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



Kuparuk Deadarm Reservoir meteorological station, photo by D. Reichardt









by Kristie Holland, Dan Reichardt, Matthew Whitman, and Michael Lilly

February 2008

North Slope Lakes Hydrologic Project Report No. INE/WERC 08.07



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

By:

Kristie Holland<sup>1</sup>, Dan Reichardt<sup>1</sup>, Matthew Whitman<sup>2</sup>, and Michael Lilly<sup>1</sup>

## 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

February 2008 North Slope Lakes Hydrologic Project Report Number INE/WERC 08.07

<sup>1</sup>Geo-Watersheds Scientific, Fairbanks, Alaska <sup>2</sup>Bureau of Land Management, Fairbanks, Alaska

### **Recommended Citation:**

Holland, K.M., Reichardt, D.A., Whitman, M. and Lilly, M.R., 2007. Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: December 2007. University of Alaska Fairbanks, Water and Environmental Research Center, Report INE/WERC 08.07, Fairbanks, Alaska, p7.

> Fairbanks, Alaska February 2008

### 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

## **TABLE OF CONTENTS**

TABLE OF CONTENTS i
LIST OF FIGURES i
LIST OF TABLES i
DISCLAIMERii
CONVERSION FACTORS, UNITS, WATER QUALITY UNITS, VERTICAL AND
HORIZONTAL DATUM, ABBREVIATIONS AND SYMBOLSiii
PROJECT COOPERATORSvii
ACKNOWLEDGEMENTS vii
INTRODUCTION
TRIP OBJECTIVES
PROCEDURES
SELECTED RESULTS
SUMMARY
REFERENCES
APPENDIX A. WATER QUALITY FIELD SAMPLING FORMS
APPENDIX B. WATER QUALITY METER CALIBRATION FORMSB-1
APPENDIX C. ELEVATION SURVEY FORMSC-1

## LIST OF FIGURES

Figure 1. Location of study lakes in the NPR-A, Alpine, Kuparuk, and Prudhoe Bay field	
operating areas, North Slope, Alaska	2
Figure 2 Lathes marking L9312 for sampling, photo by D. Reichardt	5

## LIST OF TABLES

Table 1.	In-Situ Troll 9000 calibration quality control criteria.	4
Table 2.	Ice thickness, Median DO Concentration, Median Actual Conductance and Monthly	
Wa	ter Change for North Slope lakes in December	6

## 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 or 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 (UAF), 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	Ву	To obtain
inch (in.) inch (in.) foot (ft) mile (mi)	<u>Length</u> 25.4 2.54 0.3048 1.609	millimeter (mm) centimeter (cm) meter (m) kilometer (km)
Acre Acre Square foot (ft <sup>2</sup> ) square mile (mi <sup>2</sup> )	<u>Area</u> 43559.999 0.405 3.587e-8 2.590	square feet (ft <sup>2</sup> ) hectare (ha) square mile (mi <sup>2</sup> ) square kilometer (km <sup>2</sup> )
gallon (gal) gallon (gal) Cubic foot (ft <sup>3</sup> ) Acre-ft	<u>Volume</u> 3.785 3785.412 28.317 1233	liter (L) milliliter (mL) liter (L) Cubic meter (m <sup>3</sup> )
foot per day (ft/d) Square foot per day (ft²/d ) cubic foot per second (ft³/s)	Velocity and Discharge 0.3048 .0929 0.02832	meter per day (m/d) square meter per day (m <sup>2</sup> /d) cubic meter per second (m <sup>3</sup> /sec)
foot per day (ft/d) foot per day (ft/d) meter per day (m/d)	Hydraulic Conductivity 0.3048 0.00035 0.00115	meter per day (m/d) centimeter per second (cm/sec) centimeter per second (cm/sec)
foot per foot (ft/ft) foot per mile (ft/mi)	<u>Hydraulic Gradient</u> 5280 0.1894	foot per mile (ft/mi) meter per kilometer (m/km)
pound per square inch (lb/in <sup>2</sup> )	Pressure 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 equivalent value in cubic meters per second ( $m^3/s$ ) in parentheses.

### **Physical and Chemical Water-Quality Units:**

### Temperature:

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

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

Specific electrical conductance (conductivity):

Conductivity of water is expressed in microsiemens per centimeter at 25°C ( $\mu$ S/cm). This unit is equivalent to microhms per centimeter at 25°C.

Milligrams per liter (mg/L) or micrograms per liter ( $\mu$ g/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.

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
С	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 <sup>2</sup>	square kilometers
kPa	kilopascal
lb/in <sup>2</sup>	pounds per square inch
m	meters
mg/L	milligrams per liter, equivalent to ppm
μg/L	micrograms per liter
mi <sup>2</sup>	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, Inc. (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: December 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 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 had been used in past years for ice-road construction, but was not pumped during the 2005-06 or 2006-07 winters, however, it was heavily pumped throughout the 2007-08 winter. 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 nine reservoirs. The three southernmost reservoir cells (1-3) are included in the study to observe ground-water and surfacewater interactions between each cells and the adjacent Kuparuk River. Study location can be seen in Figure 1.

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 purposes of this publication are to 1) report data collected for the month of December 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 or a raft is taken onto the water when conditions are ice-free. 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, 2007). In December 2007, we focused on the following locations/tasks:

- 1. Mine Site B, Milne-Point Facility
  - Measure field water-quality parameters on North and South cells. This includes vertical profile measurements at each location for temperature, dissolved oxygen (DO), conductivity, pH, turbidity, and barometric pressure.
  - Survey water levels to local elevation control.
  - Conduct snow surveys at standard locations
- 2. Kuparuk Deadarm Lakes, (Cells 1-3)
  - Measure field water-quality parameters on cells 1, 2, and 3. This includes vertical profile measurements at each location for temperature, dissolved oxygen (DO), conductivity, pH, turbidity, and barometric pressure.
  - Survey water levels of KDA 1-3 to local elevation control.
  - Conduct snow surveys at standard locations.
  - Automated data collection station maintenance.
- 3. L9312, Alpine Facility
  - Measure field water-quality parameters at standard locations. This includes vertical profile measurements for temperature, dissolved oxygen (DO), conductivity, pH, turbidity, oxygen reduction potential (ORP) and barometric pressure.
  - Survey water levels to local elevation control.
  - Conduct snow surveys at standard locations.
  - Automated data collection and station maintenance.
- 4. Prudhoe Bay Operating Area, Primary Objective
  - Betty Pingo: Automated data collection station maintenance.
  - Conduct snow survey at standard location.

## PROCEDURES

#### Water Chemistry Sampling

All field work follows the specified health, safety, and environmental guidelines outlined by BPX and CPA (White and Lilly, 2007 a, b, c). Physical measurements of water depth were taken at each sampling location (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.

Parameter	Standards used	Acceptable deviation from calibration standard value
Turbidity	Factory calibrated	± 2 (NTU)
pН	4.01, 7.0, 10.0	$\pm 0.2$
Conductivity	447 (µs/cm)	within 10%
100% DO	100 % saturated	within 10%
0% DO	0 % saturated solution	within 0.3 mg/L
ORP	In-Situ Quick Cal 224 mV	within 10%

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

![](_page_14_Picture_0.jpeg)

Figure 2 Lathes marking L9312 for sampling, photo by D. Reichardt.

### Snow Surveys

Small-scale snow depth measurements were conducted in "L" shaped patterns on 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.

## SELECTED RESULTS

Sampling occurred at Kuparuk Deadarm Lakes, Mine Site B and L9312 during the December field campaign. Table 2 summarizes selected data acquired and compares with findings from November 2007 field activities. Each lake visited had one or more locations where water-quality parameters were taken along a depth profile of the water column. 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.

Ice thicknesses at KDA 1 and 2 have increased since last month as did the median conductivity, while the median DO remained the same. Ice thickness, DO concentration and conductivity have remained consistent compared to last month's sampling at MSBN and MSBS. At L9312, there was no change in elevation and only a slight increase in conductivity, however DO levels were 1.38 mg/L higher in December compared to the November readings.

 Table 2. Ice thickness, Median DO Concentration, Median Actual Conductance and Monthly Water Change for North Slope lakes in December.

Sampling Site	Ice	Median DO	Median Actual	Water level Change	
	Thickness	Concentration	Conductivity	since mid November	
	[ft; (m)]	[mg/L]	[µS/cm]	[ft; (m)]	
KDA1-CT	2.58; (0.786)	14.85	99.19	-0.07; (-0.021)	
KDA2-CT	2.53; (0.771)	14.60	102.50	+0.39; (+0.119)	
MSBS-CT	1.70; (0.518)	12.60	138.30	-0.27; (-0.822)	
MSBN-CT	1.60; (0.488)	12.51	136.50	-0.27; (-0.822)	
L9312 Raft B	1.83; (0.558)	15.01	54.17	0.00; (0.00)	

## SUMMARY

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 change due to season and pumping activities, 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.

