Environment Canada Environnement Canada

2009 Annual Automated Water Quality Monitoring Report

St. Croix River at Forest City Dam

Figure 1: St. Croix River at Monitoring Station in the Winter

Program Description and Objective

The objective of the automated monitoring network is to collect and provide water quality information in a timely manner for selected streams and rivers. Important water quality trends can be identified and specific events can be highlighted with this type of data, which can help provide us with the overall health of our aquatic ecosystems. The information can be of benefit to the general public, community groups that have an interest in the environment, other government organizations, and the private sector. This project and report have been developed in partnership with the New Brunswick Department of Environment.

An automated monitoring instrument called a "sonde" is submerged in the river downstream of the Forest City dam, and takes measurements for temperature, dissolved oxygen, specific conductance, pH and turbidity, at 15-minute intervals. This data gets recorded and transmitted by telemetry every three hours to a centralized national database. Stage height is also monitored at this site by the Water Survey of Canada and is converted to daily mean discharge values.

Canada

Station Description

This station is located on the St. Croix River downstream of the Forest City dam at the outlet of East Grand Lake in Forest City, Maine (Figure 2). The river at this location is approximately 8 metres wide and forms the natural boundary between the United States and Canada. The river discharge rate and reservoir elevation at this site are managed by Domtar Inc. as specified by the Orders of Approval issued by the International Joint Commission (IJC) and monitored by the International St. Croix River Watershed Board. These orders strive to balance the competing needs for the water resources of the St Croix International Watershed. Because the water level is controlled, the flow and the water quality parameters do not vary as much with precipitation events as is typical of free flowing rivers. Populations of alewives and smallmouth bass are closely monitored in the St. Croix River watershed for their respective importance within the river ecosystem and recreational fisheries.

Maintenance for this station is jointly fulfilled by the New Brunswick Department of Environment and the Water Quality Monitoring and Surveillance Division of Environment Canada. It consists of calibration visits at 4 to 6 week intervals, at which time grab samples for a range of parameters are collected for laboratory analysis. Grab sample results are available for this station at: http://map.ns.ec.gc.ca/envirodat/root/main/en/extraction_page_e.asp?stations=NB01AR0151

