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

Water sampling at reservoir KDA-2 (truck pumping water in background), Photo by K. Hilton.

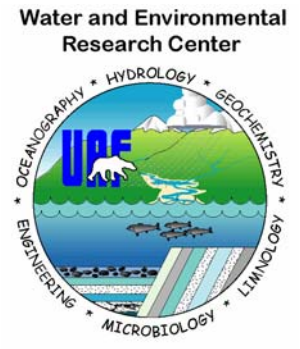
by

Kristie Hilton, Dan Reichardt, and Michael Lilly

March 2007

North Slope Lakes Hydrologic Modeling Project

Report No. INE/WERC 06.03



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by

Kristie Hilton[1], Dan Reichardt[2], Michael Lilly[1]

A report on research sponsored by the

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

March 2007

North Slope Lakes Hydrologic Modeling Project

Report Number INE/WERC 06.03

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[2]University of Alaska Fairbanks, Water and Environmental Research Center

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DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the accuracy of the data presented herein. This research was funded by the U.S. Department of Energy (DOE), 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.

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

Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
Acre	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)
	Volume	
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)
	Velocity and Discharge	
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)
	Hydraulic Conductivity	
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per day (ft/d)	0.00035	centimeter per second (cm/sec)
meter per day (m/d)	0.00115	centimeter per second (cm/sec)
	Hydraulic Gradient	
foot per foot (ft/ft)	5280	foot per mile (ft/mi)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
	Pressure	
pound per square inch (lb/in^2)	6.895	kilopascal (kPa)

Units

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

Physical and Chemical Water-Quality Units:

Temperature:

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

$$°F = 1.8(°C) + 32$$

Electrical Conductance (Actual Conductivity and Specific Conductance):

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

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

where:

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

AC = Actual Conductivity, in µS/cm

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

T = temperature of the sample, in °C

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

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

Millivolt (mV):

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

Vertical Datum:

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

Horizontal Datum:

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

Abbreviations, Acronyms, and Symbols

AC	Actual conductivity
ADOT&PF	Alaska Department of Transportation and Public Facilities
ASTM	American Society for Testing and Materials
atm	atmospheres
C	Celsius
DO	Dissolved oxygen
DVM	digital voltage multi-meter
e-tape	electric tape
F	Fahrenheit (^{o}F).
ft	feet
GWS	Geo-Watersheds Scientific
GWSI	USGS Ground-Water Site Inventory
km^2	square kilometers
kPa	kilopascal
lb/in^2	pounds per square inch
m	meters
mg/L	milligrams per liter, equivalent to ppm
µg/L	micrograms per liter
mi^2	square miles
mm	millimeters
µS/cm	microsiemens per centimeter
mV	Millivolt
NGVD	National Geodetic Vertical Datum
NWIS	National Water Information System
ORP	oxygen-reduction potential
ppm	parts per million, equivalent to mg/L
SC25	specific conductance at 25^{o}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.
- ConocoPhillips Alaska (CPA)
- Alaska Department of Natural Resources
- The Nature Conservancy
- Northern Alaska Environmental Center

ACKNOWLEDGEMENTS

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Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: December 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 natural lake used for facility water 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 (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.

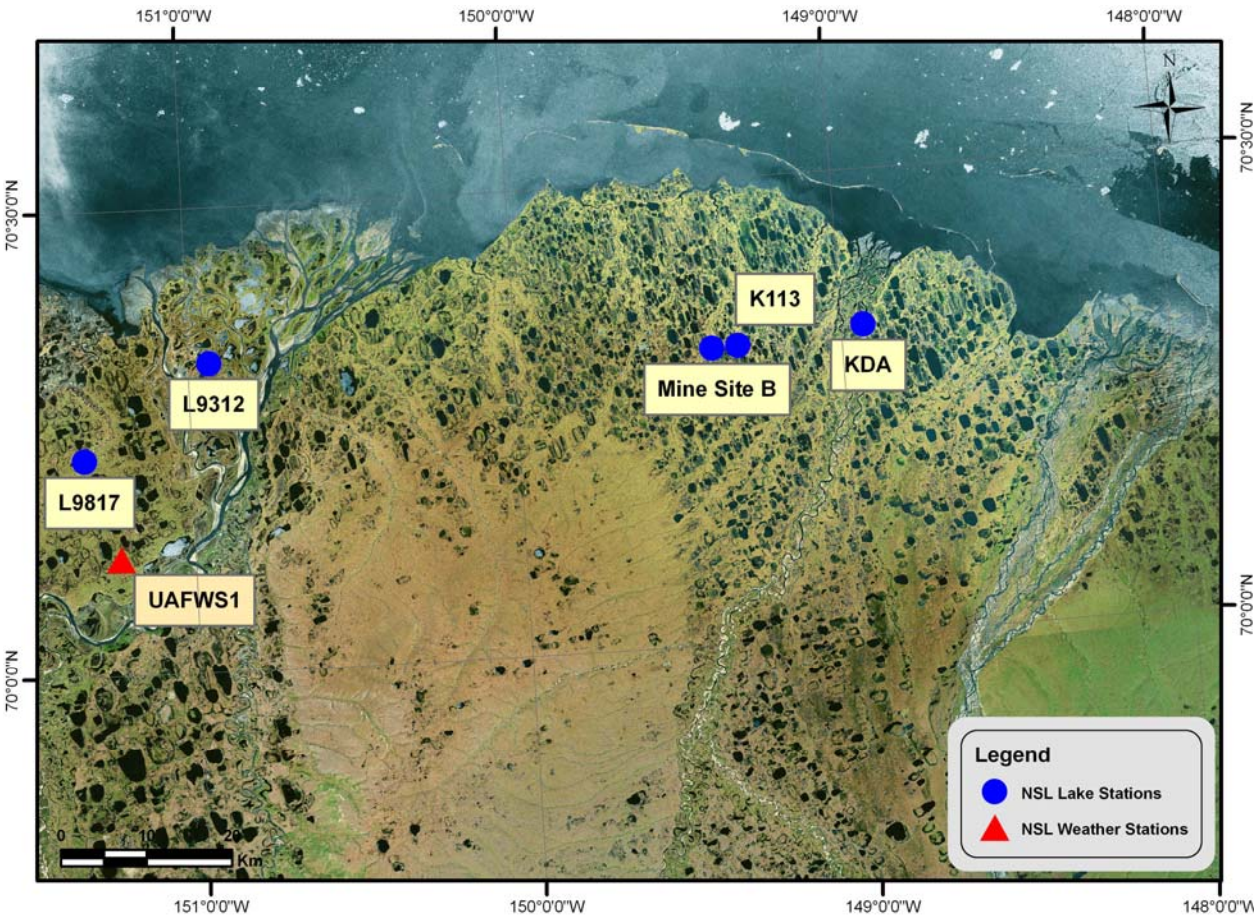

Figure 1. Location of study lakes in the NPRA, Alpine, Kuparuk, and Prudhoe Bay field operating area, North Slope, Alaska.

