Waterford River
@
Kilbride

NF02ZM0009

January – April 2013

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

Real Time Water Quality Monthly Report
Waterford River - St. John's NL
January – April 30, 2013

General

- Data from the Waterford River real-time station is regularly monitored by the Water Resources Management Division (WRMD) staff.
- The instrument used for the deployment period from January 16 to April 30, 2013 was a YSI 6600 series multi-probe, which continuously measured water temperature, dissolved oxygen, pH, specific conductivity and turbidity. The duration of the deployment was 104 days.

Maintenance and Calibration of Instrumentation

- **Table 1** displays the dates when routine cleaning, maintenance and calibration were performed on the water quality probe during this deployment.

Table 1: **Table of Water Quality Probe Installation and Removal**

Date Deployed	Date Removed
January 16, 2013	April 30, 2013

- Water quality readings were taken with a second freshly cleaned and calibrated water quality instrument at the time of deployment and removal, in compliance with WRMD quality assurance and quality control protocol.

Table 2: Comparison rankings for deployment of RTWQ instrument on January 16, 2013

Deployment

Field Sonde to QAQC Sonde Comparisons

Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	0.94	0.90	0.04	Excellent
pH	7.11	7.13	0.02	Excellent
Specific Conductivity (µS/cm)	681.0	679.0	0.3	Excellent
Total Dissolved Solids (g/l)	0.4430	0.4420	0.0010	
Dissolved Oxygen (%-Sat)	100.2	103.2	3.0	
Dissolved Oxygen (mg/l)	14.26	14.67	0.41	Good
Turbidity (NTU)	1.9	1.0	0.9	Excellent

- **Deployment rankings** of "excellent" and "good" for water temperature, pH, specific conductivity, dissolved oxygen and turbidity indicate successful cleaning and calibration, which enable these sensors to produce reliable data during the deployment period.

- Removal comparison rankings between the field instrument and the QAQC instrument are summarized in **Table 3**.

Table 3: Comparison rankings for removal of RTWQ instrument on January 16, 2013

Removal

Field Sonde to QAQC Sonde Comparisons

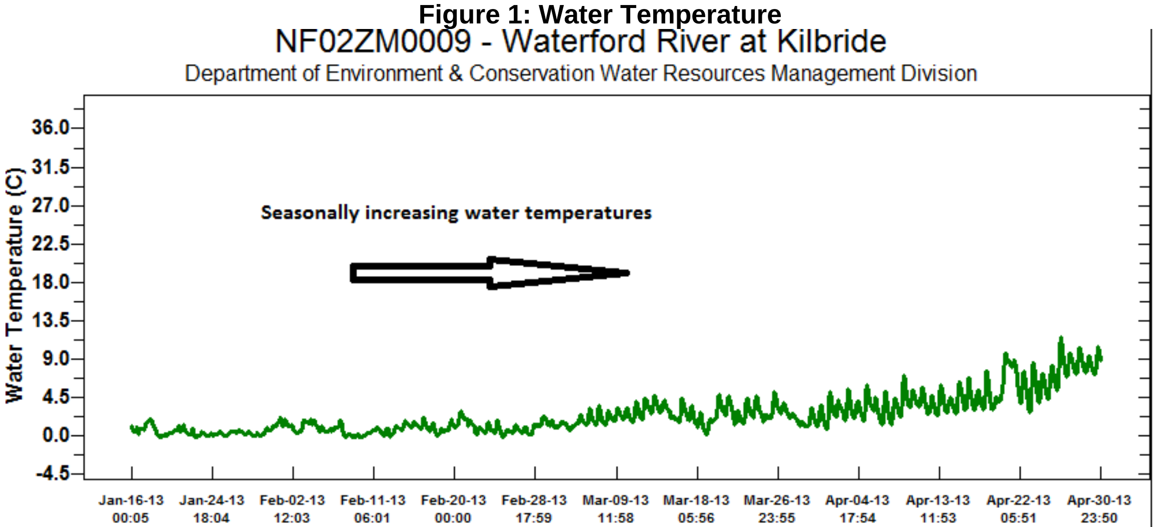
Parameter	Field Sonde	QAQC Sonde	Difference / % Difference	Ranking
Temperature ('C)	9.43	9.63	0.20	Good
pH	7.15	7.15	0.00	Excellent
Specific Conductivity (µS/cm)	484.0	518.0	7.0	Good
Total Dissolved Solids (g/l)	0.3150	0.3360	0.0210	
Dissolved Oxygen (%-Sat)	3.4	108.5	105.1	
Dissolved Oxygen (mg/l)	0.39	12.34	11.95	Poor
Turbidity (NTU)	4.9	1.8	3.1	Good

- **Removal rankings** of "excellent" and "good" for water temperature, pH, specific conductivity and turbidity increase confidence that the data collected for these parameters over the duration of this deployment are reliable. A ranking of "poor" for dissolved oxygen indicates that the sensor was fouled during this long deployment period, and readings during the latter part of the deployment are not reliable.

