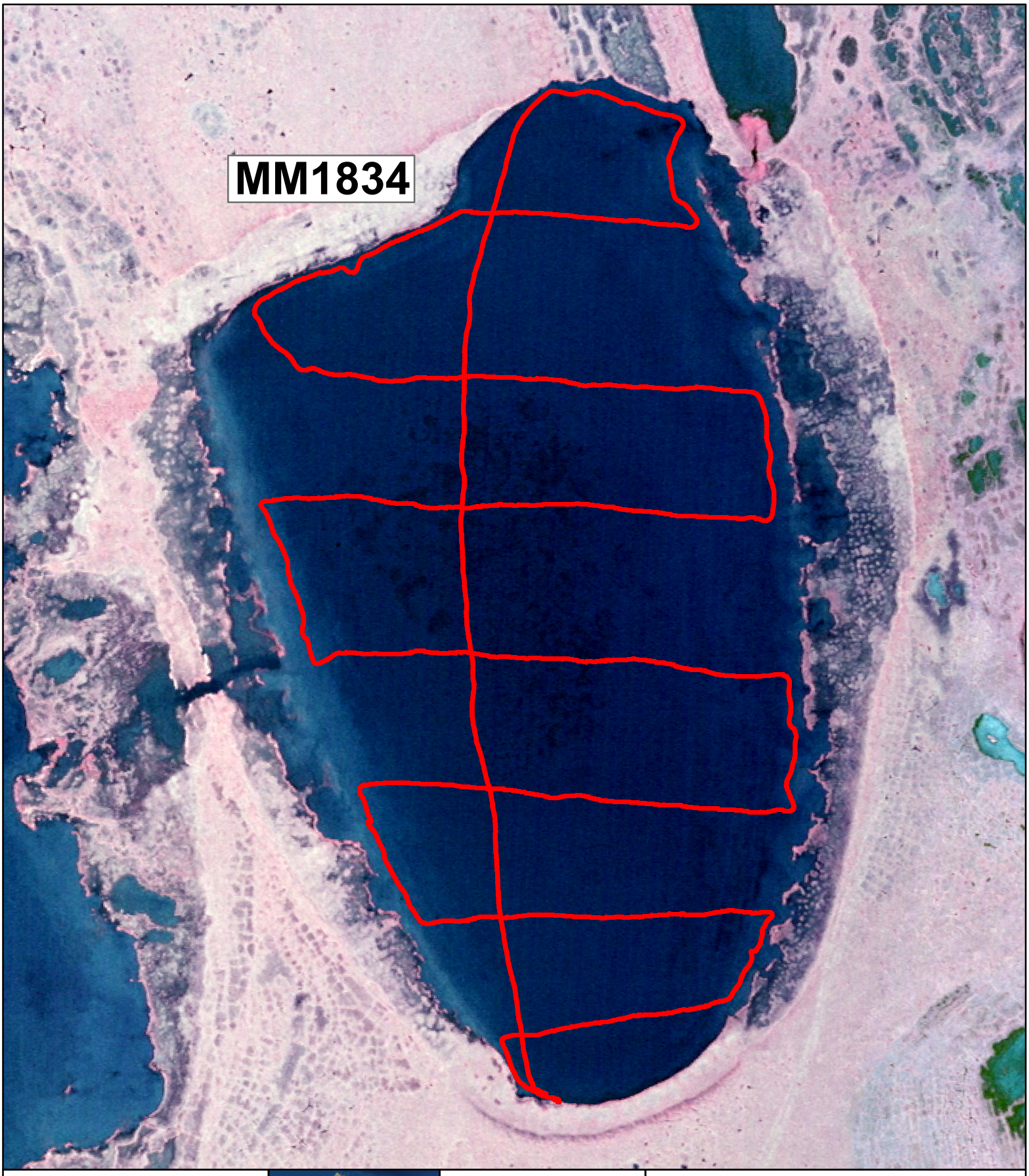
Area Available for Ice Chip Collection at Lake MM1834

based on transects surveyed on July 27, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

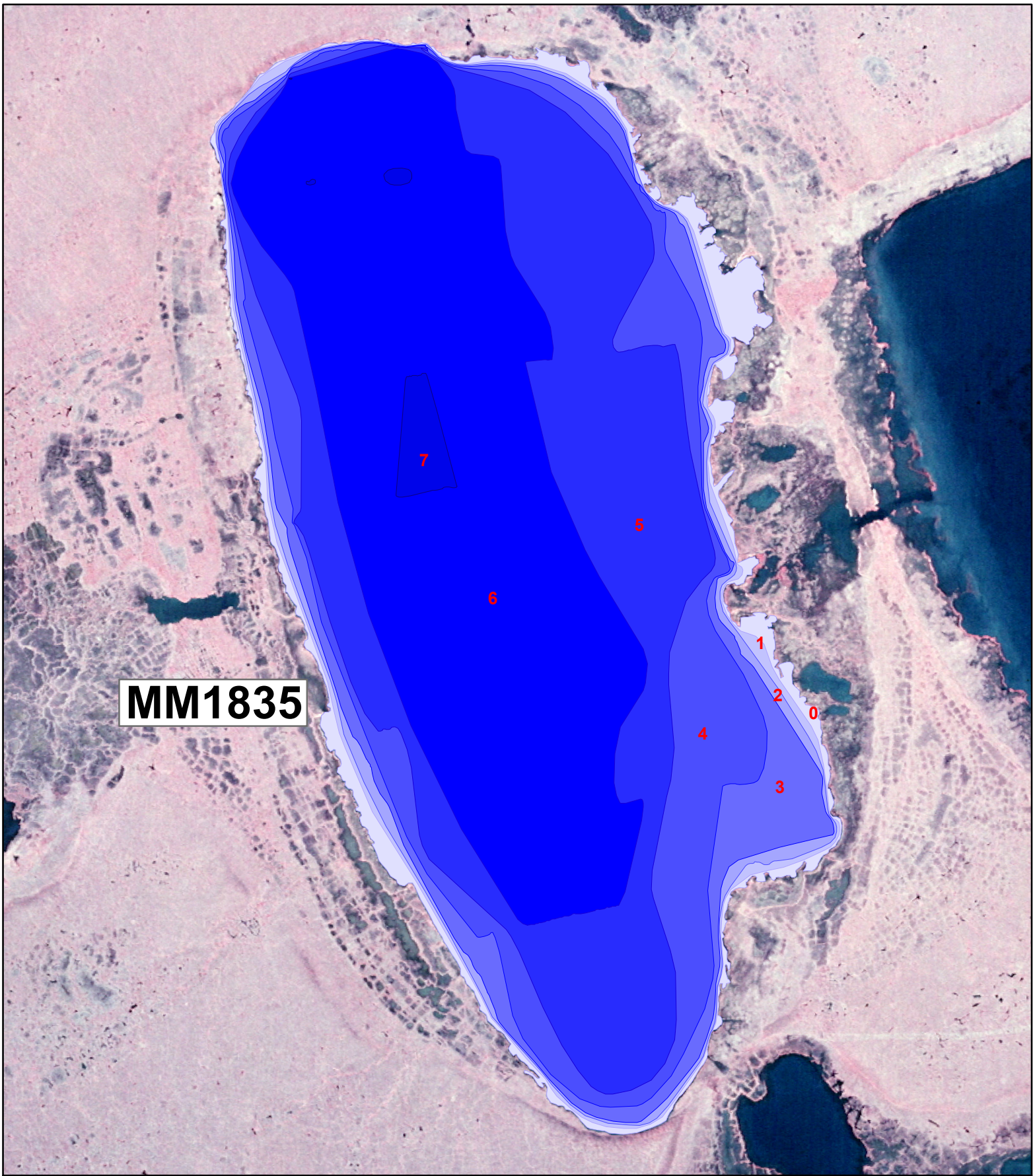
Depth Transects Surveyed at Lake MM1834

surveyed on July 27, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth in Feet

0 1 2 3 4 5 6 7

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1835

based on transects surveyed on July 26, 2018

SCALE:

500 250 0 500 1,000 Feet

N

Lake MM1835

Other Names: None Known
Location: 70.07792°N 152.49293°W
USGS Quad Sheet: Harrison Bay A-5: T8N R2W, Sec. 6,7; T8N R3W Sec. 1; T9N R2W Sec. 31
Habitat: Drainage Lake
Area: 501 acres
Maximum Depth: 8.2 feet in 2018
Active Outlet: Yes
Total Lake Volume: 853.361 million gallons
Volume Under 4 ft of ice: 245.816 million gallons
Volume Under 5 ft of ice: 119.869 million gallons
Volume Under 7 ft of ice: 0.663 million gallons

Potential Ice Aggregate: 81.86 acres (water depth 4 ft or less)
24.276 million gallons

Maximum Recommended Winter Removal: **0.099 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

Water Chemistry:

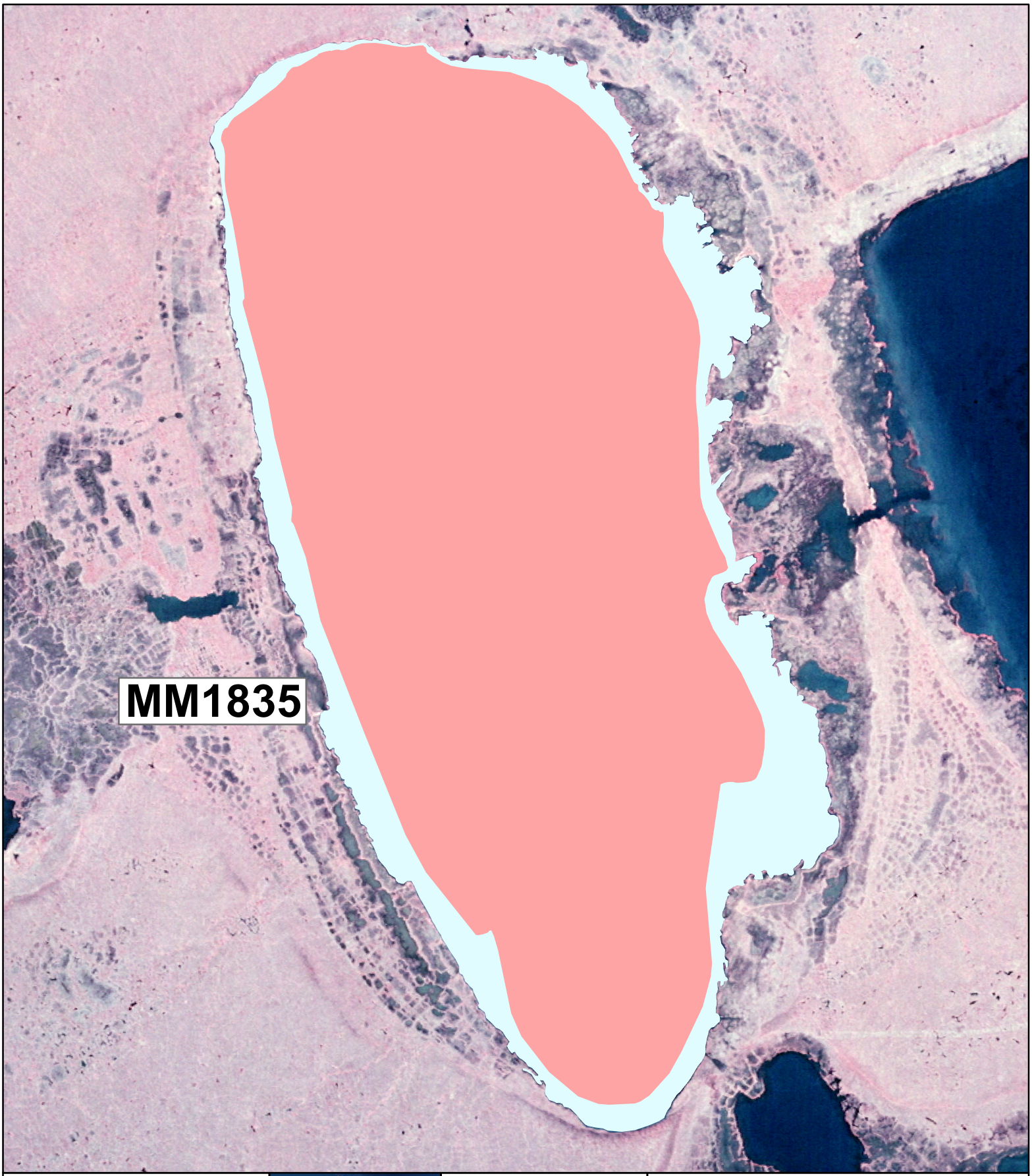
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	7.8	1.6	3.1	6.7	27	70	1.5	7.00	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 26 18	9.2	Broad whitefish	3	176-265
			Least cisco	3	229-316
Minnow Traps	Jul 26 18	11.6	Ninespine stickleback	1	
Seine	not used				
Visual +Dipnet	Jul 26 18	15 yards	Ninespine stickleback	1	

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.08796	-152.49940	7/26/2018	4.68	-2.29

Last Revised: January 8, 2019



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

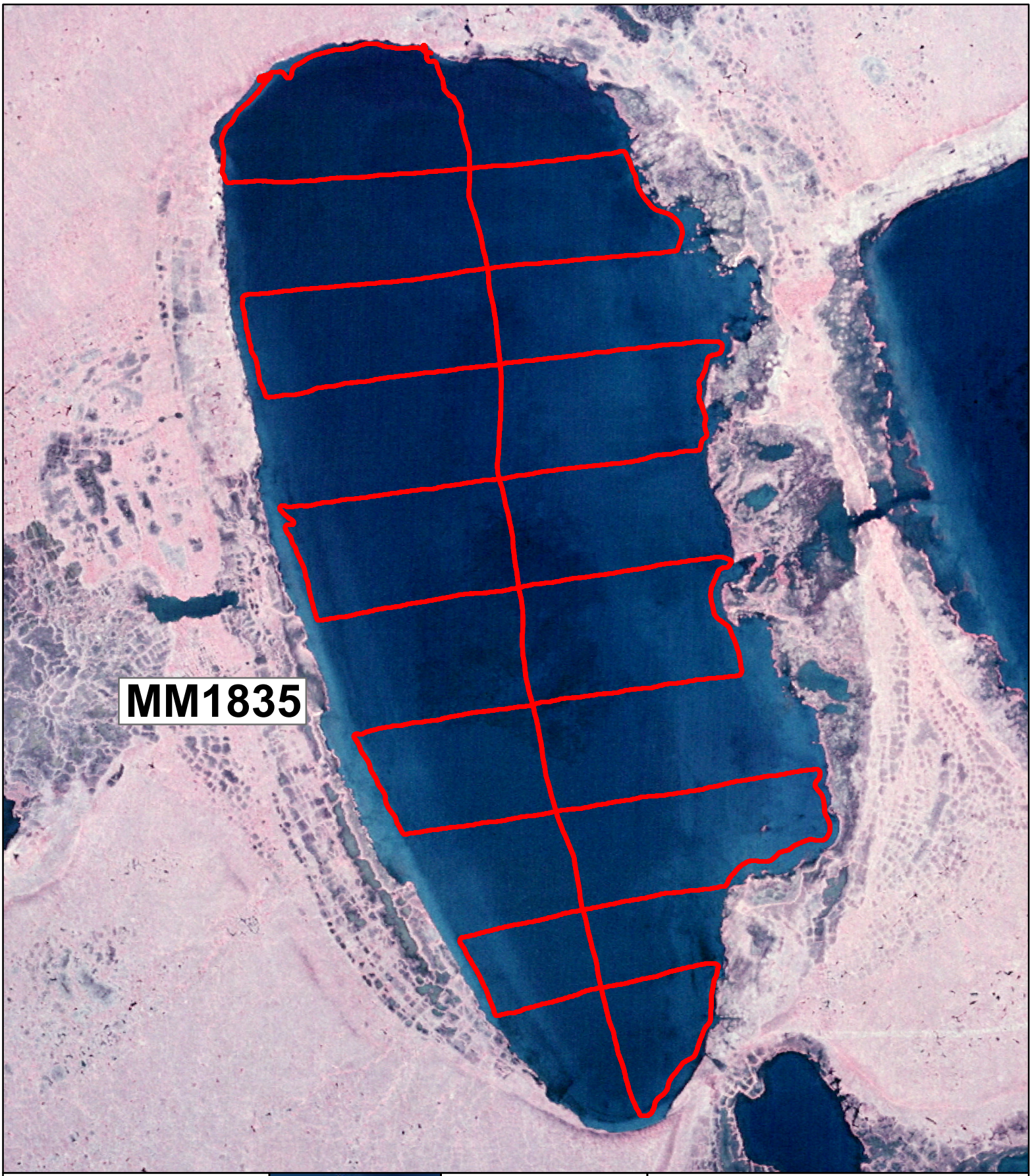
Area Available for Ice Chip Collection at Lake MM1835

based on transects surveyed on July 26, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

