Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: February 2007

Sun Dog at Mine Site B -Kuparuk, by J. Derry

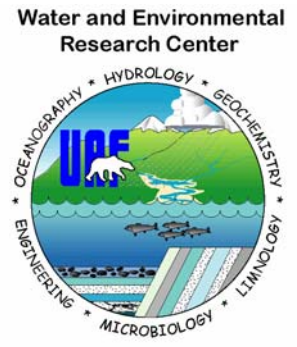
by

Jeff Derry, Dan Reichardt, Michael Lilly, Jessie Cherry, and Hannah Clilverd

March 2007

North Slope Lakes Hydrologic Modeling Project

Report No. INE/WERC 07.07



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Jeff Derry[1], Dan Reichardt[1], Michael Lilly[1], Jessie Cherry[2], Hannah Clilverd[3]

A report on research sponsored by:

- U.S. Department of Energy
- National Energy Technology Laboratory
- BP Exploration (Alaska), Inc.
- ConocoPhillips (Alaska), Inc.
- Bureau of Land Management
- Geo-Watersheds Scientific

March 2007

North Slope Lakes Hydrologic Project

Report Number INE/WERC 07.07

[1]Geo-Watersheds Scientific
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[3]University of Alaska Fairbanks, Water and Environmental Research Center

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Fairbanks, Alaska
March 2007

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DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the accuracy of the data presented herein. This research was funded by the U.S. Department of Energy (DOE) and the National Energy Technology Laboratory (NETL). Funding and support was also provided by the Bureau of Land Management (BLM), BP Exploration (Alaska) Inc.(BPX), ConocoPhillips Alaska, Inc. (CPA), and Geo-Watersheds Scientific (GWS). The contents of the report do not necessarily reflect the views of policies of the DOE, NETL, BLM, BPX, CPA, GWS, or any local sponsor. This work does not constitute a standard, specification, or regulation.

The use of trade and firm names in this document is for the purpose of identification only and does not imply endorsement by the University of Alaska Fairbanks, DOE, NETL, BLM, BPX, CPA, GWS, or other project sponsors.

CONVERSION FACTORS, UNITS, WATER QUALITY UNITS, VERTICAL AND HORIZONTAL DATUM, ABBREVIATIONS AND SYMBOLS

Conversion Factors

Multiply	By	To obtain
	Length	
inch (in)	25.4	millimeter (mm)
inch (in)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
Acre	43560.0	square feet (ft^2)
Acre	0.405	hectare (ha)
square foot (ft^2)	3.587e-8	square mile (mi^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (L)
gallon (gal)	3785.412	milliliter (mL)
cubic foot (ft^3)	28.317	liter (L)
Acre-ft	1233.482	cubic meter (m^3)
Acre-ft	325851.43	gallon(gal)
gallon(gal)	0.1337	cubic feet (ft^3)
	Velocity and Discharge	
foot per day (ft/d)	0.3048	meter per day (m/d)
Square foot per day (ft^2/d)	0.0929	square meter per day (m^2/d)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/sec)
	Hydraulic Conductivity	
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per day (ft/d)	0.00035	centimeter per second (cm/sec)
meter per day (m/d)	0.00116	centimeter per second (cm/sec)
	Hydraulic Gradient	
foot per foot (ft/ft)	5280	foot per mile (ft/mi)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
	Pressure	
pound per square inch (lb/in^2)	6.895	kilopascal (kPa)

Units

For the purposes of this report, both English and Metric (SI) units were employed. The choice of "primary" units employed depended on common reporting standards for a particular property or parameter measured. Whenever possible, the approximate value in the "secondary" units was also provided in parentheses. Thus, for instance, stream flow was reported in cubic feet per second (cfs) followed by the value in cubic meters per second (m^3/s) in parentheses.

Physical and Chemical Water-Quality Units:

Temperature:

Water and air temperature is given in degrees Celsius (°C) and in degrees Fahrenheit (°F). Degrees Celsius can be converted to degrees Fahrenheit by use of the following equation:

$$°F = 1.8(°C) + 32$$

Electrical Conductance (Actual Conductivity and Specific Conductance):

In this report conductivity of water is expressed as Actual Conductivity [AC] in microSiemens per centimeter (µS/cm). This unit is equivalent to micromhos per centimeter. Elsewhere, conductivity is commonly expressed as Specific Conductance at 25°C [SC25] in µS/cm which is temperature corrected. To convert AC to SC25 the following equation can be used:

$$SC25 = \frac{AC}{1 + r(T - 25)}$$

where:

SC25 = Specific Conductance at 25°C, in µS/cm

AC = Actual Conductivity, in µS/cm

R = temperature correction coefficient for the sample, in °C

T = temperature of the sample, in °C

Milligrams per liter (mg/L) or micrograms per liter (μg/L):

Milligrams per liter is a unit of measurement indicating the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 mg/L, the numerical value is the same as for concentrations in parts per million (ppm).

Millivolt (mV):

A unit of electromotive force equal to one thousandth of a volt.

Vertical Datum:

In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929), a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called *Sea Level Datum of 1929.*

Horizontal Datum:

The horizontal datum for all locations in this report is the North American Datum of 1983 or North American Datum of 1927.

Abbreviations, Acronyms, and Symbols

AC	Actual conductivity
ADOT&PF	Alaska Department of Transportation and Public Facilities
ASTM	American Society for Testing and Materials
atm	atmospheres
C	Celsius
DO	Dissolved oxygen
DVM	digital voltage multi-meter
e-tape	electric tape
F	Fahrenheit (^{o}F).
ft	feet
GWS	Geo-Watersheds Scientific
GWSI	USGS Ground-Water Site Inventory
km^2	square kilometers
kPa	kilopascal
lb/in^2	pounds per square inch
m	meters
mg/L	milligrams per liter, equivalent to ppm
µg/L	micrograms per liter
mi^2	square miles
mm	millimeters
µS/cm	microsiemens per centimeter
mV	Millivolt
NGVD	National Geodetic Vertical Datum
NPR-A	National Petroleum Reserve - Alaska
NTU	Nephelometric Turbidity Units
NWIS	National Water Information System
ORP	oxygen-reduction potential
ppm	parts per million, equivalent to mg/L
SC25	specific conductance at 25^{o}C
SWE	Snow Water Equivalent
QA	quality assurance
QC	quality control
UAF	University of Alaska Fairbanks
USACE	U.S. Army Corps of Engineers, Alaska District
USGS	U.S. Geological Survey
WERC	Water and Environmental Research Center
WWW	World Wide Web
YSI	Yellow Springs Instruments

Lake Nomenclature

KDA	Kuparuk Dead Arm (Prudhoe Bay field, serves Prudhoe Bay field operations)
MSB	Mine Site B (Prudhoe Bay field, serves Milne Point and Kuparuk field operations)
L9312	Lake L9312 (Alpine field, serves Alpine field operations)
L9817	Lake L9817 (Alpine field, serves Alpine field operations)
K113	Lake K113 (Prudhoe Bay field, not currently used for field operations)

PROJECT COOPERATORS

The North Slope Lakes project covers a large area of the North Slope and benefits from a number of positive partnerships, all contributing to the overall project objectives.

- BP Exploration (Alaska) Inc.
- ConocoPhillips Alaska (CPA)
- Bureau of Land Management
- Alaska Department of Natural Resources
- The Nature Conservancy
- Northern Alaska Environmental Center

ACKNOWLEDGEMENTS

This project was funded by cooperative agreement number DE-FC26_01NT41248, from the U.S. Department of Energy's (DOE) Arctic Energy Office to the University of Alaska Fairbanks Arctic Energy Technology Development Laboratory (AETDL). Field coordination and logistics support were provided by BP Exploration (Alaska) Inc. and ConocoPhillips Alaska. Additional support was provided by other project cooperators, North Slope Borough, Bureau of Land Management (BLM), National Weather Service, and Geo-Watersheds Scientific (GWS), in the form of financial and in-kind match

Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: February 2007

INTRODUCTION

The University of Alaska Fairbanks (UAF) Water and Environmental Research Center (WERC) and Geo-Watersheds Scientific (GWS), together with project cooperators, initiated a study in the Fall of 2002 (Phase One) to obtain baseline information about the physical and chemical characteristics of North Slope tundra lakes. The project was extended in 2005 (Phase Two). The location of study lakes changed and was expanded to include other reservoirs so as to further develop the understanding and simulation tools necessary for water-source management (Figure 1). K113 is an un-pumped lake in the Kuparuk oilfield and is sampled on selected field trips during the year. L9312 is a natural lake studied in the Alpine operations area. L9817 is a natural lake in eastern NPRA, west of Nuiqsut. This lake has been used in previous years for ice-road construction, but was not used during winter 2005-06, nor will it be used during the winter of 2006-07. Two reservoir systems (mine sites) were added to the study in 2005. Mine Site B, also known as Six-mile Lake, is located near the Milne Point facility at the intersection of the Spine Road with the Milne Point Road and has two cells connected to East Milne Creek. The Kuparuk Reservoir System (Kuparuk Deadarm Lakes) has 9 reservoirs. The three southernmost reservoir cells (1-3) are included in the study to observe ground-water and surface-water interactions between each cell and the adjacent Kuparuk River.

Water-quality and hydrologic data is collected in the field during monthly visits to the lakes and water samples are collected from priority locations for further analysis at the UAF-WERC chemistry laboratories. The purpose of this publication is to 1) report data collected for the month of February 2007, 2) summarize accomplished field trip objectives.

