North Slope, Alaska, Snow-Course and Lake Survey Data: April 2010

Michael Lilly and Sarah Byam preparing to conduct lake ice and water quality measurements. Photo by Jeff Murray, April 2010.

by

Jeff Murray, Kristie Hilton, Sarah Byam, Horacio Toniolo,

and Michael Lilly

June 2010

Arctic Transportation Networks Project

Report GWS.TR.10.04

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by

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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

June 2010

Arctic Transportation Networks Project

Report Number GWS.TR.10.04

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Recommended Citation:

Murray, J., Hilton, K., Byam, S., Toniolo, H., and Lilly, M. 2010. North Slope, Alaska, Snow-Course and Lake Survey Data: April 2010. Geo-Watersheds Scientific, Report GWS.TR.10.04, Fairbanks, Alaska. 13 pp. (plus appendices).

Fairbanks, Alaska
June 2010

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

Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (mm)
mile (mi)	1.609	kilometer (km)
	Area	
Acre	43559.826	square feet (ft^2)
Acre	0.407	hectare (ha)
Square foot (ft^2)	2.590	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	1233	cubic meter (m^3)
	Velocity and Discharge	
foot per day (ft/d)	0.3048	meter per day (m/d)
Square foot per day (ft^2/d)	.0929	square meter per day (m^2/d)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/sec)
	Hydraulic Conductivity	
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per day (ft/d)	0.00035	centimeter per second (cm/sec)
meter per day (m/d)	0.00115	centimeter per second (cm/sec)
	Hydraulic Gradient	
foot per foot (ft/ft)	5280	foot per mile (ft/mi)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
	Pressure	
pound per square inch (lb/in^2)	6.895	kilopascal (kPa)

Units

For the purposes of this report, both English and Metric (SI) units were employed. Common regulations related to tundra travel and water use on the North Slope, Alaska, uses 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 is given in degrees Celsius (°C) and in degrees Fahrenheit (°F). Degrees Celsius can be converted to degrees Fahrenheit by use of the following equation:

$°F = 1.8(°C) + 32$

Snow Water Equivalent (SWE):

Water content of a given 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. Elsewhere, conductivity is commonly expressed as Specific Conductance at 25°C [SC25] in µS/cm which is temperature corrected. To convert AC to SC25 the following equation can be used:

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

where:

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

AC = Actual Conductivity, in µS/cm

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

T = temperature of the sample, in °C

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

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

Millivolt (mV):

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

Vertical Datum:

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

Horizontal Datum:

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

Abbreviations, Acronyms, and Symbols

AC	Actual conductivity
ADOT&PF	Alaska Department of Transportation and Public Facilities
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
- Alaska Department of Natural Resources
- The Nature Conservancy
- Northern Alaska Environmental Center
- North Slope Borough
- National Weather Service
- Geo-Watersheds Scientific
- University of Alaska-Fairbanks
- Idaho National Laboratory
- Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)

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 and logistics support were provided by ConocoPhillips Alaska. Additional support was provided by other project cooperators, North Slope Borough, Bureau of Land Management, Bureau of Ocean Energy Management Regulation and Enforcement, 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 and Lake Survey Data: April 2010

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 10 meteorological and lake stations (such as snow-depth, air and soil temperatures, unfrozen soil moisture, precipitation, wind and radiation data). Data is 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 can only commence once a spatially consistent snow depth of 6 in (15 cm) in the coastal plain management areas, or 9 in (23 cm) in the Foothills management areas is maintained. Soil temperatures are also used to manage tundra travel. The soil temperature must reach 23° F (-5°C) at a depth of 12 in (30 cm) (Bader, 2004) to meet tundra travel management criteria. The intent of the soil temperature criteria is to ensure frozen soil strengths are adequate in terms of reaching maximum soil strength. Many meteorological factors determine when these conditions will be met. An established network of meteorological stations and increased manual snow measurements – both amount collected and number of sites visited – will improve the understanding of the timing and amount of snow distribution and will assist in the development of predictive and management tools.

TRIP OBJECTIVES

The April field effort was primarily focused on conducting snow-courses, lake measurements, and verification of meteorological station operations. Snow sampling was performed at co-located ADNR and ATN project sampling sites. ATN project sites will include additional ADNR sites to cover areas that are no longer monitored by ADNR. Concurrent with these

activities, 2L-Pad station installation continued. A workplan was published prior to the April field campaign containing a site-by-site list of objectives (Hilton et al. 2010). Project accomplishments include the following:

1. Toolik NRSC Climate Site and Toolik Lake
   - Conduct snow surveys
   - Measure lake-ice parameters near shore and in center of lake
   - Measure DO and conductivity levels

2. Dalton Highway ADNR Sites
   - Conduct snow courses at Sag River ADOT, 318 Mile, 62 Mile, and 30 Mile locations

3. Badami and Eastern BP Sites
   - Conduct snow courses at Badami and eastern BP sites
   - Measure lake-ice parameters at Badami Reservoir
   - Measure DO and conductivity levels at Badami Reservoir
   - General maintenance at Badami climate station

4. Central Kuparuk Sites
   - Conduct snow courses at central sites

5. Western Kuparuk Sites
   - Conduct snow courses at western Kuparuk sites
   - 2L Met station work, installed solar panel

6. L9312
   - Conduct snow courses on tundra and lake surface
   - Measure lake-ice parameters
   - L9312 station maintenance

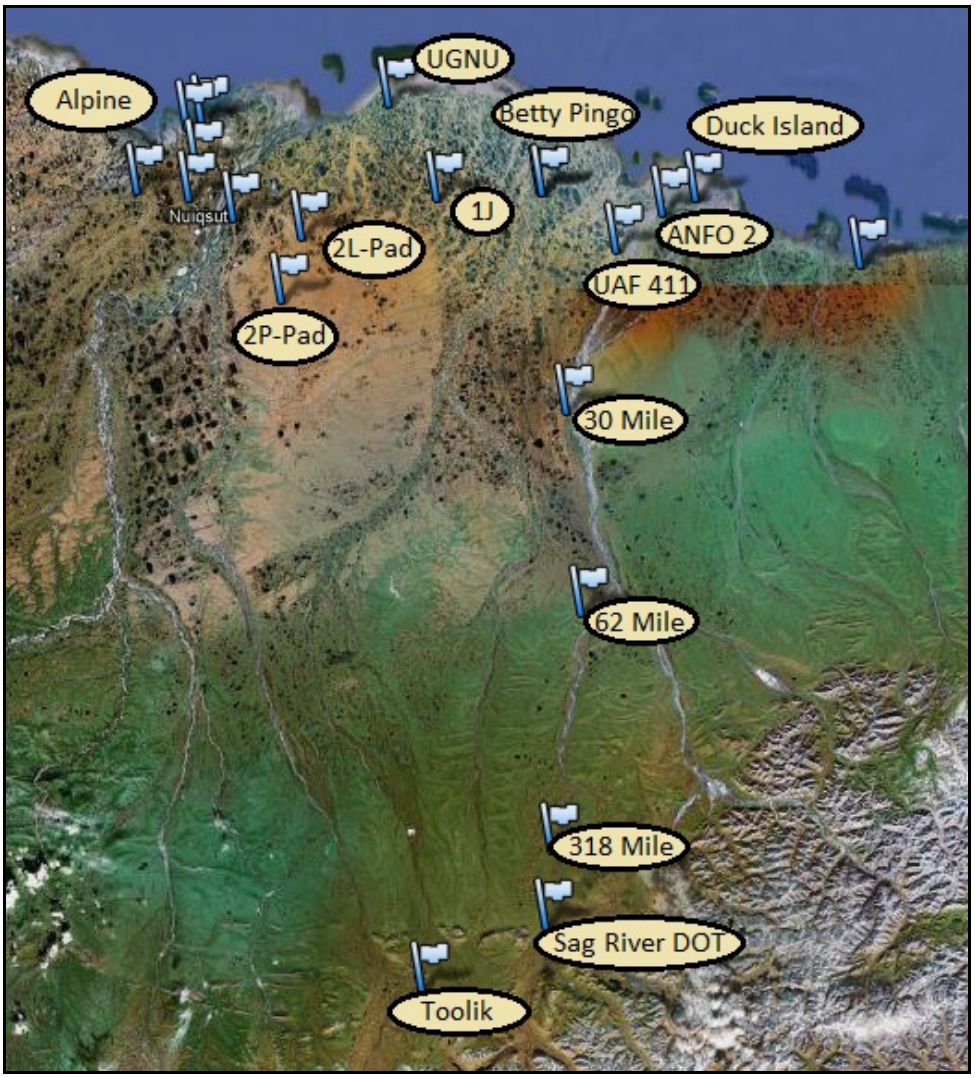

Figure 1. Snow-course locations visited in April 2010 by ATN and UAF personnel.

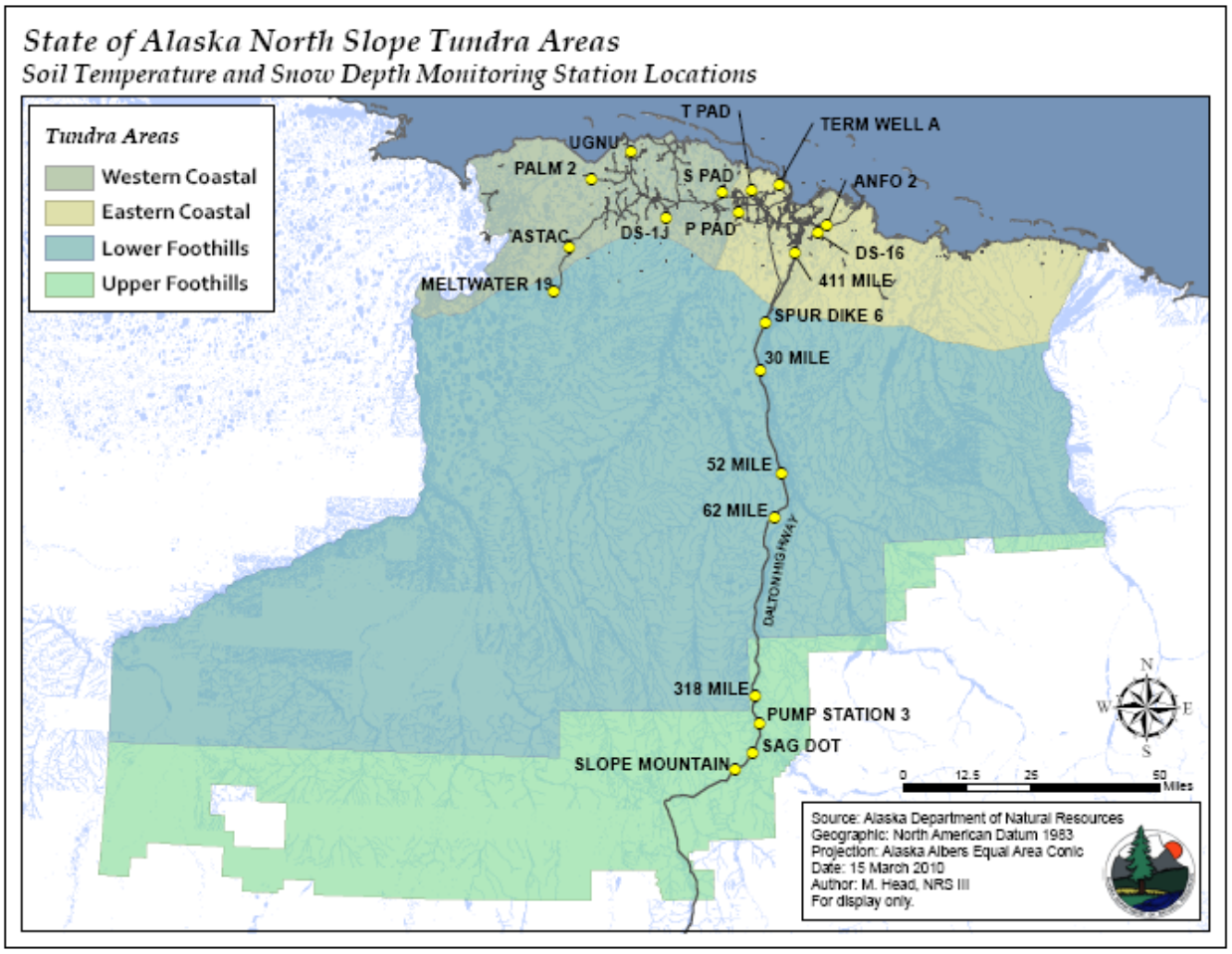

Figure 2. Map of ADNR snow and soil temperature sampling sites (ADNR, 2010).

PROCEDURES

Snow-depth measurements were 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 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. A number of sampling sites are co-located with ADNR snow and soil sampling sites to compare sampling methods. The ADNR method involves collecting 20 depth measurements along a transect spaced at 1.5 ft (0.5 m) increments and two density measurements collected with a Federal

Sampler (Derry et al. 2009). The intent of co-located sites is to provide data for ADNR and ATN project staff to compare measurement methods at representative sites.

At Lake L9312, holes were drilled through the ice with a gas powered, 10-inch diameter ice 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 after the hole was drilled. Water depth was measured with a flexible tape, and freeboard and ice thickness was measured with a folding tape. Snow depth was measured with the same T-handle probe that is used for snow courses. The same physical measurements were also recorded at Toolik Lake and Badami Reservoir.

Water-quality measurements were recorded at Badami Reservoir. Temperature, conductivity, and DO were obtained at depths throughout the water column by using a Hach LDO and a YSI Conductivity Meter. Measurements started just below ice surface and continued at 1 foot intervals until the lake bottom was reached. The LDO sensor, however, did not pass post-check calibration, so those measurements will not be used in any data analysis.

SELECTED RESULTS

Snow courses were conducted at 23 different locations during the April trip. Eleven sites are co-located with ADNR sampling sites (Table 1).

Table 1. March snow sampling locations, locations in bold indicate site is co-located with ADNR snow and soil temperature sampling sites.

Station	Elevation Ft	North Latitude NAD 83	West Longitude NAD 83
Meltwater 19 (2P-Pad)	200	70° 03.853’	150° 26.779’
Sag River DOT	1,630	68° 45.686’	148° 52.746’
J-Pad	82	70° 16.260'	149° 31.140'
2L-Pad	112	70° 11.481'	150° 19.397'
30 Mile	209	69° 50.333'	148° 45.461'
62 Mile	1,090	69° 25.320'	148° 40.140'
318 Mile	1,280	68° 55.328'	148° 51.004'
ANFO 2	27	70° 14.447'	148° 10.760'
UGNU	16	70° 27.480'	149° 48.540'
UAF 411	78	70° 09.949'	148° 27.307'
P-Pad	33	70° 16.967'	148° 54.807'
Alpine 1	2	70° 25.431'	150° 54.939'
Alpine 2	2	70° 24.564'	151° 00.601'
Alpine 4	2	70° 16.183'	150° 59.730’
Alpine 5	3	70° 13.801'	150° 43.969’
Badami MET	26	70° 08.195'	150° 00.554’
Badami Reservoir – Lake	21	70° 07.775'	146° 59.956’
Badami Reservoir – Tundra	26	70° 07.870'	147° 00.076’
Betty Pingo (NRCS Site)	10	70° 16.772’	148° 53.741’
Duck Island	45	70° 16.206'	147° 59.265'
L9312 - Lake Surface	7	70° 20.008’	150° 57.083’
L9312 - Tundra Surface	7	70° 19.995’	150° 56.918’
NRCS Soil Monitoring Site (Toolik Camp)	2,362	68° 37.366’	149° 36.598’

Despite continued freezing temperatures in April, the weather was considerably warmer throughout the majority of this month’s field trip. All ice roads were open for travel, but their conditions were beginning to deteriorate. Table 2 provides a summary of the 23 snow sampling sites visited in April. Individual site snow forms can be found in Appendix A.

Table 2. Summary of snow depth, density and SWE values from sites visited by ATN personnel in April.

