North Slope, Alaska, Snow-Course, Lake Chemistry and Physical Data: March 2011

Crea Creek, photo by J. Derry, March 2011.

by

Jeff Derry, Kristie Hilton, and Michael Lilly

August 2012

Arctic Transportation Networks Project

Report GWS.TR.12.08

North Slope, Alaska, Snow-Course, Lake Chemistry and Physical Data: March 2011

by

Jeff Derry[1], Kristie Hilton[1], and Michael Lilly[1]

A report on research sponsored by:

- U.S. Department of Energy
- National Energy Technology Laboratory
- Alaska Department of Natural Resources
- ConocoPhillips Alaska, Inc.
- Bureau of Land Management
- Geo-Watersheds Scientific

August 2012

Arctic Transportation Networks Project

Report Number GWS.TR.12.08

[1]Geo-Watersheds Scientific, Fairbanks, AK

Recommended Citation:

Derry, J., Hilton, K., and Lilly, M. 2012. North Slope, Alaska, Snow-Course, Lake Chemistry and Physical Data: March 2011. Geo-Watersheds Scientific, Report GWS.TR.12.08. Fairbanks, Alaska. 11 pp (plus appendices).

Fairbanks, Alaska
August 2012

For additional information write to:

Geo-Watersheds Scientific
PO Box 81538
Fairbanks, Alaska 99708
mlilly@gwscientific.com

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

The contents of this report reflect the views of the authors, who are responsible for the accuracy of the data presented herein. The contents of the report do not necessarily reflect the views of policies of DOE or any local sponsor. This work does not constitute a standard, specification, or regulation.

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

Conversion Factors

Multiply	By	To obtain
	Length	
inch (in)	25.4	millimeter (mm)
inch (in)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
Acre	43560	square feet (ft^2)
Acre	0.4047	hectare (ha)
square foot (ft^2)	$3.587X10^{-8}$	square mile (mi^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (l)
gallon (gal)	3785	milliliter (ml)
cubic foot (ft^3)	23.317	liter (l)
acre-ft (ac-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)	0.0929	square meter per day (m^2/d)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/sec)
	Hydraulic Conductivity	
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per day (ft/d)	0.00035	centimeter per second (cm/sec)
meter per day (m/d)	0.00115	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. Regulations related to tundra travel and water use on Alaska's North Slope apply combinations of both English and SI units. 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, snow depth was reported in inches (in) followed by the value in centimeters (cm) 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:

$$°F = 1.8(°C) + 32$$

Snow Water Equivalent (SWE):

Water content of a column of snow is determined by knowing the depth of the snowpack and density.

$$SWE = d_s * \rho_s / p_w$$

where:

d_s = snow depth

ρ_s = snow density

p_w = density of water.

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. Conductivity can also be expressed as specific conductance at 25°C (SC25) in which the actual conductivity (µS/cm) is temperature corrected. To convert AC to SC25 the following equation can be used:

Error! Bookmark not defined. $$SC25 = \frac{AC}{1 + r(T - 25)}$$

where:

SC25 = specific conductance at 25^{o}C, in µS/cm
AC = actual conductivity, in µS/cm
r = temperature correction coefficient for the sample, in ^{o}C
T = temperature of the sample, in ^{o}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 reported in mg/L is equivalent to the concentration in parts per million (ppm).

Millivolt (mV):
A unit of electromotive force equal to one thousandth of a volt.

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

Horizontal Datum:
The horizontal datum for all locations in this report is the North American Datum of 1983 or North American Datum of 1927. The datum used for each data set is reported on field forms located in the appendix.

Abbreviations, Acronyms, and Symbols

AC	Actual conductivity
ADOT&PF	Alaska Department of Transportation and Public Facilities
ADNR	Alaska Department of Natural Resources
ASTM	American Society for Testing and Materials
atm	Atmospheres
ATN	Arctic Transportation Networks
C	Celsius (^{o}C)
cm	Centimeters
DO	Dissolved oxygen
DVM	Digital voltage multi-meter
F	Fahrenheit (^{o}F)
ft	Feet
GWS	Geo-Watersheds Scientific
in	Inches
kg	Kilograms
km^2	Square kilometers
kPa	Kilopascal
lb/in^2	Pounds per square inch
m	Meters
mg/l	Milligrams per liter
µg/l	Micrograms per liter
mi^2	Square miles
mm	Millimeters
µS/cm	Microsiemens per centimeter
mV	Millivolt
NGVD	National Geodetic Vertical Datum
NRCS	Natural Resources Conservation Service
NWIS	National Water Information System
ORP	Oxygen-reduction potential
ppm	Parts per million
QA	Quality assurance
QC	Quality control
Sag	Sagavanirktok River
SC25	Specific conductance at 25°C
SWE	Snow water equivalent
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 Arctic Transportation Network project covers a large area of the North Slope and benefits from a number of positive partnerships, all contributing to the overall project objectives.

- U.S. Department of Energy, National Energy Technology Laboratory (NETL)
- ConocoPhillips Alaska, Inc. (CPA)
- Bureau of Land Management (BLM)
- Alaska Department of Natural Resources (ADNR)
- North Slope Borough (NSB)
- National Weather Service (NWS)
- Geo-Watersheds Scientific (GWS)
- University of Alaska-Fairbanks (UAF)
- Idaho National Laboratory (INL)

ACKNOWLEDGEMENTS

This material is based upon work supported by the U.S. Department of Energy (National Energy and Technology Laboratory) under Award Number DE-FE0001240. Field coordination, logistics and data support were provided by ConocoPhillips Alaska. Additional support was provided by other project cooperators, North Slope Borough, Bureau of Land Management, National Weather Service, and Geo-Watersheds Scientific, in the form of financial and in-kind match. Alaska Department of Natural Resources provided data and supporting information for snow survey sites in the study area.

North Slope, Alaska, Snow-Course, Lake Chemistry and Physical Data: March 2011

INTRODUCTION

Geo-Watersheds Scientific (GWS), University of Alaska Fairbanks (UAF), and Idaho National Laboratory (INL), together with project cooperators, initiated a study in October 2009 to collect field data for the development of management tools for various aspects of Arctic Transportation Networks (ATN). Some of the variables collected include data from meteorological and lake stations, such as snow depth, air and soil temperatures, unfrozen soil moisture, precipitation, wind and radiation data. Data are also collected at selected lakes and reservoirs. Lake data may include snow depth and density data, water-quality and water-level measurements, and general observations of watershed conditions.

Snow depth is considered an important variable by regulatory agencies, since tundra travel operations in the Coastal Tundra Area (Alaska state lands) can only commence once data stations report a snow depth of 6 in (15 cm) in the coastal plain management areas, or 9 in (23 cm) in the foothills management areas. Soil temperatures are also used to manage tundra travel on Alaska state lands. The soil temperature must reach 23° F (-5°C) at a depth of 12 in (30 cm) (Bader, 2004) to ensure frozen soil has adequate strength to meet tundra-travel management criteria. The direct relationship of soil strength to the temperature criteria has not been defined, though this criterion is considered conservative. Many meteorological factors determine when these conditions will be met. An established network of meteorological stations and increased manual snow measurements – both number of samples collected and number of sites visited – will improve the understanding of the timing and amount of snow and its spatial distribution and will assist in the development of predictive and management tools.

Ice thickness on lakes and reservoirs is another important measurement related to Arctic transportation networks. Adequate ice thickness must exist before safe travel over ungrounded ice (not frozen to bottom of lake or reservoir) can be conducted. In most cases, for lakes over 7 feet (2.1 m) deep, an end-of-season ice thickness of 7 ft (2.1 m) is assumed for the North Slope.

This is a conservative seasonal ice thickness that is rarely measured, but has provided a safe management approach in lack of supporting data for seasonal ice thicknesses over the North Slope. Ice thickness data collected by the ATN project and others will be used to help develop better management approaches associated with water use and North Slope lakes and reservoirs.

TRIP OBJECTIVES

The March field effort was a collaborative effort with BLM and UAF personnel with the objectives primarily focused on visiting lakes and beaded streams in the NPR-A (Figure 1). At each location snow-courses were conducted both on the lake surface and on the tundra surface near the lake. Water quality measurements, consisting of dissolved oxygen, temperature, and conductivity, were collected at the center of each lake visited. Lake ice measurements (freeboard, ice thickness, water depth) were collected at the center of each lake and in the four cardinal directions of each lake. Water level surveys were completed at lakes L9817, M9925, L9820, L9819, L9323, L9824, L9312, and L9322. A number of beaded stream cross sections were visited and water quality and physical information was collected. Meteorological station operations were completed and the stream camera station was brought online at L9817. Images were collected and batteries were replaced at non-telemetry cameras. The list below summarizes the primary trip objectives:

- Snow measurements
- Lake ice measurements and observations
- Lake chemistry profile measurements
- Lake elevation surveys
- Beaded stream observations and chemistry
- Weather station/camera operations
- Tundra travel network observations

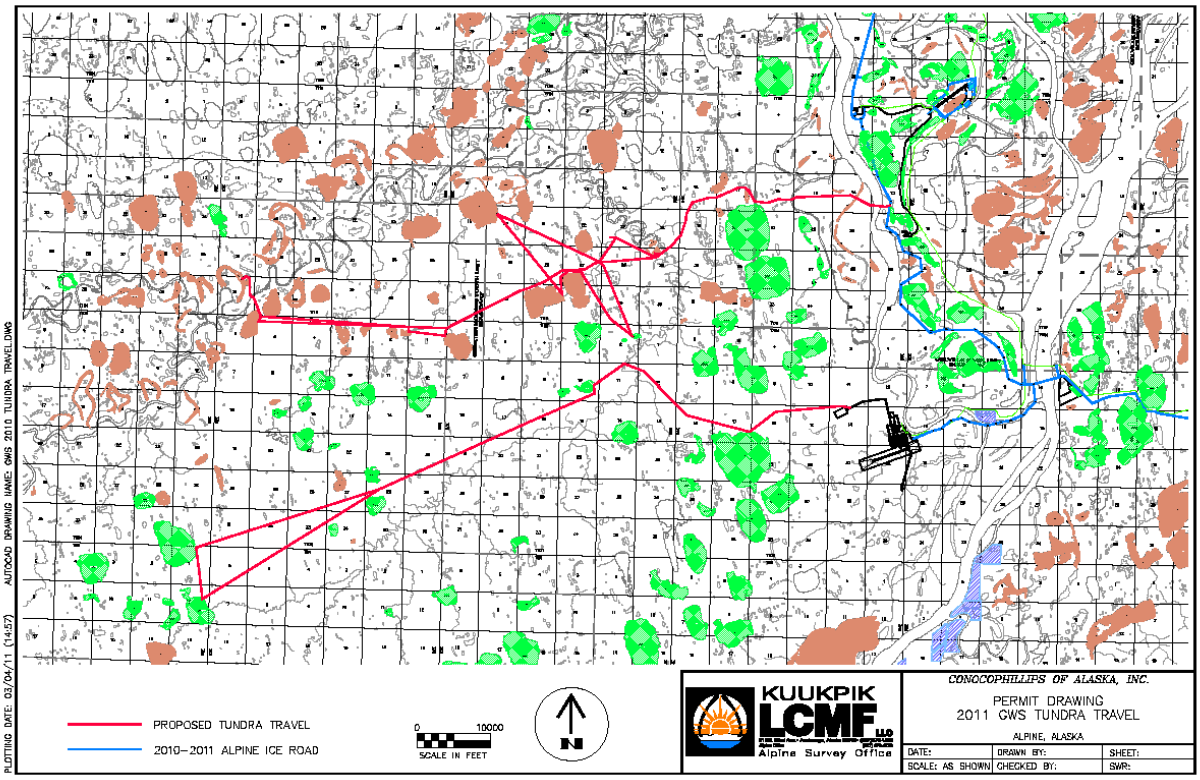

Figure 1. Map of routes taken to lake and beaded stream sampling sites in NPR-A.

A workplan was published prior to the March field campaign containing a site-by-site list of objectives (Derry et al. 2011). Project accomplishments include the following:

1. Toolik Lake
   - Conduct snow survey on Toolik Lake
   - Measure lake-ice parameters on Toolik Lake
2. NPRA – NPRA sites
   - L9811, snow survey on lake and on tundra (North edge), lake chemistry profile
   - L9817, snow survey on lake, snow survey on tundra, lake chemistry profile at standard location, check weather station operations, elevation surveys, new battery for camera station, get it in operation
   - R0066– Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile
   - R0061– Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile
   - Bills Creek – camera maintenance
   - Bills Creek Intersection – camera maintenance
   - L9822 – Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile

- M9925 – Snow survey on lake and on tundra, look for lake ice not frozen to bottom, lake chemistry, new batteries and memory card in camera, determine lake levels going into freeze-up, install marker stakes in view of camera
- M9913 – Snow surveys on lake and on tundra, lake chemistry profile, ice measurements
- R0079/M0020 – Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile
- M9910 - Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile
- Crea Creek Upper - Gulch snow, upland snow survey and snowmelt gage install, bead ice thickness, depth, talik depth, set channel sensors
- Crea Creek Middle - Gulch snow, upland snow survey and snowmelt gage install, bead ice thickness, depth, talik depth, set channel sensors
- Crea Creek Lower - Gulch snow, upland snow survey and snowmelt gage install, bead ice thickness, depth, talik depth, set channel sensors
- L9820 - Snow survey on lake and on tundra, look for lake ice not frozen to bottom, lake chemistry, determine lake levels going into freeze-up
- L9819 - Snow survey on lake and on tundra, look for lake ice not frozen to bottom, lake chemistry, new batteries and memory card in camera, determine lake levels going into freeze-up, install marker stakes in view of camera
- L9824 - Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile, determine lake levels going into freeze-up
- MC7916 - Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile
- L9312 - Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile, determine lake levels going into freeze-up, install marker stakes in view of camera
- L9322 - Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile, determine lake levels going into freeze-up, install marker stakes in view of camera
- L9321 – Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile
- L9323 - Snow survey on lake and on tundra, lake ice measurements, lake chemistry profile, determine lake levels going into freeze-up

PROCEDURES

ATN's standard snow course procedures include snow-depth measurements conducted in "L" shaped patterns on lake surfaces and/or tundra surfaces at predetermined locations according to ATN snow measurement methods (Derry et al. 2009). Snow-depth measurements were taken with a T-handle probe approximately every 3.3 ft (1 m) for 82 ft (25 m), then turning 90 degrees, and continuing for another 82 ft (25 m). Snow samples were also collected for density measurements with an Adirondack snow sampler. Five densities were collected at each location and averaged to establish a representative density.