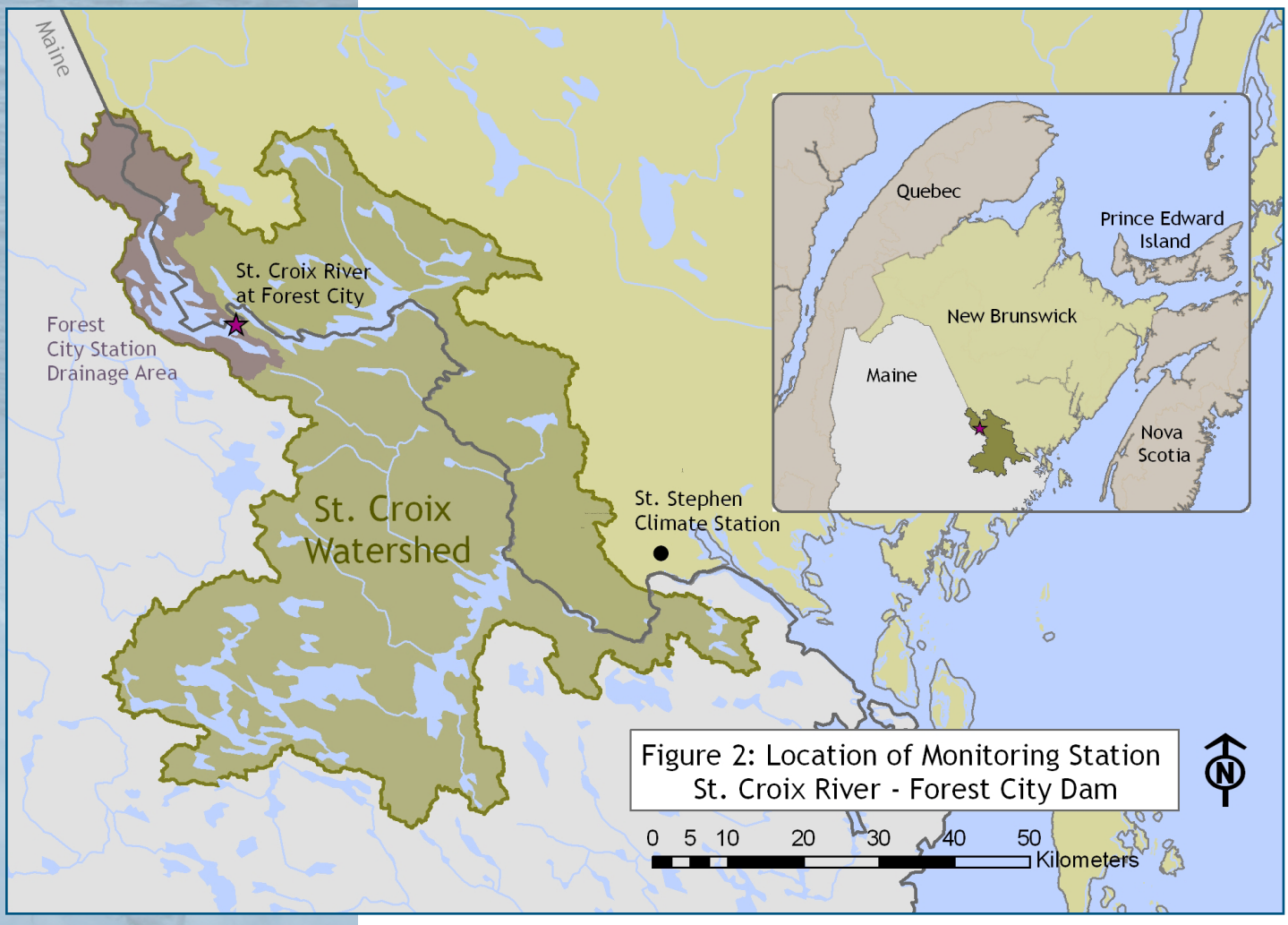


Figure 2: Location of Monitoring Station
St. Croix River - Forest City Dam

Daily Weather and Flow Conditions

The nearest Environment Canada climate station is located at St. Stephen, New Brunswick, approximately 60 kilometres southeast of the Forest City station. Daily precipitation totals, snow depths and mean air temperature are presented in Figure 3. This information is useful to identify periods of surface water run-off, snowmelt, warming and cooling, and other conditions that may influence water quality parameters at the site. Daily mean discharge in cubic metres per second (m^3/sec) is provided in Figure 4. By having this data available, it is possible to see how individual parameters respond to individual weather events and flow conditions.

