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# Data Sources and Methods for Phosphorus Levels in the St. Lawrence River Indicator

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# 1 Introduction

The Phosphorus Levels in the St. Lawrence River indicator is part of the Canadian Environmental Sustainability Indicators (CESI) program (<http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=En>), which provides data and information to track Canada's performance on key environmental sustainability issues.

## 2 Description and rationale of the Phosphorus Levels in the St. Lawrence River indicator

### 2.1 Description

The Phosphorus Levels in the St. Lawrence River Indicator provides a measure of how frequently phosphorus concentrations exceed Quebec's water quality phosphorus guideline for the protection of aquatic life in the St. Lawrence River. It compares water quality monitoring data to water quality guidelines to create a risk rating for each monitoring station. The more times the water quality guideline is exceeded, the more risk phosphorus poses to the health of the St. Lawrence River ecosystem. Water quality at a monitoring station is considered good (green) when ambient water quality exceeds the phosphorus guideline less than 10% of the time and poor (red) when exceedences occur in greater than 50% of samples. A caution (yellow) category is applied when phosphorus exceeds 10 -50% of the time.

### 2.2 Rationale

The St. Lawrence River links the Great Lakes with the Atlantic Ocean and is among the world's most important commercial waterways. It is a complex ecosystem that includes lakes and freshwater reaches, a long estuary and a gulf with marine features. It is home to many diverse habitats as well as a diverse collection of plants, fish and animals. Excess phosphorus in the river from human activity has the potential to alter the river's food web. The Phosphorus Levels in the St. Lawrence River Indicator reports on the status of total phosphorus levels in the river.

Phosphorus is an essential nutrient for plant growth; however, too much in the environment is harmful. Phosphorus enters the St. Lawrence River from many natural and human sources. Used in the manufacture of chemical fertilizers, phosphorus reaches the river through erosion and leaching from urban areas and farmland runoff. It can be found in aquatic ecosystems at levels that lead to eutrophication, a situation where excess plant growth begins to change the structure of a river's ecosystem. Phosphorus also reaches the St. Lawrence River in municipal and industrial wastewaters and air pollution. Natural sources of phosphorus include rock weathering and the rotting of dead plants and animals.

The indicator assumes that, in the absence of human development, river water would rarely exceed the phosphorus guidelines; thus, the indicator shows how human activity contributes to phosphorus levels in the St. Lawrence River. The more times the water quality guideline is exceeded, the greater the risk phosphorus poses to the health of the St. Lawrence River ecosystem.

## 3 Data

### 3.1 Data source

Total phosphorus data were obtained from the Quebec office of Environment Canada's Water Quality Monitoring and Surveillance Division. Quebec's provincial water quality guideline for phosphorus is 0.03 mg P/L.<sup>1</sup>

### 3.2 Spatial coverage

Data were obtained for nine water quality monitoring stations on the St. Lawrence River from the Quebec-Ontario border in the east to Quebec City in the west (Table 1). Three stations are located on the main stem of St. Lawrence, while the other six are at or close to the mouths of the river's major tributaries.

Table 1. Water quality monitoring stations used for this indicator

Station Code	Station Name	Longitude	Latitude	Dates
QU02LB9001	Rivière des Outaouais, en aval du barrage de Carillon	-74.37987	45.56757	April 2008 to March 2011
QU02OB9004	Fleuve Saint-Laurent, Prise d'eau de l'usine de filtration de Lavaltrie	-73.280645	45.874418	February 2009 to March 2011
QU02OJ0052	Rivière Richelieu, Prise d'eau de l'usine de filtration de Sorel	-73.117582	46.033974	April 2008 to March 2011
QU02OG3007	Rivière Yamaska, pont de la route 132	-72.910075	46.005059	May 2008 to Sept 2010
QU02OF3004	Rivière Saint-François à Pierreville	-72.81218	46.066375	May 2008 to August 2010
QU02OD3004	Rivière Nicolet à Nicolet	-72.651229	46.245373	May 2008 to August 2010
QU02OD9009	Fleuve Saint-Laurent, Prise d'eau de l'usine de filtration de Bécancour	-72.546012	46.311578	April 2008 to March 2011
QU02NG3013	Rivière Saint-Maurice, Prise d'eau de l'usine de filtration de Trois-Rivières	-72.6105	46.382	February 2009 to March 2011
QU02PH9024	Fleuve Saint-Laurent, prise d'eau de l'usine de filtration de Lévis	-71.190009	46.807123	April 2008 to March 2011