Data Interpretation

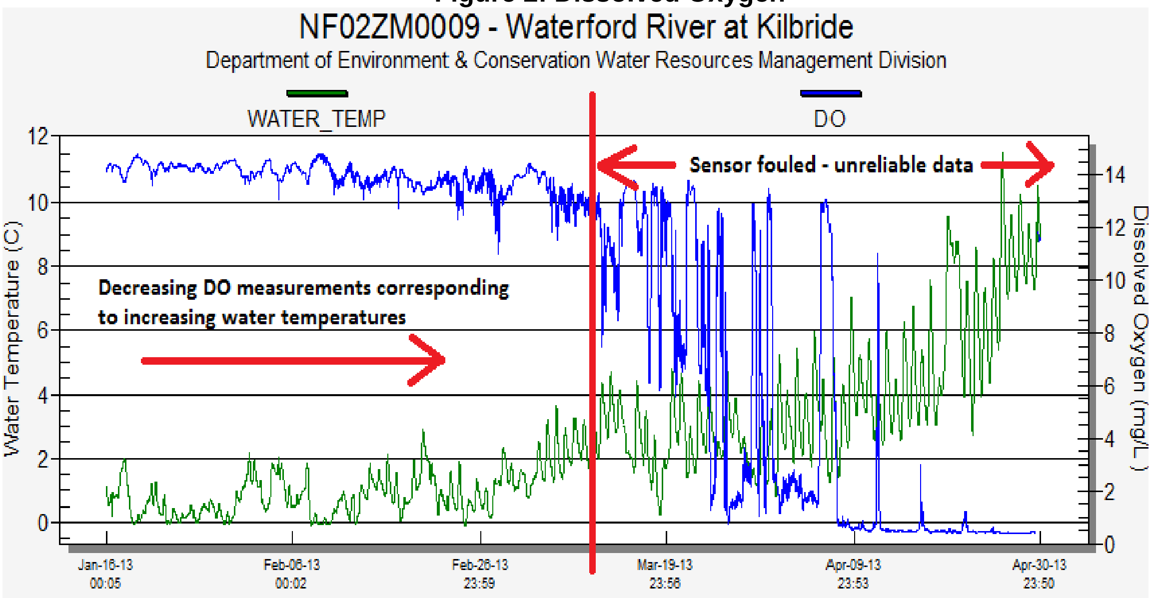
- **Water temperatures** fluctuated between -0.08 and 11.54°C during this deployment period, with the colder temperatures occurring during January and February and the seasonally warmer temperatures occurring toward the latter part of April. Water temperature data are shown in green ink in **Figure 1**. The overall increasing trend in water temperature corresponds to the seasonal increase in air temperature, as shown in the Daily Climate Data for this period, in **Appendix 1** at the end of this report.