	ATN Snow Data Collected in February				
	Snow Depth		Density	SWE	
	cm	in	g/cm^3	cm	in
Eastern Coastal Area					
P Pad	29.10	11.46	0.25	7.20	2.83
Betty Pingo	39.00	15.35	0.293	11.40	4.49
Badami MET	23.50	9.25	0.27	6.30	2.48
Badami Res - Lake	8.00	3.15	0.33	2.70	1.06
Badami Res - Tundra	35.90	14.13	0.32	11.50	4.53
ANFO 2	27.28	10.74	0.28	7.50	2.95
Duck Island	24.80	9.76	0.30	7.40	2.91
UAF 411	41.30	16.26	0.29	11.80	4.65
Area Averages	***28.61***	***11.26***	***0.29***	***8.23***	***3.24***
Western Coastal Area					
DS-1J	31.10	12.24	0.24	7.50	2.95
UGNU Pad	25.20	9.92	0.32	8.00	3.15
DS-2L (ASTAC)	34.10	13.43	0.24	8.20	3.23
L9312 - Tundra Surface	39.40	15.51	0.31	12.00	4.72
L9312 - Lake Surface	23.70	9.33	0.36	8.50	3.35
Alpine 1	34.10	13.43	0.29	10.00	3.94
Alpine 2	35.90	14.13	0.26	9.40	3.70
Alpine 4	31.20	12.28	0.25	7.90	3.11
Alpine 5	36.40	14.33	0.30	10.90	4.29
Area Averages	***32.34***	***12.73***	***0.29***	***9.16***	***3.60***
Lower Foothills Area					
30 Mile	19.40	7.64	0.21	4.10	1.61
62 Mile	29.30	11.54	0.24	6.90	2.72
Meltwater 19 (2-P Pad)	29.00	11.42	0.27	7.70	3.03
Area Averages	***25.90***	***10.20***	***0.24***	***6.23***	***2.45***
Upper Foothills Area					
318 Mile	45.40	17.87	0.26	11.80	4.65
Sag R. DOT	40.60	15.98	0.20	8.10	3.19
NRCS - Toolik	35.00	13.78	0.21	7.20	2.83
Area Averages	***40.33***	***15.88***	***0.22***	***9.03***	***3.56***

Note: Above is ATN collected data but separated according to ADNR Regions

Once a region has been opened to tundra travel, ADNR generally does not continue snow sampling in that region. Thus, there are no reported snow depth values in the Eastern and Western Coastal regions from latter December through April (Appendix C). By April, ADNR only continued to sample in the lower foothills. Snow at only three stations was measured, and only two of those were sites co-located with ATN. Figure 3 shows the regional comparison of snow depths. ATN observed greater snow depths in that region throughout the winter season. Later in this report, reasons for the large differences in snow depths will be offered.

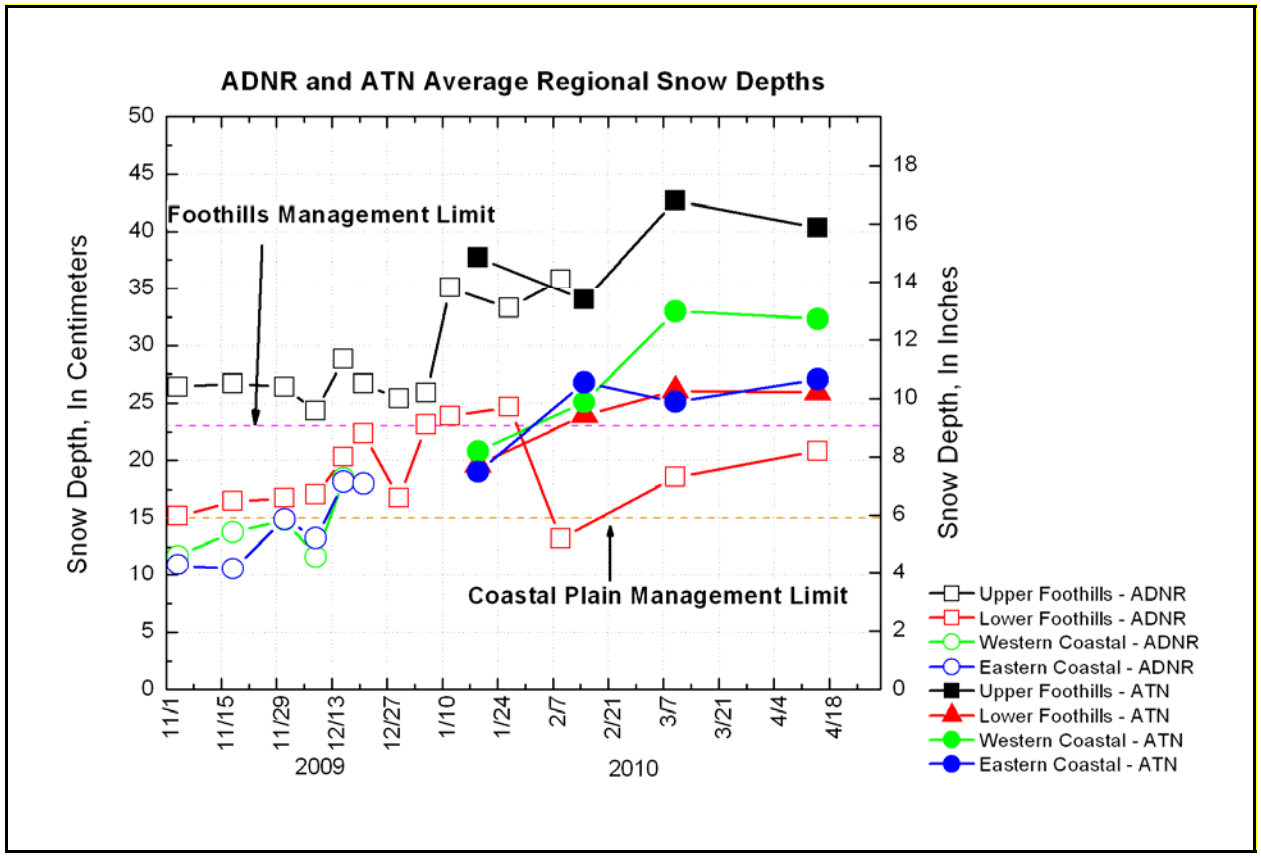

Figure 3. Regional average snow depths for ADNR and ATN field campaigns from November 2009 to April 2010.

The April ATN field trip was the last of the winter season, and Figure 4 shows the final regional averages for snow depth, density, and water equivalent. The Lower Foothills region shows the lowest snow depth and SWE, and it has slightly lower density than both of the coastal regions. Besides the Lower Foothills, the other three regions all had approximately the same SWE. The Upper Foothills had the highest snow depth, and it had the lowest snow density.

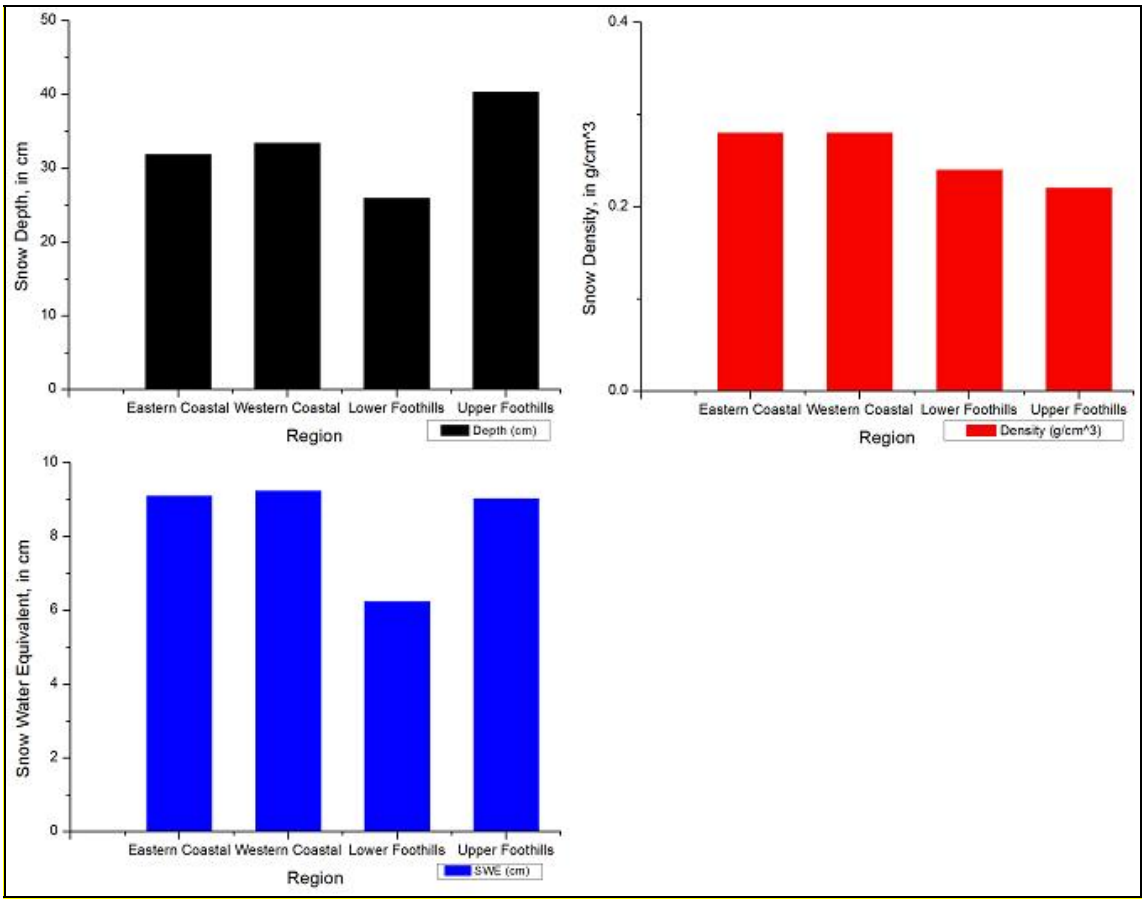

Figure 4. Regional Comparison of Snow Depth, Density, and SWE measured during April trip.

Significant effort was made during the April ATN trip to develop a transferable technique for accurately, and precisely, measuring snow depth by both experienced and inexperienced personnel. As previously stated, ATN and ADNR have been recording different snow depths at co-located snow sites. A goal of this project is to be able to re-create identical measurements by anyone who is measuring snow at a given time. Sarah Byam, a UAF graduate student, attended the April trip and was beneficial in this process. Prior to the trip, she had minimal experience collecting snow depth measurements. Sarah was provided a copy of the GWS Snow Data Collection Methods paper (Derry et al., 2009) and was given basic instructions for collecting snow depth measurements. Figure 5 shows the comparison of Jeff Murray's (ATN) and Sarah Byam's (UAF) snow depth measurements. Both conducted measurements at the same time in the same location. On both Figures 5 and 6, lines were drawn at both 2 cm more and 2 cm less than the equivalent values line. While 2 cm has no regulatory significance, it has been chosen to signify an acceptable range of values for comparing snow depth measurements. Any value that

falls within this range should be considered a successful evaluation of the snow depth. Figure 5 shows that the vast majority of depth measurements fell within the desired range. The measurements were taken with identical equipment at the same time within approximately 5 feet of each other. This comparison was designed so that the only major differences between the two measurements were the actual difference in snow depth and varying terrain below. All other sources of variance were removed to the fullest possible extent. According to Figure 5, it is expected that someone with little experience should be able to reproduce precise snow depth measurements with only minimal instructions and guidance.

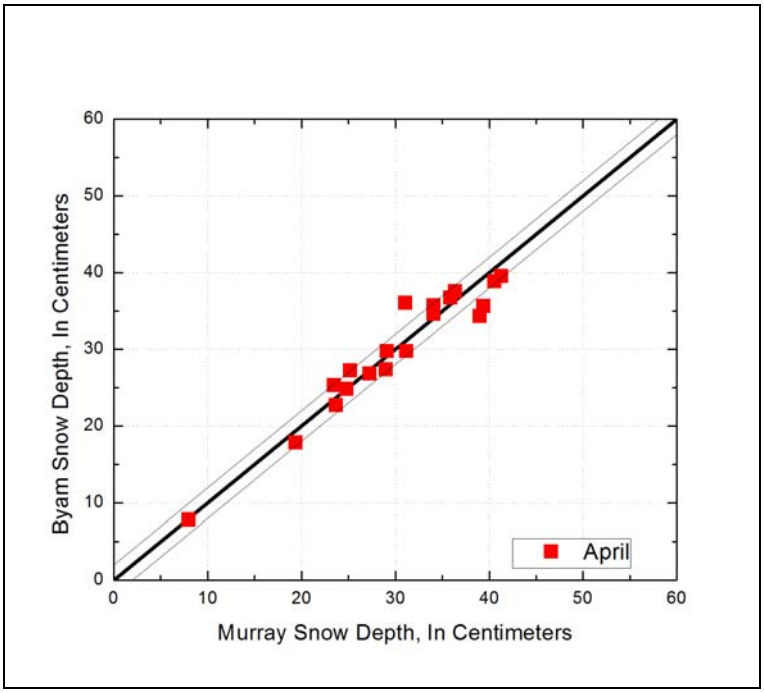

Figure 5. Comparison plot between Jeff Murray (ATN) and Sarah Byam (UAF) snow depth measurements taken at various locations during April trip.

As shown in Figure 6, most of the co-located sites visited throughout the winter resulted in average snow depths that fell outside of the recommended +/- 2 cm range. Several factors, including different equipment, method, time difference, and measurement goal likely accounted for the difference in recorded depths. The procedures section describes the difference in equipment and methods used by both groups to measure snow depth. The difference in probe and number of samples likely results in a difference in depths, and ADNR often performs its sampling on different dates than ATN. Strong wind and snow events can greatly alter the snow

distribution throughout the North Slope, so it should not be surprising if samples conducted on different days result in different depths. Lastly, ATN and ADNR both have different reasons for measuring snow depth. The ATN project collects snow depths in order to calculate both depths and SWE at each location. In order to do this, it is necessary to sample the overall landscape, which includes both snow drifts and troughs. ADNR, on the other hand, samples snow depth for the purpose of protecting the tundra from damage by travelling vehicles. ADNR avoids both drifts and troughs, so they are more likely to find lower overall snow depths than ATN.

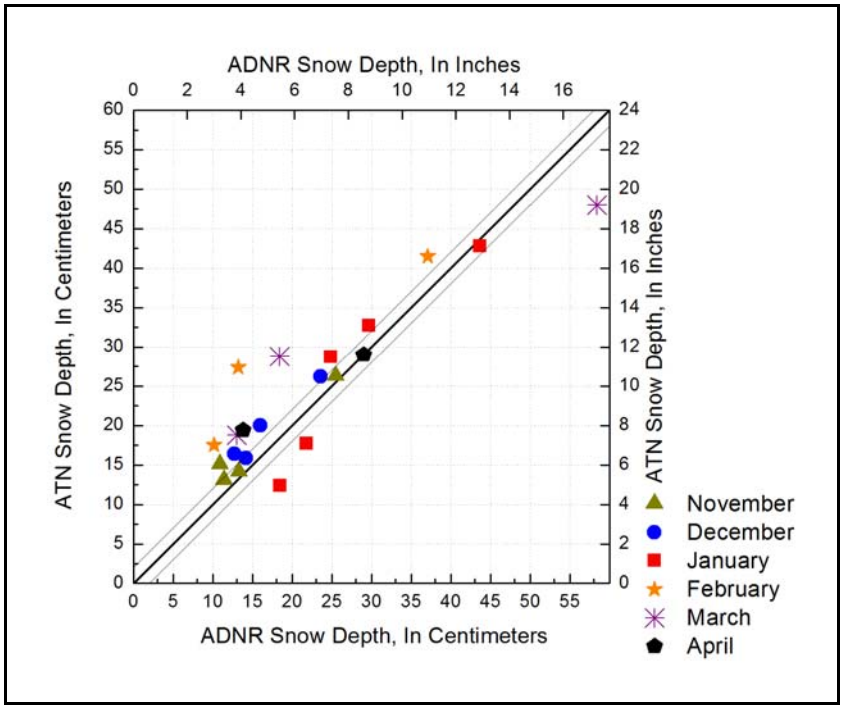

Figure 6. Comparison plot between ATN and ADNR of snow depth measurements taken at co-located sites from November 2009 to April 2010.

Despite continued cold temperatures into the month of April, the water level at L9312 increased from the level measured during the previous month's trip. According to Figure 7, the lake level tends to increase later in the spring/summer. This year, however, the lake level increased between the months of March and April due to an increase in snow accumulation on the lake ice surface.

