

Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: November 2005



Sunrise at Alpine on lake L9312 (sampling tent in background), Photo by K.Hilton.

by
Kristie Hilton, Molly Chambers, and Michael Lilly

June 2007

North Slope Lakes Hydrologic Modeling Project
Report No. INE/WERC 06.02

Water and Environmental
Research Center



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A report on research sponsored by the

**Alaska Department of Energy, National Energy Technology Laboratory, BP
Exploration (Alaska) Inc., Conoco Phillips Alaska, Inc., and the Bureau of
Land Management.**

June 2007

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DISCLAIMER

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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	43559.999	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	cubic meter (m 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)	.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)	0.00115	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 approximate 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:

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

Specific electrical conductance (conductivity):

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

Millivolt (mV):

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

Vertical Datum:

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

Horizontal Datum:

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

Abbreviations, Acronyms, and Symbols

AC	Actual conductivity
ADOT&PF	Alaska Department of Transportation and Public Facilities
ASTM	American Society for Testing and Materials
atm	atmospheres
C	Celsius
DO	Dissolved oxygen
DVM	digital voltage multi-meter
e-tape	electric tape
F	Fahrenheit (°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
NWIS	National Water Information System
ORP	oxygen-reduction potential
ppm	parts per million, equivalent to mg/L
SC25	specific conductance at 25°C
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

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.

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

ACKNOWLEDGEMENTS

This project was funded by cooperative agreement number DE-FC26_01NT41248, University of Alaska Fairbanks, Arctic Energy Technology Development Laboratory. Field coordination and logistics support were provided by BP Exploration (Alaska) Inc. and Conoco Phillips Alaska.

Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: November 2005

INTRODUCTION

The University of Alaska Fairbanks (UAF) Water and Environmental Research Center (WERC) and Geo-Watersheds Scientific (GWS), together with project cooperators, initiated a study in the Fall of 2002 (Phase One) to obtain baseline information about the physical and chemical characteristics of North Slope tundra lakes. The project was extended in 2005 (Phase Two). The location of study lakes changed and was expanded to include other reservoirs so as to further develop the understanding and simulation tools necessary for water source management. K113 is an unpumped lake in the Kuparuk oilfield and is sampled on selected field trips during the year. L9312 is a pumped lake studied in the Alpine operations area. L9817 is a natural lake in eastern NPRA, west of Nuiqsut. This lake has been used in previous years for ice-road construction, but was not used during winter 2005-06. Two new reservoir systems (former mine sites) were included in the study in 2005. Mine Site B 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 data is collected during monthly visits to the lakes and samples are collected for further analysis in UAF-WERC chemistry laboratories.