Figure 1: Water Temperature



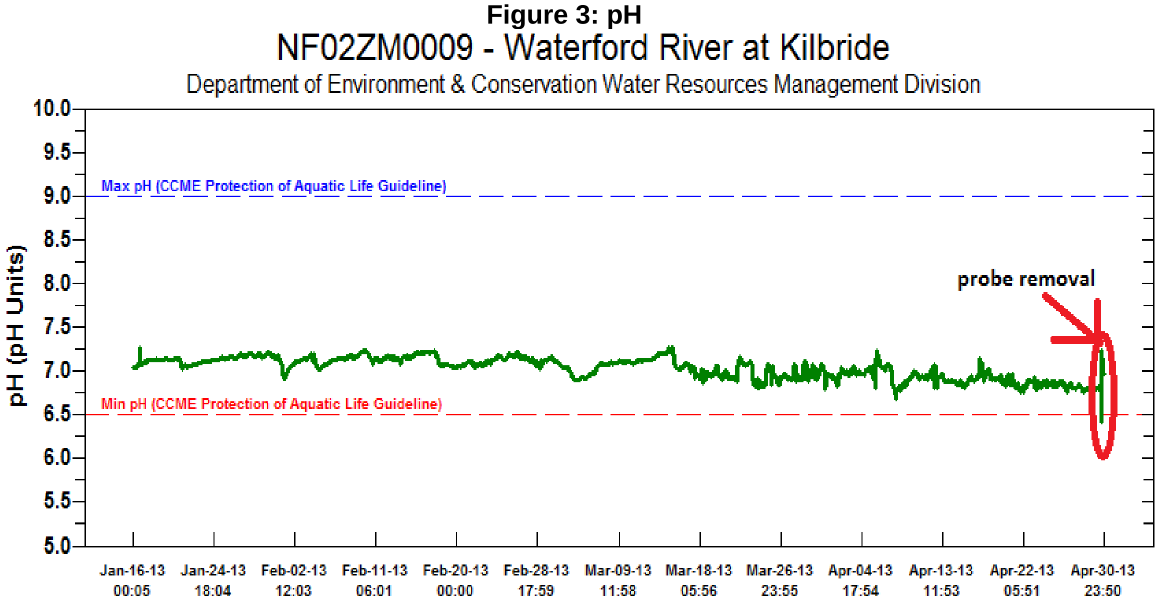
- **Dissolved Oxygen (DO)** measurements during this deployment are reliable from January 16 to approximately March 11, after which time areas of the protective casing that houses the probe became blocked with sediment. DO measurements within this shorter, more reliable time frame generally ranged between 11.03 – 14.81 mg/L, with higher DO measurements occurring between January 16 and late February, when water temperatures were coldest. The solubility of oxygen is greater in colder water than in warmer water, thus as water temperatures decrease DO levels increase, and visa versa. The DO and water temperature data collected during the reliable period reflect this inverse relationship, as shown in **Figure 2**. DO data are shown in green ink and water temperature in blue ink. DO levels from January 16 to March 11 were above the minimum guidelines recommended by the CCME for the protection of freshwater aquatic life, of 6.5 mg/L for early life stages and 9.5 mg/L for other life stages in cold water systems.

Figure 2: Dissolved Oxygen



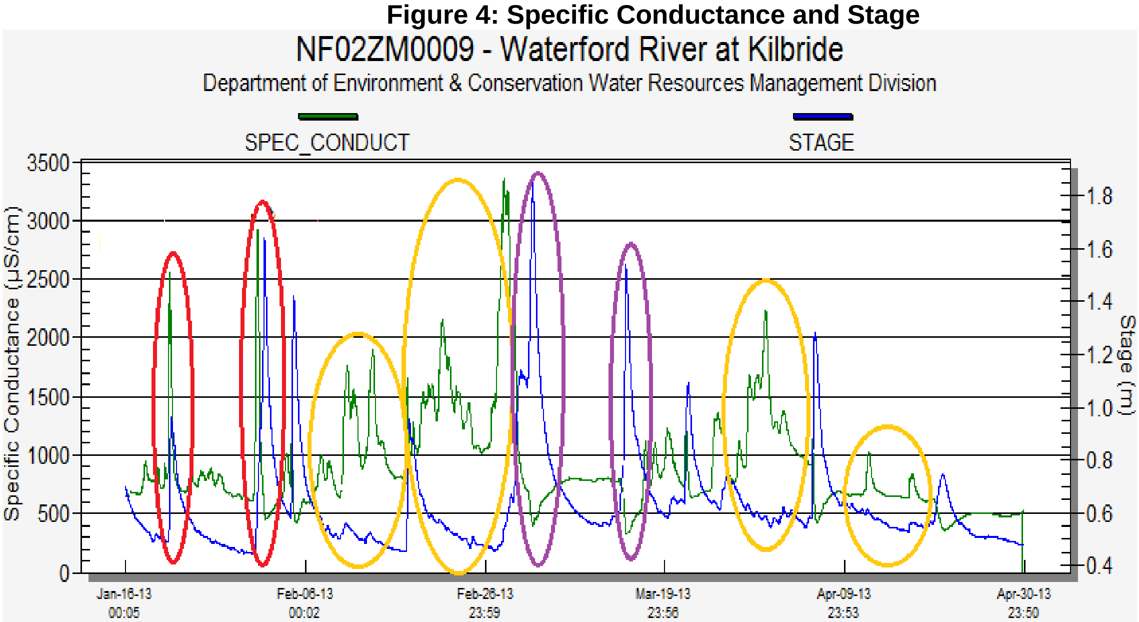
▪ **pH** values during this deployment period were fairly stable, showing mostly diurnal variation. pH values are typically lower (more acidic) at night, when photosynthesis is not occurring. During the daylight hours, the process of photosynthesis removes carbon dioxide, which readily forms carbonic acid in water, resulting in an increase in pH. pH values ranged from 6.69 to 7.26 during this deployment. The uncharacteristic spike in both directions at the end of the deployment period is not a true water quality measurement; it reflects the measurement that was collected as the probe was being removed from the station. pH measurements were within the CCME recommended guideline range for the protection of aquatic life, of 6.5 to 9.0 units, for the duration of this deployment.

