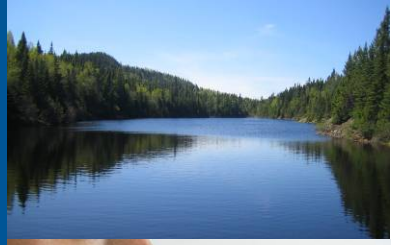







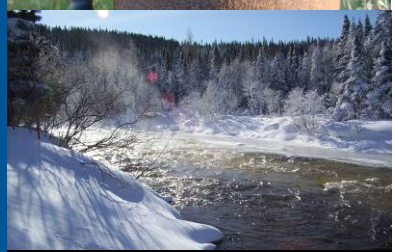

SNOW SURVEY 2011
UPPER HUMBER RIVER WATERSHED

April 4-8, 2011

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

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INTRODUCTION

- Since 2009, the Water Resources Management Division (WRMD), of the Newfoundland and Labrador Department of Environment and Conservation has conducted an annual snow survey in the Humber River Watershed.
- The main objective of the survey is to measure the amount of water contained within the snowpack, i.e., Snow Water Equivalent (SWE).
- SWE information is used by the WRMD to help forecast flood events in the Humber Valley.
- This report summarizes data collected during the April 4-9, 2011 snow survey and compares the results to previous year's data and to estimates made by satellite and ground-based remote sensors.

SURVEY SITES

- A total of 26 snow survey sites were established in the Humber River Watershed (22 sites), Main River Watershed (3 sites) and Exploits River Watershed (1 site) (Figure 1).
- Twenty-four sites were concentrated in or around the Upper Humber River Watershed since it is an area that: (i) retains its snow cover longer than other regions of the watershed, and thus complete melting of snow in this area usually precludes the occurrence of flooding along the Humber River; (ii) has no associated snow cover monitoring program, unlike the south-eastern portion of the Humber River Watershed that is surveyed by Deer Lake Power; and (iii) contains a large elevation range (6m-769m), which is ideal for examining elevation effects on snowfall accumulation.
- Two additional sites were established next to two GMON sensor stations[1] (Figure 1). This was to assess the accuracy of GMON sensor SWE measurements. Only the Humber GMON station was installed at the time of this field report.
- To examine the effect of elevation on snowfall accumulation, five sites were established at each of five elevation classes: 100 m, 200 m, 300 m, 400 m, and 500 m. Sites are labelled according to their elevation, followed by a hyphen and an id number (Figure 1).

[1] A GMON sensor is a ground-based remote sensing instrument that measures SWE.

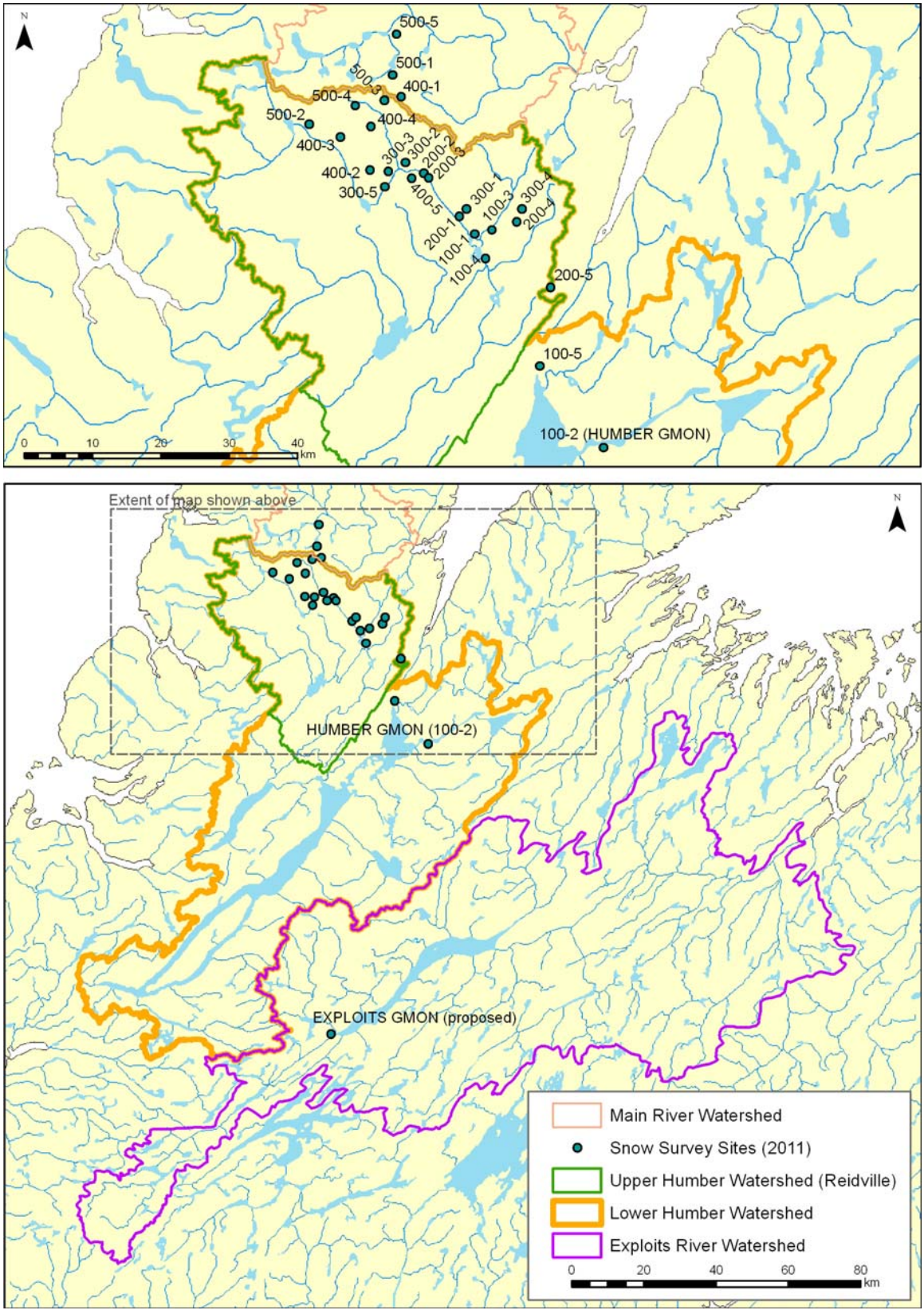

Figure 1. Survey sites were located in the Humber River, Main River and Exploits River Watersheds.

- Several watersheds and sub-watersheds are mentioned in this report. The area of each watershed is shown in Table 1.

Table 1. Watershed area.

Watershed	Area (km^2)
Lower Humber River Watershed (at Village Bridge)	7824.19
Upper Humber River Watershed (at Reidville)	2101.58
Upper Humber River Watershed (at Birchy Lake)	861.88
Upper Humber River Watershed (above Black Brook)	473.52
Exploits River Watershed (at Bond Bridge)	10247.50
Main River Watershed (at Bridge)	1016.58

MATERIALS & METHODS

- The snow survey was conducted over a four-day period from April 4-8, 2011.
- Twenty-six sites were visited, with five snow core samples collected at each site, for a total of 130 samples.
- Snow samples were extracted using the Mt. Rose Snow Sampling Tube (a.k.a. Model 3600 Federal).
- Each snow sample had its depth (cm), weight (kg), SWE (cm) and density (%) recorded.
- Depth (cm) measurements are made by inserting the sampling tube, vertically, into the snowpack and reading depth directly from the graduated measure on the outside of the tube.
- Weight (kg) was measured by subtracting the weight of the empty tube from the weight of the tube with the snow contents.
- SWE (cm) was computed using the equation:

$$\text{SWE (cm)} = \text{weight (kg)} \times 89.59 \text{ cm/kg} \quad [1]$$

- Density (%) was computed using the equation:

$$\text{Density (\%)} = \text{SWE (cm)} / \text{depth (cm)} \times 100\% \quad [2]$$

- Two snow pits were also dug to record characteristics of the snowpack profile; one pit was dug at 100m elevation and a second pit was dug at 500m elevation.

RESULTS - WEATHER DATA

- Weather conditions during the snow survey maybe have influenced SWE results between sites by as much as 3 mm, based on temperature and precipitation data (Figures 2 & 3).
- Air temperatures during the snow survey fluctuated between -11.8°C and 10.2 °C, as recorded by Environment Canada at Deer Lake Airport (Figure 2).

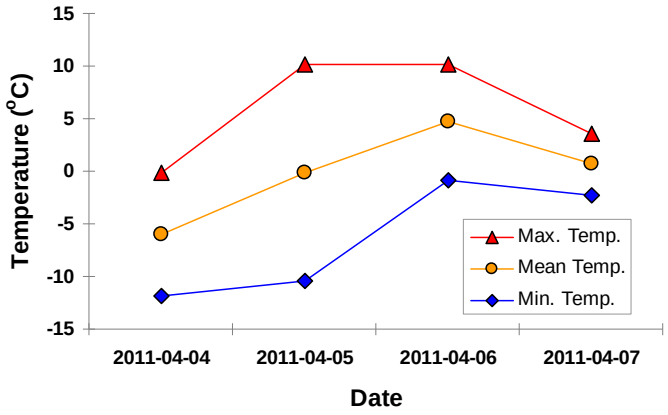

Figure 2. Minimum, maximum and mean air temperatures recorded during the snow survey by Environment Canada at Deer Lake Airport.

