

Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: November 2006



M. Lilly with an ice auger at Kuparuk Dead Arm Cell 1, Photo by D. Reichardt.

by

Colleen Rust, Dan Reichardt, Jeff Derry and Michael Lilly

June 2007

North Slope Lakes Hydrologic Project

Report No. INE/WERC 07.03

Water and Environmental
Research Center



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Colleen Rust¹, Dan Reichardt¹, Jeff Derry¹, and Michael Lilly¹

A report on research sponsored by:

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For additional information write to:

Publications,
Water and Environmental Research Center
University of Alaska Fairbanks
Fairbanks, Alaska 99775
www.uaf.edu/water/

For Project Information write to:

Daniel White – Project Manager
Box 5860, WERC. UAF
Fairbanks, AK 99775-5860
907-474-6222
ffdmw@uaf.edu

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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
<u>Length</u>		
inch (in)	25.4	millimeter (mm)
inch (in)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
<u>Area</u>		
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)
<u>Volume</u>		
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)
<u>Velocity and Discharge</u>		
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)
<u>Hydraulic Conductivity</u>		
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)
<u>Hydraulic Gradient</u>		
foot per foot (ft/ft)	5280	foot per mile (ft/mi)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
<u>Pressure</u>		
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 (m³/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:

$$^{\circ}\text{F} = 1.8(^{\circ}\text{C}) + 32$$

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:

“Sea level” in the following report 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 (°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
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°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)
- Bureau of Land Management
- Alaska Department of Natural Resources
- The Nature Conservancy
- Northern Alaska Environmental Center

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Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: November 2006

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 the 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. 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. L9817 has been used in previous years for ice-road construction, but was not used during winter 2005-06, nor will 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 access road and has two cells connected to 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 November 2006, 2) summarize accomplished field trip objectives.

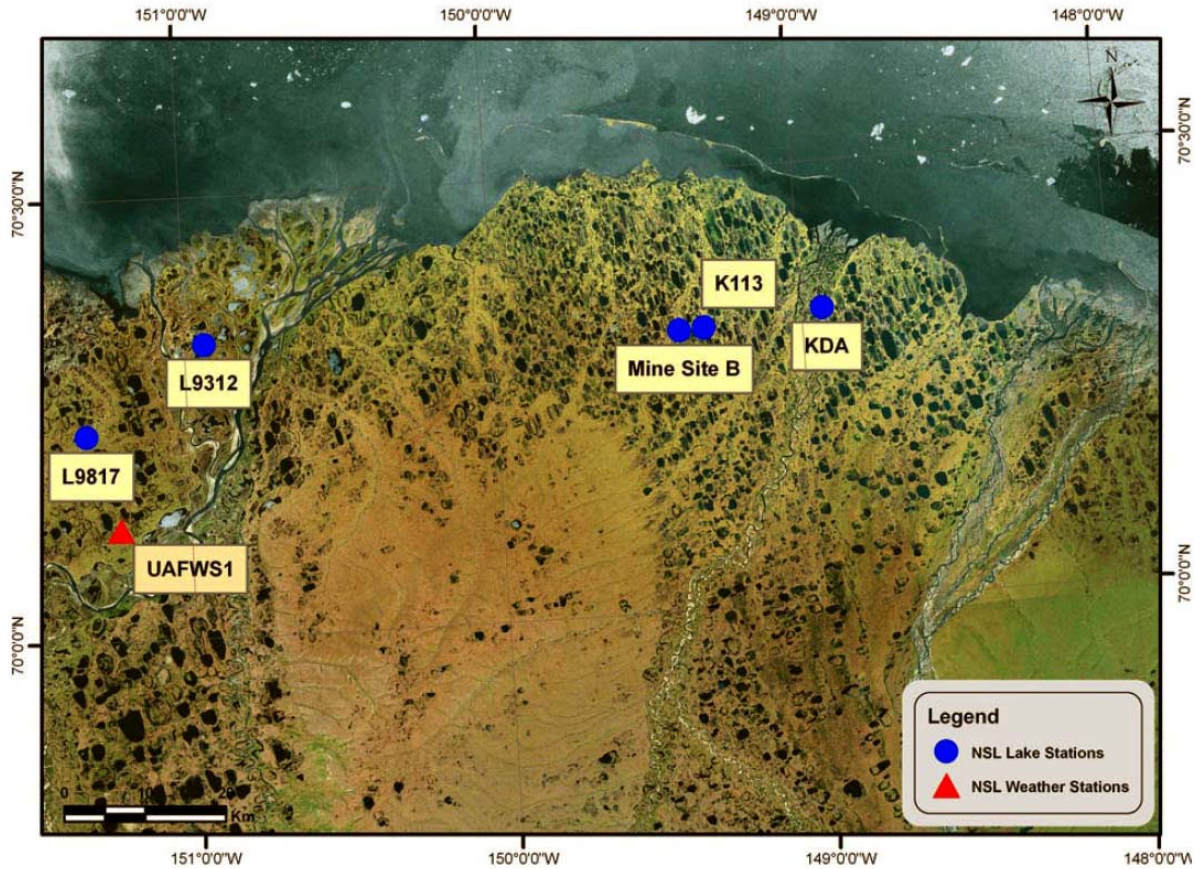


Figure 1. Location of study lakes in the NPR-A, Alpine, Kuparuk, and Prudhoe Bay field operating areas, North Slope, Alaska.

TRIP OBJECTIVES

The goal of each sampling trip is to collect physical and chemical data from each study lake. We drilled a series of holes at designated sampling locations for each lake. 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 November 2006, we focused on the following locations/tasks:

1. Kuparuk Dead Arm Reservoirs (1-3)
 - Survey water levels to local elevation control on cells 1, 2, and 3.
 - Collect water quality data in cells 1, 2, and 3.
 - Install Pressure Transducer and Thermistor string in Cell 2.

- Automated data collection station maintenance. Install Free Wave Radio System.
 - Collect water column samples from cells 1 and 2.
2. Mine Site B
- Survey water levels to local elevation control on North cell.
 - Collect water quality data.
 - Install Pressure Transducer and Thermistor string in North Cell.
 - Automated data collection station maintenance. Install Free Wave Radio System.
 - Collect water column samples from North Cell, South Cell and Stream Junction.
3. L9312: Alpine Facility
- Survey water level to local elevation control.
 - Collect water quality data.
 - Collect water column samples from Raft “B”.
4. L9817: NPR-A
- L9817 was not visited due to tundra travel restrictions.



Figure 2. Kuparuk Dead Arm (KDA) Station, Photo by D. Reichardt.

PROCEDURES

Water Chemistry Sampling

All field work followed 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-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%

Water samples were also collected at 3 depths (1 ft. below bottom of ice, within the central part of the water column, and 1 ft. above Lake Bottom). Some 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 analyses are 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, along a transect shown in Figure 3. Snow-depth measurements were taken every meter for twenty-five meters, then turning at a 90 degree angle, 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. During the November trip a concentrated effort was put towards gathering more information on larger scale snow distributions at MSB. These larger-scale snow depth measurements were conducted along general east/west and north/south transects (Figure 3). MSB depth measurements were typically recorded every 20 feet (4 paces).

SELECTED RESULTS

Snow depths and density on lake surfaces (Table 2) in the Prudhoe Bay operating area are similar, while L9312 in the Alpine operating area shows more accumulation on the lake surface than other sites. Betty Pingo is a WERC and USDA operated meteorological station with a Wyoming precipitation gauge. The relatively long data records from Betty Pingo can be utilized in drawing comparisons and improving modeling efforts on the North Slope Lake sites.