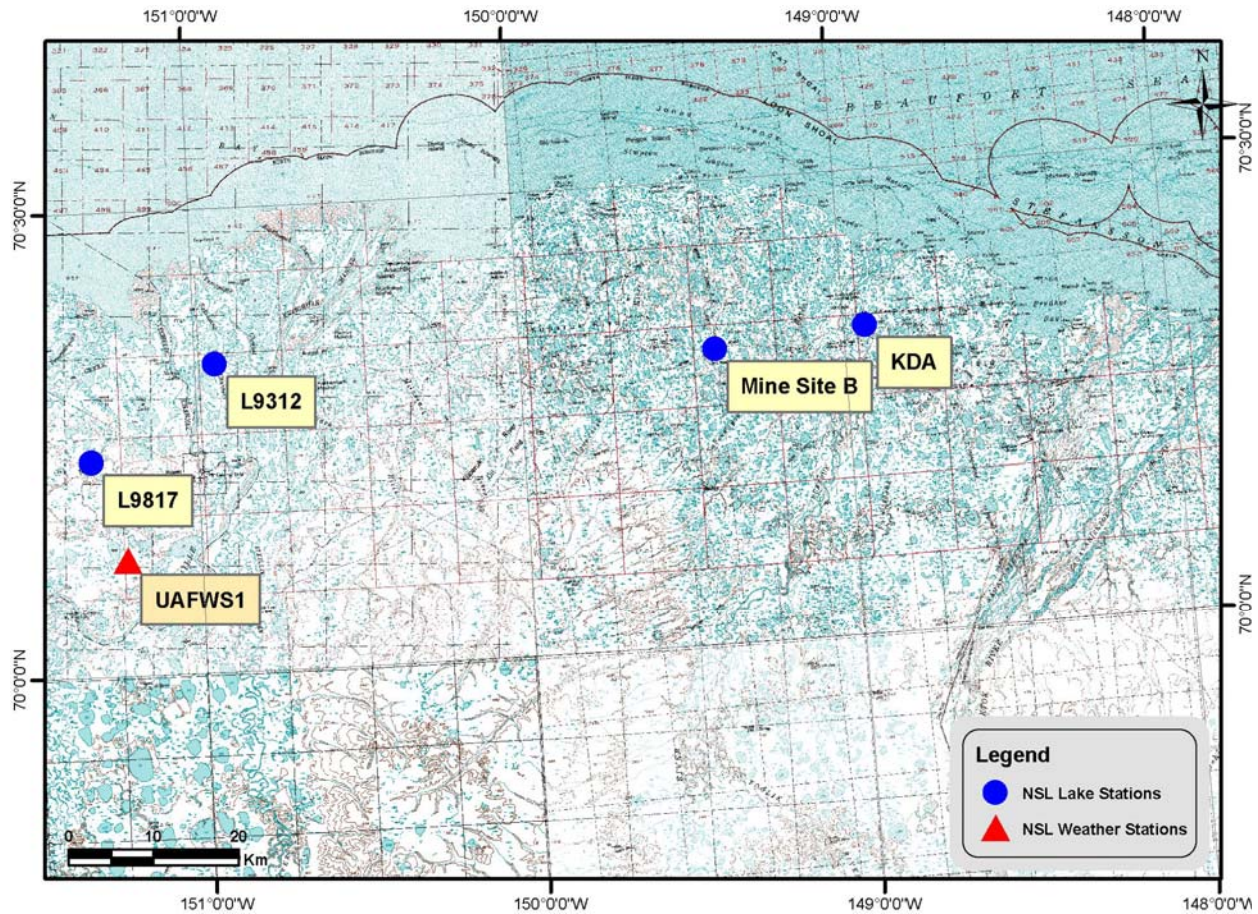


Figure 1. Location of study lakes in the NPRA, Alpine, Kuparuk, and Prudhoe Bay field operating area, North Slope, Alaska.

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. In November, we chose the following locations/tasks as the focus of our trip:

1. L9312: Alpine operating area.
 - Survey water levels to local elevation control.
 - Measure snow depth, ice thickness, and field water quality parameters.
 - Take samples for more detailed analysis.

- Hydrologic assessment of watershed area.
 - Measure water quality parameters and take samples at Alpine water plant for comparative analysis.
2. Mine Site B: Prudhoe Bay operating area.
- Measure snow depth, ice thickness, and field water quality parameters.
 - Hydrologic assessment of watershed area.

PROCEDURES

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 pre-specified locations at each study lake. Physical measurements of 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, conductivity, turbidity, and dissolved oxygen (DO) were obtained using an In-Situ Troll 9000 (submersible meter), at several depths throughout the water column. The precision with which physical measurements were reported takes into account field conditions, and the calibration of each parameter was checked before and after each day of sampling. To pass the calibration check, pH had to be within 0.2 pH units, turbidity had to be within 2 NTU, and ORP, DO, and conductivity had to be within 10% of the calibration standard value. Water samples were also taken at 3 depths (1 ft. below bottom of ice, middle of water column, 1 ft. above lake bottom). Some of these samples were preserved with acid for further analysis at UAF, while other samples were analyzed with a Hach spectrophotometer while still at the facility. Chemistry analysis will be addressed in a separate report.