- A total of 3 mm of precipitation fell during the sampling period, as recorded by Environment Canada at Deer Lake Airport (Figure 3).

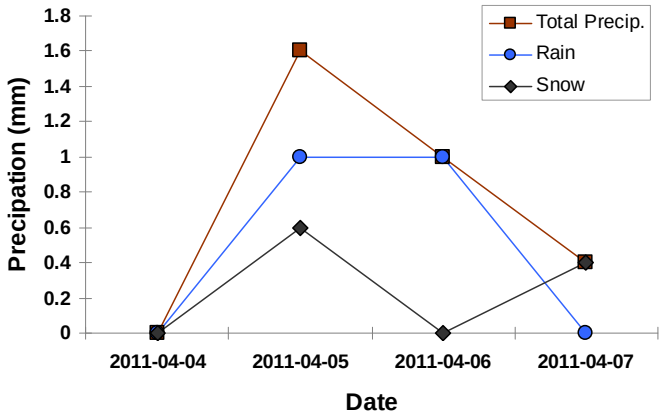

Figure 3. A total of 3 mm of precipitation fell in the form of snow or rain during the sampling period, as recorded by Environment Canada at Deer Lake Airport.

RESULTS - SNOW WATER EQUIVALENT DATA

- Table 2 summaries snow data sampled at each site.
- Data for all 130 snow samples is provided in Appendix A.

Table 2. Mean and Standard Deviation (SD) values of depth, weight, SWE, and density, as recorded at each site.

Station ID	Sample date (yyyy-mm-dd)	Sample time	n*	Depth (m)		Weight (kg)		SWE (cm)		Density (%)	
				Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD
100-1	2011-04-05	15:45	5	0.91	0.11	0.28	0.09	24.73	7.77	27.74	8.73
100-2	2011-04-07	16:35	5	0.61	0.05	0.27	0.02	24.01	1.47	39.54	3.53
100-3	2011-04-05	19:10	5	0.81	0.04	0.34	0.02	30.10	1.50	37.08	3.02
100-4	2011-04-05	16:20	5	0.75	0.07	0.27	0.06	24.55	5.25	33.06	8.02
100-5	2011-04-04	14:55	5	0.76	0.07	0.30	0.01	26.70	1.33	35.40	4.89
200-1	2011-04-05	15:10	5	1.18	0.12	0.38	0.04	34.22	3.19	29.06	1.71
200-2	2011-04-05	13:25	5	1.03	0.07	0.36	0.05	32.61	4.72	31.60	4.51
200-3	2011-04-05	13:55	5	0.99	0.05	0.39	0.02	34.94	1.42	35.39	1.09
200-4	2011-04-05	17:40	5	1.04	0.13	0.41	0.06	36.91	5.04	35.47	1.66
200-5	2011-04-04	15:25	5	1.05	0.09	0.47	0.07	42.11	6.40	39.87	3.68
300-1	2011-04-05	14:45	5	1.44	0.08	0.43	0.16	38.52	14.65	26.74	10.18
300-2	2011-04-05	12:15	5	1.19	0.13	0.37	0.11	33.15	9.54	27.82	7.78
300-3	2011-04-06	16:55	5	1.26	0.09	0.41	0.05	36.37	4.32	28.84	1.74
300-4	2011-04-05	18:10	5	1.51	0.21	0.56	0.09	50.17	7.86	33.22	1.10
300-5	2011-04-06	17:10	5	1.03	0.10	0.38	0.05	34.22	4.54	33.10	3.17
400-1	2011-04-06	12:45	5	1.61	0.17	0.58	0.08	51.96	7.44	32.23	1.58
400-2	2011-04-06	16:35	5	1.35	0.11	0.50	0.15	44.62	13.25	32.72	8.42
400-3	2011-04-06	15:40	5	1.37	0.30	0.48	0.15	43.18	13.25	31.30	4.17
400-4	2011-04-06	15:10	5	1.65	0.04	0.71	0.09	63.25	8.49	38.27	4.84
400-5	2011-04-05	12:55	5	1.46	0.15	0.46	0.08	40.85	7.24	28.29	5.71
500-1	2011-04-06	12:20	5	1.36	0.26	0.54	0.12	48.02	10.95	35.11	2.67
500-2	2011-04-06	16:00	5	1.34	0.10	0.61	0.11	54.83	10.16	40.78	5.09
500-3	2011-04-06	13:15	5	1.69	0.26	0.58	0.15	51.96	13.75	30.61	5.85
500-4	2011-04-06	14:10	5	1.61	0.14	0.54	0.09	48.38	7.89	29.81	2.77
500-5	2011-04-06	11:30	5	1.02	0.33	0.39	0.09	34.76	8.02	34.82	5.09

*n = number of samples

- Table 3 displays the mean and standard deviation values for depth, weight, SWE, and density of the snow sampled at each elevation. This data is also presented in Figures 4-10, along with data from previous year surveys (i.e., 2009 & 2010).

Table 3. Mean and Standard Deviation (SD) values of depth, weight, SWE, and density, as recorded at each elevation.

Elevation class (m)	Number of samples	Depth (m)		Weight (kg)		SWE (cm)		Density (%)	
		Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD
100	25	0.77	0.12	0.29	0.05	26.02	4.57	34.56	6.91
200	25	1.06	0.11	0.40	0.06	36.16	5.29	34.28	4.59
300	25	1.29	0.21	0.43	0.12	38.49	10.34	29.95	6.12
400	25	1.49	0.20	0.54	0.14	48.77	12.55	32.56	5.95
500	25	1.41	0.32	0.53	0.13	47.59	11.80	34.23	5.73

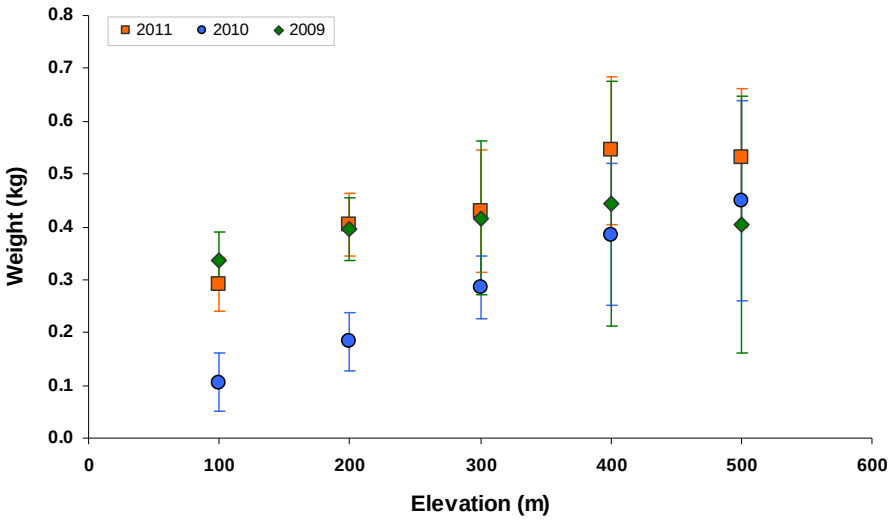

Figure 4. Snow weight (mean & standard deviation) at five different elevations, for years 2009, 2010 and 2011. Error bars represent one standard deviation. Number of samples per elevation class was 12 for year 2009 and 25 for years 2010 and 2011.

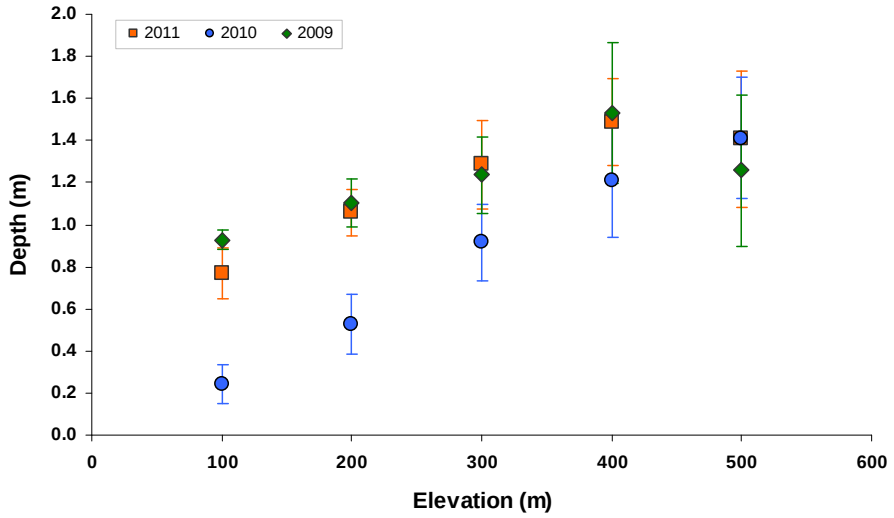

Figure 5. Snow depth (mean & standard deviation) at five different elevations, for years 2009, 2010 and 2011. Error bars represent one standard deviation. Number of samples per elevation class was 12 for year 2009 and 25 for years 2010 and 2011.