Figure 3: Daily Weather Data

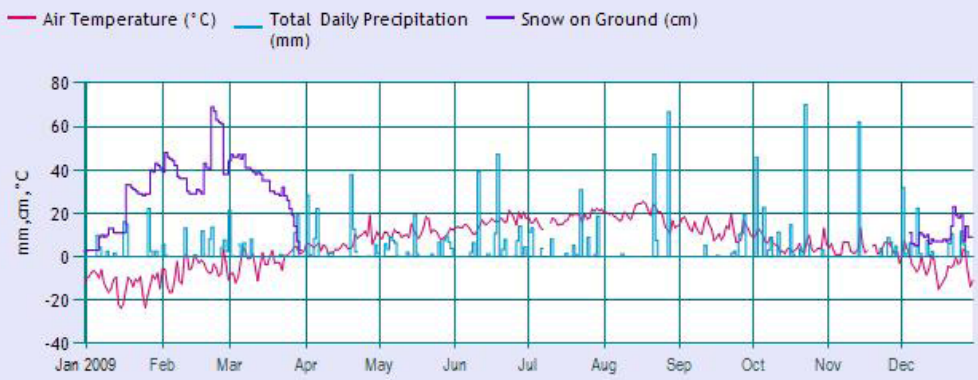
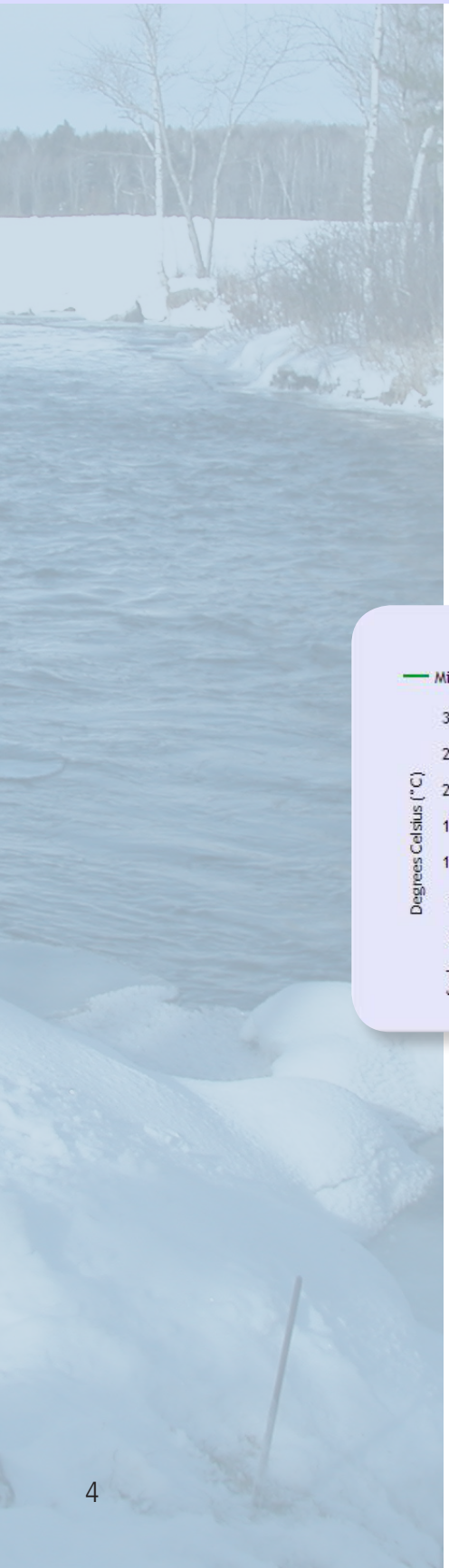


Figure 4: Discharge - Daily Mean for 2009

Measured Water Quality Parameters – Annual Summary

Summary graphs for the five water quality parameters collected at this site are presented in the following sections. There is no water quality data available from November 24, 2009, to December 31, 2009, due to a sonde failure during the final deployment of the year. Parameters with guidelines are assessed against the Canadian Council of Ministers of the Environment (CCME) Freshwater Guidelines for the Protection of Aquatic Life (www.ccme.ca/assets/pdf/aql_summary_7.1_en.pdf).



Temperature

Daily mean temperatures, along with the daily minimum and maximum temperatures, measured at this station are presented in Figure 5. Temperatures in excess of 20 degrees Celsius were recorded on a total of 68 days during the months of July, August, and September. At higher temperatures, the availability of dissolved oxygen is reduced thereby increasing the oxygen demand of fish. Also, aquatic species have both upper and lower temperature limits for optimal growth, spawning, egg incubation and migration.