RESULTS

There were differences and consistencies found in both of the study sites, however it should be noted that the depths measured were quite different. Physical measurements indicated Alpine

(L9312) as approximately 11 ft. (3.35 m) deep and Mine Site B roughly 25 ft. (7.62 m), with similar freeboard and ice thickness measurements at both lakes. At each lake, the dissolved oxygen levels increased slightly within the first few feet under the ice, then dropped towards the bottom. However, at some sampling locations on L9312 there were DO readings as high as 16 mg/L at the surface, compared with 14 mg/L at Mine Site B. The pH levels at various locations and depths at L9312 remained between 6.8 and 7.4, with the highest readings at the surface and lowest at the bottom. The raw water supply for the Alpine water plant, which is drawn from L9312, had readings at the mid-range of what was seen in the lake, a pH close to 7.1. The pH was consistently higher with less variation at Mine Site B, where at the surface readings were close to 8, with only a drop of 0.2 towards the bottom. There were also higher conductivity readings at Mine Site B (168.9-175.0 uS/cm) when compared to L9312 (56.2- 64.87 uS/cm). The raw water at the Alpine water plant showed a similarly low number, but it was slightly higher than what was seen in the lake (80.9 uS/cm).



Figure 2. Preparing for sampling at Mine Site B, Photo by M. Lilly.

SUMMARY

This was the first sampling trip for the 2005-2006 winter period; as such the data will be used as the baseline information for comparisons throughout the season. Both L9312 and Mine Site B had ice thicknesses of approximately 1.5 ft (.46 m) by the middle of November. Each also showed high DO concentrations at the surface with steady decreases towards the lake bottom, with the highest surface DO recorded at L9312. Conductivity remained consistently higher at Mine Site B when compared with L9312 and the raw water supply at the Alpine water plant, indicating a larger concentration of total dissolved solids (TDS). The pH at both locations remained relatively neutral with more fluctuation between depths at L9312, and higher pH levels at Mine Site B. Continued sampling throughout the winter will help in the comparison of differences within each of these lakes, as well as between different sampling locations.

Continuous monitoring of the water quality parameters seen in North Slope lakes throughout the winter will help in the understanding and development of simulation tools necessary for water resource management. As water levels decrease due to freezing and pumping activities in 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 hope to answer some of the questions brought forth on the effects of mid-winter pumping of North Slope tundra lakes.

REFERENCES

White, D.M., and Lilly, M.R. 2006a. BPX: Health, Safety, and Environmental Interface Document. Water and Environmental Research Center, University of Alaska Fairbanks. 4 pages.

White, D.M., and Lilly, M.R. 2006*b*. BPX: Health, Safety, and Environmental Plan. Water and Environmental Research Center, University of Alaska Fairbanks. 6 pages.

White, D.M., and Lilly, M.R. 2006*c*. Conoco Phillips Alaska, Inc.: Health, Safety, and Environmental Plan. Water and Environmental Research Center, University of Alaska Fairbanks. 5 pages.

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: L9312-Raft A
 Sample Purpose: Lake Water Quality Date: 11/18/2005 Time: 16:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70 20.071 Easting: W150 56.401 Datum: NAD 27
 Measurements By: Hilton Time: 16:30
 Water Depth (ft): 10.35 Ice Thickness (ft): 1.48
 Freeboard (ft): 0.08 Snow Depth (ft): 0.4
 Elev. (BPMSL): 7.4 +/- .02 Survey By: Lilly Time: 18:00 11/17/2005
 Sampled By: Hilton Sample Depths BWS (ft): #. n/a Time: n/a
 #. n/a
 #. n/a

