



Drinking Water Quality

Formerly Indicator #4175

Overall Assessment:

Status: Good

Trend: Unchanging

Rationale: The overall quality of source and finished drinking water in the Great Lakes basin can be considered good. The potential risk of human exposure to the noted chemical and/or microbiological contents, and any associated health effect, is generally low.

Lake-by-Lake Assessment: Each lake was categorized with a not assessed status and an undetermined trend, indicating that assessments were not made on an individual lake basis.

Other Spatial Scales: No other spatial scales were used in this indicator.

Purpose:

- To evaluate the potential for human exposure to drinking water contaminants and the effectiveness of policies and technologies to ensure safe drinking water throughout the Great Lakes basin
- To evaluate the chemical and microbial contaminant levels in source and treated water.

Ecosystem Objective:

Treated and source drinking water supplies in the Great Lakes basin should be free from harmful chemical and microbiological contaminants and should be safe to drink. This indicator supports the restoration and maintenance of the chemical, physical and biological integrity of the Great Lakes basin (GLWQA Annex 1, 2, 12 and 16).

Ecological Condition:

Background

There are several sources of drinking water within the Great Lakes basin, including the Great Lakes themselves, smaller lakes and reservoirs, streams, ponds and groundwater (seeps and wells). These systems are vulnerable to contamination from several sources (chemical, biological, radioactive). Substances that may be present in source water include microbial contaminants (e.g. viruses and bacteria), inorganic contaminants (e.g. salts and metals), pesticides and herbicides, organic chemical contaminants (e.g. synthetic and volatile organic chemicals), and radioactive contaminants. After collection, source water undergoes a detailed treatment process prior to being sent to a distribution system where it is dispersed to consumers. The treatment process involves several basic steps, which are often varied and repeated depending on the condition of the source water. Source water can affect the finished water that is consumed. Good quality source water is an important approach to assuring the safety and quality of drinking water.

The information provided by the United States for this report focuses on finished, or treated, drinking water. There is currently no national drinking water database in the U.S. that includes source water data. In the United States, the Safe Drinking Water Act Reauthorization of 1996 requires all drinking water utilities to provide yearly water quality information to their consumers. To satisfy this obligation, U.S. WTPs produce an annual Consumer Confidence/Water Quality Report (CC/WQR). These reports provide information regarding source water type (i.e. surface water, groundwater), the availability of source water assessment and a brief summary of the drinking water systems susceptibility to potential sources of



contamination, the water treatment process, contaminants detected in finished drinking water, and violations that occurred, and other relevant information. Records of the number and type of health based violations are also recorded in the nationwide U.S. EPA Safe Drinking Water Information System (SDWIS). Health based violations in the U.S. include: Maximum Contaminant Level (MCL) which is the highest level of a contaminant that is allowed in drinking water, the Maximum Residual Disinfectant Level (MRDL) which is the highest level of a disinfectant allowed in drinking water, and Treatment Technique (TT) which is a required process intended to reduce the level of contaminants in drinking water.

The data used for the Canadian component of this report was provided by the Ontario Ministry of the Environment (OMOE) and includes results from two program areas. Source water data is collected as part of the Drinking Water Surveillance Program (DWSP). The DWSP is a voluntary partnership program with municipalities that monitors source and treated water quality at over 100 systems in Ontario. The Drinking Water Management Division at OMOE provides information on adverse water quality incidents (AWQI). An AWQI is when a water sample exceeds the Ontario Drinking Water Quality Standards or when an operator observes unsafe water. The Ontario Drinking Water Quality Standards are described by the Maximum Acceptable Concentration (MAC), which is established for parameters that, when present above a certain concentration, have known or suspected adverse health effects. The Interim Maximum Acceptable Concentration (IMAC) is used for parameters when there is insufficient toxicological data or it is not feasible for practical reasons to establish a MAC.