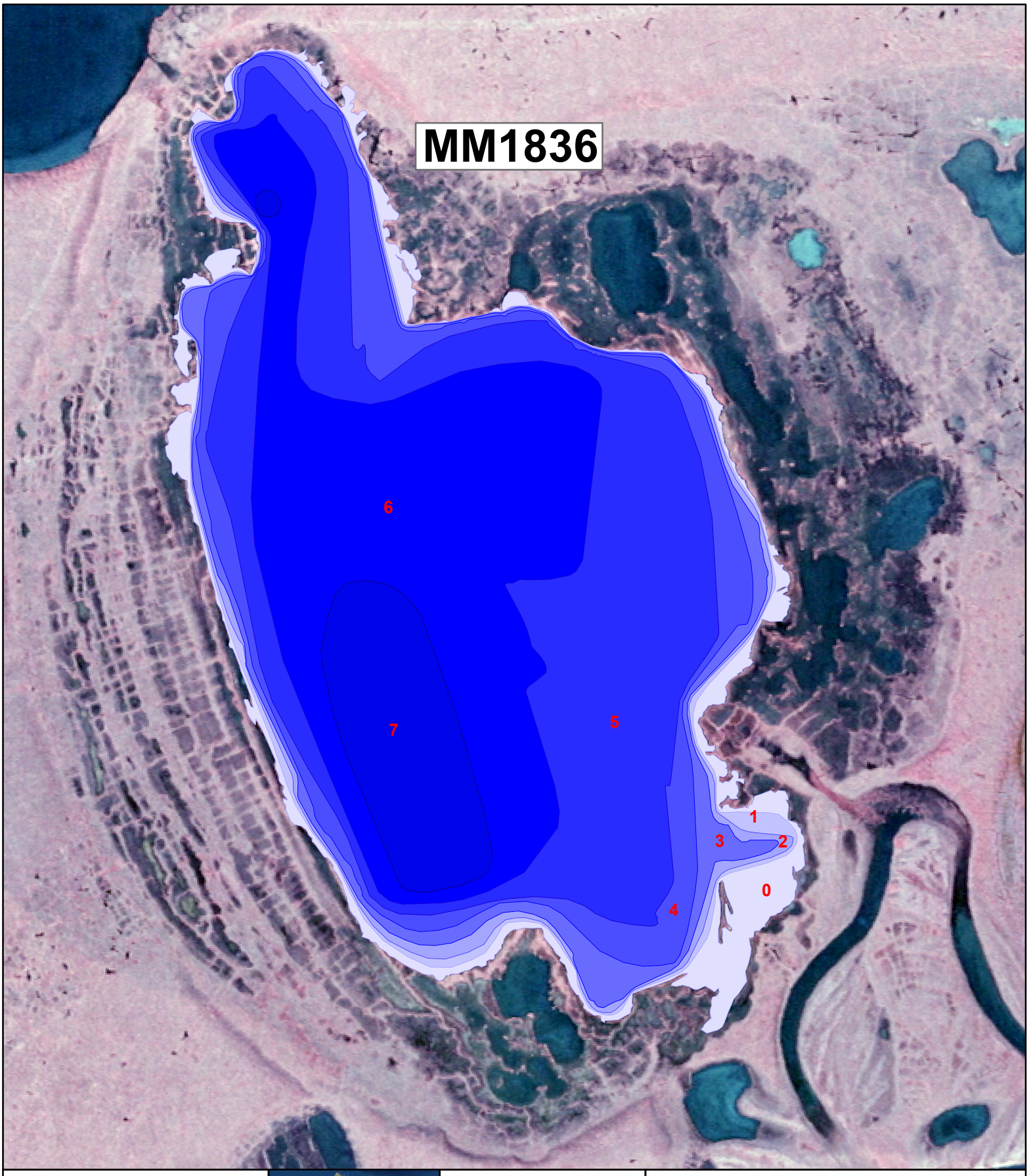
Depth Transects Surveyed at Lake MM1835

surveyed on July 26, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth in Feet

0 1 2 3 4 5 6 7

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1836

based on transects surveyed on July 26, 2018

SCALE:

250 125 0 250 500 750 1,000 Feet

N

Lake MM1836

Other Names: None Known
Location: 70.05987°N 152.46674°W
USGS Quad Sheet: Harrison Bay A-5: T8N R2W, Sec. 7,8
Habitat: Perched Lake
Area: 188 acres
Maximum Depth: 7.5 feet in 2018
Active Outlet: No
Total Lake Volume: 318.273 million gallons
Volume Under 4 ft of ice: 96.599 million gallons
Volume Under 5 ft of ice: 49.595 million gallons
Volume Under 7 ft of ice: 1.846 million gallons

Potential Ice Aggregate: 32.93 acres (water depth 4 ft or less)
9.764 million gallons

Maximum Recommended Winter Removal: **14.878 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	9.5	1.5	3.1	5.9	30	77	1.5	7.19	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Jul 26 18	9.0	none	0
Minnow Traps	Jul 26 18	15.2	Ninespine stickleback	3
Seine	not used			
Visual +Dipnet	Jul 26 18	25 yards	Ninespine stickleback	1

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.06386	-152.45859	7/26/2018	4.67	-0.48

Last Revised: January 8, 2019

Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

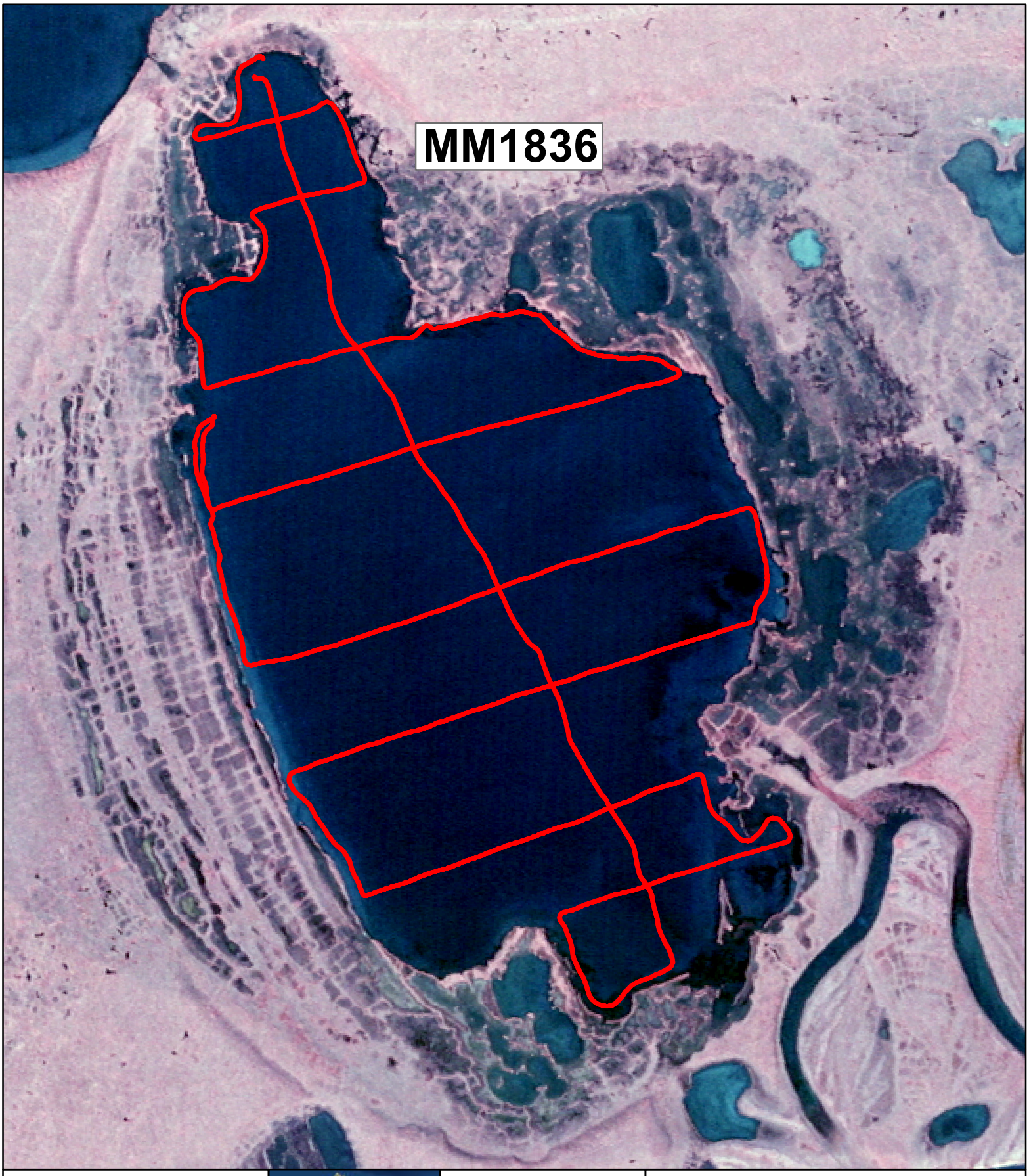
Area Available for Ice Chip Collection at Lake MM1836

based on transects surveyed on July 26, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 1,000 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

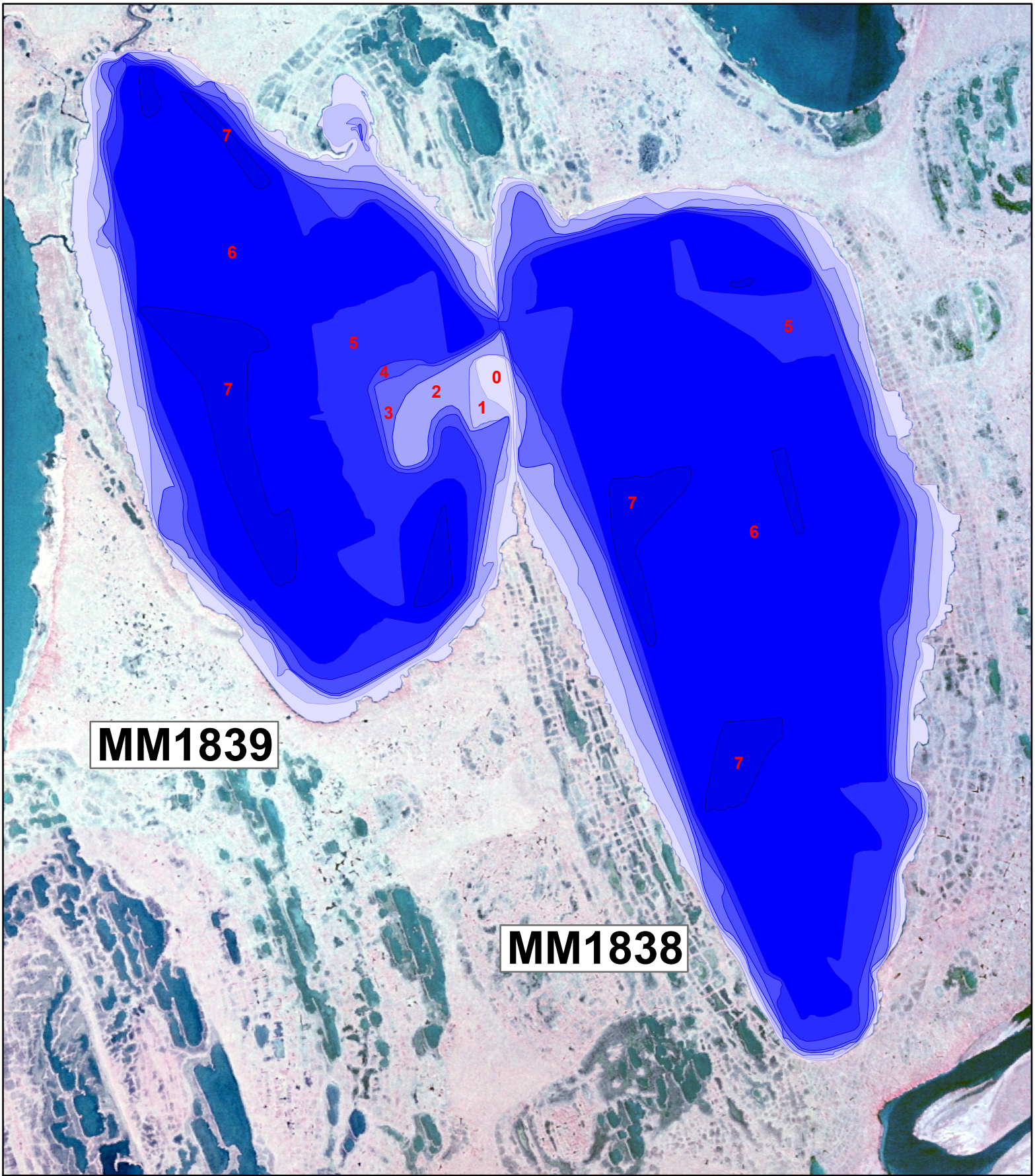
Depth Transects Surveyed at Lake MM1836

surveyed on July 26, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 750 1,000 Feet

N



Depth in Feet

0 1 2 3 4 5 6 7

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1838 and Lake MM1839

based on transects surveyed on July 13, 2018

SCALE:

500 250 0 500 1,000 1,500 Feet

N

Lake MM1838

Other Names: None Known
Location: 70.04601°N 152.60651°W
USGS Quad Sheet: Harrison Bay A-5: T8N R3W, Sec. 9,10,15,16,22
Habitat: Drainage Lake
Area: 407 acres
Maximum Depth: 7.4 feet in 2018
Active Outlet: Yes
Total Lake Volume: 691.364 million gallons
Volume Under 4 ft of ice: 222.592 million gallons
Volume Under 5 ft of ice: 126.099 million gallons
Volume Under 7 ft of ice: 1.893 million gallons

Potential Ice Aggregate: 99.07 acres (water depth 4 ft or less)
29.379 million gallons

Maximum Recommended Winter Removal: **0.284 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

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
2018	17.8	2.0	3.5	7.7	53	117	0.9	7.79	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 13 18	1.1	Broad whitefish	6	363-458
			Humpback whitefish	3	385-440
			Arctic grayling	1	343
Minnow Traps	Jul 13 18	19.8	Ninespine stickleback	1	
Seine	not used				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.05297	-152.64883	7/13/2018	3.43	-0.98

Last Revised: November 7, 2018

Lake MM1839

Other Names: None Known
Location: 70.04943°N 152.63884°W
USGS Quad Sheet: Harrison Bay A-5: T8N R3W, Sec. 9,10,15,16,22
Habitat: Drainage Lake
Area: 319 acres
Maximum Depth: 7.9 feet in 2018
Active Outlet: Yes
Total Lake Volume: 521.258 million gallons
Volume Under 4 ft of ice: 164.881 million gallons
Volume Under 5 ft of ice: 91.753 million gallons
Volume Under 7 ft of ice: 2.978 million gallons

Potential Ice Aggregate: 86.71 acres (water depth 4 ft or less)
25.714 million gallons

Maximum Recommended Winter Removal: **0.447 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

Water Chemistry:

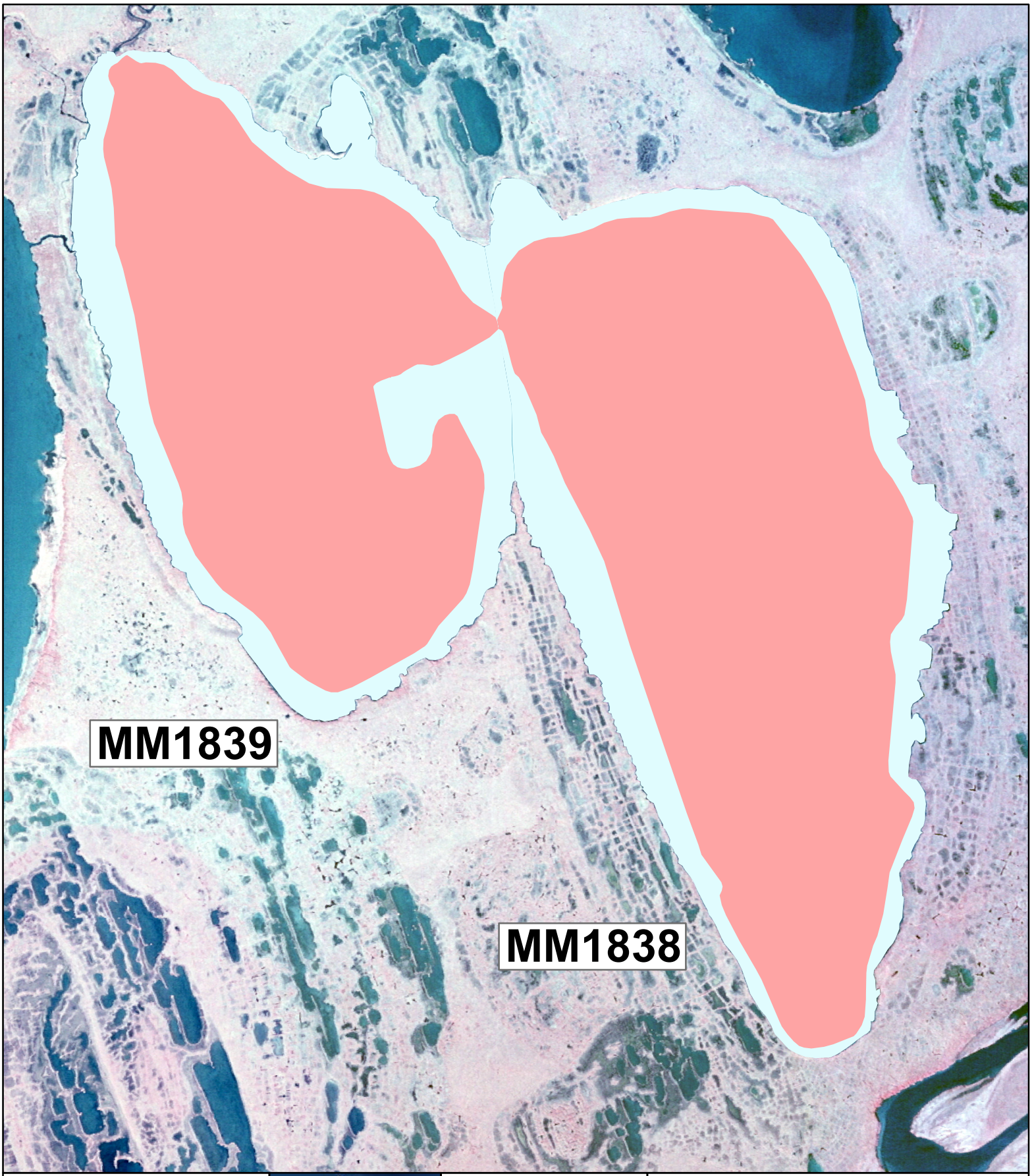
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	17.8	2.0	3.5	7.7	53	117	1.1	7.79	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 13 18	1.1	Broad whitefish	6	363-458
			Humpback whitefish	3	385-440
			Arctic grayling	1	343
Minnow Traps	Jul 13 18	19.8	Ninespine stickleback	1	
Seine	not used				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.05297	-152.64883	7/13/2018	3.43	-0.98

Last Revised: November 7, 2018



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

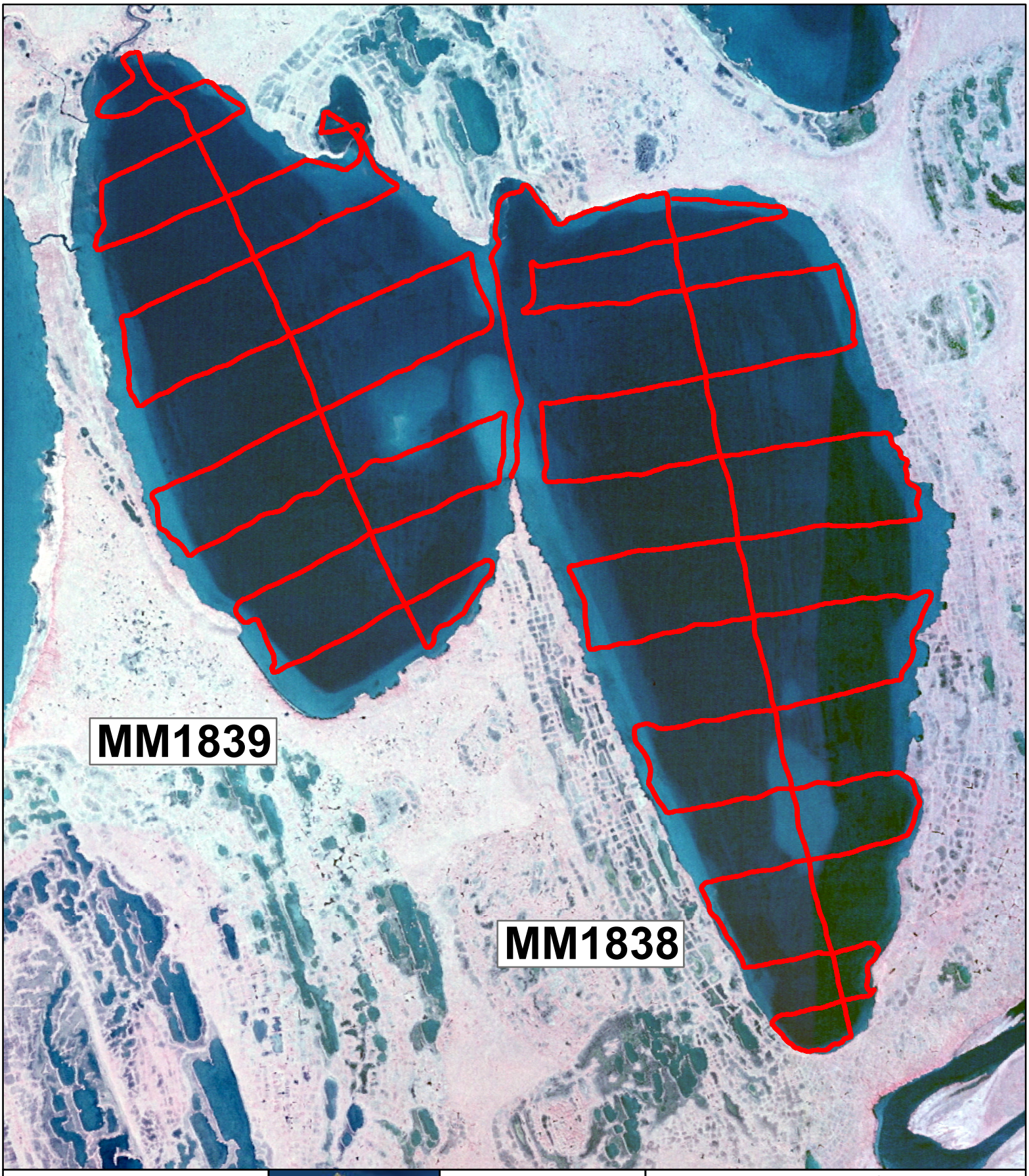
Area Available for Ice Chip Collection at Lake MM1838 and Lake MM1839

based on transects surveyed on July 13, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

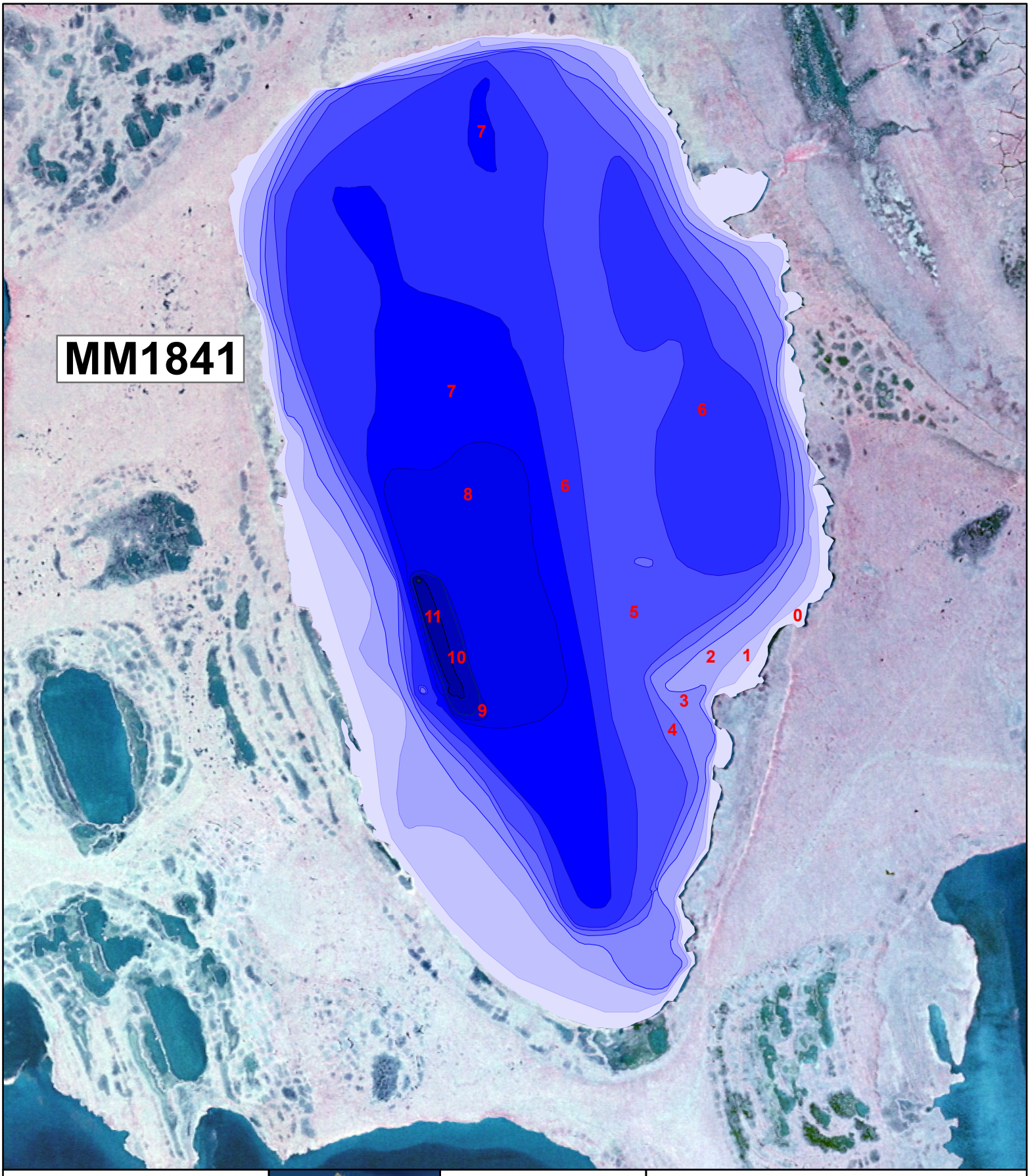
Depth Transects Surveyed at Lake MM1838 and Lake MM1839

surveyed on July 13, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N



Depth in Feet

0	3	6	9	12
1	4	7	10	
2	5	8	11	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1841

based on transects surveyed on July 14, 2018

SCALE:

500 250 0 500 1,000 Feet

N

Lake MM1841

Other Names: None Known
Location: 70.06556°N 152.60440°W
USGS Quad Sheet: Harrison Bay A-5: T8N R3W Sec. 3,10,11
Habitat: Tundra Lake
Area: 428 acres
Maximum Depth: 12.9 feet in 2018
Active Outlet: Yes
Total Lake Volume: 728.700 million gallons
Volume Under 4 ft of ice: 252.123 million gallons
Volume Under 5 ft of ice: 156.009 million gallons
Volume Under 7 ft of ice: 29.069 million gallons

Potential Ice Aggregate: 123.97 acres (water depth 4 ft or less)
36.765 million gallons

Maximum Recommended Winter Removal: **46.803 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	19.7	3.2	7.0	17.5	62	153	1.3	7.92	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Jul 14 18	9.4	none	0
Minnow Traps	Jul 14 18	8.5	Ninespine stickleback	63
Seine	not used			
Visual +Dipnet	not used			

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.07108	-152.61864	7/14/2018	3.83	-1.18

Last Revised: November 7, 2018

MM1841

Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

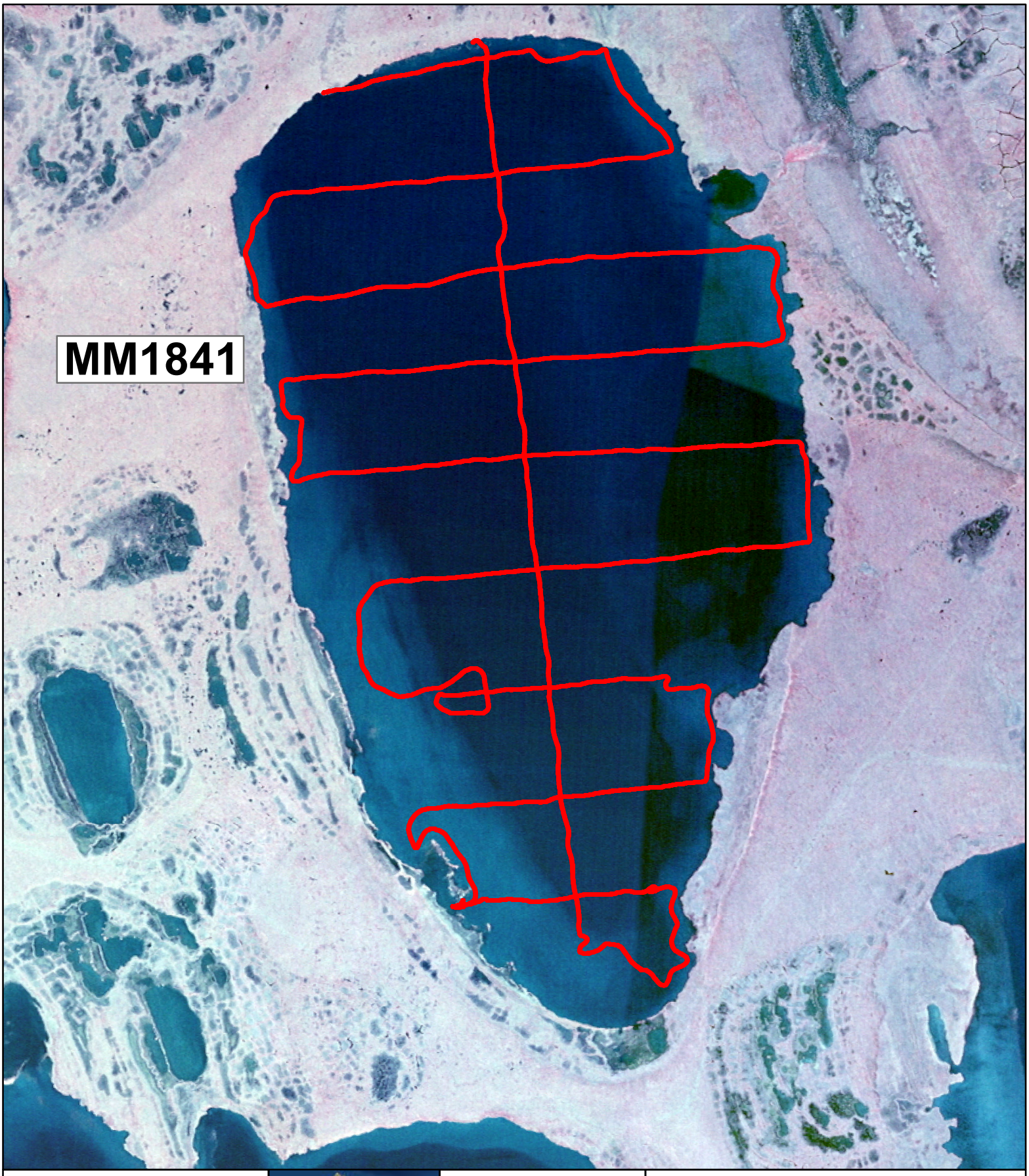
Area Available for Ice Chip Collection at Lake MM1841

based on transects surveyed on July 14, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

