

**INTERNATIONAL ST. CROIX RIVER
WATERSHED BOARD**

ANNUAL REPORT

2014

**ST. CROIX RIVER
MAINE AND NEW BRUNSWICK**

2014 ANNUAL REPORT
OF THE
INTERNATIONAL ST. CROIX RIVER WATERSHED BOARD

Covering

The Orders of Approval with respect to the control of the discharge of the St. Croix River at Forest City, Vanceboro, and the water levels of East Grand Lake, Spednic Lake, Grand Falls Flowage and Milltown Dam Forebay

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The Water Quality and Aquatic Ecosystem Health of the
St. Croix River Boundary Waters

SUBMITTED TO
THE INTERNATIONAL JOINT COMMISSION
BY
THE INTERNATIONAL ST. CROIX RIVER WATERSHED BOARD

Prepared March 2015

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1.0 GENERAL

1.1 Synopsis for 2014

In 2014, water quality in the system remained in good to excellent condition with respect to aquatic life.

2014 was an above average year for water levels on the St. Croix River system. During most of the year, reservoir levels and flows were operated within prescribed levels. Reservoir levels and flows in the river provided satisfactory conditions for power generation, canoeing and kayaking, and support of aquatic life.

Water levels at reservoir stations were above average with annual mean levels slightly higher than their respective long term means. Higher river flows were also evident with gaging stations in the basin reporting flows to be about 30% higher than their respective long term mean values.

In April 2014, during high spring river flows, an obstruction at one of the gates at Grand Falls Dam resulted in the water level at Grand Falls reservoir exceeding the IJC order of of 62.106 meters (203.76 feet). The exceedances occurred from April 16 at 09:15 EST to April 19 at 06:30 EST. During the event, Woodland Pulp LLC (dam owner-operator) took action to remove the obstruction at the gate and no impacts related to the higher water level were reported.

The Board held its annual public meeting on the evening of June 3, 2014 in Calais, Maine. The Board also partnered with the St. Croix International Waterway Commission to hold a St. Croix watershed forum, a two-day workshop in November 2014 in St. Andrews, New Brunswick. This forum brought together multiple levels of government, aboriginal communities, community and environmental organizations, academia and students, and citizens to discuss current science and information on the state of the St. Croix watershed, share perspectives and concerns, and collectively look at efforts and needs for planning and management of the watershed.

The Board continued to support scientific research in the St. Croix watershed that monitored restoration of alewife (gaspereau) and investigated environmental conditions affecting aquatic species.

1.2 Board Membership

The International St. Croix River Watershed Board (Board) was established to assist the International Joint Commission. The International Joint Commission (IJC) is a bi-national United States-Canada organization established under the Boundary Waters Treaty of 1909. The Board has ten members with an equal number of members from the United States and Canada. Board members are appointed by the IJC and serve the Commission in their personal and professional capacity and not as representatives of their agencies. Current Board membership is shown below. In 2014 Colonel Charles Samaris, US Army Corps of Engineers completed his term as Co-Chair US Section and Colonel Christopher Barron was appointed by the IJC to the Board as the new Co-Chair US Section for three years.

International St. Croix River Watershed Board - Membership	
Canadian Section	U.S. Section
Bill Appleby, Canadian Co-Chair Director, Prediction Services Operations East, Meteorological Service of Canada Environment Canada Dartmouth, Nova Scotia	Colonel Christopher Barron, U.S. Co-Chair District Engineer U.S. Army Corps of Engineers New England District Concord, Massachusetts
Darryl Pupek Director, State of the Environment Branch New Brunswick Dept. of the Environment and Local Government Fredericton, New Brunswick	Ralph Abele Chief Water Quality Branch EPA New England, Region 1 Boston, Massachusetts
Jessie Davies 4 O'Neill Farm Road St. Andrews, New Brunswick	Susanne Miller Regional Director, Eastern Maine Office, Department of Environmental Protection Bangor, Maine
Mr. Geoff Mercer Associate Regional Director General Atlantic and Québec Regions Environment Canada Dartmouth, Nova Scotia	Oliver Cox Director, Division of Sea Run Fisheries and Habitat Maine Department of Marine Resources Bangor, Maine

International St. Croix River Watershed Board – Membership (continued)	
Canadian Section	U.S. Section
Robert Stephenson, Ph.D. Principal Investigator Canadian Capture Fisheries Research Network Visiting Research Professor University of New Brunswick Research Scientist, St. Andrews Biological Station St. Andrews, New Brunswick	Robert Lent, Ph.D. Maine District Chief United States Geology Survey Augusta, Maine
Secretariat	
Kathryn Parlee Senior Analyst, Regional Analysis & Relations – Atlantic & Quebec Regions Environment Canada Dartmouth, Nova Scotia	Barbara Blumeris U.S. Army Corps of Engineers New England District Concord, Massachusetts

1.3 Annual Public Meeting in Basin

The Board’s annual public meeting was held in Calais, Maine on the evening of June 3, 2014 at the Washington County Community College. The meeting began at about 6:00 pm. There were about 20 people in attendance. Colonel Samaris, Board Co-Chair and IJC Commissioner Dereth Glance welcomed attendees and provided brief opening remarks. Following opening remarks, the Board Co-Chairs, provided a PowerPoint presentation that summarized Board activities in calendar year 2013 and early 2014. Next Ms. Abby Pond with the St. Croix International Waterway Commission provided information on the St. Croix watershed forum planned for November 2014. Mr. Bob Lent, Board member and Maine District Chief, United States Geology Survey was next with an informational presentation on recent Spednic Lake studies. The presentation included a summary of the data and methods used to estimate historical daily mean lake surface-water temperatures from early spring through late autumn at Spednic Lake. (See Section 6.2 for link to published report.) Following the presentations, there was an opportunity for public questions and comments. Mr. Ed Bassett with the Passamaquoddy Tribe noted that the Tribe is working on the restoration of the alewife to the St. Croix River. Mr. Bassett noted that the development of the dams on the river for hydropower and the past lumber industry have had an impact on the river ecosystem. The public meeting concluded at about 8:00 pm.



Figure 1. Annual Public Meeting in Calais, Maine, June 2014

1.4 Annual Site Visit of Facilities in the Basin

Board members met with New Brunswick Power Corporation officials on the morning of June 4, 2014 to tour the Milltown Dam operations in New Brunswick. On the same day, Board members also met with Woodland Pulp, LLC officials in the Woodland Mill at Baileyville, Maine and then toured the Grand Falls, Forest City and Vanceboro dam sites. (Visit notes and information describing the dams is provided in Appendix 2.)

It is the responsibility of the dam owners, operators and appropriate jurisdictional agencies to conduct the necessary dam inspections and maintenance to ensure the safety and security of the dams.

1.5 Policy of the Board Regarding Dam Regulation

In accordance with its mandate from the IJC, the Board leaves the control of operation of the dams at Forest City, Vanceboro, and Grand Falls (owned and operated by Woodland Pulp, LLC) and Milltown (owned and operated by New Brunswick Power) to the owners.

During the 2014 reporting period, the Board reviewed conditions prevailing in the river by the following means:

- a continuous record of water elevations of East Grand Lake and a continuous record of discharge below Forest City Dam
- a continuous record of water elevations of Spednic Lake and a continuous record of discharge at Vanceboro
- a continuous record of water levels above the dam at Grand Falls
- a continuous record of discharge at Baring
- monthly reports from New Brunswick Power indicating daily forebay elevations obtained during regular work days at the Milltown Dam
- water level data from a continuous monitoring station in the head pond at Milltown Dam operated by Environment Canada

This information is discussed in Section 2.

2.0 MANAGEMENT OF WATER LEVELS AND FLOWS

2.1 Summary

In 2014, the annual mean water level at East Grand Lake was 131.996 meters (433.06 feet), which is higher than the long term mean value of 131.822 meters (432.49 feet).

The annual mean flow from the lake at Forest City Stream was 9.43 m³/s (333 cfs), 30% higher than the long term mean value of 6.59 m³/s (233 cfs).

The annual mean water level for the year at Spednic Lake was 116.554 meters (382.40 feet), higher than the long term mean value of 116.325 meters (381.64 feet).

The annual mean flow as recorded at Vanceboro was 33.3 m³/s (1080 cfs), 37% higher than the long term mean value of 20.9 m³/s (738 cfs).

The annual mean water level for the year at Grand Falls Flowage was 61.795 meters (202.74), which is higher than the long term mean value of 61.763 meters (202.63 feet).

The annual mean flow at Baring was 109 m³/s (3850 cfs), which is 31% higher than the long term mean value at Baring of 75 m³/s (2650 cfs).

2.2 East Grand Lake Reservoir and Discharges Below Forest City Dam

During the period from January 1 to December 31, East Grand Lake reservoir was operated between a maximum daily mean water level of 132.445 meters (434.53 feet) on April 25 and a minimum daily mean of 131.454 meters (431.28 feet) on October 16. The maximum water level as prescribed by the Commission's Order is 132.571 meters (434.94 feet); the minimum is 130.436 meters (427.94 feet). The Order was maintained throughout the year. The daily mean water levels are presented in Table I and depicted in Figure I in Appendix 3 and 4.

Table II and Figure II in Appendix 3 and 4 present the daily mean discharges below the Forest City Dam at the outlet of East Grand Lake for 2014. The maximum daily mean for the reporting period was 35.4 m³/s (1250 cfs) on April 25 and the minimum daily mean was 2.42 m³/s (85.5 cfs) on March 27. The mean discharge for the year was 9.43 m³/s (333 cfs). The Commission's Order of 2.12 (75 cfs) as a minimum flow was maintained throughout the year

2.3 Spednic Lake Reservoir and Discharges below Vanceboro Dam

During the year, levels in the Spednic Lake reservoir, ranged from a maximum daily mean water level of 117.389 meters (385.13 feet) on July 8, to a minimum daily mean water level of 115.269 meters (378.18 feet) on October 16. The maximum limit specified in the Commission's Order is 117.610 meters (385.86 feet). The allowable minimum level is 113.233 meters (371.50 feet) for the period January 1 to April 30 and October 1 to December 31 inclusive, and 114.757 meters (376.50 feet) for the period May 1 to September 30 inclusive. These orders were maintained throughout the year.

The daily mean elevations for the Spednic Lake Reservoir during the year are presented in Table III and depicted in Figure III in Appendix 3 and 4.

The maximum daily mean discharge recorded from the outflow at the reservoir at Vanceboro was 151 m³/s (5330 cfs) on April 26 and the minimum daily mean discharge recorded was 8.16 m³/s (288) on October 14. The Commission's Order of a minimum flow of 5.66 m³/s (200 cfs) was maintained throughout the year.

Daily mean discharges are presented in Table IV and Figure IV in Appendix 3 and 4.

2.4 Water Levels above Grand Falls Dam

Table V and Figure V in Appendix 3 and 4 include water level elevations of the headpond above the Grand Falls Dam. The recorded maximum daily mean elevation was 62.246 meters (204.22 feet) on April 17 and the minimum recorded elevation was 61.464 meters (201.65 feet) on April 2. The maximum prescribed elevation of 62.106 meters (203.76 feet), as set by the Commission, was maintained throughout the year except when it was exceeded for the period April 16 at 09:15 EST to April 19 at 06:30 EST. This occurrence of exceedance is referenced in Appendix 3 of Water levels and Flows for April 16-18 and depicted in Figures V (Daily Mean Values) and Figure VIII of Appendix 4 (15 Minute Values). The high flow was discussed at the Board site visit in June 2014 and Woodland Pulp reported that the high flow incident at Grand Falls was due to high flows in the river and reduction in capacity at one of gates caused by an obstruction. Woodland reported that all gates were open and passing high river flow when the log boom became disconnected and lodged in one of the gates. Woodland staff took action to remediate the situation and there were no impacts reported due to the water level exceeding the prescribed elevation in the IJC order.

2.5 Discharges at Baring, Maine

Table VI and Figure VI in Appendix 3 and 4 present the daily mean discharges of the St. Croix River at Baring, Maine. The mean discharge for the report period was 109 m³/s (3850 cfs). The maximum daily mean was 473 m³/s (1670 cfs) on April 17. The minimum daily mean was 24.3 m³/s (858 cfs) on October 4.

Woodland Pulp LLC met the minimum flow requirements set at 21.2 m³/s (750 cfs); this is the minimum flow requirement as considered by the Maine Department of Environmental Protection.

2.6 Headwater Elevations above Milltown Dam

Table VII and Figure VII in Appendix 3 and 4 present and depict daily water elevations in the forebay of the New Brunswick Power Corporation plant at Milltown, New Brunswick. These elevations refer to mean sea level datum. In 2009, Environment Canada established a continuous water-level and water quality monitoring station. The supplied data for 2014 was extracted from this gauging station located on the headpond.

3.0 WATER QUALITY

3.1 USGS Milltown Monitor

Water-quality values for the St. Croix River at the USGS Milltown monitor were within the extreme values for the period of daily record during the summer of 2014 based on record since September 1969. Values were above the water-quality objectives for the river. The USGS station is located about 2,900 ft. (884 metres) above Milltown Dam.

TABLE 1

St. Croix River at Milltown, USGS Station # 01021050
Water-Quality Monitor, June – September 2014.

Dissolved Oxygen (mg/L), IJC objective = 5.0 mg/L minimum
Maximum for the season: 9.9 mg/L
Minimum for the season: 6.8 mg/L

	June	July	August	September
Maximum	9.3	8.6	8.7	9.9
Minimum	7.8	6.8	6.8	7.3
Mean	8.4	7.5	7.7	8.6

Water Temperature (degrees Celsius)

	June	July	August	September
Maximum	24.0	26.4	25.7	24.0
Minimum	16.0	19.3	21.1	15.4
Mean	19.4	23.4	23.2	19.3

pH (standard units)

	June	July	August	September
Maximum	6.9	6.8	7.2	7.1
Minimum	6.6	6.3	6.7	6.7
Median	6.8	6.6	6.8	7.0

Specific conductance (microsiemens per centimeter at 25 C)

	June	July	August	September
Maximum	65	70	78	110
Minimum	49	28	59	61
Mean	56	46	66	74

3.2 Environment Canada Monitoring Stations – Forest City and Milltown

Environment Canada, in partnership with the New Brunswick Department of Environment and Local Government, maintains two automated real-time water quality monitoring stations on the St. Croix River system. The first station is located at the Milltown Dam in Milltown (St. Stephen), New Brunswick and the second station is located in Forest City, Maine. The Milltown station records hourly measurements of temperature, dissolved oxygen, pH, specific conductance and turbidity while the Forest City station records hourly measurements of temperature and conductivity. In order to re-calibrate the measuring devices and to collect a grab sample for water quality analysis, the sites were visited every 5 to 6 weeks during the warmer months and less frequently during the colder months when fouling of the sensors is less problematic.

Real time monitoring allows an observer to assess several river water quality parameters quickly at any particular instant in time. This can alert managers to sudden changes in the characteristics of the river and relate them to particular events such as rapid spilling of water, accidental discharges from industry, severe weather events or remote introduction of atmospheric or other pollutants which might threaten the health of aquatic organisms or humans using the river. It could also allow responsible agencies to take rapid intervention to correct the problem.

3.2.1 Interpretation of Real-Time Monitoring Data

3.2.1.1 Milltown Station

Monthly summaries of the real-time data and annual charts showing daily means from the Milltown station for each parameter are presented in Appendix 5. This station, operated by Environment Canada (EC), is located just above the Milltown dam at a depth of 1.8 to 3.0 metres depending on head pond elevation. This station and the USGS station reported in Section 3.1 monitor water quality in the “urban” area below Baileyville but generally above St. Stephen/Calais.

The real-time water quality station at Milltown was operational for the 2014 year except for a two week period at the end of January.

Temperature

Water temperature at the site increased gradually until it reached its maximum of 26.5°C on July 24. The lowest temperature registered was -0.01°C in January.

The daily mean water temperature stayed over 20 °C for 77 consecutive days between June 27 and September 12 which is very similar to the 2012 and 2013 data. Water temperature was below 5 °C for 153 days in 2014. Water temperature at this station averaged 10.4 °C which is 1.3 degree less than in 2013. A small gap in data is present in early September.

Dissolved Oxygen

Dissolved oxygen readings followed a similar, but inverse, trend to water temperature, reaching the lowest concentration of 7.75 mg/L on July 24, and the highest concentration of 14.87 mg/L on December 8. Dissolved oxygen averaged 11.32 mg/L in 2014. All dissolved oxygen values measured in 2014 were above the minimum Canadian Council of Ministers of the Environment (CCME) Guideline for the Protection of Aquatic Life of 6.5 mg/L with very few values below 8 mg/L. Diurnal changes can be observed at a daily range of values.

pH

As in 2010 to 2013, measurements of pH in 2014 stayed around the CCME guideline of 6.5 pH units during the coldest half of the year as well as in November. However, pH was slightly below the minimum guideline for a period of 64 days, while it stabilized between 6.5 and 7.1 pH units during the warmer months. The minimum pH measurement was 5.85 pH units, recorded on November 4; and the maximum pH was 7.26, recorded on June 25. Average pH at this station was 6.73 for the year of 2014. The deployment of a new sonde in early September produced a sharp decrease. When the sonde was replaced in early November there was a sharp increase, indicating that the pH sensor for this sonde may have been under reporting pH levels. Corrections for sensor fouling and calibration drift did not help to mitigate these drastic changes.

Specific Conductance

Specific conductance readings fluctuated moderately between 22 and 120 µS/cm and averaged 49.5 µS/cm during 2014. The lower values were similar to those in 2012-2013, although the maximum was 40µS/cm higher than previous maximum measurements. Measurements of specific conductance reached their highest of 120 µS/cm on October 6, and their lowest of 22 µS/cm on April 18. A sharp drop in specific conductance is usually associated with a rise in stream height or volume.

Turbidity

Daily mean turbidity values stayed below 1 NTU over 50% of measurements, although turbid events (spikes) occurred once or twice per month (for the period of the record). Turbidity did not record correctly for the deployment period from November to the end of December, thus there is a gap in the figure for that period.

3.2.1.2 Forest City Station

Monthly summaries of the real-time data and annual charts showing daily means for conductivity and temperature from the Forest City station for each parameter are presented in Appendix 5. This station, operated by Environment Canada (EC), is located immediately downstream of the dam in Forest City.

The real-time water quality station at Forest City was operational for the whole 2014 year.

Specific conductance

The highest conductivity reading of 50.0 $\mu\text{S}/\text{cm}$ was recorded on July 20 while the lowest of 19 $\mu\text{S}/\text{cm}$ was recorded on October 17. An average of 23 $\mu\text{S}/\text{cm}$ was recorded for the year which is a decrease of almost 10 $\mu\text{S}/\text{cm}$ from last year. The general trend of the specific conductance data is an increasing trend towards the summer months and a decreasing trend in the fall months.

Temperature

Water temperature at the site increased gradually until it reached its maximum of 25.9°C on August 5th. Water temperatures above 20°C were recorded on 73 days, between June 28 and September 11th. There were 169 days when water temperature was below 5°C.