## REFERENCES

- Derry, J., Holland, K.M., Reichardt, D.A., and Lilly, M.R., 2007. Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: November 2007. University of Alaska Fairbanks, Water and Environmental Research Center, Report INE/WERC 07.22, Fairbanks, Alaska, 9 pp.
- Lilly, M.R., Holland, K., Reichardt, D. 2007. A Workplan for Meteorological Station Maintenance, Lake Chemistry Sampling, and Surveying at Study Lakes in Alpine, Kuparuk River, and Prudhoe Bay Areas: December 2007. Water and Environmental Research Center, University of Alaska Fairbanks. 15 pages.
- White, D.M., and Lilly, M.R. 2007 *a*. BPX: Health, Safety, and Environmental Interface
   Document. Water and Environmental Research Center, University of Alaska Fairbanks. 4
   p.
- White, D.M., and Lilly, M.R. 2007 *b*. BPX: Health, Safety, and Environmental Plan. Water and Environmental Research Center, University of Alaska Fairbanks. 6 p.
- White, D.M., and Lilly, M.R. 2007 c. ConocoPhillips Alaska, Inc.: Health, Safety, and Environmental Plan. Water and Environmental Research Center, University of Alaska Fairbanks. 5 p.

## APPENDIX A. WATER QUALITY FIELD SAMPLING FORMS

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

Project ID:	North Slope Lake	S		Site Location	n/Lake ID:	MSE	3N-CT (p. 1 of 2)
Sample Purpose:	Lake Water Quali	ty	-	Date:	12/14/07	Time:	14:00
FIELD MEASUREMENTS							
GPS Coord. Northing:	N70°19.280'	Easting:	W149°24.009'	Datum:	NAD83		
Measurements By:	Whitman/DAR	Time:	14:00				
Water Depth (ft):	34.74	Ice Thickness (ft):	2.40				
Freeboard (ft):	0.2	Snow Depth (ft):	0.10				
Elev. (BPMSL +/02):	94.88	Survey By:	DAR/Whitman	Date:	12/14/07	Time:	17:00
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date:	n/a	Time:	n/a
			2	·			

3

#### WATER QUALITY METER INFORMATION Calibration Information

							D			De et Oenerlin e
Parameter (s)	Owner	Owner Meter Make/Model		Seria	Serial No					
	Owner	Wiet		nouci	00110	ar NO.	QAQC	Oneck		QAQU UNCCK
MULTI	GWS	IN-S	ITU Troll	9000	33	033	Pa	ass		Pass
Parameters	Field Measurements									
Time:	14:13	14:19	14:23	14:27	14:34	14:37	14:42	14:46	14:49	14:52
Depth BWS (ft):	3	4	5	7	9	11	13	15	17	19
Temp (°C):	0.11	0.10	0.10	0.11	0.95	0.88	1.38	1.68	1.76	1.83
pH:	7.91	7.88	7.88	7.89	7.87	7.88	7.88	7.87	7.86	7.86
Barometeric (mmHg):	29.88	29.88	29.88	29.88	29.88	29.88	29.88	29.88	29.88	29.88
Pressure (kPa):	7.360	10.195	13.140	19.122	25.051	31.034	37.077	42.940	49.413	55.083
Conductivity (ųS/cm):	145.8	145.2	145.1	143.8	143.6	143.7	143.4	143.2	142.8	142.4
RDO (ppm): (mg/L)	13.18	13.31	13.35	13.32	12.88	12.78	12.60	12.48	12.36	12.34
Turbidity (NTU):	0.1	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ORP	298	296	295	294	290	290	290	289	288	288

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Pemarke:										

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	AJB	Date:	12/31/07

Project ID:	North Slope Lake	es		Site Location	/Lake ID:	MSBN	I-CT (p. 2 of 2)
Sample Purpose:	Lake Water Qual	ity		Date:	12/14/07	Time:	14:00
FIELD MEASUREMENTS							
GPS Coord. Northing:	N70°19.280'	Easting:	W149°24.009'	Datum:	NAD83		
Measurements By:	Whitman/DAR	Time:	14:00				
Water Depth (ft):	34.74	Ice Thickness (ft):	2.40				
Freeboard (ft):	0.2	Snow Depth (ft):	0.10				
Elev. (BPMSL +/02):	94.88	Survey By:	DAR/Whitman	Date:	12/14/07	Time:	17:00
Water Sampling By:	n/a	Sample Depths BV	NS (ft): 1 n/a	Date:	n/a	Time:	n/a
			2				

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Meter Make/Model			Seria	Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check
MULTI	GWS	IN-SITU Troll 9000			330	033	Pa	ass		Pass
Parameters	Field Measurements									
Time:	14:55	14:59	15:04	15:11	15:18	15:25	15:29	15:32	15:36	
Depth BWS (ft):	21	23	25	27	29	31	33	34	вот	
Temp (°C):	1.92	1.99	2.10	2.20	2.38	2.39	2.61	2.63	2.61	
pH:	7.85	7.85	7.82	7.70	7.45	7.45	7.25	7.49	7.90	
Barometeric (mmHg):	29.89	29.89	29.89	29.89	29.89	29.89	29.89	29.89	29.89	
Pressure (kPa):	61.219	67.181	72.900	79.216	85.054	90.851	96.878	99.756	103.189	
Conductivity (ųS/cm):	142.1	141.9	141.9	143.0	150.0	167.0	194.9	223.6	274.5	
RDO (ppm): (mg/L)	12.27	12.14	11.86	9.76	6.88	3.05	1.33	0.96	0.48	
Turbidity (NTU):	0.0	0.1	0.0	0.0	0.2	1.1	2.3	4.4	448.0	
ORP	288	288	287	290	295	303	298	262	193	

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	Depth BWS (ft):			Depth BWS (ft):			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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Remarks:		•	•		•	•	•	•		-

Field-Form Filled Out By: DAR Date: 12/18/07	Field-Form Filled Out By:
QAQC Check By:         AJB         Date:         12/31/07	QAQC Check By: A

Project ID:	North Slope Lake	s		Site Location	n/Lake ID:	MSE	3S-CT (p. 1 of 2)
Sample Purpose:	Lake Water Quali	-	Date:	12/14/07	Time:	15:55	
FIELD MEASUREMENTS							
GPS Coord. Northing:	N70°19.214'	Easting:	W149°24.020'	Datum:	NAD83		
Measurements By:	Whitman	Time:	n/a				
Water Depth (ft):	27.4	Ice Thickness (ft):	2.40				
Freeboard (ft):	n/r	Snow Depth (ft):	0.00				
Elev. (BPMSL +/02):	94.88	Survey By:	DAR/Whitman	Date:	12/14/07	Time:	17:00
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date:	n/a	Time:	n/a
			2				

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Meter Make/Model			Seria	Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check
MULTI	GWS	IN-SITU Troll 9000			330	033	Pa	Pass		Pass
Parameters	Field Measurements									
Time:	16:02	16:05	16:09	16:12	16:15	16:18	16:21	16:25	16:30	
Depth BWS (ft):	3	4	5	7	9	11	13	15	17	
Temp (°C):	0.12	0.19	0.37	0.98	1.34	1.59	1.68	1.78	1.95	
pH:	7.84	7.85	7.85	7.83	7.83	7.81	7.79	7.78	7.75	
Barometeric (mmHg):	29.85	29.85	29.86	29.86	29.86	29.86	29.87	29.87	29.87	
Pressure (kPa):	7.606	10.255	13.257	19.325	25.225	31.140	37.124	43.117	19.139	
Conductivity (ųS/cm):	148.5	147.6	146.6	146.3	146.2	146.1	145.9	145.4	145.3	
RDO (ppm): (mg/L)	13.36	13.31	13.30	13.01	12.88	12.59	12.46	12.22	12.01	
Turbidity (NTU):	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	
ORP	263	261	262	261	261	261	262	262	263	

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	Depth BWS (ft):			Depth BWS (ft):			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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Remarks:										

12/18/07

12/31/07

Field-Form Filled Out By: DAR Date: QAQC Check By: AJB Date:

Project ID:	North Slope Lak	kes		Site Locatio	n/Lake ID:	MSBS	-CT (p. 1 of 2)
Sample Purpose:	Lake Water Qua	llity		Date:	12/14/07	Time:	15:55
FIELD MEASUREMENTS							
GPS Coord. Northing:	N70°19.214'	Easting:	W149°24.020'	Datum:	NAD83		
Measurements By:	Whitman	Time:	n/a				
Water Depth (ft):	27.4	Ice Thickness (ft):	2.40				
Freeboard (ft):	n/r	Snow Depth (ft):	0.00				
Elev. (BPMSL +/02):	94.88	Survey By:	DAR/Whitman	Date:	12/14/07	Time:	17:00
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date:	n/a	Time:	n/a
			2				
WATER QUALITY METER INFORMATION			3				

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Meter Make/Model		Seria	Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check		
MULTI	GWS	IN-SITU Troll 9000		330	33033		Pass		Pass		
Parameters		Field Measurements									
Time:	16:34	16:38	16:46	16:54	17:00	17:05	17:09				
Depth BWS (ft):	19	21	23	25	26	27	вот				
Temp (°C):	2.08	2.21	2.47	2.58	2.65	2.73	2.76				
pH:	7.72	7.66	7.38	7.27	7.22	7.23	7.34				
Barometeric (mmHg):	29.87	29.87	29.87	29.87	29.87	29.87	29.87				
Pressure (kPa):	55.209	61.113	67.065	73.012	76.012	78.862	81.187				
Conductivity (ųS/cm):	145.2	145.3	148.1	154.6	161.3	176.0	175.7				
RDO (ppm): (mg/L)	11.30	10.93	6.10	3.32	1.83	0.87	0.55				
Turbidity (NTU):	0.0	0.2	0.5	1.5	2.8	4.8	31.6				
ORP	263	265	272	277	280	275	250				

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Remarks:	•	•	•	•	•	•	•	•	-	

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	AJB	Date:	12/31/07

### University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID:	North Slope Lakes	S		Site Locatio	n/Lake ID:	KD/	A1-CT (p. 1 of 2)
Sample Purpose:	Lake Water Qualit	y	-	Date:	12/15/07	Time:	12:30
FIELD MEASUREMENTS							
GPS Coord. Northing:	N70°19.894'	Easting:	W148°56.743'	Datum:	NAD83		
Measurements By:	Whitman	Time:	12:30				
Water Depth (ft):	20.03	Ice Thickness (ft):	2.58				
Freeboard (ft):	0.18	Snow Depth (ft):	0.00				
Elev. (BPMSL +/02):	7.92	Survey By:	DAR/Whitman	Date:	12/15/07	Time:	11:45
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date:	n/a	Time:	n/a
			2				

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	er Meter Make/Model		Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check		
MULTI	GWS	IN-S	ITU Troll 9	9000	330	033	PA	SS		PASS
Parameters					Fi	eld Meas	urements	5		
Time:	12:42	12:48	12:50	12:55	12:59	13:01	13:04	13:07	13:12	
Depth BWS (ft):	3	4	5	7	9	11	13	15	17	
Temp (°C):	0.19	0.55	0.82	1.14	1.40	1.49	1.57	1.74	1.98	
pH:	7.86	7.87	7.87	7.87	7.85	7.85	7.84	7.83	7.78	
Barometeric (mmHg):	757.8	757.8	757.8	757.8	757.8	757.9	758.0	758.0	758.2	
Pressure (kPa):	7.549	10.658	13.337	19.201	25.315	31.114	37.193	43.042	49.102	
Conductivity (ųS/cm):	99.09	99.01	98.95	99.20	99.29	99.23	99.15	99.12	99.31	
RDO (ppm): (mg/L)	14.83	15.24	15.19	15.04	14.96	14.87	14.84	14.68	13.99	
Turbidity (NTU):	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ORP	260	257	256	255	254	253	252	252	252	

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Bomarka:		•	-		-			•	-	

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	A. Blackburn	Date:	12/31/07

Project ID:	North Slope Lake	S		Site Location/Lake ID:	KD	A1-CT (p. 2 of 2)
Sample Purpose:	Lake Water Qualit	y	_	Date: 12/15/07	Time:	12:30
FIELD WEASUREMENTS						
GPS Coord. Northing:	N70°19.894'	Easting:	W148°56.743'	Datum: NAD83		
Measurements By:	Whitman	Time:	12:30			
Water Depth (ft):	20.03	Ice Thickness (ft):	2.58			
Freeboard (ft):	0.18	Snow Depth (ft):	0.00			
Elev. (BPMSL +/02):	7.92	Survey By:	DAR/Whitman	Date: 12/15/07	Time:	11:45
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date: n/a	Time:	n/a
			2			

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Mete	er Make/M	lodel	Seria	al No.	Pre-Sa QAQC	Pre-Sampling QAQC Check		Post-Sampling QAQC Check
MULTI	GWS	IN-S	ITU Troll 9	9000	33	33033		PASS		PASS
Parameters		Field Measurements								1
Time:	13:27	13:34	13:38							
Depth BWS (ft):	18	19	BOT							
Temp (°C):	2.13	2.21	2.00							
pH:	7.52	7.43	7.41							
Barometeric (mmHg):	758.2	758.2	758.3							
Pressure (kPa):	52.38	55.123	59.354							
Conductivity (ųS/cm):	104	107.50	111.40							
RDO (ppm): (mg/L)	8.52	6.39	5.50							
Turbidity (NTU):	0.1	0.1	27.0							
ORP	259	261	252							

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Parameter Depth BWS (ft):			Depth	Depth BWS (ft):			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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Pemarke:										

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	A. Blackburn	Date:	12/31/07

Project ID:	D: North Slope Lakes			Site Locatio	n/Lake ID:	KDA2-CT (p. 1 of 2)		
Sample Purpose:	Lake Water Qual	ity	-	Date:	12/15/07	Time:	10:15	
FIELD MEASUREMENTS								
GPS Coord. Northing:	N70°19.966'	Easting:	W148°56.429'	Datum:	NAD83			
Measurements By:	Whitman/DAR	Time:	10:15					
Water Depth (ft):	18.94	Ice Thickness (ft):	2.53					
Freeboard (ft):	0.21	Snow Depth (ft):	0.00					
Elev. (BPMSL +/02):	6.94	Survey By:	DAR/Whitman	Date:	12/15/07	Time:	11:45	
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date:	n/a	Time:	n/a	
		-	2					

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Mete	Meter Make/Model		Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check	
MULTI	GWS	IN-S	ITU Troll 9	9000	33033		PASS			PASS
Parameters	Field Measurements									
Time:	10:30	10:34	10:37	10:40	10:45	10:49	10:52	10:55	11:07	
Depth BWS (ft):	3	4	5	7	9	11	13	15	17	
Temp (°C):	0.17	0.28	0.46	0.95	1.19	1.27	1.42	1.64	2.06	
pH:	7.95	7.95	7.95	7.93	7.90	7.90	7.89	7.87	7.48	
Barometeric (mmHg):	757.2	757.3	757.3	757.4	757.5	757.5	757.6	757.7	757.8	
Pressure (kPa):	7.469	10.312	13.179	19.213	25.187	31.284	37.267	43.174	49.234	
Conductivity (ųS/cm):	103.20	102.80	102.40	102.30	102.40	102.50	102.60	102.70	112.10	
RDO (ppm): (mg/L)	14.85	15.12	15.06	14.88	14.66	14.60	14.48	14.41	7.98	
Turbidity (NTU):	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	
ORP	231	226	226	225	224	223	221	221	229	

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Bemerke:										

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	A. Blackburn	Date:	12/31/07

Project ID:	North Slope Lake	s		Site Location/Lake ID:	KDA	A2-CT (p. 2 of 2)
Sample Purpose:	Lake Water Quali	ty	-	Date: 12/15/07	Time:	10:15
FIELD MEASUREMENTS						
GPS Coord. Northing:	N70°19.966'	Easting:	W148°56.429'	Datum: NAD83		
Measurements By:	Whitman/DAR	Time:	10:15			
Water Depth (ft):	18.94	Ice Thickness (ft):	2.53			
Freeboard (ft):	0.21	Snow Depth (ft):	0.00			
Elev. (BPMSL +/02):	6.94	Survey By:	DAR/Whitman	Date: 12/15/07	Time:	11:45
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1_n/a	Date: n/a	Time:	n/a
		-	2			

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Meter Make/Model		Seria	Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check
MULTI	GWS	IN-S	ITU Troll 9000	33	33033		PASS		PASS
Parameters				Fi	ield Meas	surement	s		
Time:	11:17	11:22							
Depth BWS (ft):	18	BOT							
Temp (°C):	2.25	2.36							
pH:	7.4	7.39							
Barometeric (mmHg):	757.9	758.0							
Pressure (kPa):	52.123	56.266							
Conductivity (ųS/cm):	123.2	136.20							
RDO (ppm): (mg/L)	5.82	4.72							
Turbidity (NTU):	0.7	118.9							
ORP	229	207							