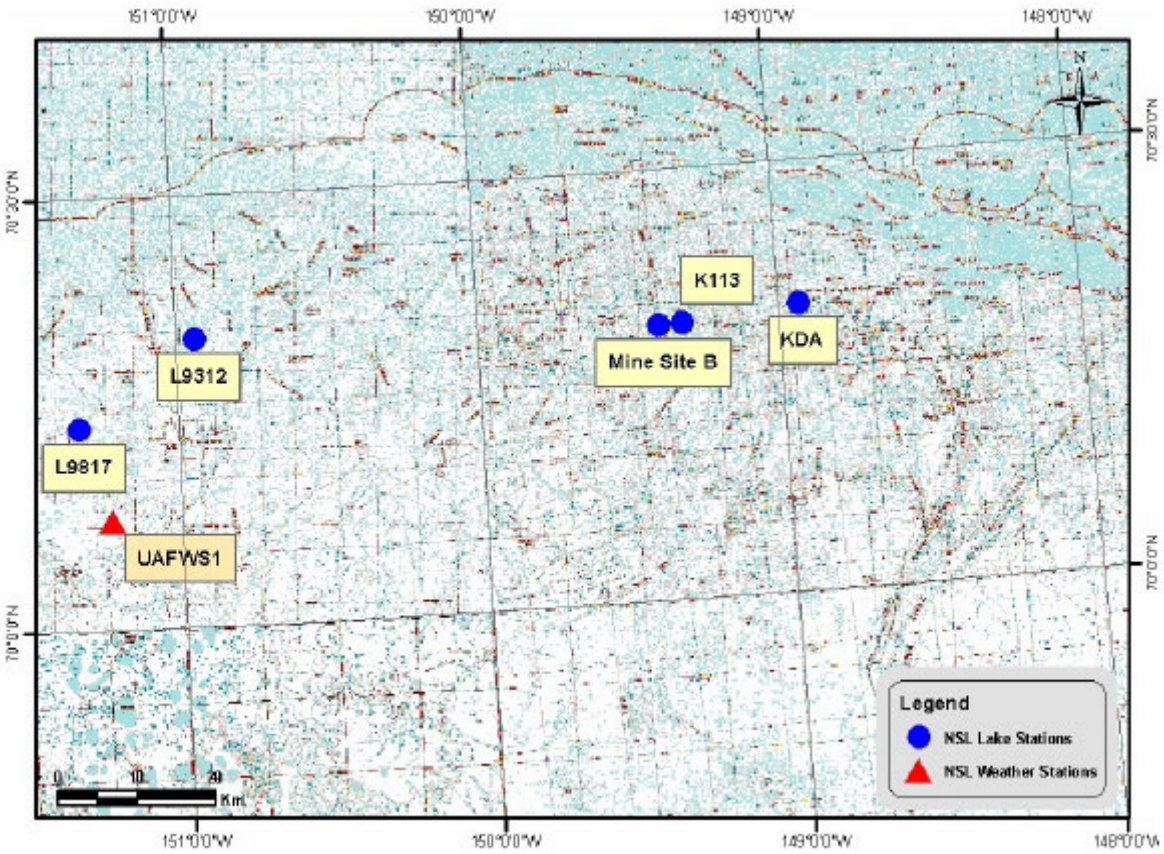

Figure 1. Location of study lakes in the NPR-A, Alpine, Kuparuk, and Prudhoe Bay field operating areas, North Slope, Alaska.

TRIP OBJECTIVES

The goal of each sampling trip is to collect physical and chemical data from each study lake. For each lake, a series of holes are drilled at designated sampling locations. Logistical, personnel, and weather constraints, can limit the amount of time available in the field for sampling. A project workplan was distributed before the trip outlining the sampling schedule (Lilly and others, 2006). In Febraury 2007, we focused on the following locations/tasks:

1. Kuparuk Dead Arm (KDA) Reservoirs: Prudhoe Bay operating area.
    - Measure water-quality profile parameters in cells KDA-1, KDA-2 and KDA-3.
    - Survey water levels to local elevation control at KDA-1, KDA-2 and KDA-3.
    - Collect water-column samples from KDA-1 and KDA-2
    - Measure snow depth, ice thickness, and field water quality parameters.
2. Mine Site B: Kuparuk operating area.
    - Measure water-quality profile parameters in North Cell (MSBN) and South Cell (MSBS).
    - Survey water levels to local elevation control at North Cell and South Cell
    - Collect water-column samples from sampling locations MSBN-CT and MSBS-CT
    - Measure snow depth, ice thickness, and field water quality parameters.
3. Lake L9312: Alpine operating area.
    - Measure water-quality profile parameters.
    - Survey water level to local elevation control.
    - Collect water-column samples from sampling location "L9312 Raft-B"
    - Measure snow depth, ice thickness, and field water quality parameters.
4. Lake L9817: NPR-A.
    - L9817 was not visited due to mechanical problems.

PROCEDURES

Water Chemistry Sampling

All field work follows the specified health, safety, and environmental guidelines outlined by BPX and CPA (White and Lilly, 2006*a,b,c*). Using a gas powered auger, holes were drilled through the ice at specified locations at each study lake. Physical measurements of water depth (top of water to bottom of lake), ice thickness (top of ice to bottom of ice), freeboard (top of water to top of ice), and snow depth (top of ice to top of snow), were taken at each sampling location. Water-surface elevation surveys were conducted using closed level loops and optical levels (Figure 2). Water quality parameters such as temperature, pH, turbidity, oxygen

reduction potential (ORP), conductivity, and dissolved oxygen (DO) were obtained by using an In-Situ Troll 9000 (submersible meter), at multiple depths throughout the water column. The precision with which physical measurements were reported takes into account field conditions. The calibration of each parameter was checked before and after each day of sampling using the criteria in Table 1.

Table 1. In-Situ Troll 9000 calibration quality control criteria.

Parameter	Standards used	Acceptable deviation from calibration standard value
Turbidity	Factory calibrated	± 2 (NTU)
pH	4.01, 7.0, 10.0	± 0.2
Conductivity	447 (µs/cm)	within 10%
100% DO	100 % saturated	within 10%
0% DO	0 % saturated solution	within 0.3 mg/L
ORP	InSitu QuickCal 224 mV	within 10%

Figure 2. Surveying Water Surface Elevations at Kuparuk Deadarm Reservoirs, photo by D. Reichardt.

Water samples were also collected at 3 depths (1 ft. below bottom of ice, within the central part of the water column, 1 ft. above lake bottom). Some of these samples were preserved for

further analysis at UAF, while other samples were analyzed with a Hach spectrophotometer while still at the facility. UAF laboratory chemistry analysis will be reported separately.

Snow Surveys

Small-scale snow depth measurements were conducted in "L" shaped patterns on the lake surface and/or tundra surface at predetermined locations. Snow depth measurements were taken every meter for twenty-five meters, then turning 90 degrees, and continuing for another twenty-five meters. Snow samples were also collected for density measurements with an Adirondack snow sampler. Five densities were collected from points on tundra and lake and averaged to establish a representative density. Larger-scale snow depth measurements were conducted at L9312 along general east/west and north/south transects. Depth measurements were typically recorded every 10 feet (2 paces). Measurements at transition zones from tundra to lake were recorded at five feet increments (1 pace), and on homogeneous lake surfaces depths were recorded every 20 feet (4 paces).

SELECTED RESULTS

Mine Site B is a gravel mine site that consists of two cells (North and South), with overburden placed on the eastern side of the cells, uphill of the adjacent East Milne Creek to the west of the mine site. The two cells are connected to each other by two channels. Each channel has a fairly flat bottom and allows a connection during both summer and winter conditions. If water levels were to drop below the lowest channel elevation, then the two cells would be disconnected from each other. The two cells are also connected to the adjacent East Milne Creek at various stage levels. During high water levels, East Milne Creek will flow into the South cell and flow out of the North cell back into the creek over the narrow strip of ground between the creek and the North cell. At lower water levels, the creek is connected just to the south cell at the southwestern corner of the cell. The connecting portion of the channel (stream junction) is thought to be manmade as part of the restoration plan for the mine site. The outlet control elevation is probably in East Milne Creek, downstream of the stream junction.

Water withdrawal typically occurs along the access road located along the North side of the North Cell. There are several access pipes that have piping going from near the road access to near the bottom depths of the northern end of the North cell. The piping is finished with screens to limit intake of fish into the piping during pumping operations. This allows the water to be withdrawn from the lower part of the water column in the North Cell.

Access to the South cell has typically only been during winter conditions, when an ice road can be built to access the cell. Water is then generally withdrawn by placement of a pump house, with screen intake placed just below winter ice levels. Water would then be withdrawn and pumped into waiting tanker trucks. Water withdrawn from this method typically takes water form the upper portion of the water column. During the winter of 2006-07, the South cell was pumped directly, with a pump house located on the northwest corner of the cell.

Figure 3 shows the measured waters levels in the South and North cells during the 2005-06 and 2006-07 water years. The water year is typically defined as the period from October through September. Hinzman and others (2006) recommended the use of the water year as a primary water-use management period. Winter freeze-up normally occurs during October and extends to spring breakup in early May. The timing of freeze-up and spring breakup will vary from year to year, and across the North Slope by several weeks. Recharge to the mine site occurs early in the spring due to the impact of the road dust on the surrounding snowpack. Recharge will come from both the surrounding land-surface area draining directly into the cells (watershed area) and from East Milne Creek. To help show the hydraulic connection between the two cells during winter months, water level surveys started including the South cell during the February 2006 field trip.

Water levels are currently lower in the 2006-07 winter, compared to the prior year. The dropping of water levels during early October is due to drainage from the cells into East Milne Creek during the early winter recession, and water-withdrawal activities. The discharge back into Milne Creek results in a more significant drop in water levels than water withdrawal. After East Milne Creek has frozen up in the shallow stream areas just upstream of the Spine Road crossing, it is still flowing into the South cell during the early part of the winter, until the stream freezes completely upstream of the South cell. Increases in water levels during the winter period have

been observed and are related to snow loading on the cells. The North cell developed thick drifts along the eastern boundary due to prevailing winds and local topology. During the winter of 2005-06, snow loading resulted in an increase in water levels. The effect of snow loading during this winter has likely reduced the measured decline in water levels between January and February measurements.

Ice thickness, freeboard, and the open water below ice are also measured in both of the access channels between the North and South cells. This data is shown in Appendix E. This data and water levels surveyed in both cells demonstrate the connection between the two cells and the joint contribution of water during pumping from either the North or South cells.