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Samp QAQC Chk	Post-Samp QAQC Chk				
pH, cond., turb., temp, pressure, RDO	GWS	In-Situ Troll 9000	33033	yes	yes				
Parameters	Field Measurements								
Time:	16:07	16:10	16:13	16:17	16:21	16:24	16:29	16:34	16:40
Depth BWS (ft):	2	3	4	5	6	7	8	9	10
Temp (°C):	0.03	0.11	0.32	0.57	0.78	0.95	1.07	1.24	1.34
pH:	7.30	7.31	7.32	7.32	7.32	7.3	7.27	7.13	6.91
Barometric (mmHg):	760.5	760.5	760.6	760.6	760.7	760.6	760.6	760.6	760.6
Pressure (kPa):	4.567	7.520	10.606	13.291	16.539	19.316	22.172	26.102	25.352
Conductivity (µS/cm):	58.79	57.71	57.20	56.76	56.37	56.26	56.46	59.17	61.05
RDO (ppm):	16.17	16.33	16.37	16.24	16.01	15.86	15.64	14.48	11.73
Turbidity (NTU):	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10	0.40	3.20
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):		
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3
Oxygen (mg/L)									
Alkalinity (mg/L as CaCO ₃)									
Nitrate (mg/L NO ₃ ⁻ -N)									
Nitrite (mg/L NO ₂ ⁻ -N)									
Ammonia (mg/L NH ₃ -N)									
Sulfate (mg/L)									
Sulfide (µg/L)									
Total iron--UF (mg/L)									
Ferrous (II) iron--F tot Fe (mg/L)									

Remarks: Accidentally hit bottom on last measurement (10 ft depth), waited for stabalization but data may not reflect true water chemistry at depth.

Field-Form Filled Out By: Hilton Date: 11/21/2005
 QAQC Check By: Lawson Date: 2/5/2006

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-MP
 Sample Purpose: Lake Water Quality Date: 11/18/2005 Time: 15:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70 20.043 Easting: W150 56.563 Datum: NAD 27
 Measurements By: Hilton Time: 15:30
 Water Depth (ft): 11.15 Ice Thickness (ft): 1.57
 Freeboard (ft): 0.08 Snow Depth (ft): 0.4
 Elev. (BPMSL): 7.4 +/- .02 Survey By: Lilly Time: 18:00 11/17/2005
 Sampled By: Hilton Sample Depths BWS (ft): #. n/a Time: n/a
 #. n/a
 #. n/a

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Samp QAQC Chk	Post-Samp QAQC Chk				
pH, cond., turb., temp, pressure, RDO	GWS	In-Situ Troll 9000	33033	yes	yes				
Parameters	Field Measurements								
Time:	15:30	15:32	15:35	15:39	15:42	15:46	15:49	15:53	15:57
Depth BWS (ft):	2	3	4	5	6	7	8	9	10
Temp (°C):	0.00	0.08	0.28	0.53	0.75	0.96	1.14	1.35	1.70
pH:	7.26	7.28	7.29	7.29	7.28	7.28	7.27	7.19	6.83
Barometric (mmHg):	760.4	760.5	760.5	760.5	760.5	760.6	760.6	760.7	760.7
Pressure (kPa):	4.827	7.402	10.377	13.796	16.399	19.168	22.612	25.601	28.362
Conductivity (µS/cm):	58.63	57.98	57.59	57.11	56.72	56.43	56.31	57.74	64.87
RDO (ppm):	16.10	16.22	16.16	15.99	15.73	15.48	15.16	13.46	9.15
Turbidity (NTU):	0.9	1.5	1.6	1.4	1.6	1.6	0.2	0.0	0.7
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):		
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3
Oxygen (mg/L)									
Alkalinity (mg/L as CaCO ₃)									
Nitrate (mg/L NO ₃ ⁻ -N)									
Nitrite (mg/L NO ₂ ⁻ -N)									
Ammonia (mg/L NH ₃ -N)									
Sulfate (mg/L)									
Sulfide (µg/L)									
Total iron--UF (mg/L)									
Ferrous (II) iron--F tot Fe (mg/L)									

Remarks: _____

Field-Form Filled Out By: Hilton Date: 11/21/2005
 QAQC Check By: Lawson Date: 2/5/2006

University of Alaska Fairbanks, Water and Environmental Research Center

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

Raw Water

Project ID: North Slope Lakes Site Location/Lake ID: Alpine Water Plant
 Sample Purpose: Lake Water Quality Date: 11/16/2005 Time: 14:45