FIELD TES	STING OF WATER S	SAMPLES	(if small	probe is u	sed)
Probe:					
Depth (ft)					
Temp (°C)					
pН					
Eh					

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Bemerke:										

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	A. Blackburn	Date:	12/31/07

Project ID:	North Slope Lake		Site Locatio	n/Lake ID:	KDA3-CT (p. 1 of 2)		
Sample Purpose:	Lake Water Quality		-	Date:	Date: 12/15/07		14:00
FIELD MEASUREMENTS							
GPS Coord. Northing:	N70°20.025'	Easting:	W148°56.204'	Datum:	NAD83		
Measurements By:	Whitman	Time:	14:00				
Water Depth (ft):	22.59	Ice Thickness (ft):	2.48				
Freeboard (ft):	0.2	Snow Depth (ft):	0.00				
Elev. (BPMSL +/02):	6.94	Survey By:	DAR/Whitman	Date:	12/15/07	Time:	11:45
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date:	n/a	Time:	n/a
		_	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	IN-S	IN-SITU Troll 9000			33033		SS		PASS
Parameters	Field Measurements									
Time:	14:07	14:11	14:14	14:17	14:19	14:22	14:25	14:28	14:32	
Depth BWS (ft):	3	4	5	7	9	11	13	15	17	
Temp (°C):	0.22	0.43	0.74	1.27	1.49	1.59	1.67	1.76	1.86	
pH:	7.83	7.86	7.86	7.85	7.85	7.83	7.82	7.81	7.79	
Barometeric (mmHg):	758	758	758.1	758.1	758.2	758.3	758.4	758.4	758.5	
Pressure (kPa):	7.67	10.591	13.348	19.159	25.455	31.018	37.158	43.115	49.103	
Conductivity (ųS/cm):	101.8	101.3	101.2	101.4	101.6	101.5	101.3	101.2	101.3	
RDO (ppm): (mg/L)	14.91	14.93	14.81	14.64	14.61	14.55	14.29	14.10	13.73	
Turbidity (NTU):	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ORP	303	302	301	299	298	297	296	295	295	

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Pomarka:									-	

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	A. Blackburn	Date:	12/31/07

Project ID:	North Slope Lake	s		Site Locatio	n/Lake ID:	KD,	A3-CT (p. 2 of 2)
Sample Purpose:	Lake Water Qualit	ty	-	Date:	12/15/07	Time:	14:00
FIELD MEASUREMENTS							
GPS Coord. Northing:	N70°20.025'	Easting:	W148°56.204'	Datum:	NAD83		
Measurements By:	Whitman	Time:	14:00				
Water Depth (ft):	22.59	Ice Thickness (ft):	2.48				
Freeboard (ft):	0.2	Snow Depth (ft):	0.00				
Elev. (BPMSL +/02):	6.94	Survey By:	DAR/Whitman	Date:	12/15/07	Time:	11:45
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date:	n/a	Time:	n/a
			2				

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Meter Make/Model		Seria	al No.	Pre-Sa QAQO	ampling C Check		Post-Sampling QAQC Check	
MULTI	GWS	IN-S	ITU Troll 9	9000	330	033	PASS			PASS
Parameters	Field Measurements									
Time:	14:37	14:47	14:56	15:01						
Depth BWS (ft):	19	21	22	BOT						
Temp (°C):	2.14	2.38	2.48	2.51						
pH:	7.63	7.34	7.28	7.27						
Barometeric (mmHg):	758.6	758.8	758.8	759.0						
Pressure (kPa):	55.189	61.031	63.957	67.382						
Conductivity (ųS/cm):	101.3	104.5	106.8	109.8						
RDO (ppm): (mg/L)	11.65	6.57	4.53	4.46						
Turbidity (NTU):	0.0	0.2	0.2	82.1						
ORP	296	302	303	301						

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Bemerke:										

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	A. Blackburn	Date:	12/31/07

Project ID:	North Slope Lake	S		Site Location	/Lake ID:		L9312 Ra	aft B
Sample Purpose:	Lake Water Quali	ty		Date:	12/17/07	Time:		10:30
FIELD MEASUREMENTS								
GPS Coord. Northing:	N70°19.995'	Easting:	W150°56.918'	Datum:	NAD83			
Measurements By:	Whitman	Time:	10:30					
Water Depth (ft):	11.03	Ice Thickness (ft):	1.83					
Freeboard (ft):	0.04	Snow Depth (ft):	0.27					
Elev. (BPMSL +/02):	7.32	Survey By:	DAR/MRL	Date:	12/17/07	Time:		12:00
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date:	n/a	Time:		n/a
		-	2					

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Mete	Meter Make/Model		Seria	Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check	
MULTI	GWS	IN-S	ITU Troll	9000	33033		PASS			PASS	
Parameters		Field Measurements									
Time:	10:38	10:43	10:54	11:07	11:18	11:29	11:36	11:47			
Depth BWS (ft):	2	3	4	5	7	9	10	BOT			
Temp (°C):	0.18	0.52	0.86	1.26	1.91	2.44	2.63	2.75			
pH:	7.39	7.37	7.37	7.35	7.28	6.90	6.76	7.12			
Barometeric (mmHg):	763.2	763.3	763.3	763.4	763.4	763.5	763.6	763.7			
Pressure (kPa):	5.814	8.807	11.729	14.903	20.694	26.414	29.565	32.892			
Conductivity (ųS/cm):	54.92	54.61	54.43	54.44	53.90	54.83	59.68	86.91			
RDO (ppm): (mg/L)	15.40	15.56	15.31	15.23	14.80	8.94	4.67	0.45			
Turbidity (NTU):	0.3	0.3	0.4	0.5	0.3	1.1	3.4	77.3			
ORP	290	287	285	283	283	272	245	126			

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

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Bomarka:										

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	A. Blackburn	Date:	12/30/07

Project ID:	North Slope Lake	es		Site Location	/Lake ID:	L	9312 Screen	l
Sample Purpose:	Lake Water Qual	ity		Date:	12/17/07	Time:	12:1	5
FIELD MEASUREMENTS								
GPS Coord. Northing:	N70°20.003'	Easting: W	150°57.005'	Datum:	NAD83			
Measurements By:	Whitman	Time: 12	2:15					
Water Depth (ft):	11.34	Ice Thickness (ft): 2.0	03					
Freeboard (ft):	0	Snow Depth (ft): 0.3	32					
Elev. (BPMSL +/02):	7.32	Survey By: DA	AR/MRL	Date:	12/17/07	Time:	12:00	)
Water Sampling By:	n/a	Sample Depths BWS	6 (ft): 1 n/a	Date:	n/a	Time:	n/a	
		_	2					

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Mete	er Make/N	lodel	Seria	al No.	Pre-Sa QAQC	ampling Check		Post-Sampling QAQC Check
MULTI	GWS	IN-S	ITU Troll 9	9000	330	033	PA	SS		PASS
Parameters					Fi	eld Meas	urements	5		
Time:	12:27	12:31	12:34	12:39	12:43	12:55	12:59	13:04	13:10	
Depth BWS (ft):	2	3	4	5	7	9	10	11	BOT	
Temp (°C):	0.21	0.45	0.81	1.19	1.69	2.33	2.63	2.76	2.86	
pH:	7.18	7.19	7.20	7.15	7.07	6.83	6.72	6.86	7.58	
Barometeric (mmHg):	763.5	763.5	763.5	763.5	763.5	763.6	763.7	763.8	763.9	
Pressure (kPa):	5.827	8.712	11.829	14.826	20.806	26.587	29.541	32.260	33.655	
Conductivity (ųS/cm):	55.71	55.39	54.97	54.64	54.57	54.90	59.86	79.67	117.40	
RDO (ppm): (mg/L)	14.98	15.01	14.89	14.32	13.24	6.14	3.78	1.71	0.28	
Turbidity (NTU):	0.5	0.4	0.3	0.3	0.5	7.4	7.0	34.1	60.1	
ORP	186	186	186	188	190	197	204	184	-63	

FIELD TES	TING OF WATER S	SAMPLES	(if small	probe is u	sed)
Probe:					
Depth (ft)					
Temp (°C)					
pН					
Eh					

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Bomarka:										

Field-Form Filled Out By:	DAR Date	: 12/18/07
QAQC Check By:	A. Blackburn Date	: 12/31/07