### 3.3 Temporal coverage

The Phosphorus Levels in the St. Lawrence River Indicator was calculated using water quality monitoring data collected either bi-weekly or monthly from April 1, 2008 to March 31, 2011 depending on the sampling station.

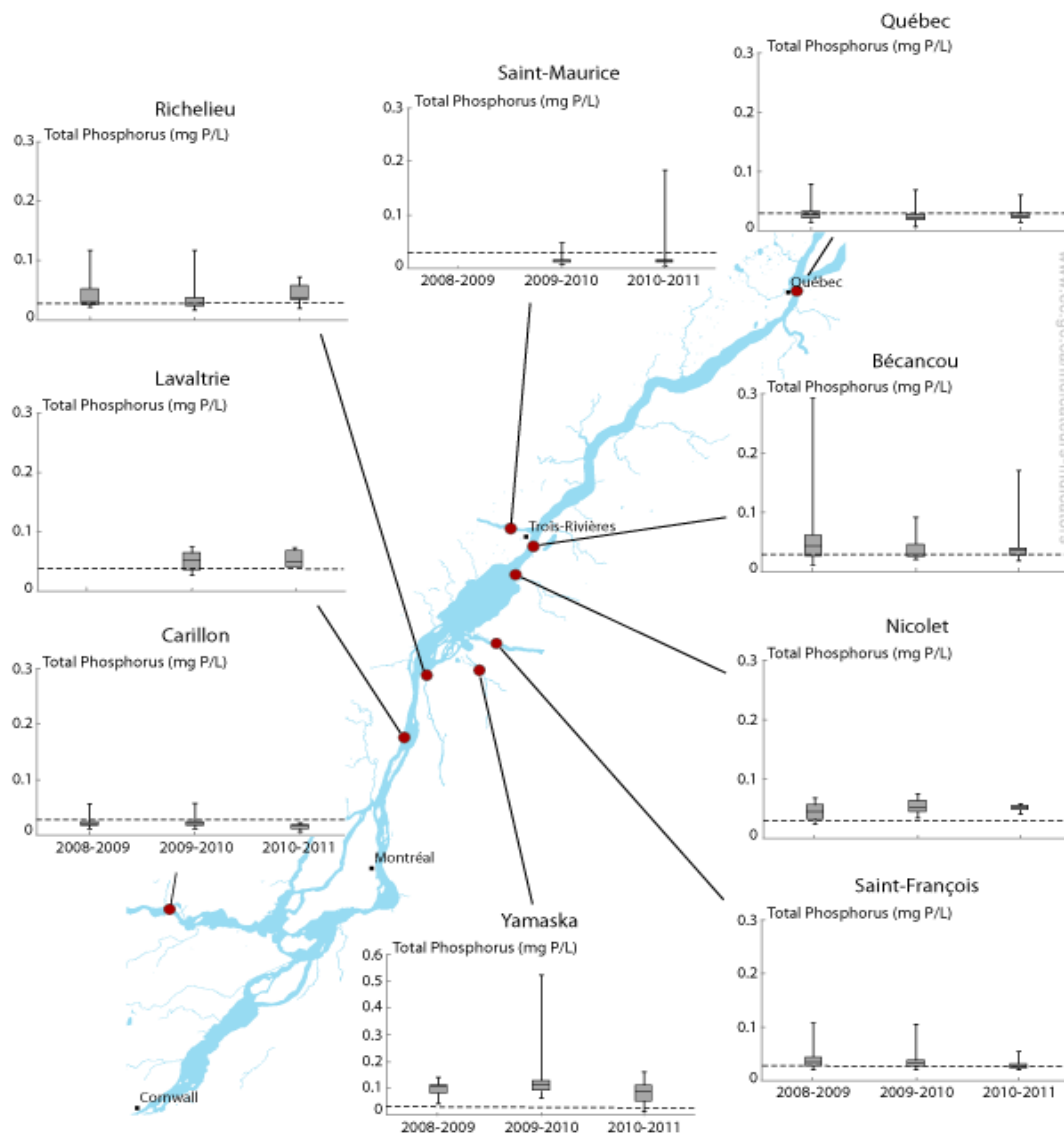
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<sup>1</sup> Ministère du Développement durable, Environnement et Parcs (2009) Critères de qualité de l'eau de surface. Retrieved on 27 September 2011.  
Available in French only from: [http://www.mddep.gouv.qc.ca/eau/criteres\\_eau/index.asp](http://www.mddep.gouv.qc.ca/eau/criteres_eau/index.asp).