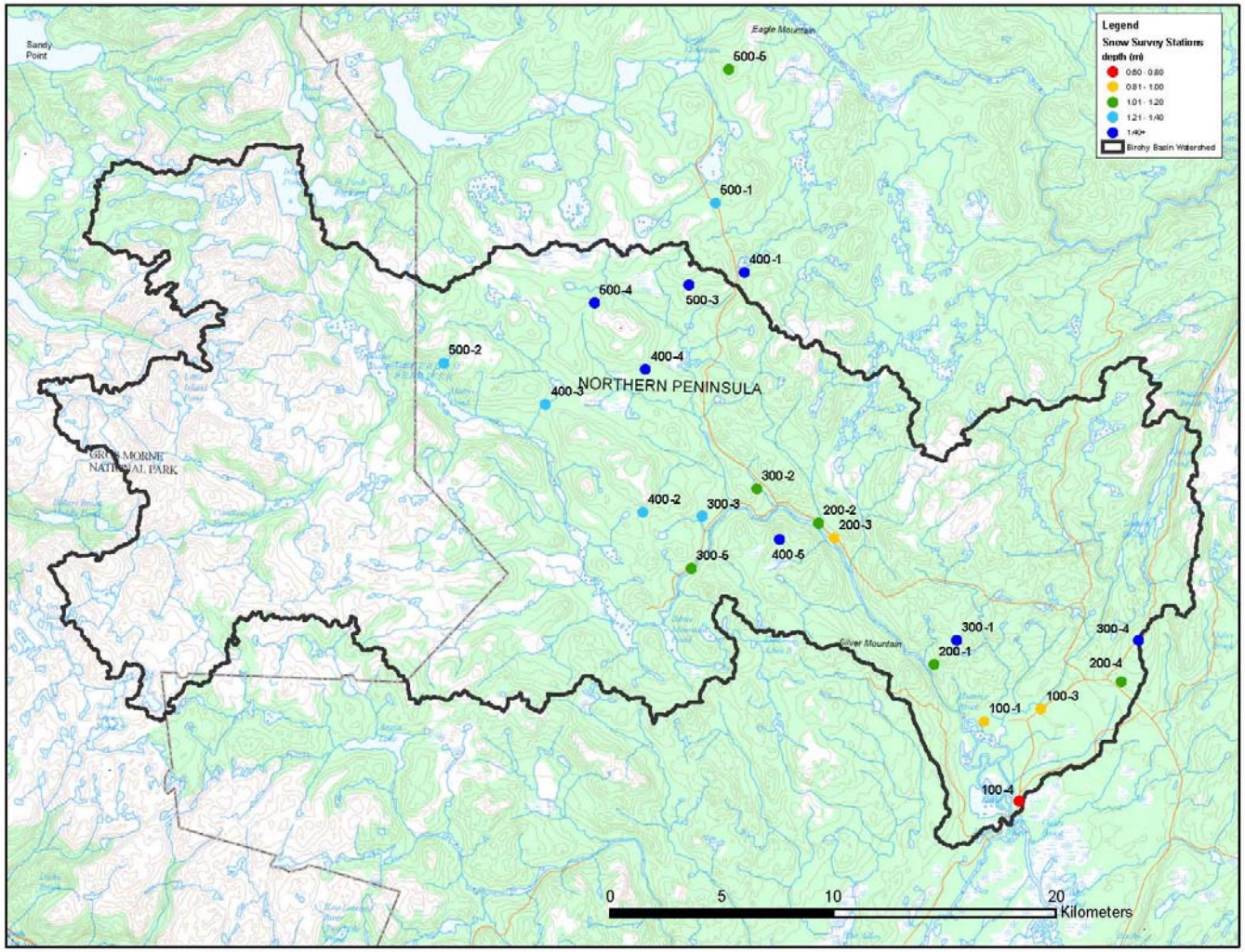

Figure 6. Spatial distribution of snow depth in and around the Upper Humber River Watershed (above Birchy Lake), during the April 2011 snow survey.

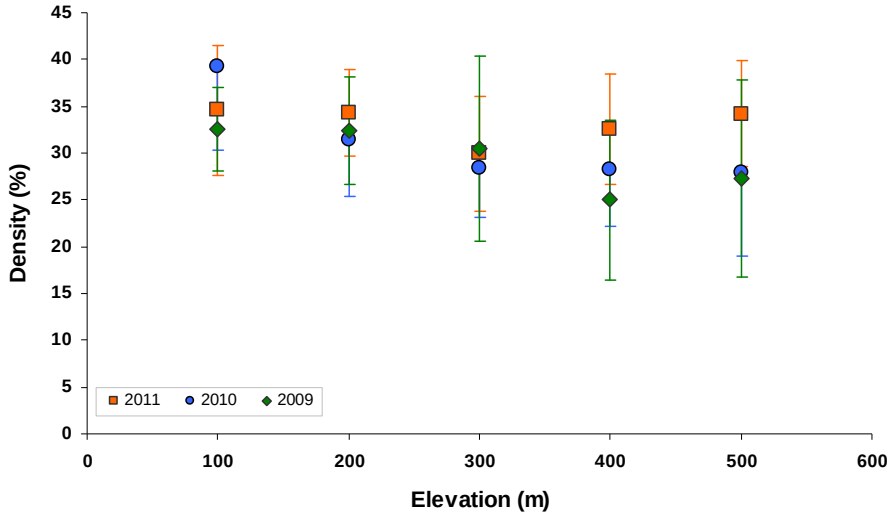

Figure 7 Snow density (mean & standard deviation) at five different elevations, for years 2009, 2010 and 2011. Error bars represent one standard deviation. Number of samples per elevation class was 12 for year 2009 and 25 for years 2010 and 2011.

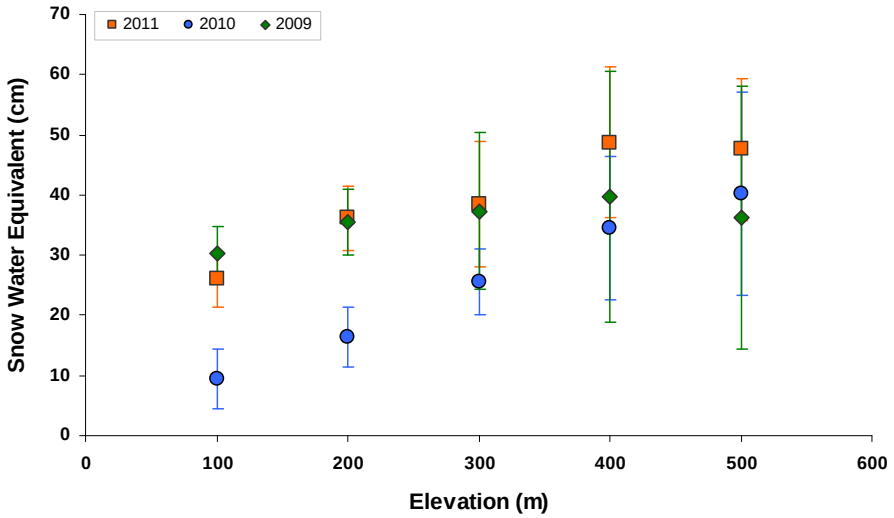

Figure 8. SWE (mean & standard deviation) of snow cores sampled at five different elevations, for years 2009, 2010 and 2011. Error bars represent one standard deviation. Number of samples per elevation class were 12 for year 2009, 25 for year 2010 and 25 for year 2011.

