

Introduction

Clean Annapolis River Project (CARP) has been monitoring water quality in the Annapolis River since 1992. In addition to the annual report on water quality monitoring (found at http://annapolisriver.ca/projects_guardians.php), CARP summarizes a variety of water quality data into a report card format. The purpose of these report cards is to provide a means to communicate water quality information to local and provincial decision makers, including residents of the watershed.

This document summarizes the methodology used by CARP in preparing its water quality report card. The top portion of the report card summarizes a number of individual water quality parameters, with its analysis methodology contained in Table 1. The lower portion of the report card makes use of the Canadian Council of Ministers of the Environment (CCME) Water Quality Index (WQI) to the longer-term status of the Annapolis River. The methodology used in WQI analysis is summarized in Table 2.

Table 1. Methodology for analysis of individual parameters in the top portion of the Water Quality Report Card

Variable	Water Quality Goal	Criteria Used To Determine WQ Status	Criteria Used to Determine WQ Trend
E.coli	The geometric mean of E.coli densities should not exceed 200 E.coli /100ml ¹	Good: <15% of samples exceed 200 FC/100 ml Fair: 15 to 30% of samples exceed 200 FC/100 ml Poor: >30% of samples exceed 200 FC/100 ml	Seasonal Kendall test or linear regression analysis
Dissolved Oxygen Saturation	The percent saturation of DO in the Annapolis River, its tributaries and estuary should be greater than 60% at all times ²	Good: >98% of samples are greater than 60% Fair: 90 to 98% of samples are greater than 60% Poor: <90% of samples are greater than 60%	Mann Kendall test or linear regression analysis
Water Temp.	Mean summer water temperatures (July 1 to September 30) in the Annapolis River and its tributaries should not exceed 20 °C ³	Good: <20% of measurements exceed 20 °C Fair: 20 to 40% of measurements exceed 20°C Poor: >40% of measurements exceed 20°C	Mann Kendall test or linear regression analysis
pH	The pH of the Annapolis River should been within the range of 6.5 to 9.0, the range necessary to support healthy aquatic life. ¹	Good: <15% of samples outside pH 6.5 to 9.0 Fair: 15 to 30% of samples outside pH 6.5 to 9.0 Poor: >30% of samples outside pH 6.5 to 9.0	Mann Kendall test or linear regression analysis Note: pH of surface waters in Nova Scotia tend to be acidic.
Total Nitrogen	The concentration of Total Nitrogen (TN) should not exceed 0.9 mg/L ⁴	Good: <1% of TN samples exceed 0.9 mg/L Fair: 1% to 20% of TN samples exceed 0.9 mg/L Poor: >20% of TN samples exceed 0.9 mg/L	Currently not enough information to assess trends
Total Phosphorus	The concentration of Total Phosphorus (TP) at the 75 th percentile ⁵ should not exceed 0.030 mg/L ^{3,6}	Good: <1% of TP samples exceed 0.030 mg/L Fair: 1% to 20% of TP samples exceed 0.030 mg/L Poor: >20% of TP samples exceed 0.030 mg/L	Currently not enough information to assess trends
Turbidity – Total Suspended Solids	The median turbidity in the Annapolis River should not exceed 3 NTU ⁷	Good: 0% to 15% of samples exceed 10 NTU Fair: 15% to 30% of samples exceed 10 NTU Poor: >30% of samples exceed 10 NTU	Currently not enough information to assess trends
Benthic Invertebrates	The Family Biotic Index (FBI) for samples collected in the main Annapolis River should be less then 5 ⁸	Good: 0% of samples had a FBI >5 Fair: 1% to 20% of samples had a FBI >5 Poor: >20% of samples had a FBI >5	

Notes on the use of these criteria

1. These criteria are under development – this should be considered a work in progress. The criteria that are used to determine a parameter’s WQ status ranking are provisional.
2. Input and suggestions for improvement are welcome. Contact Andy Sharpe at Clean Annapolis River Project; 902 532 7533 or 888 547 4344; andysharpe@annapolisriver.ca