Large-scale snow distribution at MSB shows some interesting results, associated with the presence of an island in the middle of the lake. The east-west and south-north snow transects show different results with the presence of an island that the south-north transect bisects, and the east-west transect does not include. For the east-west transect the snow depths were approximately 2.5 in (6.4 cm) on the lake and around 8.0 in (20.32 cm) in tundra areas . Whereas, the north-south transect had snow depths around 2.5 in (6.4 cm) on the lake and 4.5 in (11.5 cm) in tundra areas. Table 3 shows spatial variation of snow depth at various lakes and reservoirs based upon snow courses and snow transects. Topographic affects on spatial snow distribution appears to be a critical factor in wind-dominated arctic environments.

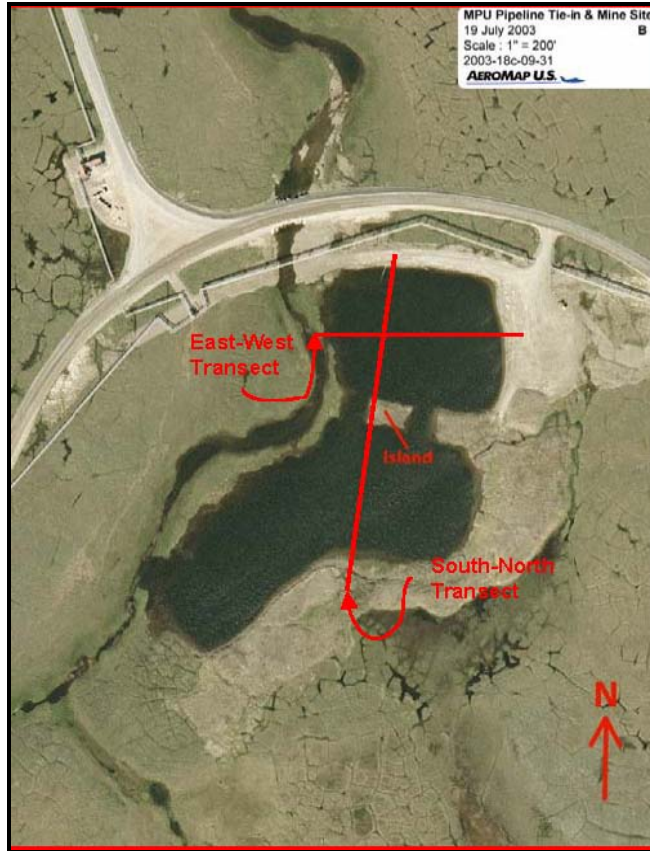


Figure 3. MSB snow site map and snow transect locations.

Table 2. Average density and snow depth from snow courses.

	KDA [in; (cm)]	MSB [in; (cm)]	L9312 [in; (cm)]	Betty Pingo [in; (cm)]
Lake	1.4; (3.5)	2.1; (5.4)	6.6; (16.7)	
Tundra			2.9; (7.3)	2.7; (6.9)
Density (%)	0.29	0.26	0.25	0.21

Table 3. Average snow depth from transect measurements at Mine Site B (MSB).

	East-West [in; (cm)]	South-North [in; (cm)]
Lake	2.5; (6.4)	2.3; (5.9)
Tundra	7.1; (18.0)	4.3; (10.9)
Transition Zones	8.5; (21.7)	4.5; (11.5)

At MSB, snow depositional sinks are located at the transition between lake and tundra with the exception of the north-south transect influenced by the presence of an island. Clearly topography at transition zones plays a large role in the snow distribution in a wind dominated arctic environment. To illustrate the importance of these transition areas, the East-West transect (Figure 4), which includes the abrupt transition zone, is a third less in length than the South-North transect (Figure 5), yet has close to two and half times the cumulative snow depth. Depending on the size of the watershed this can equate to a significant amount of snow water equivalent (SWE) being held in a relatively small area of the basin. Additionally, studies have indicated drift density is higher than lake un-drifted snow density, thereby further increasing the water content in these zones (Benson and Sturm, 1993).

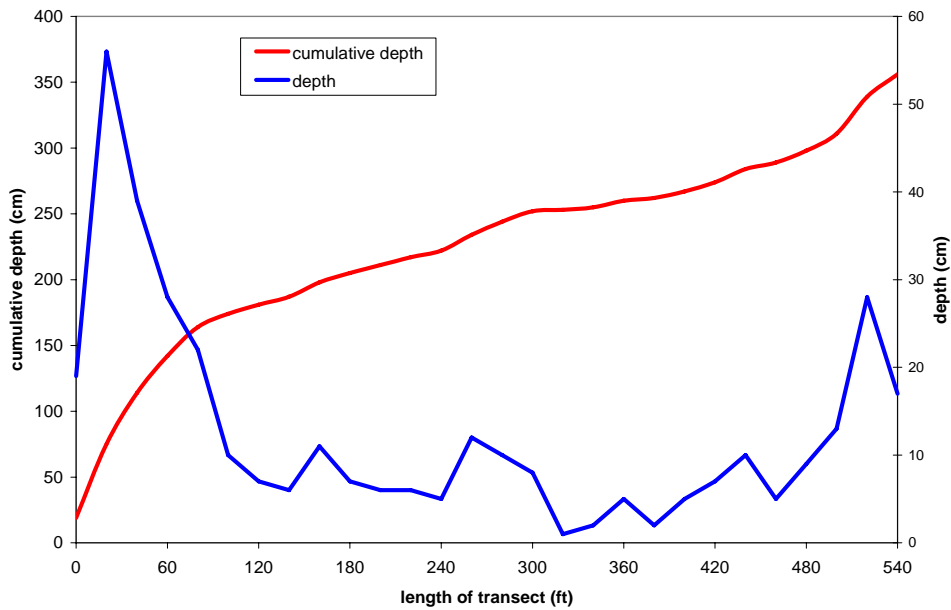


Figure 4. MSB: Cumulative snow depth, East-West transect.