Figure 3: pH



▪ **Specific conductivity (SpC)** measures the ability of water to pass an electrical current. Conductivity in streams and rivers is affected by the geology of the area through which the water flows. Streams that run through granite bedrock tend to have lower conductivity than those that flow through limestone and clay soils. Changes in conductivity can be the result of the presence of inorganic dissolved solids such as chloride, sulfate, sodium and calcium which increase conductivity, or organic compounds, such as oil, which do not conduct electrical current well and lower the conductivity. High specific conductance readings are often the result of industrial pollution or urban run-off. The effects of urban run-off are most noticeable during the winter months when road salt is used to control ice on urban streets. Precipitation events and snow-melt during the winter months usually cause spikes in specific conductance, as road salt gets washed into urban streams and rivers. This explains some of the spikes that are seen in the graph in **Figure 4**, where specific conductance measurements for this deployment period are displayed in green ink, and stage height is displayed in blue ink. Spikes in conductivity and stage that occur at or near the same time during this deployment period, are most likely the result of significant precipitation and/or warm temperatures causing snow melt and surface run-off. These spikes are circled in red in **Figure 4.** During dryer periods of no precipitation, stage height in surface water bodies tends to decrease, resulting in an increase in the concentration of dissolved solids in the water column and a resultant increase in specific conductance. These periods are circled in yellow ink in **Figure 4**. During periods when the air temperature stays above 0^{o}C and surface run-off doesn't contain concentrated amounts of road salt, precipitation often dilutes the level of specific conductance in surface water bodies, resulting in an increase in stage height that corresponds with a decrease in specific conductance. These occurrences are circled in purple ink in **Figure 4.** Environment Canada daily climate data for January, February, March and April 2013 are shown in **Appendix 1** at the end of this report. Specific conductance values in Waterford River during this deployment period reflect the impact road salt has on urban rivers during the winter months, ranging between 325 and 3359µS/cm, with a mean of 902µS/cm.

Figure 4: Specific Conductance and Stage



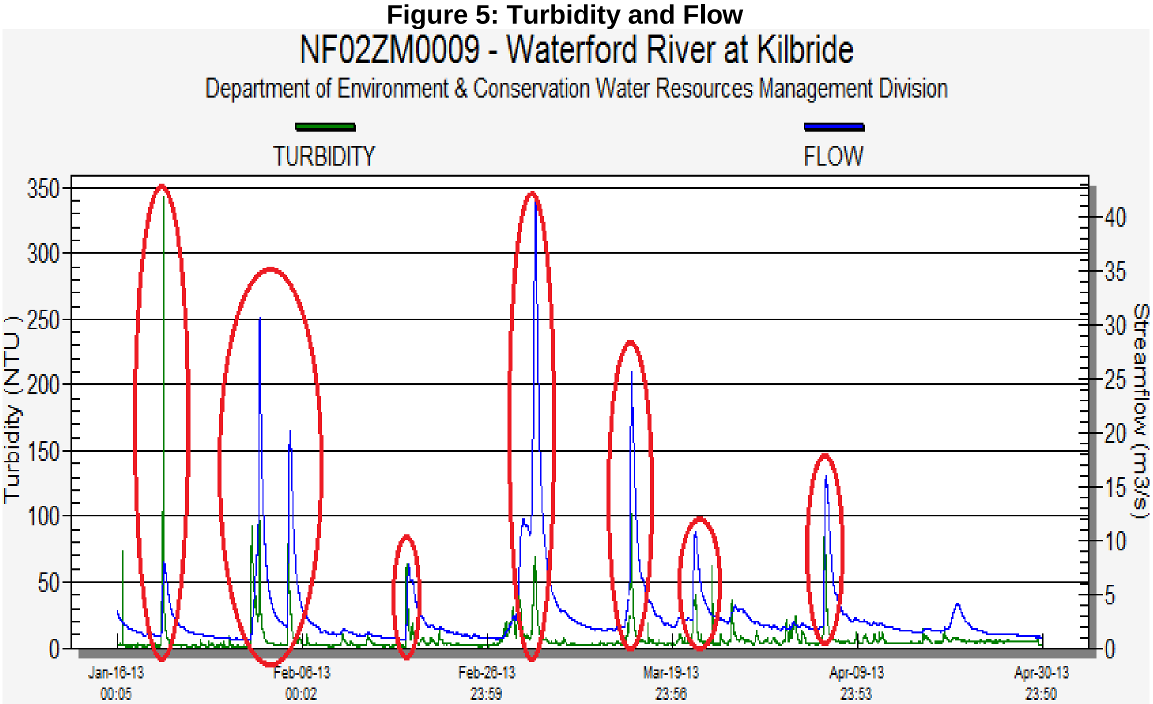
SpC increases coincide with stage height increases during precipitation events while road salting is in effect.