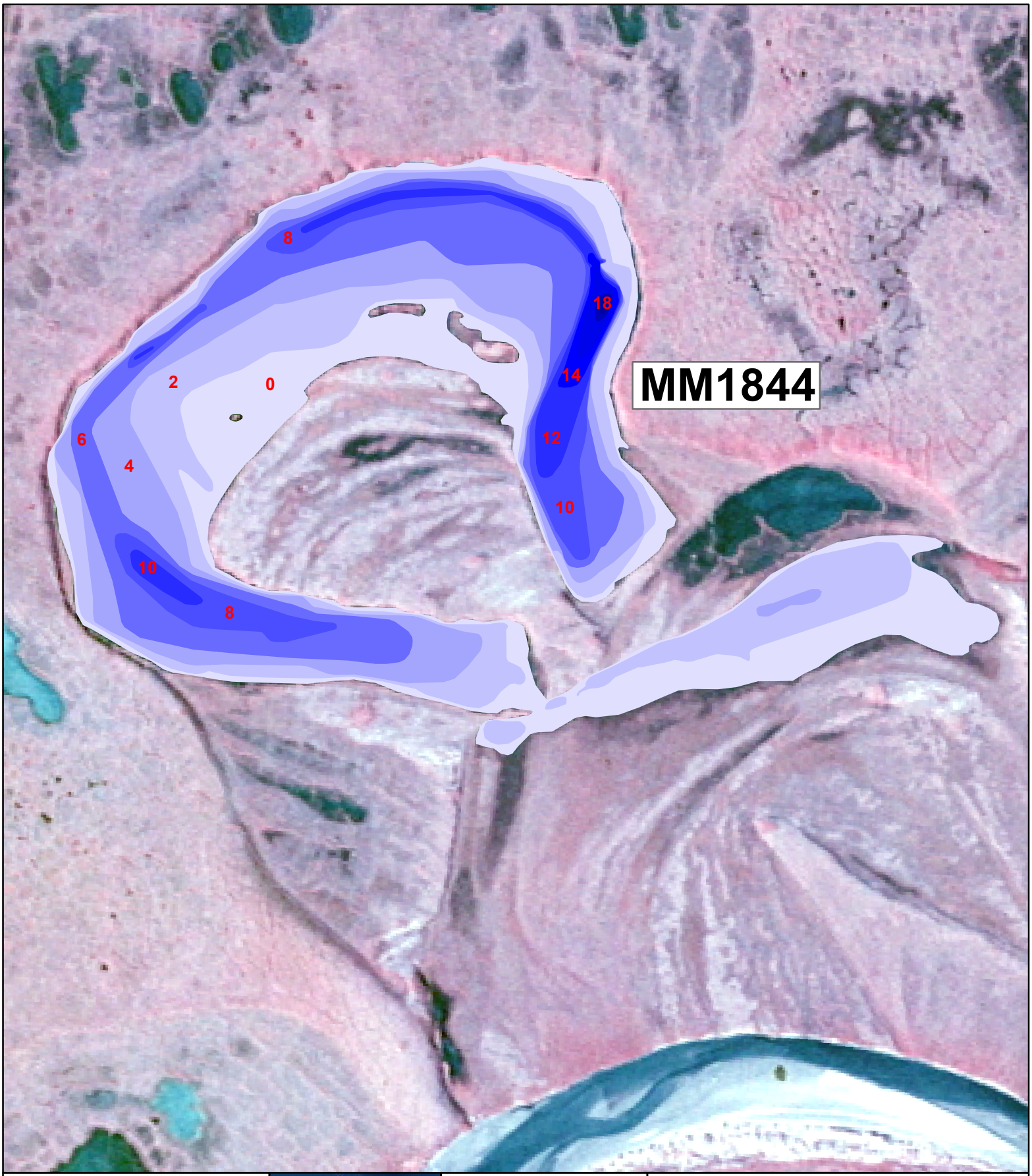
Depth Transects Surveyed at Lake MM1841

surveyed on July 14, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 Feet

N



Depth in Feet

0	6	12	18
2	8	14	
4	10	16	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1844 (depths in 2 foot intervals)

based on transects surveyed on August 13, 2018

SCALE:

250 125 0 250 500 Feet

N

Lake MM1844

Other Names: None Known
Location: 70.08232°N 152.42876°W
USGS Quad Sheet: Harrison Bay A-5: T8N R2W Sec. 4,5
Habitat: Oxbow Lake
Area: 48 acres
Maximum Depth: 19.0 feet in 2018
Active Outlet: No
Total Lake Volume: 69.355 million gallons
Volume Under 4 ft of ice: 23.313 million gallons
Volume Under 5 ft of ice: 16.366 million gallons
Volume Under 7 ft of ice: 6.815 million gallons

Potential Ice Aggregate: 24.01 acres (water depth 4 ft or less)
7.119 million gallons

Maximum Recommended Winter Removal: **4.910 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	22.2	3.1	3.6	7.8	68	150	0.8	8.23	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 13 18	9.0	none	0
Minnow Traps	Aug 13 18	12.8	Ninespine stickleback	1
Seine	not used			
Visual +Dipnet	Aug 13 18	5 yards	Ninespine stickleback	2+

+ denotes additional fish were visually observed but not caught

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.07877	-152.42407	8/13/2018	4.63	-1.39

Last Revised: January 8, 2019

Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake MM1844

based on transects surveyed on August 13, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N

Depth Transects Surveyed

MM1844 Transect Survey Line

MM1844

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

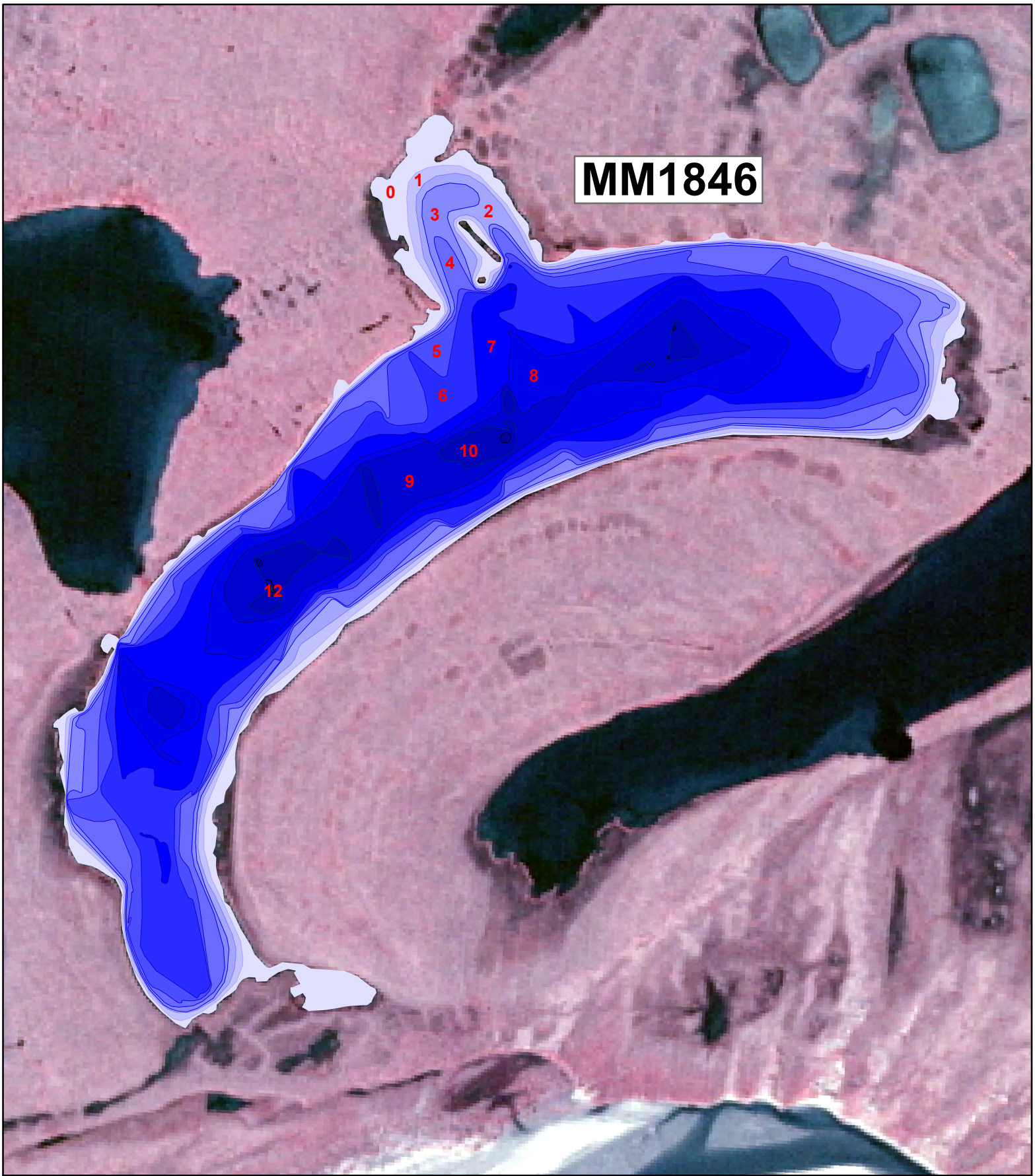
Depth Transects Surveyed at Lake MM1844

surveyed on August 13, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth in Feet

0	3	6	9		12
1	4	7	10		
2	5	8	11		

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1846

based on transects surveyed on July 28, 2018

SCALE:

250 125 0 250

Feet

N

Lake MM1846

Other Names: None Known
Location: 70.08936°N 152.36415°W
USGS Quad Sheet: Harrison Bay A-4: T9N R2W Sec. 34
Habitat: Oxbow Lake
Area: 36 acres
Maximum Depth: 13.1 feet in 2018
Active Outlet: No
Total Lake Volume: 67.588 million gallons
Volume Under 4 ft of ice: 27.150 million gallons
Volume Under 5 ft of ice: 18.911 million gallons
Volume Under 7 ft of ice: 6.647 million gallons

Potential Ice Aggregate: 8.82 acres (water depth 4 ft or less)
2.617 million gallons

Maximum Recommended Winter Removal: **5.673 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	11.0	1.5	2.2	4.9	33	79	0.7	7.65	B. Morris

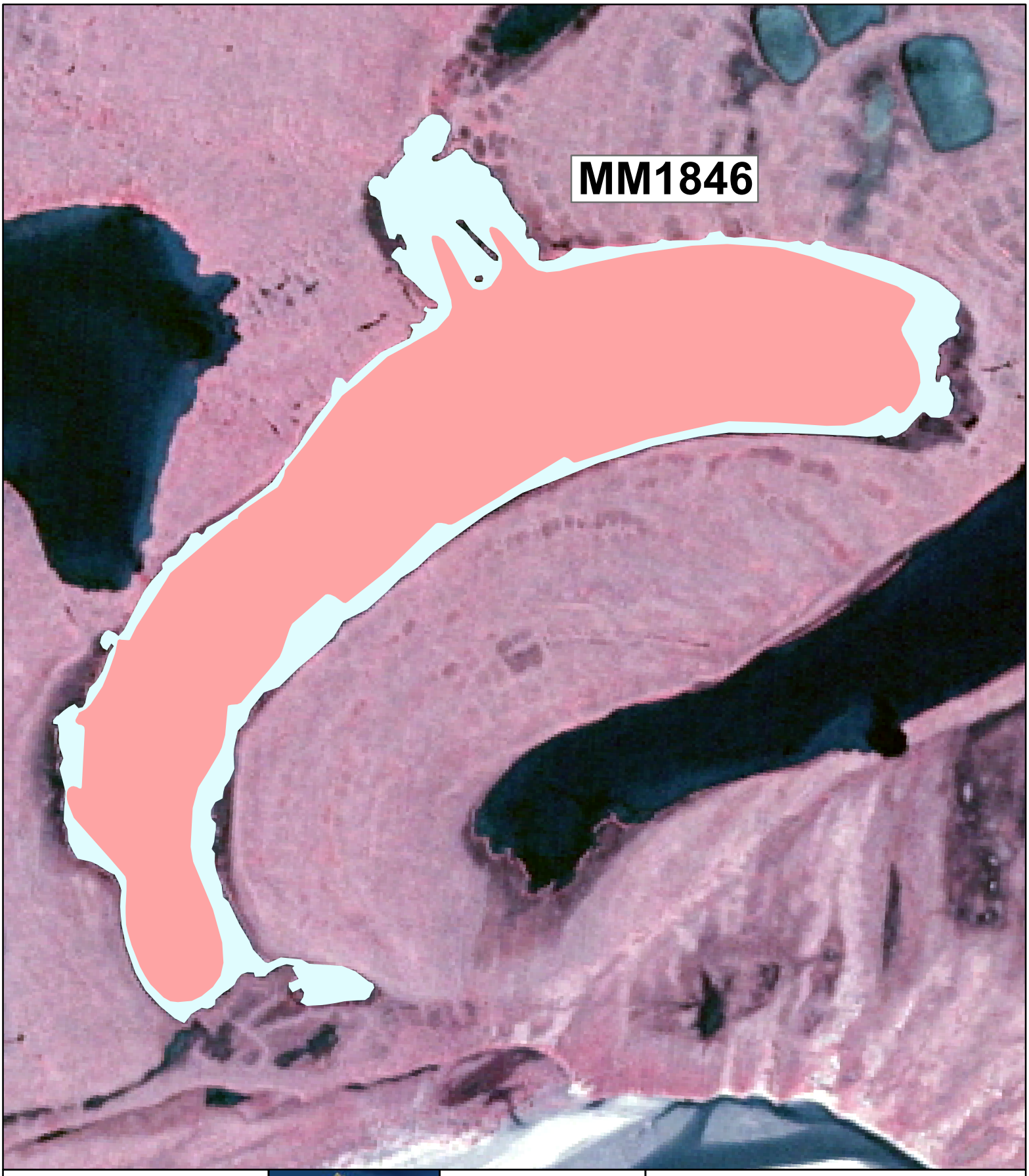
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Jul 28 18	9.3	none	0
Minnow Traps	Jul 28 18	11.6	Ninespine stickleback	4
Seine	not used			
Visual +Dipnet	not used			

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.08973	-152.35516	7/28/2018	5.10	-0.79

Last Revised: January 8, 2019



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

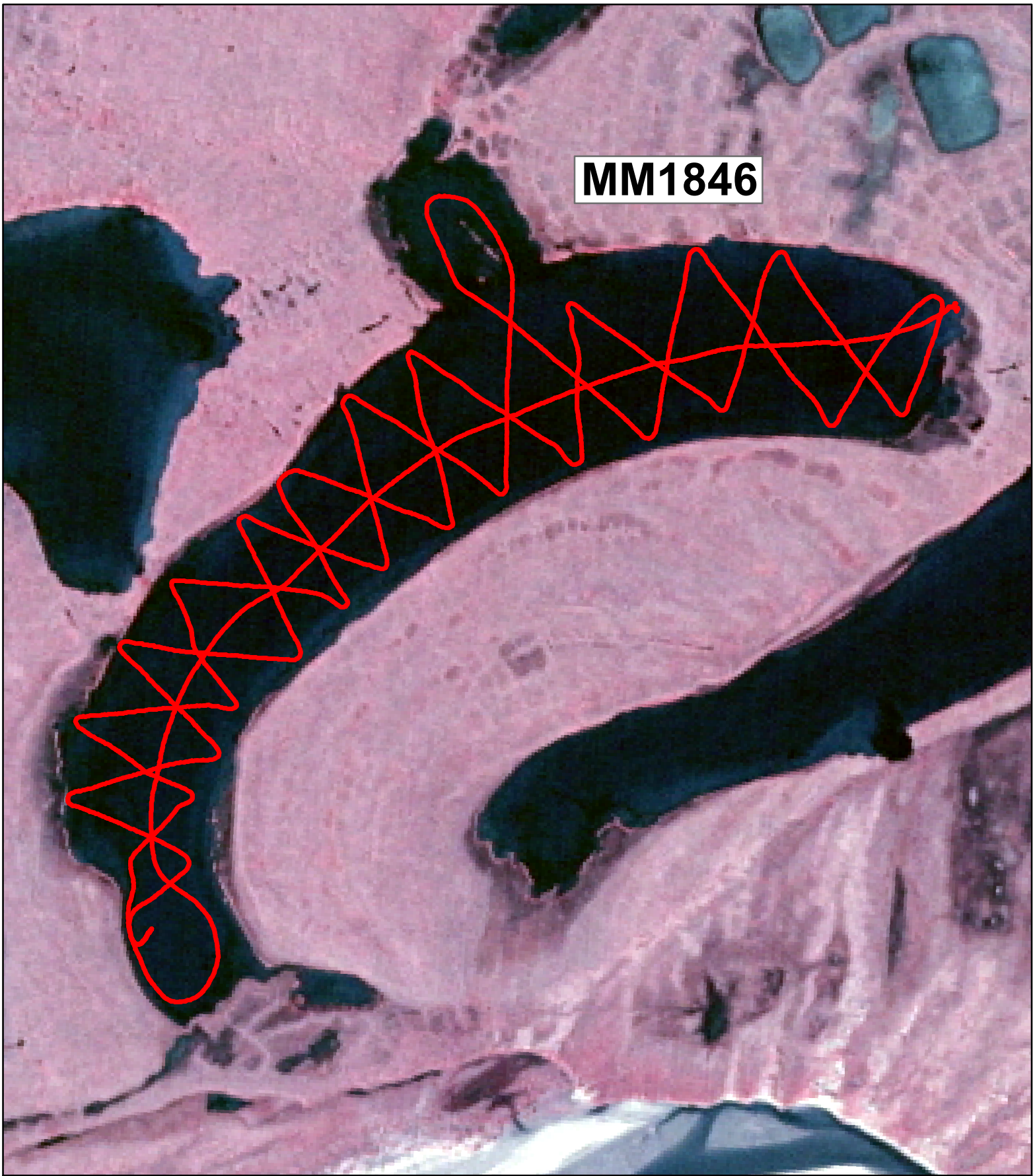
Area Available for Ice Chip Collection at Lake MM1846

based on transects surveyed on July 28, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