TRIP OBJECTIVES

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

1. Kuparuk Dead Arm Reservoirs: Prudhoe Bay operating area.
   - KDA-1 and KDA-2.
   - Survey water levels to local elevation control.

- Measure snow depth, ice thickness, and field water quality parameters.
- Hydrologic assessment of watershed area.

2. Mine Site B: Prudhoe Bay operating area.
   - North Cell, South Cell, and stream junction.
   - Survey water levels to local elevation control.
   - Measure snow depth, ice thickness, and field water quality parameters.
   - Hydrologic assessment of watershed area.

PROCEDURES

All field work follows the specified health, safety, and environmental guidelines outlined by BPX and CPA (White and Lilly, 2006*a,b,c*). Using a gas powered auger, holes were drilled through the ice at specified locations at each study lake. Physical measurements of water depth (top of water to bottom of lake), ice thickness (top of ice to bottom of ice), freeboard (top of water to top of ice), and snow depth (top of ice to top of snow), were taken at each sampling location. Water quality parameters such as temperature, pH, conductivity, and dissolved oxygen (DO) were obtained in-situ by 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, and 1 ft. above lake bottom). Some of these samples were preserved for further analysis at UAF, while other samples were analyzed with a Hach spectrophotometer while still at the facility. Chemistry analysis will be addressed in a separate report.

Figure 2. Surveying at Mine Site B, Photo by K. Hilton

SELECTED RESULTS

Each reservoir showed high DO levels just below the ice, with declining concentrations towards the lake bottom, except for the near shore sampling locations where DO levels remained relatively uniform. The highest readings at the Kuparuk Deadarm Reservoirs was at roughly 9 ft. (2.74 m) below the water surface, where at KDA-1 we saw readings of 18.0 mg/L and at KDA-2 we recorded 17.4-17.4 mg/L of dissolved oxygen (Figure 3). At the north cell of Mine Site B, the highest reading (14.7 mg/L) was also seen at 9 ft. (2.74 m.), but at the south cell the highest reading (15.4 mg/L) was found 5 feet (1.52 m.) below the ice (Figure 4). The DO levels at the stream junction were significantly lower, ranging between 10.5 mg/L at the surface and 7.8 mg/L near the bottom. In general, the south cell had the highest dissolved oxygen levels of any of the Mine Site B sampling locations.

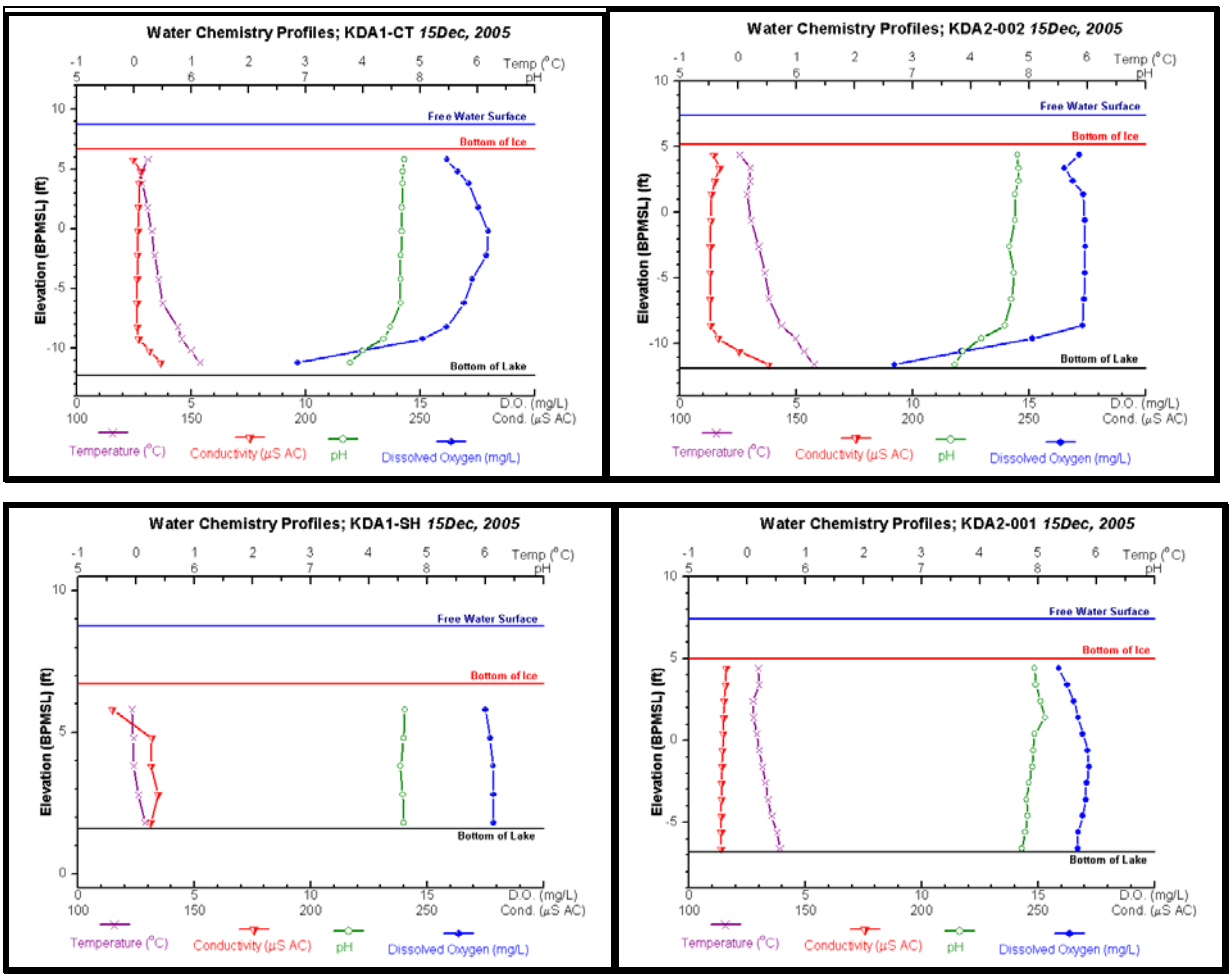

Figure 3. Water chemistry profiles from the Kuparuk Deadarm Reservoirs: KDA1-CT (center), KDA2-002 (center), KDA1-SH (shore side), and KDA2-001 (shore side).