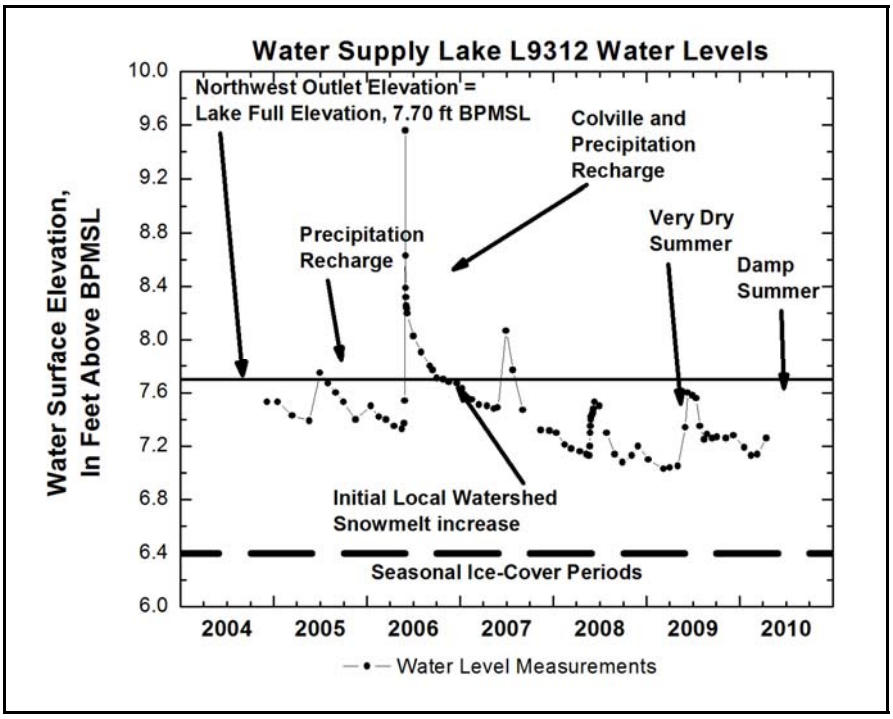

Figure 7. Plot of water level at L9312 through April 15, 2010.

SUMMARY

During the April ATN trip, objectives continued to focus on snow depth and density measurements. Most of the snow sites visited had two sets of snow depth measurements taken, one by ATN and one by UAF personnel. The depths were compared in order to assess the precision of measurements taken by two different people. Lake and ice depth measurements were taken, along with lake level survey and water quality sampling measurements. At 2L-Pad Met station, a solar panel was installed, and it is successfully charging and transmitting data. The collection of snow and lake information related to Arctic transportation networks will help the development of regulatory and user management tools and forecast modeling tools. These tools will help with the increasing development of resources and variation of natural conditions in these extreme Arctic climates.

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APPENDIX A. 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 Project**	Site Location/Lake ID:	**ADNR J-Pad**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/14/2010	Time: 14:45

Location Description:	East of road before 1J-Pad, near soil thermistors. GWS measures to right (as looking at bore tube from road) and DNR measures to left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management			Weather Observations	20 F, Windy, Cloudy
Latitude:	N 70° 16.260'	Longitude:	W 149° 31.140'	Datum:	NAD83
Elevation:	82 ft	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Unnamed stream east of Ugnuravik River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	2 solid layers, sintering at base
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	36.0	26.0	27.0	39.0	24.0
2	26.0	24.5	23.0	41.5	31.5
3	18.5	45.0	22.0	35.0	35.5
4	17.0	46.0	26.0	35.0	45.0
5	19.0	45.0	29.0	35.5	50.0
6	23.5	51.0	32.0	29.0	42.0
7	25.5	45.0	31.5	19.0	33.0
8	23.0	38.0	32.0	12.0	31.5
9	24.0	37.0	34.0	22.0	26.5
10	19.0	32.0	35.0	22.5	35.0

	(cm)
Average snow depth =	**31.1**
Maximum snow depth =	51.0
Minimum snow depth =	12.0
Standard deviation =	9.2

	(inches)
Average snow depth =	**12.3**
Maximum snow depth =	**20.1**
Minimum snow depth =	**4.7**
Standard deviation =	**3.6**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
k4	24	245.4	856.8	0.29	
k2	26	197.5	928.2	0.21	
k5	24	225.2	856.8	0.26	
k3	36	350.5	1285.2	0.27	
k1	38	226.7	1356.6	0.17	

Average Density =	**0.240**	
Average Snow Water Equivalent (SWE) =	**7.5**	cm H2O
Average Snow Water Equivalent =	**2.95**	inches H2O
Average Snow Water Equivalent =	**0.25**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: K. Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR J-Pad - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/14/2010	Time: 14:45

Location Description:	East of road before 1J-Pad, near soil thermistors. GWS measures to right (as looking at bore tube from road) and DNR measures to left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management			Weather Observations	20 F, Windy, Cloudy
Latitude:	N 70° 16.260'	Longitude:	W 149° 31.140'	Datum:	NAD83
Elevation:	82 ft	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Unnamed stream east of Ugnuravik River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	2 solid layers, sintering at base
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	21.0	35.0	35.0	41.5	26.5
2	19.0	32.0	45.0	36.5	30.0
3	24.0	42.0	36.5	36.5	42.0
4	21.5	29.0	38.0	42.0	42.0
5	31.5	35.5	33.5	44.0	44.5
6	24.0	44.5	30.0	36.0	51.5
7	21.0	42.0	29.5	31.5	54.5
8	14.0	55.0	28.0	35.5	50.0
9	23.0	46.0	43.5	40.0	43.0
10	34.0	41.0	42.0	32.0	43.0

	(cm)
Average snow depth =	**36.0**
Maximum snow depth =	55.0
Minimum snow depth =	14.0
Standard deviation =	9.3

	(inches)
Average snow depth =	**14.2**
Maximum snow depth =	**21.7**
Minimum snow depth =	**5.5**
Standard deviation =	**3.7**

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR 2L-Pad**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/16/2010	Time: 11:45

Location Description:	West of road between 2L-Pad and 2N-Pad, near soil thermistors. GWS measures to right (as looking at bore tube from road) and DNR measures to left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management. Snow depth comparison between ATN personnel.			Weather Observations	10 F, Cloudy, Light wind
Latitude:	N 70° 11.481'	Longitude:	W 150° 19.397'	Datum:	NAD83
Elevation:	112 ft	Elevation Datum:	NGVD29	Reference Markers:	Just northeast of weather station
Drainage Basin:	Miluveach River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Thermal construction, packed
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	33.5	45.5	37.0	43.0	26.0
2	37.5	46.0	32.0	47.0	31.0
3	39.0	37.0	32.0	43.0	34.0
4	34.0	30.0	17.0	37.0	36.0
5	31.5	32.0	20.5	37.0	31.0
6	44.0	25.0	32.5	44.5	35.0
7	39.0	24.0	32.0	36.0	34.5
8	42.0	31.0	31.0	30.5	26.0
9	43.0	28.0	34.0	39.0	23.5
10	41.0	26.0	31.0	29.0	32.0

	(cm)
Average snow depth =	**34.1**
Maximum snow depth =	47.0
Minimum snow depth =	17.0
Standard deviation =	6.8

	(inches)
Average snow depth =	**13.4**
Maximum snow depth =	**18.5**
Minimum snow depth =	**6.7**
Standard deviation =	**2.7**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
a3	34	271.6	1213.8	0.22	
a4	21	199.5	749.7	0.27	
a1	18	150.3	642.6	0.23	
a2	38	339.5	1356.6	0.25	
a5	34	280.4	1213.8	0.23	

Average Density =	**0.241**	
Average Snow Water Equivalent (SWE) =	**8.2**	cm H2O
Average Snow Water Equivalent =	**3.23**	inches H2O
Average Snow Water Equivalent =	**0.27**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: K. Hilton Date: 6/1/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR 2L-Pad - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/16/2010	Time: 11:45

Location Description:	West of road between 2L-Pad and 2N-Pad, near soil thermistors. GWS measures to right (as looking at bore tube from road) and DNR measures to left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management. Snow depth comparison between ATN personnel			Weather Observations	10 F, Cloudy, Light wind
Latitude:	N 70° 11.481'	Longitude:	W 150° 19.397'	Datum:	NAD83
Elevation:	112 ft	Elevation Datum:	NGVD29	Reference Markers:	Just northeast of weather station
Drainage Basin:	Miluveach River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Thermal construction, packed
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	38.0	36.0	28.5	33.5	37.0
2	42.0	26.0	29.0	44.5	36.5
3	42.0	38.5	35.0	47.0	26.5
4	37.0	34.5	28.5	46.0	33.0
5	34.0	31.0	24.0	45.0	34.0
6	38.0	29.0	24.0	42.0	28.0
7	38.0	26.0	31.5	46.0	34.0
8	37.0	24.5	33.0	40.0	31.0
9	38.0	30.0	31.0	31.0	33.0
10	37.5	35.0	32.0	35.5	36.5

	(cm)
Average snow depth =	**34.6**
Maximum snow depth =	47.0
Minimum snow depth =	24.0
Standard deviation =	5.9

	(inches)
Average snow depth =	**13.6**
Maximum snow depth =	**18.5**
Minimum snow depth =	**9.4**
Standard deviation =	**2.3**

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: K. Hilton Date: 6/1/10

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

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR 2P-Pad**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/15/2010	Time: 18:02

Location Description:	West of road to 2P-Pad, North of 2P Pad, North of soil thermistors. GWS measures to right (as looking at bore tube from road) and DNR measures to left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management. Snow depth comparison between ATN personnel			Weather Observations:	20 F, Calm, Sunny
Latitude:	N 70° 03.853'	Longitude:	W 150° 26.779'	Datum:	NAD83
Elevation:	200 ft	Elevation Datum:	NGVD29	Reference Markers:	none
Drainage Basin:	Kachemach River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Packed, Sintering, 2 layers, Vegetation visible
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	23.5	22.5	53.5	15.0	24.0
2	19.0	27.0	53.0	19.5	31.5
3	35.5	28.0	48.5	16.5	27.5
4	34.0	22.5	37.5	14.0	28.5
5	20.0	30.5	42.5	18.0	33.0
6	25.5	31.0	37.5	26.5	30.0
7	25.5	31.0	37.0	28.0	20.0
8	26.0	26.5	27.0	25.5	28.0
9	29.0	46.0	28.0	23.5	35.0
10	22.0	50.0	14.0	22.0	28.5

	(cm)
Average snow depth =	**29.0**
Maximum snow depth =	53.5
Minimum snow depth =	14.0
Standard deviation =	9.5

	(inches)
Average snow depth =	**11.4**
Maximum snow depth =	**21.1**
Minimum snow depth =	**5.5**
Standard deviation =	**3.7**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
e1	20	178.7	714.0	0.25	
e2	26	259.4	928.2	0.28	
e3	32	378.3	1142.4	0.33	
e4	18	157.7	642.6	0.25	
e5	24	196.0	856.8	0.23	

Average Density =	**0.267**	
Average Snow Water Equivalent (SWE) =	**7.7**	cm H2O
Average Snow Water Equivalent =	**3.04**	inches H2O
Average Snow Water Equivalent =	**0.25**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10
Data QA/QC by: Kristie Hilton Date: 4/28/10

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

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR 2P-Pad - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/15/2010	Time: 18:02

Location Description:	West of road to 2P-Pad, North of 2P Pad, North of soil thermistors. GWS measures to right (as looking at bore tube from road) and DNR measures to left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management. Snow depth comparison between ATN personnel			Weather Observations:	20 F, Calm, Sunny
Latitude:	N 70° 03.853'	Longitude:	W 150° 26.779'	Datum:	NAD83
Elevation:	200 ft	Elevation Datum:	NGVD29	Reference Markers:	none
Drainage Basin:	Kachemach River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Packed, Sintering, 2 layers, Vegetation visible
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	33.0	26.0	47.0	34.0	23.0
2	31.0	29.0	36.5	28.0	21.5
3	39.0	25.0	37.0	24.0	29.5
4	36.0	21.5	40.0	21.0	14.5
5	23.0	22.5	46.5	16.0	20.5
6	12.0	19.5	41.0	16.0	20.0
7	13.0	23.5	46.0	28.0	20.0
8	16.5	28.5	44.5	14.0	15.0
9	23.0	39.0	45.0	21.0	17.0
10	23.0	39.5	30.0	23.0	21.5

	(cm)
Average snow depth =	**27.3**
Maximum snow depth =	47.0
Minimum snow depth =	12.0
Standard deviation =	9.9

	(inches)
Average snow depth =	**10.7**
Maximum snow depth =	**18.5**
Minimum snow depth =	**4.7**
Standard deviation =	**3.9**

Data entered by: Jeff Murray Date: 4/20/10
Data QA/QC by: Kristie Hilton Date: 4/27/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**30 Mile**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/11/2010	Time: 17:30

Location Description:	Near the black PVC pipe. GWS stays to right (as looking at the pipe) and DNR stays left.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	30 F, Light, Partly cloudy, calm
Latitude:	N 69° 50.337'	Longitude:	W 148° 45.458'	Datum:	NAD 83
Elevation:	209 ft	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Sagavanirktok River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Hard Packed Snow, vegetation visible
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Michael Lilly, Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	18.5	17.0	20.0	23.0	31.0
2	19.5	19.0	15.0	20.5	29.0
3	23.0	25.0	7.5	9.0	30.0
4	21.0	17.0	12.0	27.0	25.5
5	22.0	10.5	15.0	20.0	23.0
6	25.0	14.5	18.0	15.0	24.0
7	23.5	13.0	16.0	22.0	21.0
8	21.0	11.0	17.5	22.0	19.5
9	16.0	15.5	20.5	25.0	20.0
10	16.0	12.0	20.5	24.5	15.0

	(cm)
Average snow depth =	**19.4**
Maximum snow depth =	31.0
Minimum snow depth =	7.5
Standard deviation =	5.3

	(inches)
Average snow depth =	**7.6**
Maximum snow depth =	**12.2**
Minimum snow depth =	**3.0**
Standard deviation =	**2.1**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
W2	22	163.8	785.4	0.21	
W4	26	249.6	928.2	0.27	
FB2	18	143.1	642.6	0.22	
D3	15	102.6	535.5	0.19	
F3	19	120.6	678.3	0.18	

Average Density =	**0.214**	
Average Snow Water Equivalent (SWE) =	**4.1**	cm H2O
Average Snow Water Equivalent =	**1.63**	inches H2O
Average Snow Water Equivalent =	**0.14**	feet H2O

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

Data entered by: Jeff Murray Date: 4/12/2010

Data QA/QC by: Kristie Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**30 Mile - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/11/2010	Time: 17:30

Location Description:	Near the black PVC pipe. GWS stays to right (as looking at the pipe) and DNR stays left.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	30 F, Light, Partly cloudy, calm
Latitude:	N 69° 50.337'	Longitude:	W 148° 45.458'	Datum:	NAD 83
Elevation:	209 ft	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Sagavanirktok River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Hard Packed Snow, vegetation visible
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Michael Lilly, Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	13.0	10.5	13.5	16.0	23.5
2	17.0	18.5	11.5	32.0	27.0
3	27.0	24.0	16.0	11.5	26.0
4	21.5	18.0	12.0	10.0	24.0
5	20.5	11.5	12.5	16.0	24.5
6	19.0	8.5	18.5	15.0	23.0
7	24.0	8.5	16.0	19.0	19.0
8	22.0	7.0	17.5	20.0	21.0
9	18.0	8.0	19.0	21.5	15.0
10	13.0	12.0	21.0	23.0	22.0

(cm)	
Average snow depth =	**17.8**
Maximum snow depth =	32.0
Minimum snow depth =	7.0
Standard deviation =	5.7

(inches)	
Average snow depth =	**7.0**
Maximum snow depth =	**12.6**
Minimum snow depth =	**2.8**
Standard deviation =	**2.2**

Data entered by: Jeff Murray Date: 4/12/2010

Data QA/QC by: Kristie Hilton Date: 6/1/2010

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

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR 318 Mile**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/16/2010	Time: 21:03