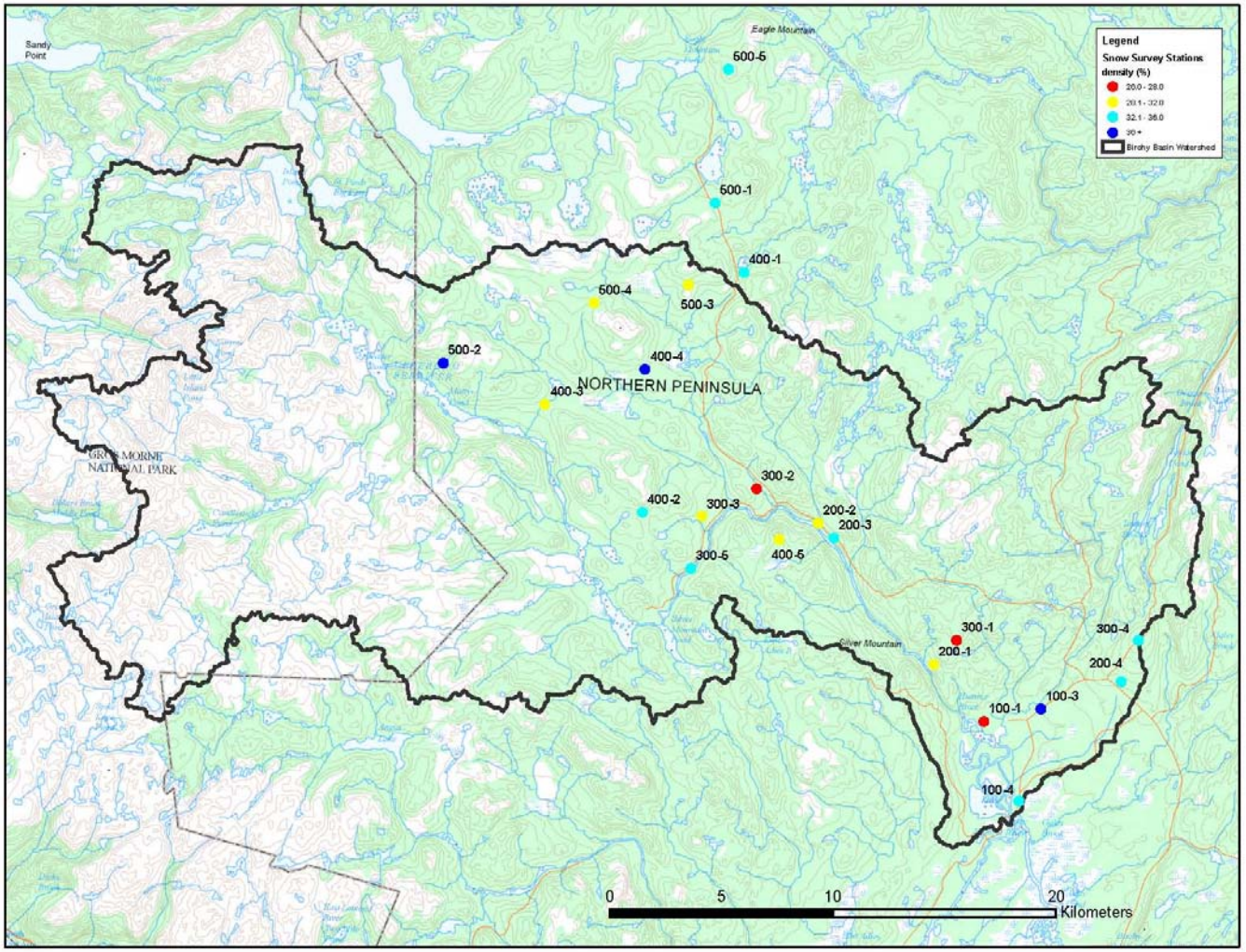

Figure 9. Spatial distribution of snow density in and around the Upper Humber River Watershed (above Birchy Lake), during the April 2011 snow survey.

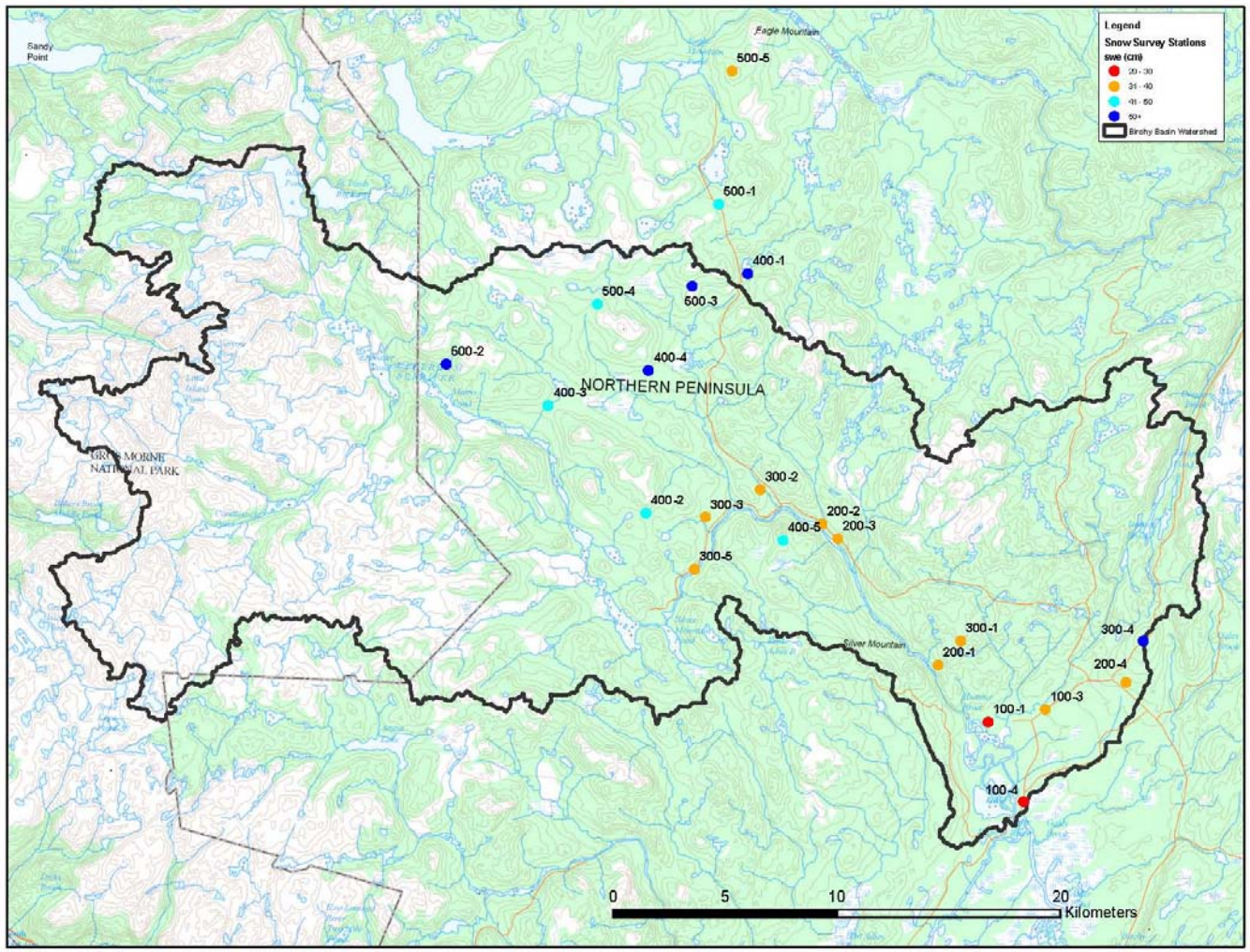

Figure 10. Spatial distribution of SWE in and around the Upper Humber River Watershed (above Birchy Lake), during the April 2011 snow survey.

- A linear regression model was used to determine the relationship between elevation and SWE for years 2009, 2010 and 2011 (Figure 11).
- It has been noted that the linear model may not be the best model to use, since SWE appears to become saturated at elevations greater than 400 m for years 2009 and 2011.

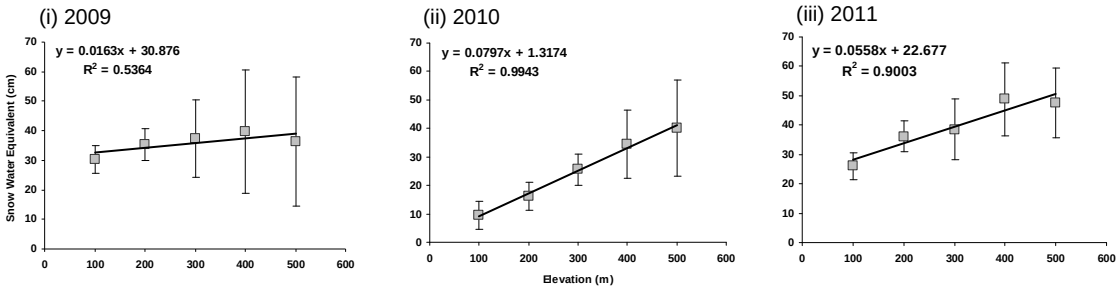

Figure 11. Linear regression model results describe the relationship between elevation and SWE for snow data collected in (i) 2009, (ii) 2010, and (iii) 2011. Number of samples per elevation class were 12 for year 2009, 25 for year 2010 and 25 for year 2011.

- The results of the linear regression model varied from year to year, which may preclude the development of a generalized elevation-SWE relationship.
- The linear regression model for elevation and SWE for all years combined is shown in Figure 12. The sample size for each elevation class was 62 for elevation classes 200 and 300, and 63 for elevation classes 100, 400 and 500.

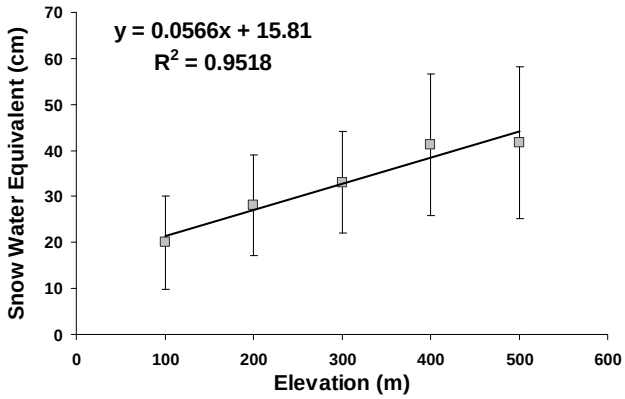

Figure 12. Linear regression model showing the relationship between elevation and SWE for snow data collected in 2009, 2010, and 2011, combined. Number of samples per elevation class were 62 for elevation classes 200 and 300, and 63 for elevation classes 100, 400 and 500.

- The 2011 linear regression model was applied to a DEM to create the SWE map displayed in Figure 13. Elevation data was derived from the Canadian Digital Elevation Data (CDED), downloaded from GeoBase (*www.geobase.ca*).
- Based on this SWE map, the total volume of water contained in the snowpack for the Upper Humber River Watershed above Birchy Lake and above Reidville on April 4-8, 2011 is estimated at 401,964,568 m^3 and 847,749,129 m^3, respectively.

