

Protecting the Great Lakes from Radionuclides

June 2016

Environmental protection under the *Nuclear Safety and Control Act*

Under the *Nuclear Safety and Control Act* (NSCA), the Canadian Nuclear Safety Commission (CNSC) is responsible for ensuring that licensed nuclear facilities are operating in a safe manner that ensures the protection of the environment and the health and safety of people.

Nuclear facilities around the Great Lakes

A number of nuclear facilities are situated along the Great Lakes in both Canada and the United States (US). These facilities are regulated by the Canadian Nuclear Safety Commission (CNSC) and the US Nuclear Regulatory Commission (US NRC).

CNSC-licensed facilities around the Great Lakes include three nuclear power plants and a uranium refinery, as well as processing and waste management facilities. As a condition of their licences, these facilities are permitted to release controlled amounts of nuclear and hazardous substances, below authorized release limits. Release limits are set at levels that are considered to be protective of the environment and the public.

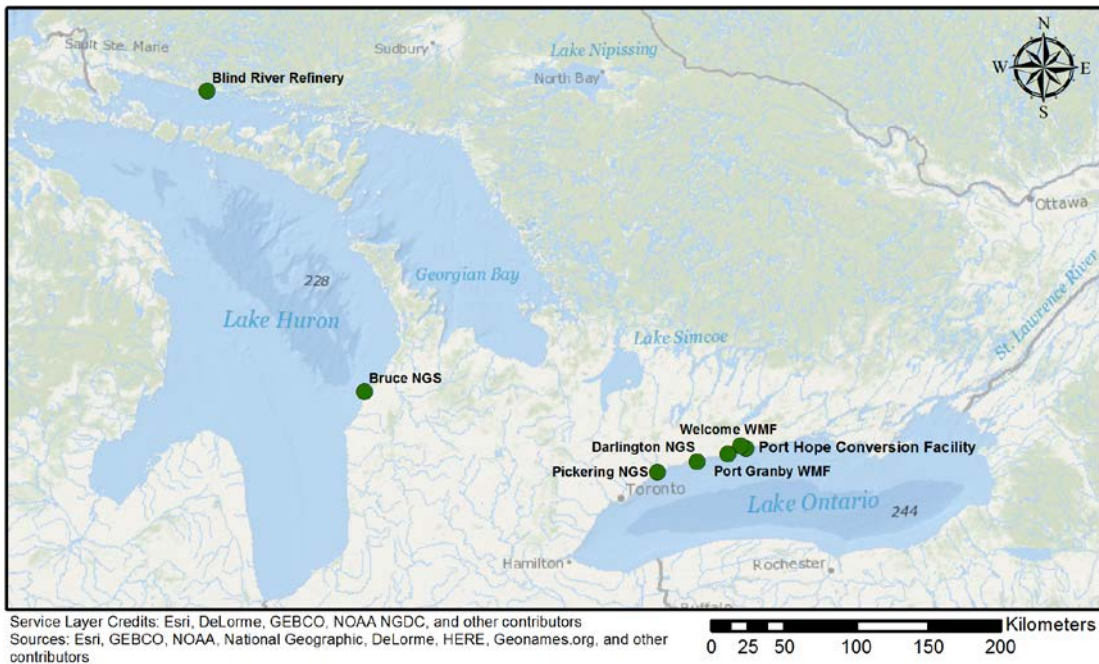
The Canadian nuclear facilities which are permitted to discharge directly to the Great Lakes include:

- Bruce Nuclear Generating Station (NGS) and Cameco Blind River Refinery to Lake Huron
- Pickering NGS, Darlington NGS, Welcome Waste Management Facility (WMF) and Port Granby WMF to Lake Ontario