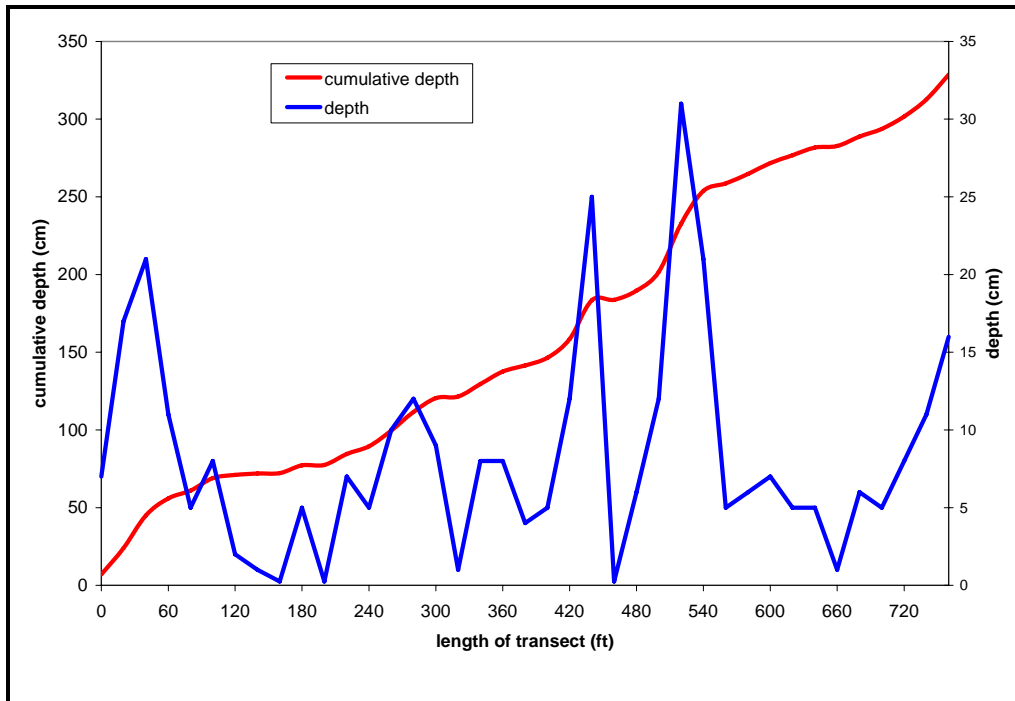


Figure 5. MSB: Cumulative snow depth, South-North transect.

SUMMARY

Sampling occurred at Kuparuk Deadarm Lakes, Mine Site B and L9312 during November field activities. Sampling was planned at L9817; however access was not possible due to tundra travel restrictions. As Table 4 demonstrates, water levels in MSB and KDA are dropping at a rate of between 0.25 ft (0.08 m) and 0.41 ft (0.12 m) per month, while L9312 does not show a similarly rapid drop in level.

Table 4 summarizes conditions at priority sampling sites. Each lake visited had one or more locations where water samples were drawn 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 4. Ice thickness, Median DO Concentration, Median Actual Conductance and Monthly Water Drop for North Slope lakes in mid-November.

Sampling Site	Ice Thickness [ft; (m)]	Median DO Concentration[mg/L]	Median Actual Conductivity[μS/cm]	Water level drop since mid-October [ft; (m)]
KDA1-CT	1.15; (0.35)	14.64	111.7	0.36; (0.11)
KDA2-CT	1.00; (0.30)	14.78	108.6	0.41; (0.12)
MSBS-CT	1.30; (0.40)	10.97	214.0	0.25; (0.08)
MSBN-CT	1.17; (0.36)	11.71	205.4	0.25; (0.08)
L9312 Raft B	1.40; (0.43)	15.25	46.6	0.02; (0.006)

Continuous monitoring of the 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 resource management. As water levels drop during the winter, it is important to identify the changing water chemistry as well as the potential spring recharge. This information is important for permitting agencies as well as the industry professionals who depend on this resource 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 brought forth on the effects of mid-winter pumping of North Slope tundra lakes.

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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: 11/14/06 Time: 15:43
 2 of 2

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.9026' Easting: W148°56.6748' Datum: NAD83
 Measurements By: DAR Time: 15:43
 Water Depth (ft): 20.6 Ice Thickness (ft): 1.15
 Freeboard (ft): 0.05 Snow Depth (ft): nr
 Elev. (BPMSL +/- .02): 88.68 Survey By: JD, MRL Date: 11/14/06 Time: 17:00
 Water Sampling By: DAR Sample Depths BWS (ft): 1 2 Date: 11/14/06 Time: 16:35
 2 10.5
 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	GWS	InSitu Troll 9000	33033	Pass	Pass

Parameters	Field Measurements						
	16:09	16:15	16:19	16:25	16:29	16:33	
Time:	16:09	16:15	16:19	16:25	16:29	16:33	
Depth BWS (ft):	17	18	19	20	20.5	Bottom	
Temp (°C):	0.46	0.81	1.06	1.27	1.32	1.35	
pH:	8.26	8.14	7.94	7.79	7.76	7.7	
Barometric (mmHg):	766.9	767.0	767.0	767.2	767.3	767.4	
Pressure (kPa):	49.05	52.28	55.11	58.11	60.00	60.86	
Conductivity (µS/cm):	111.0	112.9	117.6	124.1	124.9	125.2	
RDO (ppm): (mg/L)	14.35	12.74	9.53	6.85	5.81	5.79	
Turbidity (NTU):	-0.1	-0.2	-0.1	1.2	1.6	210.7	
ORP	209	210	213	216	216	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): _____			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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: _____
 No turbidity cal check

Field-Form Filled Out By: Reichardt Date: 11/15/06
 QAQC Check By: Chambers Date: 12/4/06

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: 11/14/06 Time: 13:29
 1 of 2

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.9776' Easting: W148°56.4462' Datum: WGS84
 Measurements By: DAR Time: 13:29
 Water Depth (ft): 19.85 Ice Thickness (ft): 1.0
 Freeboard (ft): 0.05 Snow Depth (ft): 0.2
 Elev. (BPMSL +/- .02): 88.66 Survey By: JD, MRL Date: 11/14/06 Time: 17:00
 Water Sampling By: DAR Sample Depths BWS (ft): 1 2 Date: 11/14/06 Time: 13:47
 2 10
 3 19.5

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check				
Multi	GWS	InSitu Troll 9000	33033	Pass	Pass				
Parameters									
	Field Measurements								
Time:	13:46	13:47	13:48	13:49	13:50	13:51	13:53	13:54	13:56
Depth BWS (ft):	2	3	4	5	7	9	11	13	15
Temp (°C):	-0.10	-0.02	0.01	0.01	0.06	0.08	0.09	0.14	0.22
pH:	8.23	8.22	8.20	8.20	8.23	8.22	8.21	8.20	8.23
Barometric (mmHg):	764.6	764.7	764.8	764.8	765.0	765.1	765.2	765.3	765.4
Pressure (kPa):	4.52	7.47	10.11	13.26	18.93	25.09	31.31	37.28	43.38
Conductivity (µS/cm):	109.4	109.0	108.9	108.8	108.6	108.4	108.4	108.2	107.9
RDO (ppm): (mg/L)	14.78	14.79	14.80	14.80	14.79	14.78	14.75	14.74	14.71
Turbidity (NTU):	-0.1	-0.2	-0.2	-0.2	-0.1	-0.1	-0.2	-0.1	-0.1
ORP	181	182	183	184	184	185	186	187	188

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)	75	76	81	74	80	74	115	107	107	Digital titrator 10-4000 mg/L as CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: Pocket Situ Log 2006-11-14 132745.. Popping ice, followed by water column bobbing up and down .02' or so was periodic.
 No turbidity cal check

Field-Form Filled Out By: Reichardt Date: 11/15/06
 QAQC Check By: Chambers Date: 12/4/06

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: 11/14/06 Time: 13:29
 2 of 2

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.9776' Easting: W148°56.4462' Datum: WGS84
 Measurements By: DAR Time: 13:29
 Water Depth (ft): 19.85 Ice Thickness (ft): 1.00
 Freeboard (ft): 0.05 Snow Depth (ft): 0.20
 Elev. (BPMSL +/- .02): 88.66 Survey By: JD, MRL Date: 11/14/06 Time: 17:00
 Water Sampling By: DAR Sample Depths BWS (ft): 1 2 Date: 11/14/06 Time: 13:47
 2 10
 3 19.5