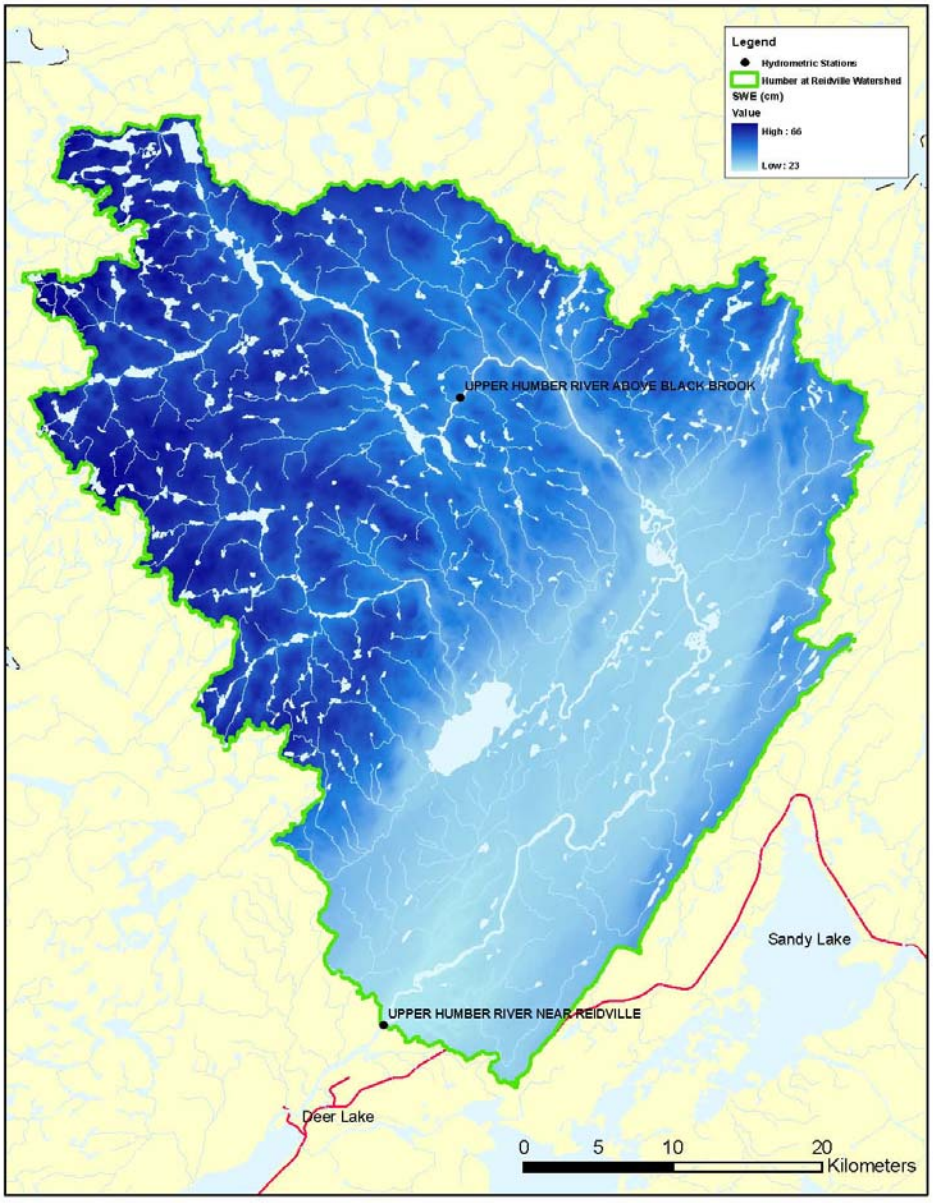

Figure 13. SWE map of the Upper Humber River Watershed above Reidville for April 4-8, 2011. This map was derived from the Canadian Digital Elevation Data (CDED) and linear regression model results for 2011 (displayed in Figure 11).

RESULTS – GMON SENSOR ACCURACY

- The GMON sensor provides two estimates of SWE based on gamma radiation emissions from the ground by Potassium (^{40}K) and Thallium (^{208}Tl) elements. The presumption is, with more snow on the ground, there is less gamma radiation detected from these ground elements by the sensor.
- Survey results show that the Humber GMON sensor provided accurate estimates of SWE based on Thallium (TL) and Potassium (K) gamma radiation readings (Figure 14).

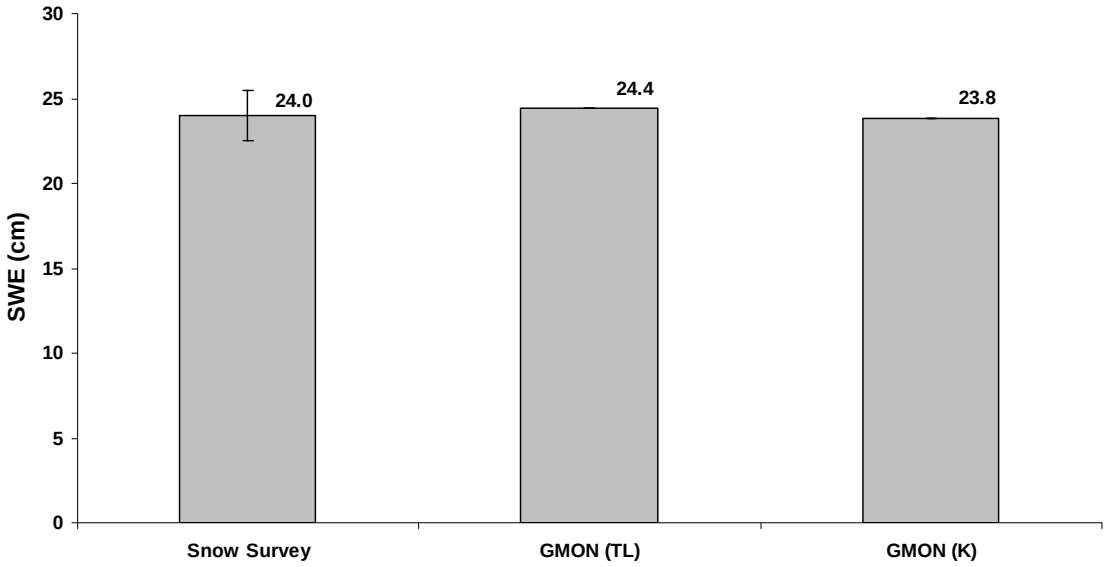

Figure 14. Based on snow survey results (n = 5), GMON estimates of SWE were accurate for both Thallium (TL) and Potassium (K) gamma radiation measurements. Error bars represent one standard deviation. GMON estimates were computed based on five hourly data readings. Standard deviation was zero for the GMON estimates, since there was no change in the hourly SWE values during five hours of sampling.

RESULTS – GLOBSNOW & NSIDC PRODUCT ACCURACY

- GlobSnow and the National Snow & Ice Data Center (NSIDC) each provide estimates of SWE for all areas of the Province.
- Their products are distributed in raster data format.
- Each pixel of the raster dataset has a ground resolution of approximately 25 km^2.
- Figure 15 shows the pixel coverage of the Humber River Watershed.
- Snow survey sites were concentrated in Pixels 8 and 15 (Figure 15).

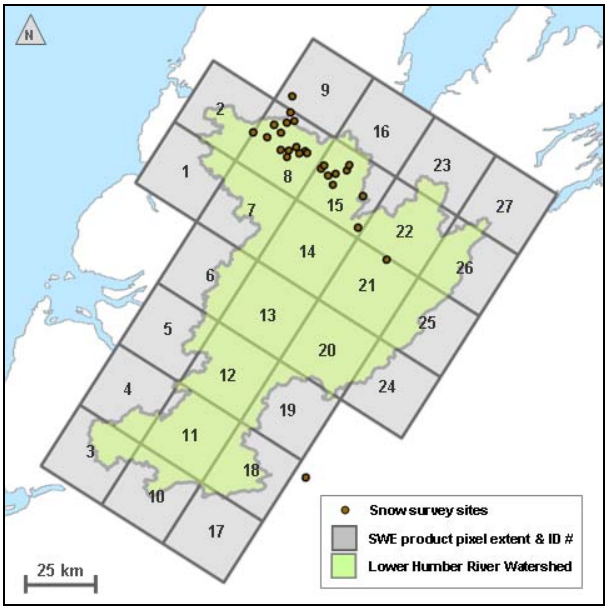

Figure 15. Twenty-seven pixels of the GlobSnow and NSIDC SWE products cover the Humber River Watershed (above the Humber Village Bridge). Snow survey sites were concentrated in Pixels 8 and 15.

- Figures 16 and 17 display quasi-daily SWE values for Pixel 8 and Pixel 15, as estimated by GlobSnow and the NSIDC, from March 20, 2011 to April 17, 2011.
- Both products showed high variability of SWE (i.e., 0-8 cm for NSIDC product and 0-16 cm for the GlobSnow product) from March 20, 2011 to April 17, 2011.
- GlobSnow estimates of SWE were on average 4.9 cm and 5.7 cm greater than NSIDC SWE estimates for Pixels 8 and 15, respectively.