Location Description:	Off of Dalton Highway. Near PVC pipe. GWS stays to right (as looking at the pipe) and DNR stays left.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations:	10 F, Light wind, Partly cloudy
Latitude:	N 68° 55.328'	Longitude:	W 148° 51.004'	Datum:	NAD 83
Elevation:	1,280 ft	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Sagavanirktok River	Slope Direction:	Gently sloping to east	Vegetation Type:	Woody brush, Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	4 cm crust, hor underneath, quick snow
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	60.0	55.0	34.0	47.5	40.0
2	54.0	46.5	39.0	51.0	35.0
3	51.5	44.0	43.5	55.0	25.0
4	58.0	46.5	28.5	51.5	38.0
5	42.0	46.0	41.5	41.0	51.0
6	58.5	44.0	22.5	44.0	45.0
7	48.0	46.5	29.0	38.0	43.5
8	51.5	45.0	46.0	37.0	57.0
9	54.5	41.0	52.5	39.0	55.0
10	57.5	49.5	43.0	32.5	66.0

	(cm)
Average snow depth =	**45.4**
Maximum snow depth =	66.0
Minimum snow depth =	22.5
Standard variation =	9.3
	(inches)
Average snow depth =	**17.9**
Maximum snow depth =	**26.0**
Minimum snow depth =	**8.9**
Standard variation =	**3.7**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
j2	46	543.7	1642.2	0.33	
h4	33	285.2	1178.1	0.24	
j1	26	297.5	928.2	0.32	
e5	39	313.0	1392.3	0.22	
f3	49	323.8	1749.3	0.19	

Average Density =	**0.261**	
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: Jeff Murray Date: 4/20/10
Data QA/QC by: Kristie Hilton Date: 6/1/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR 62 Mile**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/16/2010	Time: 19:15

Location Description:	Off of Dalton Highway, top of ridge, west side of highway.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations:	10 F, Light wind, Cloudy
Latitude:	N 69° 25.320'	Longitude:	W 148° 40.140'	Datum:	NAD 83
Elevation:	1,090 ft	Elevation Datum:	NGVD29	Reference Markers:	Stakes in ground
Drainage Basin:	Toolik River	Slope Direction:	Ridge Top	Vegetation Type:	Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Sintering to surface, melting
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	25.0	28.0	20.5	25.0	29.0
2	35.0	26.0	16.0	41.5	39.5
3	27.0	23.0	29.0	21.0	41.0
4	21.0	37.5	58.5	27.5	30.5
5	31.0	23.0	32.5	23.0	41.0
6	28.0	25.5	36.0	25.0	29.5
7	25.0	19.0	23.5	30.0	35.0
8	30.5	37.5	18.5	39.5	25.5
9	33.0	17.5	29.0	22.5	28.0
10	30.5	33.0	37.0	28.0	26.0

	(cm)
Average snow depth =	**29.3**
Maximum snow depth =	58.5
Minimum snow depth =	16.0
Standard variation =	7.7

	(inches)
Average snow depth =	**11.5**
Maximum snow depth =	**23.0**
Minimum snow depth =	**6.3**
Standard variation =	**3.0**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
z2	25	203.5	892.5	0.23	
h2	22	205.1	785.4	0.26	
n1	24	214.1	856.8	0.25	
n3	23	150.5	821.1	0.18	
:)2	23	171.4	821.1	0.21	

Average Density =	**0.226**	
Average Snow Water Equivalent (SWE) =	**6.6**	cm H2O
Average Snow Water Equivalent =	**2.61**	inches H2O
Average Snow Water Equivalent =	**0.22**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**Alpine 1**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 13:24

Location Description:	Along Alpine ice road. Proposed snow depth sampling location northeast of road.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	10 F, Calm, Scattered clouds
Latitude:	N 70° 25.383'	Longitude:	W 150° 54.944'	Datum:	NAD 83
Elevation:	3 ft.	Elevation Datum:	NGVD29	Reference Markers:	Orange stakes
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Track through site, drifting from wind shadow, packed
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	35.0	40.0	36.5	28.0	32.5
2	40.0	46.0	29.0	26.0	29.0
3	35.5	55.0	33.0	27.0	25.0
4	38.0	43.0	35.0	28.5	29.5
5	31.0	43.0	34.0	33.5	20.0
6	23.5	37.0	28.5	34.5	34.0
7	33.0	38.0	30.0	35.5	35.0
8	34.5	40.0	31.5	30.0	42.0
9	30.0	42.0	29.0	32.5	38.0
10	35.0	43.0	28.5	33.0	36.0

	(cm)
Average snow depth =	**34.1**
Maximum snow depth =	55.0
Minimum snow depth =	20.0
Standard variation =	6.3
	(inches)
Average snow depth =	**13.4**
Maximum snow depth =	**21.7**
Minimum snow depth =	**7.9**
Standard variation =	**2.5**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
i1	32	336.1	1142.4	0.29	
i3	44	485.3	1570.8	0.31	
i4	30	277.3	1071.0	0.26	
i5	31	324.2	1106.7	0.29	
i2	33	368.6	1178.1	0.31	

Average Density =	**0.294**	
Average Snow Water Equivalent (SWE) =	**10.0**	cm H2O
Average Snow Water Equivalent =	**3.95**	inches H2O
Average Snow Water Equivalent =	**0.33**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**Alpine 1 - SB**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 13:24

Location Description:	Along Alpine ice road. Proposed snow depth sampling location northeast of road.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	10 F, Calm, Scattered clouds
Latitude:	N 70° 25.383'	Longitude:	W 150° 54.944'	Datum:	NAD 83
Elevation:	3 ft.	Elevation Datum:	NGVD29	Reference Markers:	Orange stakes
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Track through site, drifting from wind shadow, packed
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	35.0	41.5	33.0	27.0	37.0
2	42.0	42.5	33.5	28.0	36.0
3	44.5	43.5	30.0	24.0	34.0
4	36.5	42.0	31.0	31.0	33.5
5	34.0	42.0	33.0	33.0	39.0
6	39.5	39.0	29.5	34.0	43.0
7	39.5	36.0	30.0	33.5	38.0
8	38.0	41.0	31.0	33.0	40.0
9	34.0	39.0	31.5	31.0	35.0
10	52.0	36.0	28.0	33.0	34.5

	(cm)
Average snow depth =	**35.7**
Maximum snow depth =	52.0
Minimum snow depth =	24.0
Standard variation =	5.3

	(inches)
Average snow depth =	**14.1**
Maximum snow depth =	**20.5**
Minimum snow depth =	**9.4**
Standard variation =	**2.1**

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**Alpine 2**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 14:15

Location Description:	Along ice road. Proposed snow depth sampling location west of the road.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	10 F, Calm, Sunny
Latitude:	N 70° 24.564'	Longitude:	W 151° 00.482'	Datum:	NAD 83
Elevation:	2 ft.	Elevation Datum:	NGVD29	Reference Markers:	Orange stakes
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Packed, Hard surface, Heavy sintering
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	26.0	33.0	43.0	35.5	30.0
2	28.5	23.5	41.0	42.0	33.0
3	31.5	33.0	40.0	37.0	34.5
4	28.0	31.5	37.0	44.0	41.5
5	32.0	34.0	40.0	47.0	37.0
6	32.5	36.0	33.0	49.5	38.0
7	35.0	37.0	35.0	39.0	26.0
8	33.0	43.5	39.0	48.0	35.0
9	31.5	44.0	39.0	38.0	31.0
10	32.0	42.0	36.0	34.0	24.0

	(cm)
Average snow depth =	**35.9**
Maximum snow depth =	49.5
Minimum snow depth =	23.5
Standard variation =	5.9

	(inches)
Average snow depth =	**14.1**
Maximum snow depth =	**19.5**
Minimum snow depth =	**9.3**
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)
j5	34	325.9	1213.8	0.27	
j4	32	274.7	1142.4	0.24	
j1	36	321.8	1285.2	0.25	
j3	29	258.9	1035.3	0.25	
j2	31	325.3	1106.7	0.29	

Average Density =	**0.261**	
Average Snow Water Equivalent (SWE) =	**9.4**	cm H2O
Average Snow Water Equivalent =	**3.68**	inches H2O
Average Snow Water Equivalent =	**0.31**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

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

Project ID:	**ATN**	Site Location/Lake ID:	**Alpine 2 - SB**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 14:15

Location Description:	Along ice road. Proposed snow depth sampling location west of the road.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	10 F, Calm, Sunny
Latitude:	N 70° 24.564'	Longitude:	W 151° 00.482'	Datum:	NAD 83
Elevation:	2 ft.	Elevation Datum:	NGVD29	Reference Markers:	Orange stakes
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Packed, Hard surface, Heavy sintering
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	31.5	34.0	40.0	36.5	39.0
2	30.0	28.5	33.0	37.5	29.5
3	28.0	27.0	44.0	36.0	25.0
4	28.5	33.0	47.0	40.0	29.0
5	35.0	26.0	46.0	41.5	41.5
6	32.0	34.0	49.0	49.0	35.0
7	32.0	34.0	42.0	46.0	41.0
8	34.0	30.5	43.0	44.0	43.0
9	35.0	29.0	37.0	42.0	40.0
10	35.0	43.0	41.5	49.0	29.5

	(cm)
Average snow depth =	**36.7**
Maximum snow depth =	49.0
Minimum snow depth =	25.0
Standard variation =	6.6
	(inches)
Average snow depth =	**14.5**
Maximum snow depth =	**19.3**
Minimum snow depth =	**9.8**
Standard variation =	**2.6**

Data entered by: Jeff Murray Date: 4/20/10
Data QA/QC by: Kristie Hilton Date: 4/27/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**Alpine 4**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 15:14

Location Description:	Along ice road. Proposed snow depth sampling location west of the road.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	20 F, Calm, Sunny
Latitude:	N 70° 16.183'	Longitude:	W 150° 59.730'	Datum:	NAD 83
Elevation:	2 ft.	Elevation Datum:	NGVD29	Reference Markers:	Orange stakes
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Polygon topography, vegetation visible
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	32.0	21.0	52.0	24.0	35.5
2	25.0	16.0	32.0	29.0	37.5
3	31.0	14.0	46.0	21.5	37.5
4	39.0	18.5	57.5	24.0	34.0
5	28.0	15.0	49.0	20.5	30.0
6	32.5	21.0	49.0	21.5	38.0
7	36.0	23.5	52.0	39.0	20.0
8	17.0	28.0	53.0	37.0	18.0
9	14.0	33.0	39.0	28.0	26.0
10	8.0	46.5	35.0	41.0	33.0

	(cm)
Average snow depth =	**31.2**
Maximum snow depth =	57.5
Minimum snow depth =	8.0
Standard variation =	11.7

	(inches)
Average snow depth =	**12.3**
Maximum snow depth =	**22.6**
Minimum snow depth =	**3.1**
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)
z1	19	174.5	678.3	0.26	
z5	32	347.6	1142.4	0.30	
z3	44	381.5	1570.8	0.24	
z2	27	200.3	963.9	0.21	
z4	21	187.0	749.7	0.25	

Average Density =	**0.252**	
Average Snow Water Equivalent (SWE) =	**7.9**	cm H2O
Average Snow Water Equivalent =	**3.10**	inches H2O
Average Snow Water Equivalent =	**0.26**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**Alpine 4 - SB**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 15:14

Location Description:	Along ice road. Proposed snow depth sampling location west of the road.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	20 F, Calm, Sunny
Latitude:	N 70° 16.183'	Longitude:	W 150° 59.730'	Datum:	NAD 83
Elevation:	2 ft.	Elevation Datum:	NGVD29	Reference Markers:	Orange stakes
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Polygon topography, vegetation visible
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	36.0	13.0	26.0	33.0	28.0
2	40.0	15.0	31.0	22.0	29.0
3	31.0	13.0	22.0	20.0	30.5
4	33.5	18.0	43.0	22.0	34.0
5	34.5	39.0	48.0	42.0	44.0
6	27.0	31.0	41.5	30.0	34.5
7	25.0	26.5	48.5	27.0	34.0
8	22.0	21.0	39.0	20.0	31.5
9	21.0	29.0	28.0	28.0	24.0
10	26.0	26.0	27.0	42.0	26.0

	(cm)
Average snow depth =	**29.7**
Maximum snow depth =	48.5
Minimum snow depth =	13.0
Standard variation =	8.6

	(inches)
Average snow depth =	**11.7**
Maximum snow depth =	**19.1**
Minimum snow depth =	**5.1**
Standard variation =	**3.4**

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/27/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**Alpine 5**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 16:30

Location Description:	Along Alpine ice road. Proposed snow depth sampling location northeast of road and on a lake.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	20 F, Calm, Sunny, Scattered clouds
Latitude:	N 70° 13.801'	Longitude:	W 150° 43.969'	Datum:	NAD 83
Elevation:	3 ft.	Elevation Datum:	NGVD29	Reference Markers:	Between Ice Road and Pipeline
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Density pts 4 & 5 were over ice
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	51.0	46.5	39.0	29.0	28.0
2	55.0	50.0	29.0	33.0	35.0
3	51.0	42.0	29.0	26.5	42.0
4	45.0	41.0	30.0	29.0	46.0
5	52.0	42.0	42.5	32.0	39.0
6	54.5	34.0	34.0	32.0	33.0
7	50.0	29.0	24.0	31.0	32.0
8	50.0	31.0	20.0	30.0	26.0
9	49.5	33.5	15.0	28.0	29.5
10	49.0	29.0	28.0	28.0	34.0

	(cm)
Average snow depth =	**36.4**
Maximum snow depth =	55.0
Minimum snow depth =	15.0
Standard variation =	9.7

	(inches)
Average snow depth =	**14.3**
Maximum snow depth =	**21.7**
Minimum snow depth =	**5.9**
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)
b2	50	582.5	1785.0	0.33	
b1	36	316.6	1285.2	0.25	
b4	34	343.1	1213.8	0.28	
x2	29	373.6	1035.3	0.36	
b3	24	243.4	856.8	0.28	

Average Density =	**0.300**	
Average Snow Water Equivalent (SWE) =	**10.9**	cm H2O
Average Snow Water Equivalent =	**4.30**	inches H2O
Average Snow Water Equivalent =	**0.36**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**Alpine 5 - SB**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 16:30

Location Description:	Along Alpine ice road. Proposed snow depth sampling location northeast of road and on a lake.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	20 F, Calm, Sunny, Scattered clouds
Latitude:	N 70° 13.801'	Longitude:	W 150° 43.969'	Datum:	NAD 83
Elevation:	3 ft.	Elevation Datum:	NGVD29	Reference Markers:	Between Ice Road and Pipeline
Drainage Basin:	Colville River	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Density pts 4 & 5 were over ice
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	50.0	48.0	34.0	23.0	29.5
2	52.0	49.0	25.5	29.0	27.0
3	51.5	56.0	21.5	26.5	31.0
4	50.5	40.0	34.0	27.0	33.5
5	48.0	43.5	42.0	35.0	39.0
6	55.0	36.5	35.5	28.0	40.0
7	56.0	32.0	32.0	28.0	42.0
8	58.0	34.0	33.0	32.5	46.5
9	45.0	32.5	23.0	33.0	44.5
10	47.5	35.0	22.0	31.0	27.0

	(cm)
Average snow depth =	**37.5**
Maximum snow depth =	58.0
Minimum snow depth =	21.5
Standard variation =	10.1

	(inches)
Average snow depth =	**14.8**
Maximum snow depth =	**22.8**
Minimum snow depth =	**8.5**
Standard variation =	**4.0**

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/27/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**ANFO2**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/12/2010	Time: 16:15

Location Description:	Off road to the North. Near Duck Island gravel pit. Close to PVC pipe.. GWS stays to right (as looking at pipe) and DNR stays left.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	20 F, Light Winds, Scattered Clouds
Latitude:	N 70° 14.460'	Longitude:	W 148° 10.800'	Datum:	NAD 83
Elevation:	27 ft.	Elevation Datum:	NGVD29	Reference Markers:	Black PVC pipe
Drainage Basin:	Sagavanirktok River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	multi wind packed layers, long grass
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	29.5	33.0	31.0	17.0	27.0
2	24.5	40.0	25.0	19.0	24.5
3	26.5	38.5	27.5	21.0	27.0
4	23.0	40.5	26.0	17.0	27.5
5	24.0	39.0	25.0	22.0	24.0
6	24.0	37.0	22.0	25.0	24.0
7	29.0	34.5	20.0	21.5	27.0
8	35.0	32.5	23.5	17.0	29.0
9	36.0	33.0	21.5	25.0	
10	35.0	31.0	20.0	27.5	