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	GWS	InSitu Troll 9000	33033	Pass	Pass
Parameters					
Field Measurements					
Time:	13:57	14:06	14:14	14:24	14:28
Depth BWS (ft):	17	18	19	19.5	Bottom
Temp (°C):	0.43	0.99	1.26	1.4	1.48
pH:	8.2	7.84	7.67	7.61	7.59
Barometric (mmHg):	765.5	765.6	765.9	766.0	766.0
Pressure (kPa):	49.18	52.22	55.19	56.85	58.55
Conductivity (µS/cm):	108.3	118.6	131.9	140.5	144.7
RDO (ppm): (mg/L)	14.66	10.06	6.92	5.89	5.22
Turbidity (NTU):	-0.1	0.1	1.0	1.5	215.0
ORP	189	198	203	205	152

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: _____
 No turbidity cal check

Field-Form Filled Out By: Reichardt Date: 11/15/06
 QAQC Check By: Chambers Date: 12/4/06

University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID: North Slope Lakes
 Sample Purpose: Lake Water Quality

Site Location/Lake ID: KDA3-CT
 Date: 11/14/06 Time: 18:30

1 of 2

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.025 Easting: W148°56.2044 Datum: NAD83
 Measurements By: DAR Time: 18:30
 Water Depth (ft): 23.65 Ice Thickness (ft): 1.15
 Freeboard (ft): 0.08 Snow Depth (ft): 0.15
 Elev. (BPMSL +/- .02): 88.66 Survey By: JD, MRL Date: 11/14/06 Time: 17:00
 Water Sampling By: N/A Sample Depths BWS (ft): 1 N/A 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	GWS	InSitu Troll 9000	33033	Pass	Pass				
Parameters									
	Field Measurements								
Time:	18:40	18:41	18:42	18:43	18:44	18:45	18:46	18:47	18:49
Depth BWS (ft):	2	3	5	7	9	11	13	15	17
Temp (°C):	-0.11	-0.15	0.03	0.11	0.13	0.15	0.17	0.20	0.26
pH:	8.26	8.22	8.21	8.20	8.21	8.21	8.22	8.24	8.22
Barometric (mmHg):	767.8	767.9	768.0	768.1	768.1	768.2	768.3	768.3	768.4
Pressure (kPa):	4.75	7.46	13.04	19.17	25.49	31.13	37.10	43.16	49.05
Conductivity (µS/cm):	107.3	107.2	106.5	106.1	105.9	105.9	105.5	105.5	105.4
RDO (ppm): (mg/L)	14.76	14.78	14.76	14.7	14.64	14.59	14.54	14.51	14.33
Turbidity (NTU):	-0.2	-0.2	-0.1	-0.2	-0.2	-0.2	-0.1	-0.2	-0.1
ORP	204	205	206	206	205	206	206	205	205

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: Pocket Situ Log 2006-11-14 182133

No turbidity cal check

Field-Form Filled Out By: Reichardt Date: 11/15/06
 QAQC Check By: Chambers Date: 12/4/06

University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID: North Slope Lakes
 Sample Purpose: Lake Water Quality

Site Location/Lake ID: KDA3-CT
 Date: 11/14/06 Time: 18:30

2 of 2

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.025 Easting: W148°56.2044 Datum: NAD83
 Measurements By: DAR Time: 18:30
 Water Depth (ft): 23.65 Ice Thickness (ft): 1.15
 Freeboard (ft): 0.08 Snow Depth (ft): 0.15
 Elev. (BPMSL +/- .02): 88.66 Survey By: JD, MRL Date: 11/14/06 Time: 17:00
 Water Sampling By: _____ 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	GWS	InSitu Troll 9000	33033	Pass	Pass				
Parameters		Field Measurements							
Time:	18:51	18:53	19:01	19:05	19:07	19:10			
Depth BWS (ft):	19	21	22	23	23.5	Bottom			
Temp (°C):	0.32	0.85	1.11	1.34	1.44	1.47			
pH:	8.23	8.00	7.72	7.58	7.51	7.52			
Barometric (mmHg):	768.4	768.5	768.6	768.7	768.8	768.8			
Pressure (kPa):	55.02	61.13	64.09	67.21	68.93	69.86			
Conductivity (µS/cm):	105.3	107.7	110.1	113.8	115.9	116.3			
RDO (ppm): (mg/L)	14.29	12.93	9.64	7.28	5.6	5.43			
Turbidity (NTU):	-0.1	0.0	0.4	1.7	2.8	184			
ORP	205	209	214	217	218	141			

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: _____
 No turbidity cal check

Field-Form Filled Out By: Reichardt Date: 11/15/06
 QAQC Check By: Chambers Date: 12/4/06

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: 11/15/06 Time: 13:11
 2 of 2

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.280' Easting: W149°24.009' Datum: NAD83
 Measurements By: DAR Time: 13:11
 Water Depth (ft): 35.15 Ice Thickness (ft): 1.17
 Freeboard (ft): 0.07 Snow Depth (ft): 0.10
 Elev. (BPMSL +/- .02): 95.91 Survey By: JD, MRL Date: 11/15/06 Time: 16:18
 Water Sampling By: DAR Sample Depths BWS (ft): 1 2 Date: 11/15/06 Time: 14:00
 2 25
 3 34.5

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check					
Multi	GWS	InSitu Troll 9000	33033	Pass	Pass					
Parameters										
	Field Measurements									
Time:	13:26	13:28	13:30	13:32	13:40	13:47	13:50	13:54	13:59	
Depth BWS (ft):	25	27	29	31	33	34	35	35	Bottom	
Temp (°C):	0.08	0.12	0.26	0.43	0.92	0.99	1.06	1.10	1.11	
pH:	7.84	7.86	7.79	7.86	7.68	7.58	7.55	7.52	7.50	
Barometric (mmHg):	771.2	771.3	771.4	771.5	771.6	771.7	771.8	771.8	771.7	
Pressure (kPa):	72.91	79.12	85.08	91.01	97.17	100.13	102.02	102.95	104.38	
Conductivity (µS/cm):	205.5	205.4	205.3	205.7	212.6	218.1	224.2	227.8	229.4	
RDO (ppm): (mg/L)	11.31	11.27	11.15	11.03	7.92	5.57	4.48	3.81	3.68	
Turbidity (NTU):	0.3	0.3	0.5	0.4	1.1	1.3	2.1	1.9	30.8	
ORP	223	223	223	223	226	227	227	222	56	
Hach LDO (UAF) mg/L										
Hach temp °C										

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: _____
 No turbidity cal check.

Field-Form Filled Out By: Reichardt Date: 11/15/06
 QAQC Check By: Chambers Date: 12/4/06

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: 11/15/06 Time: 13:11
 2 of 2

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.214' Easting: W149°24.020' Datum: NAD83
 Measurements By: DAR Time: 15:20
 Water Depth (ft): 28.7 Ice Thickness (ft): 1.30
 Freeboard (ft): 0.10 Snow Depth (ft): 0.15
 Elev. (BPMSL +/- .02): 95.91 Survey By: JD, MRL Date: 11/15/06 Time: 16:18
 Water Sampling By: DAR Sample Depths BWS (ft): 1 2 Date: 11/15/06 Time: 16:15
 2 18.5
 3 28

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	GWS	InSitu Troll 9000	33033	Pass	Pass
Parameters					
Field Measurements					
Time:	15:55	15:59	16:01	16:04	16:09 16:13
Depth BWS (ft):	24.0	26.0	27.0	28.0	28.5 Bottom
Temp (°C):	0.39	0.57	0.71	0.91	1.10 1.18
pH:	7.55	7.53	7.49	7.47	7.45 7.45
Barometric (mmHg):	772.0	772.1	772.2	772.2	772.2 772.2
Pressure (kPa):	70.54	76.32	78.97	82.12	83.76 84.97
Conductivity (µS/cm):	223.0	225.0	233.7	237.4	242.0 245.5
RDO (ppm): (mg/L)	8.58	8.05	6.95	6.09	4.18 3.37
Turbidity (NTU):	0.6	0.6	0.9	1.2	2.1 23.6
ORP	233	234	235	235	198 32

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: Pocket Situ Log 2006-11-15 145826

No turbidity cal check.