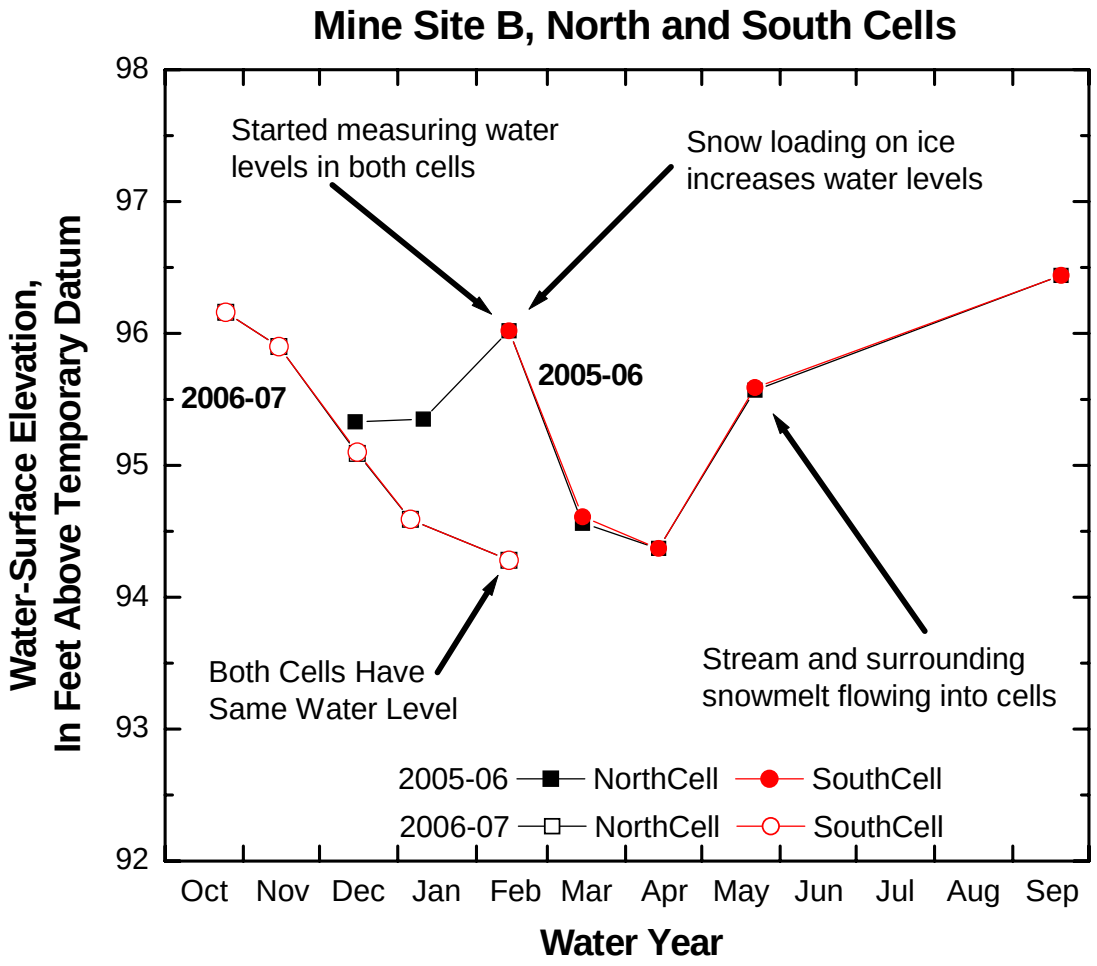

Figure 3. Mine Site B (Six Mile Lake) water levels for 2005-07 water years.

SUMMARY

Sampling occurred at Kuparuk Deadarm Lakes, Mine Site B and L9312 during February field activities. Sampling was planned at L9817; however access was not possible due to mechanical problems with the Haglands track vehicle used for transport to the lake. As Table 4 demonstrates, water levels in KDA Reservoir 2 and Mine Site "B" are dropping at a rate of over 0.3 ft (0.09 m) per month. KDA Reservoir 1 and L9312 do not show a similarly rapid drop in level. KDA Reservoir 1 is not being pumped, while L9312 has a large surface area relative to the experienced pumping rate. Examination of the survey forms for KDA shows that Reservoir 3 Water Surface is 0.19 ft (0.06 m) higher than Reservoir 2, suggesting that these two reservoirs are at least partially hydraulically isolated from each other.

Table 2 summarizes conditions at "priority sampling sites". Each lake we visit has one or more locations where we draw water samples from multiple depths for laboratory analysis. These locations have more historical data than other locations on the lakes, and have been chosen as representative of the deeper portion of the respective lakes.

Table 2. Ice thickness, Median DO Concentration, Median Actual Conductance and Monthly Water Drop for North Slope lakes in mid-February.

Sampling Site	Ice Thickness [ft; (m)]	Median DO Concentration [mg/L]	Median Actual Conductivity [μS/cm]	Water level drop since mid January [ft; (m)]
KDA1-CT	4.05; (1.23)	15.42	139.1	-0.02; (-0.006)
KDA2-CT	3.95; (1.20)	14.58	137.5	0.88; (0.268)
MSBS-CT	3.80; (1.16)	8.44	259.6	0.31; (0.094)
MSBN-CT	3.88; (1.18)	9.50	243.2	0.31; (0.094)
L9312 Raft B	3.55; (1.08)	11.50	75.66	0.08; (0.024)

Continuous monitoring of water-quality parameters and spatial distribution of snow cover at North Slope lakes throughout the winter will help in the understanding and development of simulation tools necessary for water-resources management. As lake water levels change due to freezing and pumping activities in the winter, it is important to identify the changing water chemistry as well as the potential spring-snowmelt recharge. This information is important for permitting agencies as well as industry professionals who depend on water assets for facility use and ice road/pad construction. Through monthly hydrologic assessments, water-chemistry testing, and water-sample analysis, we will continue to answer some of the questions on the hydrology of North Slope lakes and adaptive management strategies.

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APPENDIX A. WATER QUALITY FIELD SAMPLING FORMS

The following forms report the data collected with the water quality meters during field sampling.

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: KDA1-CT

Sample Purpose: **Lake Water Quality** Date: 2/13/07 Time: 13:29

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.9026' Easting: W148°56.6748' Datum: NAD83

Measurements By: DAR Time: 13:33

Water Depth (ft): 20.54 Ice Thickness (ft): 4.05

Freeboard (ft): 0.36 Snow Depth (ft): 0.10

Elev. (BPMSL +/- .02): 8.36 Survey By: DAR Date: 2/13/07 Time: 13:45

Water Sampling By: HMC Sample Depths BWS (ft): 1 4 Date: 2/13/07 Time: 15:05

2 10

WATER QUALITY METER INFORMATION 3 20

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	13:39	13:41	13:43	13:46	13:47	13:49	13:51	13:53	13:56	14:02
Depth BWS (ft):	4	5	6	7	9	11	13	15	17	18
Temp (°C):	0.11	0.11	0.18	0.23	0.34	0.44	0.57	0.76	0.99	1.14
pH:	7.81	7.80	7.82	7.82	7.81	7.82	7.79	7.80	7.80	7.68
Barometeric (mmHg):	757.6	757.6	757.6	757.8	757.8	757.8	757.8	757..9	758.0	758
Pressure (kPa):	10.436	12.991	16.097	19.031	24.971	30.882	36.959	42.874	49.024	51.938
Conductivity (µS/cm):	140.9	139.4	139.1	139.0	138.7	138.5	138.4	138.40	138.80	138.9
RDO (ppm): (mg/L)	14.58	14.61	14.62	14.62	14.64	14.63	14.59	14.50	14.22	12.6
Turbidity (NTU):	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.2
ORP	59	59	58	58	58	57	57	57	57	55

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):____4___**			**Depth BWS (ft):__10____**			**Depth BWS (ft):___20___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)	117	117	115	107	107	107	110	110	109	Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)	0.01	0.01	0.03	0	0	0	0.02	0.03	0.03	Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)	0.02	0.02	0	0	0	0	0.10	0.11	0.11	Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: IN-SITU BATTERY WAS DEPLEATED AT END OF SAMPLING

Field-Form Filled Out By: HMC Date: 2/14/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: KDA1-CT

Sample Purpose: **Lake Water Quality** Date: 2/13/07 Time: 13:29

FIELD MEASUREMENTS

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2 10

3 20

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	14:16	14:25	14:51							
Depth BWS (ft):	19	20	BOT							
Temp (°C):	1.16	1.30	1.34							
pH:	7.64	7.41	7.38							
Barometeric (mmHg):	758.2	758.2	758.3							
Pressure (kPa):	54.933	57.848	60.644							
Conductivity (µS/cm):	141.1	143.4	144.5							
RDO (ppm): (mg/L)	6.71	5.12	4.02							
Turbidity (NTU):	0.8	2.3	42.1							
ORP	48	44	21							

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: IN-SITU BATTERY WAS DEPLEATED AT END OF SAMPLING

Field-Form Filled Out By: HMC Date: 2/14/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: KDA2-CT

Sample Purpose: **Lake Water Quality** Date: 2/13/07 Time: 11:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.9776' Easting: W148°56.4462' Datum: NAD83

Measurements By: DAR, HMC Time: 11:35

Water Depth (ft): 18.09 Ice Thickness (ft): 3.95

Freeboard (ft): 0.23 Snow Depth (ft): 0.10

Elev. (BPMSL +/- .02): 6.28 Survey By: DAR Date: 2/13/07 Time: 13:45

Water Sampling By: HMC Sample Depths BWS (ft): 1 4 Date: 2/13/07 Time: 12:45

2 8

WATER QUALITY METER INFORMATION 3 18

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	11:40	11:44	11:47	11:52	11:55	11:58	12:01	12:03	12:10	12:29
Depth BWS (ft):	4	5	6	7	9	11	13	15	16	17
Temp (°C):	0.11	0.11	0.14	0.20	0.25	0.35	0.52	0.80	1.05	1.31
pH:	7.78	7.80	7.80	7.80	7.78	7.80	7.80	7.79	7.59	7.31
Barometeric (mmHg):	757.6	757.7	757.8	757.8	757.9	758.0	758.0	758.1	758.1	758.2
Pressure (kPa):	10.348	13.124	16.212	19.154	25.083	30.927	36.960	42.943	45.955	48.862
Conductivity (µS/cm):	138.3	138.1	137.5	137.0	136.5	136.3	136.2	136.4	137.0	144.9
RDO (ppm): (mg/L)	15.43	15.42	15.53	15.59	15.73	15.80	15.83	15.71	13.75	4.8
Turbidity (NTU):	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.4
ORP	59	61	62	62	63	62	61	61	60	48

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):___4____**			**Depth BWS (ft):__8____**			**Depth BWS (ft):___18___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)	108	105	104	104	103	103	124	124	124	Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)	0	0	0	0	0	0	0.01	0.02	0.02	Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)	0.02	0.02	0.02	0.01	0.01	0	0.02	0.02	0.01	Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: HMC Date: 2/14/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: KDA2-CT

Sample Purpose: **Lake Water Quality** Date: 2/13/07 Time: 11:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.9776' Easting: W148°56.4462' Datum: NAD83

Measurements By: DAR, HMC Time: 11:35

Water Depth (ft): 18.09 Ice Thickness (ft): 3.95

Freeboard (ft): 0.23 Snow Depth (ft): 0.10

Elev. (BPMSL +/- .02): 6.28 Survey By: DAR Date: 2/13/07 Time: 13:45

Water Sampling By: HMC Sample Depths BWS (ft): 1 4 Date: 2/13/07 Time: 12:45

2 8

WATER QUALITY METER INFORMATION 3 18

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	12:36	12:39								
Depth BWS (ft):	18	BOT								
Temp (°C):	1.47	1.50								
pH:	7.27	7.28								
Barometeric (mmHg):	758.2	758.2								
Pressure (kPa):	51.840	53.366								
Conductivity (µS/cm):	151.1	154								
RDO (ppm): (mg/L)	2.11	1.51								
Turbidity (NTU):	3.2	36.8								
ORP	38	27								

FIELD TESTING OF WATER SAMPLES (if small probe is used) Probe:					
Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: HMC Date: 2/14/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: KDA3-CT

Sample Purpose: **Lake Water Quality** Date: 2/13/07 Time: 16:05

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.025 Easting: W148°56.2044 Datum: NAD83

Measurements By: HMC Time: 16:00

Water Depth (ft): 22.05 Ice Thickness (ft): 3.11

Freeboard (ft): 0.55 Snow Depth (ft): 0.10

Elev. (BPMSL +/- .02): 6.47 Survey By: DAR Date: 2/13/07 Time: 13:45

Water Sampling By: HMC Sample Depths BWS (ft): 1 Date: Time:

2

WATER QUALITY METER INFORMATION 3

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	16:07	16:09	16:10	16:12	16:14	16:16	17:05	17:07	17:08	17:10
Depth BWS (ft):	4	5	6	7	9	11	13	15	17	19
Temp (°C):	0.08	0.09	0.18	0.36	0.40	0.46	0.47	0.78	0.79	1.05
pH:	7.81	7.80	7.81	7.81	7.81	7.82	7.82	7.71	7.73	7.65
Barometeric (mmHg):	758.0	758.0	758.0	758.1	758.2	758.2	758.1	758.1	758.2	758.2
Pressure (kPa):										
Conductivity (µS/cm):	128.5	128.1	127.7	126.8	126.6	126.5	126.5	126.10	126.10	126.2
RDO (ppm): (mg/L)	15.49	15.49	15.46	15.41	15.30	15.24	15.24	14.39	14.13	13.66
Turbidity (NTU):	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.2
ORP	60	60	39	59	58	58	58	100	83	71

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: Pressure reading is erratic and does not pass Quality Control.