Table 2. Methodology for analysis of the WQI in the lower portion of the Water Quality Report Card

Parameter	Form	Guideline Description	Unit	Source of Data	Reference
E.coli	Most Probable Number (MPN)	200 (water contact recreation)	MPN/100 ml	CARP/River Guardians	CCME 2002
Dissolved Oxygen		5.5	mg/L	CARP/River Guardians	CCME 2002
Water Temperature (entire season)		20	°C	CARP/River Guardians	MacMillian <i>et al</i> , 2005
pH		6.5 to 9.0		CARP/River Guardians	CCME 2002
Turbidity		10	NTU	CARP/River Guardians/EC	Interim, based on 2008 sampling season

Methodology Used for River Guardian Signs

The River Guardian signs have a section that says, “The overall health of the river at this location is...” with the options of ‘improving,’ ‘not changing’ or ‘declining.’ The trend analyses calculated for the final report and the report card will be used each year to determine which of these will be displayed. There are currently 4 parameters for which trends can be produced at each location and two types of trend analyses done (parametric and non-parametric. See River Guardians Final Report 2008 for more information on trend analysis).

This means there will be eight trend results for each location. The following formula will be used:

$$[(D - I)/T]*100$$

where: D = number of parameters declining (increase for bacteria or temperature, decrease for pH or DO)

I = number of parameters improving (opposite of the declining parameters above)

T = total number of parameter results (8 in this case)

A score of =-50% will yield an “improving” value.

A score of -50% to 50% will yield a “not changing” value

A score of =50% will yield a “declining” value

The River Guardians signs will be changed at the beginning of each sampling season to reflect these results.

For example, in 2008, Lawrencetown showed an improvement in Bacteria count and declines in Temperature according to non-parametric analyses. It also showed a decline in Temperature according to parametric analyses. This means 2 parameters are declining and 1 is improving. According to the formula:

$$[(D - I)/T]*100$$

$$[(2 - 1)/8]*100 = 12.5\%$$

12.5 is between -50% and 50%, therefore this is a 'not changing' value.

References

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- ¹ Canadian Council of Ministers of the Environment. 2002. Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life.
- ² Institute of Ecosystem Studies, Changing Hudson Project, 2007. Dissolved Oxygen. http://www.ecostudies.org/images/education/chp/dissolved_oxygen.pdf. Accessed February 6th, 2008.
- ³ MacMillian, J.L., D. Cassie, J.E. LeBlanc, T.J. Crandlemere. 2005. Characterization of water temperature for 312 selected sites in Nova Scotia. Canadian Technical Report of Fisheries and Aquatic Sciences 2582.
- ⁴ Dodds, W.K., E.B. Welch. 2000. Establishing Nutrient Criteria in Streams. Journal of the North American Benthological Society. 19(1): 186-196.
- ⁵ The Ontario Ministry of Environment/Conservation Authority Working Group utilized the 75th percentile (means 75% of the data fall below this value) to reflect the tendency for sampling data to be dry weather biased and, therefore, more accurately reflects pollution levels. See also Upper Thames Conservation Authority http://www.thamesriver.on.ca/Watershed_Report_Cards/Watershed_Report_Cards-2007_water-quality.htm Site accessed October 17, 2008.
- ⁶ Mackie, G., 2004, Applied Aquatic Ecosystem Concepts. 2nd Edition, Kendall/Hunt Publishing Company, Dubuque, Iowa.
- ⁷ Interim turbidity goal established by CARP, January 2009 based on 2008 sampling season data. Turbidity goal and criteria to be revised following 2009 sampling season.
- ⁸ Upper Thames Conservation Authority, Watershed Report Card Methodology, 2007. http://www.thamesriver.on.ca/Watershed_Report_Cards/Watershed_Report_Cards-2007_water-quality.htm Site accessed October 17, 2008.