FIELD MEASUREMENTS

GPS Coord. Northing: n/a Easting: n/a Datum: n/a
 Measurements By: Hilton Time: 15:00
 Water Depth (ft): n/a Ice Thickness (ft): n/a
 Freeboard (ft): n/a Snow Depth (ft): n/a
 Elev. (BPMSL): n/a Survey By: n/a Time: n/a
 Sampled By: Hilton Sample Depths BWS (ft): #. n/a Time: n/a
 #. n/a
 #. n/a

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Samp QAQC Chk	Post-Samp QAQC Chk
pH, cond., turb., temp, pressure, RDO	GWS	In-Situ Troll 9000	33033	yes	yes
Parameters		Field Measurements			
Time:	15:05	15:10	15:15	15:20	15:25
Depth BWS (ft):	n/a	n/a	n/a	n/a	n/a
Temp (°C):	12.69	12.70	12.71	12.71	12.70
pH:	7.08	7.08	7.08	7.08	7.08
Barometric (mmHg):	768.8	768.8	768.7	768.7	768.7
Pressure (kPa):	0.501	0.501	0.501	0.501	0.499
Conductivity (µS/cm):	80.92	80.94	80.97	80.98	80.98
RDO (ppm):	9.58	9.58	9.57	9.56	9.56
Turbidity (NTU):	-0.10	-0.10	0.00	0.00	0.00
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):			Method	Detection range
	rep 1	rep 2	rep 3		
Oxygen (mg/L)	10.5			Hach spectrophotometer	0.3-15 mg/L
Alkalinity (mg/L as CaCO ₃)	23	23		Digital titrator	10-4000 mg/L as CaCO ₃
Nitrate (mg/L NO ₃ ⁻ -N)	2	1.4		Hach spectrophotometer	0.3-30.0 mg/L NO ₃ ⁻ -N
Nitrite (mg/L NO ₂ ⁻ -N)	0.004	-		Hach spectrophotometer	0.002-0.300 mg/L NO ₂ ⁻ -N
Ammonia (mg/L NH ₃ -N)	0.01	-		Hach spectrophotometer	0.01-0.50 mg/L NH ₃ -N
Sulfate (mg/L)	0	0		Hach spectrophotometer	2-70 mg/L
Sulfide (µg/L)	-	-		Hach spectrophotometer	5-800 µg/L
Total iron--UF (mg/L)	0.07	0.07		Hach spectrophotometer	0.02-3.00 mg/L
Ferrous (II) iron--F tot Fe (mg/L)	0.02	0.02		Hach spectrophotometer	0.02-3.00 mg/L

Remarks: Couldn't test for Sulfide- no Sulfide 2 Reagent. Water was taken from WP sink labeled as "Raw Water".

Bottles were collected and transferred to a small clean cooler for In-Situ measurements. Separate bottle kept with lid on for Hach measurements.

Field-Form Filled Out By: Hilton Date: 11/22/2005
 QAQC Check By: Blackburn Date: 8/1/2006

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: Mine Site B-NC (pg 1 of 2)
 Date: 11/21/2005 Time: 12:30

FIELD MEASUREMENTS

GPS Coord. Northing: nr Easting: nr Datum: n/a
 Measurements By: Hilton Time: 16:30
 Water Depth (ft): 25.1 Ice Thickness (ft): 1.48
 Freeboard (ft): 0.04 Snow Depth (ft): 0.4
 Elev. (BPMSL): n/a Survey By: n/a Time: n/a
 Sampled By: Hilton Sample Depths BWS (ft): #. n/a Time: n/a
 #. n/a
 #. n/a