SpC increases during dry periods with little or no precipitation, and resultant decreases in stage height.

SpC decreases coincide with stage height increases during warmer weather precipitation when road salt isn't used.

- **Turbidity** generally increases as flow increases, due to higher levels of suspended particles and entrapped air in the water column. Increased flow can be caused by precipitation and/or a sudden rise in winter air temperatures that results in snowmelt. This relationship is seen below in **Figure 5**, where turbidity is shown in green ink and flow in blue ink. Periods of rainfall and days with air temperatures above zero correspond with peaks in turbidity and flow in **Figure 5**. Daily climate data is found in **Appendix 1** at the end of this report. Increased turbidity that does not coincide with increased flow may be an indicator of pollution. Turbidity measurements during this deployment period were within the range of 0.9 and 342.8 NTU, with a mean value of 6.3 NTU and a median of 3.7 NTU.

Figure 5: Turbidity and Flow



Appendix 1: Environment Canada Climate Data, St. John's International Airport

Daily Data Report for January 2013

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10s deg	Spd of Max Gust km/h
01											
02‡	-2.3	-6.5	-4.4	22.4	0.0	0.2	5.6	3.0	1	M	44
03‡	-1.9	-5.7	-3.8	21.8	0.0	0.0	0.6	T	5	M	48
04‡	-3.8	-7.6	-5.7	23.7	0.0	0.0	T	T	5	M	52
05‡	-0.6	-10.5	-5.6	23.6	0.0	0.0	2.6	2.0	6	M	61
06‡	-3.5	-11.8	-7.7	25.7	0.0	0.0	T	T	6	M	65
07‡	-3.4	-11.9	-7.7	25.7	0.0	0.0	0.2	T	6	M	76
08‡	0.0	-11.2	-5.6	23.6	0.0	0.0	0.6	0.4	6	M	78
09‡	-0.6	-11.0	-5.8	23.8	0.0	0.0	0.0	0.0	6	M	65
10											
11											
12‡	3.9	0.2	2.1	15.9	0.0	22.8	0.0	22.8	46	M	65

Daily Data Report for January 2013

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10s deg	Spd of Max Gust km/h
13‡	3.8	0.7	2.3	15.7	0.0	2.2	0.0	2.2	31	M	33
14‡	6.4	-1.1	2.7	15.3	0.0	T	0.0	T	25	M	69
15‡	3.6	-7.2	-1.8	19.8	0.0	T	0.0	T	18	M	50
16‡	-5.8	-7.9	-6.9	24.9	0.0	0.0	T	T	17	M	48
17‡	0.5	-9.0	-4.3	22.3	0.0	0.0	1.0	1.0	16	M	65
18‡	-1.4	-16.4	-8.9	26.9	0.0	0.0	10.0	9.0	17	M	67
19‡	-0.2	-16.3	-8.3	26.3	0.0	0.0	1.8	1.8	26	M	67
20											
21‡	6.6	-6.0	0.3	17.7	0.0	15.1	T	15.1	21	M	85
22											
23											
24‡	-7.4	-12.5	-10.0	28.0	0.0	0.0	0.8	0.8	40	M	70
25											
26‡	-3.4	-8.7	-6.1	24.1	0.0	0.0	T	T	45	M	83
27‡	-6.4	-9.3	-7.9	25.9	0.0	0.0	0.6	0.2	45	M	43
28											
29‡	-5.9	-12.3	-9.1	27.1	0.0	0.0	T	T	45	M	52
30‡	1.7	-6.1	-2.2	20.2	0.0	0.0	1.6	1.6	45	M	89
31											