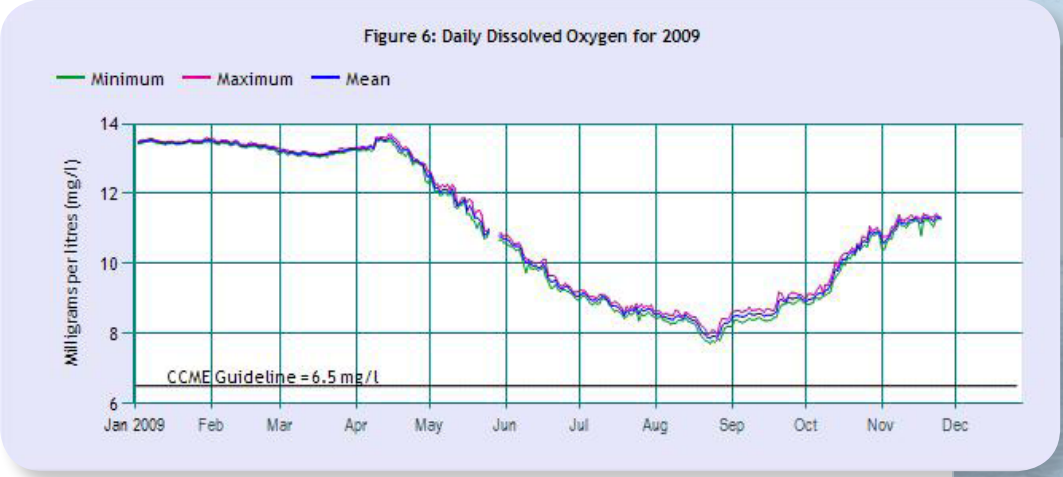
Water temperatures were consistent in January and February indicating ice conditions on the upstream lake (reservoir) and began to increase in mid-March when significant decreases in snow depth occurred as a result of snow melt (Figure 3). Water temperatures peaked in mid-August and began to decline as air temperatures decreased. Diurnal (daily) fluctuations in temperature were observed in the spring and summer months and are less pronounced in the fall and winter months.

Figure 5: Daily Water Temperature for 2009

Dissolved Oxygen (DO)

Daily mean DO concentrations, along with the daily minimum and maximum DO concentrations, measured at this station are presented in Figure 6. Dissolved oxygen, which is a measure of the concentration of oxygen dissolved in the water and therefore available to aquatic life, ranged from a maximum of 13.7 milligrams per litre (mg/L) on April 15, 2009, to a minimum of 7.7 mg/L on August 23, 2009. Concentrations below the CCME freshwater guideline for the protection of aquatic life (6.5 mg/L) were not observed at this location in 2009 for the period of record.

Dissolved oxygen concentrations were consistently between 13 and 14 mg/L during early 2009 indicating a good supply of oxygen at cooler temperatures when oxygen is more soluble in water. Concentrations began to decrease in mid-April corresponding to an increase in water temperatures. The lowest DO concentrations (<8 mg/L) were observed in late August when water temperatures were greater than 25 degrees Celsius. Daily fluctuations in DO were greatest in August to October when daily temperature fluctuations, biological respiration, and photosynthesis would be the primary controls of DO concentrations.



pH

Daily mean pH readings, along with the daily minimum and maximum pH readings, measured at this station are presented in Figure 7. pH is a measure of the hydrogen ion concentration of water with 7 being a neutral condition. Systems with a pH less than 7 are generally acidic and those with a pH greater than 7 are generally alkaline. During 2009, pH values ranged between 6.9 and 7.5 and therefore never exceeded the CCME guidelines (6.5 and 9.0 pH units) for the protection of aquatic life.

pH was stable (varied by only 0.6 units through entire sample period) at this site and is not typical of smaller rivers in this region that usually show a drop in pH following a rain event. This stability is reflective of the location of the site downstream of a large lake (reservoir) that controls the chemistry at the site by diluting the effect of inputs (e.g. precipitation) with different chemistry due to its large volume. The stable pH may also be a result of the buffering capacity of the water but this is not expected to be significant as measured alkalinity concentrations at this station are typically <20 mg/L expressed as calcium carbonate.