The pH levels at both KDA reservoirs remained between 7.4 and 8.1 throughout the water column, with the highest reading found at KDA-2. At Mine Site B, the pH was highest at the north cell (7.6- 8.1), compared to the south cell (7.1- 7.8), and the stream junction (7.1- 7.2). Conductivity was slightly higher at KDA-1 than KDA-2. At all of the center sampling locations where it is deeper, there was a slight decrease in conductivity towards the bottom, whereas in the shallow near shore sampling locations there was little variation. At the Mine Site B locations, conductivity was highest at the stream junction (251.1- 253.0 uS/cm.), followed by readings between 164.2- 205.5 uS/cm. at the south cell, and the lowest readings at the north cell (160.4- 201.7 uS/cm).

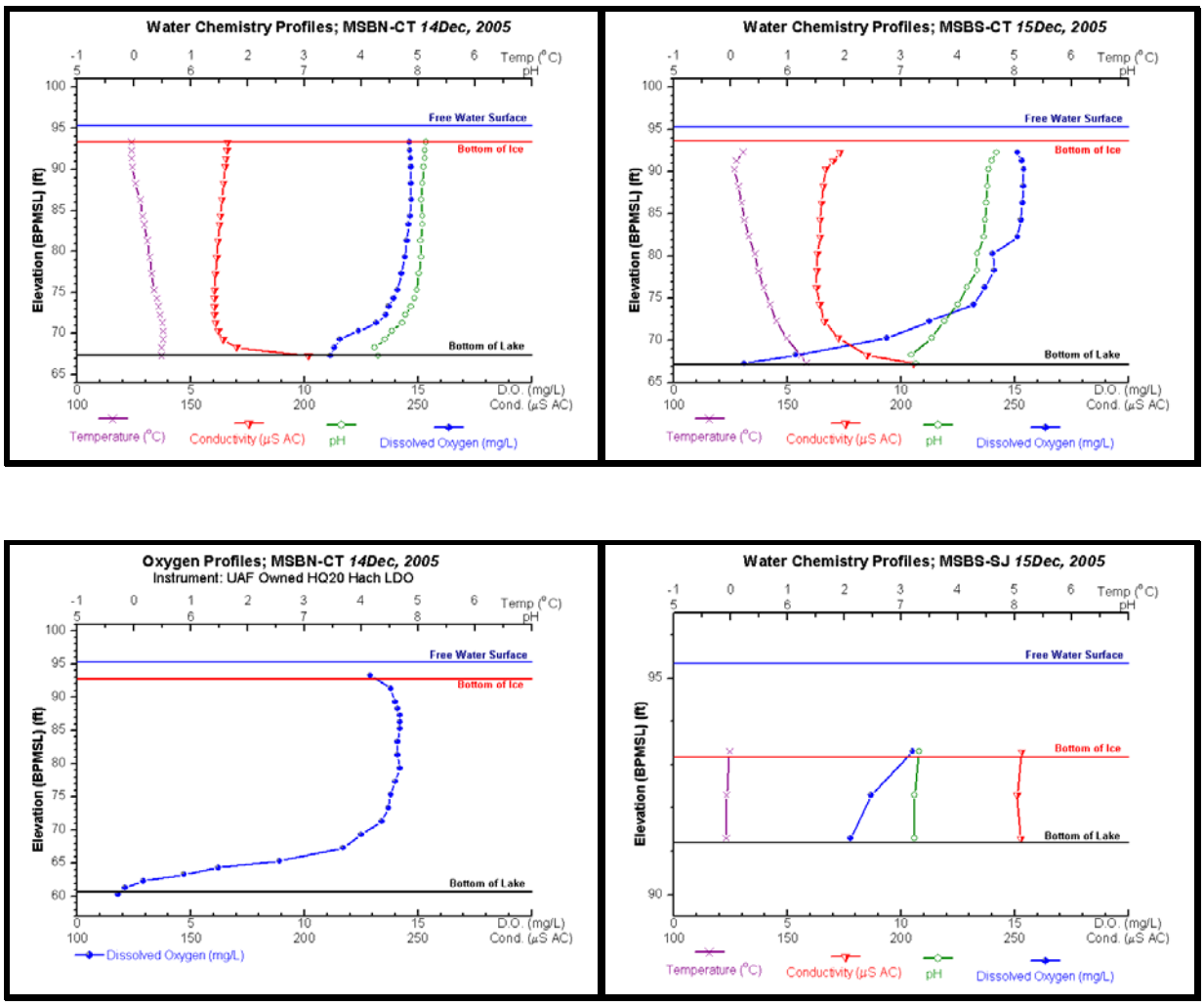

Figure 4. Water chemistry profiles from Mine Site B: MSBN-CT (north cell- center), MSBS-CT (south cell-center), MSBN-CT (north cell- center, LDO), MSBS-SJ (stream junction).

SUMMARY

The ice thickness was approximately 2.6 ft (0.79 m) at Mine Site B mid-December and between 2.1 and 2.3 ft (0.64- 0.70 m.) at the Kuparuk Deadarm Reservoirs (KDA-1 and KDA-2). Each sample site showed high oxygen levels at the surface with a steady decline towards the bottom, except for the near shore locations, where oxygen levels remained relatively consistent to the bottom. Mine Site B had generally lower DO concentrations than at the Kuparuk Deadarm Reservoirs, but showed the same decline as the sampling depths got closer to the substrate. Conductivity was similar in KDA-1 and KDA-2, with an increase towards the lake bottom at

the center locations. At Mine Site B, there was less variation between the north and south cells, but conductivity was much higher at the stream junction, an indication of a higher concentration of total dissolved solids. The pH levels at each of the Kuparuk Deadarm Reservoir sampling sites remained relatively similar; however they were slightly higher at KDA-2 than KDA-1. At Mine Site B, the pH remained slightly higher at the north cell, compared to the south cell, and almost one pH unit higher than at the stream junction.

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 change due to freezing and pumping activities in the winter, it is important to identify the changing water chemistry as well as the potential spring 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 lakes.

REFERENCES

Lilly, M.R., Hilton, K., and Reichardt, D. 2006. A Workplan for Chemistry Sampling and Surveying at Mine Site B and Kuparuk Deadarm Lakes: December 2005. Water and Environmental Research Center, University of Alaska Fairbanks. 9 p.

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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 p.

White, D.M., and Lilly, M.R. 2006*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.