At lakes and beaded streams, holes were drilled through the ice with an electric drill using a 5 cm (2 in) bit or 10 in diameter auger. Water depth (lake bottom to water surface), freeboard (water surface to top of ice), ice thickness (bottom of ice to top of ice), and snow depth (top of ice to top of snow, measured at the hole where snow was cleared to drill) were measured. Water depth was measured with a flexible tape fitted with a weight at the end. Freeboard and ice thickness were measured with a folding tape. Snow depth was measured with the same T-handle probe that was used for snow courses.

Water-quality parameters were obtained using a Hach RLDO and a Hach Rcond at multiple depths throughout the water column. The calibration of each parameter was checked before and after each day of sampling using the criteria in Table 1.

Table 1. Hach calibration quality control criteria.

Parameter	Standards used	Acceptable deviation from calibration standard value
pH	4.01, 10.01	± 0.2
Conductivity	3900 (µs/cm)	within 10%
100% DO	100 % saturated	within 10%
0% DO	0 % saturated solution	within 0.3 mg/L

SELECTED RESULTS

The March field effort continued snow-data collection for regional snow distribution analysis and lake ice thickness modeling. Snow-course measurements were conducted at thirty different locations during the March trip (Table 2). In addition, three snow depth transects were done across the stream channel at Crea Creek. Snow data collected for each of the sampling sites visited can be found in Appendix B.

Table 2. Snow depth, density, and snow water equivalent for sites sampled in March.

	Average Snow Depth		Minimum Snow Depth		Maximum Snow Depth		Standard Deviation		Average Density	Snow Water Equivalent	
	cm	in	cm	in	cm	in	cm	in	g/cm^3	cm	in
L9312 - Lake (Raft B)	18.3	7.2	8.0	3.1	41.0	16.1	7.0	2.7	0.34	6.3	2.5
L9312 - Tundra	46.6	18.3	20.0	7.9	78.0	30.7	12.2	4.8	0.30	13.8	5.4
L9321 - Lake	20.2	8.0	12.0	4.7	34.0	13.4	5.3	2.1	0.32	6.4	2.5
L9321 - Tundra	25.0	9.8	16.0	6.3	37.0	14.6	4.4	1.7	0.33	8.1	3.2
L9322 - Lake	21.5	8.5	14.0	5.5	30.0	11.8	4.2	1.7	0.34	7.3	2.9
L9322 - Tundra	38.4	15.1	29.0	11.4	50.0	19.7	5.7	2.3	0.28	10.7	4.2
L9323 - Lake	16.4	6.4	8.0	3.1	30.0	11.8	6.1	2.4	0.33	5.3	2.1
L9811 - Lake	34.0	13.4	22.0	8.7	48.0	18.9	7.0	2.8	0.33	11.2	4.4
L9811 - Tundra	34.9	13.7	20.0	7.9	62.0	24.4	9.9	3.9	0.23	8.1	3.2
L9817 - Lake	22.2	8.7	8.0	3.1	41.0	16.1	7.0	2.8	0.32	7.1	2.8
L9817 - Tundra	36.1	14.2	21.0	8.3	56.0	22.0	8.5	3.3	0.20	7.2	2.8
L9819 - Lake	25.3	9.9	14.0	5.5	46.0	18.1	8.3	3.3	0.33	8.4	3.3
L9819 - Tundra	45.9	18.1	29.0	11.4	69.0	27.2	10.7	4.2	0.25	11.6	4.5
L9822 - Lake	10.3	4.1	6.0	2.4	16.0	6.3	2.3	0.9	0.28	2.9	1.2
L9822 - Tundra	43.2	17.0	25.0	9.8	61.0	24.0	8.0	3.1	0.28	12.0	4.7
M0020 - Lake	15.4	6.1	9.0	3.5	22.0	8.7	3.3	1.3	0.28	4.3	1.7
M0020 - Tundra	41.3	16.3	16.0	6.3	67.0	26.4	11.6	4.6	0.24	10.0	3.9
M9910 - Lake	28.4	11.2	19.0	7.5	39.0	15.4	4.7	1.9	0.31	8.8	3.5
M9910 - Tundra	43.9	17.3	27.0	10.6	62.0	24.4	8.4	3.3	0.24	10.7	4.2
M9925- Lake	23.7	9.3	14.0	5.5	33.0	13.0	5.5	2.2	0.35	8.3	3.3
L9925 - Tundra	39.7	15.6	29.0	11.4	54.0	21.3	5.9	2.3	0.23	9.2	3.6
MC7916 - Lake	22.7	8.9	16.0	6.3	36.0	14.2	3.3	1.3	0.35	8.0	3.1
MC7916 - Tundra	47.9	18.9	36.0	14.2	59.0	23.2	6.2	2.4	0.28	13.2	5.2
R0061 - Lake	26.1	10.3	13.0	5.1	46.0	18.1	9.7	3.8	0.32	8.4	3.3
R0061 - Tundra	38.8	15.3	27.0	10.6	61.0	24.0	5.9	2.3	0.19	7.2	2.8
R0066 - Lake	25.6	10.1	14.0	5.5	39.0	15.4	5.6	2.2	0.28	7.2	2.8
R0066 - Tundra	48.4	19.1	30.0	11.8	81.0	31.9	9.0	3.5	0.27	12.9	5.1
SWE-DTLB1 - Tundra	42.0	16.5	24.0	9.4	54.0	21.3	5.3	2.1	0.31	12.9	5.1
SWE - 1 Tundra	44.0	17.3	26.0	10.2	58.0	22.8	6.2	2.4	0.27	11.8	4.7
Toolik - Lake	26.3	10.4	13.0	5.1	44.0	17.3	8.1	3.2	0.27	7.0	2.8
Tundra Average	41.1	16.2	25.0	9.8	60.6	23.9	7.9	3.1	0.26	10.6	4.2
Lake Average	22.7	8.9	13.0	5.1	36.0	14.2	5.8	2.3	0.31	7.2	2.8
Overall Average	31.8	12.5	18.8	7.4	48.5	19.1	6.8	2.7	0.29	8.9	3.5

Less snow accumulation was measured on lake surfaces compared to tundra surfaces by nearly half, 22.7 cm (8.9 in) on the lakes compared with 41.1 cm (16.2 in) on the tundra. Greater snow density was measured on lakes compared to tundra surfaces, 0.31 g/cm^3 compared to 0.26 g/cm^3. These results are expected and are in-line with data that has been collected over previous seasons. The increased surface roughness of tundra compared to lake ice tends to trap and keep a certain amount of snow starting with the first snow events of the season. Smoother lake surfaces, on the other hand, experience greater wind erosion of the snowpack. Increased densification of the snowpack on lake surfaces is due to greater susceptibility to wind compaction as well as

comparatively increased snow metamorphism, due to greater temperature (vapor) gradients, on tundra surfaces compared to the lake surface snowpack. The resulting snow water equivalent on tundra is an average 10.6 cm (4.2 in) with lake surfaces being a third less at an average of 7.2 cm (2.8 in). The greater density of snow on lakes helps make-up for receiving almost half the snow accumulation, but not entirely. The overall average of SWE is 8.9 cm (3.5 in).

At most lakes visited, ice thickness was measured at the lake center and in four directions (north, south, east, and west) around the lake. The average ice thickness of all the lakes sampled was 3.72 ft (1.13 m) with a standard deviation of 0.30 ft (0.09 m). There is approximately a one foot difference between the average thinnest (3.24 ft/1.0 m) and average thickest (4.29 ft/1.31 m) lake ice (Table 3). Water level and ice thickness data collected for each of the sampling sites visited can be found in Appendix C.

Table 3. Average ice thickness and standard deviation of ice thickness at lakes sampled. Lakes where only one ice thickness was measurement are in italics.

Location	Average Ice Thickness		Standard Deviation	
	(ft)	(m)	(ft)	(m)
L9811	3.93	1.20	0.56	0.17
L9817	3.47	1.06	0.30	0.09
L9819	3.92	1.19	0.29	0.09
L9822	4.29	1.31	0.11	0.03
M0022	3.42	1.04	0.44	0.14
M9910	3.32	1.01	0.35	0.11
MC7916	3.96	1.21	0.20	0.06
R0061	3.49	1.06	0.25	0.08
R0066	3.52	1.08	0.16	0.05
L9322	*4.04*	*1.23*	--	--
L9323	*4.20*	*1.28*	--	--
L9820	*3.58*	*1.09*	--	--
L9824	*3.24*	*0.99*	--	--

L9811, located near Nuiqsut in NPR-A, was the shallowest of the sites visited (6.0 ft) and had the lowest recorded median DO concentration (average 1.72 mg/L) and the second highest median conductivity reading (average 587.5 µS/cm) of all of the sites. L9817, also located near

Nuiqsut in NPRA, was of average depth (7.0 ft) with the fourth lowest DO concentration (4.03 mg/L) and the highest conductivity reading (average 913.0 µS/cm) of all of the sites. L9323, located near the Alpine facility, was the deepest sampling location (11.0 ft) with the fourth highest DO concentration (10.10 mg/L) and the second lowest median conductivity reading recorded (195.0 µS/cm). L9312, also located near the Alpine facility, was relatively deep (10.0 ft) and had the highest median DO concentration (13.54 mg/L) and the third lowest conductivity measurement recorded (213.0 µS/cm) of all the sites. Water depth, mean DO concentration, and median conductivity for sites samples are presented in Table 4. Additional data and water quality field forms can be found in Appendix A.

Table 4. Water depth, median dissolved oxygen and median conductivity.

Location	Water Depth		Median DO Concentration	Median Actual Conductivity
	ft	m	mg/l	mS/cm
L9312	10.0	3.0	13.54	213.0
L9321	10.0	3.0	10.72	229.5
L9322	9.0	2.7	11.92	229.5
L9323	11.0	3.4	10.10	195.0
L9811-Center	6.0	1.8	1.43	624.0
L9811: Mid-point	6.0	1.8	2.00	551.0
L9817	8.0	2.4	3.88	909.0
L9817: Mid-point	6.0	1.8	4.18	917.0
L9819: Mid-point	6.3	1.9	5.99	442.0
L9822	8.0	2.4	7.84	na
L9824	9.0	2.7	1.87	178.5
MC7916: Mid-point	7.0	2.1	7.85	325.0
R0061: Mid-point	6.5	2.0	7.04	425.5
R0066: Mid-point	10.0	3.0	3.77	263.0

Figure 2 shows the relationship between dissolved oxygen concentrations and depth at sampled sites, while Figure 3 shows the relationship between conductivity and dissolved oxygen concentrations.

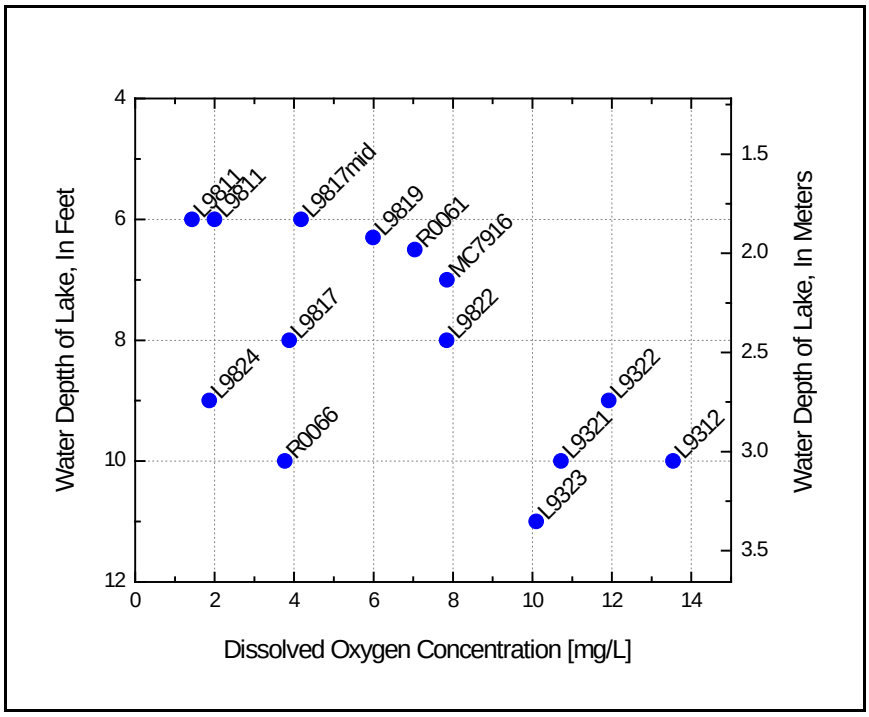

Figure 2. Plot of water depth and dissolved oxygen concentrations at sampled sites.

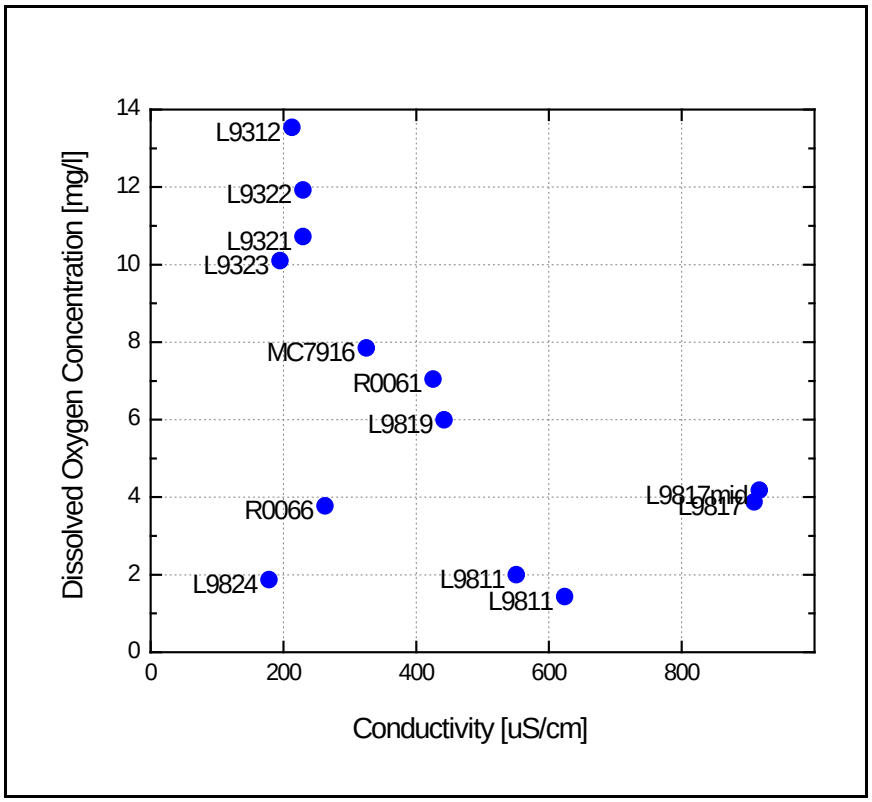

Figure 3. Plot of dissolved oxygen and conductivity concentrations at sampled sites.