Status of Drinking Water in the Great Lakes Basin

Established drinking water standards were used to assess the quality of source and treated drinking water quality in the Great Lakes basin. Potential health effects may occur from long term exposure above these drinking water standards.

Source (Untreated) Drinking Water Quality

Nine chemical drinking water parameters that frequently result in water quality exceedences and which have potential health effects associated with exposure above the established MAC/IMAC, were selected to provide an assessment of source drinking water quality in Ontario from 2007 to 2009. As stated previously, no source water data was assessed in the U.S. due to the lack of centrally located source. The percentage of drinking water systems monitored through the DWSP where source water is below the MAC/IMAC was used as the metric.

Six of the nine chemical drinking water parameters were never detected above the MAC/IMAC in source waters (Table 1). These parameters included nitrate, nitrite, atrazine, arsenic, uranium and barium. Fluoride, lead and selenium were the only parameters that had concentrations exceeding the MAC/IMAC in source waters. Exceedences of these chemical parameters were only found in a few groundwater systems and may be the result of erosion of natural deposits and/or anthropogenic contamination. The percentage of sites and the actual drinking water systems with fluoride and selenium source water exceedences did not change over the time period (Table 1). Lead was the only parameter the percent of exceedences decreased over time, with none occurring in 2009 (Table 1).

Overall, source water quality is good in Ontario in regards to these selected chemical parameters. There were only four drinking water systems, all sourced from groundwater, where the MAC/IMAC was exceeded and at two of these sites the concentrations in treated and distributed water were below the MAC/IMAC.



Treated Drinking Water Quality

Treated drinking water was assessed for all community drinking water systems in U.S. Great Lakes basin counties and for all municipal residential drinking water systems in Ontario. Metrics were slightly different between countries due to differences in the way data is recorded and stored in their respective databases. In the U.S. the average percentage of drinking water systems and population that did not have any health based violations was used as metrics. In Ontario the percentage of drinking water systems that did not have any health based violations and the percentage of drinking water tests meeting standards were used as metrics.

In the U.S. the average percentage of drinking water systems and population that did not have any health based violations has remained mostly unchanged between 2007 and 2010, with the average percentage of community water systems with no exceedences consistently exceeding 90% (Figure 1). The percentage of the population with no violations was a little more variable but, on average, exceeded 90% (Figure 1). These numbers are similar to the national average in the U.S.

In Ontario the average percentage of drinking water systems that did not have any health based violations increased between 2004 and 2010 while the percentage of drinking water systems that met drinking water standards less than 99% of the time decreased (Figure 2). Over the past three years the percentage of drinking water systems with no exceedences has been fairly stable at around 65% and 96% of drinking water systems meet standards greater than 99% of the time. The average percentage of drinking water tests meeting standards in Ontario has increased slightly between 2004 and 2010 but has always exceeded 99.7% (Figure 3).

The proportion of health based exceedences caused by chemical, microbiological, radiological, disinfection by-products and treatment techniques differs between countries. The majority of exceedences in Ontario are microbiological while in the U.S. microbiological, chemical and disinfection by-product exceedences co-dominate (Figure 4). Another major difference between countries is that radiological parameters are responsible for 9% of exceedences in the U.S. while there were no radiological exceedences in Ontario (Figure 4). This large difference may be due to the small number of systems in Ontario that submitted results for radiological tests rather than higher concentrations in the U.S. The chemical category was comprised of different parameters for each county with some overlap. In Ontario most chemical exceedences were from fluoride and lead while in the U.S. most were from arsenic. Standards for fluoride and lead are stricter in Ontario which may be why there were more exceedences for these chemical there.

Summary

Based on the information provided from the OMOE DWSP, source water quality in Ontario can be considered good. It is important to note however that source waters as part of the DSWP are not currently analyzed for microbiological contamination, the largest contributor to health exceedences in Ontario. Treated drinking water quality in the U.S. and Canada can also be considered good. In the U.S. more than 90% of the population was never exposed to a health based violation while in Canada greater than 99.7% of all tests met drinking water standards.