Note increase in ORP between 13' and 15'. This may be instrument error.

Field-Form Filled Out By: HMC Date: 2/14/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: KDA3-CT

Sample Purpose: **Lake Water Quality** Date: 2/13/07 Time: 16:05

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.025 Easting: W148°56.2044 Datum: NAD83

Measurements By: HMC Time: 16:00

Water Depth (ft): 22.05 Ice Thickness (ft): 3.11

Freeboard (ft): 0.55 Snow Depth (ft): 0.10

Elev. (BPMSL +/- .02): 6.47 Survey By: DAR Date: 2/13/07 Time: 13:45

Water Sampling By: HMC Sample Depths BWS (ft): 1 Date: Time:

2

WATER QUALITY METER INFORMATION 3

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	17:20	17:29	17:35							
Depth BWS (ft):	20	21	BOT							
Temp (°C):	1.29	1.40	1.67							
pH:	7.45	7.27	7.22							
Barometeric (mmHg):	758.4	758.5	758.6							
Pressure (kPa):										
Conductivity (µS/cm):	125.8	127.3	129.7							
RDO (ppm): (mg/L)	9.44	5.41	3.30							
Turbidity (NTU):	0.4	1.2	641.7							
ORP	53	46	38							

FIELD TESTING OF WATER SAMPLES (if small probe is used) Probe:					
Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: HMC Date: 2/14/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: MSBN-CT

Sample Purpose: **Lake Water Quality** Date: 2/14/07 Time: 13:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.280' Easting: W149°24.009' Datum: NAD83

Measurements By: DAR Time:

Water Depth (ft): 33.54 Ice Thickness (ft): 3.88

Freeboard (ft): 0.3 Snow Depth (ft): 0.25

Elev. (BPMSL +/- .02): 94.28 Survey By: JD Date: 2/14/07 Time: 15:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 4 Date: 2/14/07 Time: 14:35

2 23

3 33

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	13:46	13:47	13:48	13:48	13:49	13:51	13:52	13:53	13:56	13:58
Depth BWS (ft):	4	5	6	7	9	11	13	15	16	17
Temp (°C):	0.05	0.04	0.04	0.04	0.05	0.04	0.05	0.05	0.13	0.15
pH:	7.49	7.49	7.49	7.48	7.50	7.49	7.50	7.49	7.50	7.49
Barometeric (mmHg):	761.6	761.7	761.8	761.8	761.9	761.9	762.0	762.1	762.1	762.1
Pressure (kPa):	13.046	16.058	19.145	22.086	24.857	31.115	36.979	42.890	46.084	48.957
Conductivity (µS/cm):	243.3	243.3	243.2	243.2	243.2	243.2	243.3	243.2	242.2	242.1
RDO (ppm): (mg/L)	9.68	9.68	9.68	9.68	9.69	9.70	9.71	9.71	9.52	9.50
Turbidity (NTU):	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.2
ORP	52	52	52	53	52	52	53	53	53	53

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft): 4**			**Depth BWS (ft): 23**			**Depth BWS (ft): 33**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)	207	181	182	177	172	174	187	188	188	Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)	0.09	0.05	0.1	0.04	0.07	0.03	2.69	2.61	2.53	Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)	0.03	0.04	0.05	0.06	0.08	0.08	1.12	1.1	1.1	Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: DAR Date: 2/14/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: MSBN-CT

Sample Purpose: **Lake Water Quality** Date: 2/14/07 Time: 13:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.280' Easting: W149°24.009' Datum: NAD83

Measurements By: DAR Time:

Water Depth (ft): 33.54 Ice Thickness (ft): 3.88

Freeboard (ft): 0.3 Snow Depth (ft): 0.25

Elev. (BPMSL +/- .02): 94.28 Survey By: JD Date: 2/14/07 Time: 15:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 4 Date: 2/14/07 Time: 14:35

2 23

3 33

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	13:59	14:01	14:04	14:06	14:09	14:14	14:17	14:24	14:25	14:27
Depth BWS (ft):	19	21	23	25	27	29	31	32	33	BOT
Temp (°C):	0.16	0.24	0.36	0.46	0.61	0.77	0.92	0.96	1.01	1.05
pH:	7.51	7.52	7.50	7.50	7.48	7.44	7.35	7.33	7.31	7.40
Barometeric (mmHg):	762.2	762.3	762.3	762.4	762.5	762.6	762.6	762.7	762.7	762.8
Pressure (kPa):	54.678	60.778	66.795	72.663	78.618	84.586	90.475	93.660	96.630	99.781
Conductivity (µS/cm):	241.9	241.7	241.1	241.0	241.1	241.9	247.3	249.8	268.0	298.0
RDO (ppm): (mg/L)	9.49	9.44	9.16	8.98	8.56	7.47	3.92	2.83	1.55	0.84
Turbidity (NTU):	0.3	0.3	0.4	0.4	0.7	1.2	3.6	3.9	8.0	103.0
ORP	52	51	51	51	50	48	41	34	9	-27

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**4**			**Depth BWS (ft):__17____**			**Depth BWS (ft):___27___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: Log 2007-02-14 133213

Field-Form Filled Out By: DAR Date: 2/14/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: MSBS-CT

Sample Purpose: **Lake Water Quality** Date: 2/14/07 Time: 15:10

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.214' Easting: W149°24.020' Datum: NAD83

Measurements By: DAR Time: 15:15

Water Depth (ft): 27.23 Ice Thickness (ft): 3.80

Freeboard (ft): 0.25 Snow Depth (ft): 0.30

Elev. (BPMSL +/- .02): 94.28 Survey By: JD Date: 2/14/07 Time: 15:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 4 Date: 2/14/07 Time: 16:00

2 17

WATER QUALITY METER INFORMATION 3 27

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	15:20	15:21	15:22	15:23	15:24	15:25	15:27	15:28	15:32	
Depth BWS (ft):	4	5	6	7	9	11	13	15	17	
Temp (°C):	0.07	0.07	0.08	0.08	0.07	0.07	0.11	0.16	0.23	
pH:	7.45	7.42	7.40	7.40	7.39	7.40	7.40	7.39	7.42	
Barometeric (mmHg):	762.0	762.1	762.1	762.0	762.1	762.1	762.2	762.2	762.3	
Pressure (kPa):	10.299	13.247	16.028	18.977	24.922	30.920	37.045	43.383	48.162	
Conductivity (µS/cm):	260.9	260.1	259.9	259.8	259.6	259.5	258.9	258.1	257.8	
RDO (ppm): (mg/L)	8.58	8.57	8.55	8.54	8.54	8.54	8.50	8.46	8.41	
Turbidity (NTU):	0.3	0.3	0.4	0.5	0.3	0.4	0.3	0.5	0.5	
ORP	47	48	49	49	48	48	48	48	46	

FIELD TESTING OF WATER SAMPLES (if small probe is used) Probe:					
Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**4**			**Depth BWS (ft):__17____**			**Depth BWS (ft):___27___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)	214	190	191	186	186	187	210	210	212	Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)	0.08	0.08	0.08	0.1	0.13	0.15	13.4*	13.3*	13.4*	Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)	0.02	0.09	0.09	0.06	0.05	0.05	11.8*	11.7*	12.1*	Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: log 2007-02-14 151912

*1:10 DULUTION

Field-Form Filled Out By: HMC Date: 2/15/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: MSBS-CT

Sample Purpose: **Lake Water Quality** Date: 2/14/07 Time: 15:10

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.214' Easting: W149°24.020' Datum: NAD83

Measurements By: DAR Time: 15:15

Water Depth (ft): 27.23 Ice Thickness (ft): 3.80

Freeboard (ft): 0.25 Snow Depth (ft): 0.30

Elev. (BPMSL +/- .02): 94.28 Survey By: JD Date: 2/14/07 Time: 15:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 4 Date: 2/14/07 Time: 16:00

2 17

WATER QUALITY METER INFORMATION 3 27

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	15:33	15:35	15:36	15:38	15:39	15:48	15:49			
Depth BWS (ft):	19	21	23	25	26	27	BOT			
Temp (°C):	0.46	0.58	0.73	0.89	1.03	1.22	1.26			
pH:	7.40	7.40	7.40	7.38	7.37	7.42	7.55			
Barometeric (mmHg):	762.4	762.4	762.5	762.6	762.6	762.7	762.7			
Pressure (kPa):	54.853	61.181	67.001	72.865	75.771	78.612	80.772			
Conductivity (µS/cm):	257.7	258.0	258.2	259.0	260.3	292.7	358.8			
RDO (ppm): (mg/L)	8.28	8.15	8.06	7.81	7.35	2.00	1.27			
Turbidity (NTU):	0.5	0.8	0.8	1.0	1.4	6.1	23.2			
ORP	46	46	47	46	45	-26	-83			

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):_____**			**Depth BWS (ft):__24___**			**Depth BWS (ft):___34___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: HMC Date: 2/15/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: MSBS-SW

Sample Purpose: **Lake Water Quality** Date: 2/14/07 Time: 16:47

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.186' Easting: W149°24.234' Datum: NAD83

Measurements By: DAR Time: 16:45

Water Depth (ft): 19.29 Ice Thickness (ft): 4.43

Freeboard (ft): 0.3 Snow Depth (ft): 0.10

Elev. (BPMSL +/- .02): 94.28 Survey By: JD Date: 2/14/07 Time: 15:00

Water Sampling By: JED Sample Depths BWS (ft): 1 Date: Time:

2

3

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	16:47	16:52	16:56	16:59	17:03	17:07	17:10	17:13	17:17	
Depth BWS (ft):	5	6	7	9	11	13	15	17	18	
Temp (°C):	0.09	0.08	0.07	0.08	0.08	0.08	0.08	0.16	0.28	
pH:	7.41	7.41	7.41	7.40	7.40	7.40	7.41	7.40	7.39	
Barometeric (mmHg):	762.1	762.1	762.1	762.2	762.2	762.3	762.3	762.4	762.5	
Pressure (kPa):	13.611	16.005	19.017	24.952	31.017	36.922	42.848	48.874	51.788	
Conductivity (µS/cm):	264.1	263.4	263.3	262.7	262.5	262.5	262.7	262.00	261.50	
RDO (ppm): (mg/L)	8.61	8.62	8.63	8.61	8.60	8.61	8.61	8.40	8.19	
Turbidity (NTU):	0.4	0.3	0.4	0.3	0.3	0.4	0.3	0.4	0.6	
ORP	41	40	40	40	39	39	38	38	37	

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):_____**			**Depth BWS (ft):__24___**			**Depth BWS (ft):___34___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: HMC Date: 2/15/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: MSBS-SW

Sample Purpose: **Lake Water Quality** Date: 2/14/07 Time: 16:47

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.186' Easting: W149°24.234' Datum: NAD83

Measurements By: DAR Time: 16:45

Water Depth (ft): 19.29 Ice Thickness (ft): 4.43

Freeboard (ft): 0.3 Snow Depth (ft): 0.10

Elev. (BPMSL +/- .02): 94.28 Survey By: JD Date: 2/14/07 Time: 15:00

Water Sampling By: JED Sample Depths BWS (ft): 1 Date: Time:

2

3

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	PASS

Parameters	**Field Measurements**									
Time:	17:20	17:24								
Depth BWS (ft):	19	BOT								
Temp (°C):	0.37	0.40								
pH:	7.37	7.35								
Barometeric (mmHg):	762.5	762.5								
Pressure (kPa):	54.895	55.930								
Conductivity (µS/cm):	261.3	261.5								
RDO (ppm): (mg/L)	7.8	7.46								
Turbidity (NTU):	0.8	1.0								
ORP	36	34								

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):_____**			**Depth BWS (ft):__24___**			**Depth BWS (ft):___34___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: HMC Date: 2/15/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: MSBS-W

Sample Purpose: **Lake Water Quality** Date: 2/14/07 Time: 16:45

FIELD MEASUREMENTS

GPS Coord. Northing: n/a Easting: n/a Datum:

Measurements By: DAR Time: 16:45

Water Depth (ft): 15.88 Ice Thickness (ft): 4.52

Freeboard (ft): 0.55 Snow Depth (ft): 0.10

Elev. (BPMSL +/- .02): 94.28 Survey By: JD Date: 2/14/07 Time: 15:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 Date: Time:

2

3

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
[DO], temp1	UAF	Hach HQ20		PASS	PASS
Conductivity, temp2	GWS	YSI 30		Pass	Pass

Parameters	**Field Measurements**									
Time:	16:45	16:47	16:50	16:53	16:55	16:59	17:05	17:20		
Depth BWS (ft):	5	7	9	11	13	14	15	BOT		
Temp1 (°C):	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.4		
Temp2 (°C):	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.3		
LDO (ppm): (mg/L)	9.32	9.37	9.36	9.35	9.34	9.30	6.32	0.97		
Conductivity (µS/cm):	263.7	264.0	264.0	264.2	264.1	264.1	253.3	243.7		
Barometeric (mmHg):	761	761	761	761	761	761	761	761		

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):_____**			**Depth BWS (ft):__24___**			**Depth BWS (ft):___34___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: approximately 20 feet East of West Bank near location of pumphouse in November.

Field-Form Filled Out By: DAR Date: 2/14/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: L9312 Raft B

Sample Purpose: **Lake Water Quality** Date: 2/16/07 Time 11:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.995' Easting: W150°56.918' Datum: NAD83

Measurements By: HCM Time: 11:00

Water Depth (ft): 11.3 Ice Thickness (ft): 3.55

Freeboard (ft): 0.30 Snow Depth (ft): 0.40

Elev. (BPMSL): 7.55 Survey By: M. Lilly Date: 2/16/07 Time: 15:30

Water Sampling By: HMC Sample Depths BWS (ft): 1 4 Date: 2/16/07 Time: 12:50

2 6

WATER QUALITY METER INFORMATION 3 11 Additional Samples at 9ft, 10 ft.

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	UAF	InSitu Troll 9000	33205	PASS	Pass

Parameters	**Field Measurements**									
Time:	11:30	11:36	11:42	11:51	11:59	12:08	12:13	12:35	12:45	
Depth BWS (ft):	4	5	6	7	8	9	10	11	BOT	
Temp (°C):	0.14	0.34	0.73	0.96	1.22	1.55	1.66	1.97	2.04	
pH:	6.80	6.83	6.83	6.84	6.82	6.79	6.77	7.11	7.41	
Barometeric (mmHg):	773.7	773.7	773.8	771.2	771.3	771.4	771.4	771.6	771.6	
Pressure (kPa):	10.303	13.261	16.287	x	22.274	25.292	28.269	31.231	33.031	
Conductivity (µS/cm):	76.61	75.77	75.37	75.66	75.62	74.78	74.29	97.60	118.80	
RDO (ppm): (mg/L)	12.07	12.38	12.40	12.04	11.50	10.79	10.12	3.94	2.90	
Turbidity (NTU):	2.3	2.1	2.7	2.5	2.8	3.0	4.0	6.5	122.1	
ORP	71	73	75	74	73	69	65	-26	-80	

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):____4 ft__**			**Depth BWS (ft):__6ft__**			**Depth BWS (ft):___11___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Alkalinity (mg/L as $CaCO_3$)	38	42	40	41	40	39	84*	83*	83*	
Total iron--UF (mg/L)	0.14	0.13	0.14	0.16	0.16	0.15	18.80	18.80	18.80	
Filtered Iron--F tot Fe (mg/L)	0.10	0.10	0.11	0.10	0.13	0.11	20.90	21.10	21.10	

Remarks: *1:10 DILUTION. REPORTED VALUE IS CALCULATED CONCENTRATION.

Field-Form Filled Out By: HMC Date: 2/16/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: L9312 Raft B

Sample Purpose: **Lake Water Quality** Date: 2/16/07 Time 11:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.995' Easting: W150°56.918' Datum: NAD83

Measurements By: HCM Time: 11:00

Water Depth (ft): 11.3 Ice Thickness (ft): 3.55

Freeboard (ft): 0.30 Snow Depth (ft): 0.40

Elev. (BPMSL): 7.55 Survey By: M. Lilly Date: 2/16/07 Time: 15:30

Water Sampling By: HMC Sample Depths BWS (ft): 1 4 Date: 2/16/07 Time: 12:50

2 6

WATER QUALITY METER INFORMATION 3 11 Additional Samples at 9ft, 10 ft.

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	UAF	InSitu Troll 9000	33205	PASS	Pass

Parameters										
Time:										
Depth BWS (ft):										
Temp (°C):										
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Conductivity (µS/cm):										
RDO (ppm): (mg/L)										
Turbidity (NTU):										
ORP										

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):____9 ft__**			**Depth BWS (ft):__10ft__**			**Depth BWS (ft):_____**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)	0.17	0.17	0.18	0.25	0.25	0.26				
Filtered Iron--F tot Fe (mg/L)	0.11	0.08	0.10	0.16	0.14	0.14				

Remarks:

Field-Form Filled Out By: HMC Date: 2/16/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: L9312 Raft A

Sample Purpose: **Lake Water Quality** Date: 2/16/07 Time: 14:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.053' Easting: W150°56.600' Datum: NAD83

Measurements By: HMC Time: 14:00

Water Depth (ft): 10.15 Ice Thickness (ft): 3.08

Freeboard (ft): 0.3 Snow Depth (ft): 0.52

Elev. (BPMSL): 7.55 Survey By: M. Lilly Date: 2/16/07 Time: 15:30

Water Sampling By: HMC Sample Depths BWS (ft): 1 Date: Time:

2

3

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	UAF	InSitu Troll 9000	33205	PASS	Pass

Parameters										
Time:	14:17	14:22	14:25	14:46	15:50	16:04	16:19	16:33		
Depth BWS (ft):	4	5	6	7	8	9	10	BOT		
Temp (°C):	0.14	0.28	0.46	0.84	1.07	1.12	1.35	1.43		
pH:	6.94	6.92	6.89	6.76	6.69	6.65	6.62	6.62		
Barometeric (mmHg):	771.5	771.6	771.6	771.6	771.6	771.7	771.8	772.0		
Pressure (kPa):	10.520	13.432	16.218	19.542	22.561	25.312	28.396	29.564		
Conductivity (µS/cm):	81.80	84.56	85.76	85.24	84.66	82.67	83.15	85.73		
RDO (ppm):	13.99	14.23	13.99	11.69	9.67	8.32	6.63	5.00		
Turbidity (NTU):	1.0	1.1	1.9	3.3	4.8	5.9	7.6	20.4		
ORP	43	46	47	44	37	30	21	12		

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):____**			**Depth BWS (ft):____**			**Depth BWS (ft):_____**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks:

Field-Form Filled Out By: HMC Date: 2/16/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: L9312 AB Midpoint

Sample Purpose: **Lake Water Quality** Date: 2/16/07 Time: 17:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.024' Easting: W150°56.753' Datum: NAD83

Measurements By: JED Time: 17:00

Water Depth (ft): 11.1 Ice Thickness (ft): 3.80

Freeboard (ft): 0.3 Snow Depth (ft): 0.1

Elev. (BPMSL): 7.55 Survey By: M. Lilly Date: 2/16/07 Time: 15:30

Water Sampling By: JED Sample Depths BWS (ft): 1 Date: Time:

2

3

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	UAF	InSitu Troll 9000	33205	PASS	Pass

Parameters										
Time:	17:03				17:50	18:05	18:27			
Depth BWS (ft):	4	6	7	8	9	10	BOT			
Temp (°C):	0.11	0.53	0.81	1.10	1.37	1.55	1.81			
pH:	6.90	6.89	6.88	6.85	6.60	6.63	6.89			
Barometeric (mmHg):	771.7	771.8	771.8	771.8	771.9	771.9	771.8			
Pressure (kPa):	10.225	16.202	19.376	22.413	25.472	28.378	31.239			
Conductivity (µS/cm):	80.07	78.32	77.83	77.61	78.11	77.82	87.35			
RDO (ppm):	13.41	13.78	13.82	13.71	10.16	7.37	4.76			
Turbidity (NTU):	0.6	0.9	0.7	1.1	4.0	4.8	6.6			
ORP	41	42	42	41	26	19	-25			

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):____**			**Depth BWS (ft):____**			**Depth BWS (ft):_____**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks:

Field-Form Filled Out By: HMC Date: 2/16/07

QAQC Check By: DAR Date: 3/7/07

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004a: Water Quality Field-Sampling General

Project ID: **North Slope Lakes** Site Location/Lake ID: Alpine WTP

Sample Purpose: **Lake Water Quality** Date: 2/17/07 Time 18:00

FIELD MEASUREMENTS

GPS Coord. Northing: n/a Easting: n/a Datum:

Measurements By: Time:

Water Depth (ft): Ice Thickness (ft):

Freeboard (ft): Snow Depth (ft):

Elev. (BPMSL): Survey By: Date: Time:

Water Sampling By: HMC Sample Depths BWS (ft): 1 tap Date: 2/17/07 Time: 18:00

2

WATER QUALITY METER INFORMATION 3

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	UAF	InSitu Troll 9000	33205	PASS	Pass

Parameters	**Field Measurements**									
Time:	18:00									
Depth BWS (ft):	tap									
Temp (°C):	10.37									
pH:	6.65									
Barometeric (mmHg):										
Pressure (kPa):										
Conductivity (µS/cm):	88.09									
RDO (ppm): (mg/L)	5.33									
Turbidity (NTU):	3.7									
ORP	3									

FIELD TESTING OF WATER SAMPLES (if small probe is used)

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):___tap_**			**Depth BWS (ft):____**			**Depth BWS (ft):_____**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Alkalinity (mg/L as $CaCO_3$)	34	39	36							
Total iron--UF (mg/L)	0.25	0.27	0.27							
Filtered Iron--F tot Fe (mg/L)										

Remarks: sample taken at Raw Water Tap at Water Treatment Plant sink.