3.2.2 Interpretation of Grab Samples Results

Six grab samples at the Milltown station and at the Forest City station were collected in 2014. Samples were analysed at Environment Canada's Atlantic Laboratory for Environmental Testing located in Moncton, NB. That laboratory is accredited by the Canadian Association for Laboratory Accreditation (CALA) for all the parameters reported here.

3.2.2.1 St. Croix River at Milltown, NB

Results for each sample taken at Milltown are shown in Appendix 5, along with the applicable CCME guideline for the protection of aquatic life. Where no CCME guideline exists for a parameter, the most pertinent guidelines from another province were used as reference. Missing results reported as "VNA" indicate the results were still pending at the time of this report. A summary of the parameters analyzed is included below.

- Total aluminum exceeded the CCME guideline of 100 micrograms per litre ($\mu\text{g/L}$) in four out of six samples in 2014. Elevated levels of aluminum are fairly common in areas of Atlantic Canada although the aquatic life seems to be in good health. This is believed to be because most of the aluminum in Atlantic Canada rivers is complexed with organic compounds and therefore not bio-available to aquatic life. Dennis and Clair (2012) produced data which supported that theory and developed an algorithm for calculating the amount of complexed aluminum based on measured total organic carbon (TOC) in Atlantic rivers. With TOC values ranging from 6.4 to 11.4 the calculated complexed aluminum concentrations made up a large proportion of the measured total aluminum (at least 75%).
- One of the samples exceeded the calculated CCME guideline for cadmium, which ranged from 0.029-0.031 $\mu\text{g/L}$ based on the water hardness, while the other measured values were very near the *guideline*. Cadmium values at Forest City station were all below the detection limit of the laboratory, indicating that a natural or anthropogenic source of cadmium is located between the two water quality stations. Major pathways for cadmium to enter the aquatic environment are atmospheric fallout and in effluents from smelting and refining industries (CCME 1999). No smelting or refining facilities are located between the two sites.

- On one occasion, iron was measured slightly above the CCME guideline for iron of 0.3 mg/L. Iron is not considered to pose a risk to aquatic life as a small proportion of it is likely available for uptake by aquatic life.
- The CCME guidelines for copper, nickel and lead are all based on a formula which uses water hardness to determine guideline concentration and also has a minimum regardless of water hardness. Based on the range of water hardness at the Milltown station, we used the minimum values stated in the CCME guidelines for these metals (Appendix 5). No values exceeded those guidelines.
- No total phosphorous concentrations were above the Ontario Ministry of the Environment (OMOE, 1994) phosphorous guideline of 0.03 mg/L indicating no eutrophic conditions in the river.
- pH values were not measured outside the 6.5 to 9 range, recommended by the CCME.

3.2.2.2 St. Croix River at Forest City, ME

Results for the sample taken at Forest City are shown in Appendix 5, along with the applicable guideline for the protection of aquatic life. Where no CCME guideline exists for a parameter, the most pertinent guidelines from another province were used as reference.

No parameters exceeded applicable guidelines in 2014.

3.3 Water Quality Index

The CCME water quality index (WQI) is a useful tool to summarize water quality at monitoring sites visited regularly. It measures the frequency and extent to which selected parameters exceed water quality guidelines and reports the results as a single score. This allows for a quick assessment of the status of the water body and can be used as an indicator of overall aquatic health. Further analysis should always be completed on individual parameters in addition to other assessments (e.g. biological) for a full evaluation of aquatic health. More information on the CCME WQI is available at: http://www.ccme.ca/ourwork/water.html?category_id=102.

The WQI ratings were calculated each year using samples from the current year and those from the previous two years. Three-year rolling scores dampens strong fluctuations that may result from having small sample sizes and provides a more accurate representation of overall water quality. The parameters and guidelines used in the index are included in Table 2. These are consistent with parameters used by New Brunswick Department of Environment and Local Government in the Canadian Environmental Sustainability Indicators (CESI) project with the exception of ammonia as this is not part of the laboratory analysis at these two sites. Guidelines used are for the protection of aquatic life and thus, the WQI scores will reflect this intended water use only.

Table 2. Parameters and Guidelines used in the WQI Calculations

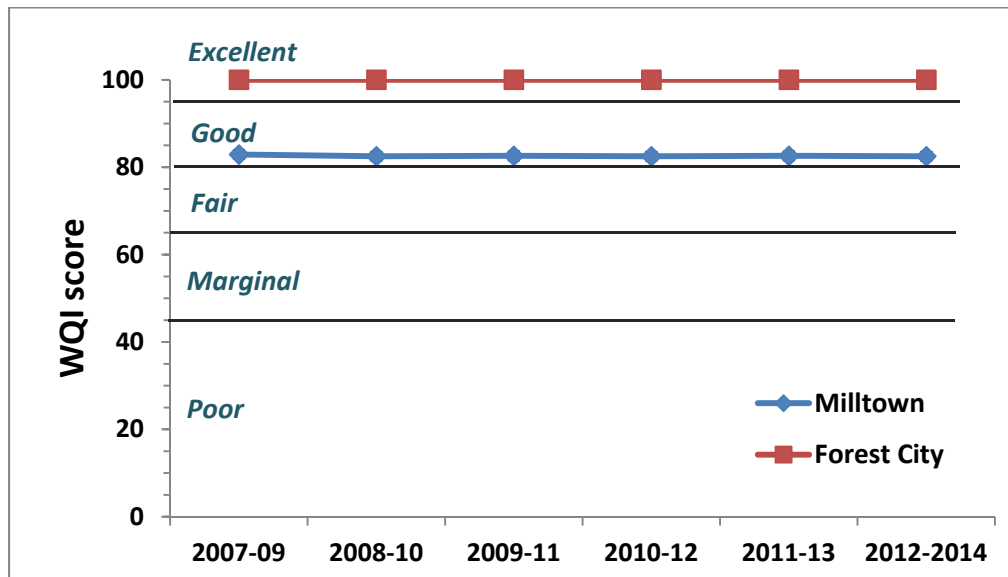
Parameter	Units	Lower Guideline	Upper Guideline	Guideline Source
Arsenic	µg/L		5	CCME, 2005
Chloride	mg/L		120	BC MOE, 2001
Copper	µg/L		2	CCME, 2005
Iron	mg/L		0.3	CCME, 2005
Nitrate	mg/L as Nitrogen		3	CCME, 2005
Dissolved Oxygen	mg/L	6.5		CCME, 2005
Phosphorous	mg/L		0.03	OMOE, 1994
pH	pH units	6.5	9.0	CCME, 2005
Turbidity	NTU		10	CCME, 2005
Zinc	µg/L		calculated	BC MOE, 2001

Notes: µg/L – micrograms per Litre; mg/L – milligrams per Litre; NTU – nephelometric turbidity units

WQI ratings rank from 0 to 100, with higher scores indicating better water quality. Forest City was only sampled once in 2011, rather than the typical 6 to 8 per year, as a result of flooding resulting in stoppage of the stream gauge and water quality sonde for part of the year.

The WQI scores for both stations were very consistent over the 2007 to 2014 period. Scores varied between 82.5 and 82.9, or “good”, at Milltown and stayed at 100, or “excellent”, at Forest City. Over the eight-year period, exceedances of water quality guidelines at Milltown were observed for zinc for 15% of samples, 8% for total phosphorus, and 4% for iron. Increased levels of zinc, phosphorus and iron between the two stations are indicative of wastewater discharge from municipal and industrial sources.

Figure 2. Water Quality Index Scores for the St. Croix River, 2007-2014



References:

[BC MOE] British Columbia Ministry of the Environment, 2001. BC Approved Water Quality Guidelines (criteria) 1998 edition. Environmental Protection Division, British Columbia Ministry of Environment, Victoria, British Columbia. Updated August 24, 2001 (http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html).

[CCME] Canadian Council of Ministers of the Environment. 2005. Canadian Environmental Quality Guidelines. Update 5.0. Canadian Council of Ministers of the

Environment, Winnipeg, Manitoba (www.ccme.ca/publications/ceqg_rcqe.html).

Dennis IF and Clair TA. 2012. The distribution of dissolved aluminum in Atlantic salmon (*Salmo salar*) rivers of Atlantic Canada and its potential effect on aquatic populations. *Can J Aquat Sci* 69:1174-1183.

[OMOE] Ontario Ministry of the Environment. 1994. [Water Management Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment](#) [reprinted February 1999]. Ontario Ministry of the Environment. 67 pp.

4.0 STATUS OF POLLUTION ABATEMENT

4.1 Maine

Baileyville: The Baileyville Wastewater Treatment Facility was in compliance with its wastewater discharge permit except for the following incidents: a monthly average flow violation for April 2014 and one settleable solids violation in July 2014. The monthly average flow violation in April was attributed to snow melt and rain. The settleable solids violation in July was due to significant influent flows from high rains attributed to Tropical Storm Arthur.

Calais: The Calais Wastewater Treatment Facility continues to be in compliance with their wastewater discharge permit. The facility is part of the Maine Department of Environmental Protection's Combined Sewer Overflow (CSO) program and has a Department approved CSO Master Plan which was updated in December 2014. The updated CSO Master Plan lists the many projects that have been completed as well as a tentative schedule for completing the projects that remain. The tentative schedule lists projects out to the year 2019.

Woodland Pulp LLC: The Woodland Pulp Mill in Baileyville (Woodland Pulp) was in compliance with its wastewater discharge permit except for the following incidents. Woodland Pulp had three months with zinc violations in 2014: February, March and April. During this time the mill was still implementing corrective actions that were initiated in 2013. Additionally, the mill's Wastewater Discharge Permit was renewed in June 2014 and concentration limits for zinc are no longer applicable for this facility. The mill does have a daily maximum pound limitation for zinc and has reported compliance with that limitation in 2014. The mill reported two silver violations during April 2014. The mill reported that this result was out of the ordinary but could be attributed to a period of time when a greater amount of bark was being added to the process.

Woodland Pulp reported a <500 gallon spill of dilute leachate from its landfill collection pond in January. This was attributed to a leaking weir plate that was repaired upon discovery. In July the mill identified a sink hole adjacent to a catch basin in the courtyard area. An unknown quantity of process wastewater was discharged to the ground. A temporary repair was made immediately and a more permanent repair was made during a mill shutdown in early September. In November the mill reported a <10,000 gallon discharge of filtrate and stock from the knot bunker area to the ground adjacent to a paved containment area. The compromised berm was repaired immediately after discovery.

In accordance with permit requirements the mill submitted a Site Specific Criteria Development Plan to seek alternative water quality criteria for cadmium, copper, lead and zinc. In addition, a report was submitted to the Department summarizing source reduction opportunities for mitigating the discharge of total cadmium. Both documents are being reviewed by Maine Department of Environmental Protection staff.

4.2 New Brunswick

On January 1, 2013, the Government of Canada, through the Canadian Council of the Ministers of the Environment (CCME), launched the Wastewater System Effluent Regulation (WSER), a new regulation aimed at the management and improvement of Municipal wastewater effluent. This regulation, coupled with the Canada Wide Strategy for the Management of Municipal Effluent from the CCME, works to help to regulate and improve wastewater systems across New Brunswick. Among other requirements under the strategy, all Municipal Systems will have to undertake an Environmental Risk Assessment (ERA) to identify any potential discharge objectives associated with their facilities. These assessments typically take up to three years to complete and are partially funded by the NB Environmental Trust Fund.

Beginning in 2013, the New Brunswick Department of Environment and Local Government began a partnership with Environment Canada under an agreement to administer both the WSER and Provincial regulations for Municipal systems. Under this agreement, each system will receive an Approval to Operate containing all appropriate regulatory requirements with the single point of contact being the Province. This method will ensure a seamless transition to the WSER regulation while safeguarding that all systems are aware and in compliance with the complete suite of applicable regulations.

McAdam: The McAdam wastewater treatment facility continues to meet the effluent requirements of the Province of New Brunswick. The McAdam wastewater treatment facility is an oxidation type system that uses an activated sludge process.

The Village has submitted the completed ERA for their system. The collection system upgrades in 2012/2013 have shown a noticeable reduction in influent to the Municipal Wastewater Plant. Pending upgrades also include a dechlorination chamber to meet WSER requirements.

St. Stephen: The Wastewater lagoon system along Dennis Stream continues to meet the effluent requirements of the Province of New Brunswick.

By 2016 the Town of St. Stephen will have to identify all Combined Sewer Overflow (CSO) points and adhere to their developed CSO plan.

The St. Croix Estuary Project (SCEP) has received funds from Environment Canada to conduct outfall sampling beginning in 2012 and continuing through 2014. As results become available, the Town and SCEP will evaluate this data to verify the effectiveness of upgrades undertaken to the collection system. Starting in 2015, SCEP will begin to shift their focus to pathogenic issues in the St. Croix River system as well as include an outfall sampling project.

Champlain Industrial Park: The extended aeration facility treats the domestic wastewater of its employees as well as the industrial inputs from the industrial park. Current loadings on this facility suggest that there is a reduction of activity within the Industrial Park which will lead to improved effluent standards though the effluent currently meets the limits set in the Certificate of Approval to Operate.

St. Croix Ventures Mobile Home Park: The facultative lagoon treats the domestic wastewater of the 58 mobile homes in the park. The facility discharges treated effluent to the marshy headwaters of Meadow Brook. In 2012, a new owner purchased this facility. Prior to taking ownership, the purchaser enquired with the Province as to what permits and responsibilities they would have to undertake and are thus fully cognizant of their Wastewater Approval compliance obligations to the Province. In 2014 another new owner has purchased this property and began upgrades to both the potable and domestic systems.

Oak Bay Park: The Oak Bay Campground uses a trickling filter system to treat the domestic wastewater from 110 campsites prior to discharging the treated, disinfected effluent to Oak Bay. The Department of Environment and Local Government, Regional Office in Saint John is responsible for this file and maintains regular contact with the system proprietor. A discussion was held in 2014 to ensure the proprietor was aware that prior to an expansion of sites, a wastewater upgrade would be required.

5.0 FISHERIES

5.1 Anadromous Fisheries

Summary: Anadromous fish species – including alewives (*Alosa pseudoharengus*), also known as gaspereau, and Atlantic salmon (*Salmo salar*) – have been counted annually at the research trap at the Milltown dam fishway since 1981. The dam is at the head-of-tide on the St. Croix River and is owned by the New Brunswick Power Corporation. The fishway and research trap are located on the Canadian side of the river and are under the jurisdiction of Canada's Department of Fisheries and Oceans (DFO).

Since 2007, the Milltown research trap has been operated for only a limited number of weeks in May-July to record the alewife spawning run. Since 2012, the Atlantic Salmon Federation (ASF) has operated the trap and collected data under agreements and/or partnerships with the St. Croix International Waterway Commission, the IJC, DFO, New Brunswick Power and the Maine Department of Marine Resources (DMR).

The Milltown fishway and research trap were activated simultaneously on May 5 when spring water flows had fallen to levels that allowed for effective fishway operation. The trap was then operated continuously, with all fish counted individually, until July 8 when it was lifted due to hazardous conditions resulting from high flows and debris from an intense tropical storm. Unfavorable water conditions persisted into mid-July and trap counts to July 8 are presumed to record the full 2014 run. After July 8, NB Power continues to operate the fishway until November, without recording fish passage.

River Herring¹: There has been a general trend toward improving returns in recent years, presumably due to DFO trap-and-truck operations (2001-2008) and the State of Maine's re-opening of the Woodland fishway (2008-present) that together restored access to 475 hectares (1,174 acres) of river herring spawning habitat, and Maine's re-opening of the Grand Falls fishway in 2013 to restore access to another 16,724 hectares (41,325 acres) of spawning habitat in the upper watershed. Prior to spawning barriers first being initiated in 1987, these St. Croix waters supported a run of up to 2.6 million alewives in the mid-1980s.

The 2014 run of 27,312 was the third highest return in the last 16 years but still lower than anticipated. Variability in freshwater or marine survival of one or more year

1. River herring is the general name for two species, the alewife and the blueback herring.

classes may have been a contributing factor. A technical issue with the fishway attraction flow was also noted and preliminarily investigated by the Department of Fisheries and Oceans. This will be examined further for 2015.

In 1995, the State of Maine blocked alewife passage at the next upstream dam, at Woodland, which restricted the fish to less than 0.2% of its believed historic St. Croix spawning habitat. A trap-and-truck operation by DFO from 2001-2007 and the State's reopening of the Woodland fishway to alewives in 2008 has given the species access to an additional 475 hectares (1174 acres) of spawning habitat in Woodland Flowage for the last twelve years. In April 2013, the Maine Legislature and Senate overwhelmingly approved an emergency bill to reopen the remaining areas of the eastern branch of the St. Croix (above Grand Falls and Vanceboro) to alewife passage. The re-opening of this habitat is expected to contribute to the increased return trend noted previously.

A total of 39 alewives were lethally sampled at Milltown for fork length, body weight, gonad weight, sexual maturity stage, scale age and previous spawning record. An additional 30 alewives were live sampled for fork length, scale age and previous spawnings for a tracking study.

Scale reading identified one fish as a blueback herring: a three-year-old male returning for the first time. This is the second consecutive year that a blueback herring has appeared in the Milltown sample, after more than a decade of absence. This fish and a seven-year-old female recorded in 2013 suggest that blueback herring have continued to comprise a portion of the St. Croix river herring run over the long term, generally undetected in the small Milltown sample size. Blueback herring were last documented in Milltown river herring samples in 1993 (18% of 413 fish) and 1990 (27% of 313 fish) while samples in 1992 (509 fish) and 1991 (111 fish) were exclusively alewife. Variable sampling protocols and limited sample size preclude any conclusions from these data but do offer some insight.

Other species: Other fish captured in the Milltown trap during the course of the monitoring period are counted and immediately released upstream, unharmed, unless specified by fisheries agencies for removal.

In 2014, three freshwater fish species were recorded in small numbers; these are all assumed to have passed over the dam spillway or through open gates and returned up the fish ladder after encountering brackish water.

Four diadromous fish species in addition to river herring have been recorded at the Milltown trap at various times since 1981. In 2014 only one was documented: individual sea lamprey (*Petromyzon marinus*) passed the trap on June 3 and June 30. Both were approximately 40 cm in length. Juvenile American eel (*Anguilla rostrata*) can pass through the trap's 1-inch mesh unimpeded and therefore are rarely recorded. Wild Atlantic salmon (*Salmo salar*) have not been recorded at the Milltown trap since 2006 and American shad (*Alosa sapidissima*) have not been recorded since 1999. Escaped farmed salmon have been recorded at the trap in the past. A summary by fish species for 2014 is shown below.

Species	Hrap 7 ount
Alewife/blueback herring	27,312
Sea lamprey	2
White sucker	40
Smallmouth bass	8
Brook trout	2

5.2 Shellfish Harvesting

New Brunswick: Shellfish harvesting occurs principally in Oak Bay, either for direct marketing within areas designated as conditionally approved, or for depuration in areas designated as restricted. Environment Canada sampled St. Croix River and Oak Bay marine water quality stations on five occasions from July 3 to October 17, 2014. Additional water quality sampling was performed as part of the bay's Conditional Management Plan (CMP) which allows shellfish harvesting during dry / low rainfall conditions.