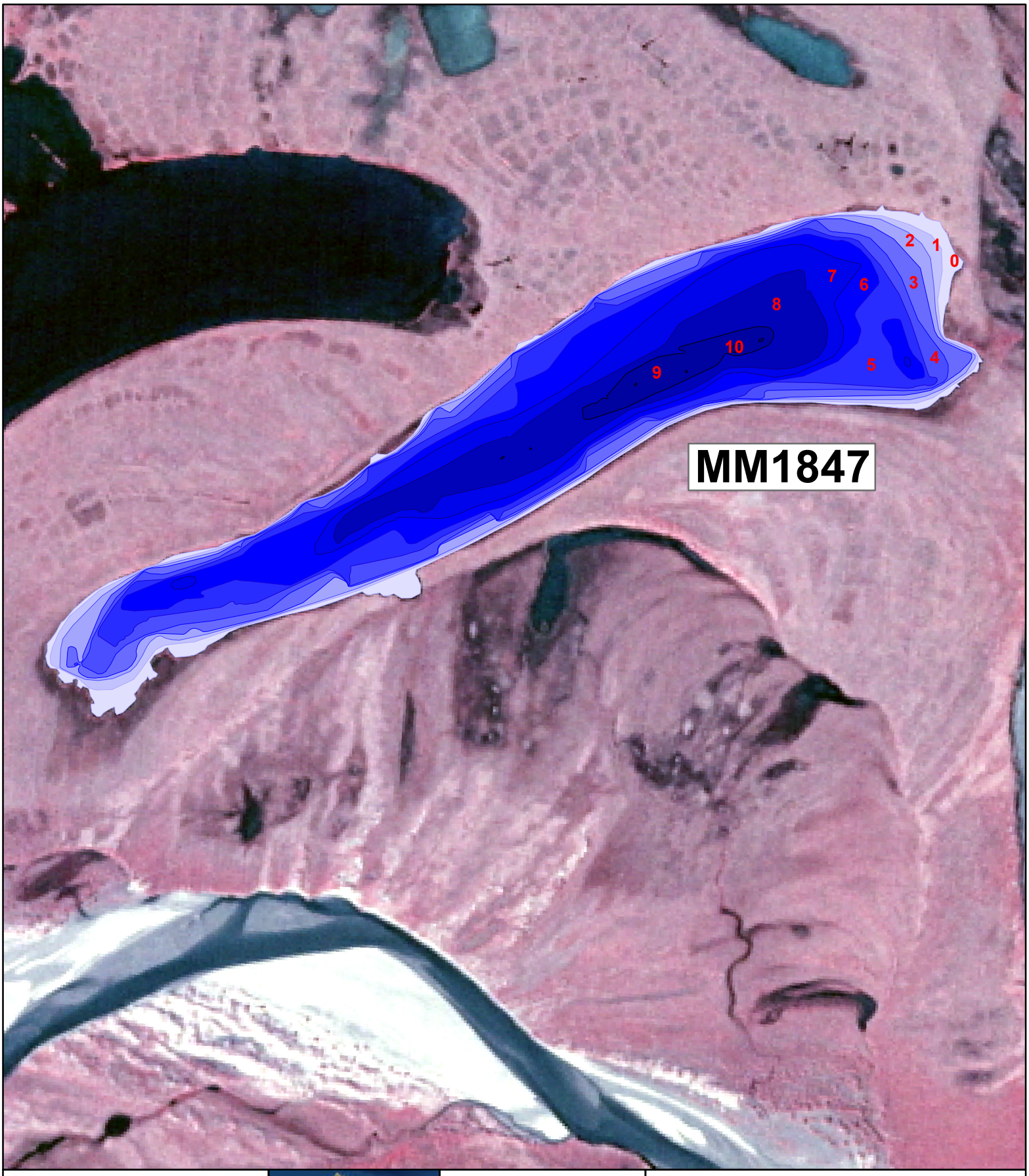
Depth Transects Surveyed at Lake MM1846

surveyed on July 28, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake MM1847

based on transects surveyed on July 28, 2018

SCALE:

250 125 0 250 500 Feet

N

Lake MM1847

Other Names: None Known
Location: 70.08962°N 152.34749°W
USGS Quad Sheet: Harrison Bay A-4: T9N R2W Sec. 34,35
Habitat: Oxbow Lake
Area: 28 acres
Maximum Depth: 11.0 feet in 2018
Active Outlet: No
Total Lake Volume: 50.682 million gallons
Volume Under 4 ft of ice: 18.602 million gallons
Volume Under 5 ft of ice: 12.319 million gallons
Volume Under 7 ft of ice: 3.434 million gallons

Potential Ice Aggregate: 7.31 acres (water depth 4 ft or less)
2.166 million gallons

Maximum Recommended Winter Removal: **3.696 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

Water Chemistry:

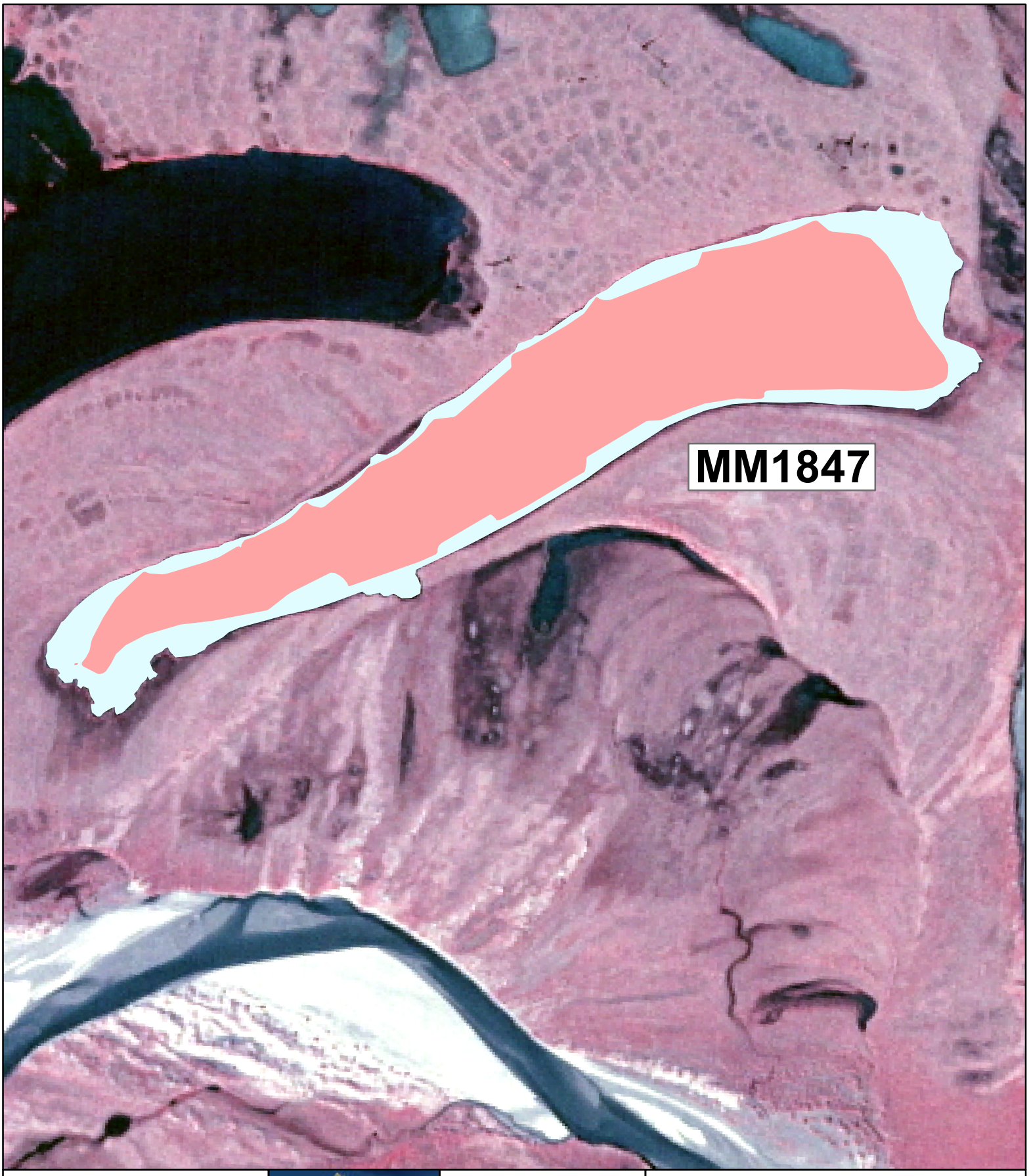
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	10.0	1.2	1.1	2.3	30	65	0.8	7.72	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Jul 28 18	9.2	none	0
Minnow Traps	Jul 28 18	14.0	none	0
Seine	not used			
Visual +Dipnet	Jul 28 18	60 yards	Ninespine stickleback	3

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.08920	-152.35333	7/28/2018	5.38	-0.66

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake MM1847

based on transects surveyed on July 28, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N

Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Transects Surveyed at Lake MM1847

surveyed on July 28, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N

R0205

0
1
2
3
4
5
6
7

Depth in Feet

0 1 2 3 4 5 6 7

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips
Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake R0205

based on transects surveyed on August 9, 2018

SCALE:

500 250 0 500 1,000 1,500 Feet

N

Lake R0205

Other Names: MM1837
Location: 70.04945°N 152.55842°W
USGS Quad Sheet: Harrison Bay A-5: T8N R3W, Sec. 11,12,13,14
Habitat: Perched Lake
Area: 664 acres
Maximum Depth: 7.2 feet in 2018 (6.1 feet in 2002 Reanier survey)
Active Outlet: No
Total Lake Volume: 924.941 million gallons
Volume Under 4 ft of ice: 204.443 million gallons
Volume Under 5 ft of ice: 74.314 million gallons
Volume Under 7 ft of ice: 0.487 million gallons

Potential Ice Aggregate: 196.83 acres (water depth 4 ft or less)
58.371 million gallons

Maximum Recommended Winter Removal: **22.294 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	29.8	6.9	14.5	35.7	103	269	1.4	8.21	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Aug 9 18	9.9	none	0
Minnow Traps	Aug 9 18	19.0	none	0
Seine	Aug 9 18	4 hauls	Ninespine stickleback	1
Visual +Dipnet	Aug 9 18	160 yards	Ninespine stickleback	+

+ denotes fish were visually observed but not caught

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.04219	-152.55040	8/9/2018	4.31	-7.31

Last Revised: January 8, 2019

R0205

Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Area Available for Ice Chip Collection at Lake R0205

based on transects surveyed on August 9, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N

R0205

Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

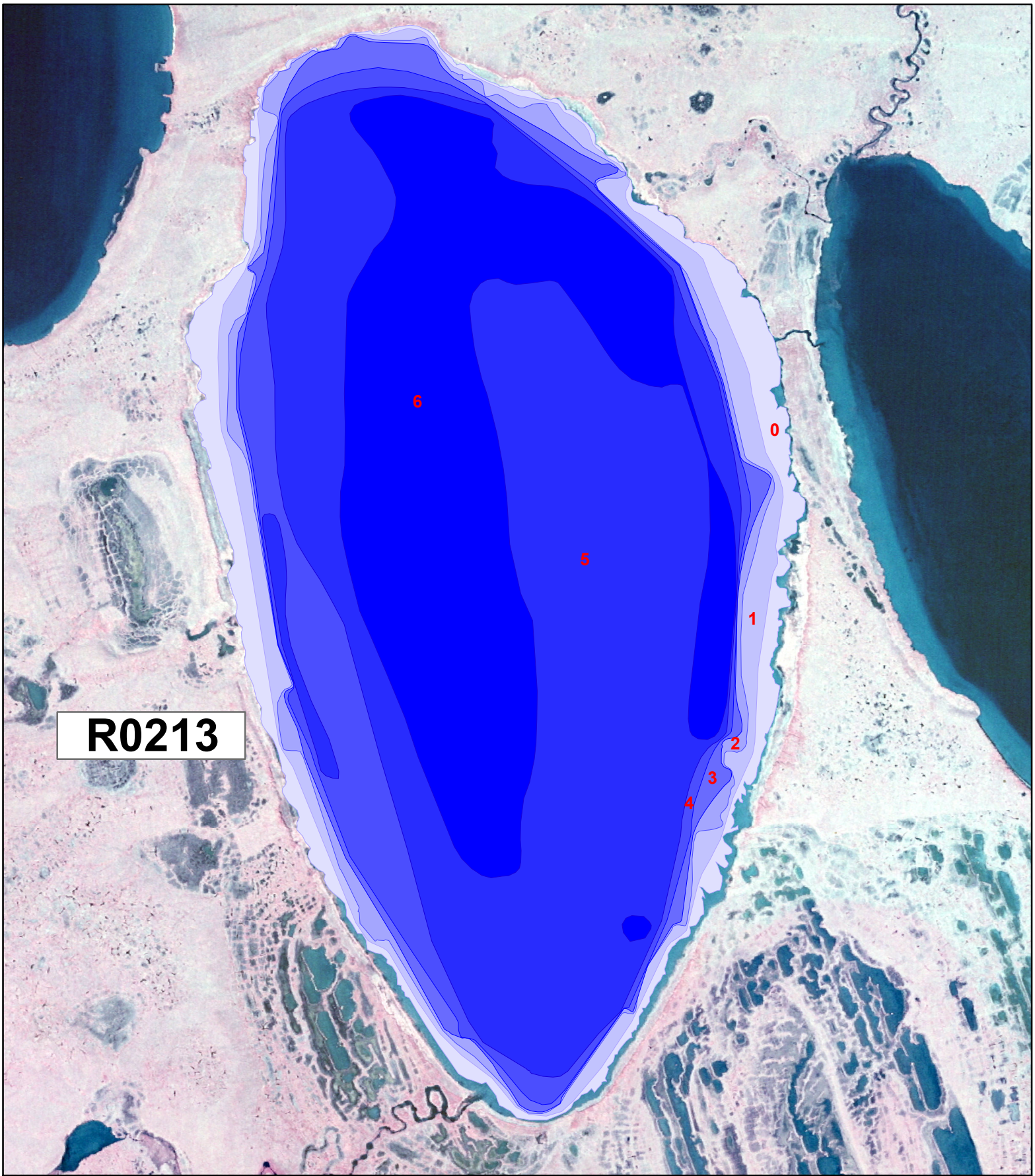
Depth Transects Surveyed at Lake R0205

surveyed on August 9, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N



Depth in Feet

0 1 2 3 4 5 6

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake R0213

based on transects surveyed on July 14, 2018

SCALE:

500 250 0 500 1,000 1,500 Feet

N

Lake R0213

Other Names: MM1840
Location: 70.04534°N 152.66957°W
USGS Quad Sheet: Harrison Bay A-5: T8N R3W Sec. 8,9,16,17,20,21
Habitat: Drainage Lake
Area: 770 acres
Maximum Depth: 7.1 feet in 2018 (5.9 feet in 2002 Reanier survey)
Active Outlet: Yes
Total Lake Volume: 1221.466 million gallons
Volume Under 4 ft of ice: 334.715 million gallons
Volume Under 5 ft of ice: 145.050 million gallons
Volume Under 7 ft of ice: 0.000 million gallons

Potential Ice Aggregate: 153.045 acres (water depth 4 ft or less)
45.387 million gallons

Maximum Recommended Winter Removal: **0.000 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

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
2018	16.4	1.8	3.0	6.4	49	106	1.0	7.72	B. Morris

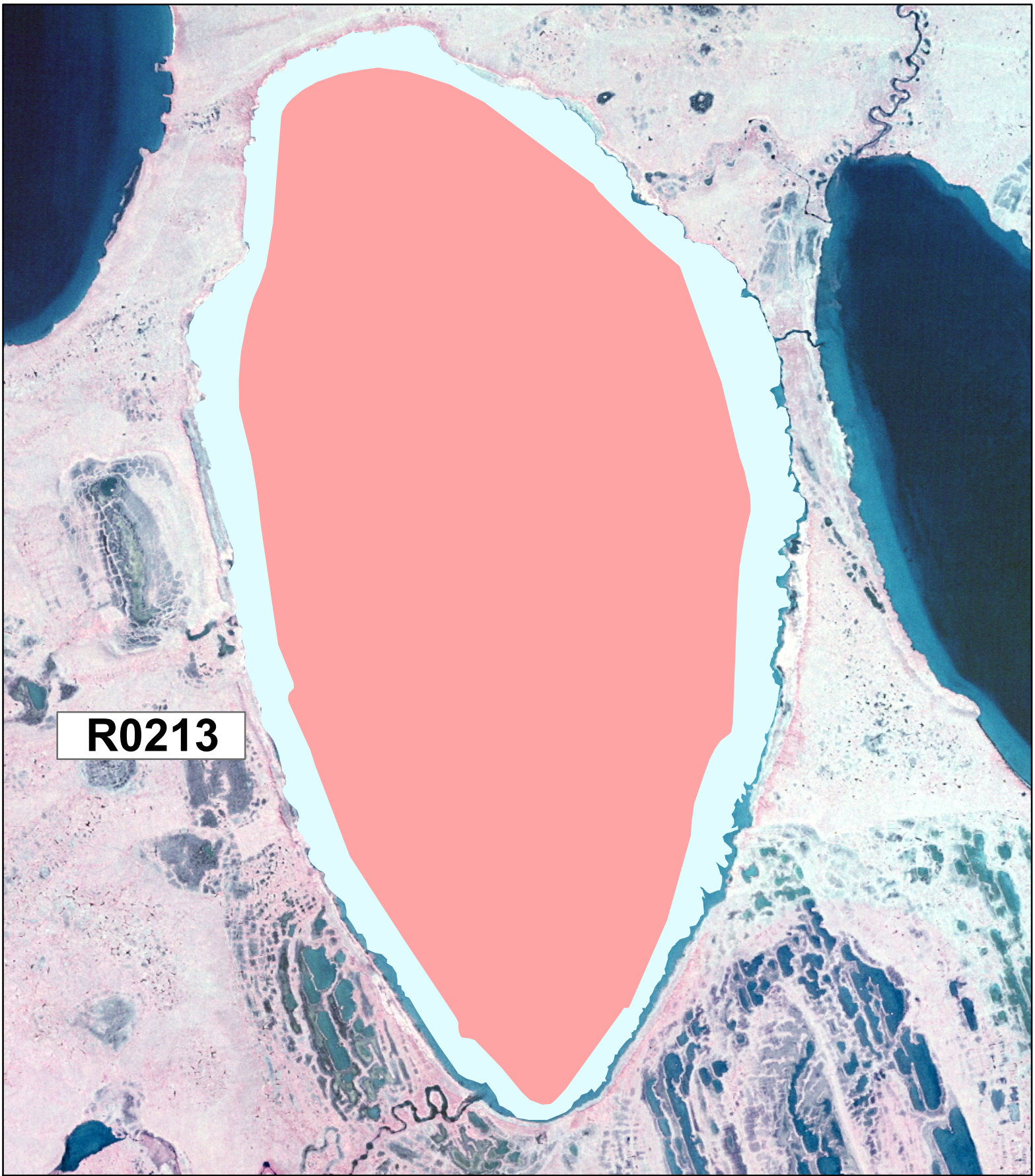
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	gear not set, connected to MM1838			
Minnow Traps				
Seine				
Visual +Dipnet				

Water Surface Elevation

Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.03311	-152.66329	7/14/2018	3.61	-6.24

Last Revised: November 7, 2018



Ice Chip Areas

- 4 feet or shallower - available for ice chips
- Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

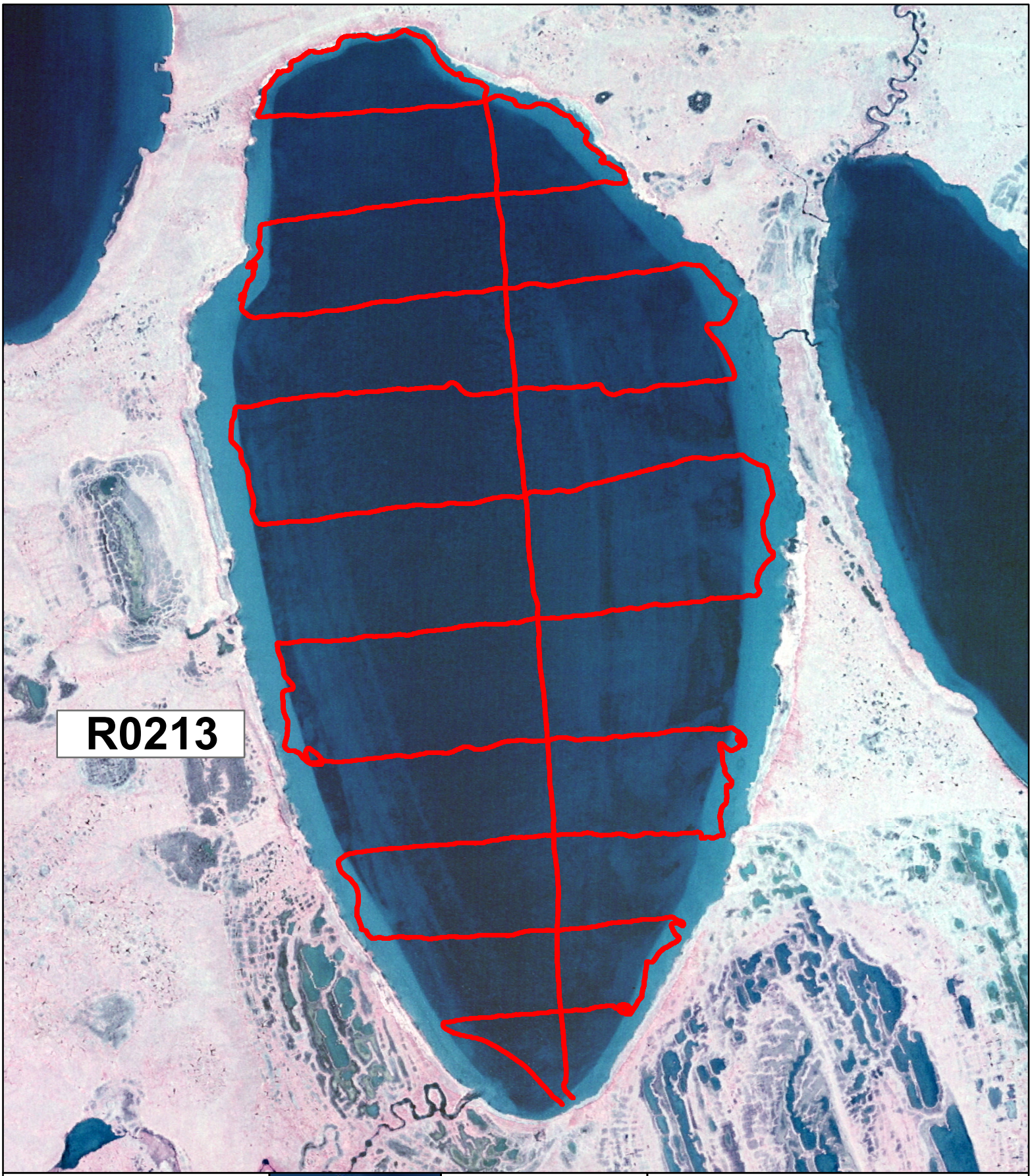
Area Available for Ice Chip Collection at Lake R0213

based on transects surveyed on July 14, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N



Depth Transects Surveyed

—— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

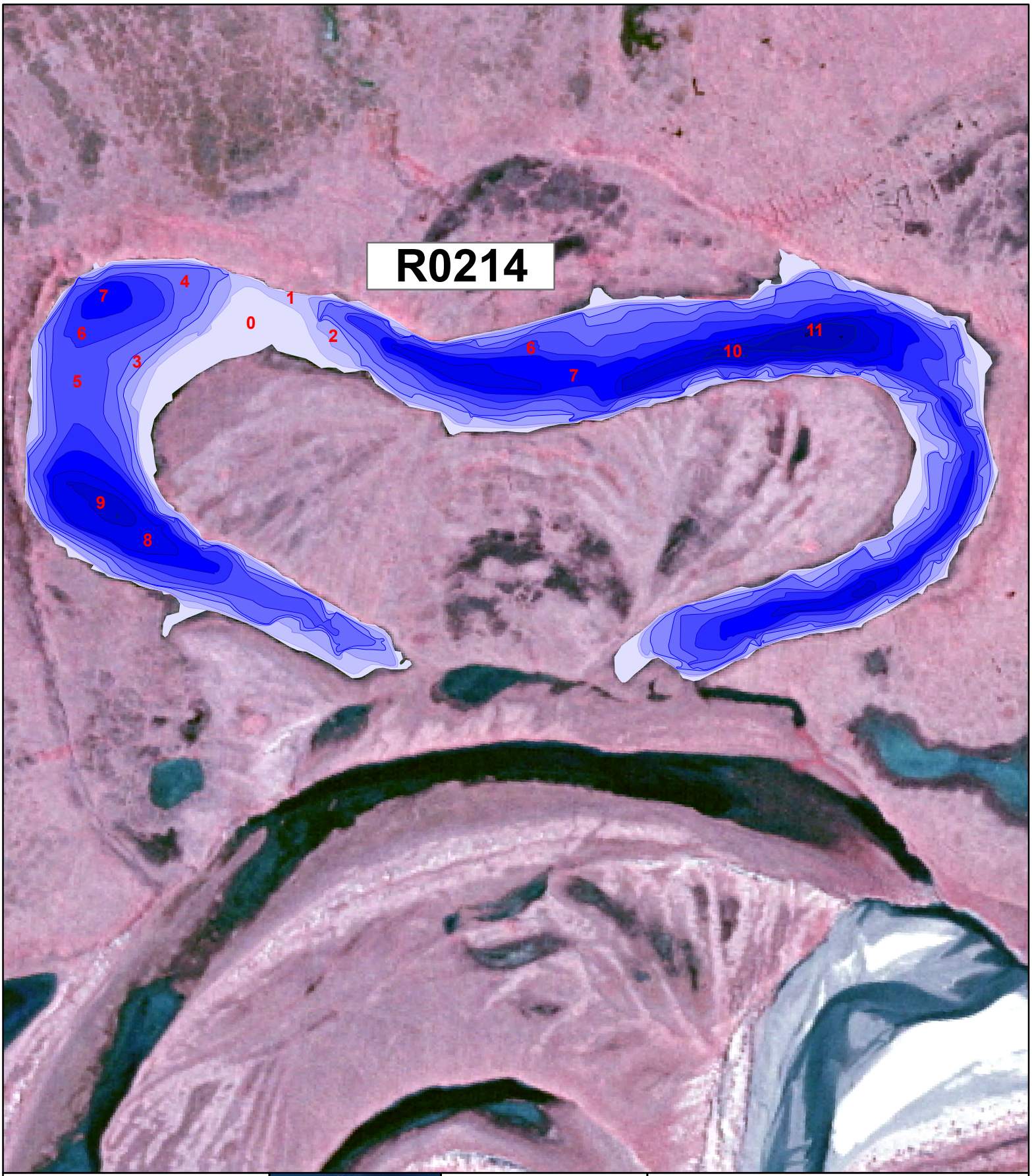
Depth Transects Surveyed at Lake R0213

surveyed on July 14, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	11

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake R0214

based on transects surveyed on July 16, 2018

SCALE:

250 125 0 250 500 Feet

N

Lake R0214

Other Names: MM1845
Location: 70.08917°N 152.39186°W
USGS Quad Sheet: Harrison Bay A-4/5: T9N R2W Sec. 33,34
Habitat: Oxbow Lake
Area: 44 acres
Maximum Depth: 11.1 feet in 2018 (11.2 feet in 2002 Reanier survey)
Active Outlet: Yes
Total Lake Volume: 66.639 million gallons
Volume Under 4 ft of ice: 20.616 million gallons
Volume Under 5 ft of ice: 12.834 million gallons
Volume Under 7 ft of ice: 3.592 million gallons

Potential Ice Aggregate: 16.41 acres (water depth 4 ft or less)
4.866 million gallons

Maximum Recommended Winter Removal: **3.850 million gallons**
(30% of water volume under 5 ft of ice)
(Resistant species present)

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
2018	17.9	2.0	2.5	5.6	53	81	0.6	7.70	B. Morris

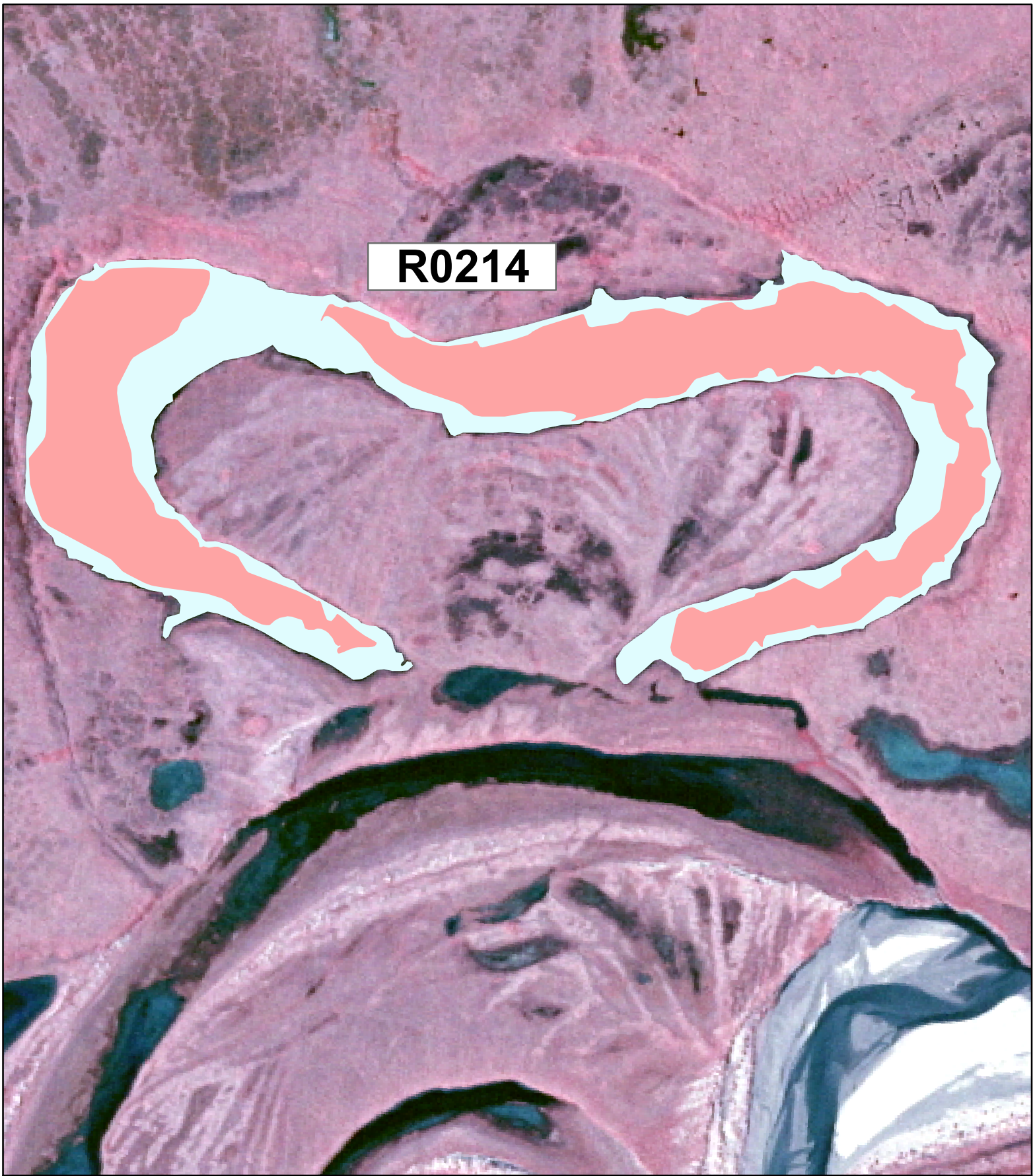
Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught
Gill Net	Jul 16 18	10.0	none	0
Minnow Traps	Jul 16 18	16.9	Ninespine stickleback	1
Seine	Jul 16 18	2 hauls	Ninespine stickleback	1
Visual +Dipnet	not used			