Field-Form Filled Out By: Reichardt Date: 11/15/06
 QAQC Check By: Chambers Date: 12/4/06

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: MSB-MC3
 Sample Purpose: Lake Water Quality Date: 11/15/06 Time: 18:45

FIELD MEASUREMENTS

GPS Coord. Northing: NR Easting: NR Datum: N/A
 Measurements By: DAR Time: 18:52
 Water Depth (ft): 3.8 Ice Thickness (ft): 1.3
 Freeboard (ft): 0.40 Snow Depth (ft): 0.45
 Elev. (BPMSL +/- .02): n/a Survey By: _____ Date: _____ Time: _____
 Water Sampling By: n/a Sample Depths BWS (ft): 1 N/A 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	GWS	InSitu Troll 9000	33033	Pass	Pass
Parameters					
Field Measurements					
Time:	18:52				
Depth BWS (ft):	3.0				
Temp (°C):	-0.42				
pH:	7.30				
Barometric (mmHg):	772.5				
Pressure (kPa):	7.766				
Conductivity (µS/cm):	293.9				
RDO (ppm): (mg/L)	1.15				
Turbidity (NTU):	2.0				
ORP	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): <u>3</u>			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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: Pocket Situ Log 2006-11-15 184014. MC3 is downstream of stream-lake junction, in Milne Creek.
 No turbidity cal check.

Field-Form Filled Out By: Reichardt Date: 11/15/06
 QAQC Check By: Chambers Date: 12/4/06

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: 11/19/06 Time: 15:10
 1 of 2

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.186' Easting: W149°24.234' Datum: WGS84
 Measurements By: DAR Time: 15:10
 Water Depth (ft): 20.3 Ice Thickness (ft): 1.5
 Freeboard (ft): 0.18 Snow Depth (ft): TRACE
 Elev. (BPMSL +/- .02): 95.91 Survey By: JD, MRL Date: 11/15/06 Time: 16:18
 Water Sampling By: N/A Sample Depths BWS (ft): 1 N/A 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	GWS	InSitu Troll 9000	33033	Pass	none					
Parameters										
	Field Measurements									
Time:	15:14	15:16	15:20	15:22	15:26	15:30	15:36	15:41	15:45	
Depth BWS (ft):	2	4	6	9	12	15	17	18	19	
Temp (°C):	-0.6	-0.12	-0.24	-0.3	-0.27	-0.2	-0.12	-0.07	-0.06	
pH:	7.48	7.59	7.69	7.72	7.73	7.72	7.68	7.59	7.59	
Barometric (mmHg):	765.7	765.8	766.0	766.2	766.3	766.4	766.5	766.5	766.6	
Pressure (kPa):	5.26	10.23	16.55	25.02	34.22	42.99	49.23	52.21	55.48	
Conductivity (µS/cm):	237.1	235.8	234.4	233.8	232.5	230.4	228.5	228.5	228.4	
RDO (ppm): (mg/L)	10.64	10.87	11.27	11.43	11.52	11.35	11.01	9.53	9.38	
Turbidity (NTU):	0.3	0.2	0.2	0.2	0.3	0.2	0.2	0.4	0.5	
ORP	250	248	247	246	246	246	247	248	248	

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: Located at site staked based upon 2005/2006 GPS coordinates. MRL believes this may not be the same location as last year.
 ORP not cal checked.

No turbidity cal check.

Field-Form Filled Out By: Reichardt Date: 11/19/06
 QAQC Check By: Chambers Date: 12/4/06

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: 11/19/06 Time: 15:10
 2 of 2

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.186' Easting: W149°24.234' Datum: WGS84
 Measurements By: DAR Time: 15:10
 Water Depth (ft): 20.3 Ice Thickness (ft): 1.5
 Freeboard (ft): 0.18 Snow Depth (ft): TRACE
 Elev. (BPMSL +/- .02): 95.91 Survey By: JD, MRL Date: 11/15/06 Time: 16:18
 Water Sampling By: N/A Sample Depths BWS (ft): 1 N/A 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	GWS	InSitu Troll 9000	33033	Pass	none
Parameters					
Field Measurements					
Time:	15:47	15:50			
Depth BWS (ft):	20	Bottom			
Temp (°C):	-0.04	-0.03			
pH:	7.59	7.58			
Barometric (mmHg):	766.6	766.6			
Pressure (kPa):	57.84	60.05			
Conductivity (µS/cm):	229.0	229.4			
RDO (ppm): (mg/L)	9.29	9.22			
Turbidity (NTU):	0.6	198			
ORP	249	191			

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: Located at site staked based upon 2005/2006 GPS coordinates. MRL believes this may not be the same location as last year.
 No turbidity cal check.

Field-Form Filled Out By: Reichardt Date: 11/19/06
 QAQC Check By: Chambers Date: 12/4/06

University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID: North Slope Lakes
 Sample Purpose: Lake Water Quality

Site Location/Lake ID: MSBS-W
 Date: 11/19/06 Time: 15:59

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.232' Easting: W149°24.089' Datum: WGS84
 Measurements By: DAR Time: 15:59
 Water Depth (ft): 16.1 Ice Thickness (ft): 1.7
 Freeboard (ft): 0.19 Snow Depth (ft): TRACE
 Elev. (BPMSL +/- .02): 95.91 Survey By: JD, MRL Date: 11/15/06 Time: 16:18
 Water Sampling By: JD/DAR Sample Depths BWS (ft): 1 N/A 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	GWS	InSitu Troll 9000	33033	Pass	none				
Parameters									
	Field Measurements								
Time:	16:11	16:15	16:19	16:22	16:26	16:30	16:35	16:39	
Depth BWS (ft):	2	4	6	9	12	14	15	Bottom	
Temp (°C):	-0.36	-0.35	-0.33	-0.31	-0.23	-0.15	-0.11	-0.09	
pH:	7.90	7.81	7.78	7.75	7.76	7.74	7.70	7.72	
Barometric (mmHg):	765.8	765.8	765.9	766.0	766.1	766.1	766.1	766.2	
Pressure (kPa):	4.634	10.336	16.245	25.214	34.162	40.182	43.115	45.741	
Conductivity (µS/cm):	218.1	220.5	220.7	219.8	219.1	218.7	218.7	218.9	
RDO (ppm): (mg/L)	11.73	11.52	11.24	11.08	10.84	10.51	10.03	9.79	
Turbidity (NTU):	0.2	0.2	0.2	0.2	0.2	0.3	0.3	3.5	
ORP	216	220	223	224	226	228	229	230	

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: ORP not cal checked.

No turbidity cal check.