No significant change in bacteriological water quality was observed in 2014. Fecal coliform densities were consistent with those observed in previous years (i.e., 2000, 2003, 2006, 2007, 2008, 2009, 2011, 2012 & 2013). Significant rainfall events continue to trigger a rise in fecal coliform densities. This confirms the adequacy of the current shellfish growing area classification.

Maine: The shoreline along Calais and Robbinston, Maine has limited habitat for commercial shellfish. Most of area is classified as prohibited to shellfishing by the Maine Department of Marine Resources, Division of Shellfish Management to protect public health. However, there are two small coves opened on a seasonal conditional

basis. For more information on these areas refer to the November 2014 notice from that Maine Department of Marine Resources at:

http://www.maine.gov/dmr/rm/public_health/closures/62.pdf

6.0 IJC INTERNATIONAL WATERSHED INITIATIVES

The following are projects in the St. Croix Watershed that are supported in part by the IJC's International Watershed Initiative (IWI) program.

6.1 On-going Aquatic Food-Web Study

Beginning in 2013, an ecological assessment of the St. Croix system was initiated by the IJC's International Watershed Initiative (IWI) and headed by the USGS Maine Cooperative Fish and Wildlife Research Unit at the University of Maine (Orono, Maine). The objective of this study is to explore the effects of marine-derived nutrients on freshwater food webs as alewives return to the St. Croix watershed. To characterize the presence of marine-derived nutrients, fish, aquatic insect, and zooplankton samples were collected in 2013 and 2014 for stable isotope analysis. Stable isotope ratios will be used to infer differences between communities with and without direct marine input. Such information will provide a baseline description of the freshwater food web prior to the anticipated recovery of the alewife run after fish passage improvements. Samples have been collected from seven sites in the St. Croix watershed. These sites include lake, impoundment, and main stem reaches. Samples were also collected at two sites in the East Machias River, a system with an established alewife run comparable to that which is anticipated in the St. Croix River. Samples from both years are currently being analyzed. In order to characterize nutrient limitation in the areas sampled, "nutrient diffusers" were deployed beginning in 2014. This approach allows for the characterization of limitations of primary productivity. A last year of samples will be collected in 2015 and focus will shift to analysis and reporting. A nutrient model will be developed to trace the net flow of nutrients into and out of the St. Croix watershed based on the information collected.

6.2 USGS Spednic Lake Study

The objective of this project was to establish an estimated historical record of the temperature of Spednic Lake based on available meteorological data and use the estimated historical record to model survival of small mouth bass juveniles in their first year from 1970 to 2008. Regression modeling was used to estimate average daily

water temperature in Spednic Lake for April through October for each year; on the basis of estimated water temperatures, the dates of spawning were determined for each year. Mortality was estimated from the minimum average daily temperature each year. Growth models were used to estimate daily growth increments throughout the summer for bass spawned on the first and last days of the spawning period. Daily growth increments were summed over the growing period and added to an assumed average size at rise to estimate the total length of juveniles at the start of the winter for each year. The survival modeling identifies years when smallmouth bass year class strength were likely to have been challenged by meteorological conditions. A USGS Scientific Investigations Report documenting the analyses was completed in October 2014 and is available on-line at the link below.

Dudley, R.W., and Trial, J.G., 2014, Estimates of growth and mortality of under-yearling smallmouth bass in Spednic Lake, from 1970 through 2008: U.S. Geological Survey Scientific Investigations Report 2014–5164, 15 p., <http://dx.doi.org/10.3133/sir20145164>. ISSN 2328–0328 (online)

6.3 Sustaining the St. Croix Watershed: Research, Partnerships and Action

On November 20 and 21, 2014, the planned watershed forum entitled “Sustaining the St. Croix Watershed: Research, Partnerships and Action” was held at the Huntsman Marine Sciences Centre in St. Andrews, NB. The event brought together over 75 people from research institutions, government agencies, non-profit organizations, and the general public to share current research, discuss gaps and identify priorities in four theme areas. Themes were Fisheries, Ecosystems-based Management, Climate Change, and Resilient Communities. Highlights of the event included a frank and informative discussion on fisheries management during the panel session, and the after-hours event at Sunbury Shores Art Centre. Across all themes and discussions, the need for communication and facilitation amongst the groups at the event was highlighted. Speakers and Panelist and the agenda for the event are at the project web site. <http://www.stateofthecroix.org/> A summary report will be issued in spring 2015.

6.4 Alewife Count at Milltown

In 2014, the IJC’s IWI program continued to provide support for the alewife count at Milltown Dam in partnership with the efforts of government and non-governmental organizations. The collected data is discussed in Section 5.0 in this report.

7.0 Additional Items to Report

7.1 Alewife Restoration Next Steps Group

On April 10, 2013, the Maine Legislature passed, by an overwhelming majority, a bill to grant alewife (Gaspereau) unconstrained passage at Woodland and Grand Falls dam in the St. Croix River watershed. Ten days later, on April 22 the law came into effect. On June 5, 2013, a Statement of Cooperation was signed between Wabanaki Tribal leaders (Passamaquoddy) and four US Federal agencies (US Fish and Wildlife Service, National Marine Fisheries Service, US EPA, Region 1, and Bureau of Indian Affairs) and reaffirmed the commitment of the Tribe and Federal agencies to continue working together to restore the St. Croix River and Passamaquoddy Bay ecosystem. To accomplish this goal the Passamaquoddy Tribe and the four US Federal agencies noted above formed a “Next Steps” work group. As a result, and in cooperation with the Canadian government and the dam owners on both sides of the border, the group is reviewing the fish passage at the dams on the St. Croix River. The US Fish and Wildlife Service is the lead for preparing a fishway report. The report is expected to be available sometime in 2015.

7.2 FERC Dam Relicensing

Vanceboro Dam/Spednic Lake: On March 1, 2011, Woodland Pulp LLC filed a notice of intent to start the re-licensing process for Vanceboro Dam which is located along the International Boundary. The current license expires in March 2016. The process is following the U.S. Federal Energy Regulatory Commission (FERC) integrated Licensing Process requirements and is on-going. The Docket number is P-2492-000. In 2011, focus was on preparing, filing and distributing for comment the requisite documents including background information and proposed study plans. In 2012, focus moved to identification, comment approval and implementation of studies and study plans. Corresponding field work was conducted in the areas of archaeology, fisheries, water quality, flora and fauna (including aquatic invertebrates and invasive species), wetlands, recreation, bathymetry and habitat, among other attributes. In 2013, study results were circulated for review and comment individually and in the Form of a Preliminary License Application (PLA). Additional information was provided and supplemental field work associated with fisheries and water quality was conducted. A Final License Application (FLA) was filed in February 2014. The FLA included study information, project specifications, answers to comments and requests and other required and/or relevant information. FERC deemed the application complete and is reviewing the FLA and has solicited comments. Preparation of an Environmental Assessment is the next step.

As part of the FERC licensing process, Woodland Pulp also filed an application for State 401 Water Quality Certificate with Maine Department of Environmental Protection and the application is under review by the Department.

Forest City Dam/East Grand Lake: The Forest City Dam (Forest City Project) and the West Grand Lake and Sysladobsis and Farm Cove Dams (West Branch Project) on the St. Croix River system owned by Woodland Pulp LLC are also in the FERC re-licensing process. The Forest City Dam is located on the International Boundary. The licenses expired in 2000. Since 2000 these projects have been operating on annual licenses. Docket numbers are P-2660-024 and P-2618-024.

Woodland Pulp and its predecessors as licensee of these projects in past sought to have FERC determine that the projects were not required to be licensed. However, in 2011 FERC ruled that licensing was required. A draft Environmental Assessment was issued by the FERC in October 2014 and comments were solicited. A final Environmental Assessment was issued in January 2015. It is expected that the licenses will be issued by FERC in 2015.

***Note:** The above FERC licensing information is provided in the Board's Annual Report for general information purposes only.*

ACKNOWLEDGEMENTS

The International St. Croix River Watershed Board gratefully acknowledges the valuable input and efforts in support of this report provided by the following groups/ individuals and without which the preparation of this report would not be possible.

Jonathan	Carr	Atlantic Salmon Federation
Lee	Sochasky	Atlantic Salmon Federation
Tim	Andrews	Environment Canada
Dave	Benoit	Environment Canada
Luc	Bernard	Environment Canada
Derek	Elliott	Environment Canada
Benoit	Lalonde	Environment Canada
Vincent	Mercier	Environment Canada
Paul	Noseworthy	Environment Canada
Bernard	Richard	Environment Canada
Kathyrn	Parlee	Environment Canada
Susanne	Miller	Maine Department of Environmental Protection
Brad	McPherson	New Brunswick Department of Environment and Local Government
Darryl	Pupek	New Brunswick Department of Environment and Local Government
Abby	Pond	St. Croix International Waterway Commission
Barbara	Blumeris	U.S. Army Corps of Engineers
Laura	Flight	U.S. Geological Survey
Nick	Stasulius	U.S. Geological Survey
Gregory	Stewart	U.S. Geological Survey
Bob	Lent	U.S. Geological Survey
Joseph	Zydlowski	U.S. Geological Survey
Jay	Beaudoin	Woodland Pulp LLC.

APPENDIX 1

SUMMARY - ORDERS OF APPROVAL & BASIN MAP

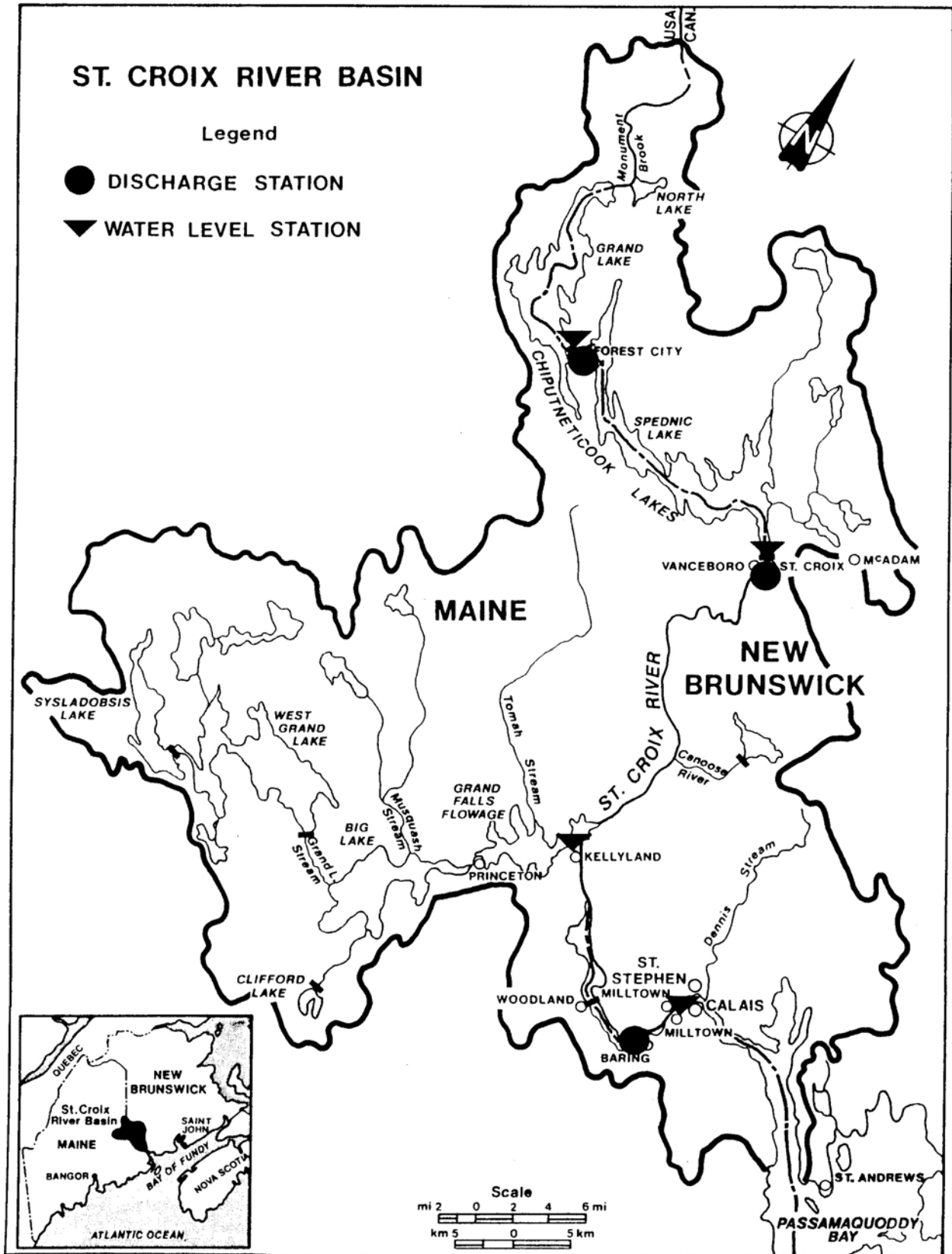
SUMMARY - ST. CROIX RIVER ORDERS OF APPROVAL

INTERNATIONAL JOINT COMMISSION

- 9 November, 1915- For approval of a dam and power canal and the obstruction, diversion and use of the waters of the St. Croix River at Grand Falls in the State of Maine and the Province of New Brunswick:
Maximum elevation 202.0 feet m.s.l.
- 3 October, 1923- Erection and repairs of fishways in the St. Croix River.
- 6 October, 1931- For the obstructions of the waters of the St. Croix River at Grand Falls in the State of Maine and the Province of New Brunswick.
Increase in elevation to 203.5 feet m.s.l.
- 2 October, 1934- For the reconstruction of a dam across the St. Croix River from Milltown in the Province of New Brunswick to Milltown in the State of Maine.
- 15 October, 1965- For the construction of a storage dam in the St. Croix River at Vanceboro, Maine and St. Croix, New Brunswick:

Discharge from Spednic Lake-	200 cfs (5.66 m ³ /s) minimum
Elevation of Spednic Lake-	385.86 feet (117.611 metres) maximum
Between 1 October and 30 April-	371.50 feet (113.233 metres) minimum
Between 1 May and 30 September-	376.50 feet (114.759 metres) minimum
Discharge from East Grand Lake-	75 cfs (2.12 m ³ /s) minimum
Elevation of East Grand Lake-	434.94 feet (132.571 metres) maximum 427.94 feet (130.438 metres) minimum

- 16 November, 1982- For the reconstruction of the diversion dike in the St. Croix River near Baileyville, Maine.



APPENDIX 2

**MILLTOWN, GRAND FALLS, VANCEBORO
AND FOREST CITY DAMS**

GENERAL DESCRIPTION OF MILLTOWN, GRAND FALLS, VANCEBORO & FOREST CITY DAMS

Milltown Dam & Fish Passage Facilities

The Milltown facility is located in Milltown, New Brunswick across the river from Calais, Maine and approximately one mile upstream from the international bridge between Calais and St. Stephen, New Brunswick. It consists of a powerhouse with 7 hydroelectric generating units (installed capacity is 3.96 MW), an upstream fish passage facility that goes from the lower pool around the side of the powerhouse to the upper pool. The spillway is located adjacent to the powerhouse and has 6 openings with large wooden stop logs that can be removed or installed via a railed vertical lifting mechanism. Other sections of the spillway have been equipped with wooden flashboards that are meant to fail and increase the spillway's capacity during high flows. At the far end of the spillway, running perpendicular from the spillway to the river bank, is a gatehouse with 5 vertical lift gates used to control the forebay elevation. A wooden-chute downstream fish passage facility is located in the area between the spillway and the gatehouse.

Grand Falls Dam & Fish Passage Facilities

Grand Falls Flowage Dam is approximately 8 miles upstream of the town of Baileyville, Maine and can store approximately 88,000 acre-feet of water. This dam has 9 steel tainter gates on the right (facing downstream) of the spillway, and a concrete emergency spillway approximately 800 to 850 feet in length running from the concrete gatehouse and ending at the left shoreline. The gatehouse is located between the gates and the emergency spillway. A floating walkway allows access to the entire upstream length of the spillway. Lake levels are recorded by a gauging station on the right bank of the dam.

The downstream side of the emergency spillway/dam has a concrete face sloping at an angle of approximately 45 degrees, and supported by concrete buttresses along its length. The space between these buttresses has been enclosed with a pressure-treated timber log system. This log system was installed to minimize the temperature differential in the downstream face area during freezing conditions to reduce possible degradation of the concrete face.

Water is impounded behind Grand Falls Dam and delivered to the hydroelectric plant and fish passage facilities via a channel on the right side of the impoundment, approximately 1000 feet upstream of the dam.

Water flows to the turbines via three steel penstocks. A Denil fishway is located on the side of the hydroelectric plant. It is a concrete structure with a series of bays equipped with guide slots that allow for the installation of wooden V notched weirs to modify flows to levels acceptable for fish migration.

Vanceboro Dam & Fish Passage Facilities

Vanceboro Dam consists of an earth embankment with a concrete gate structure and with rock filled gabions on the upstream face. The concrete structure is 69 feet (21 m) long, and contains a fishway and two tainter gates, each 22'-6" (6.9 m) wide by 14'-6" (4.4 m) high. These gates are operated by electrical cable lifts. The gate structure is located on the International Boundary line between the United States and Canada. Gate sill elevation is at 371.5 feet (113.23 m) NGVD. Normal full pond elevation is at 385.86 feet (117.61 m), with an impounded surface of 20,870 acres (84.5 km²). There are approximately 221,200 acre-feet (0.27 km³) of useable storage at normal full pond. The fishway is a vertical slot fish ladder and is to the left of the tainter gates and consists of 10 bays or pools. There are 5 vertical lift wooden gates to regulate flow through the ladder. There is a steel trash rack on the upstream face of the fish passage.

Forest City Dam & Fish Passage Facilities

Forest City Dam is a small timber crib rock filled structure with three wooden sluice gates operated with a wooden ratchet lever system that lifts the gates using a steel cable or steel chain. These gates have openings of 8'-4" (2.54 m) and a sill elevation of 427.94 feet (130.44 m) NGVD. Full pond elevation is at elevation 434.94 feet (132.57 m) NGVD, and impounds 105,300 acre-feet (0.130 km³) of water. The fishway is located on the left side (facing downstream) of the dam and consists of timber baffle system with an upstream timber trash rack.

FACILITY SITE VISITS IN 2014

Board members met with New Brunswick Power Corporation officials (NB Power) on June 4, 2014 at the Milltown Dam in New Brunswick and participated in a site visit of the facility.

Board members met with Woodland Pulp LLC officials on June 4, 2014 at the Woodland Mill at Baileyville, Maine and then Board members participated in site visits at Grand Falls, Forest City, and Vanceboro Dams.