Field-Form Filled Out By: HMC Date: 2/17/07

QAQC Check By: DAR Date: 3/7/07

APPENDIX B. WATER QUALITY METER CALIBRATION FORMS

The following forms report the pre- and post-calibration checks for the water quality meters used during field sampling.

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004e: Water Quality Meter Calibration Form

Project ID: **North Slope Lakes** Site Location/Lake I Prudhoe SRT Lab

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Model: Troll 9000

Owner: UAF S/N: 33205

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	2/12/07	16:03	Oakton 4.01	2512012	10/1/08	4.05	16.17	Pass
pH	2/12/07	16:03	Oakton 7.00	2512282	4/1/08	7.00	16.33	Pass
pH	2/12/07	16:03	Oakton 10.00	2512278	10/1/08	10.00	16.53	Pass
ORP	2/12/07	16:03	InSitu QuickCal	2207B	5/1/07	239	16.27	Pass
RDO - 100% DO	2/12/07	16:03	Bubbled Nanopure	n/a	n/a	9.40	16.80	Pass
RDO - Zero DO	2/12/07	16:03	HANNA HI7040	W012	2/1/11	0.00	16.36	Pass
Conductivity	2/12/07	16:03	Oakton 447uS	2701471	1/1/08	385.5	16.37	Pass

ORP read in mV, RDO read in mg/L, Conductivity read in uS/cm AC. Pre sample cal check KDA.

Field-Form Filled Out By:	HMC	Date:	2/12/2007			
QAQC Check By:	DAR	Date:	3/7/2007			

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004e: Water Quality Meter Calibration Form

Project ID: **North Slope Lakes** Site Location/Lake I Prudhoe SRT Lab

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Model: Troll 9000

Owner: UAF S/N: 33205

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	2/13/07	18:30	Oakton 4.01	2512012	10/1/08	4.09	12.86	Pass
pH	2/13/07	18:30	Oakton 7.00	2512282	4/1/08	7.08	12.58	Pass
pH	2/13/07	18:30	Oakton 10.00	2512278	10/1/08	10.13	13.21	Pass
ORP	2/13/07	18:30	InSitu QuickCal	2207B	5/1/07	239	14.30	Pass
RDO - 100% DO	2/13/07	18:30	Bubbled Nanopure	n/a	n/a	10.10	16.52	Pass
RDO - Zero DO	2/13/07	18:30	HANNA HI7040	W012	2/1/11	0.02	15.09	Pass
Conductivity	2/13/07	18:30	Oakton 447uS	2701471	1/1/08	374.0	15.69	Pass

ORP read in mV, RDO read in mg/L, Conductivity read in uS/cm AC. Post sample cal check KDA. Pre sample cal check MSB.

Field-Form Filled Out By:	HMC	Date:	2/13/2007			
QAQC Check By:	DAR	Date:	3/7/2007			

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004e: Water Quality Meter Calibration Form

Project ID: **North Slope Lakes** Site Location/Lake I Prudhoe SRT Lab

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Model: Troll 9000

Owner: UAF S/N: 33205

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	2/14/07	18:43	Oakton 4.01	2512012	10/1/08	4.08	13.43	Pass
pH	2/14/07	18:43	Oakton 7.00	2512282	4/1/08	7.08	13.87	Pass
pH	2/14/07	18:43	Oakton 10.00	2512278	10/1/08	10.11	15.29	Pass
ORP	2/14/07	18:43	InSitu QuickCal	2207B	5/1/07	239	13.97	Pass
RDO - 100% DO	2/14/07	18:43	Bubbled Nanopure	n/a	n/a	10.51	16.07	Pass
RDO - Zero DO	2/14/07	18:43	HANNA HI7040	W012	2/1/11	0.06	15.19	Pass
Conductivity	2/14/07	18:43	Oakton 447uS	2701471	1/1/08	380	12.67	Pass

ORP read in mV, RDO read in mg/L, Conductivity read in uS/cm AC. Post sample cal check MSB. Pre sample cal check L9312.

Field-Form Filled Out By:	HMC	Date:	2/14/2007			
QAQC Check By:	DAR	Date:	3/7/2007			

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004e: Water Quality Meter Calibration Form

Project ID: **North Slope Lakes** Site Location/Lake I Alpine WTP

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Model: Troll 9000

Owner: UAF S/N: 33205

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	2/16/07	20:13	Oakton 4.01	2612530	10/1/08	4.09	14.70	Pass
pH	2/16/07	20:13	Oakton 7.00	2612531	4/1/08	7.06	15.03	Pass
pH	2/16/07	20:13	Oakton 10.00	2612532	10/1/08	10.15	15.16	Pass
ORP	2/16/07	20:13	InSitu QuickCal	2207B	5/1/07	235	12.47	Pass
RDO - 100% DO	2/16/07	20:13	Bubbled Nanopure	n/a	n/a	11.66	12.61	Pass
RDO - Zero DO	2/16/07	20:13	HANNA HI7040	W012	2/1/11	0.03	14.15	Pass
Conductivity	2/16/07	20:13	Oakton 447uS	2701471	1/1/08	353.2	14.70	Pass

ORP read in mV, RDO read in mg/L, Conductivity read in uS/cm AC. Post sample cal check for L9312.

Field-Form Filled Out By:	HMC	Date:	2/16/2007			
QAQC Check By:	DAR	Date:	3/7/2007			

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004e: Water Quality Meter Calibration Form

Project ID: **North Slope Lakes** Site Location/Lake I Prudhoe SRT Lab

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: Hach Model: HQ20 - LDO

Owner: UAF S/N: _061100015039

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
LDO - 100% DO	2/12/07	16:40	Bubbled Nanopure	n/a	n/a	98.5%_	17.10	Pass
LDO - Zero DO	2/12/07	16:40	HANNA HI7040	W012	2/1/11	0.50	n/a	Pass

RDO read in % Saturation and mg/L. Pre sample calibration for MSB.

Field-Form Filled Out By:	HMC	Date:	2/12/2007			
QAQC Check By:	DAR	Date:	3/7/2007			

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004e: Water Quality Meter Calibration Form

Project ID: **North Slope Lakes** Site Location/Lake I Prudhoe SRT Lab

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: YSI Model: YSI 30

Owner: GWS S/N: n/a

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
Conductivity	2/13/07	20:55	Oakton 447uS	2701471	1/1/08	339.8	11.30	Pass
Conductivity	2/14/07	16:45	Oakton 447uS	2701471	1/1/08	310.0	9.30	Pass

Conductivity read in uS/cm AC. Pre/Post Sample Check for MSB.

Field-Form Filled Out By:	HMC	Date:	2/13/2007			
QAQC Check By:	DAR	Date:	3/7/2007			

APPENDIX C. ELEVATION SURVEY FORMS

The following form reports the elevation survey information obtained during field sampling.

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-011: Elevation Survey Form

Project ID: **North Slope Lakes** Site Location/Lake ID: Kuparuk Dead Arm

Survey Purpose: **Water-Level Elevations** Date: 2/13/2007 Time: 13:45

Location:	Kuparuk Deadarm Reservoirs Cells 1, 2, 3							
Survey objective:	Determine FWS Elevation of KDA 1,2,3					Weather Observations:		
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)		Unrestricted overcast, -8F, 5mp East Wind, No precipitation		
Rod Type:	Craine fiberglass 20'		Rod ID:	GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Jeff Derry, Dan Reichardt		
BM #1 WO040768	BP	19.32	N70 20.048 NAD83	W148 56.367 NAD83				

Station	**BS (ft)**	**HI (ft)**	**FS (ft)**	**Elevation (fasl)**	**Distance (ft)**	**Horizontal Angle**	**Vertical Angle**	**Remarks**
BM#1	1.82	21.14		19.32				Shot to flagged benchmark
KDA3-SH		21.14	14.67	**6.47**				**WS Elevation for Reservoir #3**
KDA2-SH1		21.14	14.86	**6.28**				**WS Elevation for Reservoir #2**
Turn point, Moved instrument.								
KDA2-SH1	14.97	21.25		6.28				
KDA3-SH		21.25	14.78	6.47				
BM#1		21.25	1.93	19.32				Close survey to 0.00
Move instrument to island between KDA2 and KDA1. Use KDA2 FWS as turn point.								
KDA2-SH2	9.89	16.17		6.28				
KDA1-SH		16.17	7.81	**8.36**				**WS Elevation for Reservoir #1**
Turn point, Moved instrument.								
KDA1-SH	7.35	15.71		8.36				
KDA2-SH2		15.71	9.43	6.28				Close survey to 0.00

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasml; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-011: Elevation Survey Form

Project ID: **North Slope Lakes** Site Location/Lake ID: Kuparuk Dead Arm

Survey Purpose: **Water-Level Elevations** Date: 2/15/2007 Time: 13:00

Location:	Kuparuk Deadarm Reservoirs Cells 1, 2, 3							
Survey objective:	Channel water elevation survey					Weather Observations:		
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)		Unrestricted, -25F, windy		
Rod Type:	Craine fiberglass 20'		Rod ID:	GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Jeff Derry, Hannah Clilverd		
BM #1 WO040768	BP	19.32	N70 20.048 NAD83	W148 56.367 NAD83				
Station	**BS (ft)**	**HI (ft)**	**FS (ft)**	**Elevation (fasl)**	**Distance (ft)**	**Horizontal Angle**	**Vertical Angle**	**Remarks**
BM#1	2.50	21.82		19.32				Shot to flagged benchmark
Channel		21.82	15.57	**6.25**				**WSElevation for Channel between KDA2 and KDA3**
KDA2		21.82	15.63	**6.19**				**WS Elevation for KDA2**
Turn point, Moved instrument.								
KDA2	15.31	21.50		6.19				
Channel		21.50	15.25	6.25				
BM#1		21.50	2.19	19.32				Survey closes within 0.00'