Linkages

Drinking water quality may be negatively impacted by increases in nutrient, pesticide and bacterial loadings from tributaries, contamination in sediment, atmospheric deposition, land conversion, municipal wastewater and industrial loadings and runoff. These pressures result in changes to ground and surface water quality which may act as sources for drinking water. Improved wastewater treatment, sediment



remediation and increased protected areas in response to these pressures may improve source drinking water quality.

Management Challenges/Opportunities

A more standardized, updated approach to monitoring contaminants and reporting data for drinking water needs to be established. Even though extensive lists of contaminants and their MCLs have been established in the U.S. and Ontario, newer parameters of concern might not be listed due to available resources or technology. Additionally, state monitoring requirements may differ, requiring only a portion of this list to be monitored.

Standardized monitoring and reporting, especially of source water in the U.S., would make trend analysis easier and provide a more effective assessment of the state of the ecosystem and the potential for health hazards associated with drinking water. By providing source water data, the origin of contamination at WTPs will be easier to identify as some utilize multiple sources of water. Inclusion of microbiological tests into source water assessments will be important to understand potential impacts to human health.

Comments from the author(s)

A concern for future efforts would be the comparability of metrics between countries. Focusing on the population that is impacted by drinking water quality exceedences, rather than the number of exceedences or number of systems with exceedences, will allow us to better evaluate the potential for human exposure to drinking water contaminants. Source waters may also be examined in the future to better understand where the contaminants are coming from.

Assessing Data Quality:

Insert “x” under the statement that best corresponds with each data characteristic

Data Characteristics	Strongly Agree	Agree	Neutral or Unknown	Disagree	Strongly Disagree	Not Applicable
1. Data are documented, validated, or quality-assured by a recognized agency or organization	X					
2. Data are traceable to original sources	X					
3. The source of the data is a known, reliable and respected generator of data	X					
4. Geographic coverage and scale of data are appropriate to the Great Lakes basin	X					
5. Data obtained from sources within the U.S. are comparable to those from Canada		X				
6. Uncertainty and variability in the data are documented and within acceptable limits for this indicator report	X					
Clarifying Notes:						



Acknowledgments

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Michelle Craddock, Oak Ridge Institute for Science and Education, on assignment to the U.S. Environmental Protection Agency, Great Lakes National Program Office (GLNPO) 2011

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Danielle J. Sass, Oak Ridge Institute for Science and Education, on assignment to the U.S. Environmental Protection Agency, Great Lakes National Program Office (GLNPO) 2008

Jeffrey C. May, Oak Ridge Institute for Science and Education, on assignment to the U.S. Environmental Protection Agency, Great Lakes National Program Office (GLNPO) 2006

Tracie Greenberg, Environment Canada, Burlington, ON 2006

Information Sources

Ontario Ministry of the Environment. Drinking Water Surveillance Program dataset:

http://www.ene.gov.on.ca/environment/en/resources/collection/data_downloads/index.htm#DWSP

Ontario Ministry of the Environment. 2006 (Revised from 2003). *Technical support Document for Ontario Drinking Water Standards, Objectives and Guidelines.*

http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079707.pdf

Ontario Ministry of the Environment. 2011. Annual Report 2009-2010, Chief Drinking Water Inspector.

http://www.portal.gov.on.ca/drinkingwater/dw_el_prd_044304.pdf

United States and Canada. 1987. *Great Lakes Water Quality Agreement of 1978, as amended by Protocol signed November 18, 1987.* Ottawa and Washington.

U.S. Environmental Protection Agency. 2011. Safe Drinking Water Information System database. Select data from this database can be found at:

<http://water.epa.gov/scitech/datait/databases/drink/pivottables.cfm>

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Source: U.S. EPA Safe Drinking Water Information System.