Participants included in the NB Power and Woodland Pulp LLC meetings and site visits are shown below:

IJC and Board Representatives:

<u>Name</u>	<u>Affiliation</u>
Dereth Glance	IJC Commissioner, U.S. Section
Benoit Bouchard	IJC Commissioner, Canadian Section
Joe Babb	IJC staff, US Section
Glenn Benoy	IJC staff, Canadian Section
Bill Appleby	St. Croix Board, Chair, Canadian Section
Colonel Samaris	St. Croix Board, Chair, U.S. Section
Ralph Abele	St. Croix Board, U.S. Section
Bob Lent	St. Croix Board, U.S. Section
Susanne Miller	St. Croix Board, U.S. Section
Jessie Davies	St. Croix Board, Canadian Section
Barbara Blumeris	Secretary, St. Croix Board, U.S. Section
Kathryn Parlee	Secretary, St. Croix Board, Canadian Section

Facility Representatives:

Jeff Babcock	Hydro Manager, NB Power
Glen Hanscom	Hydro Technical Services, NB Power
Jay Beaudoin	Environmental Manager, Woodland Pulp LLC
Kevin Dean	Hydro Superintendent, Woodland Pulp LLC
Scott Beal	Environmental Manager, Woodland Pulp LLC

Forest City Dam. No changes reported in 2014. In 2013 a new gate was added to control access to dam. FERC conducts periodic dam safety inspections.

Forest City Dam (6-4-2014), View of dam from downstream.



Forest City Dam (6-4-2014), View of gates from upstream.



Vanceboro Dam. No changes reported in 2014.
FERC conducts periodic dam safety inspections.

Vanceboro Dam (6-4-2014), View of fishway.



Vanceboro Dam (6-4-2014). View of flow through Tainter gates.



Grand Falls Dam. Maine Emergency Management Agency, Dam Safety Program and the owner Woodland Pulp conduct periodic dam safety inspections. In 2014 Woodland Pulp reported rebuilding one of the turbines at project.

Grand Falls Dam (6-4-2014), Upstream side of spillway from US side.



Grand Falls Dam (6-4-2014), View of Tainter gates from downstream.



Grand Falls Dam (6-4-2014), View of Denil fishway above the powerhouse.



Grand Falls Dam (6-4-2014), View of Denil fishway alongside powerhouse.

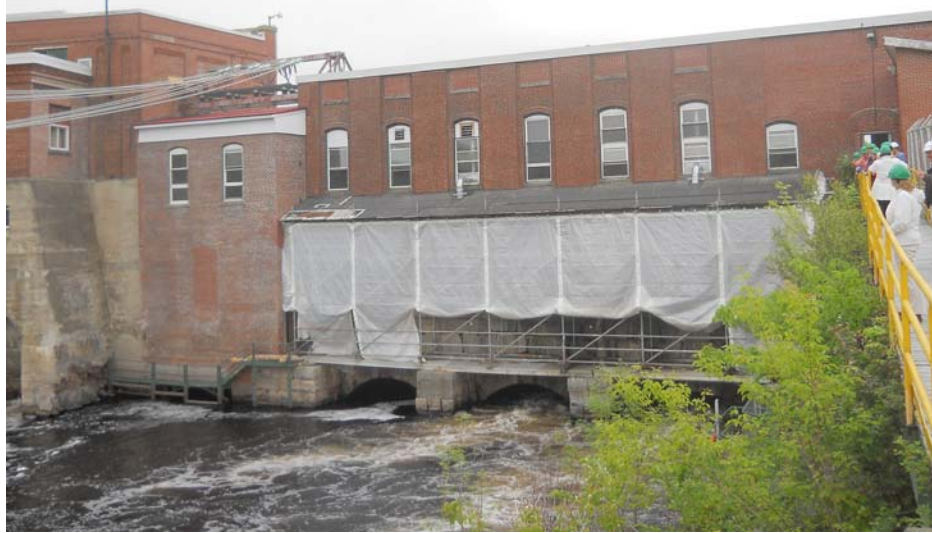


Milltown Dam. During the Board's annual site visits, it has been observed that there is a crack in the floor of the powerhouse near units 5/6/7. This is not a new issue as the crack has been apparent since the 1980s. However, several years ago NB Power reported to the Board that there was increased movement in the crack. At that time (2003) NB Power took actions to assess the situation and established procedures to prevent further movement of the wall. NB Power set up heated hoarding on the outside face of the wall to prevent freezing and thawing action and has continued to use this method. NB Power continues to monitor the wall to make sure that additional actions are not required. As part of 2014 facility maintenance, NB power reported repair to the hoarding, replacement of wooden stop logs, and planned repair to one of the wooden gates at the gatehouse. Each year, NB Power technical staff conducts an annual inspection of the facility structures. In addition, NB power engages an independent engineering consultant to provide periodic review of the facilities. Milltown conduct their 4 year inspection in summer 2012 and the report completed in April 2013 indicated satisfactory conditions.

Milltown Dam (6-4-2014), View of spillway and powerhouse.



Milltown Dam (6-4-2014), Powerhouse with enclosure installed on tailrace wall.



Milltown Dam (6-4-2014), Gate House.



Milltown Dam (6-4-2014), View of fishway.



APPENDIX 3

WATER LEVELS AND FLOWS

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GRAND LAKE AT FOREST CITY
DAILY MEAN WATER LEVEL IN METERS FOR 2014

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	131.713	131.962	131.791	131.823	132.397	132.355	132.346	132.077	131.883	131.493	131.723	132.043	1
2	131.713	131.959	131.783	131.821	132.390	132.344	132.330	132.071	131.870	131.486	131.762	132.047	2
3	131.714	131.950	131.773	131.821	132.376	132.332	132.317	132.066	131.870	131.479	131.779	132.057	3
4	131.705	131.940	131.766	131.821	132.364	132.327	132.313	132.065	131.853	131.473	131.771	132.072	4
5	131.703	131.933	131.760	131.831	132.368	132.328	132.404	132.086	131.831	131.483	131.772	132.071	5
6	131.713	131.929	131.753	131.838	132.359	132.353	132.437	132.094	131.819	131.481	131.781	132.076	6
7	131.736	131.919	131.747	131.842	132.354	132.352	132.434	132.092	131.811	131.468	131.825	132.093	7
8	131.740	131.909	131.742	131.860	132.352	132.345	132.422	132.085	131.787	131.485	131.853	132.089	8
9	131.744	131.899	131.738	131.882	132.346	132.340	132.402	132.075	131.765	131.494	131.864	132.089	9
10	131.748	131.892	131.734	131.902	132.350	132.344	132.384	132.065	131.746	131.487	131.881	132.124	10
11	131.760	131.882	131.732	131.927	132.356	132.343	132.357A	132.054	131.725	131.480	131.892	132.201	11
12	131.809	131.871	131.736	131.960	132.356	132.334	132.333	132.045	131.718	131.476	131.906	132.237	12
13	131.830	131.865	131.765	131.999	132.352	132.327	132.298	132.030	131.691	131.467	131.918	132.256	13
14	131.853	131.884	131.763	132.041	132.345	132.343	132.280	132.039	131.678	131.460	131.928	132.261	14
15	131.920	131.880	131.763	132.104	132.340	132.356	132.258	132.049	131.656	131.458	131.936	132.261	15
16	131.954	131.883	131.763	132.222	132.336	132.348	132.263	132.042	131.638	131.454	131.933	132.247	16
17	131.983	131.874	131.761	132.291	132.331	132.338	132.262	132.038	131.625	131.503	131.941	132.240	17
18	132.010	131.865	131.758	132.334	132.343	132.360	132.243	132.037	131.613	131.531	131.961	132.255	18
19	132.033	131.862	131.756	132.364	132.366	132.378	132.228	132.028	131.594	131.540	131.960	132.229	19
20	132.051	131.858	131.769	132.384	132.386	132.378	132.211	132.020	131.572	131.534	131.959	132.201	20
21	132.054	131.851	131.775	132.398	132.393	132.372	132.194	132.012	131.559	131.529	131.966	132.173	21
22	132.047	131.85	131.776	132.405	132.397	132.367	132.178	132.005	131.559	131.533	131.957	132.145	22
23	132.038	131.842	131.777	132.412	132.397	132.362	132.161	131.998	131.548	131.554	131.956	132.119	23
24	132.027	131.833	131.776	132.434	132.394	132.352	132.156	131.989	131.536	131.623	131.958	132.101	24
25	132.018	131.824	131.776	132.445	132.389	132.356	132.137	131.980	131.527	131.653	131.978	132.122	25
26	132.020	131.817	131.779	132.444	132.386	132.379	132.121	131.970	131.522	131.672	131.989	132.148	26
27	132.013	131.809	131.778	132.444	132.394	132.381	132.103	131.958	131.518	131.693	132.033	132.148	27
28	132.006	131.800	131.778	132.436	132.388	132.377	132.102	131.948	131.511	131.696	132.032	132.154	28
29	131.996		131.78	132.423	132.379	132.369	132.097	131.931	131.506	131.704	132.032	132.161	29
30	131.985		131.804	132.406	132.369	132.358	132.092	131.905	131.498	131.715	132.029	132.156	30
31	131.974				132.363		132.083	131.890		131.718		132.145	31
TOTAL	4088.610	3692.642	3821.220	3964.314	4103.416	3970.598	4099.946	4092.744	3950.029	4077.822	3957.275	4096.72	TOTAL
MEAN	131.891	131.880	131.766	132.144	132.368	132.353	132.256	132.024	131.668	131.543	131.909	132.152	MEAN
MAX	132.054	131.962	131.804	132.445	132.397	132.381	132.437	132.094	131.883	131.718	132.033	132.261	MAX
MIN	131.703	131.800	131.734	131.821	132.331	132.327	132.083	131.890	131.498	131.454	131.723	132.043	MIN

SUMMARY FOR THE YEAR 2014

Mean water level, 131.996 m
Maximum daily water level, 132.445 m On 2014-04-25
Minimum daily water level, 131.454 m On 2014-10-16

NOTES: THE WATER LEVELS ARE PROVISIONAL AND ARE SUPPLIED BY ENVIRONMENT CANADA IN COOPERATION WITH WOODLAND PULP LLC
A - PARTIAL DAY

TABLE I

FOREST CITY STREAM BELOW FOREST CITY DAM
DAILY MEAN DISCHARGE CUBIC METERS PER SECOND FOR 2014

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	4.79	12.2	8.74	2.48	34.2	8.65	11.6	3.40	8.33	2.80	2.68	3.44	1
2	4.79	12.1	8.66	2.49	34.1	7.68	11.5	3.40	9.27	2.79	2.74	3.47	2
3	4.81	10.8	7.74	2.48	33.7	6.81	11.5	3.38	11.6	2.76	2.73	3.51	3
4	4.78	9.66	6.91	2.49	29.4	6.78	11.5	3.37	12.8	2.75	2.73	3.48	4
5	4.78	9.63	6.18	2.51	25.6	6.79	19.0	3.42	12.6	2.76	2.73	3.52	5
6	4.83	9.59	5.58	2.50	23.0	6.83	32.3	3.43	12.5	2.74	2.73	3.54	6
7	4.83	9.55	5.07	2.52	17.7	6.83	35.2	3.43	12.3	2.72	2.81	3.54	7
8	4.86	9.49	4.62	2.56	13.0	6.79	34.9	4.13	12.1	2.76	2.85	3.55	8
9	4.88	9.44	4.60	2.57	11.6	6.76	31.2	4.65	11.8	2.8	2.88	9.65	9
10	4.90	9.39	4.60	2.61	10.0	6.74	28.1	4.64	11.7	2.7	2.91	17.9	10
11	4.94	9.33	4.59	2.65	10.0	6.74	25.2	4.62	11.6	2.7	2.94	21.4	11
12	5.03	9.27	4.58	2.71	10.0	6.75	22.8	4.62	11.5	2.6	2.97	24.7	12
13	5.08	9.26	4.62	2.78	10.0	6.78	22.5	4.59	11.1	2.6	2.99	27.2	13
14	5.15	9.32	4.63	3.61	9.0	6.81	22.3	4.64	11.0	2.6	3.01	27.2	14
15	5.29	9.30	4.63	6.32	8.5	6.83	22.0	4.64	10.7	2.6	3.02	27.3	15
16	5.37	9.27	3.77	10.6	8.5	5.97	22.0	4.63	9.48	2.62	3.03	27.0	16
17	5.45	9.21	3.20	15.8	8.5	5.42	22.0	4.63	8.87	2.74	3.05	26.9	17
18	5.51	9.20	3.19	19.8	8.5	5.47	17.9	4.63	8.72	3.14	3.07	28.7	18
19	5.56	9.19	3.19	21.1	8.60	5.49	15.7	4.61	7.76	2.79	3.07	29.8	19
20	8.10	9.13	3.22	21.6	8.67	5.47	15.5	4.59	7.00	2.78	3.19	29.1	20
21	13.4	9.11	2.71	23.9	8.72	5.47	14.7	4.58	6.83	2.77	3.27	28.4	21
22	15.4	9.08	2.45	30.4	8.74	5.48	12.6	4.53	5.95	2.78	3.26	27.7	22
23	15.3	9.02	2.44	34.7	8.75	5.47	10.8	4.53	4.16	2.83	3.27	24.8	23
24	14.0	8.95	2.44	35.2	8.77	5.47	10.8	4.54	3.60	2.68	3.30	22.5	24
25	12.6	8.89	2.45	35.4	8.76	5.5	9.57	4.52	3.58	2.57	3.31	22.9	25
26	12.6	8.87	2.43	35.3	8.76	7.5	8.63	6.76	3.55	2.60	3.33	23.4	26
27	12.5	8.84	2.42	35.2	8.79	10.7	8.56	8.62	3.52	2.61	3.39	23.4	27
28	12.5	8.76	2.44	35.1	8.80	11.7	7.14	8.56	3.49	2.63	3.41	20.9	28
29	12.4		2.43	34.8	8.74	11.7	5.46	8.48	3.07	2.65	3.41	18.7	29
30	12.3		2.48	34.5	8.73	11.7	3.77	8.41	2.82	2.67	3.43	17.5	30
31	12.2				8.69		3.40	8.36		2.67		14.2	31
TOTAL	249	266	127	467	419	213	530	155	253	84	91	566	TOTAL
MEAN	8.03	9.49	4.23	15.6	13.5	7.10	17.1	5.01	8.44	2.72	3.05	18.9	MEAN
MAX	15.4	12.2	8.74	35.4	34.2	11.7	35.2	8.62	12.8	3.14	3.43	29.8	MAX
MIN	4.78	8.76	2.42	2.48	8.51	5.42	3.40	3.37	2.82	2.57	2.68	3.44	MIN
DAM3	21500	23000	11000	40300	36200	18400	45800	13400	21900	7300	7900	48900	DAM3

SUMMARY FOR THE YEAR 2014

Total discharge 295600 DAM
Mean discharge, 9.43 m³/s
Maximum daily discharge, 35.4 m³/s On 2014-04-25
Minimum daily discharge, 2.42 m³/s On 2014-03-27

NOTES: THE DISCHARGE ARE PROVISIONAL AND ARE SUPPLIED BY ENVIRONMENT
CANADA IN COOPERATION WITH WOODLAND PULP LLC

TABLE II

SPEDNIC LAKE AT ST. CROIX
DAILY MEAN WATER LEVEL IN METERS FOR 2014

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	116.256	117.027	116.417	116.287	117.107	117.108	117.124	116.909	116.205	115.608	115.536	116.306	1
2	116.259	117.033	116.393	116.280	117.078	117.092	117.124	116.886	116.185	115.580	115.601	116.322	2
3	116.263	117.035	116.369	116.277	117.045	117.080	117.109	116.862	116.191	115.552	115.634	116.346	3
4	116.259	117.031	116.349	116.274	117.043	117.074	117.105	116.839	116.174	115.522	115.617	116.385	4
5	116.259	117.023	116.337	116.281	117.072	117.069	117.247	116.838	116.153	115.515	115.621	116.392	5
6	116.270	117.019	116.322	116.289	117.074	117.104	117.337	116.822	116.143	115.499	115.638	116.416	6
7	116.303	117.006	116.304	116.294	117.068	117.103	117.380	116.806	116.139	115.464	115.701	116.449	7
8	116.319	116.995	116.296	116.314	117.055	117.092	117.389	116.780	116.115	115.452	115.769	116.467	8
9	116.336	116.984	116.287	116.353	117.033	117.090	117.382	116.750	116.090	115.450	115.795	116.483	9
10	116.352	116.968	116.275	116.384	117.030	117.092	117.366	116.718	116.072	115.424	115.829	116.560	10
11	116.373	116.937	116.267	116.431	117.042	117.095	117.327	116.688	116.051	115.392	115.852	116.732	11
12	116.430	116.904	116.265	116.498	117.036	117.086	117.283	116.660	116.056	115.373	115.877	116.902	12
13	116.479	116.873	116.294	116.574	117.035	117.076	117.224	116.626	116.021	115.342	115.906	117.028	13
14	116.531	116.865	116.280	116.651	117.026	117.104	117.186	116.608	116.015	115.314	115.937	117.109	14
15	116.621	116.831	116.274	116.763	117.021	117.137	117.151	116.611	115.987	115.294	115.966	117.151	15
16	116.707	116.815	116.273	116.976	117.016	117.132	117.148	116.584	115.964	115.269	115.970	117.161	16
17	116.774	116.779	116.268	117.134	117.008	117.121	117.159	116.565	115.948	115.300	115.989	117.160	17
18	116.829	116.739	116.260	117.216	117.031	117.150	117.146	116.555	115.932	115.329	116.041	117.173	18
19	116.873	116.709	116.253	117.261	117.059	117.184	117.128	116.530	115.910	115.344	116.059	117.150	19
20	116.912	116.678	116.257	117.274	117.095	117.191	117.104	116.501	115.875	115.328	116.065	117.121	20
21	116.942	116.640	116.260	117.270	117.115	117.181	117.086	116.472	115.851	115.295	116.096	117.080	21
22	116.966	116.617	116.259	117.265	117.129	117.172	117.073	116.445	115.853	115.282	116.096	117.029	22
23	116.979	116.585	116.258	117.277	117.137	117.162	117.066	116.419	115.827	115.288	116.101	116.985	23
24	116.988	116.558	116.254	117.317	117.140	117.150	117.065	116.394	115.788	115.360	116.110	116.952	24
25	116.994	116.529	116.246	117.323	117.142	117.148	117.048	116.368	115.760	115.409	116.151	116.966	25
26	117.012	116.499	116.250	117.304	117.138	117.163	117.030	116.339	115.738	115.443	116.178	117.022	26
27	117.018	116.475	116.242	117.279	117.145	117.163	117.002	116.319	115.716	115.483	116.244	117.046	27
28	117.025	116.447	116.233	117.247	117.141	117.156	116.989	116.305	115.688	115.483	116.256	117.054	28
29	117.029		116.232	117.202	117.138	117.148	116.981	116.274	115.654	115.495	116.270	117.053	29
30	117.029		116.255	117.153	117.124	117.137	116.956	116.241	115.632	115.520	116.279	117.036	30
31	117.028				117.117		116.932	116.218		115.526		117.019	31
TOTAL	3616.415	3270.601	3488.529	3504.448	3629.44	3513.76	3631.647	3613.932	3478.733	3577.935	3478.184	3622.055	TOTAL
MEAN	116.6585	116.8072	116.2843	116.8149	117.0787	117.1253	117.1499	116.5785	115.9578	115.4173	115.9395	116.8405	MEAN
MAX	117.029	117.035	116.417	117.323	117.145	117.191	117.389	116.909	116.205	115.608	116.279	117.173	MAX
MIN	116.256	116.447	116.232	116.274	117.008	117.069	116.932	116.218	115.632	115.269	115.536	116.306	MIN