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: KDA-1-001 (center)

Sample Purpose: **Lake Water Quality** Date: 12/15/05 Time: 14:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.929 Easting: W148 56.593 Datum: NAD 27

Measurements By: Hilton, Reichardt Time: 14:15

Water Depth (ft): 20.98 Ice Thickness (ft): 2.1

Freeboard (ft): 0.02 Snow Depth (ft): 0.29

Elev. (BPMSL): 8.76 +/- .02 Survey By: ML/DR Date: 12/15/05 Time: nr

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

2 NA

WATER QUALITY METER INFORMATION 3 NA

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
DO, pH, temp, pressure, cond., turb.	GWS	In-Situ Troll 9000	33033	yes	yes

Parameters	**Field Measurements**											
Time:	14:17	14:20	14:24	14:26	14:29	14:31	14:33	14:36	14:41	14:44	14:48	15:53
Depth BWS (ft):	3.0	4.0	5.0	7.0	9.0	11.0	13.0	15.0	17.0	18.0	19.0	20.0
Temp (°C):	0.24	0.12	0.14	0.23	0.31	0.36	0.43	0.50	0.76	0.83	0.99	1.15
pH:	7.86	7.85	7.85	7.84	7.84	7.83	7.83	7.83	7.74	7.68	7.50	7.39
Barometeric (mmHg):	762.3	762.3	762.3	762.3	762.3	762.4	762.4	762.5	762.5	762.6	762.5	762.6
Pressure (kPa):	7.123	10.462	13.603	19.444	25.409	31.390	37.366	42.910	48.887	52.141	54.539	57.720
Conductivity (µS/cm):	124.60	128.10	127.30	126.90	126.70	126.50	126.40	126.30	126.40	127.00	131.80	136.60
RDO (ppm):	16.17	16.63	17.13	17.54	17.98	17.89	17.28	16.92	16.16	15.11	12.46	9.65
Turbidity (NTU):	-0.30	-0.40	-0.30	-0.30	-0.30	-0.30	-0.30	-0.40	-0.30	-0.30	-0.30	-0.20
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):**			**Method**	**Detection range**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3		
Oxygen (mg/L)										Hach spec	0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator	10-4000 mg/L as CaCO3
Nitrate (mg/L NO_3^--N)										Hach spec	0.3-30.0 mg/L NO_3^--N
Nitrite (mg/L NO_2^--N)										Hach spec	0.002-0.300 mg/L NO_2^--N
Ammonia (mg/L NH_3-N)										Hach spec	0.01-0.50 mg/L NH_3-N
Sulfate (mg/L)										Hach spec	2-70 mg/L
Sulfide (µg/L)										Hach spec	5-800 µg/L
Total iron--UF (mg/L)										Hach spec	0.02-3.00 mg/L
Ferrous (II) Iron--F tot Fe (mg/L)										Hach spec	0.02-3.00 mg/L

Remarks:

Field-Form Filled Out By: Hilton Date: 12/19/05

QAQC Check By: Lawson Date: 2/6/05

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: KDA-1-002 (shore)

Sample Purpose: **Lake Water Quality** Date: 12/15/05 Time: 14:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.922 Easting: W148 56.492 Datum: NAD 27

Measurements By: Hilton Time: 15:00

Water Depth (ft): 7.15 Ice Thickness (ft): 2.17

Freeboard (ft): 0.12 Snow Depth (ft): 0.55

Elev. (BPMSL): 8.76 +/- .02 Survey By: ML/DR Date: 12/15/05 Time: nr

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

2 NA

3 NA

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check	Post-Sampling QAQC Check
DO, pH, temp, pressure, cond., turb.	GWS	In-Situ Troll 9000	33033	yes	yes	yes

Parameters	**Field Measurements**										
Time:	15:15	15:17	15:19	15:23	15:28						
Depth BWS (ft):	3.0	4.0	5.0	6.0	7.0						
Temp (°C):	-0.07	-0.05	-0.04	0.04	0.15						
pH:	7.81	7.80	7.77	7.79	7.80						
Barometeric (mmHg):	762.1	762.1	762.0	762.0	762.0						
Pressure (kPa):	7.404	10.558	12.865	13.443	19.471						
Conductivity (µS/cm):	114.80	131.70	131.40	134.40	131.20						
RDO (ppm):	17.50	17.71	17.84	17.85	17.85						
Turbidity (NTU):	0.00	-0.20	-0.20	2.50	-0.30						
ORP											

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

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):**			**Depth BWS (ft):**			**Depth BWS (ft):**			**Method**	**Detection range**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3		
Oxygen (mg/L)										Hach spec	0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator	10-4000 mg/L as CaCO3
Nitrate (mg/L NO_3^--N)										Hach spec	0.3-30.0 mg/L NO_3^--N
Nitrite (mg/L NO_2^--N)										Hach spec	0.002-0.300 mg/L NO_2^--N
Ammonia (mg/L NH_3-N)										Hach spec	0.01-0.50 mg/L NH_3-N
Sulfate (mg/L)										Hach spec	2-70 mg/L
Sulfide (µg/L)										Hach spec	5-800 µg/L
Total iron--UF (mg/L)										Hach spec	0.02-3.00 mg/L
Ferrous (II) Iron--F tot Fe (mg/L)										Hach spec	0.02-3.00 mg/L

Remarks:

Field-Form Filled Out By: Hilton Date: 12/19/05

QAQC Check By: Lawson Date: 2/6/05

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: KDA-2-001 (Survey Hole)

Sample Purpose: **Lake Water Quality** Date: 12/15/05 Time: 10:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.976 Easting: W148 56.104 Datum: NAD 27

Measurements By: Hilton, Reichardt Time: 10:30

Water Depth (ft): 14.22 Ice Thickness (ft): 2.23

Freeboard (ft): -0.17 Snow Depth (ft): 0.5

Elev. (BPMSL): 7.42 +/- .02 Survey By: ML/DR Date: 12/15/05 Time: nr

Water Sampling By: Hilton, Reichardt Sample Depths BWS (ft): 1 3 Date: 12/15/05 Time: 11:30

2 14

WATER QUALITY METER INFORMATION 3 na

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
DO, pH, temp, pressure, cond., turb.	GWS	In-Situ Troll 9000	33033	yes	yes