Project ID:	North Slope Lak	ies	Site Location/Lake ID:		L9312 SH	
Sample Purpose:	Lake Water Qua	lity	Date: 12/17/07	13:40	13:40	
FIELD MEASUREMENTS						
GPS Coord. Northing:	N70°20.017'	Easting: W150°57.076'	Datum: NAD83			
Measurements By:	Whitman	Time: 13:40				
Water Depth (ft):	9.42	Ice Thickness (ft): 2.04				
Freeboard (ft):	0.16	Snow Depth (ft): 0.26				
Elev. (BPMSL +/02):	7.32	Survey By: DAR/MRL	Date: 12/17/07	Time:	12:00	
Water Sampling By:	n/a	Sample Depths BWS (ft): 1 n/a	Date: n/a	Time:	n/a	
		2				

3

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Mete	er Make/M	lodel	Seria	al No.	Pre-Sa QAQC	ampling Check	Post-Sampling QAQC Check
MULTI	GWS	IN-S	ITU Troll	9000	330	033	PA	ASS	PASS
Parameters					Fi	eld Meas	urements	s	-
Time:	13:52	13:55	14:00	14:03	14:09	14:14	14:20	n/r	
Depth BWS (ft):	2	3	4	5	7	8	9	Bot	
Temp (°C):	0.19	0.34	0.78	1.09	1.50	2.00	2.11	2.20	
pH:	6.91	6.90	6.87	6.87	6.82	6.74	6.70	6.68	
Barometeric (mmHg):	763.8	763.8	763.8	763.8	763.8	763.8	763.8	763.9	
Pressure (kPa):	5.843	8.771	11.755	14.813	20.709	23.505	26.381	28.158	
Conductivity (ųS/cm):	58.09	57.32	56.45	56.53	56.44	56.44	57.45	71.50	
RDO (ppm): (mg/L)	11.19	11.18	10.91	10.90	9.06	7.37	4.49	3.88	
Turbidity (NTU):	0.6	0.7	0.8	0.8	1.7	3.4	10.7	210.0	
ORP	236	234	232	231	231	232	232	223	

FIELD TES	STING OF WATER S	SAMPLES	(if small	probe is u	sed)
Probe:					
Depth (ft)					
Temp (°C)					
pН					
Eh					

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Remarks:	•	•	•		•	•	•	•	•	•

Field-Form Filled Out By:	DAR Date:
QAQC Check By:	A.Blackburn Date:

Project ID:	North Slope Lake	s		Site Location	n/Lake ID:	L9312	2 SH_SHORE_MID
Sample Purpose:	Lake Water Quali	ty	-	Date:	12/17/07	Time:	14:36
FIELD MEASUREMENTS							
GPS Coord. Northing:	N70°20.017'	Easting:	W150°57.101'	Datum:	NAD83		
Measurements By:	Reichardt	Time:	14:36	·			
Water Depth (ft):	7.33	Ice Thickness (ft):	1.90				
Freeboard (ft):	0.05	Snow Depth (ft):	0.40				
Elev. (BPMSL +/02):	7.32	Survey By:	DAR/MRL	Date:	12/17/07	Time:	12:00
Water Sampling By:	n/a	Sample Depths B	WS (ft): 1 n/a	Date:	n/a	Time:	n/a
			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	IN-SITU Troll 9000		9000	330	033	PASS	PASS
Parameters					Fi	eld Meas	urements	
Time:	14:42	14:45	14:49	14:54	14:57	15:01		
Depth BWS (ft):	2	3	5	6	7	вот		
Temp (°C):	0.16	0.35	0.90	1.32	1.63	1.65		
pH:	6.89	6.87	6.84	6.79	6.73	6.73		
Barometeric (mmHg):	763.7	763.7	763.8	763.8	763.8	763.8		
Pressure (kPa):	6.159	8.753	14.572	17.560	20.404	21.248		
Conductivity (ųS/cm):	58.84	58.22	57.89	57.60	57.37	57.41		
RDO (ppm): (mg/L)	11.68	11.29	10.73	9.17	6.85	6.68		
Turbidity (NTU):	0.6	0.7	0.8	1.4	2.7	3.3		
ORP	254	252	252	252	252	251		

FIELD TES	STING OF WATER S	SAMPLES	(if small	probe is u	sed)
Probe:					
Depth (ft)					
Temp (°C)					
pН					
Eh					

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	Depth BWS (ft):		Depth	Depth BWS (ft):			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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Remarks: LIAE Rugged Rea	ader I og 200	17_12_17	144155		-	•				

Remarks: UAF Rugged Reader Log 2007-12-17 144155.

Field-Form Filled Out By:	DAR	Date:	12/18/07
QAQC Check By:	A.Blackburn	Date:	12/31/07

Project ID:	North Slope La	kes	Site Location	/Lake ID:	Alpine WTP Raw H <sub>2</sub> 0 tap		
Sample Purpose:	Lake Water Qu	ality	Date:	12/17/07	Time:	17:50	
FIELD MEASUREMENTS							
GPS Coord. Northing:	n/a	Easting: n/a	Datum:	n/a			
Measurements By:	D. Reichardt	Time: n/a					
Water Depth (ft):	n/a	Ice Thickness (ft): n/a					
Freeboard (ft):	n/a	Snow Depth (ft): n/a					
Elev. (BPMSL +/02):	n/a	Survey By: n/a	Date:	n/a	Time:	n/a	
Water Sampling By:	n/a	Sample Depths BWS (ft): 1 n/a	Date:	n/a	Time:	n/a	
		2		<u> </u>			
WATER QUALITY METER I	NFORMATION	3					

#### WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Mete	r Make/Me	odel	Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check	
MULTI	GWS	IN-SITU Troll 9000		33	033	PASS		PASS		
Parameters					F	ield Meas	urement	5		
Time:	17:50									
Depth BWS (ft):	n/a									
Temp (°C):	9.65									
pH:	6.81									
Barometeric (mmHg):	762.9									
Pressure (kPa):	0.704									
Conductivity (ųS/cm):	69.28									
RDO (ppm): (mg/L)	6.54									
Turbidity (NTU):	1.4									
ORP	448									

FIELD TES	STING OF WATER S	SAMPLES	(if small	probe is u	sed)
Probe:					
Depth (ft)					
Temp (°C)					
pН					
Eh					

#### NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	Depth BWS (ft):		Depth	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 <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										
Remarks: Sample taken from	m raw water	tap at wa	ater treatn	nent plant	sink.					

Field-Form Filled Out By: QAQC Check By: DAR 12/7/07 Date: A. Blackburn Date: 12/31/07

## 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: Wat	er Qualit	y Meter (	Calibration Form				
Project ID:	North Slo	pe Lakes		Site Loca	ation/Lake ID:	Mine Site B	
Sample Purpose:	Lake Wate	er Quality		_			
WATER QUALITY ME	ETER INFO	RMATION					
Meter Make:	InSitu		Make:	Troll 9000			
Owner:	GW Scient	tific	S/N:	33033			
CALIBRATION AND	QUALITY A	SSURAN	CE INFORMATION				
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	12/14/07	10:24	Oakton 4.01	2612530	Dec-08	4.00 @17.53°C	pass
ph 7.00	12/14/07	10:27	Oakton 7.00	2612531	Dec-08	7.03 @17.95°C	pass
ph 10.00	12/14/07	10:30	Oakton 10.00	2612532	Jun-08	10.02 @18.05°C	pass
Conductivity 447 µS/cm	12/14/07	10:16	Oakton 447	2418150	Dec-05	387 @17.7°C	pass
ORP	12/14/07	10:05	ZoBell's	7AZ-859-1	Jul-07	242 @19.76°C	pass
Saturated O <sub>2</sub>	12/14/07	10:31	Bubbled Nanopure			8.78 @19.3°C%	pass
Post-Sampling QA				T			
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	12/14/07	22:22	Oakton 4.01	2612530	Dec-08	4.04 @19.6°C	pass
ph 7.00	12/14/07	22:53	Oakton 7.00	2612531	Dec-08	6.96 @20.2°C	pass
ph 10.00	12/14/07	22:24	Oakton 10.00	2612532	Jun-08	9.95 @20.7°C	pass
Conductivity 447 µS/cm	12/14/07	21:23	Oakton 447	2418150	Dec-05	403.7 @20.65°C	pass
Conductivity 147 µS/cm	12/14/07	21:21	Oakton 147	531284-15	Apr-05	139.5 @20.08°C	pass
ORP	12/14/07	21:26	ZoBell's	7AZ-859-1	Jul-07	235 @20.67°C	pass
Saturated O <sub>2</sub>	12/14/07	21:12	Bubbled Nanopure			9.12 @19.7°C	pass
Zero O <sub>2</sub>	12/14/07	21:20	Hanna HI7040	G1012	Feb-11	0.01 @16.75°C	pass
Remarks: ph/ORP pr	obe SN:PP	10242 (GV	VS)				