Daily Data Report for February 2013

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10s deg	Spd of Max Gust km/h
01											
02‡	-1.3	-7.5	-4.4	22.4	0.0	0.0	14.0	11.6	13	M	72
03‡	-0.9	-7.7	-4.3	22.3	0.0	0.0	0.2	T	14	M	78
04											
05											
06‡	-4.5	-8.0	-6.3	24.3	0.0	0.0	9.4	9.0	6	M	44
07											
08											
09											
10											
11‡	-1.2	-8.3	-4.8	22.8	0.0	M	1.6	0.4	31	M	83
12‡	1.1	-9.1	-4.0	22.0	0.0	2.1	10.0	12.1	31	M	72
13‡	1.2	-2.4	-0.6	18.6	0.0	0.0	0.6	0.4	36	M	76
14‡	0.6	-2.4	-0.9	18.9	0.0	0.0	T	T	35	M	63
15‡	-1.7	-3.4	-2.6	20.6	0.0	0.0	T	T	32	M	56
16‡	0.0	-4.8	-2.4	20.4	0.0	0.0	0.0	0.0	26	M	52
17‡	1.8	-5.5	-1.9	19.9	0.0	23.6	3.4	27.0	20	M	85
18‡	4.0	-1.8	1.1	16.9	0.0	0.8	4.4	4.2	12	M	91
19‡	0.6	-1.9	-0.7	18.7	0.0	0.0	5.8	3.6	14	M	72

Daily Data Report for February 2013

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10s deg	Spd of Max Gust km/h
20											
21‡	-0.2	-1.0	-0.6	18.6	0.0	0.6	10.4	11.0	9	M	52
22‡	-0.7	-4.3	-2.5	20.5	0.0	0.0	11.3	11.3	25	M	70
23‡	-3.3	-5.0	-4.2	22.2	0.0	0.0	T	T	26	M	69
24‡	-4.1	-12.3	-8.2	26.2	0.0	0.0	T	T	25	M	48
25‡	-4.4	-12.3	-8.4	26.4	0.0	0.0	1.0	0.4	24	M	50
26‡	-2.9	-5.3	-4.1	22.1	0.0	0.0	0.4	T	25	M	65
27‡	-2.3	-4.2	-3.3	21.3	0.0	0.0	2.2	2.0	25	M	85
28‡	0.0	-2.7	-1.4	19.4	0.0	4.0	T	4.0	27	M	76