SUMMARY

The March 2011 field trip was a collaborative effort which provided data on snow depth and density, water elevation, water depth, freeboard, ice thickness, DO, conductivity, and water temperature. Station maintenance was conducted on the L9817 meteorological station and the L9817 camera station was made operational and is currently reporting images. At a number of sites, non-telemetry cameras were visited where images were downloaded and batteries were replaced. The collection of snow and lake information related to Arctic transportation networks will help the development of regulatory and user management tools, forecast modeling tools, and optimum field sampling methods. These tools will help manage increasing resource development and variation of natural conditions in extreme Arctic climates.

REFERENCES

Alaska Department of Natural Resources. 2009. Winter Off-road Travel Conditions Monitoring Sampling Protocol. Alaska Department of Natural Resources, Division of Mining Land and Water. 4 pages.

Bader, H.R. 2004. Tundra Travel Research Project: Validation Study and Management Recommendations. Betula Consulting. 20 pages.

Derry, J., Lilly, M., Schultz, G., Cherry, J., 2009. Snow Data Collection Methods Related to Tundra Travel, North Slope, Alaska. December 2009, Geo-Watersheds Scientific, Report GWS.TR.09.05, Fairbanks, Alaska, 12 pp (plus appendices).

Derry, J., Toniolo, H., Whitman M., Arp C., and Lilly, M. 2011. A Workplan for Snow Data Collection, Lake and Stream Observations and Meteorological Station Maintenance: March 2011. Geo-Watersheds Scientific, Fairbanks, Alaska. 17 pages.

APPENDIX A. WATER QUALITY FORMS

The following forms report the water quality information obtained during field sampling.

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: Crea Creek- Large 3

Sample Purpose: **Lake Water Quality** Date: 3/15/11 Time: 14:35

FIELD MEASUREMENTS

GPS Coord. Northing: N70 16.360 Easting: W151 20.472 Datum: NAD83

Measurements By: M. Whitman Time: 14:35

Water Depth (ft): 7.55 Ice Thickness (ft): 2.79

Freeboard (ft): nr Snow Depth (ft): nr

Elev. (BPMSL +/- .02): na Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342542015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	3	4	5	6	7					
Temp (°C):	0.4	0.2	0.1	0.1	0.0					
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	601	626	641	644	675					
RDO (ppm): (mg/L)	0.35	0.22	0.16	0.13	0.10					
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9312

Sample Purpose: **Lake Water Quality** Date: 3/17/11 Time: nr

FIELD MEASUREMENTS

GPS Coord. Northing: N 70.33325 Easting: W 150.94864 Datum: NAD83

Measurements By: C. Arp Time: na

Water Depth (ft): 10.47 Ice Thickness (ft): nr

Freeboard (ft): nr Snow Depth (ft): nr

Elev. (BPMSL +/- .02): na Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342542015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	7	8	9	10			
Temp (°C):	1.5	0.9	1.1	1.4	1.8	2.3	2.4			
RDO (ppm): (mg/L)	13.54	13.95	13.65	13.59	12.87	8.89	4.10			
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Conductivity (µS/cm):	134	139	139	137	136	135	149			
Temp (°C):	2.7	1.2	1.1	1.3	1.6	1.9	2.2			
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks: 2 temp readings, one from DO meter and the other from conductivity meter

Field-Form Filled Out By: Deana Piedra Date: 4/7/11

QAQC Check By: Kristie Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9321

Sample Purpose: **Lake Water Quality** Date: 3/17/11 Time:

FIELD MEASUREMENTS

GPS Coord. Northing: nr Easting: nr Datum: na

Measurements By: Arp Time: nr

Water Depth (ft): 9.78 Ice Thickness (ft): nr

Freeboard (ft): nr Snow Depth (ft): nr

Elev. (BPMSL +/- .02): nr Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	7	8	9	10			
Temp (°C):	4.9	1.3	1.3	1.5	1.6	1.7	2.0			
RDO (ppm): (mg/L)	10.16	11.98	12.03	11.54	10.72	7.23	0.18			
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	196	213	217	215	213	209	295			
Temp (°C):	5.3	2.2	1.5	1.5	1.5	1.6	1.7			
Turbidity (NTU):										
ORP										

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

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/7/11

QAQC Check By: Kristie Hilton Date: 4/8/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9322

Sample Purpose: **Lake Water Quality** Date: 3/17/11 Time: nr

FIELD MEASUREMENTS

GPS Coord. Northing: nr Easting: nr Datum: na

Measurements By: Lilly Time: nr

Water Depth (ft): 10.6 Ice Thickness (ft): 4.04

Freeboard (ft): nr Snow Depth (ft): nr

Elev. (BPMSL +/- .02): nr Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	7	8	9				
Temp (°C):	2.5	1.3	1.2	1.4	1.4	2.1				
RDO (ppm): (mg/L)	11.83	12.46	12.26	11.91	11.93	7.14				
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	219	232	230	231	229	226				
Temp (°C):	3.4	1.1	1.1	1.1	1.1	1.1				
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/7/11

QAQC Check By: Kristie Hilton Date: 4/8/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9323

Sample Purpose: **Lake Water Quality** Date: 3/17/11 Time: nr

FIELD MEASUREMENTS

GPS Coord. Northing:	nr	Easting:	nr	Datum:	na		
Measurements By:	Arp	Time:	na				
Water Depth (ft):	12.4	Ice Thickness (ft):	4.20				
Freeboard (ft):	4	Snow Depth (ft):	nr				
Elev. (BPMSL +/- .02):	nr	Survey By:	na	Date:	na	Time:	na
Water Sampling By:	na	Sample Depths BWS (ft):	na	Date:	na	Time:	na

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	7	8	9	10	11		
Temp (°C):	0.3	0.6	0.8	0.9	1.1	1.8	2.1	2.3		
RDO (ppm): (mg/L)	10.60	10.24	10.11	10.10	10.09	7.08	4.91	2.34		
Barometeric (mmHg):										
Pressure (kPa):										
Conductivity (µS/cm):	179	185	189	188	201	203	202	202		
Temp (°C):	3.4	2.9	2.1	1.8	1.9	2.2	1.5	1.2		
pH:										
Turbidity (NTU):										
ORP										

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

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks: 2 temp readings, one from DO meter and the other from conductivity meter

Field-Form Filled Out By: Deana Piedra Date: 4/7/11

QAQC Check By: Kristie Hilton Date: 4/8/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9811-CT

Sample Purpose: **Lake Water Quality** Date: 3/14/11 Time: 11:45

FIELD MEASUREMENTS

GPS Coord. Northing: N70 12.4182 Easting: W151 10.4952 Datum: NAD83

Measurements By: M. Whitman Time: 11:45

Water Depth (ft): 6.36 Ice Thickness (ft): 3.90

Freeboard (ft): 0.03 Snow Depth (ft): nr

Elev. (BPMSL +/- .02): na Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	110552592009	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6							
Temp (°C):										
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	616	624	627							
RDO (ppm): (mg/L)	1.55	1.43	0.33							
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9811-Mid

Sample Purpose: **Lake Water Quality** Date: 3/14/11 Time: 10:52

FIELD MEASUREMENTS

GPS Coord. Northing:	N70 12.474	Easting:	W151 10.125	Datum:	NAD83
Measurements By:	M. Whitman	Time:	10:52		
Water Depth (ft):	6.4	Ice Thickness (ft):	4.23		
Freeboard (ft):	nr	Snow Depth (ft):	nr		
Elev. (BPMSL +/- .02):	na	Survey By:	na	Date: na	Time: na
Water Sampling By:	na	Sample Depths BWS (ft):	na	Date: na	Time: na

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6							
Temp (°C):	0.7	1.3	1.4							
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	603	551	527							
RDO (ppm): (mg/L)	2.23	2.00	0.37							
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID:	**Arctic Transportation Networks**		Site Location/Lake ID:	L9817	
Sample Purpose:	**Lake Water Quality**		Date: 3/14/11	Time:	13:17

FIELD MEASUREMENTS

GPS Coord. Northing:	N70 14.070	Easting:	W151 20.121	Datum:	NAD83		
Measurements By:	M. Whitman	Time:	13:17				
Water Depth (ft):	7.97	Ice Thickness (ft):	3.71				
Freeboard (ft):	0	Snow Depth (ft):	nr				
Elev. (BPMSL +/- .02):	na	Survey By:	na	Date:	na	Time:	na
Water Sampling By:	na	Sample Depths BWS (ft):	na	Date:	na	Time:	na

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	7	8					
Temp (°C):	0.4	0.9	0.9	1.1	1.8					
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	877	896	909	912	922					
RDO (ppm): (mg/L)	3.86	3.88	3.95	3.88	0.65					
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By:	Deana Piedra	Date:	4/1/11
QAQC Check By:	K. Hilton	Date:	4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9817-Mid (ARP)

Sample Purpose: **Lake Water Quality** Date: 3/14/11 Time: 13:40

FIELD MEASUREMENTS

GPS Coord. Northing: N70 14.032 Easting: W151 20.259 Datum: NAD83

Measurements By: M. Whitman Time: nr

Water Depth (ft): 6.27 Ice Thickness (ft): 3.74

Freeboard (ft): 0.03 Snow Depth (ft): nr

Elev. (BPMSL +/- .02): na Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6							
Temp (°C):	0.2	0.3	0.5							
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	914.0	918.0	917.0							
RDO (ppm): (mg/L)	4.5	4.2	4.0							
Turbidity (NTU):										
ORP										

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

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9819-Mid

Sample Purpose: **Lake Water Quality** Date: 3/15/11 Time: 12:29

FIELD MEASUREMENTS

GPS Coord. Northing: N70 16.170 Easting: W151 21.363 Datum: NAD83

Measurements By: M. Whitman Time: nr

Water Depth (ft): 6.27 Ice Thickness (ft): 4.00

Freeboard (ft): 0 Snow Depth (ft): nr

Elev. (BPMSL +/- .02): na Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342542015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	6.25						
Temp (°C):	0.1	0.2	0.4	0.7						
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	417	432	452	472						
RDO (ppm): (mg/L)	5.86	6.11	6.75	0.16						
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9822

Sample Purpose: **Lake Water Quality** Date: 3/17/11 Time:

FIELD MEASUREMENTS

GPS Coord. Northing: N70 15.200 Easting: W151 17.265 Datum: NAD83

Measurements By: Lilly Time: nr

Water Depth (ft): 9 Ice Thickness (ft): 4.28

Freeboard (ft): 0.3 Snow Depth (ft): 0.35

Elev. (BPMSL +/- .02): nr Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	5	6	7	8						
Temp (°C):	0.40	-	1.30	1.60						
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	nd	nd	nd	nd						
RDO (ppm): (mg/L)	8.50	8.35	7.33	0.70						
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: Kristie Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: L9824

Sample Purpose: **Lake Water Quality** Date: 3/17/11 Time: nr

FIELD MEASUREMENTS

GPS Coord. Northing: N70 17.054 Easting: W 51 15.962 Datum: NAD83

Measurements By: Lilly Time: nr

Water Depth (ft): 9.42 Ice Thickness (ft): 3.24

Freeboard (ft): 0.13 Snow Depth (ft): 0.49

Elev. (BPMSL +/- .02): nr Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	7	8	9				
Temp (°C):	2.7	1.5	1.2	1.3	1.5	1.8				
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	172	176	178	179	188	279				
RDO (ppm): (mg/L)	3.49	3.09	2.16	1.58	0.87	0.42				
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: Kristie Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: MC7916-Mid

Sample Purpose: **Lake Water Quality** Date: 3/15/11 Time: 10:56

FIELD MEASUREMENTS

GPS Coord. Northing: N70 17.938 Easting: W151 27.767 Datum: NAD83

Measurements By: M. Whitman Time: 10:56

Water Depth (ft): 7.51 Ice Thickness (ft): 4.13

Freeboard (ft): 0.39 Snow Depth (ft): nr

Elev. (BPMSL +/- .02): na Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342542015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	7						
Temp (°C):	0.5	0.9	0.9	1.6						
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	317	322	328	332						
RDO (ppm): (mg/L)	7.86	7.84	8.19	4.27						
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: R0061-Mid

Sample Purpose: **Lake Water Quality** Date: 3/14/11 Time: 16:48

FIELD MEASUREMENTS

GPS Coord. Northing: N70 10.244 Easting: W151 47.433 Datum: NAD83

Measurements By: M. Whitman Time: 16:48

Water Depth (ft): 6.43 Ice Thickness (ft): 3.28

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

Elev. (BPMSL +/- .02): na Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	6.5						
Temp (°C):	0.3	0.8	1.7	1.8						
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	424	423	427	438						
RDO (ppm): (mg/L)	7.83	7.80	6.28	5.61						
Turbidity (NTU):										
ORP										

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

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: R0066-Mid

Sample Purpose: **Lake Water Quality** Date: 3/14/11 Time: 15:46

FIELD MEASUREMENTS

GPS Coord. Northing: N70 08.730 Easting: W151 45.684 Datum: NAD83

Measurements By: M. Whitman Time: 15:46

Water Depth (ft): 8.79 Ice Thickness (ft): 3.28

Freeboard (ft): 0.03 Snow Depth (ft): nr

Elev. (BPMSL +/- .02): na Survey By: na Date: na Time: na

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

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen, Temp	BLM	Hach RLDO	100342592015	Pass	Pass
Conductivity, Temp	BLM	Hach Rcond	100352583019	Pass	Pass

Parameters	**Field Measurements**									
Time:										
Depth BWS (ft):	4	5	6	7	8	9	10			
Temp (°C):	0.6	1.1	1.6	1.9	2.2	2.6	2.9			
pH:										
Barometeric (mmHg):										
Pressure (kPa):										
Specific Conductivity (µS/cm):	247	251	255	263	269	370	365			
RDO (ppm): (mg/L)	7.83	7.32	5.64	3.77	2.24	0.45	0.12			
Turbidity (NTU):										
ORP										