SUMMARY FOR THE YEAR 2014

Mean water level, 116.554 None
 Maximum daily water level, 117.389 m On 2014-07-08
 Minimum daily water level, 115.269 m On 2014-10-16

NOTES: WATER LEVELS ARE IN METERS AND ARE REFERENCED TO
 GEODETIC SURVEY OF CANADA DATUM. WATER LEVELS ARE
 PROVISIONAL AND ARE SUPPLIED BY ENVIRONMENT CANADA IN
 COOPERATION WITH WOODLAND PULP LLC
 A - PARTIAL DAY

TABLE III

ST. CROIX RIVER AT VANCEBORO
DAILY MEAN DISCHARGE CUBIC METERS PER SECOND FOR 2014

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	12.4	24.4	38.8	13.3	145	28.3	26.6	28.2	27.5	24.0	10.4	8.72	1
2	12.3	24.4	38.5	13.2	144	25.8	18.3	28.2	27.4	23.8	10.6	8.67	2
3	12.4	24.4	33.4	13.2	131	22.2	27.7	28.1	27.4	23.6	10.8	8.69	3
4	12.2	26.5	27.6	13.3	98.8	22.1	27.7	28.0	27.3	23.4	10.7	8.81	4
5	12.1	28.1	24.1	13.4	88.3	22.1	43.3	27.8	27.2	23.4	10.7	8.84	5
6	12.2	28.1	24.1	13.5	85.2	22.2	67.4	27.6	27.2	23.2	10.8	8.84	6
7	12.4	28.0	20.7	13.6	80.4	22.2	84.4	28.9	27.2	23.0	11.0	8.95	7
8	12.4	27.9	18.5	13.8	71.6	22.1	89.5	30.3	27.0	22.9	11.2	8.98	8
9	12.4	27.9	18.4	13.5	61.4	22.1	89.2	30.3	26.9	22.9	11.3	9.01	9
10	12.5	37.4	18.3	12.5	49.8	22.2	88.9	30.3	26.8	22.7	11.4	9.20	10
11	12.6	44.2	18.3	10.1	47.6	22.1	88.3	30.0	26.7	22.6	11.4	12.9	11
12	12.9A	43.9	18.3	10.2A	43.3	22.1	87.8	30.0	26.7	22.5	11.5	16.1	12
13	12.9	46.2	18.5	10.4E	40.8	22.1	86.9	29.7	26.5	22.3	9.88	27.4	13
14	13.0A	49.0	18.5	10.4E	37.4	22.2	75.0	29.7	26.4	22.1	8.16	47.0	14
15	13.3E	48.4	18.4	26.6	34.3	22.3	66.5	29.7	26.3	21.9	8.21	60.3	15
16	13.5	48.4	16.9	50.1	31.1	19.0	66.5	29.5	26.2	21.8	8.24	75.3	16
17	13.6	48.1	16.3B	63.4	28.0	16.2	66.5	29.5	26.1	22.1	8.27	81.0	17
18	13.8	47.9	16.3B	73.1	28.1	16.3	56.9	29.5	26.0	22.2	8.41	86.9	18
19	13.9	47.6	15.3	83.3	28.2	16.4	49.3	29.2	25.9	22.3	8.47	91.5	19
20	14.0	47.6	13.6	94.0	28.3	19.7	49.3	29.2	25.7	22.4	8.47	91.2	20
21	19.4	47.0	13.5	100	28.3	21.5	42.5	28.9	25.5	22.3	8.55	98.5	21
22	25.7	46.7	13.4	107	28.6	21.4	33.4	28.9	25.5	19.2	8.52	102	22
23	28.3	46.7	13.3	114	28.6	21.4	28.9	28.6	25.3	16.9	8.50	89.5	23
24	26.8	45.0	13.3	130	28.6	21.3	28.9	28.6	25.0	14.8	8.47	80.4	24
25	24.8	43.0	13.3B	147	28.6	21.4	29.2	28.3	24.8	12.9	8.52	80.7	25
26	24.9	40.5	13.3B	151	28.6	24.9	28.6	28.3	24.7	13.1	8.61	81.6	26
27	24.8	39.1	13.3B	150	28.6	28.6	28.6	28.1	24.6	12.0	8.78	81.8	27
28	24.7	39.1	13.2B	149	28.6	29.7	28.6	28.1	24.4	10.3	8.78	81.8	28
29	24.6		13.2	148	28.6	29.7	28.6	27.9	24.2	10.3	8.84	81.8	29
30	24.4		13.5	146	28.3	29.7	28.3	27.8	24.1	10.4	8.81	74.8	30
31	24.4				28.3		28.3	27.6		10.4		60.9	31
TOTAL	530	1095	566	1905	1617	680	1590	895	782	608	286	1592	TOTAL
MEAN	17.1	39.1	18.9	63.5	52.2	22.7	51.3	28.9	26.1	19.6	9.54	51.4	MEAN
MAX	28.3	49.0	38.8	151	145	29.7	89.5	30.3	27.5	24.0	11.5	102	MAX
MIN	12.1	24.4	13.2	10.1	28.0	16.2	18.3	27.6	24.1	10.3	8.16	8.67	MIN
DAM3	45800	94600	48900	164600	139700	58700	137400	77300	67600	52500	24700	137600	DAM3

SUMMARY FOR THE YEAR 2014
 Total discharge 1049400 DAM
 Mean discharge, 33.3 m³/s
 Maximum daily discharge, 151 m³/s On 2014-04-26
 Minimum daily discharge, 8.16 m³/s On 2014-10-14

NOTES: DATA ARE SUPPLIED BY THE UNITED STATES
 GEOLOGICAL SURVEY AND ARE PROVISIONAL.
 A - PARTIAL DAY
 E - ESTIMATED DAY
 B - BACKWATER

TABLE IV

GRAND FALLS FLOWAGE AT GRAND FALLS
DAILY MEAN WATER LEVEL IN METERS FOR 2014

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	61.739	61.768	61.857	61.470	62.014	61.826	61.923	61.699	61.795	61.597	61.798	61.720	1
2	61.741	61.757	61.851	61.464	62.013	61.817	61.910	61.702	61.789	61.590	61.804	61.731	2
3	61.740	61.749	61.844	61.467	62.009	61.814	61.873	61.694	61.802	61.599	61.847	61.768	3
4	61.723	61.733	61.827	61.469	61.996	61.801	61.834	61.687	61.810	61.609	61.858	61.804	4
5	61.713	61.717	61.801	61.488	61.968	61.775	61.803	61.676	61.812	61.636	61.864	61.800	5
6	61.712	61.713	61.772	61.520	61.931	61.794	61.895	61.668	61.822	61.650	61.880	61.798	6
7	61.733	61.711	61.750	61.551	61.919	61.832	61.957	61.675	61.820	61.653	61.919	61.821	7
8	61.760	61.711	61.731	61.612	61.912	61.849	61.869	61.679	61.785	61.661	61.966	61.811	8
9	61.785	61.711	61.707	61.681	61.903	61.846	61.820	61.694	61.770	61.674	61.972	61.784	9
10	61.810	61.708	61.685	61.728	61.928	61.832	61.793	61.711	61.777	61.678	61.967	61.795	10
11	61.819	61.709	61.669	61.746	61.917	61.844	61.763	61.734	61.779	61.666	61.956	61.904	11
12	61.825	61.697	61.660	61.792	61.905	61.846	61.763	61.750	61.776	61.667	61.956	62.008	12
13	61.863	61.684	61.637	61.821	61.912	61.840	61.759	61.754	61.764	61.669	61.947	61.961	13
14	61.903	61.697	61.604	61.847	61.898	61.870	61.778	61.783	61.764	61.671	61.948	61.878	14
15	61.912	61.719	61.609	61.908	61.876	61.900	61.766	61.805	61.745	61.677	61.963	61.799	15
16	61.925	61.744	61.623	62.128	61.848	61.910	61.776	61.809	61.731	61.671	61.952	61.754	16
17	61.900	61.755	61.614	62.246	61.813	61.918	61.768	61.817	61.733	61.742	61.942	61.767	17
18	61.882	61.784	61.594	62.169	61.810	61.921	61.770	61.823	61.732	61.776	61.968	61.803	18
19	61.872	61.811	61.581	62.093	61.857	61.936	61.786	61.824	61.723	61.795	61.960	61.813	19
20	61.847	61.841	61.575	62.036	61.871	61.932	61.784	61.823	61.717	61.799	61.933	61.802	20
21	61.863	61.847	61.572	62.002	61.890	61.921	61.762	61.821	61.708	61.784	61.913	61.780	21
22	61.849	61.853	61.562	61.985	61.891	61.910	61.774	61.814	61.701	61.737	61.871	61.729	22
23	61.894	61.862	61.554	61.990	61.884	61.896	61.786	61.809	61.682	61.729	61.826	61.681	23
24	61.912	61.871	61.539	62.030	61.868	61.877	61.773	61.813	61.658	61.820	61.790	61.646	24
25	61.905	61.877	61.524	62.075	61.862	61.858	61.761	61.816	61.651	61.880	61.785	61.650	25
26	61.873	61.876	61.503	62.092	61.878	61.873	61.749	61.819	61.639	61.849	61.791	61.778	26
27	61.830	61.874	61.478	62.082	61.875	61.927	61.732	61.812	61.631	61.804	61.847	61.843	27
28	61.800	61.866	61.477	62.058	61.872	61.954	61.711	61.794	61.624	61.772	61.823	61.827	28
29	61.796		61.508	62.040	61.872	61.934	61.706	61.779	61.606	61.770	61.794	61.802	29
30	61.796		61.467	62.027	61.860	61.919	61.691	61.782	61.601	61.765	61.749	61.800	30
31	61.782				61.841		61.697	61.788		61.798		61.799	31
TOTAL	1916.504	1729.645	1849.175	1855.617	1918.893	1856.172	1915.532	1914.654	1851.947	1913.188	1856.589	1915.656	TOTAL
MEAN	61.823	61.773	61.639	61.854	61.900	61.872	61.791	61.763	61.732	61.716	61.886	61.795	MEAN
MAX	61.925	61.877	61.857	62.246	62.014	61.954	61.957	61.824	61.822	61.880	61.972	62.008	MAX
MIN	61.712	61.684	61.467	61.464	61.810	61.775	61.691	61.668	61.601	61.590	61.749	61.646	MIN

SUMMARY FOR THE YEAR 2014

Mean water level, 61.795 m
Maximum daily water level, 62.246 m On 2014-04-17
Minimum daily water level, 61.464 m On 2014-04-02

NOTES: WATER LEVELS ARE IN METERS AND ARE REFERENCED TO GEODETIC SURVEY OF CANADA DATUM. WATER LEVELS ARE PROVISIONAL AND ARE SUPPLIED BY ENVIRONMENT CANADA IN COOPERATION WITH WOODLAND PULP LLC

TABLE V

ST. CROIX AT BARING
DAILY MEAN DISCHARGE CUBIC METERS PER SECOND FOR 2014

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	28.6B	62.3	74.2B	91.5	334	78.4	63.1	43.9	44.5	32.0	59.5	98.5	1
2	28.6B	58.6	73.6B	88.6	340	71.6	62.6	47.6	49.8	30.0	66.5	77.3	2
3	31.1B	60.0	72.8B	85.8	334	64.0	62.0	49.0	41.6	24.9	66.5	82.7	3
4	37.4B	53.2B	72.2B	84.4	323	63.4	83.5	47.3	40.8	24.3	65.1	106	4
5	37.9B	54.7	70.8B	86.1	317	65.1	231	48.4	44.5	25.5	66.3	96.3	5
6	44.5B	56.6B	69.4B	93.4	277	84.7	278	48.7	43.0	25.1	67.4	97.7	6
7	47.9B	56.4B	67.4B	93.2	244	85.5	334	44.7	47.9	26.6	81.8	100B	7
8	48.4B	49.3B	68.2B	106	230	81.0	337	44.5	54.4	28.3	123	99.1B	8
9	46.2B	41.6B	66.0	136	194	78.2	261	38.2	54.9	28.2	130	109	9
10	47.0B	45.0B	67.1	176	179	71.4	234	34.8	50.1	28.0	129	147	10
11	63.1B	50.1B	62.9	194	163	59.2	192	34.3	45.9	27.9	113	272	11
12	106	60.0B	62.6B	228	144	57.2	175	33.7	48.7	27.9	99.4	388	12
13	104	63.4B	65.1B	258	127	56.6	149	34.3	47.0	27.8	97.7	385	13
14	126	65.4B	64.6B	264	126	60.3	139	46.7	45.9	27.8	84.1	334	14
15	192	65.7B	61.7B	297	121	63.1	139	51.3	50.1	27.8	73.3	294	15
16	216	68.5B	61.4B	436	115	62.3	146	50.4	52.1	28.0	71.1	252	16
17	221	67.7B	61.7B	473	109	61.7	164	46.2	48.7	43.6	65.1	233	17
18	199	56.9B	56.1B	467	95.1	64.8	154	46.4	42.8	58.3	92.6	246	18
19	182	50.1B	59.2	411	101	66.0	125	46.7	42.5	61.2	111	247	19
20	155	54.1	66.5	362	126	64.3	119	46.7	42.8	60.0	104	243	20
21	131B	60.6	63.7	340	126	62.9	106	46.4	42.8	55.5	99.7	237	21
22	111B	72.5	64.0	326	126	61.7	73.3	46.2	43.0	73.1	96.3	242	22
23	87.2B	77.6	61.2B	326	125	60.6	62.6	46.2	45.0	82.1	95.4	230	23
24	88.9B	78.2B	59.5B	354	121	59.7	63.7	46.2	44.7	130	94.9A	227	24
25	89.5B	77.6B	58.1B	374	103	60.6	61.7	46.2	42.5	173	96.3E	242	25
26	102B	76.5B	58.3B	388	88.6	64.8	58.6	46.2	39.1E	183	94.3	268	26
27	91.7B	75.3B	58.1B	385	94.3	65.1	57.8	47.3	37.1	161	69.1	303	27
28	85.2B	74.8B	54.1	368	93.2	77.3	60.9	50.1	36.5	122	97.4	306	28
29	66.5B		53.0	354	90.3	93.2	62.3	49.8	33.1	106	94.0	273	29
30	65.1B		83.0	343	88.1	76.5	51.8	48.1	33.4	89.2	94.6	234B	30
31	65.1				85.2		44.5	44.2		58.1		187B	31
TOTAL	2946	1733	1936	7989	5139	2041	4152	1401	1335	1897	2698	6656	TOTAL
MEAN	95.0	61.9	64.5	266	166	68.0	134	45.2	44.5	61.2	89.9	215	MEAN
MAX	221	78.2	83.0	473	340	93.2	337	51.3	54.9	183	130	388	MAX
MIN	28.6	41.6	53.0	84.4	85.2	56.6	44.5	33.7	33.1	24.3	59.5	77.3	MIN
DAM3	254600	149700	167300	690300	444000	176400	358700	121000	115400	163900	233100	575100	DAM3

SUMMARY FOR THE YEAR 2014
 Total discharge 3449500 DAM
 Mean discharge, 109 m3/s
 Maximum daily discharge, 473 m3/s On 2014-04-17
 Minimum daily discharge, 24.3 m3/s On 2014-10-04

NOTE: DATA ARE SUPPLIED BY THE UNITED STATES
 GEOLOGICAL SURVEY AND ARE PROVISIONAL
 A - PARTIAL DAY
 B - BACKWATER
 E - ESTIMATED DAY

TABLE VI

ST. CROIX RIVER AT MILLTOWN DAM
DAILY MEAN WATER LEVEL IN METERS FOR 2014

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	13.764	13.766	13.767	13.967	13.977	13.694	13.676	13.697	13.700	13.724	13.896	13.909	1
2	13.776	13.767	13.769	13.943	14.017	13.694	13.664	13.695	13.723	13.739	13.968	13.803	2
3	13.773	13.792	13.789	13.928	13.994	13.688	13.672	13.676	13.713	13.749	13.898	13.697	3
4	13.795	13.774	13.778	13.967	13.949	13.683	13.684	13.679	13.700	13.748	13.900	13.664	4
5	13.775	13.786	13.783	14.000	13.935	13.708	13.827	13.683	13.702	13.756	13.890	13.694	5
6	13.816	13.768	13.791	13.974	13.834	13.741	13.917	13.696	13.677	13.738	13.928	13.732	6
7	13.954	13.764	13.767	13.975	13.764	13.704	13.980	13.696	13.699	13.725	13.945	13.703	7
8	13.781	13.768	13.761	14.021	13.783	13.672	13.975	13.695	13.094	13.723	13.949	13.693	8
9	13.776	13.768	13.770	14.023	13.736	13.687	13.833	13.693	12.791	13.724	13.892	13.695	9
10	13.787	13.774	13.770	14.030	13.755	13.692	13.748	13.699	12.791	13.724	13.841	13.740	10
11	13.803	13.799	13.776	14.045	13.712	13.691	13.714	13.696	12.793	13.732	13.842	13.854	11
12	13.859	13.788	13.778	14.105	13.759	13.704	13.712	13.697	13.191	13.741	13.874	14.175	12
13	13.807	13.792	13.756	14.102	13.741	13.699	13.647	13.697	13.763	13.736	13.847	14.104	13
14	13.849	13.779	13.782	14.102	13.712	13.695	13.688	13.714	13.778	13.738	13.859	13.932	14
15	13.988	13.763	13.754	14.170	13.683	13.709	13.748	13.699	13.791	13.741	13.838	13.833	15
16	13.891	13.818	13.776	14.269	13.682	13.682	13.735	13.693	13.775	13.755	13.878	13.774	16
17	13.948	13.793	13.783	14.325	13.684	13.708	13.784	13.703	13.762	13.815	13.866	13.741	17
18	13.930	13.774	13.779	14.274	13.693	13.705	13.709	13.703	13.784	13.863	13.945	13.791	18
19	13.945	13.757	13.764	14.109	13.756	13.743	13.715	13.679	13.772	13.895	13.897	13.799	19
20	13.908	13.778	13.886	14.004	13.728	13.695	13.661	13.701	13.718	13.876	13.876	13.742	20
21	13.927	13.790	13.946	13.916	13.714	13.683	13.682	13.705	13.699	13.861	13.872	13.708	21
22	13.813	13.783	13.958	13.891	13.685	13.689	13.673	13.710	13.719	13.881	13.824	13.771	22
23	13.794	13.778	13.974	13.930	13.689	13.671	13.682	13.673	13.711	13.872	13.819	13.741	23
24	13.777	13.789	13.910	14.032	13.652	13.687	13.693	13.687	13.722	13.976	13.865	13.761	24
25	13.778	13.806	13.892	14.055	13.682	13.703	13.695	13.697	13.717	14.019	13.914	13.820	25
26	13.818	13.777	13.826	14.074	13.717	13.685	13.707	13.681	13.712	13.925	13.881	13.853	26
27	13.792	13.789	13.869	14.044	13.710	13.693	13.691	13.725	13.719	13.905	13.855	13.884	27
28	13.787	13.817	13.759	14.018	13.672	13.696	13.716	13.708	13.711	13.875	13.876	13.807	28
29	13.768		13.758	14.001	13.690	13.668	13.712	13.693	13.715	13.861	13.802	13.795	29
30	13.785		13.949	13.971	13.699	13.672	13.694	13.698	13.723	13.870	13.838	13.732	30
31	13.763		13.934		13.701		13.708	13.701		13.889		13.717	31
TOTAL	428.727	385.897	428.354	421.265	426.505	410.841	425.742	424.569	407.865	428.176	416.375	427.664	TOTAL
MEAN	13.830	13.782	13.818	14.042	13.758	13.695	13.734	13.696	13.596	13.812	13.879	13.796	MEAN
MAX	13.988	13.818	13.974	14.325	14.017	13.743	13.980	13.725	13.791	14.019	13.968	14.175	MAX
MIN	13.763	13.757	13.754	13.891	13.652	13.668	13.647	13.673	12.791	13.723	13.802	13.664	MIN

SUMMARY FOR THE YEAR 2014

Mean water level, 13.786 m
 Maximum daily water level, 14.325 m On 2014-04-17
 Minimum daily water level, 12.791 m On 2014-09-09

NOTES: WATER LEVELS ARE IN METERS AND ARE REFERENCED TO
 GEODETIC SURVEY OF CANADA DATUM.