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Source: OMOE. 2011. Chief Drinking Water Inspector Annual Report 2009-2010.

Figure 3. Percentage of drinking water tests meeting standards (municipal residential drinking water systems) in Ontario.

Source: OMOE. 2011. Chief Drinking Water Inspector Annual Report 2009-2010.



Figure 4. Percentage of health based exceedences caused by chemical, microbiological, radiological, disinfection by-products and treatment technique parameters.

Source:

Last Updated

State of the Lakes Ecosystem Conference (SOLEC) 2011

Percentage of DWSP sites where source water is below the MAC/IMAC.			
	2007	2008	2009
Nitrate	100.00%	100.00%	100.00%
Nitrite	100.00%	100.00%	100.00%
Atrazine	100.00%	100.00%	100.00%
Arsenic	100.00%	100.00%	100.00%
Uranium	100.00%	100.00%	100.00%
Barium	100.00%	100.00%	100.00%
Fluoride	98.99%	98.91%	98.91%
Lead	98.99%	97.83%	100.00%
Selenium	98.99%	98.91%	98.91%

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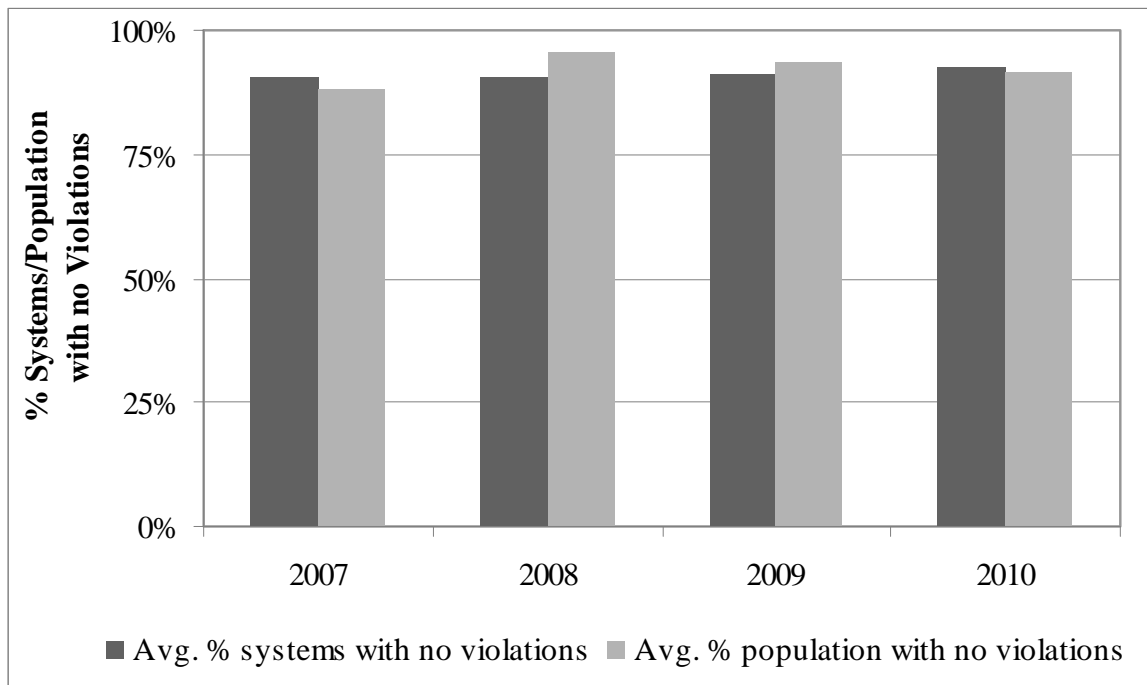