Water Surface Elevation Temporary Bench Mark

Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.08899	-152.38533	7/16/2018	5.71	-3.50

Last Revised: November 7, 2018



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

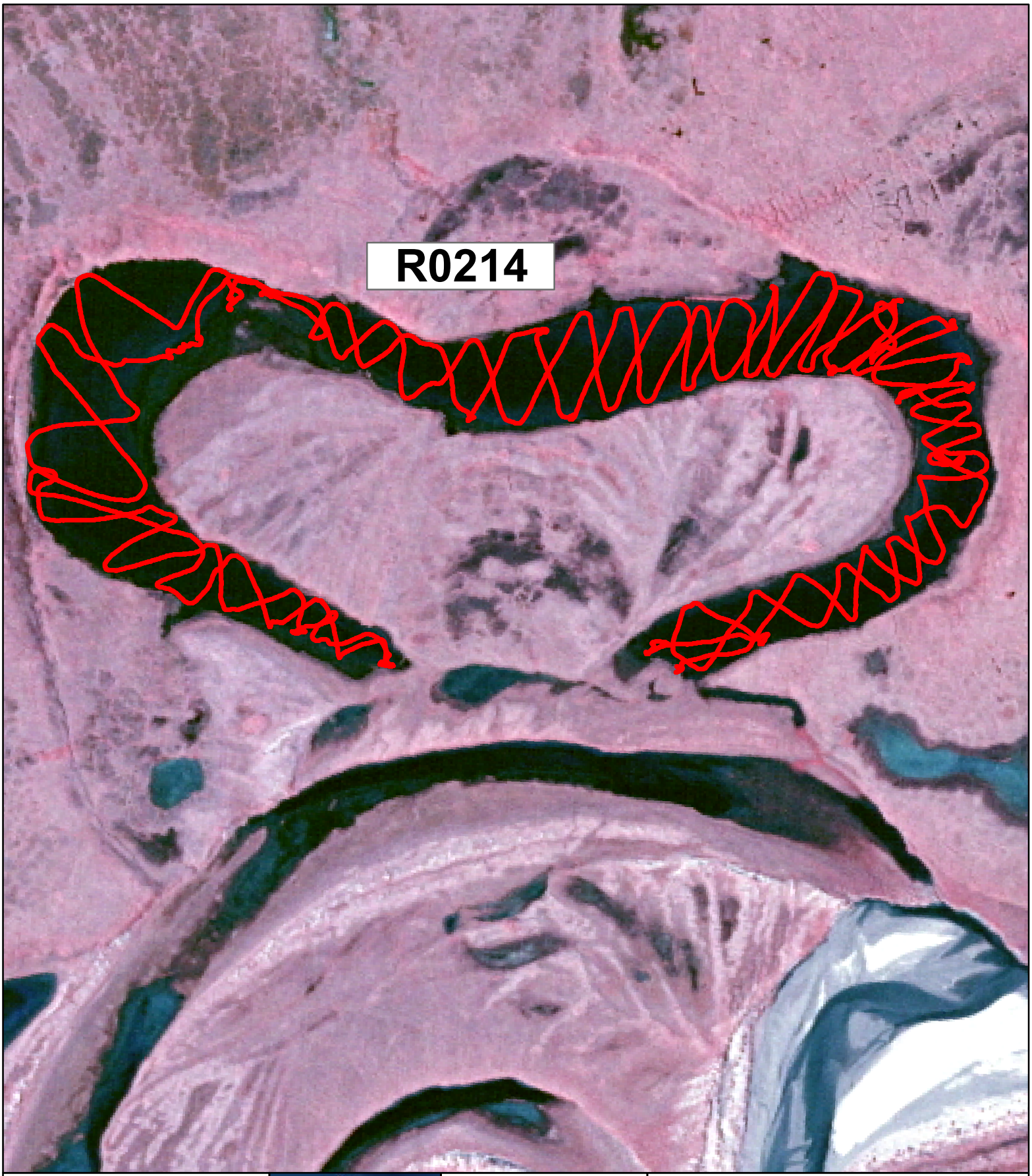
Area Available for Ice Chip Collection at Lake R0214

based on transects surveyed on July 16, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth Transects Surveyed

= Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

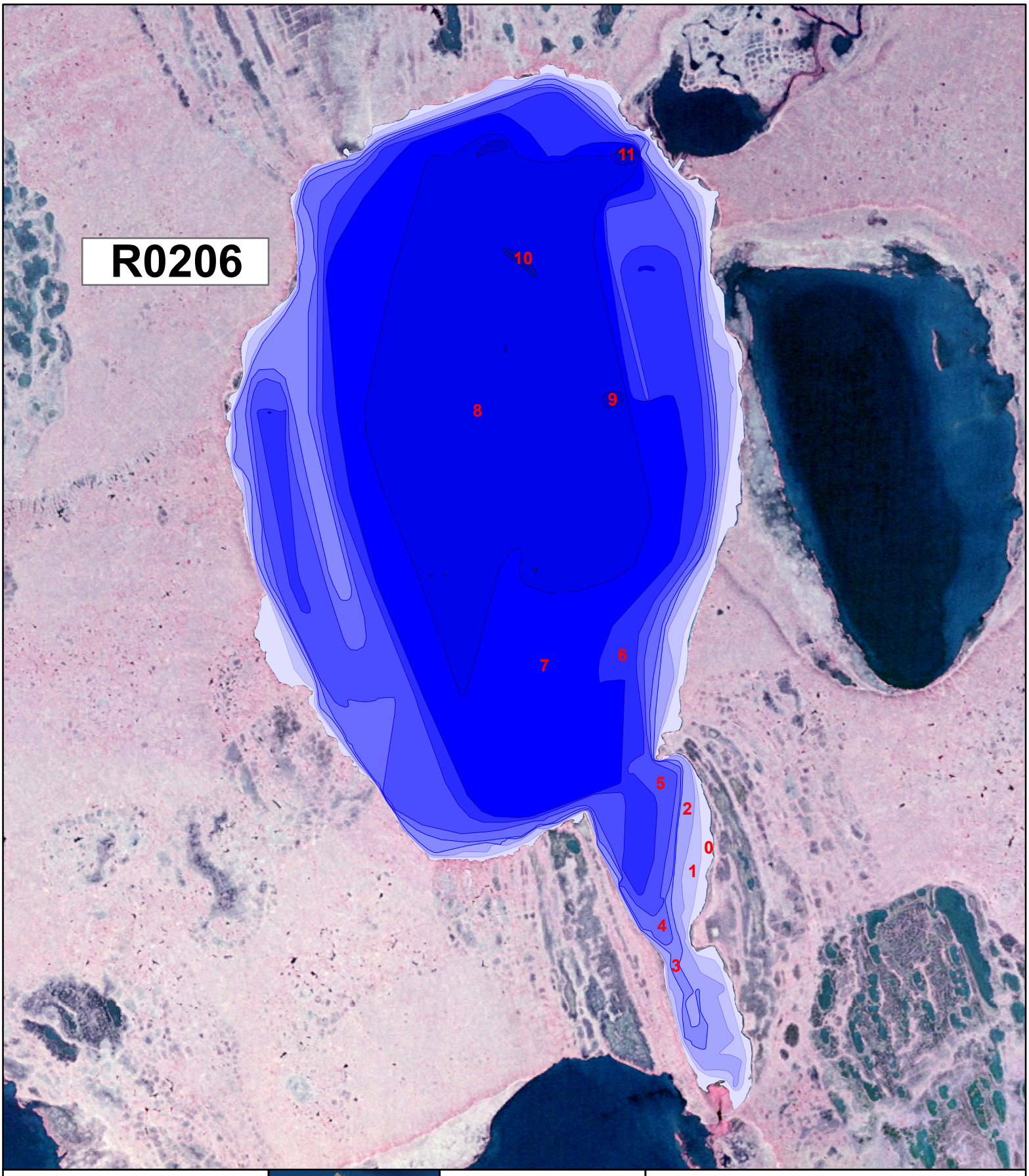
Depth Transects Surveyed at Lake R0214

surveyed on July 16, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

250 125 0 250 500 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	11

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake R0206

based on transects surveyed on July 27, 2018

SCALE:

500 250 0 500 1,000 1,500 Feet

N

Lake R0206

Other Names: MM1842
Location: 70.09937°N 152.46224°W
USGS Quad Sheet: Harrison Bay A-5: T9N R2W Sec. 29-32
Habitat: Drainage Lake
Area: 391 acres
Maximum Depth: 11.9 feet in 2018 (8.7 feet in 2002 Reanier survey)
Active Outlet: Yes
Total Lake Volume: 863.589 million gallons
Volume Under 4 ft of ice: 395.391 million gallons
Volume Under 5 ft of ice: 293.950 million gallons
Volume Under 7 ft of ice: 128.954 million gallons

Potential Ice Aggregate: 68.14 acres (water depth 4 ft or less)
20.208 million gallons

Maximum Recommended Winter Removal: **19.343 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

Water Chemistry:

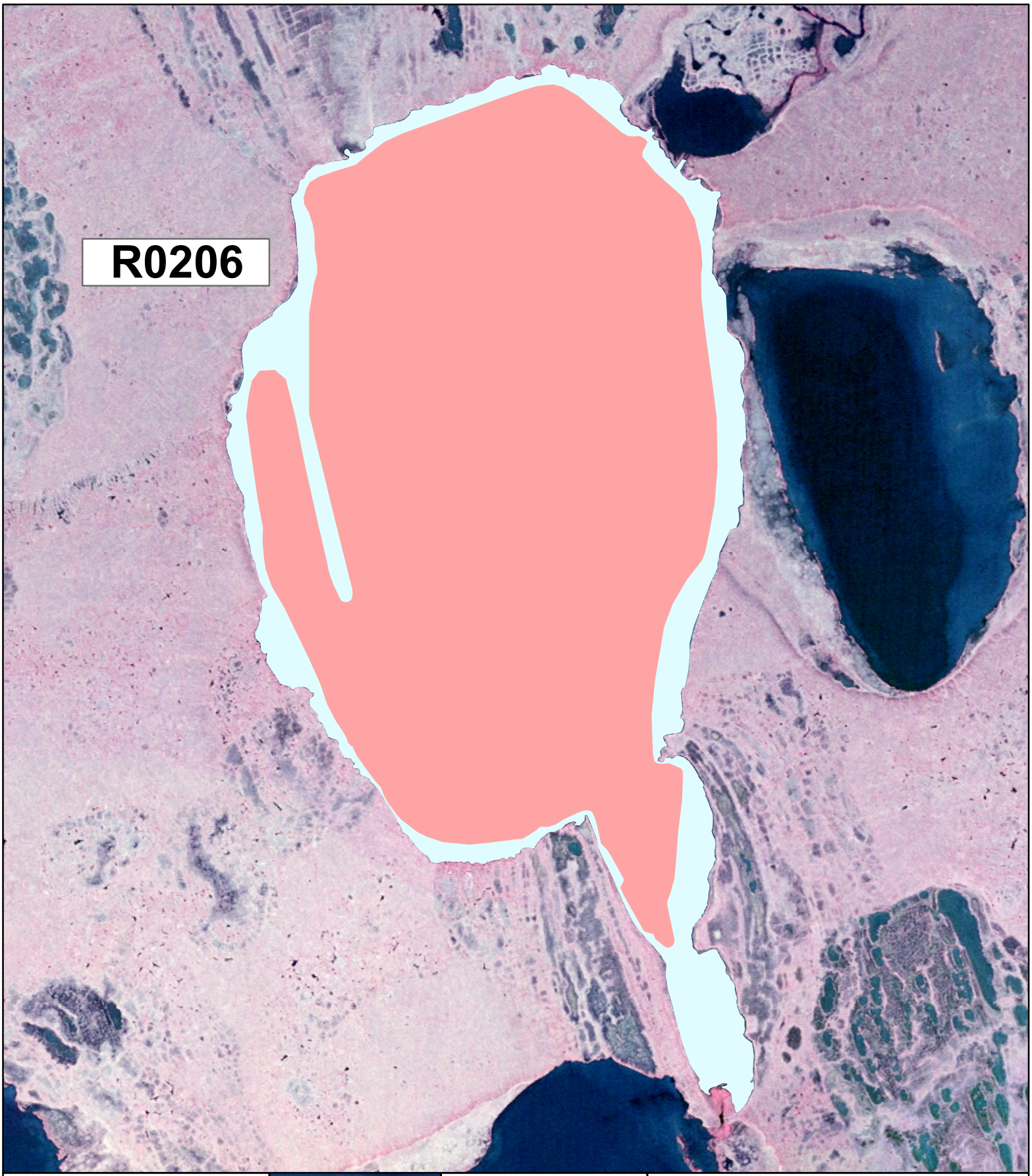
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	11.0	2.0	4.1	9.1	36	94	1.2	6.91	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 27 18	6.0	Broad whitefish	8	167-521
			Round whitefish	1	190
			Least cisco	2	180-195
Minnow Traps	Jul 27 18	12.2	Ninespine stickleback	1	
Seine	not used				
Visual +Dipnet	not used				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.08870	-152.45186	7/27/2018	4.86	-1.31