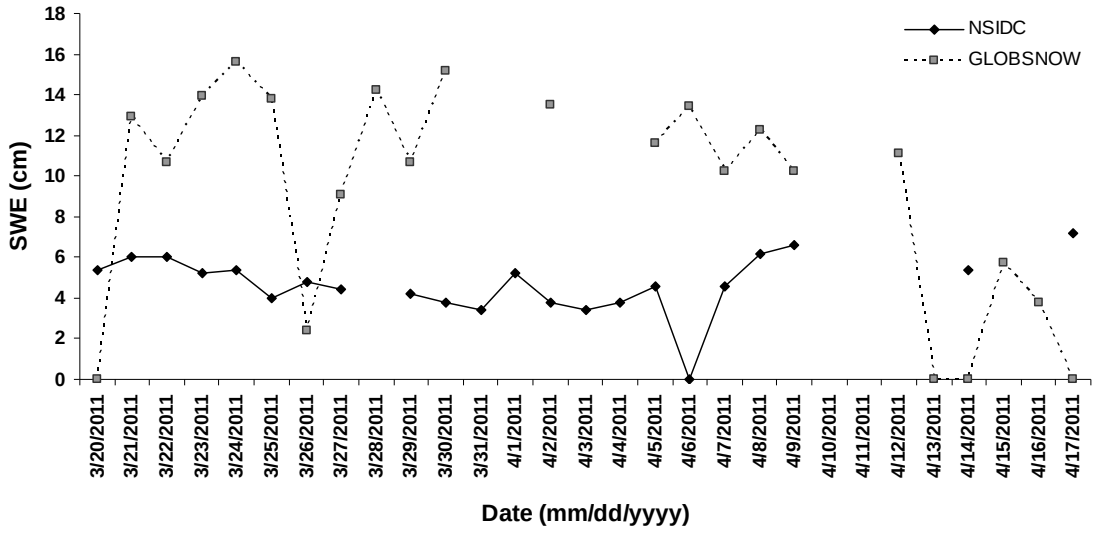

Figure 16. Daily SWE trends of the NSIDC and Globsnow products for Pixel 8, from March 20, 2011 to April 17, 2011.

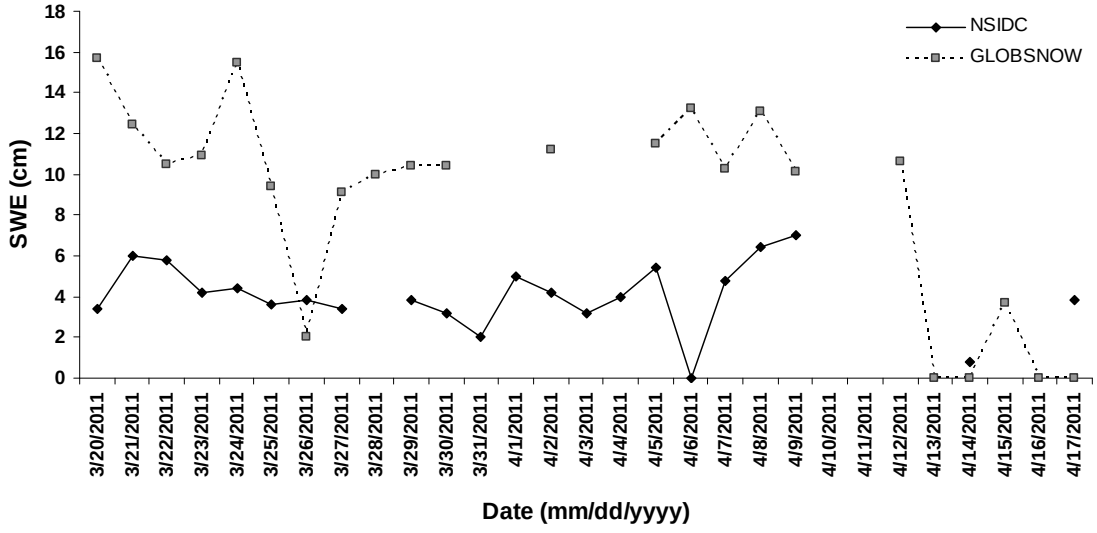

Figure 17. Daily SWE trends of the NSIDC and Globsnow products for Pixel 15, from March 20, 2011 to April 17, 2011.

- Based on the April 2011 ground survey, the GlobSnow and NSIDC products had underestimated SWE (Figure 18).
- Ground survey averages are based on a sample size of 65 for Pixel 8 and 45 for Pixel 15.
- NSIDC and GlobSnow estimates were an average of four daily SWE estimates acquired from April 4, 2011 to April 8, 2011.

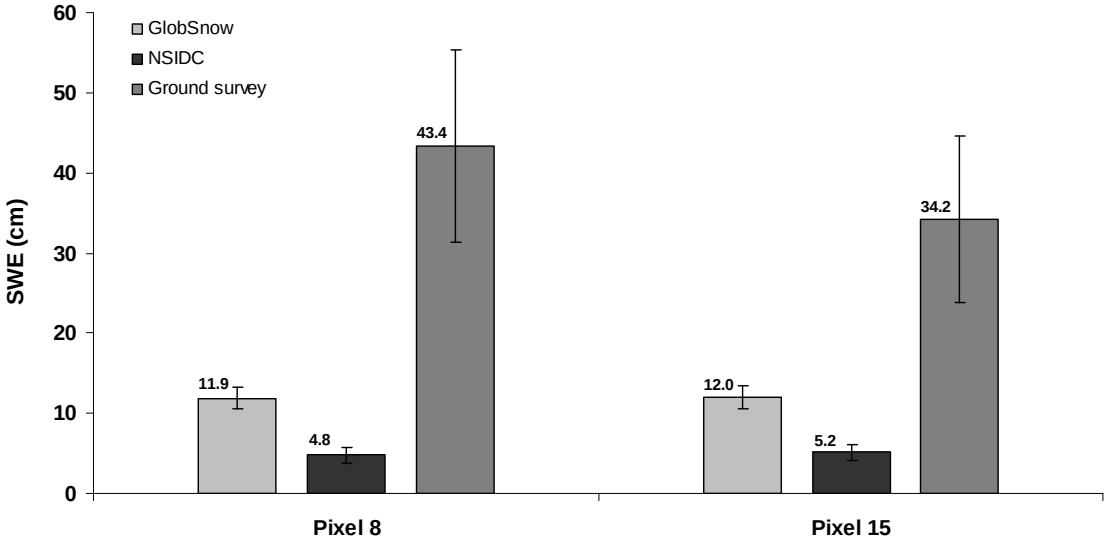

Figure 18. SWE data acquired for Pixels 8 and 15 from April 4-8, 2011 by the WRMD ground survey, GlobSnow and the NSIDC. Error bars represent one standard deviation.

RESULTS – SNOW PITS

- Two snow pits were dug to map the profile of the snowpack.
- Figure 19 displays the snowpack profile at Station 100-4 (Elevation = 100m) and Figure 20 displays the snowpack profile at Station 500-1 (Elevation = 500m).

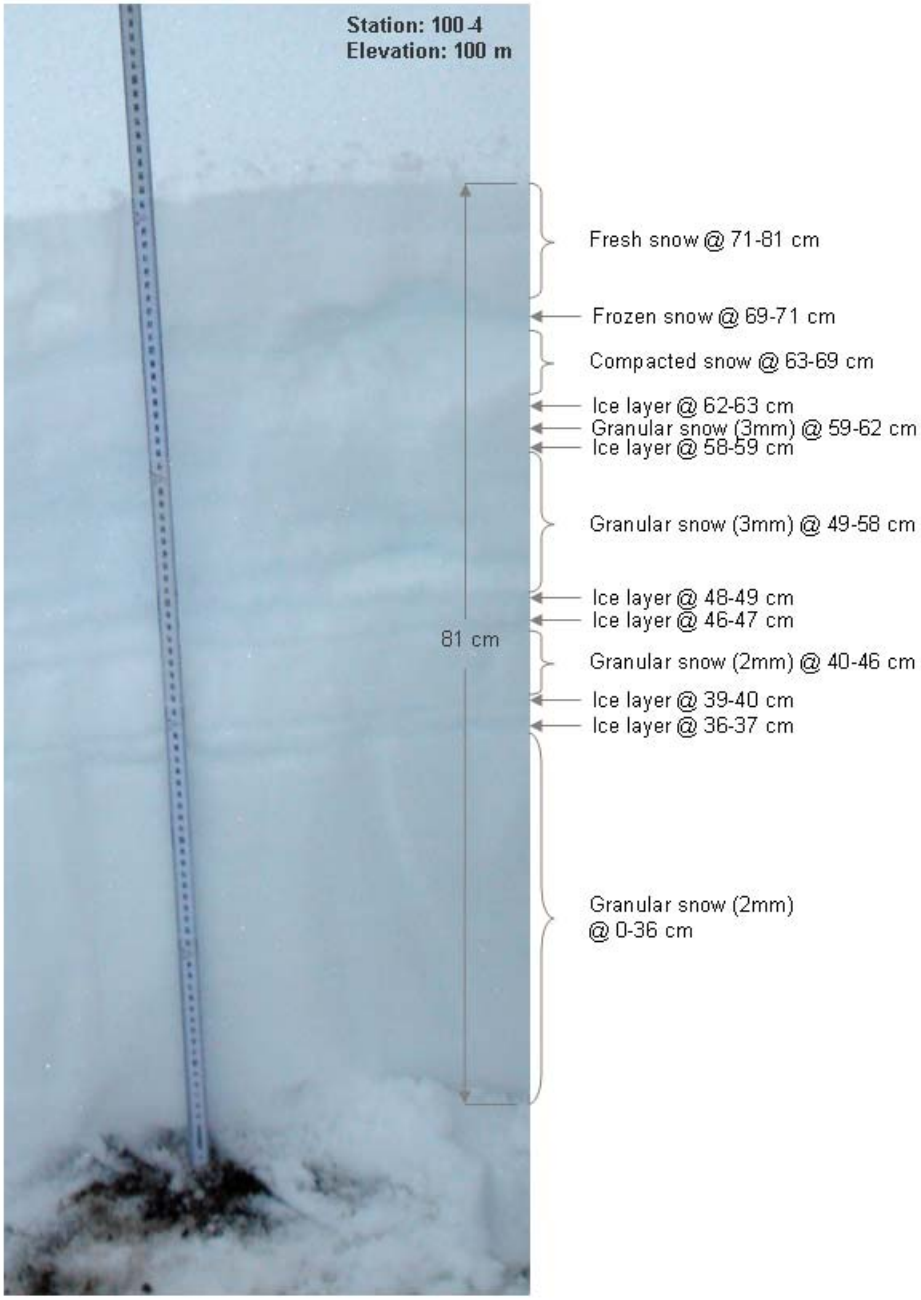

Figure 19. Snowpack profile at Station 100-4 (Elevation = 100 m).