THE WATER LEVEL DATA ARE PROVISIONAL AND ARE SUPPLIED BY
 ENVIRONMENT CANADA IN COOPERATION WITH NEW BRUNSWICK
 POWER

TABLE VII

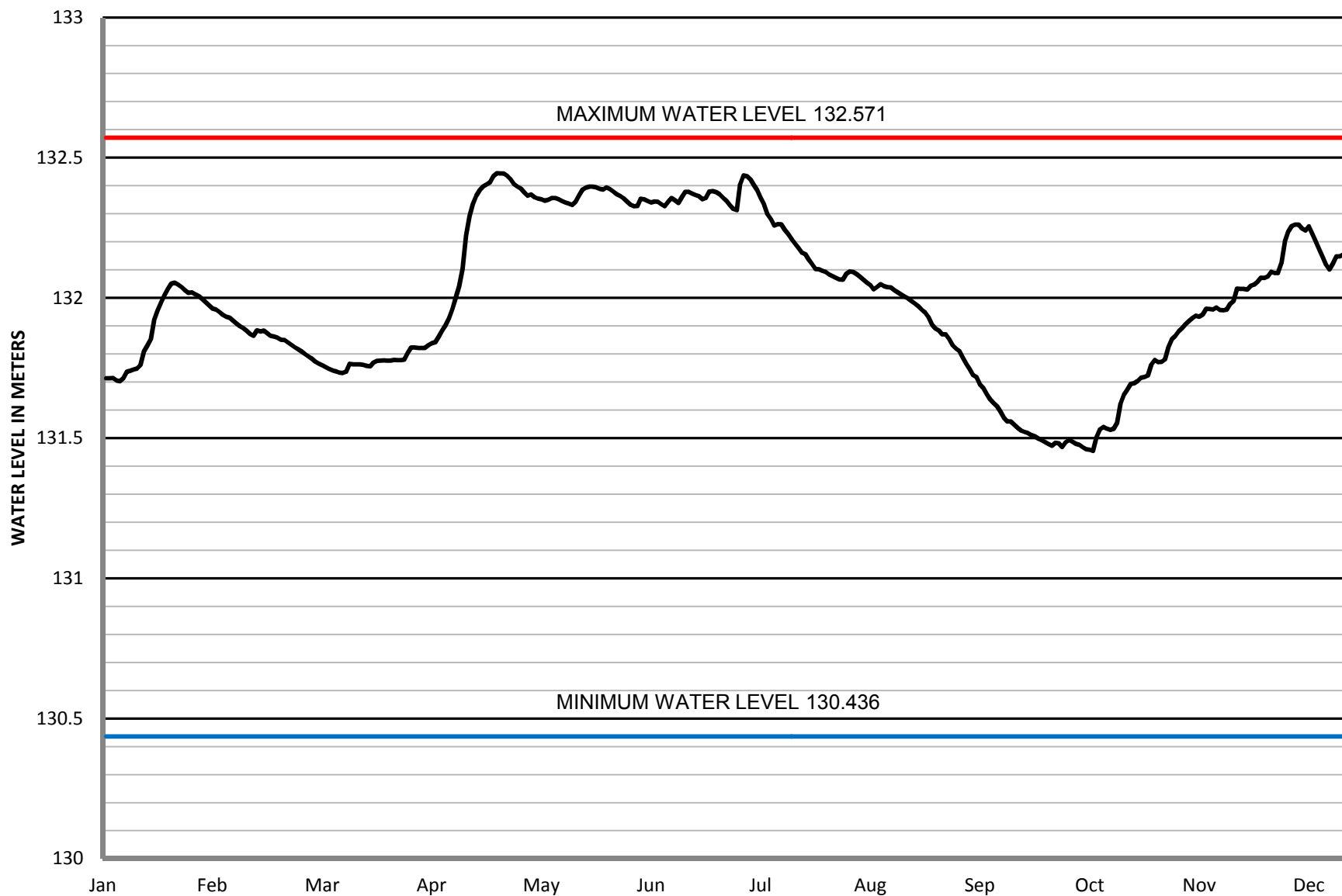
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APPENDIX 4
HYDROGRAPHS

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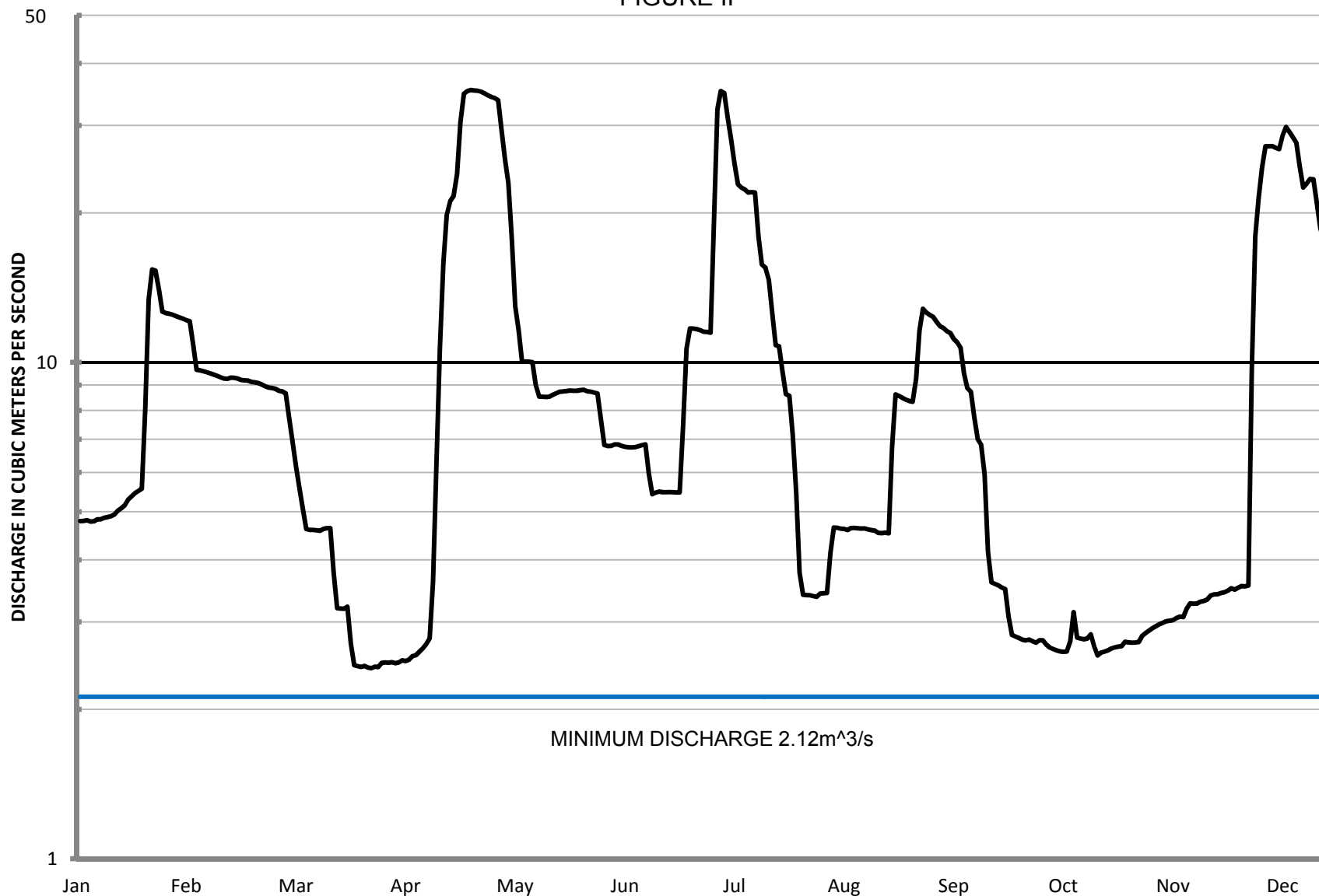
YEAR: 2014 STATION ID: 01AR009 - GRAND LAKE AT FOREST CITY

FIGURE I



**YEAR: 2014 STATION ID: 01AR011 - FOREST CITY STREAM BELOW
FOREST CITY DAM**

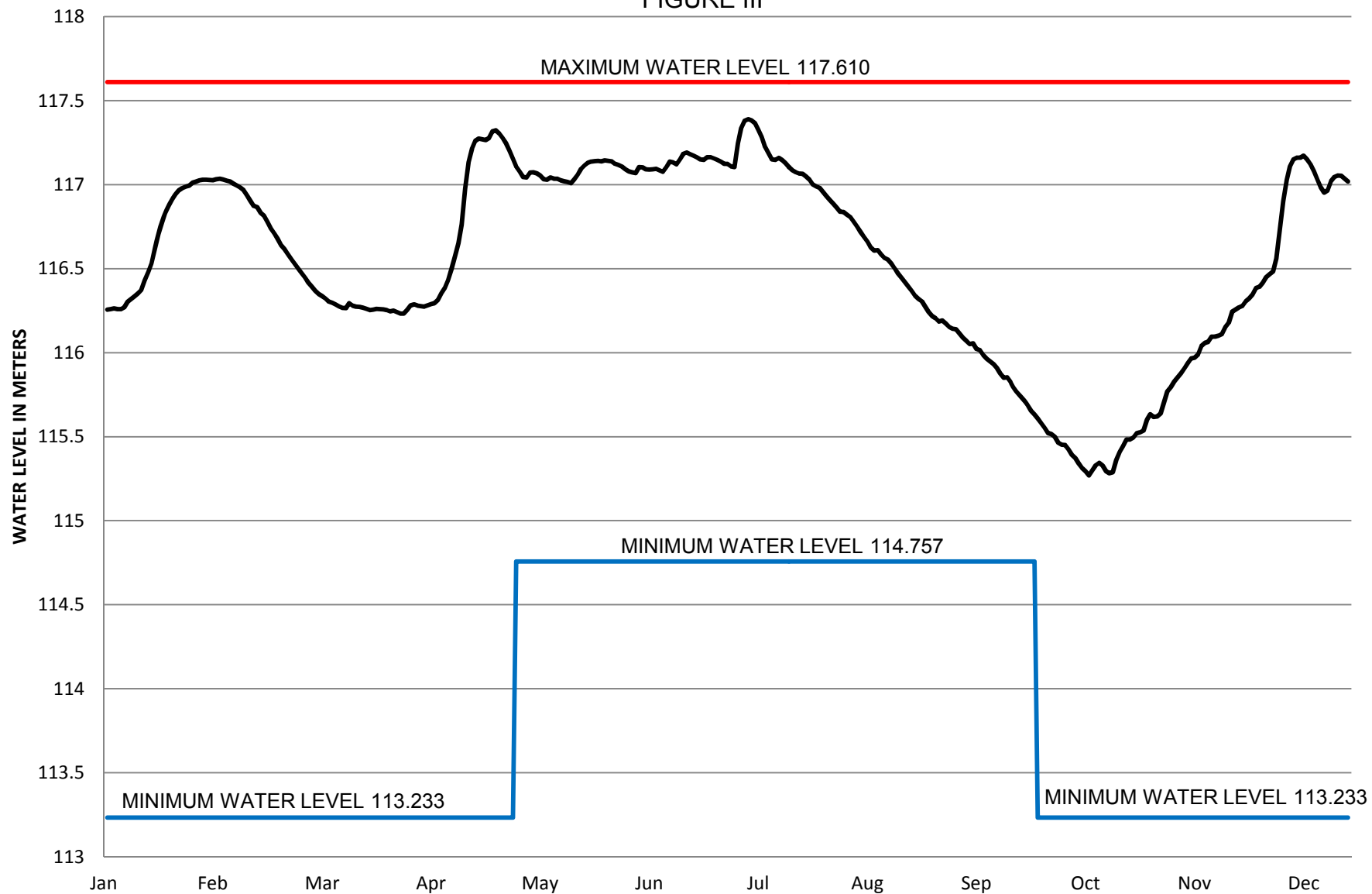
FIGURE II



MINIMUM DISCHARGE 2.12m³/s

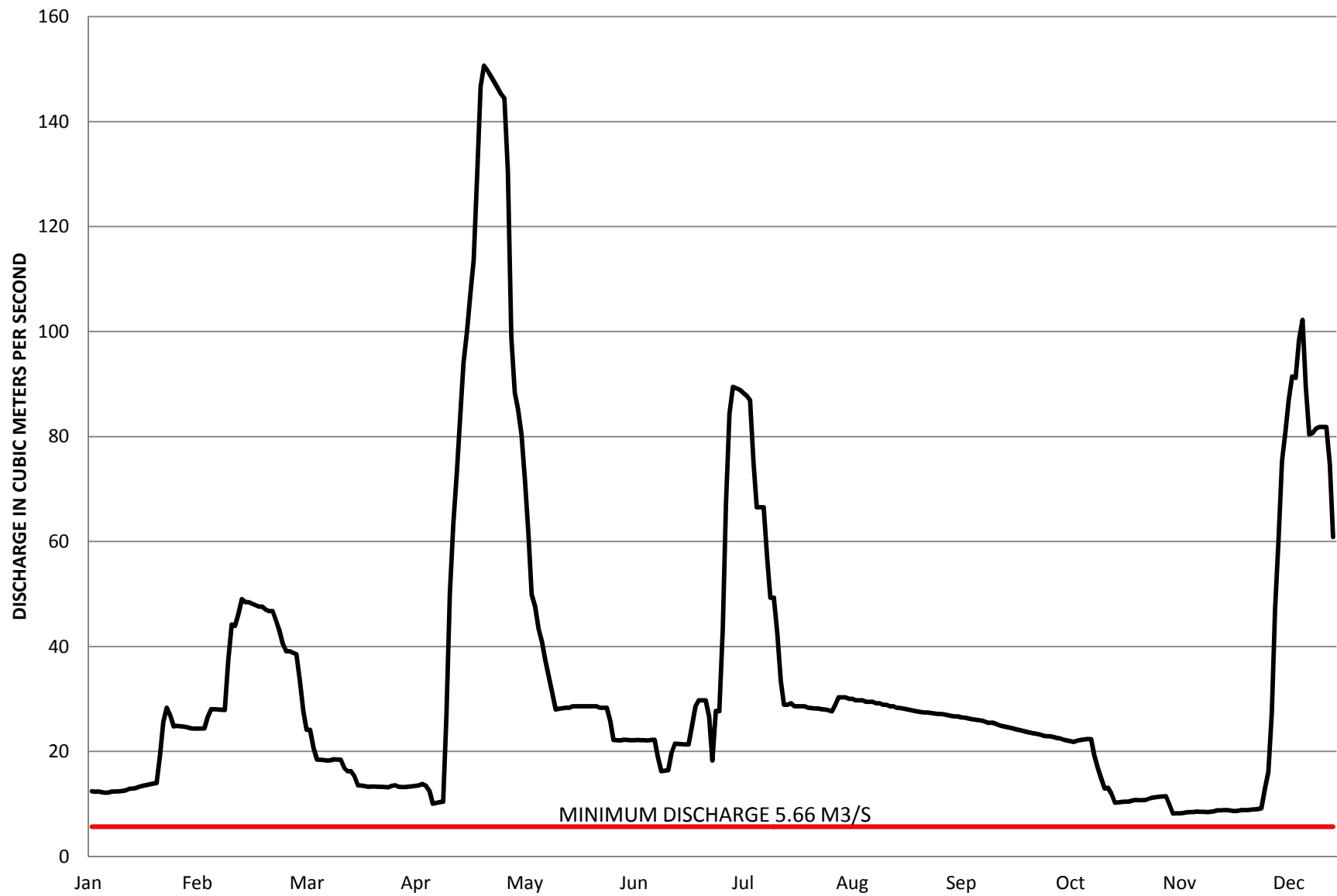
YEAR: 2014 STATION ID: 01AR010 - SPEDNIC LAKE AT ST. CROIX