Field-Form Filled Out By:	
QAQC Check By:	

DAR A. Blackburn Date: 12/14/2007 Date: 12/30/2007

## University of Alaska Fairbanks, Water and Environmental Research Center Form F-004e: Water Quality Meter Calibration Form

Project ID: Sample Purpose:	North Slop	pe Lakes er Quality		Site Loca	ation/Lake ID:	Kuparuk Deada	rm Lakes
Meter Make	InSitu		Make <sup>.</sup>	Troll 9000			
Owner:	GW Scient	tific	S/N:	33033			
			-				
CALIBRATION AND Pre-Sampling QA	QUALITY A	SSURAN	CE INFORMATION				
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	12/14/07	22:22	Oakton 4.01	2612530	Dec-08	4.04 @19.6°C	pass
ph 7.00	12/14/07	22:53	Oakton 7.00	2612531	Dec-08	6.96 @20.2°C	pass
ph 10.00	12/14/07	22:24	Oakton 10.00	2612532	Jun-08	9.95 @20.7°C	pass
Conductivity 447 µS/cm	12/14/07	21:23	Oakton 447	2418150	Dec-05	403.7 @20.65°C	pass
Conductivity 147 µS/cm	12/14/07	21:21	Oakton 147	531284-15	Apr-05	139.5 @20.08°C	pass
ORP	12/14/07	21:26	ZoBell's	7AZ-859-1	Jul-07	235 @20.67°C	pass
Saturated O <sub>2</sub>	12/14/07	21:12	Bubbled Nanopure			9.12 @19.7°C	pass
Zero O <sub>2</sub>	12/14/07	21:20	Hanna HI7040	G1012	Feb-11	0.01 @16.75°C	pass
Post-Sampling QA			-	-	-	-	
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	12/15/07	20:48	Oakton 4.01	2612530	Dec-08	3.96 @18.4°C	pass
ph 7.00	12/15/07	20:50	Oakton 7.00	2612531	Dec-08	7.06 @18.1°C	pass
ph 10.00	12/15/07	20:52	Oakton 10.00	2612532	Jun-08	10.03 @18.2°C	pass
Conductivity 447 µS/cm	12/15/07	20:33	Oakton 447	2707012	Jul-08	396 @20.3°C	pass
Conductivity 84 µS/cm	12/15/07	20:30	Oakton 84	2706156	Jun-08	77.0 @ 20.0°C	pass
ORP	12/15/07	20:53	ZoBell's	7AZ-859-1	Jul-07	241 @19.4°C	pass
Saturated O <sub>2</sub>	12/15/07	20:22	Bubbled Nanopure			9.41 @18.5°C	pass
Zero O <sub>2</sub>	12/15/07	20:26	Oakton	2706384	Jun-08	0.06 @16.29°C	pass
Remarks: ph/ORP pr	obe SN:PP	10242 (GV	VS)				

Field-Form Filled Out By: QAQC Check By:

DAR \_ \_ A. Blackburn Date: 12/15/2007 Date: 12/30/2007

## 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: Kuparuk Deadarm Lakes				
Sample Purpose:	Lake Wate	er Quality		_				
WATER QUALITY ME	TER INFO	RMATION						
Meter Make:	InSitu		Make:	Troll 9000				
Owner:	GW Scient	ITIC	S/N:	33033				
CALIBRATION AND		SSURAN	CF INFORMATION					
Pre-Sampling QA								
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail	
pH 4.01	12/15/07	20:48	Oakton 4.01	2612530	Dec-08	3.96 @18.4°C	pass	
ph 7.00	12/15/07	20:50	Oakton 7.00	2612531	Dec-08	7.06 @18.1°C	pass	
ph 10.00	12/15/07	20:52	Oakton 10.00	2612532	Jun-08	10.03 @18.2°C	pass	
Conductivity 447 µS/cm	12/15/07	20:33	Oakton 447	2707012	Jul-08	396 @20.3°C	pass	
Conductivity 84 µS/cm	12/15/07	20:30	Oakton 84	2706156	Jun-08	77.0 @ 20.0°C	pass	
ORP	12/15/07	20:53	ZoBell's	7AZ-859-1	Jul-07	241 @19.4°C	pass	
Saturated O <sub>2</sub>	12/15/07	20:22	Bubbled Nanopure			9.41 @18.5°C	pass	
Zero O <sub>2</sub>	12/15/07	20:26	Oakton	2706384	Jun-08	0.06 @16.29°C	pass	
Post-Sampling QA				•	•			
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail	
pH 4.01	12/17/07	18:13	Oakton 4.01	2709256	Aug-08	3.95 @16.9°C	pass	
ph 7.00	12/17/07	18:15	Oakton 7.00	2709203	Aug-08	7.05 @16.4°C	pass	
ph 10.00	12/17/07	18:20	Oakton 10.00	2707084	Jan-09	10.11 @16.2°C	pass	
Conductivity 447 µS/cm	12/17/07	18:27	Oakton 447	2707012	Jul-08	368 @16.9°C	pass	
Conductivity 84 µS/cm	12/17/07	18:25	Oakton 84	2706156	Jun-08	73.5 @16.7°C	pass	
ORP	12/17/07	18:27	ZoBell's	7AZ-859-1	Jul-07	250 @16.2°C	pass	
Saturated O <sub>2</sub>	12/17/07	18:07	Bubbled Nanopure			9.74 @15.9°C	pass	
Zero O <sub>2</sub>	12/17/07	18:12	Oakton	2706384	Jun-08	0.04 @14°C	pass	
Remarks: ph/ORP pr	obe SN:PP	10242 (GV	/S)					

DAR

Date: 12/18/2007

Meter Make:	InSitu	Make:	Troll 9000	
Owner:	GW Scientific	S/N:	33033	

Field-Form Filled Out By: QAQC Check By:

A. Blackburn

Date: 12/31/2007

## 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 North Slope Lakes Site Location/Lake ID: Mine Site B

Project ID:	North Slope Lakes			Site Location/Lake ID: Mine S			Mine Site B	
Survey Purp	oose:	Water-Leve	el Elevations		Date:	12/15/2007	Time:	17:00
Location:				Mine Site B	aka 6 mile L	ake		
Survey objective:	Determine lak	ke water elev	ation in North ar	nd South Cell	s	Weat Observa	her itions:	
Instrument Type:	Leica N	IA720	Instrument ID:	5482372 (G	WS owned)	0°F, 5 m	ph WNW	wind, overcast, dark
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned			
		Bench Mar	k Information:	•		Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)		Reichard	t, Whitman
TBM_1	nr	100.00 Arbitrarv	N70°19.308'	W149°2	23.882'			
Station	BS	HI	FS	Elevation	Distance	Horizontal	Vertical	Remarks
	(ft)	(ft)	(ft)	(fasl)	(ft)	Angle	Angle	
TBM_1	4.413	104.413		100.000				
MSBN-SH		104.413	9.538	94.875				WL MSBN=94.88'
VSMS		104.413	0.591	103.822				
VSMN		104.413	0.952	103.461				
VSM_Cut		104.413	3.039	101.374				
			Move instru	ment to ^2, tu	Irn on VSM-	CUT		
VSM_Cut	3 280	104 654		101 374				
Volvi_Out	0.200	101.001		101.074				
VSMN		104.654	1.190	103.464				
VSMS		104.654	0.820	103.834				
MSBN-SH		104.654	9.780	94.874				
TBM_1		104.654	4.661	99.993				Survey leg closes withir ±0.01
		Move	e instrument to ^	3 on island, t	urn on MSBI	N Water Leve	el	
MSBN-SH'	6.534	101.408		94.874				
MSBS-SH		101.408	6.530	94.878				WL MSBS=94.88'
	N	love instrum	nent to ^4, turn of	n MSBS-SH.	Water Surfa	ace has froze	en in hole.	
MSBS-SH	6.760	101.638		94.878				
MODN OU!		101 629	6 765	04 972				Survey log closes within
INISRIN-SH.		101.038	0.705	94.873				±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

#### University of Alaska Fairbanks, Water and Environmental Research Center Form F-011: Elevation Survey Form North Slope Lakes Site Location/Lake ID: KDA 1.2.3