	(cm)
Average snow depth =	**27.3**
Maximum snow depth =	40.5
Minimum snow depth =	17.0
Standard deviation =	6.3
	(inches)
Average snow depth =	**10.7**
Maximum snow depth =	**15.9**
Minimum snow depth =	**6.7**
Standard deviation =	**2.5**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
x1	21	178.2	749.7	0.24	
x4	38	406.9	1356.6	0.30	
f1	18	198.2	642.6	0.31	
w3	19	189.2	678.3	0.28	
fb4	34	310.1	1213.8	0.26	

Average Density =	**0.276**	
Average Snow Water Equivalent (SWE) =	**7.5**	cm H2O
Average Snow Water Equivalent =	**2.96**	inches H2O
Average Snow Water Equivalent =	**0.25**	feet H2O

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

Data entered by: Jeff Murray Date: 4/14/2010

Data QA/QC by: K. Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**ANFO2 - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/12/2010	Time: 16:15

Location Description:	Off road to the North. Near Duck Island gravel pit. Close to PVC pipe.. GWS stays to right (as looking at pipe) and DNR stays left.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	20 F, Light Winds, Scattered Clouds
Latitude:	N 70° 14.460'	Longitude:	W 148° 10.800'	Datum:	NAD 83
Elevation:	27 ft.	Elevation Datum:	NGVD29	Reference Markers:	Black PVC pipe
Drainage Basin:	Sagavanirktok River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	multi wind packed layers, long grass
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	37.0	31.0	22.0	16.0	25.0
2	38.5	33.5	22.0	17.5	26.5
3	32.0	42.0	21.0	22.0	28.5
4	27.0	43.0	25.0	23.0	34.0
5	25.0	36.0	24.0	20.0	31.5
6	23.0	35.5	22.0	23.0	35.0
7	22.0	28.0	24.0	25.0	35.0
8	21.0	27.0	23.5	20.0	32.0
9	24.0	22.0	23.0	23.0	31.5
10	22.5	20.0	22.0	24.0	29.5

	(cm)
Average snow depth =	**26.8**
Maximum snow depth =	43.0
Minimum snow depth =	16.0
Standard deviation =	6.3

	(inches)
Average snow depth =	**10.6**
Maximum snow depth =	**16.9**
Minimum snow depth =	**6.3**
Standard deviation =	**2.5**

Data entered by: Jeff Murray Date: 4/14/2010

Data QA/QC by: K. Hilton Date: 6/1/2010

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

Project ID:	**ATN Project**	Site Location/Lake ID:	**Badami MET**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/13/2010	Time: 15:50

Location Description:	~ 50 yards northeast of the Badami Met Station. Lath was placed in the tundra marknig the starting point of the survey.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	20 F, Calm, Cloudy
Latitude:	N 70° 8.195'	Longitude:	W 147° 0.554'	Datum:	NAD83
Elevation:	26 ft	Elevation Datum:	NGVD29	Reference Markers:	Met Station
Drainage Basin:	Beaufort Sea Coastal Plain	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Multiple brittle layers, hard surface
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	24.0	28.5	23.0	32.0	37.0
2	25.5	23.0	17.0	24.0	36.0
3	22.0	29.0	15.0	24.0	36.5
4	17.0	24.0	20.0	18.0	27.0
5	22.0	26.0	26.0	20.0	17.0
6	22.5	26.5	22.0	18.0	20.0
7	19.0	29.5	22.5	22.0	18.0
8	17.0	24.0	24.0	20.0	16.0
9	18.5	19.0	32.0	30.5	18.5
10	13.0	26.0	27.0	32.0	23.0

	(cm)
Average snow depth =	**23.5**
Maximum snow depth =	37.0
Minimum snow depth =	13.0
Standard deviation =	5.7

	(inches)
Average snow depth =	**9.2**
Maximum snow depth =	**14.6**
Minimum snow depth =	**5.1**
Standard deviation =	**2.2**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
w5	18	171.0	642.6	0.27	
o4	19	195.9	678.3	0.29	
x1	17	175.3	606.9	0.29	
fb3	16	133.1	571.2	0.23	
o2	18	165.2	642.6	0.26	

Average Density =	**0.267**	
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: Jeff Murray Date: 4/14/2010
Data QA/QC by: K. Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**Badami MET - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/13/2010	Time: 15:50

Location Description:	~ 50 yards northeast of the Badami Met Station. Lath was placed in the tundra marknig the starting point of the survey.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	20 F, Calm, Cloudy
Latitude:	N 70° 8.195'	Longitude:	W 147° 0.554'	Datum:	NAD83
Elevation:	26 ft	Elevation Datum:	NGVD29	Reference Markers:	Met Station
Drainage Basin:	Beaufort Sea Coastal Plain	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Multiple brittle layers, hard surface
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	21.0	18.5	28.5	27.0	24.0
2	20.0	25.0	20.5	27.0	29.0
3	22.0	22.0	23.5	35.0	36.5
4	16.0	20.5	25.0	28.0	38.0
5	18.0	19.0	15.0	33.0	35.0
6	17.0	18.0	18.0	29.5	32.0
7	27.0	23.0	22.0	34.5	43.0
8	22.5	30.0	24.5	31.0	32.0
9	20.0	29.0	23.5	19.0	25.0
10	20.0	29.0	19.0	27.0	24.5

	(cm)
Average snow depth =	**25.3**
Maximum snow depth =	43.0
Minimum snow depth =	15.0
Standard deviation =	6.3

	(inches)
Average snow depth =	**10.0**
Maximum snow depth =	**16.9**
Minimum snow depth =	**5.9**
Standard deviation =	**2.5**

Data entered by: Jeff Murray Date: 4/14/2010
Data QA/QC by: K. Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**Badami Reservoir**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/13/2010	Time: 17:00

Location Description:	~ 200 yards ESE of the road entrance				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	20 F, Calm, Thin clouds
Latitude:	N 70° 7.775'	Longitude:	W 146° 59.956'	Datum:	NAD83
Elevation:	21 ft	Elevation Datum:	NGVD29	Reference Markers:	none
Drainage Basin:	Beaufort Sea Coastal Plain	Slope Direction:	Flat	Vegetation Type:	none
Slope Angle:	Flat	Access Notes:	Truck	Other:	Variable depth, patches of bare ice
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	12.0	6.5	7.5	1.0	13.0
2	11.0	5.0	6.5	1.0	8.0
3	13.0	1.0	4.0	1.0	11.0
4	14.0	4.0	7.0	3.0	13.0
5	12.0	6.0	10.5	5.0	13.0
6	9.0	10.0	8.5	7.0	11.5
7	6.0	9.0	7.0	9.0	12.0
8	5.5	12.0	5.0	6.0	14.0
9	2.0	10.0	1.0	8.0	18.0
10	2.0	13.0	1.0	7.0	18.0

	(cm)
Average snow depth =	**8.0**
Maximum snow depth =	18.0
Minimum snow depth =	1.0
Standard deviation =	4.5

	(inches)
Average snow depth =	**3.2**
Maximum snow depth =	**7.1**
Minimum snow depth =	**0.4**
Standard deviation =	**1.8**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
d4	12	137.2	428.4	0.32	
f1	10	109.0	357.0	0.31	
fb2	8	106.0	285.6	0.37	
fb5	10	132.1	357.0	0.37	
w1	14	144.3	499.8	0.29	

Average Density =	**0.331**	
Average Snow Water Equivalent (SWE) =	**2.7**	cm H2O
Average Snow Water Equivalent =	**1.04**	inches H2O
Average Snow Water Equivalent =	**0.09**	feet H2O

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

Data entered by: Jeff Murray Date: 4/14/2010

Data QA/QC by: K.Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**Badami Reservoir - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/13/2010	Time: 17:00

Location Description:	~ 200 yards ESE of the road entrance				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	20 F, Calm, Thin clouds
Latitude:	N 70° 7.775'	Longitude:	W 146° 59.956'	Datum:	NAD83
Elevation:	21 ft	Elevation Datum:	NGVD29	Reference Markers:	none
Drainage Basin:	Beaufort Sea Coastal Plain	Slope Direction:	Flat	Vegetation Type:	none
Slope Angle:	Flat	Access Notes:	Truck	Other:	Variable depth, patches of bare ice
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	11.5	5.0	9.0	5.0	9.0
2	13.5	5.5	10.0	2.0	8.0
3	11.5	2.0	7.0	0.5	8.5
4	13.5	5.5	5.0	0.0	10.0
5	12.5	2.0	5.5	0.0	4.0
6	14.0	2.0	4.5	4.0	10.0
7	11.5	6.0	5.0	10.5	12.0
8	14.0	6.5	8.5	12.0	9.5
9	8.0	10.0	8.0	11.0	10.0
10	5.5	12.0	6.5	13.0	10.0

	(cm)
Average snow depth =	**7.8**
Maximum snow depth =	14.0
Minimum snow depth =	0.0
Standard deviation =	3.9

	(inches)
Average snow depth =	**3.1**
Maximum snow depth =	**5.5**
Minimum snow depth =	**0.0**
Standard deviation =	**1.5**

Data entered by: Jeff Murray Date: 4/14/2010
Data QA/QC by: K. Hilton Date: 6/1/2010

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

Project ID:	**ATN Project**	Site Location/Lake ID:	**Badami Res - Tundra**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/13/2010	Time: 18:00

Location Description:	~ 20 yards north of berm separaing tundra from Badami Reservoir				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	15 F, Windy, Scattered Clouds
Latitude:	N 70° 7.870'	Longitude:	W 147° 0.076'	Datum:	NAD83
Elevation:	26 ft	Elevation Datum:	NGVD29	Reference Markers:	Road to the west
Drainage Basin:	Beaufort Sea Coastal Plain	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Multiple wind layers
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	21.5	40.0	51.5	34.0	21.0
2	24.0	45.5	49.0	29.5	22.5
3	22.0	47.0	49.0	29.0	22.0
4	25.0	48.5	50.0	27.0	26.5
5	26.5	51.0	52.5	27.5	28.0
6	35.0	50.0	51.5	19.5	33.0
7	37.0	47.5	50.5	13.0	37.0
8	38.0	50.0	35.0	21.0	39.5
9	41.0	51.5	30.0	18.5	40.0
10	38.0	50.0	32.5	19.5	46.5

	(cm)
Average snow depth =	**35.9**
Maximum snow depth =	52.5
Minimum snow depth =	13.0
Standard deviation =	11.7

	(inches)
Average snow depth =	**14.1**
Maximum snow depth =	**20.7**
Minimum snow depth =	**5.1**
Standard deviation =	**4.6**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
w2	33	346.2	1178.1	0.29	
f2	50	556.0	1785.0	0.31	
d3	52	656.4	1856.4	0.35	
n5	34	420.2	1213.8	0.35	
fb2	22	236.8	785.4	0.30	

Average Density =	**0.321**	
Average Snow Water Equivalent (SWE) =	**11.5**	cm H2O
Average Snow Water Equivalent =	**4.54**	inches H2O
Average Snow Water Equivalent =	**0.38**	feet H2O

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

Data entered by: Jeff Murray Date: 4/14/2010
Data QA/QC by: K. Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**Betty Pingo**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/14/2010	Time: 12:55

Location Description:	Near Wyoming gage. At staked snow site. Started east and then went north. Point of beginning is flagged rebar. Vertical snow gauge = 0.2'. Snow Depth under Judd sensor = 26 cm - center, 24, 24, 28, 27, average= 25.8cm . Wyoming Gauge = 31-1/2".				
Survey objective:	SWE and tundra travel studies and management			Weather Observations:	20 F, Windy, Partly cloudy
Latitude:	N 70° 16.772'	Longitude:	W 148° 53.741'	Datum:	NAD83
Elevation:	34 ft.	Elevation Datum:	NVGD27	Reference Markers:	Re-bar and lathe
Drainage Basin:	Kuparuk River	Slope Direction:	Flat	Vegetation Type:	Lowland Moist Sedge-Shrub Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Multiple layers, wind packed
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	34.5	45.0	46.0	35.0	26.0
2	41.5	46.0	44.0	25.0	33.5
3	44.5	44.5	49.5	19.0	33.0
4	41.0	46.0	55.0	22.0	47.0
5	42.5	49.0	40.0	13.0	27.0
6	45.5	47.0	44.0	22.0	46.0
7	41.0	47.0	42.0	23.0	50.5
8	36.0	45.0	40.0	14.0	52.0
9	37.5	46.0	39.0	27.0	52.5
10	38.0	42.0	39.0	34.0	52.0

	(cm)
Average snow depth =	**39.0**
Maximum snow depth =	55.0
Minimum snow depth =	13.0
Standard variation =	10.3
	(inches)
Average snow depth =	**15.4**
Maximum snow depth =	**21.7**
Minimum snow depth =	**5.1**
Standard variation =	**4.0**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
d1	34	362.6	1213.8	0.30	
n4	32	301.5	1142.4	0.26	
f3	49	512.1	1749.3	0.29	
n1	24	280.4	856.8	0.33	
w4	56	567.1	1999.2	0.28	

Average Density =	**0.293**	
Average Snow Water Equivalent (SWE) =	**11.4**	cm H2O
Average Snow Water Equivalent =	**4.51**	inches H2O
Average Snow Water Equivalent =	**0.38**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: K. Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**Betty Pingo - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/14/2010	Time: 12:55

Location Description:	Near Wyoming gage. At staked snow site. Started east and then went north. Point of beginning is flagged rebar. Vertical snow gauge = 0.2'. Snow Depth under Judd sensor = 26 cm - center, 24, 24, 28, 27, average= 25.8cm . Wyoming Gauge = 31-1/2".				
Survey objective:	SWE and tundra travel studies and management			Weather Observations	20 F, Windy, Partly cloudy
Latitude:	N 70° 16.772'	Longitude:	W 148° 53.741'	Datum:	NAD83
Elevation:	34 ft.	Elevation Datum:	NVGD27	Reference Markers:	Re-bar and lathe
Drainage Basin:	Kuparuk River	Slope Direction:	Flat	Vegetation Type:	Lowland Moist Sedge-Shrub Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Multiple layers, wind packed
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	39.0	36.5	27.0	25.0	29.0
2	42.0	28.0	20.0	50.0	30.0
3	45.0	25.0	21.0	27.0	56.0
4	47.0	24.0	46.0	51.5	41.0
5	43.0	20.5	44.0	43.0	43.0
6	42.0	15.0	51.5	20.0	44.0
7	43.0	12.5	35.5	18.5	50.5
8	46.0	10.5	36.0	25.0	51.0
9	40.0	8.0	30.0	24.0	51.0
10	34.0	17.0	31.0	27.5	49.0

	(cm)
Average snow depth =	**34.3**
Maximum snow depth =	56.0
Minimum snow depth =	8.0
Standard variation =	12.6

	(inches)
Average snow depth =	**13.5**
Maximum snow depth =	**22.0**
Minimum snow depth =	**3.1**
Standard variation =	**5.0**

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**Duck Island MET**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/12/2010	Time: 14:45

Location Description:	Near Duck Island Meteorlogical station. Staked snow course. Snow depths under SR50 sensor: 38 cm, 38.5, 39, 37, 37.5 center. Average=38 cm				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	20 F, scattered clouds, windy .
Latitude:	N 70° 16.206'	Longitude:	W 147° 59.265'	Datum:	NAD 83
Elevation:	45 ft.	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Sagavanirktok River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Two layers, one thick homogenous, one ice
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	29.0	22.5	29.0	34.0	19.0
2	28.0	27.5	25.0	33.0	16.0
3	25.0	10.0	29.0	36.5	18.0
4	24.0	12.0	32.0	29.0	23.0
5	27.0	17.0	28.5	31.5	24.0
6	24.0	22.5	25.0	30.5	28.0
7	20.5	27.0	21.5	28.5	28.0
8	22.5	20.0	25.0	28.0	28.0
9	14.0	27.0	27.0	27.0	23.0
10	19.0	20.5	29.0	21.5	23.0