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

Probe:

Depth (ft)					
Temp (°C)					
pH					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

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

Remarks:

Field-Form Filled Out By: Deana Piedra Date: 4/1/11

QAQC Check By: K. Hilton Date: 4/7/11

APPENDIX B. SNOW SURVEY FORMS

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

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9312 - Lake (Raft B)**
Survey Purpose: **Determine snow depth, SWE** Date: 3/17/2011 Time: nr

Location Description:	On lake surface near L9312 "Raft B: location.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, breeze
Latitude:	N 70° 20.008'	Longitude:	W 150° 57.083'	Datum:	NAD 83
Elevation:	7 ft	Elevation Datum:	BPMSL	Reference Markers:	None, Ice surface
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio Toniolo	

Snow Course Depths (cm)

	1	2	3	4	5
1	20.0	18.0	10.0	14.0	15.0
2	18.0	19.0	10.0	18.0	18.0
3	15.0	19.0	12.0	22.0	19.0
4	17.0	20.0	13.0	28.0	23.0
5	20.0	20.0	11.0	21.0	24.0
6	18.0	16.0	13.0	41.0	21.0
7	18.0	17.0	13.0	31.0	20.0
8	41.0	17.0	9.0	27.0	15.0
9	25.0	10.0	10.0	23.0	12.0
10	22.0	8.0	15.0	18.0	10.0

(cm)
Average snow depth = **18.3**
Maximum snow depth = 41.0
Minimum snow depth = 8.0
Standard variation = 7.0

(inches)
Average snow depth = **7.2**
Maximum snow depth = **16.1**
Minimum snow depth = **3.1**
Standard variation = **2.7**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
F15	16	189.6	571.2	0.33	
F14	26	322.5	928.2	0.35	
F12	26	321.5	928.2	0.35	
F11	20	250.8	714.0	0.35	
T4	20	242.2	714.0	0.34	

Average Density = **0.343**
Average Snow Water Equivalent (SWE) = **6.3** cm H2O
Average Snow Water Equivalent = **2.47** inches H2O
Average Snow Water Equivalent = **0.21** feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**L9312 - Tundra**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/17/2011	Time: nr

Location Description:	On tundra on staked course, adjacent and north of L9312 weather station.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold , Breeze
Latitude:	N 70° 19.995'	Longitude:	W 150° 56.918'	Datum:	NAD 83
Elevation:	7 ft	Elevation Datum:	BPMSL	Reference Markers:	Orange stakes
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Haggland	Other:	
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio Toniolo	

Snow Course Depths (cm)

	1	2	3	4	5
1	43.0	46.0	28.0	40.0	53.0
2	44.0	53.0	42.0	52.0	70.0
3	39.0	53.0	55.0	56.0	71.0
4	39.0	47.0	46.0	58.0	70.0
5	41.0	41.0	43.0	58.0	57.0
6	68.0	36.0	33.0	78.0	60.0
7	45.0	32.0	34.0	57.0	49.0
8	41.0	47.0	34.0	44.0	37.0
9	46.0	20.0	30.0	41.0	50.0
10	45.0	34.0	31.0	36.0	55.0

	(cm)
Average snow depth =	**46.6**
Maximum snow depth =	78.0
Minimum snow depth =	20.0
Standard variation =	12.2

	(inches)
Average snow depth =	**18.3**
Maximum snow depth =	**30.7**
Minimum snow depth =	**7.9**
Standard variation =	**4.8**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T20	36	362.9	1285.2	0.28	
B40	38	369.2	1356.6	0.27	
2E	16	131.0	571.2	0.23	2
T5	20	205.0	714.0	0.29	
11C	56	823.7	1999.2	0.41	

Average Density =	**0.297**	
Average Snow Water Equivalent (SWE) =	**13.8**	cm H2O
Average Snow Water Equivalent =	**5.44**	inches H2O
Average Snow Water Equivalent =	**0.45**	feet H2O

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

Data entered by: D.Piedra Date: 3/22/2011
Data QA/QC by: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9321 - Lake Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/17/2011 Time: 11:45

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 20.561'	Longitude:	W 151° 01.611'	Datum:	NAD 83
Elevation:	23 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	21.0	23.0	18.0	16.0	25.0
2	21.0	24.0	18.0	18.0	26.0
3	22.0	21.0	16.0	16.0	22.0
4	20.0	19.0	15.0	12.0	28.0
5	19.0	18.0	16.0	14.0	33.0
6	18.0	20.0	21.0	14.0	29.0
7	20.0	17.0	17.0	14.0	34.0
8	18.0	16.0	17.0	22.0	19.0
9	18.0	16.0	19.0	33.0	20.0
10	20.0	15.0	15.0	30.0	29.0

(cm)
Average snow depth = **20.2**
Maximum snow depth = 34.0
Minimum snow depth = 12.0
Standard variation = 5.3

(inches)
Average snow depth = **8.0**
Maximum snow depth = **13.4**
Minimum snow depth = **4.7**
Standard variation = **2.1**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T1	22	253.2	785.4	0.32	
P3	23	293.1	821.1	0.36	
T7	14	153.1	499.8	0.31	
B41	14	157.6	499.8	0.32	
P4	14	140.6	499.8	0.28	

Average Density = **0.316**
Average Snow Water Equivalent (SWE) = **6.4** cm H2O
Average Snow Water Equivalent = **2.52** inches H2O
Average Snow Water Equivalent = **0.21** feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/12/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9321 - Tundra**
Survey Purpose: **Determine snow depth, SWE** Date: 3/17/2011 Time: nr

Location Description:	On tundra near lake.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Dark, Breeze
Latitude:	N 70° 20.441'	Longitude:	W 151° 01.938'	Datum:	NAD 83
Elevation:	7 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	26.0	25.0	25.0	23.0	24.0
2	27.0	27.0	20.0	27.0	21.0
3	30.0	27.0	29.0	30.0	23.0
4	29.0	27.0	16.0	24.0	25.0
5	29.0	24.0	23.0	22.0	24.0
6	37.0	23.0	21.0	23.0	26.0
7	36.0	23.0	20.0	21.0	23.0
8	34.0	24.0	21.0	23.0	21.0
9	33.0	23.0	22.0	23.0	20.0
10	33.0	25.0	23.0	25.0	19.0

(cm)
Average snow depth = **25.0**
Maximum snow depth = 37.0
Minimum snow depth = 16.0
Standard variation = 4.4

(inches)
Average snow depth = **9.8**
Maximum snow depth = **14.6**
Minimum snow depth = **6.3**
Standard variation = **1.7**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T3	28	289.6	999.6	0.29	
11B	25	279.9	892.5	0.31	
C1	28	410.4	999.6	0.41	
Z2	24	277.3	856.8	0.32	
11A	22	226.5	785.4	0.29	

Average Density = **0.325**
Average Snow Water Equivalent (SWE) = **8.1** cm H2O
Average Snow Water Equivalent = **3.20** inches H2O
Average Snow Water Equivalent = **0.27** feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/14/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**L9322 - Lake**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/17/2011	Time: nr

Location Description:	On center of lake.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Dark, Breeze
Latitude:	N 70° 20.269'	Longitude:	W 151° 01.913'	Datum:	NAD 83
Elevation:	40 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	23.0	17.0	25.0	22.0	29.0
2	30.0	22.0	28.0	24.0	23.0
3	27.0	20.0	23.0	26.0	19.0
4	26.0	21.0	22.0	27.0	18.0
5	24.0	24.0	20.0	29.0	17.0
6	21.0	18.0	21.0	27.0	15.0
7	20.0	21.0	21.0	21.0	14.0
8	16.0	21.0	21.0	23.0	14.0
9	17.0	22.0	20.0	23.0	14.0
10	15.0	27.0	23.0	21.0	15.0

	(cm)
Average snow depth =	**21.5**
Maximum snow depth =	30.0
Minimum snow depth =	14.0
Standard variation =	4.2

	(inches)
Average snow depth =	**8.5**
Maximum snow depth =	**11.8**
Minimum snow depth =	**5.5**
Standard variation =	**1.7**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
Z3	26	339.9	928.2	0.37	
2B	25	281.8	892.5	0.32	
T2	23	262.6	821.1	0.32	
2A	23	287.3	821.1	0.35	
T8	21	256.4	749.7	0.34	

Average Density =	**0.339**	
Average Snow Water Equivalent (SWE) =	**7.3**	cm H2O
Average Snow Water Equivalent =	**2.87**	inches H2O
Average Snow Water Equivalent =	**0.24**	feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/14/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9322 - Tundra**
Survey Purpose: **Determine snow depth, SWE** Date: 3/17/2011 Time: nr

Location Description:	On tundra near lake.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Breeze
Latitude:	N 70° 20.375'	Longitude:	W 151° 01.572'	Datum:	NAD 83
Elevation:	26 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	37.0	35.0	43.0	46.0	40.0
2	39.0	42.0	41.0	48.0	37.0
3	33.0	36.0	45.0	36.0	32.0
4	36.0	40.0	47.0	29.0	35.0
5	47.0	48.0	41.0	33.0	33.0
6	46.0	35.0	43.0	32.0	37.0
7	38.0	46.0	39.0	35.0	33.0
8	39.0	46.0	49.0	29.0	35.0
9	35.0	50.0	33.0	31.0	32.0
10	36.0	42.0	32.0	35.0	35.0

(cm)
Average snow depth = **38.4**
Maximum snow depth = 50.0
Minimum snow depth = 29.0
Standard variation = 5.7

(inches)
Average snow depth = **15.1**
Maximum snow depth = **19.7**
Minimum snow depth = **11.4**
Standard variation = **2.3**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T15	33	364.5	1178.1	0.31	
B44	34	379.9	1213.8	0.31	
F13	24	245.6	856.8	0.29	
T6	30	234.1	1071.0	0.22	
T16	35	322.4	1249.5	0.26	

Average Density = **0.277**
Average Snow Water Equivalent (SWE) = **10.7** cm H2O
Average Snow Water Equivalent = **4.19** inches H2O
Average Snow Water Equivalent = **0.35** feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/14/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9323 - Lake Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/17/2011 Time: nr

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70 17.915	Longitude:	W 151° 00.326'	Datum:	NAD 83
Elevation:	19 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	15.0	20.0	9.0	10.0	23.0
2	17.0	19.0	9.0	8.0	23.0
3	14.0	13.0	11.0	11.0	22.0
4	15.0	11.0	9.0	10.0	21.0
5	15.0	14.0	12.0	20.0	22.0
6	14.0	14.0	12.0	19.0	24.0
7	12.0	13.0	13.0	22.0	28.0
8	13.0	12.0	11.0	23.0	28.0
9	15.0	12.0	9.0	26.0	30.0
10	18.0	10.0	15.0	25.0	28.0

(cm)
Average snow depth = **16.4**
Maximum snow depth = 30.0
Minimum snow depth = 8.0
Standard variation = 6.1

(inches)
Average snow depth = **6.4**
Maximum snow depth = **11.8**
Minimum snow depth = **3.1**
Standard variation = **2.4**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T18	13	154.1	464.1	0.33	
11D	14	152.1	499.8	0.30	
P2	14	168.5	499.8	0.34	
B42	14	184.3	499.8	0.37	
11E	17	174.0	606.9	0.29	

Average Density = **0.326**
Average Snow Water Equivalent (SWE) = **5.3** cm H2O
Average Snow Water Equivalent = **2.10** inches H2O
Average Snow Water Equivalent = **0.18** feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/19/2011

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9811 - Lake Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/14/2011 Time: nr

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 12.474'	Longitude:	W 151° 10.125'	Datum:	NAD 83
Elevation:	79 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	26.0	42.0	26.0	32.0	40.0
2	27.0	44.0	23.0	31.0	36.0
3	28.0	46.0	22.0	36.0	42.0
4	33.0	44.0	23.0	37.0	38.0
5	29.0	36.0	22.0	31.0	34.0
6	36.0	29.0	26.0	34.0	33.0
7	44.0	31.0	26.0	33.0	31.0
8	45.0	31.0	25.0	38.0	39.0
9	44.0	33.0	28.0	39.0	43.0
10	43.0	27.0	34.0	48.0	34.0

(cm)
Average snow depth = **34.0**
Maximum snow depth = 48.0
Minimum snow depth = 22.0
Standard variation = 7.0

(inches)
Average snow depth = **13.4**
Maximum snow depth = **18.9**
Minimum snow depth = **8.7**
Standard variation = **2.8**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
C1	24	323.0	856.8	0.38	
C5	17	196.0	606.9	0.32	
C4	19	210.5	678.3	0.31	
C2	28	301.4	999.6	0.30	
na	na	na	na	na	

Average Density = **0.328**
Average Snow Water Equivalent (SWE) = **11.2** cm H2O
Average Snow Water Equivalent = **4.40** inches H2O
Average Snow Water Equivalent = **0.37** feet H2O

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

Data entered by: Deana Pie Date: 4/1/2011
Data QA/QC by: J Derry Date: 4/7/11

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9811 - Tundra**

Survey Purpose: **Determine snow depth, SWE** Date: 3/14/2011 Time:

Location Description:	On tundra near lake.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Dark, Breeze
Latitude:	N 70° 13.151'	Longitude:	W 151° 9.296'	Datum:	NAD 83
Elevation:	85 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	23.0	37.0	31.0	29.0	35.0
2	20.0	27.0	21.0	24.0	24.0
3	21.0	35.0	22.0	41.0	28.0
4	21.0	30.0	32.0	46.0	37.0
5	26.0	33.0	33.0	46.0	38.0
6	40.0	29.0	37.0	46.0	48.0
7	35.0	31.0	42.0	37.0	52.0
8	32.0	48.0	32.0	41.0	61.0
9	29.0	32.0	29.0	33.0	62.0
10	34.0	39.0	33.0	28.0	55.0

(cm)

Average snow depth = **34.9**

Maximum snow depth = 62.0

Minimum snow depth = 20.0

Standard variation = 9.9

(inches)

Average snow depth = **13.7**

Maximum snow depth = **24.4**

Minimum snow depth = **7.9**

Standard variation = **3.9**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T1A	28	252.7	999.6	0.25	
T1B	46	365.3	1642.2	0.22	
T1C	35	281.3	1249.5	0.23	
T1D	34	270.1	1213.8	0.22	
T1E	26	216.5	928.2	0.23	