Highlights

- The Canadian Nuclear Safety Commission licenses Canadian nuclear facilities around the Great Lakes including nuclear power plants, processing facilities and waste management facilities
- Environmental protection programs are in place at CNSC-licensed facilities to ensure adequate protection of the environment and the health and safety of people
- Monitoring data from the Great Lakes near Canadian nuclear facilities shows that drinking water supplies are protected and radionuclide concentrations are well below drinking water quality standards.
- The CNSC's Independent Environmental Monitoring Program provides independent verification that licensees' environmental protection programs are working
- People and the environment around nuclear facilities are protected

Figure 1: CNSC-licensed nuclear facilities around the Great Lakes



The US NRC provides oversight of the American nuclear power plants, decommissioned facilities and waste management facilities bordering the Great Lakes. Like the CNSC, the US NRC ensures that the use of nuclear materials is protective of the environment and the health and safety of people.

How the CNSC regulates nuclear facilities around the Great Lakes

Licensees must protect the environment and the health and safety of people. The CNSC ensures that licensees have effective control measures (e.g., wastewater treatment systems, air pollution control technologies, engineered barriers, and other techniques) in place to prevent or minimize releases to the environment. These control measures must be in line with the principles of pollution prevention and sustainable development. The following core programs, which form part of the environmental protection program, are in place to monitor releases and concentrations within the environment are:

- the effluent monitoring program, which is used to measure the releases of nuclear and hazardous substances in air and water to the environment
- the environmental monitoring program, which is used to measure the concentrations of nuclear and hazardous substances in different environmental media (e.g., air, water, vegetation, foodstuffs, soil)

Additional to release limits, regulatory action levels are another way the CNSC ensures that effluent is controlled. Action levels act as an early warning system to ensure that licensees are carefully monitoring their operation and performance, and to ensure release limits are not reached. They are set at the upper bounds of the facility's normal operating performance; if the action level is exceeded, the licensee must notify the CNSC and investigate to determine the cause of the exceedance. The licensee must then take appropriate corrective actions and/or preventative measures to restore the effectiveness of the environmental protection program.

As part of the CNSC’s compliance program, staff conduct routine inspections of the licensees’ environmental protection program. Nuclear facilities are required to submit their monitoring results, which are then reviewed by CNSC staff to ensure that the control measures are adequate and protective of the environment, and that the public is safe.

Monitoring results

Table 1 provides a summary of monitoring data obtained from CNSC licensees at the inlet to drinking water supply plants (WSP) for 2006 to 2014. These tritium in water results provide an example of how licensees monitor for radionuclides. The measured concentrations, in units of Becquerel per litre (Bq/L), are well below the guidelines.

The guidelines represent an activity concentration that would result in a public dose of 0.1 millisievert (mSv) per year. This represents a dose at which no health impacts are expected.

Table 1: Summary of CNSC licensee monitoring data for tritium in water from water supply plants (2006 to 2014)

Nuclear generating station	Location	Minimum (Bq/L)	Maximum (Bq/L)	Average (Bq/L)	Guideline^{1,2} (Bq/L)	Expected health impact
Bruce	Kincardine WSP	3.6	9.8	6.6	7000	No
Bruce	Southampton WSP	6.4	14.4	10.8	7000	No
Bruce	Port Elgin WSP ³	7.1	16.8	13.4	7000	No
Pickering	Ajax WSP	4.4	7.1	5.6	7000	No
Pickering	F.J Horgan WSP	4	5.8	4.8	7000	No
Pickering	R.C Harris WSP	4	5.4	4.7	7000	No
Pickering	Whitby WSP	5	8.2	5.9	7000	No
Darlington	Bowmanville WSP	4.4	6.7	5.2	7000	No
Darlington	Newcastle WSP	3.9	6.4	5.1	7000	No
Darlington	Oshawa WSP	5.5	9.2	6.7	7000	No

¹ Health Canada Guidelines for Canadian Drinking Water Quality

² Ontario Regulation 169/03 – Ontario Drinking Water Quality Standards

³ Data only available for 2005 to 2008

CNSC’s Independent Environmental Monitoring Program

The CNSC’s Independent Environmental Monitoring Program (IEMP) verifies that the public and the environment around CNSC-regulated nuclear facilities are safe from releases to the environment. CNSC staff take samples from public areas around the facilities and send them to the CNSC’s state-of-the-art laboratory to measure and analyze the amount of radionuclides and hazardous substances in those samples.