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Samp QAQC Chk	Post-Samp QAQC Chk				
pH, cond., turb., temp, pressure, RDO	GWS	In-Situ Troll 9000	33033	yes	no				
Parameters	Field Measurements								
Time:	12:50	12:54	12:58	13:03	13:06	13:10	13:12	13:15	13:15
Depth BWS (ft):	3	4	5	7	9	11	13	15	15
Temp (°C):	0.10	0.10	0.08	0.15	0.19	0.24	0.28	0.31	0.31
pH:	7.97	7.94	7.92	7.92	7.91	7.91	7.9	7.91	7.91
Barometric (mmHg):	766.6	766.6	766.7	766.7	766.8	766.9	766.9	766.9	766.9
Pressure (kPa):	7.570	10.527	13.548	19.778	25.226	31.274	37.065	42.311	42.311
Conductivity (µS/cm):	175.00	174.40	173.00	171.20	171.10	170.40	169.80	169.40	169.40
RDO (ppm):	13.94	14.07	14.14	14.11	14.08	14.01	13.94	13.91	13.91
Turbidity (NTU):	-0.1	0.1	-0.1	-0.1	0.0	0.0	-0.1	-0.1	-0.1
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):		
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3
Oxygen (mg/L)									
Alkalinity (mg/L as CaCO ₃)									
Nitrate (mg/L NO ₃ ⁻ -N)									
Nitrite (mg/L NO ₂ ⁻ -N)									
Ammonia (mg/L NH ₃ -N)									
Sulfate (mg/L)									
Sulfide (µg/L)									
Total iron--UF (mg/L)									
Ferrous (II) iron--F tot Fe (mg/L)									

Remarks: See next page for deeper readings. Sampling occurred in the Northeast corner of the North Cell.

Field-Form Filled Out By: Hilton Date: 11/22/2005
 QAQC Check By: MRL Date: 11/26/2005

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: Mine Site B- NC (pg 2 of 2)
 Sample Purpose: Lake Water Quality Date: 11/21/2005 Time: 12:30

FIELD MEASUREMENTS

GPS Coord. Northing: nr Easting: nr Datum: n/a
 Measurements By: Hilton Time: 16:30
 Water Depth (ft): 25.1 Ice Thickness (ft): 1.48
 Freeboard (ft): 0.04 Snow Depth (ft): 0.4
 Elev. (BPMSL): n/a Survey By: n/a Time: n/a
 Sampled By: Hilton Sample Depths BWS (ft): # n/a Time: n/a
 # n/a
 # n/a

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model		Serial No.	Pre-Samp QAQC Chk	Post-Samp QAQC Chk
pH, cond., turb., temp, pressure, RDO	GWS	In-Situ Troll 9000		33033	yes	no
Parameters						
Time:	13:18	13:22	13:25	13:28	13:32	13:38
Depth BWS (ft):	17.0	19.0	21.0	23.0	24.0	25.0
Temp (°C):	0.34	0.35	0.37	0.46	0.48	0.50
pH:	7.91	7.90	7.89	7.85	7.83	7.74
Barometric (mmHg):	767.0	767.1	767.2	767.1	767.1	767.2
Pressure (kPa):	50.447	54.569	61.490	69.162	70.285	74.201
Conductivity (µS/cm):	168.90	169.00	169.1	169.5	169.8	170.3
RDO (ppm):	14.02	13.92	13.32	13.32	13.12	12.89
Turbidity (NTU):	0.1	0.0	0.0	0.1	0.2	37.7
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):		
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3
Oxygen (mg/L)									
Alkalinity (mg/L as CaCO ₃)									
Nitrate (mg/L NO ₃ ⁻ -N)									
Nitrite (mg/L NO ₂ ⁻ -N)									
Ammonia (mg/L NH ₃ -N)									
Sulfate (mg/L)									
Sulfide (µg/L)									
Total iron--UF (mg/L)									
Ferrous (II) iron--F tot Fe (mg/L)									

Remarks: This form is for the lower portion of the water column. The sampling site is located in the Northeast corner of the lake, 65 feet from the east shore line. Bottom turbidity (25 ft) could be impacted by meter touching bottom.