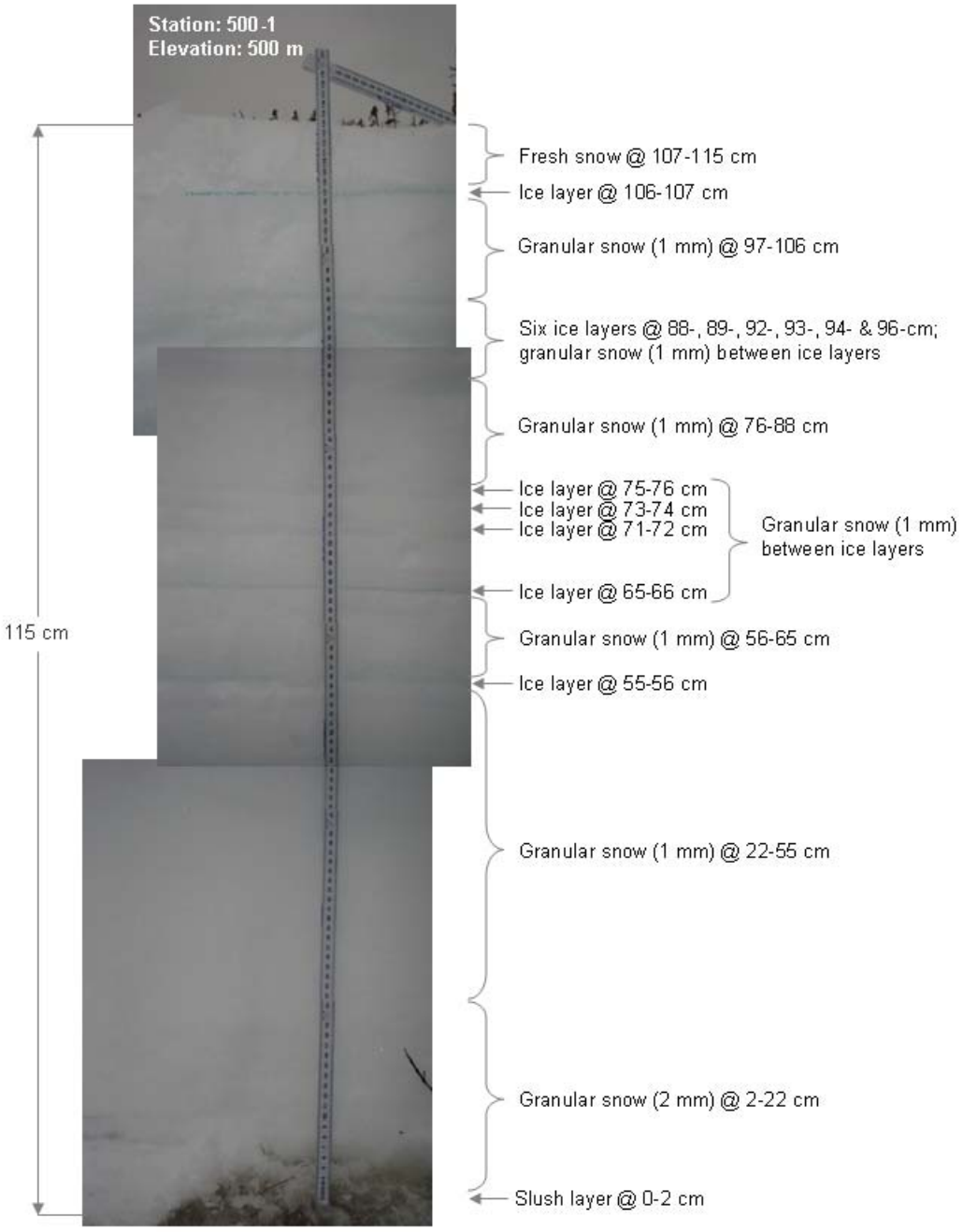

Figure 20. Snowpack profile at Station 500-1 (Elevation = 500 m).

CONCLUSIONS & RECOMMENDATIONS

- The total volume of water contained in the snowpack for the Upper Humber River Watershed above Birchy Lake and above Reidville for April 4-8, 2011 is estimated at 401,964,568 m^3 and 847,749,129 m^3, respectively.
- The GMON sensor provided accurate estimates of SWE.
- The satellite-based SWE products (i.e., GlobSnow & NSIDC) had underestimated actual SWE.
- The relationship between elevation and SWE varied from year-to-year.
- The Upper Humber Snow Surveying should continue on an annual basis for the following reasons: (i) to provide a reliable estimate of SWE for the Upper Humber River Watershed, for the purpose of flood forecasting; (ii) to monitor the accuracy of satellite and ground-based remote sensing estimates of SWE; (iii) to study the effects of elevation on snowfall accumulation, for the purpose of extrapolating SWE estimates to all areas of the Upper Humber River Watershed; and (iv) to monitor the effects of climate change on the snowpack, which directly effects flow rates of the Humber River.
- Work should be done to better distribute survey sites throughout the Upper Humber River Watershed.
- Incorporate spatial statistical tools when analyzing SWE field data.
- Build a SWE database for the Province by consolidating all snow survey data collected in the Province into one source file, such a GIS database.
- Maintain a record of SWE estimates provided by GlobSnow and NSIDC with the intention of calibrating their values to represent actual SWE amounts.
- Install a second GMON sensor at a higher elevation in the Upper Humber Watershed, to better understand the relationship between elevation and SWE, to better estimate SWE amounts as the snowpack recedes, which would be valuable information to combine with snow extent mapping.

ACKNOWLEDGEMENTS

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A special thanks goes to Paul Taylor, with the Parks and Natural Areas Division, for his field expertise and his ability to sample bog water equivalent. A special thanks also to Caryn Smith and Christine Doucet of the Wildlife Division for providing accommodations at the Main River Wildlife Cabin, as well as to Frank Turner of the Parks and Natural Areas Division for providing a snow machine and sled for the survey.

APPENDIX A
SNOW SURVEY DATA (APRIL 4-8, 2011)