Parameters	**Field Measurements**											
Time:	10:44	10:48	10:51	10:54	10:57	11:00	11:03	11:06	11:09	11:12	11:15	11:19
Depth BWS (ft):	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0
Temp (°C):	0.19	0.21	0.10	0.11	0.16	0.20	0.26	0.31	0.36	0.42	0.51	0.56
pH:	7.97	7.98	8.02	8.06	7.97	7.96	7.95	7.92	7.90	7.91	7.89	7.86
Barometeric (mmHg):	763.4	763.3	763.3	763.3	763.3	763.3	763.3	763.4	763.4	763.5	763.5	763.5
Pressure (kPa):	7.426	10.314	13.156	16.314	19.623	22.329	25.129	28.272	31.254	34.442	37.121	39.551
Conductivity (µS/cm):	116.00	115.80	115.10	114.90	114.80	114.40	114.20	114.10	114.00	113.90	113.80	113.80
RDO (ppm):	15.89	16.25	16.54	16.73	16.92	17.13	17.19	17.08	17.05	16.92	16.72	16.71
Turbidity (NTU):	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.20	-0.30	-0.30	-0.30	-0.20	-0.30
ORP												

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

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):**			**Depth BWS (ft):**			**Depth BWS (ft):**			**Method**	**Detection range**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3		
Oxygen (mg/L)										Hach spec	0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator	10-4000 mg/L as CaCO3
Nitrate (mg/L NO_3^--N)										Hach spec	0.3-30.0 mg/L NO_3^--N
Nitrite (mg/L NO_2^--N)										Hach spec	0.002-0.300 mg/L NO_2^--N
Ammonia (mg/L NH_3-N)										Hach spec	0.01-0.50 mg/L NH_3-N
Sulfate (mg/L)										Hach spec	2-70 mg/L
Sulfide (µg/L)										Hach spec	5-800 µg/L
Total iron--UF (mg/L)										Hach spec	0.02-3.00 mg/L
Ferrous (II) Iron--F tot Fe (mg/L)										Hach spec	0.02-3.00 mg/L

Remarks:

Field-Form Filled Out By: Hilton Date: 12/19/05

QAQC Check By: Lawson Date: 2/6/05

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: KDA-2-002 (center)

Sample Purpose: **Lake Water Quality** Date: 12/15/05 Time: 12:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.986 Easting: W148 56.240 Datum: NAD 27

Measurements By: Hilton, Reichardt Time: 12:30

Water Depth (ft): 19.3 Ice Thickness (ft): 2.28

Freeboard (ft): 0.08 Snow Depth (ft): 0.57

Elev. (BPMSL): 7.42 +/- .02 Survey By: ML/DR Date: 12/15/05 Time: nr

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

2 NA

WATER QUALITY METER INFORMATION 3 NA

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
DO, pH, temp, pressure, cond., turb.	GWS	In-Situ Troll 9000	33033	yes	yes

Parameters	**Field Measurements**											
Time:	12:36	12:34	12:31	12:39	12:42	12:46	12:49	12:52	12:55	12:58	13:01	13:04
Depth BWS (ft):	3.0	4.0	5.0	6.0	8.0	10.0	12.0	14.0	16.0	17.0	18.0	19.0
Temp (°C):	0.03	0.21	0.21	0.15	0.22	0.35	0.46	0.53	0.74	0.98	1.13	1.30
pH:	7.90	7.91	7.91	7.88	7.88	7.83	7.87	7.85	7.79	7.59	7.43	7.36
Barometeric (mmHg):	763.0	763.0	763.0	763.1	763.1	763.2	763.2	763.3	763.4	763.3	763.3	763.4
Pressure (kPa):	7.258	10.121	13.314	16.210	22.309	28.249	34.293	39.993	46.014	48.617	51.440	54.762
Conductivity (µS/cm):	114.50	116.90	115.00	113.50	113.30	113.10	113.00	113.00	113.20	116.40	125.40	138.10
RDO (ppm):	17.15	16.52	16.87	17.34	17.39	17.42	17.39	17.36	17.30	15.14	12.09	9.22
Turbidity (NTU):	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30	-0.30	-0.10
ORP												

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

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):**			**Depth BWS (ft):**			**Depth BWS (ft):**			**Method**	**Detection range**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3		
Oxygen (mg/L)										Hach spec	0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator	10-4000 mg/L as CaCO3
Nitrate (mg/L NO_3^--N)										Hach spec	0.3-30.0 mg/L NO_3^--N
Nitrite (mg/L NO_2^--N)										Hach spec	0.002-0.300 mg/L NO_2^--N
Ammonia (mg/L NH_3-N)										Hach spec	0.01-0.50 mg/L NH_3-N
Sulfate (mg/L)										Hach spec	2-70 mg/L
Sulfide (µg/L)										Hach spec	5-800 µg/L
Total iron--UF (mg/L)										Hach spec	0.02-3.00 mg/L
Ferrous (II) Iron--F tot Fe (mg/L)										Hach spec	0.02-3.00 mg/L

Remarks: Sampling at depths 3,4, and 5 were not in order. This may have effected the DO readings.

Field-Form Filled Out By: Hilton Date: 12/19/05

QAQC Check By: Lawson Date: 2/6/05

University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID: **North Slope Lakes** Site Location/Lake ID: MSB-NC (North East) page 1 of 2

Sample Purpose: **Lake Water Quality** Date: 12/14/05 Time: 18:50

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.310 Easting: W149 23.719 Datum: NAD 27

Measurements By: Hilton, Reichardt Time: 18:50

Water Depth (ft): 28 Ice Thickness (ft): 1.83

Freeboard (ft): -0.14 Snow Depth (ft): 0.95

Elev. (BPMSL): 95.33 +/- .02 Survey By: ML/DR Date: 12/14/05 Time: nr

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

2 NA

3 NA

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
DO, pH, temp, pressure, cond., turb.	GWS	In-Situ Troll 9000	33033	yes	yes

Parameters	**Field Measurements**										
Time:	18:50	18:53	18:56	18:57	19:00	19:03	19:05	19:08	19:11	19:14	
Depth BWS (ft):	2.0	3.0	4.0	5.0	7.0	9.0	11.0	12.0	14.0	16.0	
Temp (°C):	-0.05	-0.05	-0.04	-0.03	0.02	0.11	0.15	0.18	0.23	0.27	
pH:	8.07	8.06	8.06	8.05	8.04	8.03	8.04	8.04	8.02	8.03	
Barometeric (mmHg):	765.8	765.8	765.8	765.8	765.7	765.9	765.9	766.0	766.0	766.0	
Pressure (kPa):	5.322	7.499	10.429	13.930	19.335	25.560	31.468	34.568	41.298	46.089	
Conductivity (µS/cm):	166.20	165.90	165.50	165.20	164.50	163.80	163.10	162.70	162.00	161.40	
RDO (ppm):	14.62	14.64	14.67	14.69	14.70	14.71	14.66	14.59	14.51	14.43	
Turbidity (NTU):	-0.20	-0.20	-0.20	-0.20	-0.20	-0.30	-0.20	-0.20	-0.20	-0.20	
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):**			**Method**	**Detection range**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3		
Oxygen (mg/L)										Hach spec	0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator	10-4000 mg/L as CaCO3
Nitrate (mg/L NO_3^--N)										Hach spec	0.3-30.0 mg/L NO_3^--N
Nitrite (mg/L NO_2^--N)										Hach spec	0.002-0.300 mg/L NO_2^--N
Ammonia (mg/L NH_3-N)										Hach spec	0.01-0.50 mg/L NH_3-N
Sulfate (mg/L)										Hach spec	2-70 mg/L
Sulfide (µg/L)										Hach spec	5-800 µg/L
Total iron--UF (mg/L)										Hach spec	0.02-3.00 mg/L
Ferrous (II) Iron--F tot Fe (mg/L)										Hach spec	0.02-3.00 mg/L

