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Data Sources and Methods for the Polybrominated Diphenyl Ethers (PBDEs) in Fish and Sediment Indicators

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1 Introduction

The Polybrominated Diphenyl Ethers (PBDEs) in Fish and Sediment indicators are part of the Canadian Environmental Sustainability Indicators (CESI) program, which provides data and information to track Canada's performance on key environmental sustainability issues.

The CESI program tracks environmental levels of certain toxic substances released by human activity. These indicators help to inform Canadians about key water pollutants that have been listed as toxic to the environment. The indicators also help the government identify priorities, and develop and track progress on strategies and policies put in place to reduce or control pollution.

2 Description and rationale of the Polybrominated Diphenyl Ethers (PBDEs) in Fish and Sediment indicator

2.1 Description

The PBDEs in Fish and Sediment indicators are established by determining the drainage regions where concentrations are within or have exceeded the Federal Environmental Quality Guidelines (FEQGs) for PBDEs in fish and sediment (http://www.ec.gc.ca/scitech/default.asp?lang=En&xml=E2E4D8FD-32C7-42A1-B1D8-500D18E86718#tab1). The FEQGs were developed under the Chemicals Management Plan (CMP) and are used in various ways (http://www.chemicalsubstanceschimiques.gc.ca/plan/index-eng.php). In this report they are used to evaluate the significance of monitoring data.

PBDEs are a group of chemicals containing 209 compounds. They are classified into 10 subgroups known as homologues, based on the number of bromine atoms they contain. Four of the 10 subgroups are considered for the indicators of PBDEs in fish, and 6 in sediment.

Table 1: Polybrominated diphenyl ethers (PBDEs) subgroups

Subgroup	Chemical group name
triBDE	tribromodiphenyl ether
tetra BDE	tetrabromodiphenyl ether
pentaBDE	pentabromodiphenyl ether
hexaBDE	hexabromodiphenyl ether
octaBDE	octabromodiphenyl ether
decaBDE	decabromodiphenyl ether

2.2 Rationale

PBDEs are commonly used as additive flame retardants, in that they are physically combined with the materials being treated for flame resistance. Since PBDEs are not chemically linked in the products for which they are used, they are slowly and consistently released throughout the production, use and disposal stages of the products.

Due to the bioaccumulative characteristics of the tetraBDE, pentaBDE and hexaBDE homologues, and because PBDEs generally end up in soil and sediment, they can bioaccumulate over time in certain organisms such as soil microbes and invertebrates. In addition, tetraBDE, pentaBDE and hexaBDE have a propensity to biomagnify through food webs. As a result, certain PBDEs can attain high concentrations in and cause harm to animals at the top of food webs, such as predatory fish, birds and mammals.

The PBDEs that were assessed have been declared by the Government of Canada as "toxic," as defined under the *Canadian Environmental Protection Act, 1999 (CEPA 1999)*. As a result, the Government has developed a Risk Management Strategy for PBDEs, with the objective of minimizing their release into the Canadian environment. Among the PBDE subgroups that were assessed, tetraBDE, pentaBDE and hexaBDE were found to meet the criteria for virtual elimination under CEPA 1999 (http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=34DCDBA9-9C86-4EB2-AA93-81B6755321F9).

PBDEs found in the Canadian environment are not only from domestic sources but also from foreign sources. This is due to PBDEs being suspended in air and transported over long distances. As such, Canada is engaged in two international agreements that restrict and ultimately target the elimination of the production, use, trade, release and storage of PBDEs; the Stockholm Convention on Persistent Organic Pollutants and the Protocol on Persistent Organic Pollutants (POPs) of the United Nations Convention on Long-range Transboundary Air Pollution (LRTAP) (http://chm.pops.int/default.aspx) http://www.unece.org/env/lrtap/pops_h1.html. The objective of these international agreements is to protect human health and the environment from persistent organic pollutants (POPs).

These chemicals were also selected as indicators in the CESI program because a representative monitoring data set in fish and sediments exists, and FEQGs are available to provide context and to help characterize the potential risk. Numerous other chemicals are used as flame retardants, but only PBDEs were considered for the indicators.

2.3 Changes since last report

This is the first time that this indicator is reported under CESI.

3 Data

3.1 Data source

The PBDEs environmental concentration data were obtained from Environment Canada's CMP Monitoring and Surveillance program.