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasml; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-011: Elevation Survey Form

Project ID: **North Slope Lakes** Site Location/Lake ID: Mine Site B

Survey Purpose: **Water-Level Elevations** Date: 2/14/2007 Time: 15:00

Location:	Mine Site B, NE corner of North Cell, temporary datum							
Survey objective:	Lake water elevation survey					Weather Observations:		
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)		minus 30F at 3mph		
Rod Type:	Craine fiberglass 20'		Rod ID:	GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Jessie Cherry, Jeff Derry		
TBM_1	nr	100.00 Arbitrary	na	na				
Station	**BS (ft)**	**HI (ft)**	**FS (ft)**	**Elevation (fasl)**	**Distance (ft)**	**Horizontal Angle**	**Vertical Angle**	**Remarks**
TBM_1	6.36	106.36		100.00				
MSB_N		106.36	12.08	**94.28**				**WS Elevation for MSBN**
TBM_4		106.36	4.98	101.38				
TBM_3		106.36	2.89	103.47				
TBM_2		106.36	2.52	103.84				
Turn point, Moved instrument.								
TBM_2	2.32	106.16		103.84				
TBM_3		106.16	2.70	103.46				
TBM_4		106.16	4.79	101.37				
MSB_N		106.16	11.89	94.27				
TBM_1		106.16	6.17	99.99				Survey closes within 0.01'
Set up instrument on Island, use MSB_N as turning point								
MSB_N	8.7	102.98		94.28				Set up on island.
MSB_S		102.98	8.7	**94.28**				**WS Elevation for MSBS**
Turn point. Moved on MSB_S								
MSB_S	9.15	103.43		94.28				
MSB_N		103.43	9.15	94.28				close survey 0.00'

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasml; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-011: Elevation Survey Form

Project ID: **North Slope Lakes** Site Location/Lake ID: L9312

Survey Purpose: **Water-Level Elevations** Date: 2/16/2006 Time: 15:30

Location:	Lake L9312, located southeast of Alpine pad, survey by pump house benchmarks							
Survey objective:	Lake water elevation survey					Weather Observations:		
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)		Cold, clear		
Rod Type:	Craine fiberglass 20'		Rod ID:	GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Michael Lilly Michael Rourke (LCMF)		
L9312 "P"	CP	11.72 BPMSL	70-20.032 NAD83	150-57.138 NAD83				
Station	**BS (ft)**	**HI (ft)**	**FS (ft)**	**Elevation (fasl)**	**Distance (ft)**	**Horizontal Angle**	**Vertical Angle**	**Remarks**
P	1.67	13.39		11.72				Top of inlet pipe support
O		13.39	1.93	11.46				Top of inlet pipe support
PH-VSM		13.39	-1.16	14.55				Top of VSM plate, SE corner of pump house
WL		13.39	5.84	7.55				Top of ice in refrozen hole
moved instrument., used WL ice as turn point								
WL	5.42	12.97		**7.55**				**WS Elevation**
PH-VSM		12.97	-1.58	14.55				+0.00
O		12.97	1.52	11.45				+0.01
P		12.97	1.26	11.71				close survey to +0.01

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasml; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

APPENDIX D. SNOW DEPTH AND WATER CONTENT SURVEY FORMS

The following forms report the snow survey information obtained during field sampling.

APPENDIX D. SNOW SURVEY FORMS

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-012: Snow Depth and Water Content Survey Form

Project ID: **North Slope Lakes Project** Site Location/Lake ID: **Kuparuk Dead Arm**

Survey Purpose: **Snow Depth and Water Content** Date: 2/13/2007 Time: 11:00

Location Description:	Located at center of Lake 2 near KDA2-CT. "L" shaped pattern, first going south, then going east 1 meter for 25 meters.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations	Visibility unrestricted. Dark. Minus 20 at 0 mph
Latitude: N70°19.9776'		Longitude: W148°56.4462'		Datum:	WGS84
Elevation:		Elevation Datum:		Reference Markers:	Site staked with lathe
Drainage Basin:	Kuparuk	Slope Direction:	flat	Vegetation Type:	Snow Survey located on ice
Slope Angle:	Flat	Access Notes:	none	Other:	1 meter increments
Snow Depth Probe Type:		T-handle snow depth probe,		Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm^2			Jessie Cherry	

Snow Course Depths, in cm.

	1	2	3	4	5
1	13.5	4.0	4.8	5.0	0.0
2	8.5	2.0	7.0	0.0	1.5
3	6.5	2.0	10.0	1.0	7.0
4	6.0	1.0	8.0	5.0	11.8
5	6.5	1.0	6.5	5.5	8.8
6	6.0	1.0	15.0	4.5	5.8
7	5.0	0.0	11.0	1.0	6.5
8	7.0	0.0	9.8	1.5	4.3
9	4.0	0.0	0.0	2.0	5.8
10	5.0	1.0	0.0	0.0	5.0

	(cm)
Average snow depth =	**4.7**
Maximum snow depth =	15.0
Minimum snow depth =	0.0
Standard variation =	3.8

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
DW4-1	12.7	135.0	453.4	0.30
DW4-2	3.81	26.0	136.0	0.19
DW4-3	6.35	57.0	226.7	0.25
DW4-4	7.62	78.0	272.0	0.29
DW4-5	11.43	107.0	408.1	0.26

Average Density = **0.26**

Average Snow Water Equivalent (SWE) = **1.2** cm H2O

Average Snow Water Equivalent = **0.47** inches H2O

Average Snow Water Equivalent = **0.04** feet H2O

SWE = avg. snow depth*(density snow/density water)

University of Alaska Fairbanks, Water and Environmental Research Center
Form F-012: Snow Depth and Water Content Survey Form

Project ID:	**North Slope Lakes Project**	Site Location/Lake ID:	**Betty Pingo**
Survey Purpose:	**Snow Depth and Water Content**	Date: 2/19/2007	Time: 9:00

Location Description:	App. 50 yards north of Wyoming gauge. L-shaped, 25 m by 25 m. Measurments took every 1 meter. Went north and then west.				
Survey objective:	Snow depths and snow-water content for comparison with lake snow survey				
Latitude:	N 70° 16.832	Longitude:	W 148° 53.856	Datum:	NAD83 Alaska
Elevation:		Elevation Datum:		Reference Markers:	Wyoming precipitation gauge
Drainage Basin:		Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	truck	Other:	1 meter increments
Snow Depth Probe Type:		T-handle snow depth probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm^2			Jeff Derry	

Snow Course Depths, in cm.

	1	2	3	4	5
1	15	16	11	15	10
2	14	17	10	19	26
3	15	19	12	30	32
4	13	14	13	38	35
5	15	11	19	40	56
6	13	15	21	32	64
7	15	19	12	16	61
8	35	24	23	7	53
9	15	16	21	6	40
10	15	14	14	9	55

	(cm)
Average snow depth =	**22.6**
Maximum snow depth =	64.0
Minimum snow depth =	6.0
Standard variation =	14.6

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
DW3-1	33	273.0	1178.1	0.23
DW3-2	15.24	83.0	544.1	0.15
DW3-3	33	362.0	1178.1	0.31
DW3-4	35.56	310.0	1269.5	0.24
DW3-5	22.86	158.0	816.1	0.19

Average Density =	**0.23**	
Average Snow Water Equivalent (SWE) =	**5.1**	cm H2O
Average Snow Water Equivalent =	**2.01**	inches H2O
Average Snow Water Equivalent =	**0.17**	feet H2O

SWE = avg. snow depth*(density snow/density water)

University of Alaska Fairbanks, Water and Environmental Research Center
Form F-012: Snow Depth and Water Content Survey Form

Project ID:	**North Slope Lakes Project**	Site Location/Lake ID:	**Mine Site B**
Survey Purpose:	**Snow Depth and Water Content**	Date: 2/14/2006	Time: 12:30

Location Description:	Located at center of north cell near MSBN-CT. "L" shaped pattern, first going west 1 meter for 25 meters and then south 1 meter for 25 meters.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	sunny cold
Latitude:		Longitude:		Datum:	
Elevation:		Elevation Datum:		Reference Markers:	Center of north cell
Drainage Basin:	Mine Site B	Slope Direction:	Flat	Vegetation Type:	Ice Surface
Slope Angle:	Flat	Access Notes:	none	Other:	1 meter increments
Snow Depth Probe Type:		T-handle snow depth probe,		Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm^2			Jessie Cherry	

Snow Course Depths, in cm.

	1	2	3	4	5
1	5	4	5	1	4
2	5.5	3.5	5.5	1	7.5
3	5	4	6	0.5	8
4	4	4.5	6.75	0.5	5
5	2	0.5	5	0.5	10
6	7	2	1	0.5	15
7	1.5	1	2	0.5	21.5
8	1	4	2	0.5	5.75
9	1	5	0.5	0.5	12.25
10	4	3	0.5	1	16.75

	(cm)
Average snow depth =	**4.3**
Maximum snow depth =	21.5
Minimum snow depth =	0.5
Standard variation =	4.4

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
DW4-1	5.08	57.0	181.4	0.31
DW4-2	2.54	26.0	90.7	0.29
DW4-3	6.35	69.0	226.7	0.30
DW4-4	9.53	100.0	340.0	0.29
DW4-5	7.62	63.0	272.0	0.23

Average Density =	**0.29**	
Average Snow Water Equivalent (SWE) =	**1.2**	cm H2O
Average Snow Water Equivalent =	**0.48**	inches H2O
Average Snow Water Equivalent =	**0.04**	feet H2O

SWE = avg. snow depth*(density snow/density water)

University of Alaska Fairbanks, Water and Environmental Research Center
Form F-012: Snow Depth and Water Content Survey Form

Project ID:	**North Slope Lakes Project**	Site Location/Lake ID:	**Mine Site B**
Survey Purpose:	**Snow Depth and Water Content**	Date: 2/14/2006	Time: 14:30

Location Description:	Located east of MSB north cell on tundra. "L" shaped pattern, first going south 1 meter for 25 meters and then west 1 meter for 25 meters.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	sunny cold
Latitude:		Longitude:		Datum:	
Elevation:		Elevation Datum:		Reference Markers:	representative area
Drainage Basin:	Mine Site B	Slope Direction:	Flat	Vegetation Type:	Ice Surface
Slope Angle:	Flat	Access Notes:	none	Other:	1 meter increments
Snow Depth Probe Type:		T-handle snow depth probe,		Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm^2			Jessie Cherry	

Snow Course Depths, in cm.