Average Density = **0.231**

Average Snow Water Equivalent (SWE) = **8.1** cm H2O

Average Snow Water Equivalent = **3.18** inches H2O

Average Snow Water Equivalent = **0.26** feet H2O

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

Data entered by: DP Date: 3/21/11

Data QA/QC by: J Derry Date: 4/12/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9817 - Lake Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/12/2011 Time: nr

Location Description:	Conducted on lake. L-shaped, 25 m by 25 m. Measurments took every 1 meter.				
Survey objective:	Determine snow depth and density for application to lake recharge studies and tundra travel management.			Weather Observations:	Cold. Breeze
Latitude:	N 70° 14.032'	Longitude:	W 151° 20.411'	Datum:	NAD83
Elevation:	Approximately 10 ft	Elevation Datum:	NAD 83	Reference Markers:	none
Drainage Basin:	Lake L9817	Slope Direction:	Flat	Vegetation Type:	none
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio Toniolo	

Snow Course Depths (cm)

	1	2	3	4	5
1	28.0	22.0	34.0	20.0	28.0
2	29.0	25.0	29.0	18.0	24.0
3	26.0	26.0	26.0	18.0	14.0
4	27.0	29.0	22.0	18.0	13.0
5	22.0	31.0	23.0	20.0	14.0
6	25.0	34.0	20.0	20.0	12.0
7	27.0	36.0	19.0	16.0	14.0
8	25.0	41.0	17.0	15.0	13.0
9	26.0	29.0	16.0	16.0	11.0
10	23.0	26.0	16.0	20.0	8.0

(cm)
Average snow depth = **22.2**
Maximum snow depth = 41.0
Minimum snow depth = 8.0
Standard variation = 7.0

(inches)
Average snow depth = **8.7**
Maximum snow depth = **16.1**
Minimum snow depth = **3.1**
Standard variation = **2.8**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T7	14	160.0	499.8	0.32	
T10	24	263.9	856.8	0.31	
T9	20	226.4	714.0	0.32	
T8	20	235.1	714.0	0.33	
T6	40	462.6	1428.0	0.32	

Average Density = **0.320**
Average Snow Water Equivalent (SWE) = **7.1** cm H2O
Average Snow Water Equivalent = **2.80** inches H2O
Average Snow Water Equivalent = **0.23** feet H2O

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

Data entered by: Deana Piedr Date: 4/12/2011
Data QA/QC by: Kristie Hilton Date: 4/12/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9817 - Tundra Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/12/2011 Time: nr

Location Description:	At unmarked snow course site near camera station.				
Survey objective:	Determine snow depth and density for application to lake recharge studies and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 14.046'	Longitude:	W 151° 19.912'	Datum:	NAD 83
Elevation:	Approximately 10 ft	Elevation Datum:	NGVD29	Reference Markers:	None
Drainage Basin:	Lake L9817	Slope Direction:	Flat	Vegetation Type:	Tussock Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio Toniolo	

Snow Course Depths (cm)

	1	2	3	4	5
1	40.0	41.0	35.0	32.0	44.0
2	55.0	41.0	35.0	27.0	28.0
3	56.0	44.0	34.0	45.0	21.0
4	55.0	45.0	23.0	35.0	32.0
5	46.0	42.0	21.0	45.0	35.0
6	42.0	37.0	37.0	34.0	37.0
7	41.0	29.0	30.0	32.0	27.0
8	43.0	28.0	37.0	28.0	27.0
9	45.0	28.0	38.0	35.0	27.0
10	40.0	27.0	32.0	42.0	25.0

(cm)
Average snow depth = **36.1**
Maximum snow depth = 56.0
Minimum snow depth = 21.0
Standard variation = 8.5

(inches)
Average snow depth = **14.2**
Maximum snow depth = **22.0**
Minimum snow depth = **8.3**
Standard variation = **3.3**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T1	45	448.9	1606.5	0.28	
T2	26	163.0	928.2	0.18	
T3	20	94.6	714.0	0.13	
T4	30	204.9	1071.0	0.19	
T5	30	229.0	1071.0	0.21	

Average Density = **0.199**
Average Snow Water Equivalent (SWE) = **7.2** cm H2O
Average Snow Water Equivalent = **2.82** inches H2O
Average Snow Water Equivalent = **0.24** feet H2O

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

Data entered by: Deana Pieda Date: 4/12/2011
Data QA/QC by: Kristie Hilton Date: 4/12/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**L9819 - Lake Surface**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/15/2011	Time: nr

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 16.170'	Longitude:	W 151° 21.363'	Datum:	NAD 83
Elevation:	60 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	14.0	22.0	21.0	18.0	36.0
2	14.0	22.0	18.0	22.0	38.0
3	14.0	21.0	21.0	22.0	46.0
4	17.0	19.0	24.0	24.0	42.0
5	23.0	20.0	22.0	26.0	44.0
6	23.0	16.0	24.0	27.0	42.0
7	27.0	19.0	28.0	31.0	35.0
8	26.0	20.0	18.0	37.0	32.0
9	26.0	21.0	17.0	37.0	28.0
10	26.0	21.0	16.0	37.0	19.0

	(cm)
Average snow depth =	**25.3**
Maximum snow depth =	46.0
Minimum snow depth =	14.0
Standard variation =	8.3

	(inches)
Average snow depth =	**9.9**
Maximum snow depth =	**18.1**
Minimum snow depth =	**5.5**
Standard variation =	**3.3**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
C1	15	190.4	535.5	0.36	
2B	16	190.3	571.2	0.33	
11A	12	141.8	428.4	0.33	
T5	14	165.7	499.8	0.33	
P1	12	137.5	428.4	0.32	

Average Density =	**0.334**	
Average Snow Water Equivalent (SWE) =	**8.4**	cm H2O
Average Snow Water Equivalent =	**3.33**	inches H2O
Average Snow Water Equivalent =	**0.28**	feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/12/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**L9819 - Tundra**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/15/2011	Time: 9:00

Location Description:	On tundra near lake				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Dark, Breeze
Latitude:	N 70° 15.764'	Longitude:	W 151° 22.318'	Datum:	NAD 83
Elevation:	70 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	53.0	35.0	29.0	51.0	32.0
2	51.0	34.0	41.0	57.0	29.0
3	52.0	36.0	30.0	52.0	35.0
4	52.0	40.0	32.0	52.0	52.0
5	49.0	45.0	29.0	51.0	68.0
6	52.0	39.0	38.0	47.0	61.0
7	44.0	57.0	69.0	39.0	56.0
8	45.0	55.0	67.0	55.0	60.0
9	50.0	36.0	46.0	42.0	58.0
10	42.0	33.0	45.0	37.0	37.0

	(cm)
Average snow depth =	**45.9**
Maximum snow depth =	69.0
Minimum snow depth =	29.0
Standard variation =	10.7

	(inches)
Average snow depth =	**18.1**
Maximum snow depth =	**27.2**
Minimum snow depth =	**11.4**
Standard variation =	**4.2**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T8	29	212.5	1035.3	0.21	
P4	23	203.9	821.1	0.25	
P3	38	419.5	1356.6	0.31	
T1	32	339.5	1142.4	0.30	
T2	32	225.8	1142.4	0.20	

Average Density =	**0.252**	
Average Snow Water Equivalent (SWE) =	**11.6**	cm H2O
Average Snow Water Equivalent =	**4.55**	inches H2O
Average Snow Water Equivalent =	**0.38**	feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/12/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9822 - Lake Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/15/2011 Time: nr

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 15.200'	Longitude:	W 151° 17.265'	Datum:	NAD 83
Elevation:	20 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	10.0	13.0	8.0	11.0	12.0
2	11.0	10.0	9.0	16.0	12.0
3	10.0	8.0	10.0	14.0	9.0
4	10.0	7.0	11.0	10.0	10.0
5	6.0	9.0	12.0	9.0	9.0
6	11.0	7.0	13.0	6.0	9.0
7	12.0	7.0	13.0	7.0	12.0
8	11.0	8.0	13.0	9.0	12.0
9	10.0	9.0	12.0	10.0	12.0
10	12.0	9.0	12.0	7.0	16.0

(cm)
Average snow depth = **10.3**
Maximum snow depth = 16.0
Minimum snow depth = 6.0
Standard variation = 2.3

(inches)
Average snow depth = **4.1**
Maximum snow depth = **6.3**
Minimum snow depth = **2.4**
Standard variation = **0.9**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
ZB	10	103.3	357.0	0.29	
P3	11	102.7	392.7	0.26	
T7	9	94.4	321.3	0.29	
Z3	9	97.6	321.3	0.30	
T15	10	98.3	357.0	0.28	

Average Density = **0.285**
Average Snow Water Equivalent (SWE) = **2.9** cm H2O
Average Snow Water Equivalent = **1.15** inches H2O
Average Snow Water Equivalent = **0.10** feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/19/11

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**L9822 - Tundra**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/15/2011	Time: 9:00

Location Description:	On tundra near lake				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Breeze
Latitude:	N 70° 15.265'	Longitude:	W 151° 17.291'	Datum:	NAD 83
Elevation:	48 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	39.0	38.0	46.0	42.0	45.0
2	55.0	25.0	35.0	49.0	42.0
3	42.0	27.0	40.0	61.0	43.0
4	42.0	25.0	40.0	46.0	50.0
5	48.0	37.0	36.0	39.0	43.0
6	44.0	39.0	45.0	50.0	55.0
7	51.0	52.0	46.0	51.0	50.0
8	45.0	52.0	30.0	48.0	41.0
9	41.0	40.0	35.0	59.0	42.0
10	49.0	52.0	40.0	36.0	32.0

	(cm)
Average snow depth =	**43.2**
Maximum snow depth =	61.0
Minimum snow depth =	25.0
Standard variation =	8.0
	(inches)
Average snow depth =	**17.0**
Maximum snow depth =	**24.0**
Minimum snow depth =	**9.8**
Standard variation =	**3.1**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
C4	30	252.4	1071.0	0.24	
11C	34	549.2	1213.8	0.45	
11E	28	195.2	999.6	0.20	
T3	46	462.4	1642.2	0.28	
11D	14	110.3	499.8	0.22	

Average Density =	**0.277**	
Average Snow Water Equivalent (SWE) =	**12.0**	cm H2O
Average Snow Water Equivalent =	**4.71**	inches H2O
Average Snow Water Equivalent =	**0.39**	feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011

Data QA/QC by: J Derry Date: 4/19/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**M0020 - Lake**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/16/2011	Time: 11:20

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 16' 14.9"	Longitude:	W 151° 43' 44.9"	Datum:	NAD 83
Elevation:	43 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	12.0	14.0	11.0	15.0	19.0
2	13.0	20.0	10.0	17.0	16.0
3	15.0	22.0	9.0	19.0	15.0
4	14.0	20.0	9.0	15.0	19.0
5	14.0	15.0	10.0	11.0	19.0
6	14.0	21.0	11.0	12.0	15.0
7	16.0	19.0	12.0	14.0	16.0
8	16.0	18.0	17.0	14.0	17.0
9	15.0	12.0	19.0	19.0	17.0
10	15.0	13.0	18.0	21.0	15.0

(cm)

Average snow depth =	**15.4**
Maximum snow depth =	22.0
Minimum snow depth =	9.0
Standard variation =	3.3

(inches)

Average snow depth =	**6.1**
Maximum snow depth =	**8.7**
Minimum snow depth =	**3.5**
Standard variation =	**1.3**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
P3	12	111.2	428.4	0.26	
2B	14	152.1	499.8	0.30	
F15	22	261.1	785.4	0.33	
Z2	17	195.3	606.9	0.32	
11B	19	119.9	678.3	0.18	

Average Density = **0.279**

Average Snow Water Equivalent (SWE) = **4.3** cm H2O

Average Snow Water Equivalent = **1.69** inches H2O

Average Snow Water Equivalent = **0.14** feet H2O

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

Data entered by: Deana Piedra Date: 3/22/2011

Data QA/QC by: Jeff Derry Date: 4/12/2011

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **M0020 - Tundra**
Survey Purpose: **Determine snow depth, SWE** Date: 3/16/2011 Time: 11:20

Location Description:	On tundra near lake.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 15.897	Longitude:	W 151° 43.209'	Datum:	NAD 83
Elevation:	55 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	23.0	19.0	49.0	41.0	46.0
2	26.0	31.0	38.0	43.0	46.0
3	35.0	35.0	53.0	16.0	47.0
4	56.0	31.0	54.0	33.0	49.0
5	61.0	25.0	52.0	37.0	49.0
6	50.0	26.0	53.0	36.0	49.0
7	38.0	26.0	35.0	45.0	65.0
8	35.0	38.0	30.0	49.0	67.0
9	45.0	40.0	38.0	42.0	62.0
10	28.0	44.0	44.0	43.0	42.0

(cm)
Average snow depth = **41.3**
Maximum snow depth = 67.0
Minimum snow depth = 16.0
Standard variation = 11.6

(inches)
Average snow depth = **16.3**
Maximum snow depth = **26.4**
Minimum snow depth = **6.3**
Standard variation = **4.6**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
F12	26	206.9	928.2	0.22	
Z3	22	153.5	785.4	0.20	
B46	35	331.7	1249.5	0.27	
T7	41	458.5	1463.7	0.31	
11C	30	231.2	1071.0	0.22	

Average Density = **0.243**
Average Snow Water Equivalent (SWE) = **10.0** cm H2O
Average Snow Water Equivalent = **3.94** inches H2O
Average Snow Water Equivalent = **0.33** feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/13/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**M9910 - Lake**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/16/2011	Time: 1:05

Location Description:	On tundra on staked course, adjacent and north of L9312 weather station				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Dark, Breeze
Latitude:	N 70 15.175	Longitude:	W 151° 42.900'	Datum:	NAD 83
Elevation:	76 ft	Elevation Datum:	BPMSL	Reference Markers:	Orange stakes
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	32.0	30.0	29.0	28.0	35.0
2	33.0	30.0	31.0	30.0	35.0
3	32.0	26.0	30.0	24.0	33.0
4	33.0	20.0	32.0	22.0	32.0
5	34.0	22.0	29.0	21.0	36.0
6	25.0	24.0	32.0	19.0	39.0
7	23.0	25.0	30.0	21.0	27.0
8	25.0	25.0	29.0	23.0	29.0
9	26.0	24.0	34.0	25.0	34.0
10	24.0	24.0	31.0	33.0	28.0
	31.0				

(cm)	
Average snow depth =	**28.4**
Maximum snow depth =	39.0
Minimum snow depth =	19.0
Standard variation =	4.7