Field-Form Filled Out By: Reichardt Date: 11/19/06
 QAQC Check By: Chambers Date: 12/4/06

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 Midpt
 Sample Purpose: Lake Water Quality Date: 11/18/06 Time: 15:22

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.023' Easting: W150°56.757' Datum: WGS84
 Measurements By: DAR Time: 15:30
 Water Depth (ft): 11.2 Ice Thickness (ft): 1.35
 Freeboard (ft): 0.05 Snow Depth (ft): 0.15
 Elev. (BPMSL +/- .02): 7.68 Survey By: JD, MRL Date: 11/18/06 Time: 15:18
 Water Sampling By: N/A Sample Depths BWS (ft): 1 N/A 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	GWS	InSitu Troll 9000	33033	Pass	Pass					
Parameters										
	Field Measurements									
Time:	15:22	15:25	15:27	15:34	15:37	15:51	15:55	16:04	16:11	
Depth BWS (ft):	2	3	4	6	8	9	10	11	Bottom	
Temp (°C):	-0.22	-0.21	-0.03	0.22	0.51	0.72	0.92	1.18	1.33	
pH:	7.46	7.47	7.48	7.47	7.43	7.27	7.17	7.01	6.99	
Barometric (mmHg):	770.5	770.6	770.6	770.6	770.7	770.7	770.7	770.8	770.9	
Pressure (kPa):	4.11	7.73	10.19	16.18	22.21	25.38	28.22	31.29	32.86	
Conductivity (µS/cm):	47.23	46.89	46.31	45.67	44.70	44.65	47.32	54.26	70.12	
RDO (ppm): (mg/L)	16.18	16.21	16.09	15.59	15.07	12.42	11.3	8.61	4.41	
Turbidity (NTU):	2.7	2.7	2.6	2.8	2.8	3.0	3.5	4.7	606	
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): _____			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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: _____
 No turbidity cal check.

Field-Form Filled Out By: Reichardt Date: 11/18/06
 QAQC Check By: Chambers Date: 12/5/06

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 Screen
 Sample Purpose: Lake Water Quality Date: 11/18/06 Time: 16:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.003' Easting: W150°57.005' Datum: WGS84
 Measurements By: DAR Time: 16:47
 Water Depth (ft): 11.3 Ice Thickness (ft): 1.100
 Freeboard (ft): 0.05 Snow Depth (ft): 0.35
 Elev. (BPMSL +/- .02): 7.68 Survey By: JD, MRL Date: 11/18/06 Time: 15:18
 Water Sampling By: N/A Sample Depths BWS (ft): 1 N/A 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	GWS	InSitu Troll 9000	33033	Pass	Pass					
Parameters										
	Field Measurements									
Time:	16:37	16:38	16:41	16:43	16:45	16:58	17:06	17:14	17:22	
Depth BWS (ft):	2	3	4	6	8	9	10	11	Bottom	
Temp (°C):	-0.25	-0.24	0.02	0.15	0.37	0.77	0.99	1.28	1.39	
pH:	7.44	7.44	7.44	7.44	7.38	7.15	7.02	6.95	6.95	
Barometric (mmHg):	770.6	770.7	770.7	770.7	770.7	770.7	770.8	770.8	770.8	
Pressure (kPa):	4.63	7.51	10.25	16.48	22.37	25.22	28.42	31.54	33.4	
Conductivity (µS/cm):	47.68	47.25	46.03	45.78	45.02	44.27	44.94	52.11	57.02	
RDO (ppm): (mg/L)	16.17	16.27	16.13	15.87	14.23	12.58	10.44	7.09	4.55	
Turbidity (NTU):	2.8	2.8	2.8	3.6	3.0	2.8	2.2	4.6	10.0	
ORP	160	162	164	165	163	179	187	166	99	

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: No Cal Check for ORP or turbidity

Field-Form Filled Out By: Reichardt Date: 11/18/06
 QAQC Check By: Chambers Date: 12/5/06

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 SH
 Sample Purpose: Lake Water Quality Date: 11/18/06 Time: 17:35

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.017' Easting: W150°57.076' Datum: WGS84
 Measurements By: DAR Time: 16:47
 Water Depth (ft): 11.2 Ice Thickness (ft): 1.30
 Freeboard (ft): 0.10 Snow Depth (ft): 0.10
 Elev. (BPMSL +/- .02): 7.68 Survey By: JD, MRL Date: 11/18/06 Time: 15:18
 Water Sampling By: N/A Sample Depths BWS (ft): 1 N/A 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	GWS	InSitu Troll 9000	33033	Pass	Pass					
Parameters										
	Field Measurements									
Time:	17:35	17:41	17:45	17:47	17:51	17:55	18:01	18:03		
Depth BWS (ft):	2	3	4	6	8	9	10	Bottom		
Temp (°C):	-0.29	-0.2	-0.01	0.27	0.57	0.79	0.91	0.93		
pH:	7.38	7.37	7.38	7.37	7.23	6.96	6.86	6.80		
Barometric (mmHg):	770.5	770.6	770.6	770.7	770.8	770.9	770.9	770.9		
Pressure (kPa):	4.78	7.52	10.22	16.42	22.38	26.41	28.21	29.59		
Conductivity (µS/cm):	47.44	40.85	46.17	45.33	44.89	45.93	48.06	48.77		
RDO (ppm): (mg/L)	15.88	15.94	15.72	15.27	13.94	9.17	7.49	6.22		
Turbidity (NTU):	2.6	2.6	2.8	2.8	2.6	2.7	3.5	34.9		
ORP	139	143	149	153	161	165	161	134		

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 CaCO ₃
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 NH ₃ -N
Ammonia/ Iron dilution										

Remarks: No Cal Check for ORP. Reading may have been taken before oxygen completely stabilized, especially at bottom reading.;
 No turbidity cal check.

Field-Form Filled Out By: Reichardt Date: 11/18/06
 QAQC Check By: Chambers Date: 12/5/06

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 ID: SRT Lab
 Sample Purpose: Lake Water Quality

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Model: Troll 9000
 Owner: GWS S/N: 33033

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH	11/14/06	9:36	Oakton Lot pH 4.01	2512012	Nov-07	4.05@15.8° C	Pass
pH	11/14/06	9:45	Oakton Lot 7.00	2512282	Dec-07	7.03@15.6° C	Pass
pH	11/14/06	9:47	Oakton Lot pH 10.00	531001-1	Sep-06	10.00@15.4° C	Pass
ORP	11/14/06	9:42	Insitu Quick-cal	9406B	Nov-06	221 @16.3° C	Pass
RDO - 100% DO	11/14/06	9:30	TetraBubbler			9.55@17.76° C	Pass
RDO - Zero DO	11/14/06	9:24	Hanna HI7040	690	Dec-06	0.03@21.23° C	Pass
Conductivity	11/14/06	9:33	Oakton 447uS	2603492	Apr-07	363.8@16.5° C	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH	11/14/06	20:30	Oakton Lot pH 4.01	2512012	Nov-07	4.08@16.4° C	pass
pH	11/14/06	20:30	Oakton Lot 7.00	2512282	Dec-07	7.04@16.5° C	pass
pH	11/14/06	20:30	Oakton Lot pH 10.00	2512278	Jul-07	10.07@17.1° C	pass
ORP	11/14/06	20:30	Insitu Quick-cal	9406B	Nov-06	247@17.9° C	pass
RDO - 100% DO	11/14/06	20:30	TetraBubbler			10.32@16.87° C	pass
RDO - Zero DO	11/14/06	20:30	Hanna HI7040	690	Dec-06	0.01 mg/L	pass
Conductivity	11/14/06	20:30	Oakton 447uS	2603492	Apr-07	364.3@cm15.5° C	pass