The FEQGs were developed under the CMP, and are used to evaluate the significance of monitoring data. Measured concentrations exceeding the guideline levels indicate the potential for aquatic organisms to be affected by PBDE levels in those locations.

Table 2: Federal Environmental Quality Guidelines (FEQGs) for Polybrominated Diphenyl Ethers (PBDEs)

PBDE subgroups[a]	Fish tissues (ng/g ww)	Sediment[b] (ng/g dw)
triBDE	120	44
tetraBDE	88	39
pentaBDE	1	0.4
hexaBDE	420	440
octaBDE	-	5700[c]
decaBDE	-	19[c d]

Note: Not all of the FEQGs are shown in this table; only the ones required for the CESI indicators are shown. ww = wet weight. dw = dry weight. [a]FEQGs for triBDE, tetraBDE, hexaBDE and decaBDE are based on data for BDE-28, BDE-47, BDE-153 and BDE-209, respectively, unless otherwise noted. Congener-specific FEQGs exist for BDE-99 and BDE-100. [b]Values normalized to 1% organic carbon. [c]Values adopted from Ecological Screening Assessment Report (SAR). Sediment guidelines for octa- and deca-BDE were adapted from the SAR by being corrected for the sediment organic carbon in the actual tests, and then normalized to 1% organic carbon instead of the 4% in the SAR.
[d]Based on a mixture of decaBDE with some nonaBDE.
Source: Environment Canada (2012) Polybrominated Diphenyl Ethers in the Canadian Environment (http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=99194FEE-E8E4-48CD-97BC-C5DB118FDC64).

3.2 Spatial coverage

The PBDEs in Fish and Sediment indicators use water drainage regions as a geographical unit for the calculation of the national indicators. These drainage regions correspond to those defined in Statistics Canada's Standard Drainage Area Classification (http://www.statcan.gc.ca/subjects-sujets/standard-norme/sdac-ctad/sdacinfo2-ctadinfo2-eng.htm). The drainage regions in Figure 1, Table 3 and Table 4 outline the regions where sampling for PBDEs was conducted.

Figure 1: Geographic extent of the drainage regions used for the PBDEs in Fish and Sediment indicators