(inches)	
Average snow depth =	**11.2**
Maximum snow depth =	**15.4**
Minimum snow depth =	**7.5**
Standard variation =	**1.9**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T8	32	375.6	1142.4	0.33	
11A	23	245.0	821.1	0.30	
2B	24	244.0	856.8	0.28	
B44	22	269.6	785.4	0.34	
F14	20	212.9	714.0	0.30	

Average Density =	**0.311**	
Average Snow Water Equivalent (SWE) =	**8.8**	cm H2O
Average Snow Water Equivalent =	**3.47**	inches H2O
Average Snow Water Equivalent =	**0.29**	feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/19/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**M9910 - Tundra**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/16/2011	Time: 1:05

Location Description:	Near Lake on tundra surface				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Breeze
Latitude:	N 70° 15.195'	Longitude:	W 151° 42.156'	Datum:	NAD 83
Elevation:	82 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	39.0	40.0	42.0	52.0	47.0
2	40.0	50.0	42.0	51.0	36.0
3	46.0	48.0	45.0	53.0	34.0
4	41.0	53.0	62.0	47.0	49.0
5	36.0	50.0	36.0	51.0	27.0
6	29.0	48.0	49.0	54.0	34.0
7	40.0	45.0	56.0	56.0	30.0
8	34.0	47.0	54.0	57.0	29.0
9	38.0	45.0	47.0	53.0	31.0
10	40.0	43.0	37.0	48.0	34.0

	(cm)
Average snow depth =	**43.9**
Maximum snow depth =	62.0
Minimum snow depth =	27.0
Standard variation =	8.4

	(inches)
Average snow depth =	**17.3**
Maximum snow depth =	**24.4**
Minimum snow depth =	**10.6**
Standard variation =	**3.3**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T15	34	323.9	1213.8	0.27	
T16	32	308.1	1142.4	0.27	
T20	42	391.1	1499.4	0.26	
T3	44	401.6	1570.8	0.26	
T4	42	250.2	1499.4	0.17	

Average Density =	**0.244**	
Average Snow Water Equivalent (SWE) =	**10.7**	cm H2O
Average Snow Water Equivalent =	**4.22**	inches H2O
Average Snow Water Equivalent =	**0.35**	feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: K. Hilton Date: 4/7/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **M9925- Lake Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/16/2011 Time: nr

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 14' 52.25"	Longitude:	W 151° 29' 0.19"	Datum:	NAD 83
Elevation:	20 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	18.0	28.0	24.0	21.0	26.0
2	18.0	27.0	22.0	25.0	23.0
3	19.0	28.0	21.0	30.0	20.0
4	19.0	31.0	17.0	31.0	17.0
5	21.0	29.0	15.0	31.0	14.0
6	23.0	26.0	16.0	32.0	18.0
7	24.0	25.0	15.0	33.0	19.0
8	26.0	21.0	18.0	33.0	22.0
9	31.0	22.0	17.0	32.0	25.0
10	29.0	25.0	19.0	31.0	29.0

(cm)
Average snow depth = **23.7**
Maximum snow depth = 33.0
Minimum snow depth = 14.0
Standard variation = 5.5

(inches)
Average snow depth = **9.3**
Maximum snow depth = **13.0**
Minimum snow depth = **5.5**
Standard variation = **2.2**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T5	21	266.4	749.7	0.36	
F11	24	304.5	856.8	0.36	
T2	25	320.9	892.5	0.36	
F13	26	331.5	928.2	0.36	
T1	24	268.6	856.8	0.31	

Average Density = **0.348**
Average Snow Water Equivalent (SWE) = **8.3** cm H2O
Average Snow Water Equivalent = **3.25** inches H2O
Average Snow Water Equivalent = **0.27** feet H2O

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

Data entered by: D.Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/19/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **L9925 - Tundra**
Survey Purpose: **Determine snow depth, SWE** Date: 3/16/2011 Time: 14:59

Location Description:	On tundra near lake				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Breeze
Latitude:	N 70° 14' 59"	Longitude:	W 151° 28' 9"	Datum:	NAD 83
Elevation:	95 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	38.0	37.0	36.0	42.0	41.0
2	40.0	32.0	39.0	42.0	38.0
3	36.0	29.0	42.0	41.0	42.0
4	34.0	37.0	42.0	35.0	50.0
5	38.0	35.0	45.0	40.0	49.0
6	32.0	38.0	40.0	47.0	46.0
7	40.0	33.0	45.0	41.0	50.0
8	39.0	38.0	42.0	30.0	54.0
9	37.0	29.0	42.0	32.0	54.0
10	34.0	33.0	44.0	41.0	46.0

	(cm)
Average snow depth =	**39.7**
Maximum snow depth =	54.0
Minimum snow depth =	29.0
Standard variation =	5.9

	(inches)
Average snow depth =	**15.6**
Maximum snow depth =	**21.3**
Minimum snow depth =	**11.4**
Standard variation =	**2.3**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
B61	32	284.1	1142.4	0.25	
P4	36	204.9	1285.2	0.16	
2A	34	298.9	1213.8	0.25	
T6	36	373.0	1285.2	0.29	
C1	27	200.1	963.9	0.21	

Average Density = **0.230**
Average Snow Water Equivalent (SWE) = **9.2** cm H2O
Average Snow Water Equivalent = **3.61** inches H2O
Average Snow Water Equivalent = **0.30** feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/19/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **MC7916 - Lake Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/15/2011 Time:

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 17.938	Longitude:	W 151° 27.767'	Datum:	NAD 83
Elevation:	7 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	19.0	22.0	25.0	23.0	24.0
2	21.0	21.0	22.0	25.0	24.0
3	24.0	17.0	25.0	24.0	24.0
4	24.0	16.0	22.0	24.0	23.0
5	26.0	16.0	26.0	24.0	29.0
6	21.0	20.0	21.0	25.0	26.0
7	21.0	23.0	20.0	25.0	19.0
8	22.0	21.0	20.0	23.0	19.0
9	24.0	23.0	21.0	24.0	18.0
10	27.0	36.0	23.0	23.0	20.0

(cm)
Average snow depth = **22.7**
Maximum snow depth = 36.0
Minimum snow depth = 16.0
Standard variation = 3.3

(inches)
Average snow depth = **8.9**
Maximum snow depth = **14.2**
Minimum snow depth = **6.3**
Standard variation = **1.3**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
F11	18	229.1	642.6	0.36	
F14	20	258.0	714.0	0.36	
F13	28	375.3	999.6	0.38	
F12	24	288.9	856.8	0.34	
F15	20	236.3	714.0	0.33	

Average Density = **0.352**
Average Snow Water Equivalent (SWE) = **8.0** cm H2O
Average Snow Water Equivalent = **3.15** inches H2O
Average Snow Water Equivalent = **0.26** feet H2O

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

Data entered by: D. Piedra Date: 3/21/2011
Data QA/QC by: J Derry Date: 4/12/11

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**MC7916 - Tundra**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/15/2011	Time: 10:15

Location Description:	On tundra near lake.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Clear, Breeze
Latitude:	N 70° 17.9'	Longitude:	W 151° 26.582'	Datum:	NAD 83
Elevation:	20 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	43.0	55.0	52.0	42.0	37.0
2	45.0	56.0	55.0	41.0	36.0
3	46.0	57.0	55.0	42.0	40.0
4	46.0	58.0	55.0	44.0	43.0
5	49.0	56.0	57.0	43.0	45.0
6	48.0	50.0	59.0	46.0	51.0
7	49.0	47.0	59.0	46.0	51.0
8	51.0	47.0	50.0	46.0	46.0
9	52.0	50.0	43.0	40.0	42.0
10	54.0	51.0	40.0	40.0	38.0

	(cm)
Average snow depth =	**47.9**
Maximum snow depth =	59.0
Minimum snow depth =	36.0
Standard variation =	6.2

	(inches)
Average snow depth =	**18.9**
Maximum snow depth =	**23.2**
Minimum snow depth =	**14.2**
Standard variation =	**2.4**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
B46	50	513.9	1785.0	0.29	
B41	32	258.1	1142.4	0.23	
B42	62	650.2	2213.4	0.29	
B44	37	396.1	1320.9	0.30	
B43	43	420.9	1535.1	0.27	

Average Density =	**0.276**	
Average Snow Water Equivalent (SWE) =	**13.2**	cm H2O
Average Snow Water Equivalent =	**5.21**	inches H2O
Average Snow Water Equivalent =	**0.43**	feet H2O

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

Data entered by: D. Piedra Date: 4/1/11

Data QA/QC by: Jderry Date: 4/12/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **R0061 - Lake Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/14/2011 Time: nr

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 10' 13.0"	Longitude:	W 151° 47' 06.4"	Datum:	NAD 83
Elevation:	66 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	23.0	20.0	16.0	28.0	42.0
2	17.0	21.0	13.0	29.0	46.0
3	20.0	19.0	17.0	33.0	43.0
4	19.0	20.0	16.0	27.0	23.0
5	19.0	17.0	13.0	30.0	34.0
6	20.0	19.0	13.0	33.0	39.0
7	22.0	19.0	14.0	37.0	46.0
8	21.0	19.0	34.0	34.0	34.0
9	19.0	19.0	32.0	43.0	37.0
10	20.0	19.0	27.0	44.0	34.0

(cm)
Average snow depth = **26.1**
Maximum snow depth = 46.0
Minimum snow depth = 13.0
Standard variation = 9.7

(inches)
Average snow depth = **10.3**
Maximum snow depth = **18.1**
Minimum snow depth = **5.1**
Standard variation = **3.8**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
Z1	16	162.2	571.2	0.28	
Z2	20	272.9	714.0	0.38	
Z3	13	152.5	464.1	0.33	
Z4	29	326.4	1035.3	0.32	
Z5	30	327.1	1071.0	0.31	

Average Density = **0.323**
Average Snow Water Equivalent (SWE) = **8.4** cm H2O
Average Snow Water Equivalent = **3.31** inches H2O
Average Snow Water Equivalent = **0.28** feet H2O

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

Data entered by: D. Piedra Date: 3/21/2011
Data QA/QC by: J Derry Date: 4/13/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**R0061 - Tundra**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/14/2011	Time: 9:00

Location Description:	On tundra near lake				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, light
Latitude:	N 70° 10' 10"	Longitude:	W 151° 45' 37"	Datum:	NAD 83
Elevation:	108 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	35.0	40.0	40.0	35.0	37.0
2	33.0	41.0	37.0	42.0	32.0
3	45.0	35.0	43.0	36.0	30.0
4	37.0	40.0	42.0	45.0	27.0
5	41.0	35.0	39.0	38.0	35.0
6	38.0	36.0	46.0	42.0	37.0
7	40.0	36.0	41.0	55.0	33.0
8	39.0	40.0	35.0	61.0	38.0
9	39.0	41.0	41.0	44.0	29.0
10	40.0	47.0	32.0	38.0	34.0

	(cm)
Average snow depth =	**38.8**
Maximum snow depth =	61.0
Minimum snow depth =	27.0
Standard variation =	5.9

	(inches)
Average snow depth =	**15.3**
Maximum snow depth =	**24.0**
Minimum snow depth =	**10.6**
Standard variation =	**2.3**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
P2	30	202.7	1071.0	0.19	
P1	33	218.4	1178.1	0.19	
P5	26	200.3	928.2	0.22	
P4	30	193.1	1071.0	0.18	
P3	34	192.6	1213.8	0.16	

Average Density =	**0.186**	
Average Snow Water Equivalent (SWE) =	**7.2**	cm H2O
Average Snow Water Equivalent =	**2.84**	inches H2O
Average Snow Water Equivalent =	**0.24**	feet H2O

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

Data entered by: Deana Pied Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/12/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **R0066 - Lake Surface**
Survey Purpose: **Determine snow depth, SWE** Date: 3/14/2011 Time: nr

Location Description:	Middle of lake. Used GPS to locate as close to middle as possible.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 70° 08.608'	Longitude:	W 151° 45.740'	Datum:	NAD 83
Elevation:	95 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	14.0	39.0	20.0	22.0	33.0
2	20.0	32.0	17.0	22.0	32.0
3	29.0	24.0	19.0	23.0	32.0
4	28.0	30.0	22.0	18.0	31.0
5	29.0	28.0	22.0	17.0	33.0
6	25.0	34.0	21.0	19.0	30.0
7	25.0	30.0	24.0	21.0	28.0
8	25.0	24.0	20.0	20.0	28.0
9	31.0	25.0	23.0	25.0	28.0
10	38.0	20.0	22.0	27.0	32.0

(cm)
Average snow depth = **25.6**
Maximum snow depth = 39.0
Minimum snow depth = 14.0
Standard variation = 5.6

(inches)
Average snow depth = **10.1**
Maximum snow depth = **15.4**
Minimum snow depth = **5.5**
Standard variation = **2.2**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T16	18	185.3	642.6	0.29	
T18	26	296.2	928.2	0.32	
T19	22	194.6	785.4	0.25	
T26	19	210.1	678.3	0.31	
15T	26	225.8	928.2	0.24	

Average Density = **0.282**
Average Snow Water Equivalent (SWE) = **7.2** cm H2O
Average Snow Water Equivalent = **2.84** inches H2O
Average Snow Water Equivalent = **0.24** feet H2O

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

Data entered by: Deana Pie Date: 4/1/2011
Data QA/QC by: J Derry Date: 4/7/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**L0066 - Tundra**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/14/2011	Time: nr

Location Description:	On tundra near lake				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Light, Breeze
Latitude:	N 70° 8.503'	Longitude:	W 151° 44.591'	Datum:	NAD 83
Elevation:	95 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	56.0	61.0	33.0	46.0	53.0
2	43.0	50.0	36.0	66.0	64.0
3	43.0	58.0	43.0	57.0	56.0
4	43.0	38.0	43.0	55.0	30.0
5	44.0	36.0	45.0	54.0	44.0
6	55.0	52.0	42.0	48.0	55.0
7	43.0	54.0	42.0	50.0	49.0
8	52.0	81.0	43.0	46.0	53.0
9	46.0	51.0	38.0	51.0	45.0
10	48.0	39.0	44.0	52.0	44.0

(cm)

Average snow depth =	**48.4**
Maximum snow depth =	81.0
Minimum snow depth =	30.0
Standard variation =	9.0

(inches)