### 3.4 Data completeness

The sampling frequency at water quality monitoring stations included in this indicator is not uniform. Sampling at Carillon, Bécancour and Quebec City is conducted monthly and data from April 2008 until March 2011 are included in this indicator. Sampling at the stations at Lavaltrie and at the mouth of the Saint-Maurice River also occurs monthly but did not start until February 2009. Sampling at monitoring stations at the mouths of the Nicolet, Saint-François and Yamaska rivers is seasonal and does not occur in the winter. Samples for these stations were collected biweekly from May until the end of September from 2008 until 2010.

**Figure 1. Annual total phosphorus boxplots for nine water quality monitoring stations along the St. Lawrence River for 2008 to 2011**



**Note:** Each boxplot summarizes a year's worth of total phosphorus data for the monitoring station and show the range of values measured at each station. The dotted line represents Quebec's water quality guideline for total phosphorus.

### 3.5 Data timeliness

The Phosphorus Levels in the St. Lawrence River Indicator was calculated using data from 2008 to 2011, the most recent data available for all water quality monitoring stations included in this indicator.

## 4 Methods

The phosphorus status for each of the nine water quality monitoring stations was determined by comparing their total phosphorus concentrations to Quebec's water quality guideline for the protection of aquatic life for total phosphorus of 0.03 mg P/L. The data for each station are summarized in boxplots in Figure 1 along with the phosphorus water quality guideline.

To derive the indicator map, the number of times phosphorus concentrations were greater than the guideline were summed over the three-year dataset and divided by the total number of samples collected over the same period. The phosphorus status of each station was determined based on the percentage of samples greater than the guideline. Stations with fewer than 10% of samples greater than the guideline are considered good (green) water quality based on phosphorus concentration and stations, those with greater than 50% of samples exceeding the guidelines are considered to have poor (red) water quality. Stations with 10 to 50% are given a caution (yellow) rating because phosphorus may be becoming a problem in these areas. In rivers, total phosphorus concentrations will often exceed the guideline during flooding, most commonly when snow melts in the spring. The 10% cut-off allows for one sample per year to exceed the guideline; thus, a good designation means total phosphorus concentrations are minimally impacted by human development. If greater than 50% of the samples exceed the water quality guideline, median total phosphorus concentrations are likely well above the water quality guideline and water quality is impaired by human activity.

## 5 Caveats and Limitations

The Phosphorus Levels in the St. Lawrence River Indicator reflects the state of water quality in the St. Lawrence River based on phosphorus concentrations and does not show the effect of spills or other transient events unless these are frequent or long-lasting.

Comparisons of this indicator with similar indicators in lakes may be challenging. In rivers, total phosphorus concentrations are influenced by suspended particles in the water that increase during high-flow events. This differs from assessing water quality for a lake ecosystem in which suspended particles will always settle out. It is still reasonable to compare lake and river systems as long as the methods to determine the classifications are clear and documented.

## 6 References and further reading

### 6.1 References

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