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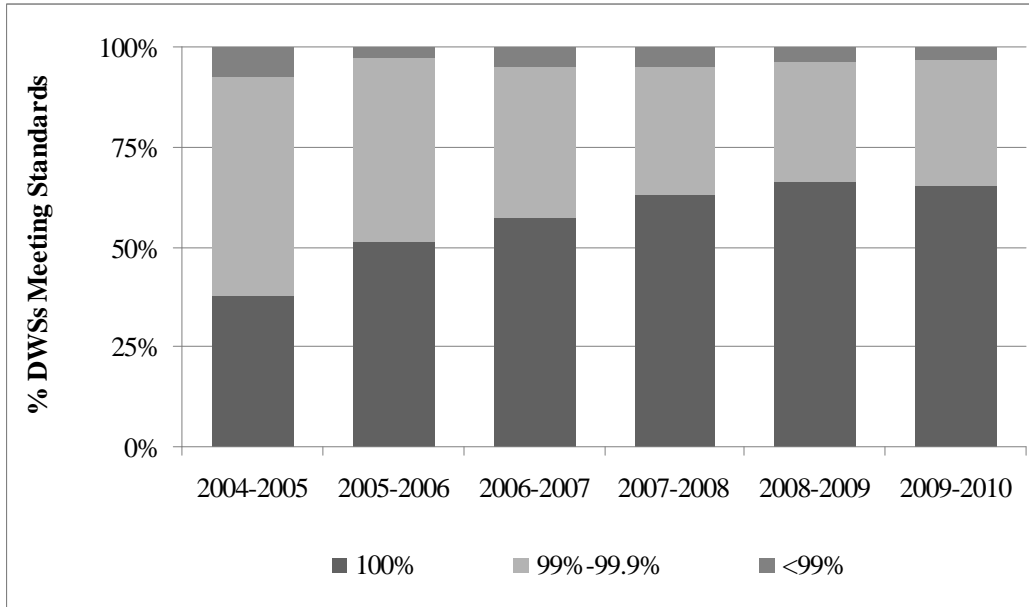


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Source: OMOE. 2011. Chief Drinking Water Inspector Annual Report 2009-2010