Remarks: _____

Field-Form Filled Out By: Derry Date: 11/20/2006
 QAQC Check By: Reichardt Date: 3/14/2007

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 ID: SRT Lab
 Sample Purpose: Lake Water Quality

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Model: Troll 9000
 Owner: GWS S/N: 33033

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH	11/15/06	20:49	Oakton Lot pH 4.01	2512012	Nov-07	4.06@18.57° C	pass
pH	11/15/06	20:49	Oakton Lot 7.00	2512282	Dec-07	7.04@18.07° C	pass
pH	11/15/06	20:49	Oakton Lot pH 10.00	2512278	Jul-07	10.09@18.63° C	pass
ORP	11/15/06	20:49	Insitu Quick-cal	9406B	Nov-06	244@15.1° C	pass
RDO - 100% DO	11/15/06	20:49	TetraBubbler			10.09@19.16° C	pass
RDO - Zero DO	11/15/06	20:49	Hanna HI7040	690	Dec-06	0.02 mg/L	pass
Conductivity	11/15/06	20:49	Oakton 447uS	2603492	Apr-07	374.7@17.72° C	pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail

Remarks: _____

Field-Form Filled Out By: Derry Date: 11/20/2006
 QAQC Check By: Reichardt Date: 3/14/2007

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 ID: Alpine WTP
 Sample Purpose: Lake Water Quality

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Model: Troll 9000
 Owner: GWS S/N: 33033

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH	11/17/06	11:06	Oakton Lot pH 4.01	2404386	Apr-07	4.05@17.64o C	pass
pH	11/17/06	11:06	Oakton Lot 7.00	2512282	Dec-07	7.00@11.74o C	pass
pH	11/17/06	11:06	Oakton Lot pH 10.00	2512278	Jun-07	10.18@10.57o C	pass
RDO - 100% DO	11/17/06	11:06	TetraBubbler			10.12@16.88o C	pass
RDO - Zero DO	11/17/06	11:06	Oakton Zero DO	2503140	Mar-06	0.12 mg/L	pass
Conductivity	11/17/06	11:06	Oakton 447uS	2511074	Oct-06	386.9@17.53o C	pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH	11/17/06	20:49	Oakton Lot pH 4.01	2512012	Nov-07	4.08	pass
pH	11/17/06	20:49	Oakton Lot 7.00	2512282	Dec-07	7.05	pass
pH	11/17/06	20:49	Oakton Lot pH 10.00	2512278	Jul-07	10.06	pass
RDO - 100% DO	11/17/06	20:49	TetraBubbler			10.68@14.77o C	pass
RDO - Zero DO	11/17/06	20:49	Oakton Zero DO	2503140	Mar-06	0.03 mg/L	pass
Conductivity	11/17/06	20:49	Oakton 447uS	2512278	Oct-06	392.8@16.12o C	pass

Remarks: _____

Field-Form Filled Out By: Derry Date: 11/20/2006
 QAQC Check By: Reichardt Date: 3/14/2007

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: 11/14/2006 Time: 17:00

Location:		Kuparuk Deadarm Reservoirs Cells 1, 2, 3						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
		high overcast, visibility unrestricted, getting dark minus 7 F at 3 mph						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Michael Lilly Jeff Derry		
BM #1 W0040768	BP	19.32	N70 20.065 NAD27	N70 20.065 NAD27				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasi)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
BM#1	0.33	19.65		19.32				Shot to flagged benchmark
KDA3		19.65	11.69	7.96				All measurements are to water level.
KDA2		19.65	11.66	7.99				
Turn point, Moved instrument.								
KDA2	11.77	19.76		7.99				WS Elevation for Reservoir #2
KDA3		19.76	11.78	7.98				WS Elevation for Reservoir #3
BM#1		19.76	0.43	19.33				Survey closes within + 0.01'
Move instrument to Island between KDA2 and KDA1, use KDA2 water level as turning point.								
KDA2	7.86	15.85		7.99				
KDA1		15.85	7.53	8.32				
Turn point. Moved on KDA1								
KDA1	7.69	16.01		8.32				WS Elevation for Reservoir #1
KDA2		16.01	8.02	7.99				Close survey to 0.00
Note: Field notes use temporary datum for BM #1 = 100.00 ft.								
KDA2-S1 is in NW Corner of Reservoir 2, KDA3-S1 is in SW Corner of Reservoir 3, BM #1 is set in dirt west of dike with pink flagging. KDA2-S2 is in SE Corner of Reservoir 2. KDA1-S1 is in NE corner of Reservoir 1.								

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasm; 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: 11/15/2006 Time: 16:18

Location:	Mine Site B, NE corner of North Cell, temporary datum							
Survey objective:	Lake water elevation survey				Weather Observations:		high overcast, visibility unrestricted	
Instrument Type:	Leica NA720	Instrument ID:	5482372 (GWS owned)			minus 5 F at 3 mph		
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)	Mike Lilly, Jeff Derry			
TBM__	nr	100	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM_1	6.22	106.22		100.00				Top of Post embedded in gravel
MSB_N		106.22	10.31	95.91				Water Surface Elevation MSBN
TBM_4		106.22	4.76	101.46				Top of cut pipe embedded in gravel
TBM_3		106.22	2.67	103.55				Top of weld on side of support post
TBM_2		106.22	2.30	103.92				Top of weld on side of support post
Turn point. Moved on TBM_2								
TBM_2	2.67	106.59		103.92				
TBM_3		106.59	3.04	103.55				
TBM_4		106.59	5.13	101.46				
MSB_N		106.59	10.69	95.90				
TBM_1		106.59	6.59	100.00				Close survey to 0.00
Move instrument to island between MSBN and MSBS, use MSBN as turning point								
MSB_N	7.33	103.23		95.90				north and south cells. Set up on island
MSB_S		103.23	7.32	95.91				Water Surface Elevation MSBS
Turn point. Moved on MSB_S								
MSB_S	7.65	103.56		95.91				
MSB_N		103.56	7.66	95.90				Close survey to 0.00

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasm; 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: 11/18/06 Time: 15:18

Location:		L9312,						
Survey objective:		Lake water elevation survey			Weather Observations:		high overcast, visibility unrestricted	
Instrument Type:		Leica NA720	Instrument ID: 5482372 (GWS owned)		minus 5 F at 3 mph			
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)	Mike Lilly, Jeff Derry			
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	2.50	14.22		11.72				Top SW HSM corner point "P", 1st VSM from
O		14.22	2.74	11.48				2nd VSM from lake
PH-VSM		14.22	0.36	13.86				Top SE corner pice. Cap SE VSM @ valve
Water Surface		14.22	6.54	7.68				Water Surface Elevation L9312
Turn point. Moved on Water Surface								
Water Surface	6.45	14.13		7.68				
PH-VSM		14.13	0.44	13.69				Blown survey point. Ignore elevation.
O		14.13	2.66	11.47				
PH-VSM		14.13	2.42	11.71				close survey 0.01'

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasm; 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.

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: 5/14/2006 Time: 19:00

Location Description:	Located at center of Lake 2 near KDA2-CT. "L" shaped pattern, first going north to south 1 meter for 25 meters and then west to east 1 meter for 25 meters.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather	High overcast, low wind, Observations: dark.
Latitude:		Longitude:		Datum:	
Elevation:	nr	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			Jeff Derry	

Snow Course Depths, in cm.