Average snow depth =	**19.1**
Maximum snow depth =	**31.9**
Minimum snow depth =	**11.8**
Standard variation =	**3.5**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
2E	43	422.7	1535.1	0.28	
2D	33	290.2	1178.1	0.25	
2B	30	226.2	1071.0	0.21	
2C	40	469.5	1428.0	0.33	
2A	44	428.0	1570.8	0.27	

Average Density =	**0.267**	
Average Snow Water Equivalent (SWE) =	**12.9**	cm H2O
Average Snow Water Equivalent =	**5.08**	inches H2O
Average Snow Water Equivalent =	**0.42**	feet H2O

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

Data entered by: Deana Piedr Date: 4/1/2011
Data QA/QC by: J Derry Date: 4/7/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **Small-1 Transect**
Survey Purpose: **Determine snow depth, SWE** Date: 3/15/2011 Time: 9:00

Location Description:	At stream crossing.Went at 2.5 meter increments across drainage. Started 200' from camera. Start 001 and finish at 002 on Horacio's GPS.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations .	Cold, Breeze
Latitude:	N 70° 17.300'	Longitude:	W 151° 18.852'	Datum:	NAD 83
Elevation:	7 ft	Elevation Datum:	BPMSL	Reference Markers:	Near Camera an stream crossing area of interest
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	84.0	64.0	79.0	67.0	
2	72.0	57.0	80.0	60.0	
3	58.0	70.0	85.0	58.0	
4	76.0	72.0	84.0	43.0	
5	72.0	76.0	87.0	44.0	
6	65.0	75.0	76.0	39.0	
7	59.0	84.0	68.0	33.0	
8	41.0	73.0	52.0		
9	41.0	77.0	59.0		
10	62.0	80.0	61.0		

(cm)
Average snow depth = **65.8**
Maximum snow depth = 87.0
Minimum snow depth = 33.0
Standard variation = 14.6

(inches)
Average snow depth = **25.9**
Maximum snow depth = **34.3**
Minimum snow depth = **13.0**
Standard variation = **5.7**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)

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

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/19/11

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**Transect 2**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/15/2011	Time: 9:00

Location Description:	At stream crossing.Went at 2.5 meter increments across drainage. Started 200' from camera. Start 003 and finish at 004 on Horacio's GPS.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Dark, Breeze
Latitude:	N 70° 16.391'	Longitude:	W 151° 20.264'	Datum:	NAD 83
Elevation:	10 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	34.0	82.0	72.0	73.0	
2	40.0	74.0	80.0	57.0	
3	63.0	74.0	52.0	38.0	
4	57.0	66.0	62.0	38.0	
5	65.0	75.0	66.0	38.0	
6	54.0	66.0	49.0		
7	52.0	63.0	50.0		
8	73.0	48.0	53.0		
9	70.0	72.0	39.0		
10	75.0	78.0	59.0		

(cm)	
Average snow depth =	**60.2**
Maximum snow depth =	82.0
Minimum snow depth =	34.0
Standard variation =	13.8

(inches)	
Average snow depth =	**23.7**
Maximum snow depth =	**32.3**
Minimum snow depth =	**13.4**
Standard variation =	**5.4**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)

Average Density =

Average Snow Water Equivalent (SWE) = _____ cm H2O

Average Snow Water Equivalent = _____ inches H2O

Average Snow Water Equivalent = _____ feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011

Data QA/QC by: J Derry Date: 4/19/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **Transect 3**
Survey Purpose: **Determine snow depth, SWE** Date: 3/15/2011 Time: nr

Location Description:	At stream crossing.Went at 2.5 meter increments across drainage. Started 200' from camera. Start 005 and finish at 007 on Horacio's GPS. Rebar=point 006 on gps				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Breeze
Latitude:	N 70° 16.356'	Longitude:	W 151° 20.539'	Datum:	NAD 83
Elevation:	7 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	27.0	57.0	45.0	47.0	
2	29.0	42.0	67.0	41.0	
3	45.0	70.0	70.0	44.0	
4	36.0	70.0	67.0	38.0	
5	39.0	70.0	78.0	43.0	
6	23.0	71.0	78.0		
7	49.0	73.0	78.0		
8	91.0	60.0	89.0		
9	35.0	76.0	70.0		
10	33.0	54.0	64.0		

(cm)
Average snow depth = **56.3**
Maximum snow depth = 91.0
Minimum snow depth = 23.0
Standard variation = 18.6

(inches)
Average snow depth = **22.1**
Maximum snow depth = **35.8**
Minimum snow depth = **9.1**
Standard variation = **7.3**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)

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

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

Data entered by: D. Piedra Date: 3/22/2011
Data QA/QC by: J Derry Date: 4/19/11

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**SWE-DTLB-1**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/15/2011	Time: nr

Location Description:	At GPS location				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Breeze
Latitude:	N 70° 17.153'	Longitude:	W 151° 18.641'	Datum:	NAD 83
Elevation:	7 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	45.0	43.0	44.0	38.0	47.0
2	41.0	47.0	44.0	36.0	47.0
3	42.0	43.0	44.0	36.0	43.0
4	38.0	24.0	42.0	37.0	36.0
5	39.0	49.0	41.0	41.0	35.0
6	37.0	53.0	42.0	38.0	35.0
7	40.0	49.0	41.0	36.0	45.0
8	37.0	44.0	43.0	37.0	49.0
9	40.0	46.0	43.0	42.0	54.0
10	41.0	44.0	42.0	47.0	51.0

	(cm)
Average snow depth =	**42.0**
Maximum snow depth =	54.0
Minimum snow depth =	24.0
Standard variation =	5.3

	(inches)
Average snow depth =	**16.5**
Maximum snow depth =	**21.3**
Minimum snow depth =	**9.4**
Standard variation =	**2.1**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
P2	42	468.7	1499.4	0.31	
2A	41	466.9	1463.7	0.32	
T6	41	464.4	1463.7	0.32	
Z5	38	408.1	1356.6	0.30	
T18	38	394.9	1356.6	0.29	

Average Density =	**0.308**	
Average Snow Water Equivalent (SWE) =	**12.9**	cm H2O
Average Snow Water Equivalent =	**5.09**	inches H2O
Average Snow Water Equivalent =	**0.42**	feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011

Data QA/QC by: J Derry Date: 4/19/2011

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID: **ATN** Site Location/Lake ID: **SWE- Tundra-1**

Survey Purpose: **Determine snow depth, SWE** Date: 3/15/2011 Time: nr

Location Description:	At GPS coordinates				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	Cold, Dark, Breeze
Latitude:	N 70° 17.358'	Longitude:	W 151° 19.160'	Datum:	NAD 83
Elevation:	7 ft	Elevation Datum:	BPMSL	Reference Markers:	None
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	Hard surface layer, consistent throughout
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	44.0	41.0	40.0	44.0	54.0
2	51.0	44.0	48.0	39.0	47.0
3	49.0	47.0	42.0	41.0	50.0
4	42.0	45.0	42.0	42.0	47.0
5	41.0	32.0	41.0	40.0	58.0
6	41.0	51.0	40.0	38.0	52.0
7	43.0	26.0	44.0	41.0	41.0
8	42.0	34.0	47.0	51.0	49.0
9	40.0	37.0	49.0	54.0	46.0
10	41.0	34.0	48.0	56.0	42.0

	(cm)
Average snow depth =	**44.0**
Maximum snow depth =	58.0
Minimum snow depth =	26.0
Standard variation =	6.2

	(inches)
Average snow depth =	**17.3**
Maximum snow depth =	**22.8**
Minimum snow depth =	**10.2**
Standard variation =	**2.4**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T20	40	340.0	1428.0	0.24	
Z2	38	366.6	1356.6	0.27	
T16	36	333.1	1285.2	0.26	
11B	26	300.1	928.2	0.32	
T4	36	326.6	1285.2	0.25	

Average Density =	**0.269**	
Average Snow Water Equivalent (SWE) =	**11.8**	cm H2O
Average Snow Water Equivalent =	**4.66**	inches H2O
Average Snow Water Equivalent =	**0.39**	feet H2O

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

Data entered by: D. Piedra Date: 3/22/2011

Data QA/QC by: J Derry Date: 4/19/11

Arctic Transportation Networks Project
Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**Toolik Lake - Lake**
Survey Purpose:	**Determine snow depth, SWE**	Date: 3/13/2011	Time: 8:30

Location Description:	Toolik Lake. Site #4. Near center of lake.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	Cold, Clear, Breeze
Latitude:	N 68° 37.926'	Longitude:	W 149° 36.670'	Datum:	NAD 83
Elevation:	-11 ft	Elevation Datum:	BPMSL	Reference Markers:	none
Drainage Basin:	Colville Basin	Slope Direction:	Flat	Vegetation Type:	None, Ice surface
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Derry, Horacio T	

Snow Course Depths (cm)

	1	2	3	4	5
1	13.0	24.0	31.0	29.0	19.0
2	13.5	24.0	38.0	26.0	22.0
3	15.0	24.5	41.0	24.0	30.0
4	20.0	23.0	44.0	22.0	36.0
5	18.0	24.0	43.0	23.0	39.0
6	17.5	23.0	42.0	23.0	34.0
7	20.0	24.0	41.0	22.0	31.0
8	22.0	29.5	38.0	22.0	21.0
9	21.0	28.5	32.0	19.0	18.0
10	23.0	30.0	28.0	18.5	21.0

(cm)

Average snow depth =	**26.3**
Maximum snow depth =	44.0
Minimum snow depth =	13.0
Standard variation =	8.1

(inches)

Average snow depth =	**10.4**
Maximum snow depth =	**17.3**
Minimum snow depth =	**5.1**
Standard variation =	**3.2**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
T5	18	151.3	642.6	0.24	
T4	30	332.6	1071.0	0.31	
T3	35	395.0	1249.5	0.32	
T2	18	149.4	642.6	0.23	
T1	30	252.1	1071.0	0.24	

Average Density =	**0.266**	
Average Snow Water Equivalent (SWE) =	**7.0**	cm H2O
Average Snow Water Equivalent =	**2.75**	inches H2O
Average Snow Water Equivalent =	**0.23**	feet H2O

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

Data entered by: D. Piedra Date: 4/7/2011
Data QA/QC by: J DERRY Date: 4/19/11

APPENDIX C. LAKE HYDROLOGICAL MEASUREMENTS

The following form reports physical measurements pertaining to lake ice obtained during field sampling.

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **L9811 Lake**

Local Number:

Survey ID	NAD83	
All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
		N 70° 12.474'	W 151°

Vertical-Datum Corrections, reference survey notes in site folders

ABBREVIATIONS

BOI, bottom of ice

Calib, used to calibrate PT
IS, ice surface
LB, lake bottom
LS, land surface
MP, measuring point
N/A, not available
WS, water surface
WD, water depth

Location	Date	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
L9811C	3/14/11	Tape	0.44	6.60	+/- 0.01	4.23	0.20	6.40	N 70° 12.474'	W 151° 10.125'
L9811C	3/14/11	Tape	1.33	6.33	+/- 0.01	3.90	-0.03	6.36	N 70° 12.474'	W 151° 10.125'
L9811C	3/14/11	Tape	0.69	6.40	+/- 0.01	3.41	0.00	6.40	N 70° 12.474'	W 151° 10.125'
L9811E	3/14/11	Tape	0.84	5.90	+/- 0.01	4.92	0.00	5.90	N 70° 12.716'	W 151° 09.091'
L9811N	3/14/11	Tape	0.53	7.28	+/- 0.01	4.16	0.38	6.90	N 70° 12.914'	W 151° 11.320'
L9811S	3/14/11	Tape	0.6	6.53	+/- 0.01	3.58	0.33	6.20	N 70° 12.069'	W 151° 09.621'
L9811W	3/14/11	Tape	1.14	7.34	+/- 0.01	3.33	-0.16	7.50	N 70° 12.373'	W 151° 10.872'

Collected Data Values

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

Calculated Values

Ice Surface (IS) Elevation = Water Elevation + Freeboard
Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **L9817 Lake**

Local Number: Survey ID NAD83

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
	40.00	N 70° 14.037'	W 151° 20.012'

Vertical-Datum Corrections, reference survey notes in site folders

ABBREVIATIONS

BOI, bottom of ice

Calib, used to calibrate PT

IS, ice surface

LB, lake bottom

LS, land surface

MP, measuring point

N/A, not available

WS, water surface

WD, water depth

Location	Date	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
L9817C	3/14/11	Tape	0.63	6.33	+/- 0.01	3.74	0.03	6.30	N 70° 14.037'	W 151° 20.012'
L9817C	3/14/11	Tape	16.5	6.60	+/- 0.01	3.51	0.07	6.53	N 70° 14.037'	W 151° 20.012'
L9817C	3/14/11	Tape	0.35	6.53	+/- 0.01	3.84	0.23	6.30	N 70° 14.037'	W 151° 20.012'
L9817E	3/14/11	Tape	0.75	8.36	+/- 0.01	2.95	-0.10	8.46	N 70° 14.055'	W 151° 20.035'
L9817N	3/14/11	Tape	1.05	6.43	+/- 0.01	3.25	-0.13	6.56	N 70° 14.107'	W 151° 20.412'
L9817S	3/14/11	Tape	0.83	5.19	+/- 0.01	3.38	-0.03	5.22	N 70° 13.918'	W 151° 20.129'
L9817W	3/14/11	Tape	0.9	4.43	+/- 0.01	3.61	0.03	4.40	N 70° 13.987'	W 151° 20.558'

Collected Data Values

Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt

Freeboard (FB) = Height of ice level over water level in open hole

Ice Thickness (IT) = Measured distance between top and bottom of ice

Total Depth (TD) = Measured distance from water surface to lake bottom

Estimated Error = Field estimate of water level measurement error

Calculated Values

Ice Surface (IS) Elevation = Water Elevation + Freeboard

Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **L9819 Lake**

Local Number: Survey ID NAD83

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
		N 70° 16.477'	W 151° 20.437'

Vertical-Datum Corrections, reference survey notes in site folders

ABBREVIATIONS

BOI, bottom of ice

Calib, used to calibrate PT
IS, ice surface
LB, lake bottom
LS, land surface
MP, measuring point
N/A, not available
WS, water surface
WD, water depth

Lcoation	Date	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
L9819N	3/15/11	Tape	0.69	7.45	+/- 0.01	3.95	0.05	7.40	N 70° 16.477'	W 151° 20.437'
L9819E	3/15/11	Tape	0.48	6.70	+/- 0.01	4.13	0.20	6.50	N 70° 16.251'	W 151° 20.912'
L9819S	3/15/11	Tape	0.57	5.75	+/- 0.01	4.10	0.10	5.65	N 70° 15.920'	W 151° 21.112'
L9819W	3/15/11	Tape	0.75	6.60	+/- 0.01	3.50	0.04	6.56	N 70° 16.161'	W 151° 21.731'