Daily Data Report for March 2013

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10s deg	Spd of Max Gust km/h
01‡	1.7	-2.0	-0.2	18.2	0.0	8.4	T	8.8	22	M	48
02‡	3.2	-1.9	0.7	17.3	0.0	17.4	T	17.4	18	M	61
03‡	2.7	0.4	1.6	16.4	0.0	11.2	0.0	11.2	12	M	63
04‡	2.0	0.1	1.1	16.9	0.0	64.6	0.0	64.6	7	M	70
05‡	0.8	-1.8	-0.5	18.5	0.0	0.0	T	T	7	M	70
06‡	0.8	-2.7	-1.0	19.0	0.0	0.0	0.0	0.0	7	M	54
07‡	0.8	-4.3	-1.8	19.8	0.0	0.0	0.0	0.0	6	M	46
08‡	-0.9	-4.1	-2.5	20.5	0.0	0.0	T	T	5	M	41
09‡	0.0	-1.7	-0.9	18.9	0.0	0.0	0.0	0.0	5	M	39
10‡	-1.5	-4.3	-2.9	20.9	0.0	0.0	0.2	0.2	5	M	43
11‡	0.0	-4.9	-2.5	20.5	0.0	0.0	0.2	T	5	M	<31
12‡	6.2	-2.2	2.0	16.0	0.0	0.0	0.0	0.0	5	M	48
13‡	7.7	0.7	4.2	13.8	0.0	0.0	0.0	0.0	4	M	37
14‡	4.8	0.4	2.6	15.4	0.0	1.0	0.0	1.0	4	M	59
15‡	4.4	0.3	2.4	15.6	0.0	23.2	0.0	23.2	3	M	69
16‡	4.6	-2.9	0.9	17.1	0.0	0.0	0.8	1.6	2	M	41
17‡	0.1	-4.9	-2.4	20.4	0.0	0.4	4.0	2.4	5	M	69
18‡	-2.6	-10.0	-6.3	24.3	0.0	M	3.8	1.6	6	M	85
19‡	0.9	-10.0	-4.6	22.6	0.0	0.6	1.2	1.0	8	M	87
20‡	3.7	0.0	1.9	16.1	0.0	0.4	T	0.4	6	M	52
21‡	5.7	-0.6	2.6	15.4	0.0	T	0.0	T	3	M	56
22‡	7.4	-2.0	2.7	15.3	0.0	7.4	2.4	9.4	3	M	76
23											
24											
25‡	0.0	-1.8	-0.9	18.9	0.0	0.8	9.2	7.8	4	M	69
26											
27											
28											
29‡	0.0	-2.0	-1.0	19.0	0.0	0.0	9.4	9.4	3	M	83
30‡	0.6	-2.3	-0.9	18.9	0.0	0.0	3.6	3.6	7	M	72

Daily Data Report for March 2013

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10s deg	Spd of Max Gust km/h
31‡	-0.5	-5.6	-3.1	21.1	0.0	M	2.2	1.0	10	M	65

Daily Data Report for April 2013

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days	Cool Deg Days	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10s deg	Spd of Max Gust km/h
01‡	4.1	-6.0	-1.0	19.0	0.0	0.0	0.0	0.0	10	M	39
02‡	3.3	-1.6	0.9	17.1	0.0	5.8	T	5.8	5	M	67
03‡	3.4	-3.2	0.1	17.9	0.0	0.0	2.2	1.8	2	M	59
04‡	1.7	-3.1	-0.7	18.7	0.0	0.0	0.2	0.2	3	M	67
05‡	6.7	-2.2	2.3	15.7	0.0	0.4	0.0	0.4	2	M	63
06											
07‡	3.7	-3.5	0.1	17.9	0.0	0.0	0.0	0.0	T	M	91
08‡	5.5	-4.1	0.7	17.3	0.0	0.0	0.0	0.0	T	M	50
09‡	6.8	-3.7	1.6	16.4	0.0	0.0	0.0	0.0	T	M	33
10‡	4.6	-2.0	1.3	16.7	0.0	0.6	1.6	2.0	T	M	32
11											
12‡	2.3	-2.7	-0.2	18.2	0.0	0.4	2.4	2.8	4	M	82
13‡	5.0	-3.5	0.8	17.2	0.0	0.0	0.0	0.0	T	M	39
14‡	2.4	-2.9	-0.3	18.3	0.0	0.0	0.4	0.2	T	M	46
15											
16‡	5.4	-3.7	0.9	17.1	0.0	0.0	0.0	0.0	T	M	46
17											
18‡	6.3	-4.5	0.9	17.1	0.0	T	0.0	T	T	M	52
19											
20‡	14.8	7.0	10.9	7.1	0.0	0.0	T	1.6	T	M	72
21‡	13.5	-2.2	5.7	12.3	0.0	0.6	0.0	0.6	T	M	78
22‡	3.2	-6.6	-1.7	19.7	0.0	0.0	0.0	0.0	T	M	46
23‡	10.5	-7.3	1.6	16.4	0.0	0.0	0.0	0.0	T	M	43
24‡	9.5	-2.6	3.5	14.5	0.0	T	0.0	T	T	M	48
25‡	12.6	0.6	6.6	11.4	0.0	0.0	0.0	0.0		M	61
26‡	15.4	3.3	9.4	8.6	0.0	0.0	0.0	0.0		M	57
27‡	12.9	4.4	8.7	9.3	0.0	0.0	0.0	0.0		M	57
28‡	12.4	2.8	7.6	10.4	0.0	0.0	0.0	0.0		M	<31
29‡	6.8	2.0	4.4	13.6	0.0	T	0.0	T		M	<31
30‡	7.7	2.8	5.3	12.7	0.0	0.2	0.0	0.2		M	<31

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