Remarks:

Field-Form Filled Out By: Hilton Date: 12/19/05

QAQC Check By: Lawson Date: 2/10/06

University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID: **North Slope Lakes** Site Location/Lake ID: MSB-NC (North East) pg 2 of 2

Sample Purpose: **Lake Water Quality** Date: 12/14/05 Time: 18:50

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.310 Easting: W149 23.719 Datum: NAD 27

Measurements By: Hilton, Reichardt Time: 18:50

Water Depth (ft): 28 Ice Thickness (ft): 1.83

Freeboard (ft): -0.14 Snow Depth (ft): 0.95

Elev. (BPMSL): 95.33 +/- .02 Survey By: ML/DR Date: 12/14/05 Time: nr

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

2 NA

WATER QUALITY METER INFORMATION 3 NA

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	QAQC Check	QAQC Check
pH, temp, pressure, cond., t	GWS	In-Situ Troll 9000	33033	yes	yes

Parameters	**Field Measurements**										
Time:	19:16	19:20	19:23	19:25	19:30	19:34	19:38	19:43	19:46	19:48	
Depth BWS (ft):	18.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	
Temp (°C):	0.31	0.35	0.40	0.43	0.45	0.50	0.51	0.51	0.48	0.48	
pH:	8.01	7.99	7.97	7.94	7.89	7.86	7.77	7.71	7.62	7.65	
Barometeric (mmHg):	766.1	766.1	766.1	766.1	766.1	766.1	766.1	766.0	766.0	766.0	
Pressure (kPa):	51.865	57.492	60.649	63.856	66.799	69.794	72.870	73.659	73.983	74.111	
Conductivity (µS/cm):	160.80	160.50	160.40	160.40	160.50	160.90	162.10	164.30	170.20	201.70	
RDO (ppm):	14.27	14.09	13.92	13.71	13.58	13.17	12.38	11.56	11.32	11.14	
Turbidity (NTU):	-0.10	0.00	0.00	0.20	0.50	0.60	1.40	8.20	47.10	7.30	
ORP											

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):**			**Depth BWS (ft):**			**Depth BWS (ft):**			**Method**	**Detection range**
	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										Digital titrator	10-4000 mg/L as CaCO3
Nitrate (mg/L NO_3^--N)										Hach spec	0.3-30.0 mg/L NO_3^--N
Nitrite (mg/L NO_2^--N)										Hach spec	0.002-0.300 mg/L NO_2^--N
Ammonia (mg/L NH_3-N)										Hach spec	0.01-0.50 mg/L NH_3-N
Sulfate (mg/L)										Hach spec	2-70 mg/L
Sulfide (µg/L)										Hach spec	5-800 µg/L
Total iron--UF (mg/L)										Hach spec	0.02-3.00 mg/L
Ferrous (II) Iron--F tot Fe										Hach spec	0.02-3.00 mg/L

Remarks: Hole is swing tied to short post of N shore of North Cell (96 ft), and bottom of tall post on NE shore of North Cell (90 ft).

Field-Form Filled Out By: Hilton Date: 12/19/05

QAQC Check By: Lawson Date: 2/10/06

University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID: **North Slope Lakes** Site Location/Lake ID: MSB-NC (Center)

Sample Purpose: **Lake Water Quality** Date: 12/15/05 Time: 18:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.310 Easting: W149 23.719 Datum: NAD27

Measurements By: KH/DAR Time: 18:50

Water Depth (ft): 34.61 Ice Thickness (ft): 2.61

Freeboard (ft): 0.07 Snow Depth (ft): 0.54

Elev. (BPMSL): 95.33 +/- 0.02 Survey By: DAR Date: 12/15/05 Time: nr

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

2 na

WATER QUALITY METER INFORMATION 3 na

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
DO	BLM	Hach LDO-10	nr	yes	yes

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	2.0	4.0	6.0	7.0	8.0	9.0	10.0	12.0	14.0	16.0
LDO (ppm):	12.90	13.80	14.00	14.10	14.20	14.20	14.20	14.10	14.10	14.20
Depth BWS (ft):	18.0	20.0	22.0	24.0	26.0	28.0	30.0	31.0	32.0	33.0
LDO (ppm):	14.00	13.80	13.70	13.40	12.50	11.70	8.90	6.20	4.70	2.90
Depth BWS (ft):	34.0	35.0								
LDO (ppm):	2.10	1.80								

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):**			**Depth BWS (ft):**			**Depth BWS (ft):**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										10-4000 mg/L as CaCO3
Nitrite (mg/L NO2--N)										0.002-0.300 mg/L NO2--N
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)										0.01-0.50 mg/L NH3-N

Remarks: Hole located in Center of North Cell of Mine Site B. Measurements taken with Matt Whitman's Hach LDO-10.

Field-Form Filled Out By: DAR Date: 1/21/06

QAQC Check By: Hilton Date: 2/6/06

University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID: **North Slope Lakes** Site Location/Lake ID: MSB-SC (South cell)

Sample Purpose: **Lake Water Quality** Date: 12/15/05 Time: 18:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.230 Easting: W149 23.823 Datum: NAD 27

Measurements By: Hilton Time: 18:30

Water Depth (ft): 28.17 Ice Thickness (ft): 1.76

Freeboard (ft): 0.1 Snow Depth (ft): 0.43

Elev. (BPMSL): 95.33 +/- .02 Survey By: ML/DR Date: 12/15/05 Time: nr

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

2 NA

WATER QUALITY METER INFORMATION 3 NA

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
DO, pH, temp, pressure, cond., turb.	GWS	In-Situ Troll 9000	33033	yes	yes