Collected Data Values

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

Calculated Values

Ice Surface (IS) Elevation = Water Elevation + Freeboard
Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **L9822 Lake**

Local Number: Survey ID

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
		N 70° 15.200'	W 151° 17.265'

Vertical-Datum Corrections, reference survey notes in site folders

NAD83

ABBREVIATIONS

BOI, bottom of ice

Calib, used to calibrate PT

IS, ice surface

LB, lake bottom

LS, land surface

MP, measuring point

N/A, not available

WS, water surface

WD, water depth

Date	Time	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
L9822C	3/15/11	Tape	0.35	9.30	+/- 0.01	4.28	0.30	9.00	N 70° 15.200'	W 151° 17.265'
L9822E	3/15/11	Tape	0.55	8.37	+/- 0.01	4.21	0.12	8.25	N 70° 15.188'	W 151° 17.074'
L9822N	3/15/11	Tape	0.4	8.40	+/- 0.01	4.28	0.19	8.21	N 70° 15.181'	W 151° 17.481'
L9822S	3/15/11	Tape	0.4	9.60	+/- 0.01	4.22	0.20	9.40	N 70° 15.146'	W 151° 17.084'
L9822W	3/15/11	Tape	0.59	8.55	+/- 0.01	4.48	0.42	8.13	N 70° 15.128'	W 151° 17.431'

Collected Data Values

Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt

Freeboard (FB) = Height of ice level over water level in open hole

Ice Thickness (IT) = Measured distance between top and bottom of ice

Total Depth (TD) = Measured distance from water surface to lake bottom

Estimated Error = Field estimate of water level measurement error

Calculated Values

Ice Surface (IS) Elevation = Water Elevation + Freeboard

Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **L9824 Lake**
Local Number: Survey ID

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
		N 70° 17.054'	W 151° 16.081'

Vertical-Datum Corrections, reference survey notes in site folders

NAD83

ABBREVIATIONS
BOI, bottom of ice
Calib, used to calibrate PT
IS, ice surface
LB, lake bottom
LS, land surface
MP, measuring point
N/A, not available
WS, water surface
WD, water depth

Location	Date	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
L9824C	3/7/11	Tape	0.49	9.55	+/- 0.01	3.24	0.13	9.42	N 70° 17.054'	W 151° 16.081'

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

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **M0022 Lake**

Local Number: Survey ID

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
		N 70° 16.404'	W 151° 45.013'

Vertical-Datum Corrections, reference survey notes in site folders

NAD83

ABBREVIATIONS

BOI, bottom of ice

Calib, used to calibrate PT
IS, ice surface
LB, lake bottom
LS, land surface
MP, measuring point
N/A, not available
WS, water surface
WD, water depth

Location	Date	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
M0022C	3/16/11	Tape	0.72	9.35	+/- 0.01	4.04	0.20	9.15	N 70° 16.404'	W 151° 45.013'
M0022C	3/16/11	Tape	0.43	11.19	+/- 0.01	3.18	0.13	11.06	N 70° 16.404'	W 151° 45.013'
M0022E	3/16/11	Tape	0.71	10.01	+/- 0.01	3.64	-0.03	10.04	N 70° 16.141'	W 151° 43.092'
M0022N	3/16/11	Tape	0.47	12.83	+/- 0.01	3.67	0.23	12.60	N 70° 16.362'	W 151° 43.966'
M0022S	3/16/11	Tape	0.89	10.46	+/- 0.01	2.79	-0.07	10.53	N 70° 15.739'	W 151° 43.717'
M0022W	3/16/11	Tape	0.75	9.91	+/- 0.01	3.22	0.00	9.91	N 70° 16.122'	W 151° 44.918'

Collected Data Values

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

Calculated Values

Ice Surface (IS) Elevation = Water Elevation + Freeboard
Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **M9910 Lake**

Local Number: Survey ID

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
		N 70° 15.175'	W 151° 42.900'

Vertical-Datum Corrections, reference survey notes in site folders

NAD83

ABBREVIATIONS

BOI, bottom of ice

Calib, used to calibrate PT

IS, ice surface

LB, lake bottom

LS, land surface

MP, measuring point

N/A, not available

WS, water surface

WD, water depth

Location	Date	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
M9910C	3/16/11	Tape	1.02	7.55	+/- 0.01	3.25	0.00	7.55	N 70° 15.175'	W 151° 42.900'
M9910E	3/16/11	Tape	0.86	6.11	+/- 0.01	2.92	-0.03	6.14	N 70° 15.102'	W 151° 42.521'
M9910N	3/16/11	Tape	0.65	4.98	+/- 0.01	3.08	0.03	4.95	N 70° 15.473'	W 151° 42.537'
M9910S	3/16/11	Tape	1.05	5.94	+/- 0.01	3.58	0.07	5.87	N 70° 14.967'	W 151° 43.192'
M9910W	3/16/11	Tape	0.88	7.32	+/- 0.01	3.77	0.07	7.25	N 70° 15.234'	W 151° 43.161'

Collected Data Values

Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt

Freeboard (FB) = Height of ice level over water level in open hole

Ice Thickness (IT) = Measured distance between top and bottom of ice

Total Depth (TD) = Measured distance from water surface to lake bottom

Estimated Error = Field estimate of water level measurement error

Calculated Values

Ice Surface (IS) Elevation = Water Elevation + Freeboard

Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **MC7916 Lake**

Local Number: Survey ID

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
		N 70° 18.229'	W 151° 28.051'

Vertical-Datum Corrections, reference survey notes in site folders

NAD83

ABBREVIATIONS

BOI, bottom of ice

Calib, used to calibrate PT

IS, ice surface

LB, lake bottom

LS, land surface

MP, measuring point

N/A, not available

WS, water surface

WD, water depth

Location	Date	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
MC7916N	3/15/11	Tape	1.09	7.45	+/- 0.01	4.17	0.00	7.45	N 70° 18.229'	W 151° 28.051'
MC7916S	3/15/11	Tape	0.52	8.14	+/- 0.01	3.90	0.07	8.07	N 70° 17.704'	W 151° 27.338'
MC7916E	3/15/11	Tape	0.69	7.22	+/- 0.01	3.71	0.00	7.22	N 70° 18.031'	W 151° 27.286'
MC7916W	3/15/11	Tape	1.16	8.07	+/- 0.01	4.04	0.10	7.97	N 70° 17.882'	W 151° 28.388'

Collected Data Values

Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt

Freeboard (FB) = Height of ice level over water level in open hole

Ice Thickness (IT) = Measured distance between top and bottom of ice

Total Depth (TD) = Measured distance from water surface to lake bottom

Estimated Error = Field estimate of water level measurement error

Calculated Values

Ice Surface (IS) Elevation = Water Elevation + Freeboard

Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **R0061 Lake**

Local Number: Survey ID

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm) NAD83	Longitude (dd-mm.mmm)
		N 70° 10.667'	W 151° 48.556'

Vertical-Datum Corrections, reference survey notes in site folders

ABBREVIATIONS

BOI, bottom of ice

Calib, used to calibrate PT

IS, ice surface

LB, lake bottom

LS, land surface

MP, measuring point

N/A, not available

WS, water surface

WD, water depth

Location	Date	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
R0061N	3/14/11	Tape	0.92	5.61	+/- 0.01	3.38	-0.07	5.68	N 70° 10.667'	W 151° 48.556'
R0061S	3/14/11	Tape	0.76	7.17	+/- 0.01	3.25	-0.03	7.20	N 70° 09.895'	W 151° 46.957'
R0061W	3/14/11	Tape	0.48	6.40	+/- 0.01	3.84	0.20	6.20	N 70° 10.155'	W 151° 48.105'
R0061E	3/14/11	Tape	0.85	6.24	+/- 0.01	3.48	0.10	6.14	N 70° 10.340'	W 151° 46.861'

Collected Data Values

Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt

Freeboard (FB) = Height of ice level over water level in open hole

Ice Thickness (IT) = Measured distance between top and bottom of ice

Total Depth (TD) = Measured distance from water surface to lake bottom

Estimated Error = Field estimate of water level measurement error

Calculated Values

Ice Surface (IS) Elevation = Water Elevation + Freeboard

Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness

Arctic Transportation Networks Project

FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **R0066 Lake**

Local Number: Survey ID

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
		N 70° 08.730'	W 151° 45.684'

NAD83

Vertical-Datum Corrections, reference survey notes in site folders

ABBREVIATIONS

BOI, bottom of ice

Calib, used to calibrate PT

IS, ice surface

LB, lake bottom

LS, land surface

MP, measuring point

N/A, not available

WS, water surface

WD, water depth

Location	Date	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WD	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
R0066C	3/14/11	Tape	0.55	7.81	+/- 0.01	3.84	0.07	7.74	N 70° 08.730'	W 151° 45.684'
R0066E	3/14/11	Tape	0.88	7.74	+/- 0.01	1.09	0	7.74	N 70° 08.805'	W 151° 45.297'
R0066N	3/14/11	Tape	19.25	6.23	+/- 0.01	1.00	-0.07	6.30	N 70° 08.957'	W 151° 46.361'
R0066S	3/14/11	Tape	0.78	5.74	+/- 0.01	1.09	-0.03	5.77	N 70° 08.553'	W 151° 45.053'
R0066W	3/14/11	Tape	1	4.63	+/- 0.01	1.12	0.03	4.60	N 70° 08.610'	W 151° 46.285'

Collected Data Values

Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt

Freeboard (FB) = Height of ice level over water level in open hole

Ice Thickness (IT) = Measured distance between top and bottom of ice

Total Depth (TD) = Measured distance from water surface to lake bottom

Estimated Error = Field estimate of water level measurement error

Calculated Values

Ice Surface (IS) Elevation = Water Elevation + Freeboard

Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness

APPENDIX D. WATER QUALITY METER CALIBRATION FORMS

The following forms report results from the meter calibration checks.

Geo-Watersheds Scientific

Form F-004e: Water Quality Meter Calibration Form

Project ID: **ATN** Site Location/Lake ID: Alpine

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: Hach Make: Rcond

Owner: BLM S/N: 10035283019

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Conductivity 447 µS/cm	3/13/11	17:54	Oakton 447	0P1	Nov-11	447 µS/cm	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Conductivity 447 µS/cm	3/15/11	6:34	Oakton 447	0P1	Nov-11	446 µS/cm	Pass

Remarks:

Field-Form Filled Out By: D. Piedra Date: 4/7/2011

QAQC Check By: K. Hilton Date: 4/8/2011

Geo-Watersheds Scientific

Form F-004e: Water Quality Meter Calibration Form

Project ID: **ATN** Site Location/Lake ID: Alpine

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: Hach Make: Rcond

Owner: BLM S/N: 10035283019

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Conductivity 447 µS/cm	3/15/11	6:34	Oakton 447	0P1	Nov-11	446 µS/cm	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Conductivity 447 µS/cm	3/16/11	6:55	Oakton 447	0P1	Nov-11	449 µS/cm	Pass

Remarks:

Field-Form Filled Out By: D. Piedra Date: 4/7/2011

QAQC Check By: K. Hilton Date: 4/8/2011

Geo-Watersheds Scientific

Form F-004e: Water Quality Meter Calibration Form

Project ID: **ATN** Site Location/Lake ID: Alpine

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: Hach Make: Rcond

Owner: BLM S/N: 110612581022

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Conductivity 447 µS/cm	3/16/11	6:55	Oakton 447	0P1	Nov-11	449 µS/cm	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Conductivity 447 µS/cm	3/21/11	14:00	Oakton 447	0P1	Nov-11	445 µS/cm	Pass

Remarks:

Field-Form Filled Out By: D. Piedra Date: 4/7/2011

QAQC Check By: K. Hilton Date: 4/8/2011

Geo-Watersheds Scientific

Form F-004e: Water Quality Meter Calibration Form

Project ID: **ATN** Site Location/Lake ID: Alpine

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: Hach Make: RLDO

Owner: BLM S/N: 100342592015

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Zero O_2	3/13/11	19:00	Oakton Zero DO	0R1	Sep-11	0.41 mg/L	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Zero O_2	3/15/11	6:50	Oakton Zero DO	0R1	Sep-11	0.26 mg/L	Pass

Remarks:

Field-Form Filled Out By: D. Piedra Date: 4/7/2011

QAQC Check By: K. Hilton Date: 4/8/2011

Geo-Watersheds Scientific

Form F-004e: Water Quality Meter Calibration Form

Project ID: **ATN** Site Location/Lake ID: Alpine

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: Hach Make: RLDO

Owner: BLM S/N: 100342592015

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Zero O_2	3/15/11	6:50	Oakton Zero DO	0R1	Sep-11	0.26 mg/L	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Zero O_2	3/16/11	6:50	Oakton Zero DO	0R1	Sep-11	0.27 mg/L	Pass

Remarks:

Field-Form Filled Out By: D. Piedra Date: 4/7/2011

QAQC Check By: K. Hilton Date: 4/8/2011

Geo-Watersheds Scientific

Form F-004e: Water Quality Meter Calibration Form

Project ID: **ATN** Site Location/Lake ID: Alpine

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: Hach Make: RLDO

Owner: BLM S/N: 110552592009

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Zero O_2	3/13/11	17:54	Oakton Zero DO	0R1	Sep-11	0.42 mg/L	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Zero O_2	3/15/11	6:44	Oakton Zero DO	0R1	Sep-11	0.26 mg/L	Pass

Remarks:

Field-Form Filled Out By: D. Piedra Date: 4/7/2011

QAQC Check By: K. Hilton Date: 4/8/2011

Geo-Watersheds Scientific

Form F-004e: Water Quality Meter Calibration Form

Project ID: **ATN** Site Location/Lake ID: Alpine

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: Hach Make: Rcond

Owner: BLM S/N: 10035283019

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Zero O_2	3/15/11	6:44	Oakton Zero DO	0R1	Sep-11	0.26 mg/L	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Zero O_2	3/21/11	14:00	Oakton Zero DO	0R1	Sep-11	2.5% (0.23mg/L)	Pass
Saturated O_2	3/21/11	14:00	Bubbled Nanopure	na	na	01.4% (9.35 mg/L	Pass

Remarks:

Field-Form Filled Out By: D. Piedra Date: 4/7/2011

QAQC Check By: K. Hilton Date: 4/8/2011