Field-Form Filled Out By: Hilton Date: 11/22/2005
 QAQC Check By: MRL Date: 11/26/2005

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
 Sample Purpose: Lake Water Quality

Site Location/Lake ID: L9312
 Date: 11/18/2005

WATER QUALITY METER INFORMATION

Meter Make: In-Situ
 Owner: GWS

Make: Troll 9000
 S/N: 33033

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	11/15/05	10:30	In-Situ pH 4.01	531034-2	Sep-06	4.0	Pass
pH 7.00	11/15/05	10:30	Oakton pH 7.00	2405162	May-06	7.00	Pass
Conductivity	11/15/05	10:30	Oakton 447 uS	2412150	Dec-05	398.9 @ 18.63C	Pass
Zero Oxygen	11/15/05	10:30	Hanna HI7040	690	Dec-06	0.00	Pass
Oxygen Saturation	11/15/05	10:30	tetra bubbler	na	na	9.84 @ 17.38C/	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	11/20/05	nr	In-Situ pH 4.01	531034-2	Sep-06	4.09	Pass
pH 7.00	11/20/05	nr	Oakton pH 7.00	2405162	May-06	7.05	Pass
pH 10.01	11/20/05	nr	Oakton pH 10.01	2404058	Sep-05	9.91	Pass
Conductivity	11/20/05	nr	Oakton 447 uS	2412150	Dec-05	352.7 @ 13.88C	Pass
Zero Oxygen	11/20/05	nr	Hanna HI7040	690	Dec-06	0.01	Pass
Oxygen Saturation	11/20/05	nr	tetra bubbler	na	na	11.86 @ 8.80C	Pass
Turbidity	11/20/05	nr	Amco Clear 5 NTU	P457987	Jan-06	5.000	Pass

Remarks: _____

Field-Form Filled Out By: Hilton
 QAQC Check By: Reichardt

Date: 2/17/2006
 Date: 2/18/2006

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004e: Water Quality Meter Calibration Form

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

Site Location/Lake ID: MSB
 Date: 11/21/2005

WATER QUALITY METER INFORMATION

Meter Make: In-Situ
 Owner: GWS

Make: Troll 9000
 S/N: 33033

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	11/20/05	nr	In-Situ pH 4.01	531034-2	Sep-06	4.09	Pass
pH 7.00	11/20/05	nr	Oakton pH 7.00	2405162	May-06	7.05	Pass
pH 10.01	11/20/05	nr	Oakton pH 10.01	2404058	Sep-05	9.91	Pass
Conductivity	11/20/05	nr	Oakton 447 uS	2412150	Dec-05	352.7 @ 13.88C	Pass
Zero Oxygen	11/20/05	nr	Hanna HI7040	690	Dec-06	0.01	Pass
Oxygen Saturation	11/20/05	nr	tetra bubbler	na	na	11.86 @ 8.80C	Pass
Turbidity	11/20/05	nr	Amco Clear 5 NTU	P457987	Jan-06	5.000	Pass

Post-Sampling QA

Remarks: Post-trip calibration check not performed. Meter went through re-calibration before check was completed.

Field-Form Filled Out By: Hilton
 QAQC Check By: Reichardt

Date: 2/17/2006
 Date: 2/18/2006

APPENDIX C. WATER-LEVEL ELEVATION FORMS

The following form reports the water-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: L9312
 Survey Purpose: Water-Level Elevations Date: 11/17/2005 Time: 17:30

Location: Lake L9312, located southeast of Alpine pad, survey by pump house benchmarks								
Survey objective: Lake water elevation survey					Weather Observations:			
Instrument Type: Optical Survey Level		Instrument ID: na		Cold, windy, blowing snow				
Rod Type: Fiberglass		Rod ID: na						
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Michael Lilly Kristie Hilton			
L9312 "P"	CP	11.61 BPMSL	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasm)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	1.03	12.64		11.61				Top of inlet pipe support
Ice		12.64	5.14	7.50				Ice at top of survey hole, south side
O		12.64	1.23	11.41				Top of VSM plate, SE corner of pump house
								moved Instr., used WL ice as turn point
O	1.16	12.57		11.41				
Ice		12.57	5.07	7.50				+0.00
P		12.57	0.96	11.61				close survey to +0.00
Survey Hole Water level				7.40				Freeboard = 0.10
		Base	This Survey	Diff				
Note: TBM movement	P (control)	11.61	11.61	0				
	O	11.46	11.41	-0.05				

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