Parameters	**Field Measurements**										
Time:	18:44	18:48	18:51	18:55	18:58	19:01	19:03	19:05	19:08	19:11	
Depth BWS (ft):	3.0	4.0	5.0	7.0	9.0	11.0	13.0	15.0	17.0	19.0	
Temp (°C):	0.22	0.10	0.07	0.13	0.19	0.24	0.32	0.43	0.49	0.58	
pH:	7.84	7.80	7.77	7.76	7.75	7.74	7.73	7.67	7.67	7.58	
Barometeric (mmHg):	759.6	759.6	759.5	759.5	759.5	759.4	759.5	759.4	759.5	759.6	
Pressure (kPa):	7.497	10.360	15.988	19.040	25.124	31.144	36.778	43.433	49.034	55.405	
Conductivity (µS/cm):	173.10	170.10	166.90	165.80	165.00	164.50	164.50	163.30	163.00	162.80	
RDO (ppm):	15.12	15.32	15.40	15.39	15.35	15.27	15.12	14.04	14.10	13.69	
Turbidity (NTU):	-0.20	-0.30	-0.30	-0.20	-0.20	-0.30	-0.30	-0.20	-0.20	-0.20	
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):**			**Method**	**Detection range**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3		
Oxygen (mg/L)										Hach spec	0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator	10-4000 mg/L as CaCO3
Nitrate (mg/L NO_3^--N)										Hach spec	0.3-30.0 mg/L NO_3^--N
Nitrite (mg/L NO_2^--N)										Hach spec	0.002-0.300 mg/L NO_2^--N
Ammonia (mg/L NH_3-N)										Hach spec	0.01-0.50 mg/L NH_3-N
Sulfate (mg/L)										Hach spec	2-70 mg/L
Sulfide (µg/L)										Hach spec	5-800 µg/L
Total iron--UF (mg/L)										Hach spec	0.02-3.00 mg/L
Ferrous (II) Iron--F tot Fe (mg/L)										Hach spec	0.02-3.00 mg/L

Remarks:

Field-Form Filled Out By: Hilton Date: 12/19/05

QAQC Check By: Lawson Date: 2/10/06

University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID: **North Slope Lakes** Site Location/Lake ID: MSB-SC (South Cell)

Sample Purpose: **Lake Water Quality** Date: 12/15/05 Time: 18:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.230 Easting: W149 23.823 Datum: NAD 27

Measurements By: Hilton Time: 18:30

Water Depth (ft): 28.17 Ice Thickness (ft): 1.76

Freeboard (ft): 0.1 Snow Depth (ft): 0.43

Elev. (BPMSL): 95.33 +/- .02 Survey By: ML/DR Date: 12/15/05 Time: nr

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

2 NA

WATER QUALITY METER INFORMATION 3 NA

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
pH, temp, pressure, cond.,	GWS	In-Situ Troll 9000	33033	yes	yes

Parameters	**Field Measurements**										
Time:	19:14	19:17	19:20	19:24	19:28						
Depth BWS (ft):	21.0	23.0	25.0	27.0	28.0						
Temp (°C):	0.69	0.80	0.98	1.23	1.33						
pH:	7.50	7.38	7.27	7.09	7.13						
Barometeric (mmHg):	759.7	759.7	759.8	759.8	759.8						
Pressure (kPa):	60.142	66.847	72.735	78.755	82.529						
Conductivity (µS/cm):	164.20	166.30	172.40	185.10	205.50						
RDO (ppm):	13.21	11.25	9.37	5.36	3.10						
Turbidity (NTU):	-0.20	-0.10	0.30	2.10	2.50						
ORP											

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Depth BWS (ft):_____**			**Method**	**Detection range**
	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										Digital titrator	10-4000 mg/L as CaCO3
Nitrate (mg/L NO_3^--N)										Hach spec	0.3-30.0 mg/L NO_3^--N
Nitrite (mg/L NO_2^--N)										Hach spec	0.002-0.300 mg/L NO_2^--N
Ammonia (mg/L NH_3-N)										Hach spec	0.01-0.50 mg/L NH_3-N
Sulfate (mg/L)										Hach spec	2-70 mg/L
Sulfide (µg/L)										Hach spec	5-800 µg/L
Total iron--UF (mg/L)										Hach spec	0.02-3.00 mg/L
Ferrous (II) Iron--F tot Fe										Hach spec	0.02-3.00 mg/L

Remarks:

Field-Form Filled Out By: Hilton Date: 12/19/05

QAQC Check By: Lawson Date: 2/10/06

University of Alaska Fairbanks, Water and Environmental Research Center

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

Project ID: **North Slope Lakes** Site Location/Lake ID: MSB-SJ (Stream Junction)

Sample Purpose: **Lake Water Quality** Date: 12/15/05 Time: 19:45

FIELD MEASUREMENTS

GPS Coord. Northing: N70 19.202 Easting: W149 24.114 Datum: Nad 27

Measurements By: Hilton Time: 19:50

Water Depth (ft): 4.14 Ice Thickness (ft): 2.17

Freeboard (ft): 0.02 Snow Depth (ft): 0.46

Elev. (BPMSL): 95.33 +/- .02 Survey By: ML/DR Date: 12/15/05 Time: nr

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

2 na

3 na

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
DO, pH, temp, pressure, cond., turb.	GWS	In-Situ Troll 9000	33033	yes	yes

Parameters											
Time:	20:19	20:22	20:24								
Depth BWS (ft):	2.0	3.0	4.0								
Temp (°C):	-0.02	-0.07	-0.08								
pH:	7.16	7.12	7.12								
Barometeric (mmHg):	758.6	758.6	758.6								
Pressure (kPa):	5.497	7.259	11.239								
Conductivity (µS/cm):	253.00	251.10	252.70								
RDO (ppm):	10.51	8.68	7.78								
Turbidity (NTU):	0.40	0.70	5.00								
ORP											
Hach Temp (°C):											
Hach LDO											

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): 3.5**			**Depth BWS (ft): 18**			**Depth BWS (ft): 33**			**Method**	**Detection range**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3		
Oxygen (mg/L)										Hach spec	0.3-15 mg/L
Alkalinity (mg/L as $CaCO_3$)										Digital titrator	10-4000 mg/L as CaCO3
Nitrite (mg/L NO_2^--N)										Hach spec	0.002-0.300 mg/L NO_2^--N
Ammonia (mg/L NH_3-N)										Hach spec	0.01-0.50 mg/L NH_3-N
Total iron--UF (mg/L)										Hach spec	0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec	0.02-3.00 mg/L

Remarks:

Field-Form Filled Out By: Hilton Date: 2/15/06

QAQC Check By: St. Amand Date: 3/20/06

APPENDIX B. WATER QUALITY METER CALIBRATION FORMS

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

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004e: Water Quality Meter Calibration Form