Project ID: North Slope Lakes				Site Locati	KDA 1,2,3			
Survey Purp	oose:	Water-Leve	el Elevations		Date:	12/15/2007	Time:	11:45
Location:	Kuparuk Dead	Jarm Lakes,	east of the Spine	e Road Kupa	ruk bridge.			
Survey objective:	Determine F	-WS Elevation	on of cell 1, cell 2	2 and cell 3.		Weat Observa	her ations:	
Instrument Type:	Leica N	IA720	Instrument ID:	5482727 (G	WS owned)	) -4°F. 3 mph W wi		d. Lt Fog 2 mile vis.
Rod Type:	Fiberg	Jlass	Rod ID:	Sokkia Fi	ber Glass	. , , -	•	
		Bench Mar	k Information:	1		Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)	Dar	n Reichardi	t, Matt Whitman
BM1	BP	19.32	nr	n	r			
Station	BS (ft)	HI (ft)	FS (ft)	Elevation	Distance	Horizontal	Vertical	Remarks
TBM1	0.987	20.307	(ft)	19.320	(11)	Angle	Angle	
KDA3-SH		20.307	13.360	6.947				
KDA2-SH		20.307	13.363	6.944				
KDA2-ICE		20.307	13.166	7.141				
	I	<u></u>	Turn on	KDA2-Ice. N	love to Inst.2	2		
KDA2-ICE	13.148	20.289		7.141				
KDA2-SH		20.289	13.350	6.939				KDA2 WL=6.94'
KDA3-SH		20.289	13.345	6.944				KDA3 WL=6.94'
TBM1		20.289	0.972	19.317				close survey to 0.00
			•	Move to Ins	it.3			
KDA2-SH'	7.305	14.245		6.940				
KDA1-SH		14.245	6.330	7.915				KDA1 WL=7.92
KDA1-ICE		14.245	6.195	8.050				
	L		Turn on	KDA3-ICE. N	love to Inst.	4		
KDA1-ICE	5.955	14.005		8.050				
KDA1-SH		14.005	6.073	7.932				
KDA2-SH'		14.005	7.058	6.947				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

## University of Alaska Fairbanks, Water and Environmental Research Center Form F-011: Elevation Survey Form

Project ID:		North Slop	e Lakes		Site Locat	ion/Lake ID:		KDA 4,5
Survey Purp	oose:	Water-Leve	Elevations		Date:	12/15/2007	Time:	14:45
Location:		harm Lakes	east of the Spine	Poad Kupa				
Survey objective:	Determ	ine FWS Ele	evation of cells 4	and 5.		Weat Observa	her ations:	
Instrument	T-Handle	Probe	Instrument ID:	n	а		I	
Туре:						-4°F, 3 r	nph W win	d. Lt Fog 2 mile vis.
Rod Type:	na	t	Rod ID:	n	а			
	1	Bench Mar	k Information:			Survey Tea	m Names	1
Name	Agency Responsible	Elevation (ft)	Latitude	Long (ddd-mr	itude n mmm)		Dan R	eichardt
nr	nr	nr	nr	n		ł		
Station	BS	н	FS	Elevation	Distance	Horizontal	Vertical	Remarks
	(ft)	(ft)	(ft)	(fasl)	(ft)	Angle	Angle	
Distance	from West Culv	vert between	I KDA 4 and KDA	15 to Water L	.evel was m	easured. Ele	v. of TOC₄	4-H from Nov'07 Survey
TOC4-H		6.560		6.560				
WL_KDA4		6.560	1.060	5.500				
				<u> </u>				
Distance	from West Culv	vert between	I KDA 4 and KDA	15 to Water L	evel was m	easured. Ele	v. of TOC	5-H from Nov'07 Survey
ТОС5-Н		6.490		6.490				
		6 4 9 0	0.951	5 539				
		0.100	0.001	0.000				

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:	12/17/2007	Time:	12:45		

Location:	Lake L9312, lo	ocated south	neast of Alpine pa	ad, survey by	pump hous	e benchmarl	<s< th=""><th></th></s<>	
Survey		Determine I	FWS Elevation.			Weat Observa	her ations:	
Instrument Type:	Leica N	IA720	Instrument ID:	5482372 (G	WS owned)			1
Rod Type:	Fiberg	lass	Rod ID:	Sokkia Fi	ber Glass	s -25°F, 5 mph wind. Vis=10 mi.		lear with light haze.
		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mr	itude n.mmm)		Reicha	ardt, Lilly
L9312"P"	СР	11.72	nr	n	r			
Station	BS (ff)	HI (ft)	FS (ft)	Elevation	Distance	Horizontal	Vertical	Remarks
TDM "D"	0.766	12,496	(11)	(1 <b>351)</b>	(1)	Aligie	Angle	
	0.766	12.400		11.720				Top of inlet pipe suppor
TBM "O"		12.486	0.994	11.492				Top of inlet pipe support. BM Elev=11.46'
99-32-59		12.486	-2.103	14.589				Top of Pumphouse SE VSM. BM Elev = 14.57
L9312 WL		12.486	5.170	7.316				Water Surface Level
			Т	urn on L931	2 WL			
L9312 WL	5.089	12.405		7.316				
99-32-59		12.405	-2.188	14.593				
TBM"O"		12.405	0.911	11.494				
TBM"P"		12.405	0.685	11.720				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

## APPENDIX D. SNOW SURVEY FORMS

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

Project ID: North Slope			Lakes		Site Loc	ation/Lake ID:	MSBN-CT	
Survey Purpo	se:	Determine sn	now water eq	uivalent	Date:	12/14/2007	Time: 16:30	
Location Description:	At MSBN-CT	snow course b	ears West 25	meters, then South	25 meters			
Survey objective:	Determine Snow Water Equivalent					Weather Observations:	2°F, 10 mph WNW wind, mostly overcast. Dark.	
Latitude:	N70°19.280'		Longitude:	W149°24.009'		Datum:	NAD83	
Elevation:	Approximately	/ 50 ft BPMSL.	Elevation Datum:	BPMSL		Reference Markers:	Lathe is at MSBN-CT	
Drainage Basin:	Milne Creek		Slope Direction:	Flat		Vegetation Type:	Ice	
Slope Angle:	flat		Access Notes:	Highway Vehicle		Other:		
Snow Depth Probe Type:			T-handle probe		Snow-Survey Team Names		Team Names	
Snow Tube Type: Arinodack sno		ow tube			Reichardt			

#### Snow Course Depths, in cm.

	1	2	3	4	5
1	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	1.0	0.0
4	0.0	1.0	0.0	0.0	0.0
5	1.0	0.0	0.0	1.0	0.0
6	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	1.0	0.0	0.0
8	1.0	0.0	1.0	0.0	0.0
9	0.0	0.0	0.0	1.0	0.0
10	0.0	0.0	1.0	0.0	0.0

 (cm)

 Average snow depth =
 0.2

 Maximum snow depth =
 1.0

 Minimum snow depth =
 0.0

 Standard variation =
 0.4

#### Snow Sample Depths and Weights

			0				
]	Density (gr/cm^3)	Volume (cm^3)	Weight (gr)	Depth (cm)	Bag #		
				s were taken	* No densities		
-		age Density =	Ave				
cm H2O		alent (SWE) =	w Water Equiv	Average Snov			
inches H2C	Average Snow Water Equivalent =						
feet H2O		er Equivalent =	ge Snow Wat	Avera			

Project ID: North Slope		North Slope I	Lakes		Site Location/Lake ID:		MSB-SN	MSB-SNOTUN	
Survey Purpo	se:	Determine sn	now water eq	uivalent	Date:	12/14/207	Time:	15:30	
Location Description:	At MSBN-SNG	DTUN snow co	ourse bears W	est 25 meters, then	South 25	meters.			
Survey objective:	Determine Snow Water Equivalent					Weather Observations:	2°F, 10 mph V mostly overc	VNW wind, ast. Dark.	
Latitude:	N70°19.256'		Longitude:	W149°24.242'		Datum:	NAD83		
Elevation:	Approximately	/ 50 ft BPMSL.	Elevation Datum:	BPMSL		Reference Markers:	Lathe is at MSB in tundra west c	N-SNOTUN f Lake	
Drainage Basin:	Milne Creek		Slope Direction:	Flat		Vegetation Type:	Tussock Tundra	1	
Slope Angle:	flat		Access Notes:	Highway Vehicle		Other:			
Snow Depth Probe Type:			T-handle probe			Snow-Survey Team Names			
Snow Tube Type: Arinodack sno		bw tube			Reichardt				

Snow Course Depths, in cm.