Figure 7: Daily pH for 2009

Specific Conductance

Daily mean specific conductance measurements for this station are presented in Figure 8. Specific conductance is a measure of water's ability to conduct a current and is a good indicator of the total concentration of dissolved solids (i.e. the more dissolved solids, the higher the specific conductance). Monitoring this parameter provides information about changes in water chemistry in the river system in response to events such as snowmelt, precipitation, or influences from human activity. The water at this station is dilute with a daily mean specific conductance ranging from 26.2 to 32.9 microSiemens per centimetre (µS/cm).

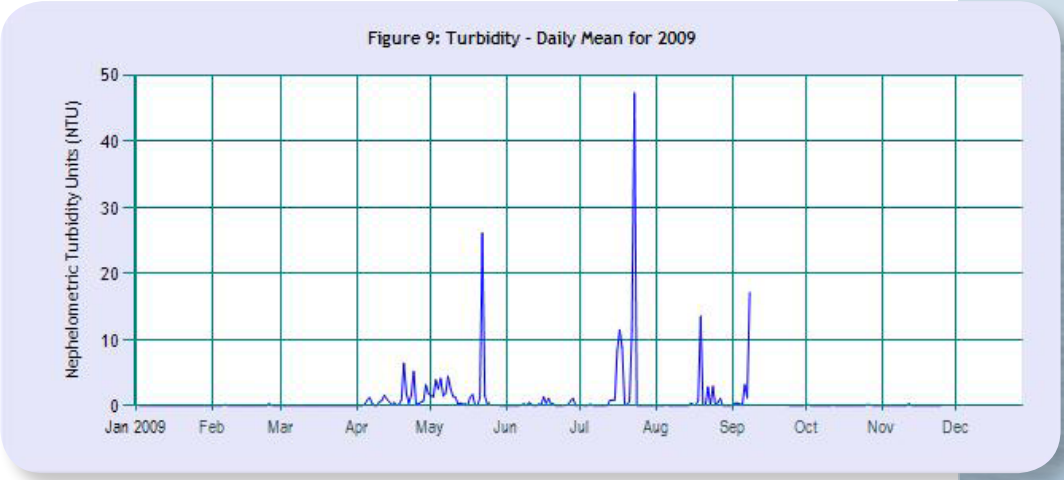
Specific conductance measurements do not appear to fluctuate directly with discharge that is controlled at the upstream dam. However, two periods of lower specific conductivity values (April and September) correspond to snowmelt and increased precipitation in April and to large precipitation events (>40 millimetres) in mid- to late August. Specific conductance generally increases during drier periods but not necessarily during lower flow conditions in this regulated river. Gaps in the data are the result of a data transmission and logger issue that only affects this parameter.

Figure 8: Specific Conductance - Daily Mean for 2009

Turbidity

Daily mean turbidity measurements for this station are presented in Figure 9. Turbidity is a measurement of the clarity of the water and is a good indicator of suspended solids in a river. Water quality guidelines exist for turbidity but are related to background levels in periods of low and high flow. The background levels have not been determined at this site yet since the river flow is controlled by a dam and therefore is not typical of ordinary free flowing waters. Therefore, a longer period of data will be required to determine background turbidity levels at this site.

Increased turbidity was observed after the spring snowmelt and also after larger precipitation events (>40 mm) indicating surface run-off with suspended sediment. Turbidity events were typically short-lived (estimated to 2 to 4 days) and quickly returned to normal levels. Gaps in the data are due to fouling of the sensor and lack of data after November 24, 2009, is due to a sonde failure.



Additional Information

For additional information contact:

Water Quality Monitoring and Surveillance
Environment Canada
eau_water@ec.gc.ca

OR Erin Douthwright
Environmental Biologist
New Brunswick
Department of Environment
506-444-2053
erin.douthwright@gnb.ca

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