	(cm)
Average snow depth =	**24.8**
Maximum snow depth =	36.5
Minimum snow depth =	10.0
Standard deviation =	5.5

	(inches)
Average snow depth =	**9.8**
Maximum snow depth =	**14.4**
Minimum snow depth =	**3.9**
Standard deviation =	**2.2**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
fb3	24	306.1	856.8	0.36	
n4	12	147.0	428.4	0.34	
fb2	16	137.4	571.2	0.24	
fb5	19	203.9	678.3	0.30	
w5	20	225.6	714.0	0.32	

Average Density =	**0.300**	
Average Snow Water Equivalent (SWE) =	**7.4**	cm H2O
Average Snow Water Equivalent =	**2.93**	inches H2O
Average Snow Water Equivalent =	**0.24**	feet H2O

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

Data entered by: Jeff Murray Date: 4/14/2010

Data QA/QC by: K. Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**Duck Island MET - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/12/2010	Time: 14:45

Location Description:	Near Duck Island Meteorlogical station. Staked snow course. Snow depths under SR50 sensor: 38 cm, 38.5, 39, 37, 37.5 center. Average=38 cm				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	20 F, scattered clouds, windy .
Latitude:	N 70° 16.206'	Longitude:	W 147° 59.265'	Datum:	NAD 83
Elevation:	45 ft.	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Sagavanirktok River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Two layers, one thick homogenous, one ice
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	30.0	11.5	31.0	26.0	26.5
2	38.0	11.0	27.0	28.0	21.0
3	22.0	12.0	26.5	26.0	29.0
4	24.0	22.5	26.0	29.0	32.0
5	20.0	27.5	27.0	29.5	34.0
6	24.0	25.0	28.5	27.0	27.0
7	36.5	26.0	28.5	15.0	22.5
8	21.5	22.5	29.5	27.0	14.0
9	24.0	27.0	30.5	21.5	11.0
10	15.0	28.0	30.5	25.0	15.5

	(cm)
Average snow depth =	**24.8**
Maximum snow depth =	38.0
Minimum snow depth =	11.0
Standard deviation =	6.3
	(inches)
Average snow depth =	**9.8**
Maximum snow depth =	**15.0**
Minimum snow depth =	**4.3**
Standard deviation =	**2.5**

Data entered by: Jeff Murray Date: 4/14/2010

Data QA/QC by: K. Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**L9312 - Lake Surface**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 9:12

Location Description:	On lake surface ~150 yards east from L9312 pumphouse.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations	10 F, Calm, Sunny
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:	Packed snow, Areas of bare ice
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	31.0	31.0	19.0	11.0	29.5
2	32.0	31.0	24.0	10.0	29.0
3	27.0	32.0	30.0	9.0	32.5
4	25.0	25.0	29.0	8.5	35.0
5	26.0	27.0	26.5	9.5	23.0
6	27.0	25.0	30.0	13.0	22.0
7	27.0	17.0	25.0	12.0	27.0
8	29.0	17.0	19.5	10.0	32.0
9	30.5	18.0	21.0	17.5	33.0
10	32.5	17.0	20.0	26.0	25.0

(cm)	
Average snow depth =	**23.7**
Maximum snow depth =	35.0
Minimum snow depth =	8.5
Standard variation =	7.5

(inches)	
Average snow depth =	**9.3**
Maximum snow depth =	**13.8**
Minimum snow depth =	**3.3**
Standard variation =	**3.0**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
:) 5	28	353.7	999.6	0.35	
:)4	24	300.0	856.8	0.35	
:)3	30	355.1	1071.0	0.33	
:)1	10	125.4	357.0	0.35	
:)2	23	332.0	821.1	0.40	

Average Density =	**0.358**	
Average Snow Water Equivalent (SWE) =	**8.5**	cm H2O
Average Snow Water Equivalent =	**3.34**	inches H2O
Average Snow Water Equivalent =	**0.28**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN**	Site Location/Lake ID:	**L9312 - Lake Surface - SB**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 9:12

Location Description:	On lake surface ~150 yards east from L9312 pumphouse.				
Survey objective:	Determine snow depth and density for application to lake recharge studies, and tundra travel management.			Weather Observations:	10 F, Calm, Sunny
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:	Packed snow, Areas of bare ice
Snow Depth Probe Type:		T- probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	27.0	29.5	16.5	20.0	14.0
2	29.0	32.0	18.0	17.5	18.0
3	29.5	31.5	21.5	10.0	24.0
4	29.0	31.5	25.0	8.0	26.0
5	21.5	30.5	23.0	9.5	28.0
6	25.0	28.0	29.5	10.0	29.0
7	28.0	25.0	27.5	11.0	34.0
8	27.0	22.5	23.0	13.0	25.0
9	29.0	22.5	20.0	11.0	21.0
10	27.0	22.0	22.0	9.5	23.5

	(cm)
Average snow depth =	**22.7**
Maximum snow depth =	34.0
Minimum snow depth =	8.0
Standard variation =	7.0

	(inches)
Average snow depth =	**8.9**
Maximum snow depth =	**13.4**
Minimum snow depth =	**3.1**
Standard variation =	**2.7**

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/27/10

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: 4/15/2010	Time: 8:45

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:	5 F, Calm, Sunny
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:	Crunchy, Hard packed snow
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	38.0	48.5	54.0	55.0	43.0
2	37.5	46.0	45.0	52.0	45.0
3	35.0	34.0	39.0	51.5	40.0
4	34.0	39.0	36.0	51.0	35.0
5	69.0	30.0	30.0	59.0	38.0
6	43.5	27.0	36.0	57.0	25.0
7	37.0	27.0	41.0	48.5	21.0
8	40.5	20.0	44.0	24.5	27.0
9	47.5	26.0	47.0	21.0	31.0
10	44.0	53.5	46.0	9.0	39.0

	(cm)
Average snow depth =	**39.4**
Maximum snow depth =	69.0
Minimum snow depth =	9.0
Standard variation =	11.6

	(inches)
Average snow depth =	**15.5**
Maximum snow depth =	**27.2**
Minimum snow depth =	**3.5**
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)
h4	26	295.5	928.2	0.32	
h5	46	487.8	1642.2	0.30	
h1	32	340.5	1142.4	0.30	
h2	46	503.3	1642.2	0.31	
h3	38				

Average Density =	**0.305**	
Average Snow Water Equivalent (SWE) =	**12.0**	cm H2O
Average Snow Water Equivalent =	**4.72**	inches H2O
Average Snow Water Equivalent =	**0.39**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10
Data QA/QC by: Kristie Hilton Date: 4/28/10

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

Project ID:	**ATN**	Site Location/Lake ID:	**L9312 - Tundra - SB**
Survey Purpose:	**Determine snow depth, SWE**	Date: 4/15/2010	Time: 8:45

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:	5 F, Calm, Sunny
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:	Crunchy, Hard packed snow
Snow Depth Probe Type:		T-probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	25.5	28.5	25.0	44.0	15.0
2	29.0	42.0	32.0	45.0	12.0
3	31.0	44.0	23.0	43.0	24.5
4	28.0	45.0	34.5	47.0	31.0
5	32.0	42.5	43.5	41.0	38.5
6	62.0	34.5	33.5	51.0	37.0
7	44.0	37.0	35.0	42.0	41.0
8	34.0	29.0	35.0	47.0	37.0
9	35.5	28.0	37.5	24.0	40.0
10	34.0	35.0	44.0	16.0	38.0

	(cm)
Average snow depth =	**35.6**
Maximum snow depth =	62.0
Minimum snow depth =	12.0
Standard variation =	9.4
	(inches)
Average snow depth =	**14.0**
Maximum snow depth =	**24.4**
Minimum snow depth =	**4.7**
Standard variation =	**3.7**

Data entered by: Jeff Murray Date: 4/20/10
Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR P-Pad**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/14/2010	Time: 12:20

Location Description:	On access road to P-Pad, north side, near Betty Pingo, near soil thermistors. GWS measurements on right (as looking at sensor pipe from road) and DNR measurements on left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management			Weather Observations	20 F, Windy, Scattered clouds
Latitude:	N 70° 16.967'	Longitude:	W 148° 54.807'	Datum:	NAD83
Elevation:	33 ft.	Elevation Datum:	NGVD29	Reference Markers:	none
Drainage Basin:	Kuparuk River	Slope Direction:	Flat	Vegetation Type:	Lowland Moist Sedge-Shrub Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Wind packed snow, wind quickly filling in footprints
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	16.0	31.0	45.5	18.0	25.0
2	16.0	34.0	46.0	13.0	27.0
3	12.0	30.0	41.5	22.0	24.5
4	31.5	32.0	35.0	24.0	30.0
5	32.0	22.0	34.5	27.0	23.0
6	32.0	17.0	21.0	30.0	27.0
7	31.0	19.0	9.0	22.0	48.0
8	29.0	39.5	24.0	32.0	48.5
9	29.0	42.0	23.5	41.0	48.5
10	31.0	44.0	15.0	27.5	33.0

	(cm)
Average snow depth =	**29.1**
Maximum snow depth =	48.5
Minimum snow depth =	9.0
Standard variation =	10.0

	(inches)
Average snow depth =	**11.5**
Maximum snow depth =	**19.1**
Minimum snow depth =	**3.5**
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)
b5	14	106.9	499.8	0.21	
d5	20	146.2	714.0	0.20	
n5	35	328.2	1249.5	0.26	
f5	34	296.3	1213.8	0.24	
fb2	48	519.7	1713.6	0.30	

Average Density =	**0.246**	
Average Snow Water Equivalent (SWE) =	**7.2**	cm H2O
Average Snow Water Equivalent =	**2.82**	inches H2O
Average Snow Water Equivalent =	**0.23**	feet H2O

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

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: K. Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR P-Pad - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/14/2010	Time: 12:20

Location Description:	On access road to P-Pad, north side, near Betty Pingo, near soil thermistors. GWS measurements on right (as looking at sensor pipe from road) and DNR measurements on left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management			Weather Observations	20 F, Windy, Scattered clouds
Latitude:	N 70° 16.967'	Longitude:	W 148° 54.807'	Datum:	NAD83
Elevation:	33 ft.	Elevation Datum:	NGVD29	Reference Markers:	none
Drainage Basin:	Kuparuk River	Slope Direction:	Flat	Vegetation Type:	Lowland Moist Sedge-Shrub Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Wind packed snow, wind quickly filling in footprints
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	13.0	23.0	46.0	14.5	18.5
2	17.5	26.0	45.5	25.0	28.0
3	16.0	24.0	42.5	25.5	32.5
4	26.0	22.0	37.0	32.0	21.0
5	31.0	28.0	25.0	38.0	23.0
6	23.0	31.0	17.0	45.5	23.5
7	28.5	45.0	25.0	50.0	24.0
8	31.0	45.5	41.0	49.0	26.0
9	34.0	46.0	36.0	18.5	25.0
10	24.5	48.0	19.0	28.0	20.5

	(cm)
Average snow depth =	**29.7**
Maximum snow depth =	50.0
Minimum snow depth =	13.0
Standard variation =	10.2

	(inches)
Average snow depth =	**11.7**
Maximum snow depth =	**19.7**
Minimum snow depth =	**5.1**
Standard variation =	**4.0**

Data entered by: Jeff Murray Date: 4/20/10

Data QA/QC by: Kristie Hilton Date: 4/28/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**Sag River DOT**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/11/2010	Time: 14:41

Location Description:	On Road to DOT garage. Near PVC pipe. GWS stays to right (as looking at pipe) and DNR stays left.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	25F, Light, Windy, High Clouds
Latitude:	N 68° 45.686'	Longitude:	W 148° 52.746'	Datum:	NAD 83
Elevation:	1640 ft.	Elevation Datum:	NGVD29	Reference Markers:	Black PVC pipe
Drainage Basin:	Kuparuk River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Strong top layer, wind polished
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Michael Lilly, Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	31.0	34.0	41.0	50.5	51.0
2	35.0	42.5	46.0	36.0	39.5
3	33.0	30.0	51.0	49.0	50.0
4	35.0	34.0	42.0	44.0	42.0
5	34.5	31.5	33.0	36.5	51.0
6	36.0	37.5	33.5	46.5	45.0
7	42.0	43.0	33.0	37.5	44.0
8	44.0	37.5	37.5	51.0	36.5
9	39.0	40.5	41.0	58.0	35.5
10	49.5	41.0	37.0	40.0	42.5

	(cm)
Average snow depth =	**40.6**
Maximum snow depth =	58.0
Minimum snow depth =	30.0
Standard deviation =	6.5

	(inches)
Average snow depth =	**16.0**
Maximum snow depth =	**22.8**
Minimum snow depth =	**11.8**
Standard deviation =	**2.6**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
F5	45	140.6	1606.5	0.09	
D5	36	297.2	1285.2	0.23	
W1	35	321.7	1249.5	0.26	
B5	36	281.7	1285.2	0.22	
F2	34	243.3	1213.8	0.20	

Average Density =	**0.199**	
Average Snow Water Equivalent (SWE) =	**8.1**	cm H2O
Average Snow Water Equivalent =	**3.19**	inches H2O
Average Snow Water Equivalent =	**0.27**	feet H2O

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

Data entered by: Jeff Murray Date: 4/11/2010
Data QA/QC by: Kristie Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**Sag River DOT - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/11/2010	Time: 14:41

Location Description:	On Road to DOT garage. Near PVC pipe. GWS stays to right (as looking at pipe) and DNR stays left.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	25F, Light, Windy, High Clouds
Latitude:	N 68° 45.686'	Longitude:	W 148° 52.746'	Datum:	NAD 83
Elevation:	1640 ft.	Elevation Datum:	NGVD29	Reference Markers:	Black PVC pipe
Drainage Basin:	Kuparuk River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	Strong top layer, wind polished
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Michael Lilly, Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	42.0	42.0	30.0	40.0	46.0
2	43.5	32.0	34.5	38.5	33.0
3	54.5	39.0	38.5	36.5	32.5
4	32.5	43.0	36.0	33.0	36.5
5	46.0	31.0	44.0	35.0	44.0
6	49.0	30.0	38.0	42.5	35.5
7	37.0	31.0	47.5	37.0	41.0
8	32.0	32.0	33.0	49.0	31.0
9	50.5	35.0	35.0	46.0	41.5
10	40.5	40.0	36.0	47.5	41.0

	(cm)
Average snow depth =	**38.8**
Maximum snow depth =	54.5
Minimum snow depth =	30.0
Standard deviation =	6.1

	(inches)
Average snow depth =	**15.3**
Maximum snow depth =	**21.5**
Minimum snow depth =	**11.8**
Standard deviation =	**2.4**

Data entered by: Jeff Murray Date: 4/11/2010
Data QA/QC by: Kristie Hilton Date: 6/1/2010

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

Project ID:	**ATN Project**	Site Location/Lake ID:	**Toolik NRCS Site**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/11/2010	Time: 12:10

Location Description:	Near Tollik Camp and Toolik Lake. Adjacent and south and west of NRCS long-term Climate Station				
Survey objective:	SWE and tundra travel studies and management			Weather Observations:	26F, windy, thin clouds
Latitude:	N 68° 37.366'	Longitude:	W 149° 36.598'	Datum:	NAD 83
Elevation:	2500 ft.	Elevation Datum:	NGVD27	Reference Markers:	NRCS Station
Drainage Basin:	Toolik Lake	Slope Direction:	East	Vegetation Type:	Upland Shrubby Tussuck Tundra
Slope Angle:	~10 degrees	Access Notes:	Walk from Toolik	Other:	strong surface layer, sintering
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	34.0	38.0	28.0	49.0	38.0
2	36.0	27.0	27.0	33.0	48.0
3	37.0	46.0	33.0	47.0	52.0
4	34.5	19.0	30.5	27.0	38.5
5	27.0	21.0	32.0	35.0	30.0
6	47.5	18.0	34.0	38.0	39.0
7	38.0	27.0	35.0	29.0	38.5
8	25.0	37.0	32.0	33.0	26.0
9	36.0	34.0	46.0	32.0	44.0
10	30.5	37.5	33.0	48.0	43.0