The IEMP is one more way that the CNSC protects public safety. [Read more about the IEMP on the CNSC website.](#)

IEMP results from around the Great Lakes

The following tables summarize the lake surface water sampling that has been completed through the IEMP. The measured quantities of tritium (table 2) and uranium (table 3) are significantly lower than the guidelines, confirming that the environment and drinking water supplies are well protected. The independent results are also within the range reported by the licensees' monitoring programs.

Table 2: Summary of published IEMP tritium sampling results from nuclear facilities around the Great Lakes

Nuclear power plant	Minimum (Bq/L)	Maximum (Bq/L)	Guideline^{2,3} (Bq/L)	Expected health impact
Bruce ⁴	< 3	55	7000	No
Darlington ⁵	< 3	5.1	7000	No

¹ The < symbol indicates that a result is below the provided laboratory analytical detection limit

² Health Canada Guidelines for Canadian Drinking Water Quality

³ Ontario Regulation 169/03 – Ontario Drinking Water Quality Standards

⁴ Sampling performed in 2013 and 2015

⁵ Sampling performed in 2014 and 2015

Table 3: Summary of published IEMP uranium sampling results from nuclear facilities around the Great Lakes

Facility	Minimum (µg/L)	Maximum (µg/L)	Guideline^{1,2,3} (µg/L)	Expected health impact
Blind River Refinery ⁴	0.04	0.26	15	No

¹ CCME Water Quality Guidelines for the Protection of Aquatic Life

² Health Canada Guidelines for Canadian Drinking Water Quality for uranium is 20 µg/L

³ Ontario Regulation 169/03 – Ontario Drinking Water Quality Standards

⁴ Sampling performed in 2013 and 2014

Historical Monitoring of Radionuclides in the Great Lakes

In 1973, historical monitoring of radionuclides in the Great Lakes was initiated as a result of the signing U.S./Canada Great Lakes Water Quality Agreement (GLWQA) in 1972. Monitoring was discontinued in 1982 due to the measurement of consistently low levels of radionuclides.

Historical monitoring results for tritium in the Great Lakes are provided in table 4. The table includes results obtained as part of the GLWQA, the 1990 Environment Canada Lake Ontario Survey, and more recent measurements obtained as part of a research project to develop a database of background concentrations in Canada.

Table 4: Summary of historical tritium concentrations in the Great Lakes

Great Lake	1973 ¹ (Bq/L)	1981 ¹ (Bq/L)	1990 ² (Bq/L)	2011 ^{3,4} (Bq/L)
Superior	11.1	6.7	-	-
Michigan	-	7.4	-	-
Huron	-	10.6	-	5 ⁵ , 3.5 ⁶
Erie	12.6	8.5	-	-
Ontario	11.1	13.5	10.1	-

¹ S.R. Joshi. (1991). Radioactivity in the Great Lakes. *The Science of the Total Environment*, 100 (61-104).

² Nuclear Task Force. (1997). *Inventory of Radionuclides for the Great Lakes*. International Joint Commission, United States and Canada

³ S.C. Sheppard and B. Sanipelli. (2011). *Environmental Radioactivity in Canada – Measurements* (NWMO TR-2011-16). NWMO; Toronto.

Sheppard et al. (2011). *Review of Environmental Radioactivity in Canada* (NWMO TR-2011-17). NWMO; Toronto.

⁵ Lake Huron near Tiverton

⁶ Lake Huron/St Clair River

The Great Lakes Are Protected

CNSC licensees are responsible for controlling and monitoring levels of radionuclides around their facilities, including within the Great Lakes. The CNSC through the IEMP program carries out sampling to independently verify the results obtained by the licensee. Historical survey results, and current monitoring results of samples obtained from the Great Lakes indicate that people and the environment living around those facilities are protected.

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