	1	2	3	4	5
1	2.0	4.0	7.0	7.0	4.0
2	1.0	0.0	4.0	8.0	3.0
3	2.0	4.0	1.0	12.0	3.0
4	2.0	3.0	1.0	12.0	0.0
5	3.0	3.0	2.0	13.0	1.0
6	1.0	1.0	3.0	5.0	4.0
7	2.0	2.0	3.0	0.0	3.0
8	4.0	5.0	3.0	0.0	3.0
9	3.0	4.0	4.0	0.0	3.0
10	4.0	6.0	5.0	2.0	1.0

(cm)
 Average snow depth = 3.5
 Maximum snow depth = 13.0
 Minimum snow depth = 0.0
 Standard variation = 2.9

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm ³)	Density (gr/cm ³)
DW4-1	6	62.0	214.2	0.29
DW4-2				
DW4-3				
DW4-4				
DW4-5				

Average Density = 0.29
 Average Snow Water Equivalent (SWE) = 1.0 cm H2O
 Average Snow Water Equivalent = 0.39 inches H2O
 Average Snow Water Equivalent = 0.03 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: 11/15/2006 Time: 18:00

Location Description:	Located at center of north cell near MSBN-CT. "L" shaped pattern, first going north to south 1 meter for 25 meters and then west to east 1 meter for 25 meters.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather	High overcast, low wind, Observations: dark.
Latitude:		Longitude:		Datum:	NAD27 Alaska
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			Jeff Derry	

Snow Course Depths, in cm.

	1	2	3	4	5
1	6.0	9.0	4.0	3.0	5.0
2	6.0	12.0	4.0	5.0	3.0
3	7.0	8.0	4.0	6.0	4.0
4	8.0	7.0	4.0	4.0	3.0
5	9.0	5.0	4.0	4.0	4.0
6	11.0	5.0	4.0	5.0	3.0
7	6.0	6.0	4.0	5.0	4.0
8	4.0	5.0	6.0	4.0	5.0
9	4.0	4.0	7.0	5.0	5.0
10	6.0	4.0	6.0	5.0	7.0

(cm)
 Average snow depth = 5.4
 Maximum snow depth = 12.0
 Minimum snow depth = 3.0
 Standard variation = 1.9

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm ³)	Density (gr/cm ³)
DW4-1	6	46.0	214.2	0.21
DW4-2	20.32	228.0	725.4	0.31
DW4-3				
DW4-4				
DW4-5				

Average Density = 0.26
 Average Snow Water Equivalent (SWE) = 1.4 cm H2O
 Average Snow Water Equivalent = 0.56 inches H2O
 Average Snow Water Equivalent = 0.05 feet H2O

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

Mine Site B: Snow Depth Transects

Project ID:	North Slope Lakes Project	Site Location/Lake ID:	MSB
Survey Purpose:	Spatial Distribution of Snow	Date:	11/15/2006
Time:	nr		
Location Description:	Transect runs East to West across the center of Mine Site B, North Cell. The west shore consists of a moderate transition to tundra, while the east shore is a 10 to 15 foot tall bank.		
Survey objective:	Snow depths and snow-water content for lake recharge estimates	Weather Observations:	Visibility unrestricted.
Elevation:	30' approximately BPMSL	Reference Markers:	Transect runs parallel to spine road, through MSBN-CT
Drainage Basin:	Mine Site B	Vegetation Type:	snow depth on ice surface and tundra

Mine Site B North Cell East-West Transect

increment (ft)	depth (cm)	Comments	increment (ft)	depth (cm)	Comments	increment (ft)	depth (cm)	Comments	increment (ft)	depth (cm)	Comments
0	19										
20	56	East Shore									
40	39	Transition									
60	28	Zone									
80	22										
100	10										
120	7										
140	6										
160	11										
180	7										
200	6										
220	6										
240	5										
260	12										
280	10	MSB North									
300	8	Lake Ice									
320	1										
340	2										
360	5										
380	2										
400	5										
420	7										
440	10										
460	5										
480	9										
500	13	West Shore									
520	28	Transition									
540	17	Zone									

Mine Site B: Snow Depth Transects

Project ID:	North Slope Lakes Project	Site Location/Lake ID:	MSB
Survey Purpose:	Spatial Distribution of Snow	Date:	11/15/2006
Time:	nr		
Location Description:	Transect runs South to North across MSBN-CT, and MSBS-CT. The north shore consists of a moderate transition to tundra, while the south shore is a 15 to 20 foot tall bank.		
Survey objective:	Snow depths and snow-water content for lake recharge estimates	Weather Observations:	Visibility unrestricted.
Elevation:	30' approximately BPMSL	Reference Markers:	Transect runs parallel to spine road, through MSBN-CT
Drainage Basin:	Mine Site B	Vegetation Type:	snow depth on ice surface and tundra

Mine Site B North South Transect

increment (ft)	depth (cm)	Comments	increment (ft)	depth (cm)	Comments	increment (ft)	depth (cm)	Comments	increment (ft)	depth (cm)	Comments
0	7										
20	17										
40	21										
60	11	Tundra									
80	5										
100	8										
120	2										
140	1										
160	0.25	South Shore									
180	5	Transition									
200	0.25	Zone									
220	7										
240	5										
260	10										
280	12										
300	9	Lake									
320	1										
340	8										
360	8										
380	4										
400	5										
420	12	Island Ice									
440	25	Transition									
460	0.25	Island									
480	6										
500	12										
520	31	Island Ice									
540	21	Transition									
560	5										
580	6										
600	7	Lake									
620	5										
640	5										
660	1										
680	6	North Shore									
700	5	Transition									
720	8										
740	11	Tundra									
760	16										

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: 11/18/2006 Time: 12:15

Location Description:	25m x 25m transect done on lake surface				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	High ovcast no winds
Latitude:	N 70°19.9444'	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska
Elevation:		Elevation Datum:	BPMSL	Reference Markers:	Site marked with GPS
Drainage Basin:	L9312	Slope Direction:	flat	Vegetation Type:	snow depth on ice 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	9.0	10.5	3.0	4.0	4.0
2	8.5	5.5	4.0	3.5	4.0
3	11.0	4.0	6.5	3.5	3.0
4	9.0	5.0	3.5	12.0	3.0
5	9.5	4.0	3.5	17.0	4.0
6	11.0	5.0	5.0	12.0	6.0
7	13.0	3.0	4.0	17.0	5.0
8	14.0	4.0	5.5	21.0	5.0
9	13.0	4.0	6.0	19.0	4.5
10	9.5	5.0	5.0	10.0	6.0

(cm)
 Average snow depth = 7.3
 Maximum snow depth = 21.0
 Minimum snow depth = 3.0
 Standard variation = 4.6

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm ³)	Density (gr/cm ³)
DW4-1	10.5	91.5	374.9	0.24
DW4-2	13.97	113.3	498.7	0.23
DW4-3	8.89	76.9	317.4	0.24
DW4-4	15.24	145.1	544.1	0.27
DW4-5				

Average Density = 0.25
 Average Snow Water Equivalent (SWE) = 1.8 cm H2O
 Average Snow Water Equivalent = 0.71 inches H2O
 Average Snow Water Equivalent = 0.06 feet H2O

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