Project ID: **North Slope Lakes** Site Location/Lake ID: KDA-1,2

Sample Purpose: **Lake Water Quality** Date: 12/15/2006

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Make: Troll 9000

Owner: GWS S/N: 33033

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 7.00	12/13/05	nr	Oakton pH 7.00	2405162	May-06	6.92	Pass
Conductivity	12/13/05	nr	Oakton 447 uS	2412150	Dec-05	331.0 @ 13.84C	Pass
Zero Oxygen	12/13/05	nr	Hanna HI7040	690	Dec-05	0.00	Pass
Oxygen Saturation	12/13/05	nr	tetra bubbler	na	na	10.77 @ 14.25C/ 769 mmHg	Pass
Turbidity	12/13/05	nr	Amco Clear 1NTU	P459643	Jan-06	1.7	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	12/15/06	nr	In-Situ pH 4.01	2404386	Apr-06	3.85	Pass
pH 7.00	12/15/06	nr	Oakton pH 7.00	2405162	May-06	6.84	Pass
pH 10.01	12/15/06	nr	In-Situ pH 10.01	531001-1	Sep-06	9.73	Pass
Conductivity	12/15/06	nr	Oakton 447 uS	2412150	Dec-05	333.0 @ 12.89C	Pass
Zero Oxygen	12/15/06	nr	Hanna HI7040	90	Dec-05	0.02	Pass
Oxygen Saturation	12/15/06	nr	tetra bubbler	na	na	10.20 @ 15.9C/ 752.6 mmHg	Pass
Turbidity	12/13/05	nr	Amco Clear 1NTU	P459643	Jan-06	1.500	Pass

Remarks:

Field-Form Filled Out By: Hilton Date: 2/17/2006

QAQC Check By: Reichardt 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** Site Location/Lake ID: MSB

Sample Purpose: **Lake Water Quality** Date: 12/14/2005

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Make: Troll 9000

Owner: GWS S/N: 33033

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 7.00	12/13/05	nr	Oakton pH 7.00	2405162	May-06	6.92	Pass
Conductivity	12/13/05	nr	Oakton 447 uS	2412150	Dec-05	331.0 @ 13.84C	Pass
Zero Oxygen	12/13/05	nr	Hanna HI7040	90	Dec-05	0.00	Pass
Oxygen Saturation	12/13/05	nr	tetra bubbler	na	na	10.77 @ 14.25C/ 769 mmHg	Pass
Turbidity	12/13/05	nr	Amco Clear 1NTU	P459643	Jan-06	1.7	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	12/15/05	nr	In-Situ pH 4.01	530478-2	Jul-06	3.85	Pass
pH 7.00	12/15/05	nr	Oakton pH 7.00	2405162	May-06	6.84	Pass
pH 10.01	12/15/05	nr	In-Situ pH 10.01	531001-1	Sep-06	9.73	Pass
Conductivity	12/15/05	nr	Oakton 447 uS	2412150	Dec-05	333.0 @ 12.89C	Pass
Zero Oxygen	12/15/05	nr	Hanna HI7040	90	Dec-05	0.02	Pass
Oxygen Saturation	12/15/05	nr	tetra bubbler	na	na	10.20 @ 15.9C/ 752.6 mmHg	Pass
Turbidity	12/15/05	nr	Amco Clear 1NTU	P459643	Jan-06	1.5	Pass

Remarks:

Field-Form Filled Out By: Hilton Date: 2/17/2006

QAQC Check By: St. Amand Date: 3/20/2006

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: MSB

Sample Purpose: **Lake Water Quality** Date: 12/15/2005

WATER QUALITY METER INFORMATION

Meter Make: Hach HQ10 Make: LDO

Owner: BLM S/N: 050200003625/050100006206

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Oxygen Saturation	12/13/05	nr	tetra bubbler	na	na	10.1 @ 14C/ 771mmHg	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Zero Oxygen	12/16/05	nr	Hanna HI7040	90	Dec-06	-1.00	Pass
Oxygen Saturation	12/16/05	nr	tetra bubbler	na	na	10.5 @ 16.4C/ 754 mmHg	Pass

Remarks:

Field-Form Filled Out By: Hilton Date: 2/17/2006

QAQC Check By: Reichardt Date: 2/18/2006

APPENDIX C. ELEVATION SURVEY FORMS

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

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-011: Elevation Survey Form

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

Survey Purpose: **Water-Level Elevations** Date: 12/15/2005 Time: nr

Client:	Tundra Ponds Study				Date:	12/15/2005	
Location:	KDA2-S1 is in NW Corner of Resevoir 2, KDA3-S1 is in SW Corner of Resevoir 3, BM____ is set in dirt west of dike with				Time:		
Survey objective:	Determine elevation of water surface at KDA Resevours 1 and 2				Weather Observations:		
Instrument Type:	Automatic Level	Instrument ID:	Rental from Surveyors Exchange				
Rod Type:	Plastic extendable	Rod ID:					
Bench Mark Information:					Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm-ss)	Longitude (ddd-mm-ss)	Dan Reichardt; Michael Lilly		
BM____		100.00 arbitrary					

Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
BM____	0.05			100				arbitrary elevation
STA-01		100.05						located on shore near BM___
KDA2-S1			11.95	88.1				S1 was measured at water surface
KDA3-S1	12.4		11.96	88.09				S1 was measured at water surface
STA-02		100.49						located on shore near BM___
KDA2-S1			12.39	88.1				closes within .00
BM____			0.5	99.99				closes within .01
KDA2-S2	8.4			88.1				assumed to be the same elevation as KDA2-S1
STA-03		96.5						on island between Resevoirs 1 and 2
KDA1-S1	6.39		7.06	89.44				
STA-04		95.83						on island between resevoirs 1 and 2
KDA2-S2			7.73	88.1				closes within 0.00 ft

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasml; foresight, FS; height of instrument, H minutes, mm; seconds, ss

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-011: Elevation Survey Form

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

Survey Purpose: **Water-Level Elevations** Date: 12/15/2005 Time: nr

Location:	Mine Site B, NE corner of North Cell, temporary datum						
Survey objective:	Lake water elevation survey				Weather Observations:		
Instrument Type:	Optical Survey Level	Instrument ID:	na		Cold		
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 Daniel Reichardt		
"Post"	WERC	100 Temp.	na	na			

Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
Post	5.64	105.64		100.00				Top of nail in post, temp elevation
WL		105.64	10.31	**95.33**				Top of ice in refrozen hole
								moved Instr., used WL ice as turn point
WL	10.52	105.85		95.33				
P		105.85	5.85	100.00				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