Last Revised: January 8, 2019



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

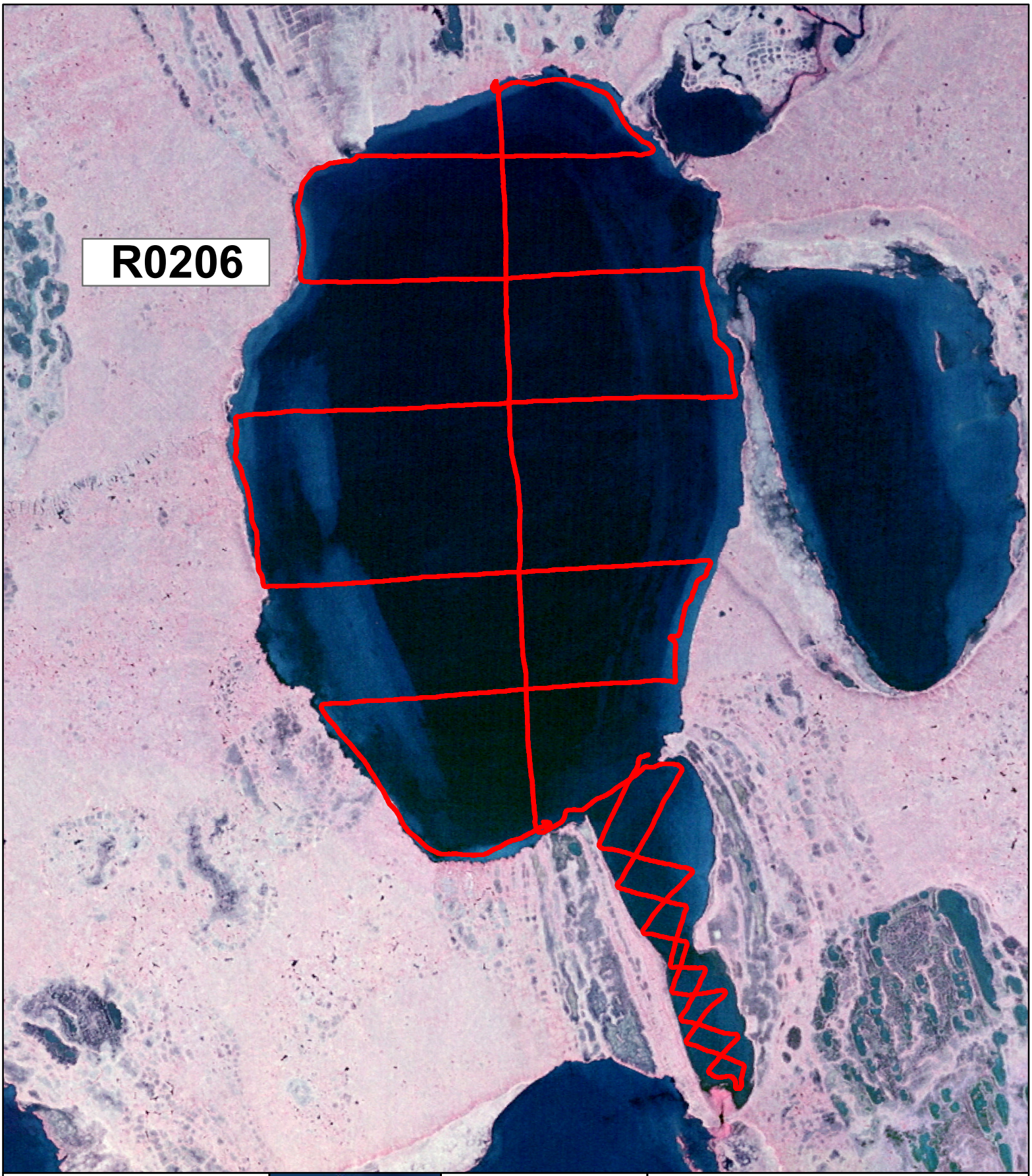
Area Available for Ice Chip Collection at Lake R0206

based on transects surveyed on July 27, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N



Depth Transects Surveyed

= Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

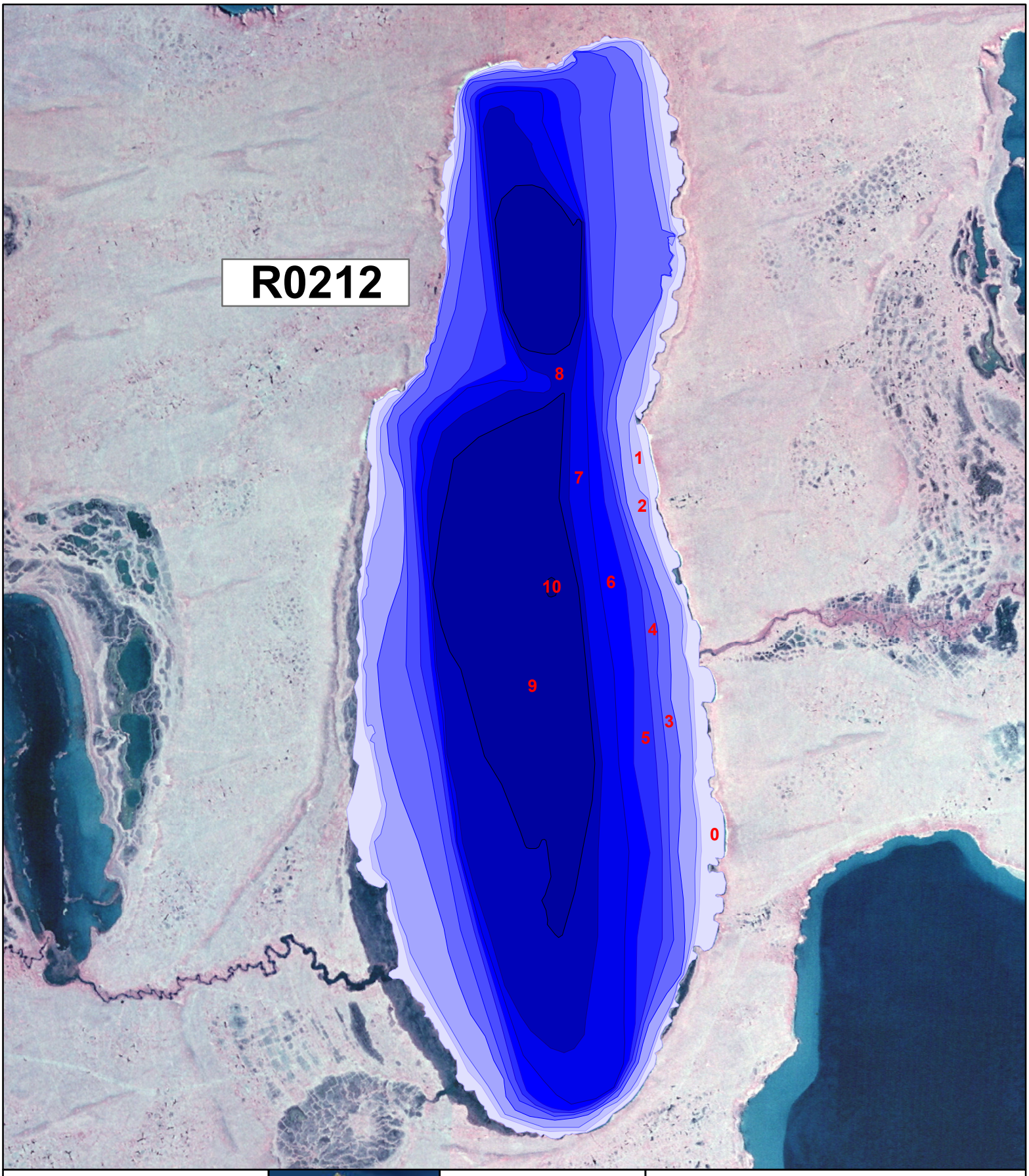
Depth Transects Surveyed at Lake R0206

surveyed on July 27, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 Feet

N



Depth in Feet

0	3	6	9
1	4	7	10
2	5	8	

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

Depth Contours at Lake R0212

based on transects surveyed on July 12, 2018

SCALE:

500 250 0 500 1,000 1,500 2,000 Feet

N

Lake R0212

Other Names: MM1843
Location: 70.06062°N 152.70638°W
USGS Quad Sheet: Harrison Bay A-5: T8N R3W Sec. 5,6,7,8,17,18
Habitat: Drainage Lake
Area: 551 acres
Maximum Depth: 11.2 feet in 2018 (9.3 feet in 2002 Reanier survey)
Active Outlet: Yes
Total Lake Volume: 1047.748 million gallons
Volume Under 4 ft of ice: 427.569 million gallons
Volume Under 5 ft of ice: 315.756 million gallons
Volume Under 7 ft of ice: 133.163 million gallons

Potential Ice Aggregate: 182.23 acres (water depth 4 ft or less)
54.043 million gallons

Maximum Recommended Winter Removal: **19.974 million gallons**
(15% of water volume under 7 ft of ice)
(Sensitive species present)

Water Chemistry:

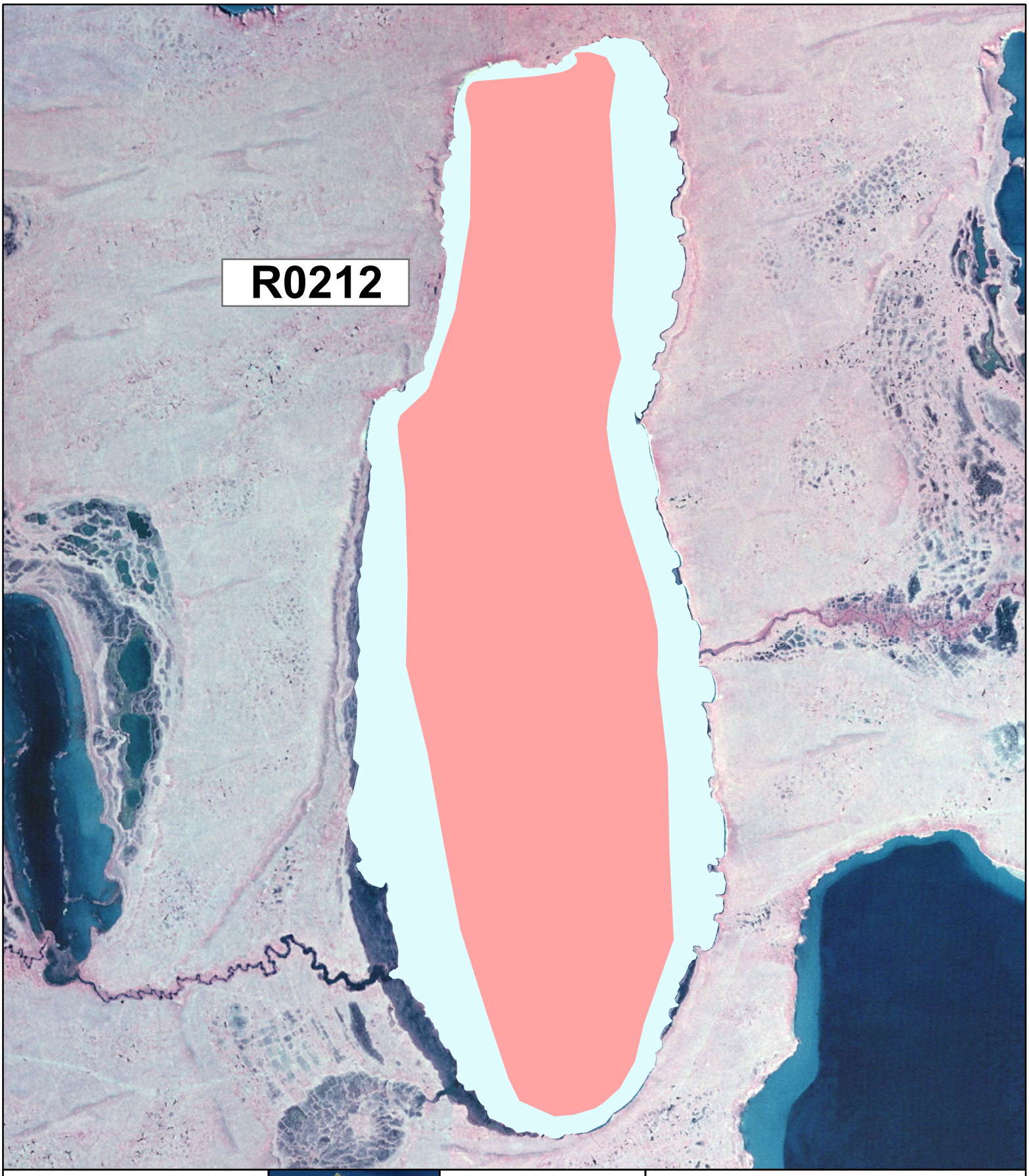
Year of Test	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Total Hardness [CaCO3] (mg/l)	Specific Conductance (microS/cm)	Turbidity (NTU)	pH	Source
2018	11.3	1.7	2.3	5.2	35	115	0.8	7.87	B. Morris

Catch Record:

Gear	Date	Effort (hours or units)	Species	Number Caught	Fork Length (mm)
Gill Net	Jul 12 18	3.0	Humpback whitefish	10	364-419
Minnow Traps	Jul 12 18	16.6	none	0	
Seine	not used				
Visual +Dipnet	not used				

Water Surface Elevation Temporary Bench Mark Latitude	Longitude	Date	Instrument Level to VEBM (feet)	Water Surface Elevation (feet)
70.05479	-152.69516	7/12/2018	5.13	-4.09

Last Revised: November 7, 2018



Ice Chip Areas

4 feet or shallower - available for ice chips

Deeper than 4 feet - unavailable for ice chips

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE NATURAL RESOURCE CONSULTANTS

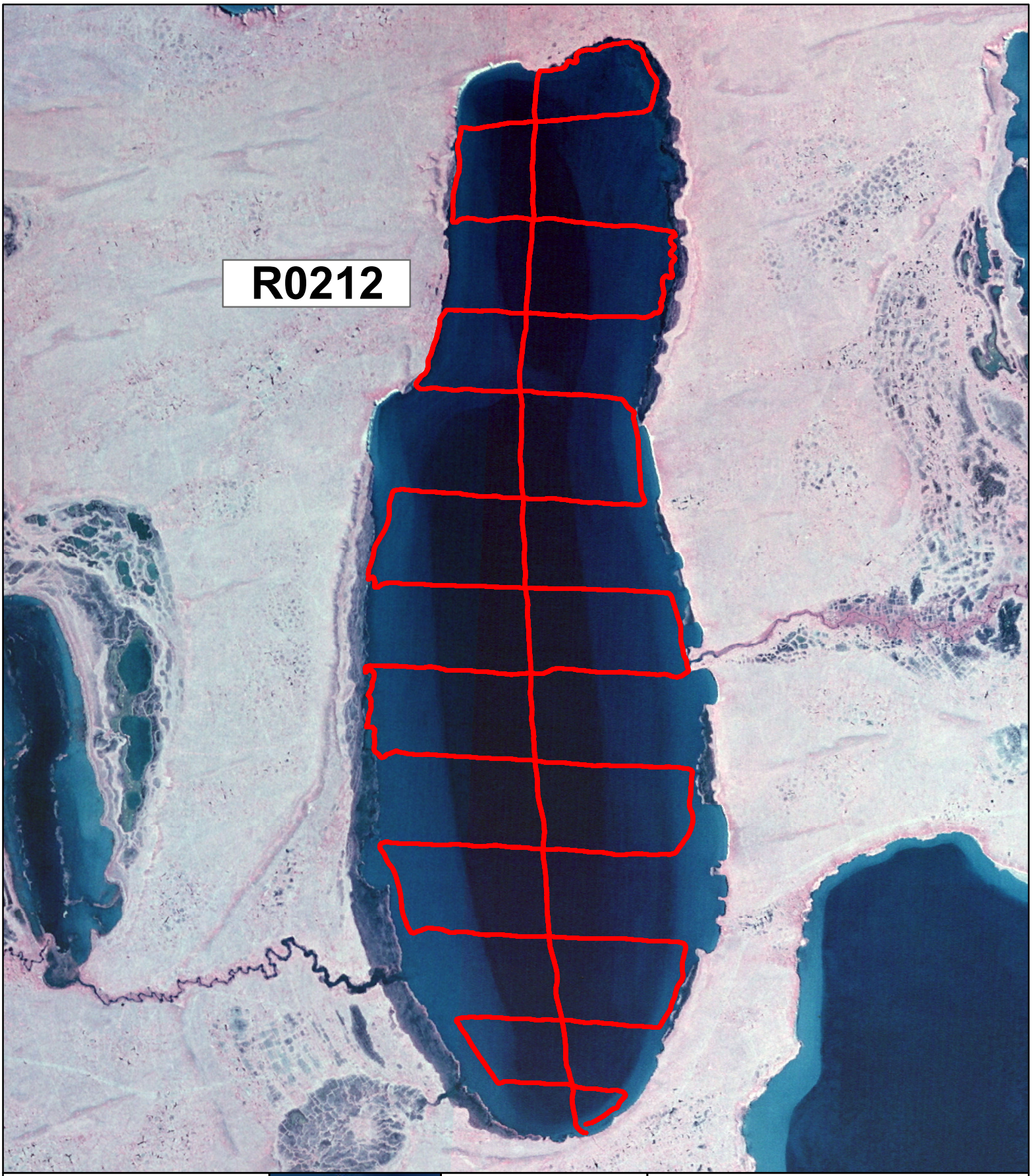
Area Available for Ice Chip Collection at Lake R0212

based on transects surveyed on July 12, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 2,000 Feet

N



Depth Transects Surveyed

— = Transect Survey Line

Imagery used from BLM aerial photographs
July 18, 2002.
NAD83, UTM Zone 5

ConocoPhillips Alaska

Prepared by:

OWL RIDGE
NATURAL RESOURCE CONSULTANTS

Depth Transects Surveyed at Lake R0212

surveyed on July 12, 2018
not to be used for navigation or to direct the operation of heavy equipment

SCALE:

500 250 0 500 1,000 1,500 2,000 Feet

N