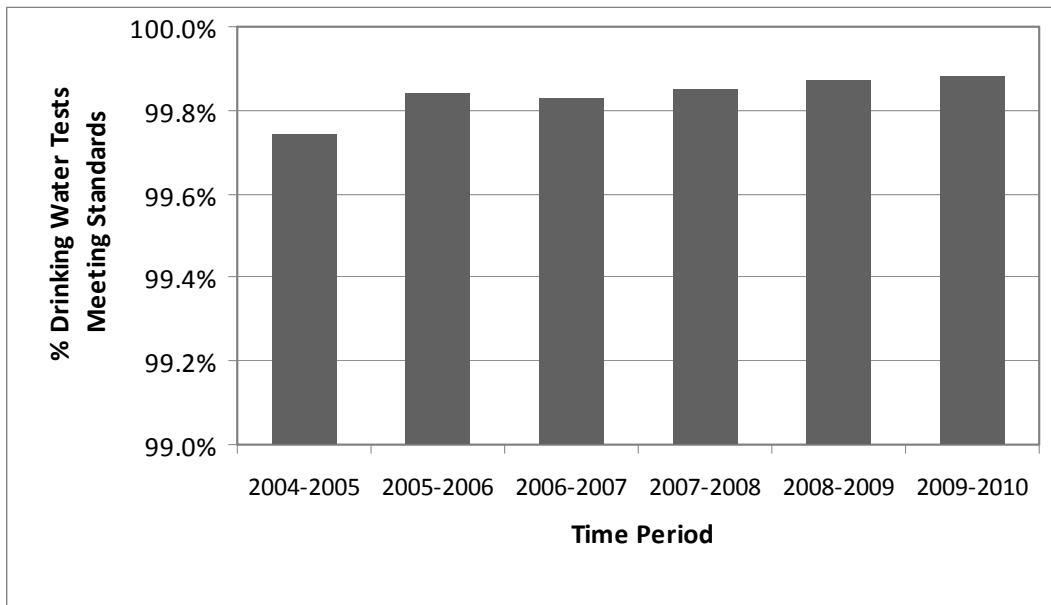


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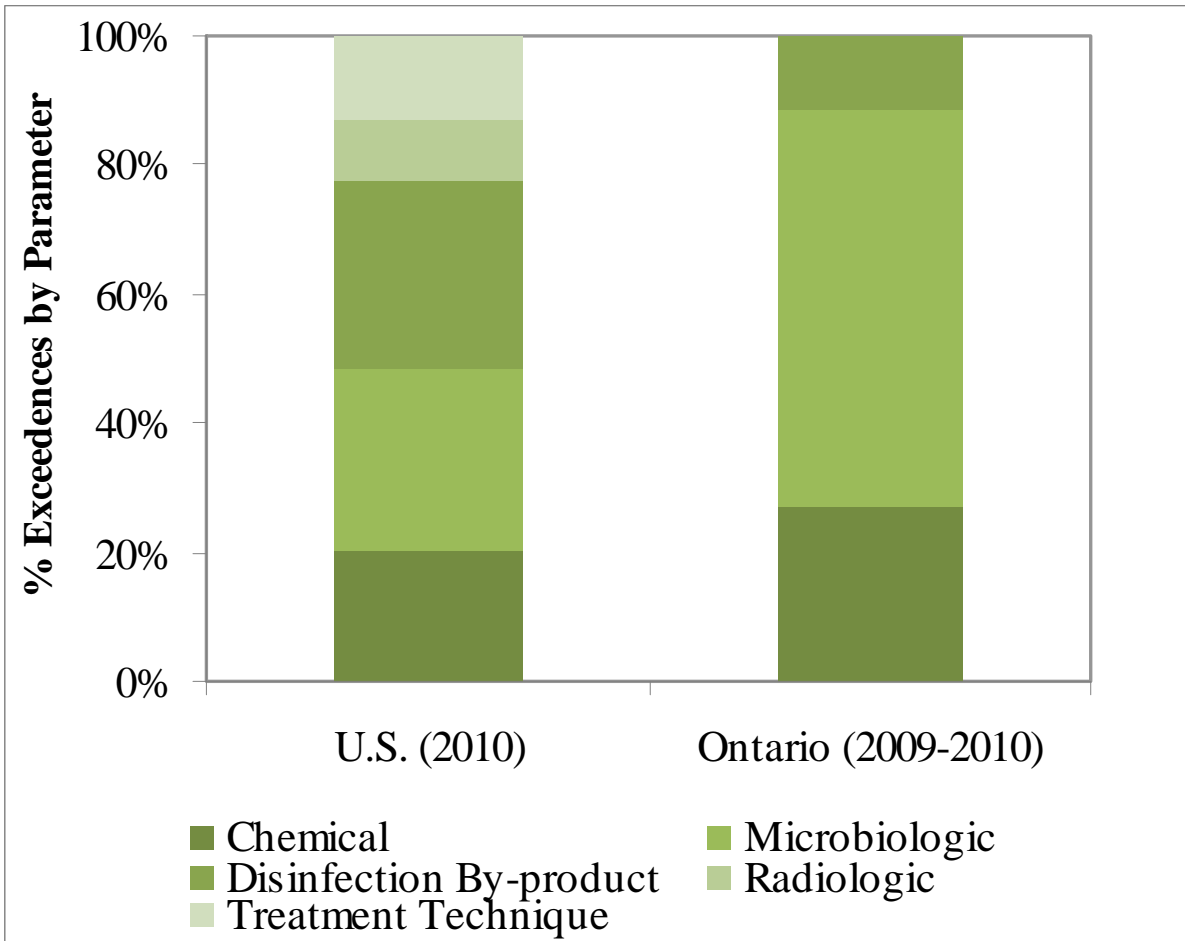


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