	1	2	3	4	5
1	8.0	11.0	12.0	11.5	15.0
2	10.0	12.0	16.5	10.0	8.0
3	12.5	12.5	8.0	14.5	24.0
4	9.0	10.5	11.0	9.0	25.0
5	9.0	15.0	8.0	7.0	34.5
6	11.0	11.0	9.0	11.5	12.0
7	16.5	12.0	11.0	9.0	8.5
8	22.5	12.5	17.0	13.0	13.0
9	17.0	15.5	6.5	17.0	19.5
10	9.5	11.0	9.0	15.0	28.0

(cm) Average snow depth = 13.2 Maximum snow depth = 34.5 Minimum snow depth = 6.5 Standard variation = 5.6

#### Snow Sample Depths and Weights

•	•	0			
Bag #	Depth (cm)	Weight (ar)	Volume (cm^3)	Density (gr/cm^3)	]
V	(0)	(9.)	(0.1. 0)	(g./ c./ c)	_
~	13.8	63.9	492.7	0.13	
L3	27	162.3	963.9	0.17	
T2	9.5	34.6	339.2	0.10	
45	17.5	112.0	624.8	0.18	
Y	28	268.9	999.6	0.27	
		Aver	0.17		
	Average Snow Water Equivalent (SWE) =			2.2	cm H2O
Average Snow Water Equivalent =				0.88	inches H2O
Average Snow Water Equivalent =				0.07	feet H2O

Project ID:	North Slope Lakes		Site Lo	cation/Lake ID	L9312-WxStation		
Survey Purpo	vey Purpose: Determine snow water equivalent		Date:	12/17/2007	Time: 11:00		
Location Description:	North of weat WxSta Snow	her station at L 070922.JPG fo	.9312. Start a or layout.	t east snow pole, tra	insect goe	es 25 m west x	25 m North. See L9312
Survey objective:	Determine Snow Water Equivalent				Weather Observations:	-25°F, 10 mph wind. Mostly clear with light haze.	
Latitude:	N70°20.019'		Longitude:	W150°57.134'		Datum:	NAD83
Elevation:	Approximately	/ 10 ft	Elevation Datum:	BPMSL		Reference Markers:	Orange snow poles
Drainage Basin:	Lake L9312		Slope Direction:	East		Vegetation Type:	Tussuck tundra
Slope Angle:	2°		Access Notes:			Other:	
Snow Depth Probe Type:			T-handle probe			Snow-Survey Team Names	
Snow Tube Type: Arinodack sr		ow tube			Dan Reichard	t	

Snow Course Depths, in cm.

	1	2	3	4	5
1	12.5	20.0	36.0	42.5	37.5
2	14.5	18.0	34.0	52.5	40.0
3	13.0	19.5	36.0	69.0	42.5
4	10.0	18.0	24.0	53.0	42.5
5	33.0	17.0	15.0	51.0	41.0
6	26.0	16.0	14.5	45.0	27.0
7	17.0	18.5	17.5	23.0	12.5
8	18.0	22.5	12.0	15.5	25.0
9	21.0	26.0	11.5	21.5	25.0
10	18.0	34.5	24.5	23.0	45.5

(cm) Average snow depth = 27.1 Maximum snow depth = 69.0 Minimum snow depth = 10.0 Standard variation = 13.4

#### Snow Sample Depths and Weights

-		-			
Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)	]
DW4-1	14	90.6	499.8	0.18	
DW4-2	19.5	157.4	696.2	0.23	
DW4-3	16	63.7	571.2	0.11	
DW4-4	59	864.3	2106.3	0.41	
DW4-5	65	886.5	2320.5	0.38	
		Aver	age Density =	0.26	_
	Average Snow Water Equivalent (SWE) =			7.1	cm H2O
	Average Snow Water Equivalent = 2				inches H2O
	Avera	ge Snow Wate	0.23	feet H2O	

Project ID:	North Slope Lakes			Site Loo	cation/Lake ID	L9312_Raft_B		
Survey Purpo	Purpose: Determine snow water equivalent		uivalent	Date:	12/17/2007	Time: 1:00pm		
Location Started 5 meters north of "Raft B" on L9312. Travelled 25 meters northerly towards Raft A. Turned left 90° and travelled 25 meters west to end point.								
Survey	Determine Sn	ow Water Equ	ivalent			Weather	Foggy, cool. Calm winds.	
objective:						Observations:	8°F	
Latitude:	N 70° 19.995'		Longitude:	W 150° 56.918'		Datum:	NAD 83	
Elevation:	7 ft		Elevation Datum:	BPMSL		Reference Markers:	Raft B is marked with lathe	
Drainage Basin:	Lake L9312		Slope Direction:	Flat		Vegetation Type:	Ice	
Slope Angle:	Flat		Access Notes:	Snowmobile		Other:		
Snow Depth Probe Type:		T-handle probe			Snow-Survey Team Names			
Snow Tube T	ype:	Arinodack sno	ow tube					
						Dan Reichard	t and Mike Lilly	

#### Snow Course Depths, in cm.

	1	2	3	4	5
1	8.0	7.5	9.0	11.0	9.0
2	7.0	5.5	10.5	10.5	9.5
3	7.5	7.5	10.0	9.5	12.0
4	8.5	6.0	11.0	8.0	10.0
5	8.5	5.0	10.0	8.5	8.0
6	11.0	5.0	8.5	9.0	9.0
7	8.0	6.0	9.0	10.0	8.0
8	6.5	6.5	11.0	10.5	9.0
9	7.0	6.0	12.5	10.0	12.0
10	7.0	7.0	12.0	9.5	12.5

(cm) Average snow depth = 8.8 Maximum snow depth = 12.5 Minimum snow depth = 5.0 Standard variation = 2.0

#### Snow Sample Depths and Weights

•	•	0			
Bag #	Depth	Weight	Volume	Density	]
	(cm)	(gr)	(cm^3)	(gr/cm^3)	
DW4-1	10	71.9	357.0	0.20	1
DW4-2	7.5	62.6	267.8	0.23	
DW4-3	10	63.0	357.0	0.18	
DW4-4	10	92.3	357.0	0.26	
DW4-5	13	121.3	464.1	0.26	
		Aver	age Density =	0.23	
	Average Sno	w Water Equiv	2.0	cm H2O	
	Average Snow Water Equivalent =				inches H2O
	Avera	ge Snow Wate	er Equivalent =	0.07	feet H2O

Project ID:	Project ID: North Slope Lakes			Site Lo	Betty Pingo		
Survey Purpose: Determine s		Determine sr	now water equivalent		Date:	12/15/2007	Time: 16:00
Location Description:	Near Wyomin	g gage. At sta	ked snow site	e. Started east and t	then went	north. Point o	f beginning is flagged rebar.
Survey objective:	Determine Snow Water Equivalent				Weather Dark, -4F, slight breeze Observations:		
Latitude:	N70°16.772'		Longitude:	W148°53.741'		Datum:	NAD83
Elevation:	Approximately	/ 10 ft	Elevation Datum:	BPMSL		Reference Markers:	Re-bar and lathe
Drainage Basin:	Kuparuk Rive	r	Slope Direction:	flat		Vegetation Type:	Tussock Tundra
Slope Angle:	: flat		Access Notes:	Highway vehicle		Other:	
Snow Depth Probe Type:			T-handle probe			Snow-Survey Team Names	
Snow Tube Type: Arinodack si		Arinodack sno	ow tube			Reichardt, Wr	nitman

Snow Course Depths, in cm.

	1	2	3	4	5
1	44.0	14.0	24.5	10.0	22.0
2	32.5	16.5	27.0	9.0	22.0
3	13.0	10.0	28.0	12.5	19.0
4	13.5	16.5	44.5	12.0	18.5
5	11.5	19.0	6.5	21.0	19.0
6	11.5	18.0	9.5	31.0	14.0
7	14.5	23.5	9.0	17.0	11.0
8	10.0	19.0	9.0	15.5	11.0
9	9.0	13.0	8.0	17.0	18.5
10	10.0	17.5	8.0	16.5	15.0

(cm) Average snow depth = 16.8 Maximum snow depth = 44.5 Minimum snow depth = 6.5 Standard variation = 8.3

#### Snow Sample Depths and Weights

•	•	0			
Bag #	Depth	Weight	Volume	Density	
	(CIII)	(gr)	(CIII^3)	(gr/cm^3)	
jed1	40	494.7	1428.0	0.35	
jed2	15	107.2	535.5	0.20	
jed3	14	88.2	499.8	0.18	
jed5	23	217.4	821.1	0.26	
jed4	14	57.0	499.8	0.11	
		Aver	age Density =	0.22	
	Average Sno	w Water Equiv	3.7	cm H2O	
Average Snow Water Equivalent = 1				1.46	inches H2O
	Avera	ge Snow Wate	er Equivalent =	0.12	feet H2O