FIGURE III



YEAR: 2014 STATION ID: 01AR004 - ST. CROIX AT VANCEBORO

FIGURE IV



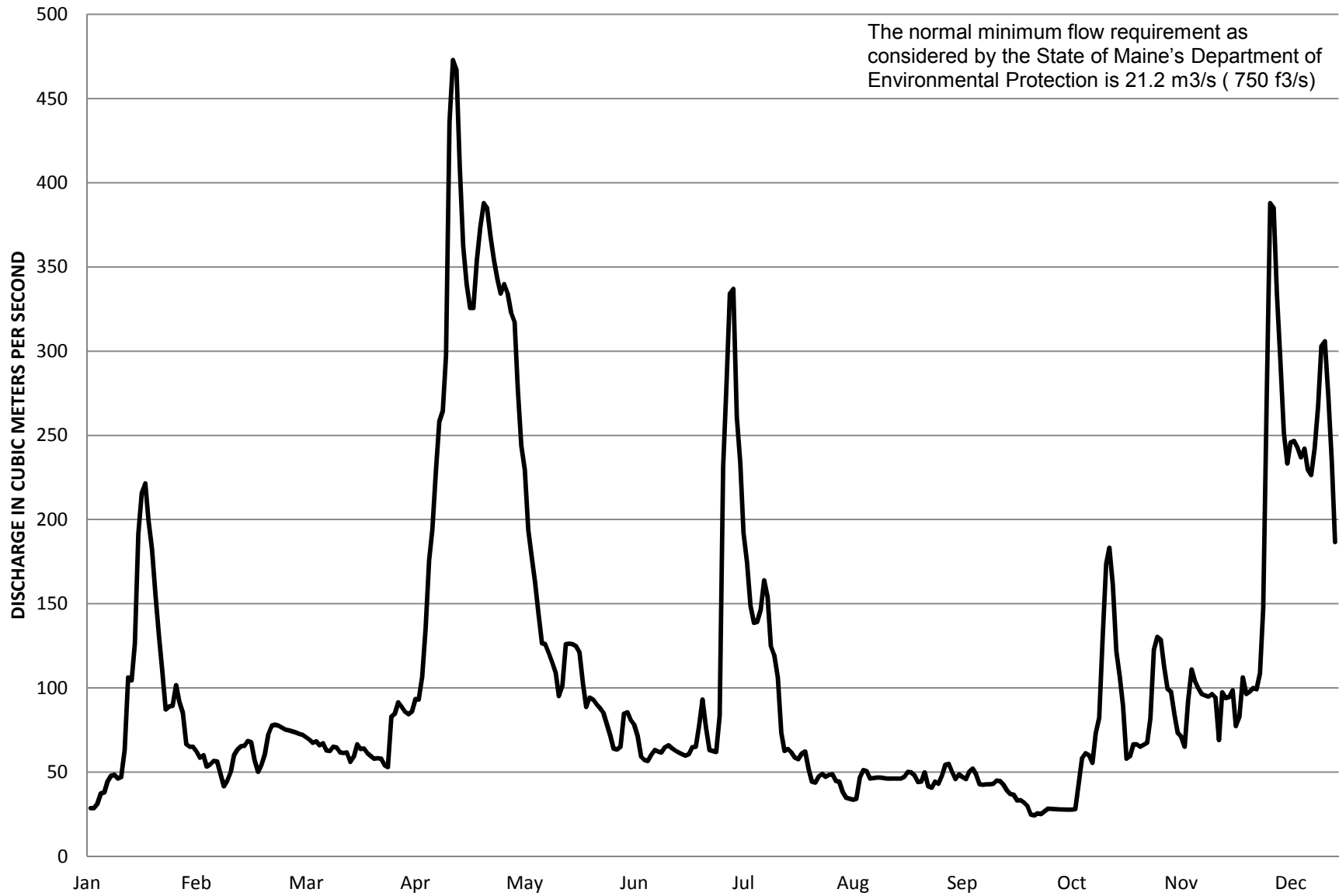
YEAR: 2014 STATION ID: 01AR013 - GRAND FALLS FLOWAGE AT GRAND FALLS

FIGURE V



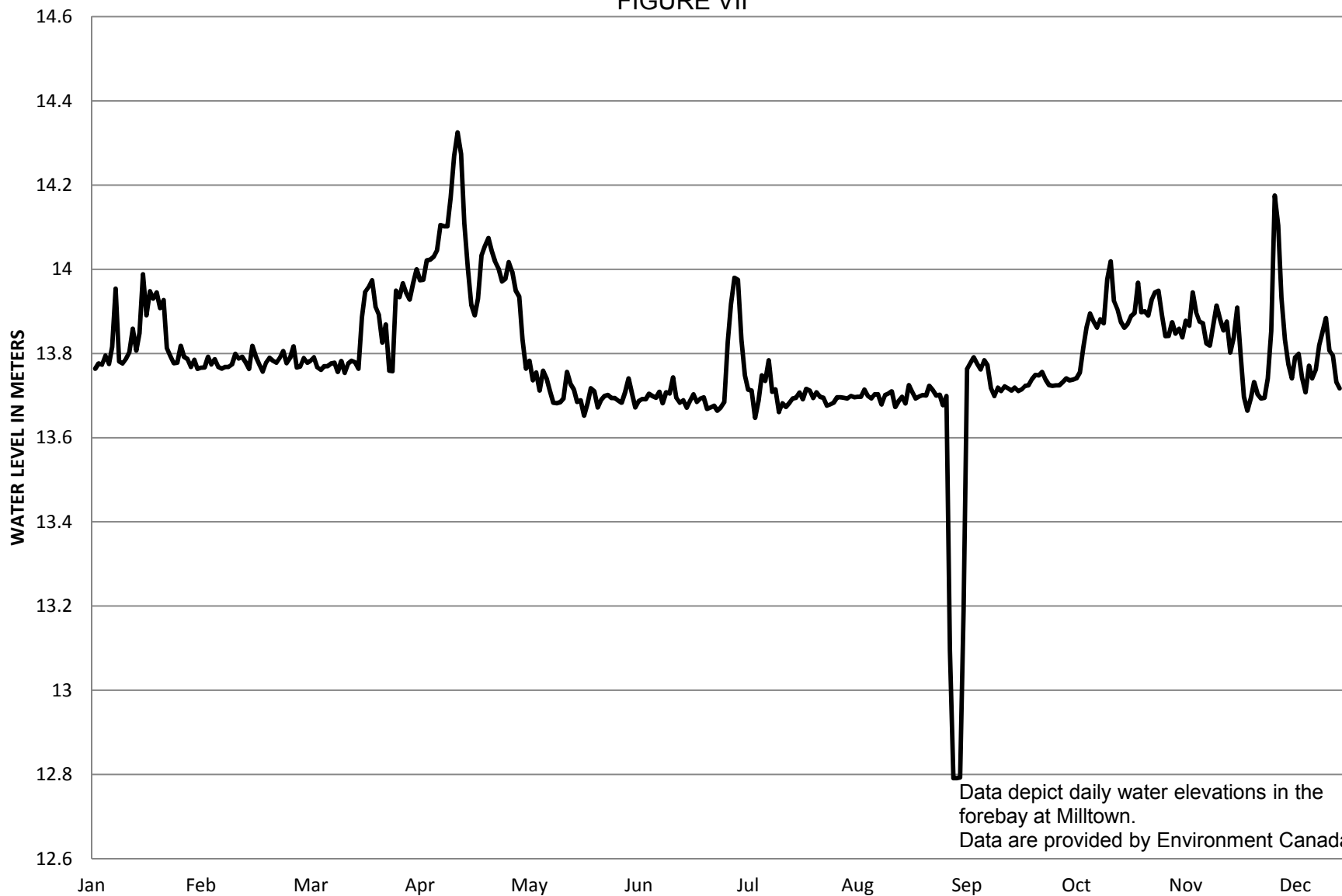
YEAR: 2014 STATION ID: 01AR005 - ST. CROIX AT BARING

FIGURE VI



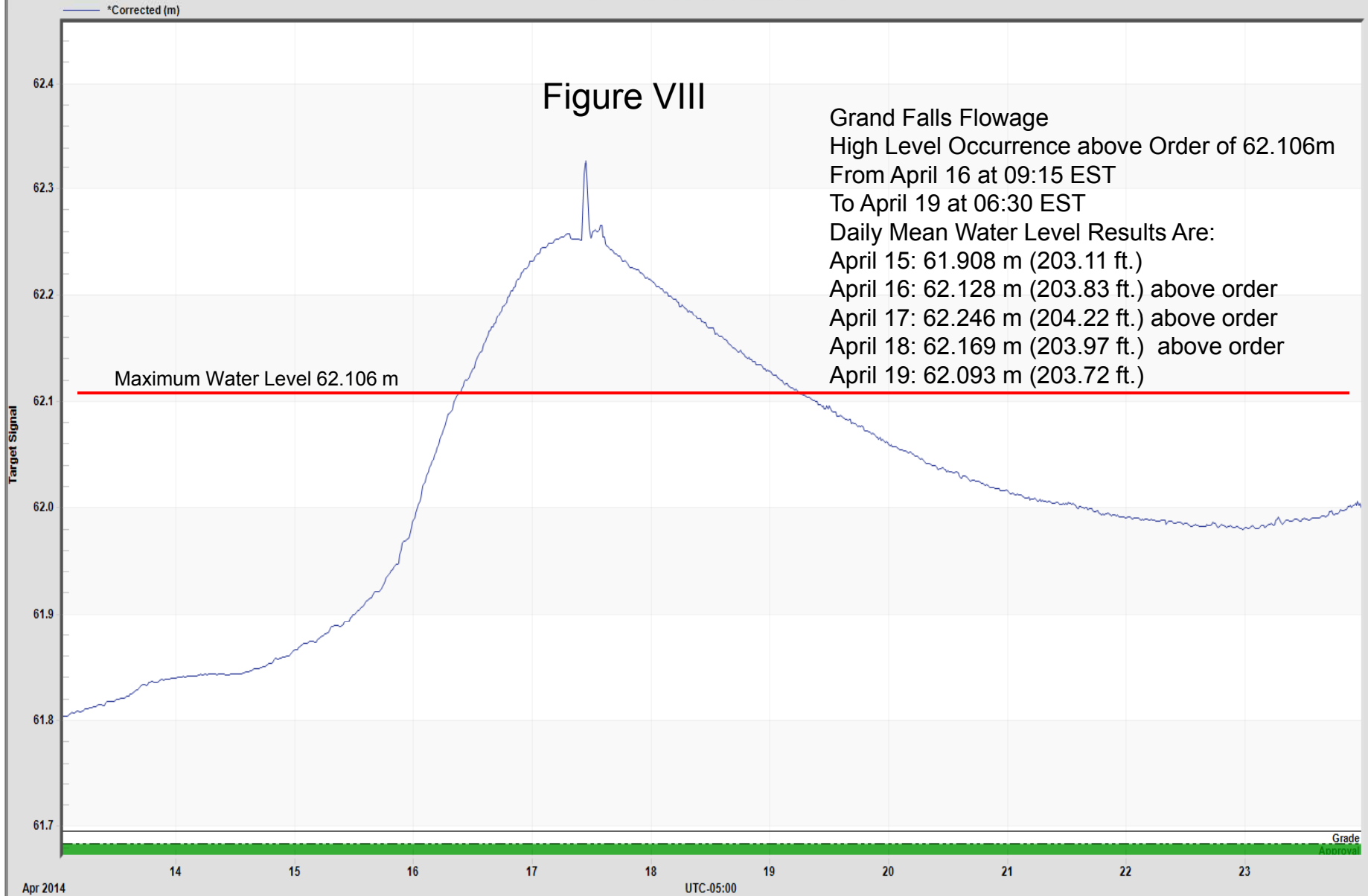
YEAR: 2014 STATION ID: 01AR014 - ST. CROIX RIVER AT MILLTOWN DAM

FIGURE VII



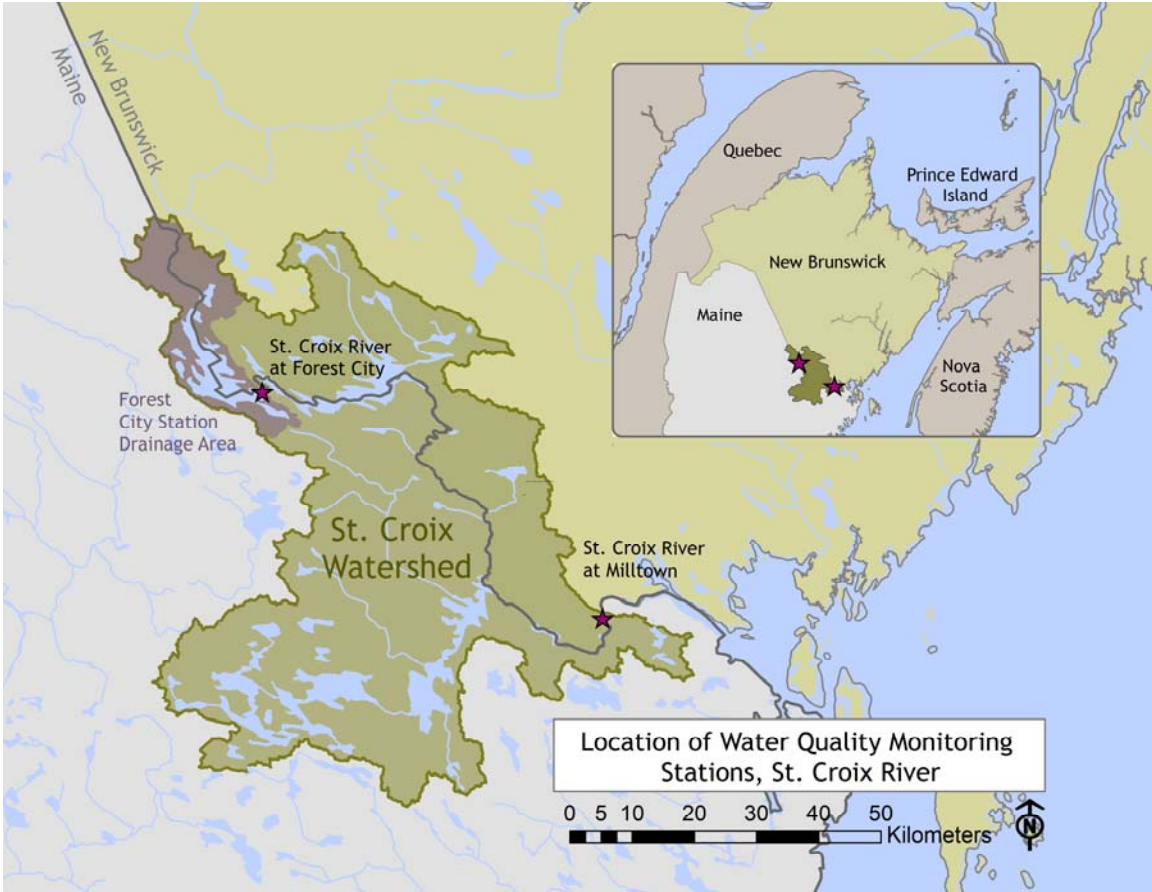


Target: Stage.Working@01AR013



APPENDIX 5
WATER QUALITY DATA

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Monthly mean, maximum and minimum temperature, dissolved oxygen, pH, specific conductance, and turbidity on the St. Croix River at Milltown, NB, 2014.

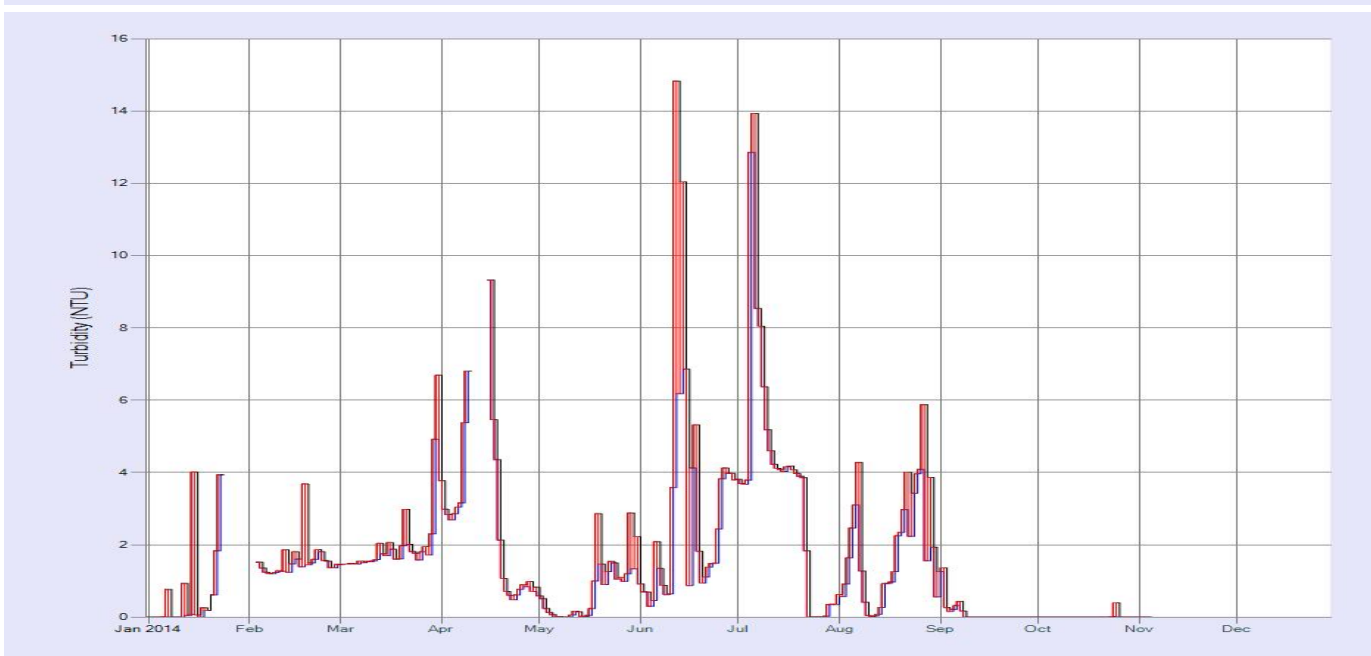
St. Croix River at Milltown, NB - 2014												
Temperature (°C)												
	January	February	March	April	May	June	July	August	September	October	November	December
Min	-0.01	0.02	0.02	0.03	6.42	16.08	19.23	21.2	15.6	9.33	0.48	0.03
Max	0.6	0.55	2.69	6.96	17.77	23.98	26.46	25.77	24.04	16.62	10.1	2.31
Mean	0.13	0.1	0.56	3.075	12.559	19.394	23.428	23.281	19.082	13.56	3.771	0.834
Dissolved Oxygen (mg/L)												
	January	February	March	April	May	June	July	August	September	October	November	December
Min	12.75	13.33	13.28	12.31	9.57	8.32	7.75	8.02	8.34	9.23	10.87	13.51
Max	13.91	13.99	14.02	13.99	12.39	9.74	9.14	8.95	9.86	11.25	14.21	14.87
Mean	13.444	13.718	13.649	13.17	10.599	9.02	8.384	8.497	9.135	10.065	12.958	14.234
pH (pH units)												
	January	February	March	April	May	June	July	August	September	October	November	December
Min	6.31	6.51	6.52	6.17	6.56	6.82	6.34	6.85	6.392	5.859	5.89	6.37
Max	6.74	6.75	6.77	6.61	7.07	7.26	6.99	7.26	7.22	6.995	6.91	6.95
Mean	6.467	6.636	6.671	6.41	6.862	7.055	6.722	7.027	6.789	6.55	6.757	6.666
Specific Conductance (µS/cm)												
	January	February	March	April	May	June	July	August	September	October	November	December
Min	30	22	28	22	22	44	27	55	56	37	38	23
Max	86	58	63	51	47	59	65	75	100	120	56	56
Mean	50.047	49.042	49.917	32.93	34.559	51.581	42.832	63.337	69.671	75.937	44.436	31.8
Turbidity (NTU)												
	January	February	March	April	May	June	July	August	September	October	November ¹	December ¹
Min	0	1.204	1.454	0.477	0	0.3	0	0.01	0	0		
Max	4.015	3.683	6.692	9.327	2.881	14.829	13.937	5.879	1.36	0.396		
Mean	0.579	1.556	2.008	2.638	0.759	3.095	3.808	1.9	0.139	0.013		

1. Insufficient data collected from 2014-11-04 to 2014-12-31 due to ice blockage and probe malfunction.

St. Croix River at Milltown



St. Croix River at Milltown



Maximum Average Minimum

Daily mean, maximum and minimum temperature and specific conductance on the St. Croix River at Forest City, 2014.