Station	Elevation (m)	Site	Depth (m)	Weight (kg)	SWE (cm)	Density (%)	Sample date	Sample time
100-1	100	1	1.06	0.16	14.33	13.52	2011-04-05	15:45
100-1	100	1	0.78	0.27	24.19	31.01	2011-04-05	15:45
100-1	100	1	0.86	0.30	26.88	31.25	2011-04-05	15:45
100-1	100	1	0.85	0.25	22.40	26.35	2011-04-05	15:45
100-1	100	1	0.98	0.40	35.84	36.57	2011-04-05	15:45
100-2	100	2	0.53	0.26	23.29	43.95	2011-04-07	16:35
100-2	100	2	0.61	0.26	23.29	38.19	2011-04-07	16:35
100-2	100	2	0.65	0.29	25.98	39.97	2011-04-07	16:35
100-2	100	2	0.65	0.25	22.40	34.46	2011-04-07	16:35
100-2	100	2	0.61	0.28	25.09	41.12	2011-04-07	16:35
100-3	100	3	0.85	0.34	30.46	35.84	2011-04-05	19:10
100-3	100	3	0.77	0.33	29.56	38.40	2011-04-05	19:10
100-3	100	3	0.85	0.31	27.77	32.67	2011-04-05	19:10
100-3	100	3	0.77	0.35	31.36	40.72	2011-04-05	19:10
100-3	100	3	0.83	0.35	31.36	37.78	2011-04-05	19:10
100-4	100	4	0.66	0.26	23.29	35.29	2011-04-05	16:20
100-4	100	4	0.70	0.33	29.56	42.24	2011-04-05	16:20
100-4	100	4	0.78	0.29	25.98	33.31	2011-04-05	16:20
100-4	100	4	0.81	0.31	27.77	34.29	2011-04-05	16:20
100-4	100	4	0.80	0.18	16.13	20.16	2011-04-05	16:20
100-5	100	5	0.79	0.30	26.88	34.02	2011-04-04	14:55
100-5	100	5	0.69	0.32	28.67	41.55	2011-04-04	14:55
100-5	100	5	0.86	0.28	25.09	29.17	2011-04-04	14:55
100-5	100	5	0.78	0.29	25.98	33.31	2011-04-04	14:55
100-5	100	5	0.69	0.30	26.88	38.95	2011-04-04	14:55
200-1	200	1	1.07	0.36	32.25	30.14	2011-04-05	15:10
200-1	200	1	1.05	0.35	31.36	29.86	2011-04-05	15:10
200-1	200	1	1.20	0.39	34.94	29.12	2011-04-05	15:10
200-1	200	1	1.27	0.37	33.15	26.10	2011-04-05	15:10
200-1	200	1	1.31	0.44	39.42	30.09	2011-04-05	15:10
200-2	200	2	1.08	0.43	38.52	35.67	2011-04-05	13:25
200-2	200	2	1.00	0.41	36.73	36.73	2011-04-05	13:25
200-2	200	2	1.13	0.34	30.46	26.96	2011-04-05	13:25
200-2	200	2	0.95	0.33	29.56	31.12	2011-04-05	13:25
200-2	200	2	1.01	0.31	27.77	27.50	2011-04-05	13:25
200-3	200	3	0.99	0.40	35.84	36.20	2011-04-05	13:55
200-3	200	3	0.93	0.37	33.15	35.64	2011-04-05	13:55
200-3	200	3	0.96	0.39	34.94	36.40	2011-04-05	13:55
200-3	200	3	1.05	0.41	36.73	34.98	2011-04-05	13:55
200-3	200	3	1.01	0.38	34.04	33.71	2011-04-05	13:55
200-4	200	4	0.93	0.36	32.25	34.68	2011-04-05	17:40
200-4	200	4	1.01	0.43	38.52	38.14	2011-04-05	17:40
200-4	200	4	1.06	0.40	35.84	33.81	2011-04-05	17:40
200-4	200	4	0.95	0.37	33.15	34.89	2011-04-05	17:40
200-4	200	4	1.25	0.50	44.80	35.84	2011-04-05	17:40
200-5	200	5	1.09	0.54	48.38	44.38	2011-04-04	15:25
200-5	200	5	1.15	0.50	44.80	38.95	2011-04-04	15:25
200-5	200	5	1.08	0.48	43.00	39.82	2011-04-04	15:25
200-5	200	5	0.91	0.35	31.36	34.46	2011-04-04	15:25
200-5	200	5	1.03	0.48	43.00	41.75	2011-04-04	15:25
300-1	300	1	1.41	0.55	49.27	34.95	2011-04-05	14:45
300-1	300	1	1.43	0.39	34.94	24.43	2011-04-05	14:45
300-1	300	1	1.42	0.16	14.33	10.09	2011-04-05	14:45
300-1	300	1	1.37	0.52	46.59	34.00	2011-04-05	14:45
300-1	300	1	1.57	0.53	47.48	30.24	2011-04-05	14:45
300-2	300	2	1.09	0.42	37.63	34.52	2011-04-05	12:15
300-2	300	2	1.24	0.38	34.04	27.46	2011-04-05	12:15
300-2	300	2	1.05	0.19	17.02	16.21	2011-04-05	12:15
300-2	300	2	1.37	0.39	34.94	25.50	2011-04-05	12:15
300-2	300	2	1.19	0.47	42.11	35.38	2011-04-05	12:15

Station	Elevation (m)	Site	Depth (m)	Weight (kg)	SWE (cm)	Density (%)	Sample date	Sample time
300-3	300	3	1.13	0.33	29.56	26.16	2011-04-06	16:55
300-3	300	3	1.20	0.39	34.94	29.12	2011-04-06	16:55
300-3	300	3	1.29	0.44	39.42	30.56	2011-04-06	16:55
300-3	300	3	1.34	0.45	40.32	30.09	2011-04-06	16:55
300-3	300	3	1.33	0.42	37.63	28.29	2011-04-06	16:55
300-4	300	4	1.20	0.45	40.32	33.60	2011-04-05	18:10
300-4	300	4	1.47	0.53	47.48	32.30	2011-04-05	18:10
300-4	300	4	1.48	0.53	47.48	32.08	2011-04-05	18:10
300-4	300	4	1.75	0.68	60.92	34.81	2011-04-05	18:10
300-4	300	4	1.64	0.61	54.65	33.32	2011-04-05	18:10
300-5	300	5	1.07	0.43	38.52	36.00	2011-04-06	17:10
300-5	300	5	0.93	0.30	26.88	28.90	2011-04-06	17:10
300-5	300	5	0.93	0.37	33.15	35.64	2011-04-06	17:10
300-5	300	5	1.17	0.40	35.84	30.63	2011-04-06	17:10
300-5	300	5	1.07	0.41	36.73	34.33	2011-04-06	17:10
400-1	400	1	1.37	0.49	43.90	32.04	2011-04-06	12:45
400-1	400	1	1.77	0.65	58.23	32.90	2011-04-06	12:45
400-1	400	1	1.72	0.65	58.23	33.86	2011-04-06	12:45
400-1	400	1	1.48	0.49	43.90	29.66	2011-04-06	12:45
400-1	400	1	1.70	0.62	55.55	32.67	2011-04-06	12:45
400-2	400	2	1.30	0.57	51.07	39.28	2011-04-06	16:35
400-2	400	2	1.26	0.45	40.32	32.00	2011-04-06	16:35
400-2	400	2	1.38	0.54	48.38	35.06	2011-04-06	16:35
400-2	400	2	1.53	0.66	59.13	38.65	2011-04-06	16:35
400-2	400	2	1.30	0.27	24.19	18.61	2011-04-06	16:35
400-3	400	3	1.58	0.61	54.65	34.59	2011-04-06	15:40
400-3	400	3	1.73	0.67	60.03	34.70	2011-04-06	15:40
400-3	400	3	1.15	0.41	36.73	31.94	2011-04-06	15:40
400-3	400	3	1.39	0.38	34.04	24.49	2011-04-06	15:40
400-3	400	3	0.99	0.34	30.46	30.77	2011-04-06	15:40
400-4	400	4	1.62	0.80	71.67	44.24	2011-04-06	15:10
400-4	400	4	1.68	0.64	57.34	34.13	2011-04-06	15:10
400-4	400	4	1.71	0.81	72.57	42.44	2011-04-06	15:10
400-4	400	4	1.60	0.60	53.75	33.60	2011-04-06	15:10
400-4	400	4	1.65	0.68	60.92	36.92	2011-04-06	15:10
400-5	400	5	1.50	0.33	29.56	19.71	2011-04-05	12:55
400-5	400	5	1.65	0.48	43.00	26.06	2011-04-05	12:55
400-5	400	5	1.30	0.50	44.80	34.46	2011-04-05	12:55
400-5	400	5	1.31	0.43	38.52	29.41	2011-04-05	12:55
400-5	400	5	1.52	0.54	48.38	31.83	2011-04-05	12:55
500-1	500	1	1.05	0.43	38.52	36.69	2011-04-06	12:20
500-1	500	1	1.31	0.46	41.21	31.46	2011-04-06	12:20
500-1	500	1	1.77	0.73	65.40	36.95	2011-04-06	12:20
500-1	500	1	1.39	0.58	51.96	37.38	2011-04-06	12:20
500-1	500	1	1.30	0.48	43.00	33.08	2011-04-06	12:20
500-2	500	2	1.41	0.65	58.23	41.30	2011-04-06	16:00
500-2	500	2	1.20	0.44	39.42	32.85	2011-04-06	16:00
500-2	500	2	1.44	0.74	66.30	46.04	2011-04-06	16:00
500-2	500	2	1.34	0.66	59.13	44.13	2011-04-06	16:00
500-2	500	2	1.29	0.57	51.07	39.59	2011-04-06	16:00
500-3	500	3	1.85	0.49	43.90	23.73	2011-04-06	13:15
500-3	500	3	1.93	0.78	69.88	36.21	2011-04-06	13:15
500-3	500	3	1.39	0.54	48.38	34.80	2011-04-06	13:15
500-3	500	3	1.85	0.69	61.82	33.41	2011-04-06	13:15
500-3	500	3	1.44	0.40	35.84	24.89	2011-04-06	13:15
500-4	500	4	1.72	0.62	55.55	32.29	2011-04-06	14:10
500-4	500	4	1.69	0.58	51.96	30.75	2011-04-06	14:10
500-4	500	4	1.69	0.56	50.17	29.69	2011-04-06	14:10
500-4	500	4	1.39	0.39	34.94	25.14	2011-04-06	14:10
500-4	500	4	1.58	0.55	49.27	31.19	2011-04-06	14:10
500-5	500	5	1.58	0.50	44.80	28.35	2011-04-06	11:30
500-5	500	5	1.07	0.47	42.11	39.35	2011-04-06	11:30
500-5	500	5	0.73	0.33	29.56	40.50	2011-04-06	11:30
500-5	500	5	0.87	0.31	27.77	31.92	2011-04-06	11:30

Station	Elevation (m)	Site	Depth (m)	Weight (kg)	SWE (cm)	Density (%)	Sample date	Sample time
Exploits	240	1	0.59	0.29	25.98	44.04	2011-04-08	13:50
Exploits	240	1	0.57	0.22	19.71	34.58	2011-04-08	13:50
Exploits	240	1	0.50	0.20	17.92	35.84	2011-04-08	13:50
Exploits	240	1	0.50	0.18	16.13	32.25	2011-04-08	13:50
Exploits	240	1	0.47	0.19	17.02	36.22	2011-04-08	13:50