	1	2	3	4	5
1	24	19	15.5	11	18
2	20	22	33	15.5	23
3	16.5	21.5	16	33	23
4	19	15	15	40	33
5	15	25	19	36	47
6	18	24	12	17.5	41
7	21	23	12	12	29
8	21	21.5	17	10.5	23
9	23.5	24	30.5	11	22
10	25	13	15.5	14.5	24

	(cm)
Average snow depth =	**21.6**
Maximum snow depth =	47.0
Minimum snow depth =	10.5
Standard variation =	8.2

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)

Average Density = _____
Average Snow Water Equivalent (SWE) = _____ cm H2O
Average Snow Water Equivalent = _____ inches H2O
Average Snow Water Equivalent = _____ feet H2O

SWE = avg. snow depth*(density snow/density water)

University of Alaska Fairbanks, Water and Environmental Research Center
Form F-012: Snow Depth and Water Content Survey Form

Project ID:	**North Slope Lakes Project**	Site Location/Lake ID:	**L9312**
Survey Purpose:	**Snow Depth and Water Content**	Date: 2/16/2007	Time: 11:30

Location Description:	Did "L" shape, started at stake between belford gauge and snow sensor. 25 x 25 meters at 1 meter increments. Went North, then West.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	overcast
Latitude:	N 70º19.9444'	Longitude:	W 150º 57.047'	Datum:	NAD27 Alaska
Elevation:	100' approximately	Elevation Datum:	BPMSL	Reference Markers:	Site marked with GPS
Drainage Basin:	L9312	Slope Direction:	flat	Vegetation Type:	snow depth on tundra surface
Slope Angle:	Flat	Access Notes:		Other:	1 meter increments
Snow Depth Probe Type:		T-handle snow depth probe,		Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm^2			Jeff Derry	

Snow Course Depths, in cm.

	1	2	3	4	5
1	17	32	20	26	33
2	19	34	17	21	56
3	18	33	24	22	39
4	17	33	36	21	39.0
5	23	40	39	27	21
6	20	39.0	21	32	33
7	21	31	20	25.0	23
8	23	20	21.0	19	40
9	30	28	27	20	46
10	31	13.0	45	24	46

	(cm)
Average snow depth =	**28.1**
Maximum snow depth =	56.0
Minimum snow depth =	13.0
Standard variation =	9.4

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	14.48	206	516.9	0.40
SWE2	33.02	288	1178.8	0.24
SWE3	15.24	101	544.1	0.19
SWE4	35.56	410	1269.5	0.32
SWE5	35.56	322	1269.5	0.25

Average Density =	**0.28**	gr/cm^3
Average Snow Water Equivalent (SWE) =	**7.9**	cm H2O
Average Snow Water Equivalent =	**3.11**	inches H2O
Average Snow Water Equivalent =	**0.26**	feet H2O

SWE = avg. snow depth*(density snow/density water)

L9312: Snow depth transects:

Project ID: **North Slope Lakes Project** Site Location/Lake ID: **L9312**
Survey Purpose **Snow Depth and Water Content** Date: 2/16/2007 Time: 1:00:00 PM

Location Description:	Transects conducted in north/southerly and east/westerly direction. East/west starts at lathe on easterly side of lake and heads towards east side of pump house. North/south begins at closest orange pole marking snow course at southerly end of lake and heading towards Alpine.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Visibility unrestricted.
Elevation:	8' approximately BPMSL		Reference Markers:	Lathe and Pumphouse
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra

EAST/WEST TRANSECT

increment (ft)	depth (cm)		increment (ft)	depth (cm)
0	16	Begin on Tundra	850	9
20	13	taken every 20'	870	0.5
40	27		890	0.5
60	29		910	6
80	25		930	6
100	18		950	5
120	20		970	11
140	45		990	49
150	185	Begin Transition a	1010	15
160	185	taken every 10'	1030	22
170	175		1050	0.5
180	150		1070	5
190	120		1090	0
200	90		1110	0
210	55		1130	0
220	30		1150	8
230	10		1170	14
240	7		1190	7
250	4	Taken every 20'	1210	0
270	8		1230	13
290	5		1250	6
310	4		1270	0
330	5		1290	7
350	4		1310	0
370	9		1330	44
390	10		1350	0.5
410	6		1370	6
430	4		1390	5
450	7		1410	16
470	0		1430	13
490	4		1450	37
510	0		1470	26
530	6		1490	21
550	0		1510	34
570	10		1530	22
590	13			
610	0			
630	0			
650	0			
670	4			
690	0			
710	0.5			
730	25			
750	20			
770	11			
790	17			
810	6			
830	10			

L9312: Snow depth transects:

Project ID: **North Slope Lakes Project** Site Location/Lake ID: **L9312**
Survey Purpose **Snow Depth and Water Content** Date: 2/16/2006 Time: 1:30:00 PM

Location Description:	Transects conducted in north/southerly and east/westerly direction. East/west starts at lathe on easterly side of lake and heads towards east side of pump house. North/south begins at closest orange pole marking snow course at southerly end of lake and heading towards Alpine.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Visibility unrestricted.
Elevation:	8' approximately BPMSL		Reference Markers:	Lathe and orange snow course pole
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra

NORTH/SOUTH TRANSECT

increment (ft)	depth (cm)		increment (ft)	depth (cm)	increment (ft)	depth (cm)	
0	15	Begin on Tundra	1180	2	2360	7	
20	16		1200	0.5	2380	8	
40	23	Begin Transition zone	1220	0	2400	9	
60	40		1240	0	2420	9	
80	16		1260	0.5	2440	9	
100	5	Transition to lake	1280	5	2460	4	
120	6		1300	6	2480	5	
140	0		1320	0	2500	20	
160	1		1340	0.5	2520	9	
180	5		1360	13	2540	6	
200	1		1380	17	2560	5	
220	0		1400	13	2580	11	
240	3		1420	6	2600	5	
260	6		1440	18	2620	10	
280	5		1460	6	2640	0.5	
300	6		1480	6	2660	6	
320	22		1500	0.5	2680	0.5	
340	10		1520	0.5	2700	9	
360	6		1540	5	2720	8	
380	9		1560	8	2740	4	
400	5		1580	7	2760	14	
420	0		1600	0.5	2780	6	
440	5		1620	5	2800	11	
460	0.5		1640	8	2820	12	
480	4		1660	20	2840	0	
500	10		1680	0	2860	8	
520	0.5		1700	20	2880	18	
540	13		1720	8	2900	6	
560	8		1740	9	2920	11	Begin Transition zone
580	2		1760	15	2940	6	
600	6		1780	10	2960	7	
620	0		1800	11	2980	8	
640	5		1820	5	3000	6	Transition to Tundra
660	6		1840	0	3020	10	
680	2		1860	5	3040	38	
700	8		1880	0.5	3060	10	
720	6		1900	8	3080	10	
740	0		1920	6	3100	25	
760	8		1940	6	3120	10	
780	0		1960	0			
800	0		1980	7			
820	0		2000	5			
840	6		2020	8			
860	15		2040	7			
880	1		2060	8			
900	0		2080	7			
920	0		2100	12			
940	7		2120	28			
960	14		2140	13			
980	12		2160	0			
1000	8		2180	6			
1020	0.5		2200	5			
1040	11		2220	4			
1060	5		2240	5			
1080	10		2260	0			
1100	0		2280	6			
1120	11		2300	23			
1140	0.5		2320	6			
1160	9		2340	7			

APPENDIX E. WATER-LEVEL MEASUREMENT FORMS

The following forms report the water levels, ice thickness, freeboard and other physical information obtained during field sampling.

North Slope Lakes Project
University of Alaska Fairbanks, Water and Environmental Research Center
FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **Mine Site B**
Local Number: West Channel

All measurements in feet, unless noted	Elevation	Latitude (degrees)	Longitude (degrees)
Lake-Bottom Datum at Station:	n/a		

Vertical-Datum Corrections, reference survey notes in site folders

Date	MP ID	MP Elevation (feet above BP Sea Level)
TBM1	100.00	Arbitrary Datum

ABBREVIATIONS
BOI, bottom of ice

Calib, used to calibrate PT
IS, ice surface
LB, lake bottom
LS, land surface
MM, mass measurement
MP, measuring point
N/A, not available
PM, partial measurement
WS, water surface

Date	Time	Method	Snow Depth	Total Depth WS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WS Elevation	IS Elevation	BOI to LB	REMARKS
10/25/06	17:45	Tape	- -	6.90	0.02	0.59	0.03			**6.34**	
11/15/06	17:10	Tape	0.15	6.75	0.02	1.28	0.03	95.90	95.93	**5.50**	
12/16/06	16:18	Tape	- -	6.05	0.02	2.20	0.50	95.10	95.60	**4.35**	
01/06/07	14:00	Tape	- -	5.35	0.02	2.80	0.70	94.59	95.29	**3.25**	
2/14/07	10:58	Tape	0.30	4.80	0.02	3.87	1.10	94.28	95.38	**2.03**	

Collected Data Values
Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt
Freeboard (FB) = Height of ice level over water level in open hole
Ice Thickness (IT) = Measured distance between top and bottom of ice
Total Depth (TD) = Measured distance from water surface to lake bottom
Estimated Error = Field estimate of water level measurement error
Calculated Values
Ice Surface (IS) Elevation = Water Elevation + Freeboard
Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness
Open Water Depth = (Total Depth + Freeboard) - Ice Thickness = BOI to LB

North Slope Lakes Project
University of Alaska Fairbanks, Water and Environmental Research
FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **Mine Site B**
Local Number: East Channel

All measurements in feet, unless noted	Elevation	Latitude (degrees)	Longitude (degrees)
Lake-Bottom Datum at Station:	n/a		

Vertical-Datum Corrections, reference survey notes in site folders

Date	MP ID	MP Elevation (feet above BP Sea Level)
TBM1	100.00	Arbitrary Datum

ABBREVIATIONS
BOI, bottom of ice
Calib, used to calibrate PT
IS, ice surface
LB, lake bottom
LS, land surface
MM, mass measurement
MP, measuring point
N/A, not available
PM, partial measurement
WS, water surface

Date	Time	Method	Snow Depth	Total Depth WS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WS Elevation	IS Elevation	BOI to LB	REMARKS
10/25/06	17:55	Tape	- -	5.39	0.02	0.60	0.02			**4.81**	
11/15/06	16:46	Tape	0.15	5.22	0.02	1.25	0.05	95.90	95.95	**4.02**	
12/16/06	16:16	Tape	- -	4.50	0.02	2.15	0.50	95.10	95.60	**2.85**	
01/06/07	14:05	Tape	- -	3.95	0.02	2.70	0.50	94.59	95.09	**1.75**	
2/14/07	10:30	Tape	0.85	3.65	0.02	3.55	0.95	94.28	95.23	**1.05**	

Collected Data Values
Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt
Freeboard (FB) = Height of ice level over water level in open hole
Ice Thickness (IT) = Measured distance between top and bottom of ice
Total Depth (TD) = Measured distance from water surface to lake bottom
Estimated Error = Field estimate of water level measurement error
Calculated Values
Ice Surface (IS) Elevation = Water Elevation + Freeboard
Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness
Open Water Depth = (Total Depth + Freeboard) - Ice Thickness = BOI to LB