	(cm)
Average snow depth =	**35.0**
Maximum snow depth =	52.0
Minimum snow depth =	18.0
Standard deviation =	7.9
	(inches)
Average snow depth =	**13.8**
Maximum snow depth =	**20.5**
Minimum snow depth =	**7.1**
Standard deviation =	**3.1**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
N2	30	251.0	1071.0	0.23	
N4	24	115.3	856.8	0.13	
N1	29	227.4	1035.3	0.22	
N3	24	140.0	856.8	0.16	
N5	44	428.9	1570.8	0.27	

Average Density =	**0.205**	
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: Jeff Murray Date: 4/12/10
Data QA/QC by: Kristie Hilton Date: 6/1/10

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**UAF 411**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/12/2010	Time: 17:25

Location Description:	Off Dalton highway to the east. Near PVC pipe.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	25 F, light winds, scattered clouds
Latitude:	N 70° 09.949'	Longitude:	W 148° 27.307'	Datum:	NAD 83
Elevation:	78 ft.	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Sagavanirktok River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	multi wind layering
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	53.0	36.5	36.0	42.0	48.0
2	43.0	31.5	33.0	46.5	45.0
3	43.0	37.5	29.5	49.0	42.5
4	46.0	36.5	35.5	43.0	47.0
5	48.0	29.5	31.5	52.0	47.0
6	41.5	30.0	37.0	53.0	44.5
7	42.0	38.5	36.0	40.0	43.0
8	47.5	38.5	31.5	50.0	47.0
9	46.5	33.0	27.0	52.5	52.0
10	43.5	34.5	30.5	52.0	43.5

	(cm)
Average snow depth =	**41.3**
Maximum snow depth =	53.0
Minimum snow depth =	27.0
Standard deviation =	7.3

	(inches)
Average snow depth =	**16.3**
Maximum snow depth =	**20.9**
Minimum snow depth =	**10.6**
Standard deviation =	**2.9**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
o1	38	385.8	1356.6	0.28	
o5	34	326.4	1213.8	0.27	
o4	30	322.8	1071.0	0.30	
o2	48	481.2	1713.6	0.28	
o3	49	520.8	1749.3	0.30	

Average Density =	**0.287**	
Average Snow Water Equivalent (SWE) =	**11.8**	cm H2O
Average Snow Water Equivalent =	**4.67**	inches H2O
Average Snow Water Equivalent =	**0.39**	feet H2O

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

Data entered by: Jeff Murray Date: 4/14/2010

Data QA/QC by: K. Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**UAF 411 - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/12/2010	Time: 17:25

Location Description:	Off Dalton highway to the east. Near PVC pipe.				
Survey objective:	SWE and Tundra Travel (Co-located snow survey site with DNR sampling site)			Weather Observations	25 F, light winds, scattered clouds
Latitude:	N 70° 09.949'	Longitude:	W 148° 27.307'	Datum:	NAD 83
Elevation:	78 ft.	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Sagavanirktok River	Slope Direction:	Flat	Vegetation Type:	Upland Tussock Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	multi wind layering
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	40.0	37.0	29.5	30.5	42.0
2	46.0	32.0	33.0	36.5	49.5
3	42.5	37.0	31.0	40.0	50.5
4	41.0	32.0	24.5	44.5	49.0
5	32.0	40.0	16.0	48.0	52.5
6	40.0	26.0	34.0	54.0	47.0
7	40.5	29.0	36.0	55.5	39.0
8	43.0	30.0	38.0	54.0	37.0
9	43.0	33.0	37.0	49.0	51.0
10	37.0	33.0	36.0	50.0	46.0

	(cm)
Average snow depth =	**39.5**
Maximum snow depth =	55.5
Minimum snow depth =	16.0
Standard deviation =	8.5

	(inches)
Average snow depth =	**15.5**
Maximum snow depth =	**21.9**
Minimum snow depth =	**6.3**
Standard deviation =	**3.4**

Data entered by: Jeff Murray Date: 4/14/2010

Data QA/QC by: K. Hilton Date: 6/1/2010

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

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR UGNU**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/13/2010	Time: 10:00

Location Description:	East of road to xxx. East of Pad. GWS measures to right (as looking at PVC pipe from road) and DNR measures to left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management			Weather Observations:	10 F, windy, overcast
Latitude:	N 70° 27.480'	Longitude:	W 149° 48.540'	Datum:	NAD83
Elevation:	16 ft	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Beaufort Sea Coastal Plain	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	multi wind layers, thick (10-15cm)
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	22.0	50.0	28.5	25.0	21.0
2	23.0	43.5	30.5	22.0	23.0
3	25.0	36.0	32.0	23.0	22.0
4	33.5	30.0	24.0	18.0	25.5
5	23.5	38.0	21.0	15.0	41.0
6	18.0	38.0	22.0	19.0	36.5
7	16.0	28.0	22.0	23.5	22.5
8	12.0	28.5	19.0	21.0	25.0
9	20.0	21.0	9.0	23.0	20.0
10	35.0	17.0	21.0	24.0	22.5

	(cm)
Average snow depth =	**25.2**
Maximum snow depth =	50.0
Minimum snow depth =	9.0
Standard deviation =	8.0

	(inches)
Average snow depth =	**9.9**
Maximum snow depth =	**19.7**
Minimum snow depth =	**3.5**
Standard deviation =	**3.2**

Snow Sample Depths and Weights

Bag #	Snow Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)	Organic Plug (cm)
w3	27	308.3	963.9	0.32	
o3	49	573.9	1749.3	0.33	
o1	20	227.8	714.0	0.32	
o5	20	218.4	714.0	0.31	
x4	33	365.8	1178.1	0.31	

Average Density =	**0.317**	
Average Snow Water Equivalent (SWE) =	**8.0**	cm H2O
Average Snow Water Equivalent =	**3.14**	inches H2O
Average Snow Water Equivalent =	**0.26**	feet H2O

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

Data entered by: Jeff Murray Date: 4/14/2010
Data QA/QC by: K. Hilton Date: 6/1/2010

Arctic Transportation Networks Project

Form F-012: Snow Survey Form

Project ID:	**ATN Project**	Site Location/Lake ID:	**ADNR UGNU - SB**
Survey Purpose:	**Determine Snow Depth and SWE**	Date: 4/13/2010	Time: 10:00

Location Description:	East of road to xxx. East of Pad. GWS measures to right (as looking at PVC pipe from road) and DNR measures to left.				
Survey objective:	Co-located snow survey site with DNR sampling site, tundra travel studies and management			Weather Observations:	10 F, windy, overcast
Latitude:	N 70° 27.480'	Longitude:	W 149° 48.540'	Datum:	NAD83
Elevation:	16 ft	Elevation Datum:	NGVD29	Reference Markers:	Black PVC Pipe
Drainage Basin:	Beaufort Sea Coastal Plain	Slope Direction:	Flat	Vegetation Type:	Lowland Wet Sedge Tundra
Slope Angle:	Flat	Access Notes:	Truck	Other:	multi wind layers, thick (10-15cm)
Snow Depth Probe Type:		T-Handle Probe		Snow-Survey Team Names:	
Snow Tube Type:	Adirondack Snow Tube			Jeff Murray, Sarah Byam	

Snow Course Depths (cm)

	1	2	3	4	5
1	25.0	40.0	22.5	14.0	20.0
2	28.0	41.5	28.5	29.0	42.0
3	28.0	44.0	28.0	21.5	25.0
4	28.0	42.0	26.5	25.0	27.5
5	19.0	36.5	18.0	18.0	22.0
6	19.5	32.0	21.0	10.5	30.0
7	16.0	32.0	21.5	18.0	41.0
8	33.0	24.0	14.0	19.0	43.5
9	46.0	21.0	24.5	21.0	34.0
10	36.0	25.0	22.0	22.0	32.0

	(cm)
Average snow depth =	**27.2**
Maximum snow depth =	46.0
Minimum snow depth =	10.5
Standard deviation =	8.8

	(inches)
Average snow depth =	**10.7**
Maximum snow depth =	**18.1**
Minimum snow depth =	**4.1**
Standard deviation =	**3.5**

Data entered by: Jeff Murray Date: 4/14/2010
Data QA/QC by: K. Hilton Date: 6/1/2010

APPENDIX B. ADNR SNOW DATA

The following tables report snow information measured by ADNR staff.

Lower Foothills

30 Mile

Date																							average		
																							g/cm^3	in	cm
11/6/2009	depth (in)	3	4	3	2	2	3	4	3	2	3	4	3	2	3	2	3	3	2	2	2			2.75	6.99
	density (g/cm^3)																								
	SWE (in)																								
11/18/2009	depth (in)	3	3	4	3	3	2	4	4	4	3	3	3	4	3	4	4	4	5	4	2			3.45	8.76
	density (g/cm^3)	0.18	0.13																				0.15		
	SWE (in)	0.62	0.52																					0.57	1.45
12/2/2009	depth (in)	3	4	4	4	4	5	4	4	4	4	3	4	4	4	4	4	6	6	8	9			4.60	11.68
	density (g/cm^3)	0.183	0.17																				0.18		
	SWE (in)	1.099	1.106																					1.10	2.80
12/9/2009	depth (in)	3	5	4	4	4	4	4	4	4	6	4	5	4	4	6	5	5	4	4	6			4.45	11.30
	density (g/cm^3)	0.224	0.206																				0.22		
	SWE (in)	0.897	0.927																					0.91	2.32
12/16/2009	depth (in)	5	4	4	6	6	5	4	6	3	4	4	5	5	6	7	4	5	5	4	4			4.80	12.19
	density (g/cm^3)	0.282	0.253																				0.27		
	SWE (in)	0.845	1.137																					0.99	2.52
12/21/2009	depth (in)	9	10	9	8	5	5	5	7	5	5	6	6	5	7	7	5	5	5	5	5			6.20	15.75
	density (g/cm^3)	0.259	0.169																				0.21		
	SWE (in)	1.165	1.058																					1.11	2.82
12/28/2009	depth (in)	3	2	3	2	2	3	2	3	3	3	2	3	3	3	3	3	3	4	3	3			2.80	7.11
	density (g/cm^3)	0.189	0.203																				0.20		
	SWE (in)	0.567	0.711																					0.64	1.62
1/6/2010	depth (in)	7	6	6	6	6	6	5	5	6	7	7	6	7	7	6	6	5	6	7	7			6.20	15.75
	density (g/cm^3)	0.187	0.179																				0.18		
	SWE (in)	2.061	1.072																					1.57	3.98
1/12/2010	depth (in)	9	8	6	7	9	7	7	5	8	9	7	6	7	10	7	7	8	7	7	4			7.25	18.42
	density (g/cm^3)	0.195	0.205																				0.20		
	SWE (in)	1.556	1.539																					1.55	3.93
1/27/2010	depth (in)	8	6	4	11	7	3	5	7	8	4	7	5	9	5	8	3	7	4	10	4			6.25	15.88
	density (g/cm^3)	0.3	0.263																				0.28		
	SWE (in)	1.498	1.58																					1.54	3.91
2/9/2010	depth (in)	6	5	4	3	2	3	3	3	3	3	5	5	3	4	4	5	5	5	5	4			4.00	10.16
	density (g/cm^3)	0.277	0.298																				0.29		
	SWE (in)	1.384	1..340																					1.38	3.52
3/10/2010	depth (in)	6	6	8	5	5	6	7	7	5	4	4	6	4	3	5	4	5	4	3	5			5.10	12.95
	density (g/cm^3)	0.236	0.202																				0.22		
	SWE (in)	1.415	0.807																					1.11	2.82
4/13/2010	depth (in)	7	7	8	7	6	5	5	5	5	5	5	5	6	5	5	5	5	5	4	5			5.50	13.97
	density (g/cm^3)	0.225	0.219																				0.22		
	SWE (in)	1.127	1.096																					1.11	2.82

Lower Foothills

Spur Dike 6 - 20 Mile

Date																							average		
																							g/cm^3	in	cm
11/6/2009	depth (in)	3	2	2	5	3	4	4	6	4	4	4	4	5	6	4	4	3	4	4	4			3.95	10.03
	density (g/cm^3)	0.20	0.26																				0.23		
	SWE (in)	0.79	1.31																					1.05	2.66
11/18/2009	depth (in)	6	8	4	8	8	10	6	8	10	8	6	5	7	7	7	9	5	6	8	6			7.10	18.03
	density (g/cm^3)	0.28	0.30																				0.29		
	SWE (in)	1.98	1.50																					1.74	4.42
12/2/2009	depth (in)	8	7	7	8	6	5	3	4	4	3	2	5	4	6	6	5	4	6	6	7			5.30	13.46
	density (g/cm^3)	0.267	0.238																				0.25		
	SWE (in)	1.467	1.309																					1.39	3.53
12/9/2009	depth (in)	2	4	4	3	3	3	3	5	3	3	8	5	4	2	3	5	3	3	6	5			3.85	9.78
	density (g/cm^3)	0.21	0.272																				0.24		
	SWE (in)	1.048	2.037																					1.54	3.92
12/16/2009	depth (in)	7	5	7	8	6	5	5	4	5	5	4	7	5	4	4	3	5	7	8	5			5.45	13.84
	density (g/cm^3)	0.291	0.234																				0.26		
	SWE (in)	2.04	1.402																					1.72	4.37
12/21/2009	depth (in)																								
	density (g/cm^3)																								
	SWE (in)																								
12/28/2009	depth (in)	6	5	7	6	3	6	5	3	5	3	2	5	8	7	3	5	3	5	5	3			4.75	12.07
	density (g/cm^3)																								
	SWE (in)																								
1/6/2010	depth (in)	6	6	7	8	9	7	8	4	6	6	7	8	7	6	9	9	10	6	8	9			7.30	18.54
	density (g/cm^3)	0.269	0.328																				0.30		
	SWE (in)	2.15	2.872																					2.51	6.38
1/12/2010	depth (in)	5	8	12	8	5	10	10	7	5	8	6	8	6	7	5	10	8	7	4	9			7.40	18.80
	density (g/cm^3)	0.27	0.178																				0.22		
	SWE (in)	1.621	0.89																					1.26	3.19
1/27/2010	depth (in)	9	7	13	10	6	6	12	11	6	6	11	9	8	6	9	9	7	10	8	12			8.75	22.23
	density (g/cm^3)	0.276	0.257																				0.27		
	SWE (in)	2.205	1.8																					2.00	5.09
2/9/2010	depth (in)	7	6	7	8	7	6	5	6	7	5	6	6	7	6	5	7	8	8	7	5			6.45	16.38
	density (g/cm^3)	0.294	0.26																				0.28		
	SWE (in)	2.058	1.948																					2.00	5.09
3/11/2010	depth (in)	5	9	13	7	9	7	10	9	9	9	7	8	8	8	7	7	6	7	5	6			7.80	19.81
	density (g/cm^3)	0.2	0.353																				0.28		
	SWE (in)	2.25	2.295																					2.27	5.77
4/13/2010	depth (in)	9	7	9	8	8	8	7	9	8	8	8	7	9	9	6	6	7	8	8	9			7.90	20.07
	density (g/cm^3)	0.316	0.313																				0.31		
	SWE (in)	2.367	2.504																					2.44	6.19

Lower Foothills

Meltwater 19

Date																							average		
																							g/cm^3	in	cm
11/3/2009	depth (in)	5	4	4	5	6	5	5	4	4	5	4	6	3	6	5	6	5	5	5	5			4.85	12.32
	density (g/cm^3)	0.12	0.15																				0.13		
	SWE (in)	0.72	0.87																					0.80	2.02
11/17/2009	depth (in)	3	4	4	5	5	5	6	4	4	4	4	6	3	6	5	3	6	4	5	4			4.50	11.43
	density (g/cm^3)	0.15	0.24																				0.19		
	SWE (in)	0.75	1.20																					0.97	2.47
12/1/2009	depth (in)	5	5	8	6	6	4	7	5	4	4	3	3	2	2	4	6	5	6	6	4			4.75	12.07
	density (g/cm^3)	0.324	0.279																				0.30		
	SWE (in)	1.621	2.927																					2.27	5.78
12/8/2009	depth (in)	8	4	3	7	5	7	7	7	5	6	4	5	7	5	5	8	5	5	5	4			5.60	14.22
	density (g/cm^3)	0.249	0.299																				0.27		
	SWE (in)	1.621	1.347																					1.48	3.77
12/15/2009	depth (in)	8	10	12	12	10	9	6	5	5	4	3	6	5	8	7	7	9	9	10	8			7.65	19.43
	density (g/cm^3)	0.248	0.228																				0.24		
	SWE (in)	0.993	1.367																					1.18	3.00
12/22/2009	depth (in)	10	7	7	7	7	7	11	8	9	7	7	8	6	8	6	6	5	6	7	6			7.25	18.42
	density (g/cm^3)	0.275	0.316																				0.30		
	SWE (in)	1.515	2.054																					1.78	4.53
12/30/2009	depth (in)	2	3	5	3	7	7	9	7	4	3	7	5	6	7	5	5	4	5	5	3			5.10	12.95
	density (g/cm^3)	0.219	0.286																				0.25		
	SWE (in)	0.766	1.573																					1.17	2.97
1/6/2010	depth (in)	8	8	8	7	9	12	11	9	8	7	8	9	11	9	11	10	9	7	7	7			8.75	22.23
	density (g/cm^3)	0.304	0.29																				0.30		
	SWE (in)	3.037	2.027																					2.53	6.43
1/13/2010	depth (in)	11	11	5	9	8	7	7	10	8	4	8	11	11	6	7	10	11	6	8	13			8.55	21.72
	density (g/cm^3)	0.321	0.266																				0.29		
	SWE (in)	3.212	2.13																					2.67	6.78
2/10/2010	depth (in)	4	4	6	9	8	9	5	5	2	2	4	6	4	5	4	4	6	6	6	5			5.20	13.21
	density (g/cm^3)	0.252	0.252																				0.25		
	SWE (in)	1.766	1.515																					1.64	4.17
3/11/2010	depth (in)	7	5	5	10	8	8	5	11	9	7	9	7	4	8	7	5	7	8	8	7			7.25	18.42
	density (g/cm^3)	0.351	0.268																				0.31		
	SWE (in)	2.985	1.34																					2.16	5.49
4/15/2010	depth (in)	12	9	9	9	12	13	14	11	10	9	11	12	12	12	14	13	13	14	12	10			11.55	29.34
	density (g/cm^3)	0.292	0.297																				0.29		
	SWE (in)	2.559	2.82																					2.69	6.83

APPENDIX C. ADNR SNOW DATA SUMMARY

The following table reports a summary of snow information obtained by ADNR staff.