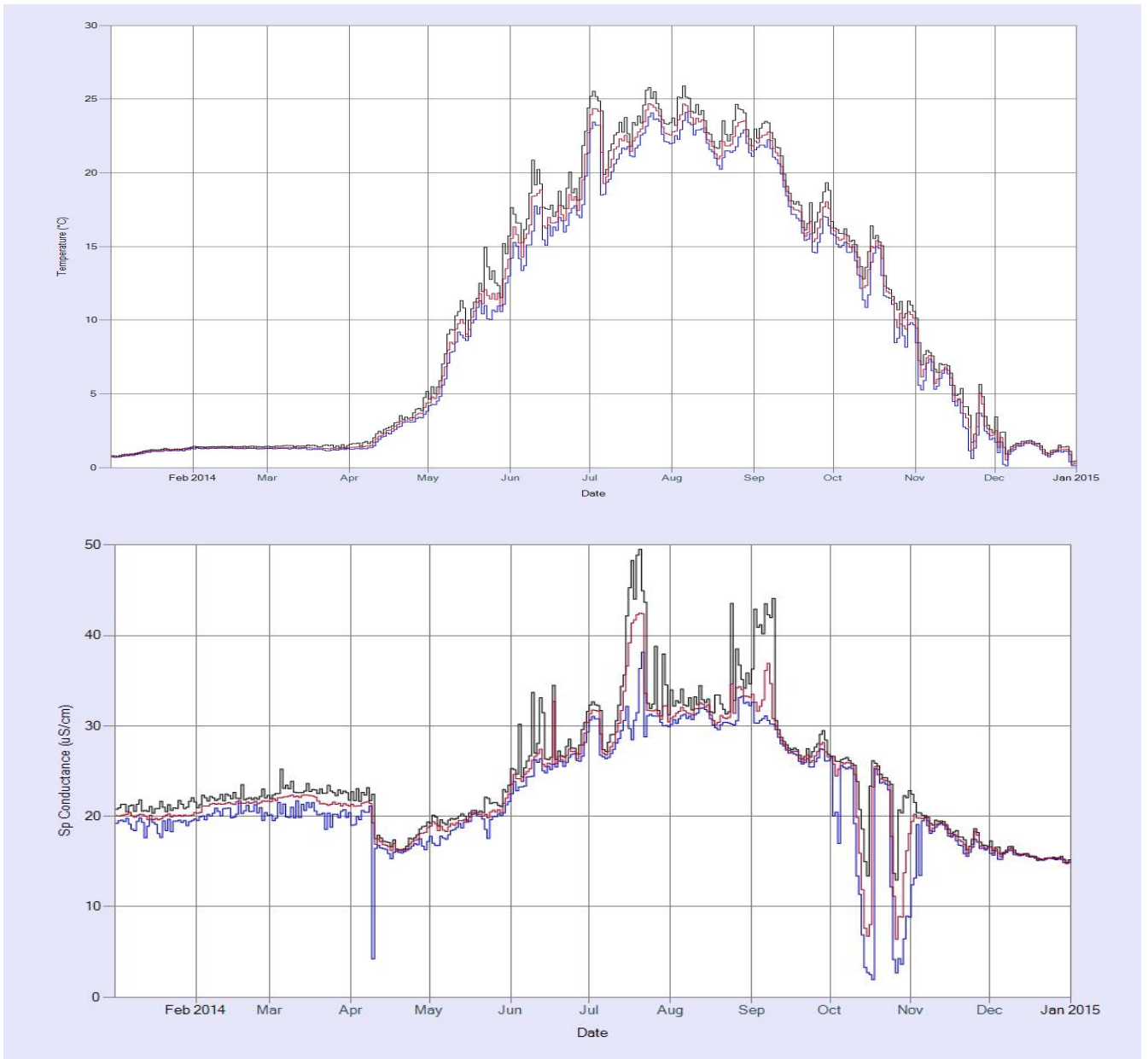
St. Croix River at Forest City, NB - 2014

Temperature (°C)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	0.698	1.268	1.142	1.251	4.206	13.37	18.49	20.24	14.57	8.17	0.615	0.117
Max	1.398	1.465	1.566	5.176	15.73	24.41	25.79	25.9	23.49	16.41	10.14	3.461
Mean	1.062	1.36	1.341	2.517	9.555	17.413	22.69	22.793	18.864	13.069	4.979	1.3

Specific Conductance (µS/cm)

	January	February	March	April	May	June	July	August	September	October	November	December
Min	17.63	19.543	18.556	4.24	16.768	22.49	26.38	29.572	25.442	1.937	12.433	14.773
Max	22.059	23.502	25.213	23.181	23.454	34.484	49.54	43.543	44.081	26.656	22.446	17.279
Mean	20.047	21.376	21.812	18.288	19.873	26.394	32.926	31.943	29.144	19.244	18.207	15.645



Maximum Average Minimum

Grab Sample Results

PARAMETER	UNIT	GUIDE-LINES ¹	St. Croix River at Milltown (NB01AR0021)					
			02/04/ 2014	04/09/ 2014	06-25- 2014	07-22- 2014	09/10/ 2014	11/04/ 2014
ALUMINUM	µg/L	100	113.2	157	100	106	43	205
ANTIMONY	µg/L		0.04	0.04	0.06	0.04	0.05	VNA
ARSENIC	µg/L	5	0.36	0.34	0.55	0.66	0.47	VNA
BARIUM	µg/L		7.5	5	7	6	7	7
BERYLLIUM	µg/L		0.02	0.01	<0.01	0.01	<0.01	VNA
CADMIUM	µg/L	calculated	0.03	0.02	0.04	0.02	0.03	VNA
CALCIUM	mg/L		4.05	3.64	4.1	3.95	4.07	4.04
CHLORIDE	mg/L	150 ²	4.52	4.3	4.4	3.1	4.7	4.8
CHROMIUM	µg/L	8.9	0.19	0.27	0.23	0.21	0.14	VNA
COBALT	µg/L		0.04	0.14	0.05	0.05	0.01	VNA
COLOUR	Hazen Units		65	51	70	82	42	97
COPPER	µg/L	2	0.4	0.39	0.54	0.4	0.32	VNA
GRAN ALKALINITY	mg/L (CaCO ₃)		9.81	9	12	10	13	9
IRON	mg/L	0.3	0.16	0.27	0.25	0.28	0.16	0.36
LEAD	µg/L	1	0.11	0.22	0.16	0.06	0.14	VNA
MAGNESIUM	mg/L		0.71	0.69	0.66	0.63	0.64	0.81
MANGANESE	µg/L		31.8	53	55	62	44	42
MOLYBDENUM	µg/L	73	0.1	0.08	0.13	0.12	0.16	VNA
NICKEL	µg/L	25	0.29	0.45	0.41	0.34	0.23	VNA
NITRATE	mg/L as Nitrogen	2.9	0.06	0.07	0.05	0.07	0.05	0.06
pH - LAB	pH Units	6.5-9.0	7.08	7.13	7.2	7.13	7.28	6.98
PHOSPHOROUS	mg/L	0.03 ³	0.017	0.018	0.018	0.019	0.02	0.02
POTASSIUM	mg/L		0.7	0.5	0.6	0.5	0.9	0.7
SELENIUM	µg/L		0.08	0.06	0.05	0.07	0.06	VNA
SILVER	µg/L	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	VNA
SODIUM	mg/L		5.78	4.2	5.88	4.16	7.22	5.31
SPECIFIC CONDUCTANCE - LAB	µS/cm		54	44.8	51.7	41.8	58.9	50
STRONTIUM	µg/L		19.3	16	19	20	20	VNA
SULPHATE	mg/L		6.36	3.3	5.2	3.5	6.6	5.4
THALLIUM	µg/L		<0.01	<0.01	<0.01	<0.01	<0.01	VNA
TIN	µg/L		<0.05	<0.05	<0.05	<0.05	<0.05	VNA
TITANIUM	µg/L		1.28	2.81	1.42	1.21	0.88	VNA
TOTAL ALKALINITY	mg/L (CaCO ₃)		<20	<20	<20	<20	<20	<20
TOTAL NITROGEN	mg/L		0.36	0.33	0.35	0.44	0.32	0.43
TOTAL ORGANIC CARBON	mg/L		8.8	6.4	9	10	6.9	11.4
TURBIDITY - LAB	NTU		1.2	3.3	1.9	1.4	1.7	4.1
URANIUM	µg/L		0.09	0.06	0.07	0.08	0.06	VNA
VANADIUM	µg/L		0.3	0.35	0.38	0.35	0.34	VNA
ZINC	µg/L	calculated ²	3.26	2.58	31.9	5	3.72	VNA

Grab Sample Results

PARAMETER	UNIT	GUIDE-LINES ¹	St. Croix River at Forest City (NB01AR0151)					
			02/04/2014	04/09/2014	06-25-2014	07-22-2014	09/10/2014	11/04/2014
ALUMINUM	µg/L	100	8.4	8	15	17	10	18
ANTIMONY	µg/L		0.04	0.04	0.04	0.04	0.04	VNA
ARSENIC	µg/L	5	0.26	0.23	0.23	0.21	0.2	VNA
BARIUM	µg/L		2.2	2	2	2	2	2
BERYLLIUM	µg/L		<0.01	<0.01	<0.01	<0.01	<0.01	VNA
CADMIUM	µg/L	calculated	<0.02	<0.02	<0.02	<0.02	<0.02	VNA
CALCIUM	mg/L		4.54	4.7	4.36	4.38	4.4	4.4
CHLORIDE	mg/L	150 ²	1.63	1.6	1.5	1.5	1.4	1.4
CHROMIUM	µg/L	8.9	0.07	0.07	0.06	0.05	0.06	VNA
COBALT	µg/L		<0.01	0.01	<0.01	<0.01	<0.01	VNA
COLOUR	Hazen Units		13	13	15	14	14	14
COPPER	µg/L	2	0.28	0.56	0.26	0.24	0.22	VNA
GRANALKALINITY	mg/L (CaCO ₃)		11.33	12	12	12	12	12
IRON	mg/L	0.3	<0.02	<0.02	0.02	0.02	<0.02	0.03
LEAD	µg/L	1	<0.03	0.03	0.03	<0.03	<0.03	VNA
MAGNESIUM	mg/L		0.65	0.65	0.61	0.6	0.62	0.63
MANGANESE	µg/L		3.2	3	3	4	4	9
MOLYBDENUM	µg/L	73	0.06	0.06	0.06	0.07	0.06	VNA
NICKEL	µg/L	25	0.15	0.17	0.14	0.15	0.16	VNA
NITRATE	mg/L as Nitrogen	2.9	0.02	0.02	0.02	<0.01	<0.02	0.03
pH - LAB	pH Units	6.5-9.0	7.33	7.31	7.37	7.41	7.36	7.3
PHOSPHOROUS	mg/L	0.03 ³	0.004	0.005	0.005	0.004	0.004	0.006
POTASSIUM	mg/L		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM	µg/L		0.06	0.08	0.04	<0.03	0.07	VNA
SILVER	µg/L	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	VNA
SODIUM	mg/L		1.49	1.55	1.46	1.39	1.42	1.41
SPECIFIC CONDUCTANCE - LAB	µS/cm		34.1	35.8	33.1	31.6	32.5	32.1
STRONTIUM	µg/L		24	24	23	23	23	23
SULPHATE	mg/L		1.68	1.6	2.3	1.4	1.6	1.9
THALLIUM	µg/L		<0.01	<0.01	<0.01	<0.01	<0.01	VNA
TIN	µg/L		<0.05	<0.05	<0.05	<0.05	<0.05	VNA
TITANIUM	µg/L		0.18	0.21	0.19	0.22	0.1	VNA
TOTAL ALKALINITY	mg/L (CaCO ₃)		<20	<20	<20	<20	<20	<20
TOTAL NITROGEN	mg/L		0.17	0.2	0.17	0.17	0.17	0.17
TOTAL ORGANIC CARBON	mg/L		4.3	4.6	5.1	4.2	4	3.72
TURBIDITY - LAB	NTU		0.5	0.3	0.5	0.4	0.5	1.1
URANIUM	µg/L		0.03	0.03	0.03	0.03	0.03	VNA
VANADIUM	µg/L		0.06	0.06	0.06	0.06	0.08	VNA
ZINC	µg/L	calculated ²	0.19	1.09	0.18	0.18	0.14	VNA

Notes:

"VNA" - Value Not Available; µg/L - microgram per litre; mg/L - milligrams per litre; CaCO₃ - calcium carbonate; µS/cm - microSiemens per centimetre; NTU - nephelometric turbidity units

1 - Guidelines refer to the Canadian Council of Ministers of the Environment (CCME) guidelines (2010 update) unless otherwise indicated. Bold and shading indicates exceedence.

2 - British Columbia Ministry of the Environment (BC MOE). 2001. BC Approved Water Quality Guidelines (criteria) 1998 edition. Environmental Protection Division, British Columbia Ministry of Environment, Victoria, British Columbia. Updated August 24, 2001 (http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html).

3 - Ontario Ministry of the Environment (OMOE). 1994. Water Management Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment [reprinted February 1999]. Ontario Ministry of the Environment. 67 pp. (http://www.ene.gov.on.ca/environment/en/resources/STD01_076352.html).

APPENDIX 6

MILLTOWN FISH DATA

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Table 2. St. Croix River ME/NB alewife/gaspereau/blueback herring spawning runs, 1981- present

(bold = 7-day peak)

Sources: Fisheries & Oceans Canada (1981-1990), St. Croix International Waterway Commission (1991-2011), Atlantic Salmon Federation (2012-).

YEARS >>>	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
April 30-May2	--	0	0	0	0	5480	0	0	0	0	0	0	0	0	0	0	0
May 3-9	--	0	0	0	0	16410	9400	24410	0	29690	170	0	0	0	0	2814	0
May 10-16	7510	32160	16970	6000	0	75150	171500	468750	0	305370	14740	8910	0	0	5898	11178	0
May 17-23	47450	64120	44050	40300	70000	429400	559500	760280	200610	319380	133820	74120	12000	102210	109388	202188	122478
May 24-30	47770	74800	33760	67100	149890	772800	674700	764990	464390	411090	154560	45520	146600	116020	99847	188538	93000
May 31- June 6	48310	56930	20770	26200	98740	628300	645300	370750	424550	141490	51110	24780	102800	144700	0	231870	4091
June 7-13	16000	4610	35650	13300	26900	57200	480400	187800	63940	132030	4010	50420	2260	0	0	9390	5951
June 14-20	1760	250	620	0	21040	0	83900	13770	11370	0	0	0	26060	0	0	0	0
June 21-27	790	210	0	0	1060	0	0	0	0	0	0	0	0	0	0	0	0
June 28 - July 4	30	20	0	0	3270	0	0	0	0	0	0	0	0	0	0	0	0
July 5-11	0	1	130	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July 12-18	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July 19-25	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
July 26 - later			0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Spawning escapement	169620	233102	151952	152900	368900	1984720	2624700	2590750	1164860	1339050	358410	203750	289720	362930	215133	645978	225521
Harvest	0	0	0	0	0	0	0	0	0	192200	228500	0	8000	15400	8000	0	0
TOTAL RUN	169620	233102	151952	152900	368900	1984720	2624700	2590750	1164860	1531250	586910	203750	297720	378330	223133	645978	225521
YEARS >>>	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
April 30-May2	0	0	0	0	0	0	0	0	0	--	--	--	--	--	--	--	--
May 3-9	0	0	3966	0	2	0	0	18	0	0	0	0	0	0	993	342	0
May 10-16	77394	195	142	160	6	3	0	0	577	0	4	1	9748	1657	343	362	7
May 17-23	25705	5933	2011	505	23	603	0	2	3111	0	33	12	17731	13053	22260	178	16
May 24-30	71534	13615	377	2625	325	2115	0	20	3155	2	119	3740	17008	1227	11190	10542	29
May 31- June 6	2684	5476	2067	1735	494	3163	0	5277	2540	0	11797	42	8520	7750	1175	5107	19971
June 7-13	0	108	6	123	35	999	951	6220	1096	1225	61	2	4446	1387	197	37	6775
June 14-20	0	0	0	54	15	1018	108	113	1227	66	23	6627	1126	50	10	83	95
June 21-27	0	0	0	0	0	0	79	0	105	1	221	26	140	10	0	23	143
June 28 - July 4	0	0	0	0	0	--	150	--	--	--	3	0	45	7	--	3	267
July 5-11	0	0	0	0	0	--	11	--	--	--	--	--	9	1	--	--	9
July 12-18	0	0	0	0	0	--	0	--	--	--	--	--	3	--	--	--	--
July 19-25	0	0	0	0	0	--	0	--	--	--	--	--	--	--	--	--	--
July 26 - later	0	0	0	0	0	--	0	--	--	--	--	--	--	--	--	--	--
Spawning escapement	177317	25327	8569	5202	900	7901	1299	11632	11829	1294	12261	10450	58776	25142	36168	16677	27312
Harvest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL RUN	177317	25327	8569	5202	900	7901	1299	11632	11829	1294	12261	10450	58776	25142	36168	16677	27312

Note 1. Enumeration. Prior to 1999, river herring were enumerated by counting all fish for 10min/hr and multiplying by 6 to yield an hourly total, this for each hour the fishway was open. In 1999 and 2000, "light" run periods were enumerated by shutting off the fishway exit for 4 hour intervals and then individually counting all fish in the trap, while "heavy" run periods were enumerated as in previous years. Since 2001, all fish have been counted individually.

Note 2. Upstream passage. Beginning in 1995, the State of Maine blocked the upstream fishways at Woodland and Grand Falls to spawning river herring. In 2001, Fisheries & Oceans Canada began to truck a portion of the spawning run from Milltown to Woodland Flowage. Number of river herring transported to Woodland: 2001 (3756), 2002 (807), 2003 (6805), 2004 (392), 2005 (7100), 2006 (6653), 2007 (1169). In 2008, Maine removed the Woodland fishway barrier, allowing river herring direct access to Woodland Flowage, and Fisheries & Oceans discontinued its trucking operation. In 2013, Maine removed the Grand Falls fishway barrier, allowing river herring access to the upper watershed.

Note 3. Duration of count. Monitoring was discontinued on June 27 in 2006, 2007 and 2012; on July 3 in 2008; July 4 in 2009 and 2013; July 8 in 2014; July 11 in 2011 and July 19 in 2010 at the presumed end of each year's run. Any fish entering the river after these dates were not recorded