	Nov 2 - 6			Nov 16 - 20			Nov 30 - Dec 4			Dec 7 - 11			Dec 14 - 18		
	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)
Eastern Coastal Area															
ANFO Pad	2.1			3.0	0.40	1.2	4.1	0.24	1.0	3.4	0.34	1.1	6.6	0.32	2.4
DS 16	5.7	0.35	2.1	5.4	0.45	3.3	6.9	0.34	2.4	5.9	0.31	2.0	8.7	0.32	3.2
UAF 411 mi	4.3	0.20	0.9	4.5	0.24	1.5	9.7	0.28	2.2	7.1	0.33	2.9	6.7	0.25	1.6
Term Well A	5.8	0.26	2.2	3.8	0.21	0.8	4.8	0.23	1.1	4.9	0.25	1.3	6.1	0.24	1.2
P Pad	4.1	0.19	0.9	4.3	0.23	0.9	4.9	0.13	0.6	6.1	0.28	1.8	9.5	0.30	2.8
T Pad	3.9	0.23	1.1	3.9	0.30	1.4	5.0	0.23	1.2	3.9	0.14	0.7	5.5	0.33	3.2
Area Averages	4.3	0.24	1.4	4.2	0.30	1.5	5.9	0.24	1.4	5.2	0.27	1.6	7.1	0.29	2.4
Western Coastal Area															
S Pad	4.1			5.5	0.39	2.3	5.3	0.19	0.9	4.0	0.19	0.9	6.3	0.24	1.3
DS-1J	3.6	0.19	0.8	7.5	0.29	2.3	6.6	0.45	4.4	4.1	0.28	1.2	9.6	0.35	3.7
UGNU Pad	4.3	0.29	1.3	4.1	0.28	1.3	4.9	0.37	2.6	4.1	0.20	0.9	6.5	0.36	2.7
Palm 2	5.4	0.25	1.5	4.9	0.21	1.1	7.2	0.32	2.0	5.8	0.28	1.6	6.6	0.22	1.4
DS-2L (ASTAC)	5.8	0.19	1.3	5.3	0.21	1.3	5.4	0.20	1.3	5.0	0.25	1.2	7.5	0.23	1.6
Area Averages	4.6	0.23	1.2	5.4	0.28	1.6	5.9	0.30	2.2	4.6	0.24	1.2	7.3	0.28	2.1
Lower Foothills Area															
SpurDike 6-20 Mi	4.0	0.23	1.0	7.1	0.29	1.7	5.3	0.25	1.4	3.9	0.24	1.5	5.5	0.26	1.7
30 Mile	2.8			3.5	0.15	0.6	4.6	0.18	1.1	4.5	0.22	0.9	4.8	0.27	1.0
52 Mile	9.3	0.20	1.8	8.8	0.15	1.4	9.6	0.18	1.8	11.9	0.24	3.1	13.2	0.22	3.2
62 Mile	9.1	0.20	1.8	8.6	0.19	1.5	8.8	0.21	1.3	7.8	0.24	2.1	9.0	0.21	1.6
Meltwater 19	4.9	0.13	0.8	4.5	0.19	1.0	4.8	0.30	2.3	5.6	0.27	1.5	7.7	0.24	1.2
Area Averages	6.0	0.19	1.4	6.5	0.20	1.2	6.6	0.22	1.6	6.7	0.24	1.8	8.0	0.24	1.7
Upper Foothills Area															
318 Mile	12.2	0.21	2.6	12.8	0.22	2.7	13.3	0.21	2.9	11.9	0.19	2.4	14.4	0.23	3.2
Pump 3	9.9	0.22	2.2	10.8	0.22	2.4	9.5	0.24	2.0	10.3	0.25	2.5	12.0	0.20	2.1
Sag R. DOT	10.3	0.24	2.4	10.1	0.23	2.0	10.1	0.25	1.6	9.3	0.22	2.8	10.9	0.26	2.8
Slope Mountain	9.3	0.14	1.2	8.5	0.21	1.3	8.7	0.21	1.5	6.9	0.21	1.7	8.2	0.13	1.0
Area Averages	10.4	0.20	2.1	10.5	0.22	2.1	10.4	0.23	2.0	9.6	0.22	2.3	11.4	0.20	2.3

	Dec 19 - 23			Dec 28 - 31			Jan 4 - 8			Jan 11 - 13		
	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)
Eastern Coastal Area												
ANFO Pad	6.1	0.34	2.1									
DS 16												
UAF 411 mi	7.2	0.34	2.9									
Term Well A	6.2	0.24	1.1									
P Pad												
T Pad	9.0	0.29	2.2									
Area Averages	7.1	0.3	2.0									
Western Coastal Area												
S Pad												
DS-1J												
UGNU Pad												
Palm 2												
DS-2L (ASTAC)				5.4	0.21	0.9						
Area Averages				5.4	0.2	0.9						
Lower Foothills Area												
SpurDike 6-20 Mi				4.8			7.3	0.30	2.5	7.4	0.22	1.3
30 Mile	6.2	0.21	1.1	2.8	0.20	0.6	6.2	0.18	1.6	7.3	0.20	1.6
52 Mile	12.5	0.21	2.7	10.8	0.17	1.9	11.9	0.23	2.6	14.0	0.19	2.2
62 Mile	9.2	0.16	1.4	9.8	0.22	2.0	11.3	0.23	2.4	9.8	0.30	2.6
Meltwater 19	7.3	0.30	1.8	5.1	0.25	1.2	8.8	0.30	2.5	8.6	0.29	2.7
Area Averages	8.8	0.2	1.7	6.6	0.2	1.4	9.1	0.2	2.3	9.4	0.2	2.0
Upper Foothills Area												
318 Mile	14.2	0.23	2.7	14.0	0.24	3.0	13.9	0.13	2.0	17.2	0.21	3.4
Pump 3	10.8	0.25	2.6	10.1	0.25	2.3	10.8	0.27	3.7	15.9	0.13	1.7
Sag R. DOT	9.8	0.30	2.8	8.6	0.23	2.0	8.7	0.27	2.3	11.7	0.20	2.3
Slope Mountain	7.0	0.18	1.2	7.4	0.17	1.0	7.7	0.24	1.2	10.4	0.18	1.7
Area Averages	10.5	0.2	2.3	10.0	0.2	2.0	10.2	0.2	2.3	13.8	0.2	2.3

	Jan 26 - 29			Feb 9 - 10			March 9 - 12			April 13-15		
	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)	Depth (in)	Density (g/cm^3)	SWE (in)
Eastern Coastal Area												
ANFO Pad												
DS 16												
UAF 411 mi												
Term Well A												
P Pad												
T Pad												
Area Averages												
Western Coastal Area												
S Pad												
DS-1J												
UGNU Pad												
Palm 2												
DS-2L (ASTAC)												
Area Averages												
Lower Foothills Area												
SpurDike 6-20 Mi	8.8	0.27	2.0	6.5	0.28	2.0	7.8	0.33	2.3	7.9	0.31	2.4
30 Mile	6.3	0.28	1.5	4.0	0.29	1.4	5.1	0.22	1.1	5.5	0.22	1.1
52 Mile	14.3	0.28	4.3									
62 Mile	9.5	0.26	2.7									
Meltwater 19				5.2	0.25	1.6	7.3	0.31	2.2	11.6	0.30	2.7
Area Averages	9.7	0.3		5.2	0.3	1.7	6.7	0.3	1.8	8.3	0.3	2.1
Upper Foothills Area												
318 Mile	16.6	0.21	3.1	14.6	0.20	2.8	23.0	0.27	6.1			
Pump 3	14.2	0.22	3.2	13.6	0.20	3.3						
Sag R. DOT	11.8	0.28	3.0									
Slope Mountain	9.8	0.30	2.6									
Area Averages	13.1	0.3	3.0	14.1	0.2	3.0	23.0	0.3	6.1			

APPENDIX D. ELEVATION SURVEY FORMS

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

Arctic Transportation Networks

Form F-011: Elevation Survey Form

Project ID: **ATN Project** Site Location/Lake ID: L9312

Survey Purpose: **Water-Level Elevations** Date: 4/15/2010 Time: 11:00

Location:	Lake L9312, located southeast of Alpine pad, survey by pump house benchmarks							
Survey objective:	Determine FWS Elevation.					Weather Observations:		
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)				
Rod Type:	Fiberglass		Rod ID:	Crane Fiber Glass		Cold, Overcast, Slight breeze		
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Jeff Murray, Michael Lilly, Chris (LCMF)		
L9312"P"	CP	11.73	na	na				
Station	**BS (ft)**	**HI (ft)**	**FS (ft)**	**Elevation (fasl)**	**Distance (ft)**	**Horizontal Angle**	**Vertical Angle**	**Remarks**
TBM "P"	1.341	13.071		11.73				Top of inlet pipe support
TBM "O"		13.071	1.599	11.47				Top of inlet pipe support. BM Elev=11.44'
99-32-59		13.071	-1.148	14.22				Top of Pumphouse SE VSM. BM Elev = 14.53
L9312 WL		13.071	5.810	**7.26**				
L9312 Ice		13.071	5.389	7.68				
Turn on L9312 Ice								
L9312 Ice	5.35	13.030						
L9312 WL		13.030	5.77	7.26				**WL = 7.26**
99-32-59		13.030	-1.571	14.60				
TBM"O"		13.030	1.549	11.48				
TBM"P"		13.030	1.300	11.73				close survey to 0.01'

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasml; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

APPENDIX E. LAKE HYDROLOGICAL MEASURMENTS

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: **Badami**
Local Number: Survey ID

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
	21.00	N 70° 7.775'	W 146° 59.956'

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

Date	Time	Method	Snow Depth	Total Depth IS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WS Elevation	IS Elevation	Remarks
4/13/10	17:20	Tape	8	28.46	+/- 0.01	5.88	0.29			

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: **Toolik Lake**
Local Number: Survey ID

All measurements in feet, unless noted	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (dd-mm.mmm)
	2382 ft.	N 68° 37.729'	W 149° 36.083'

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

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)
1/14/10	13:27	Tape	0.417'	19.383'	+/- 0.01	2.4'	0.083'	19.3'	Marked W/ Lathe	
2/11/10	11:30	Tape	0.807'	21.55'	+/- 0.01	2.72'	0.0328'	21.52	Marked W/ Lathe	
3/7/10	10:00	Tape	1.0'	25.05'	+/- 0.01	3.0'	.07'	22.05'	Marked W/ Lathe	
3/7/10	10:20	Tape	0.45	49.45	+/- 0.01	4.00	0.25	49.20	68 37.784	149 36.689
3/7/10	22:40	Tape	0.42	31.75	+/- 0.01	3.63	0.15	31.60	68 37.834	149 37.105
4/11/10	10:50	Tape	0.92	28.60	+/- 0.01	3.40	0.10	28.50	Marked W/ Lathe	
4/11/10	12:00	Tape	0.53	49.27	+/- 0.01	4.20	0.18	49.08	68 37.784	149 36.689
4/11/10	11:15	Tape	0.69	50.00	+/- 0.01	3.60	0.75	49.25	68 37.926	149 36.670

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 F. WATER QUALITY SAMPLING FORMS

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

Arctic Transportation Networks Project

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

Project ID: **Arctic Transportation Networks** Site Location/Lake ID: Badami Reservoir

Sample Purpose: **Lake Water Quality** Date: 4/13/10 Time: 17:50

FIELD MEASUREMENTS

GPS Coord. Northing: N 70° 7.775' Easting: W 146° 59.956' Datum: NAD83

Measurements By: Jeff Murray Time: 17:50

Water Depth (ft): 28.17 Ice Thickness (ft): 5.88

Freeboard (ft): 0.29 Snow Depth (ft): 0.26

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

Water Sampling By: Michael Lilly Sample Depths BWS (ft): 1 n/a 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
Conductivity/Temp	GWS	YSI30	07L100864	PASS	PASS
Temp/LDO	BLM	Hach RLDO	LDO101	PASS	PASS

Parameters	**Field Measurements**									
Time:	17:50	17:52	17:54	17:56	17:58	18:00	18:02	18:04	18:06	18:08
Depth BWS (ft):	6	7	8	9	10	12	14	16	18	20
Temp (°C):	0.4	0.5	0.4	0.4	0.4	0.4	0.5	0.6	0.6	0.7
Conductivity (µS/cm):	254.0	246.2	244.3	242.3	240.7	239.0	238.1	237.2	236.5	235.4
DO (mg/L)										
DO %Saturation										

Parameters	**Field Measurements**									
Time:	18:10	18:12	18:14	18:16	18:18	18:20	18:22			
Depth BWS (ft):	22	24	25	26	27	28	28.5			
Temp (°C):	0.7	0.8	0.8	0.8	0.8	0.8	0.9			
Conductivity (µS/cm):	-	-	-	-	-	-	-			
DO (mg/L)										
DO %Saturation										

Remarks: DO and %DO was measured, but the Hach RLDO did not pass post calibration check

Field-Form Filled Out By: Jeff Murray Date: 6/15/10

QAQC Check By: Kristie Hilton Date: 6/15/10

APPENDIX G. WATER QUALITY METER CALIBRATION FORMS

The following forms report results from the meter calibration checks.

University of Alaska Fairbanks, Water and Environmental Research Center

Form F-004e: Water Quality Meter Calibration Form

Project ID: **Arctic Transportation Network** Site Location/Lake ID: Toolik/Badami

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: Hach Make: RLDO

Owner: BLM S/N: LDO101

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Saturated O_2	3/11/10	nr	Bubbled Nanopure	na	na	96.2% (11.58 mg/L @ 6.9C)	Pass
Zero O_2	3/11/10	nr	Hanna HI7040	1756	Jul-14	0.3% (0.04 mg/L @ 6.5C)	Pass

Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Saturated O_2	4/17/10	nr	Bubbled Nanopure	na	na	99.6% (8.94 mg/L @ 18.0C)	Pass
Zero O_2	4/17/10	nr	Hanna HI7040	1756	Jul-14	12.4% (1.15 mg/L @ 18.9C)	Fail

Remarks:

Field-Form Filled Out By: JM Date: 6/10/2010

QAQC Check By: KMH Date: 6/15/2010