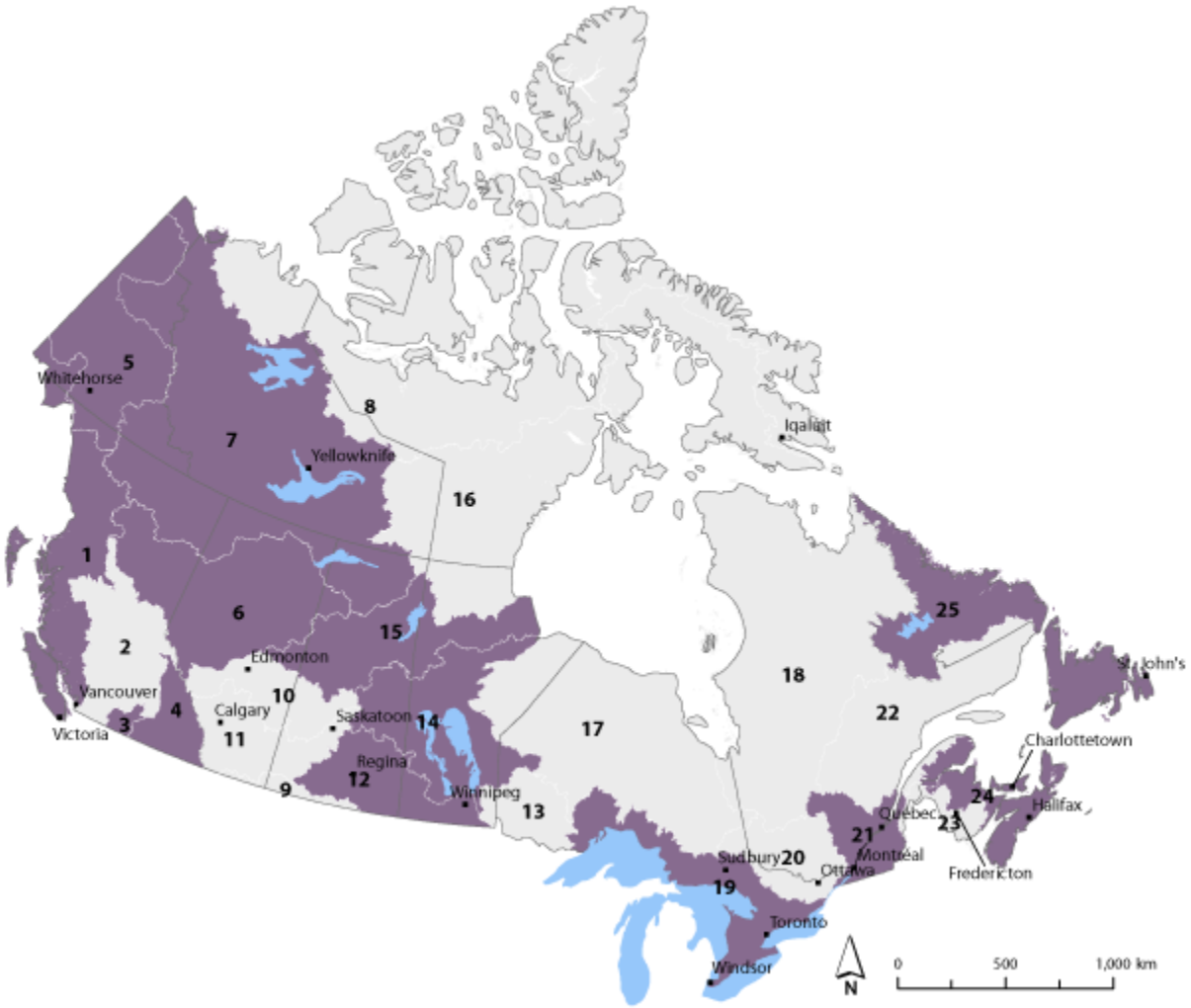


Table 3: Spatial coverage for PBDEs in fish, 2008 to 2010

Sampled drainage regions	Location	Province or territory
Pacific Coastal (1)	Frederic Lake	BC
Columbia (4)	Columbia River	BC
Yukon (5)	Lake Kusawa	YT
Peace–Athabasca (6)	Lake Athabasca	AB/SK
Lower Mackenzie (7)	Great Bear Lake	NT
Assiniboine–Red (12)	Lake Diefenbaker	SK
Lower Saskatchewan—Nelson (14)	Codette Reservoir	SK
	Lake Winnipeg	MB
Churchill (15)	Cold Lake	AB
	Reindeer Lake	SK
Great Lakes (19)	Lake Superior	ON
	Lake Huron	ON
	Lake Erie	ON
	Lake Ontario	ON
St. Lawrence (21)	Lake Champlain	QC
	St. Lawrence River Corridor	QC
Maritime Coastal (24)	Lake Kejimkujik	NS

Note: The numbers in parentheses refer to the number identifier of the drainage region in Figure 1.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

Table 4: Spatial coverage for PBDEs in sediment, 2007 to 2011

Sampled drainage region	Location	Province or territory
Pacific Coastal (1)	Frederick Lake	BC
	Deer Lake	BC
	Serpentine River	BC
	Still Creek	BC
Okanagan–Similkameen (3)	Osoyoos Lake	BC
Columbia (4)	Columbia River	BC
Yukon (5)	Lake Kusawa	YT
Assiniboine–Red (12)	Lake Diefenbaker	SK
Lower Saskatchewan–Nelson (14)	Codette Reservoir	SK
	Lake Winnipeg	MB
Great Lakes (19)	Lake Erie	ON
	Lake Ontario	ON
St. Lawrence (21)	Lake St–François	QC
	St. Lawrence River Corridor	QC
	Lake Saint-Pierre	QC
	St. Lawrence Estuary	QC
Maritime Coastal (24)	Lake Kejimkujik	NS
	Little Sackville	NS
	Nappan River	NS
Newfoundland—Labrador (25)	Waterford River	NL

Note: The numbers in parentheses refer to the number identifier of the drainage region in Figure 1.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

3.3 Temporal coverage
Three years of data, 2008-2010, are available for the "PBDEs in fish" indicator. For the "PBDEs in sediment" indicator, five years of data are available, 2007-2011.

3.4 Data completeness
The sampling locations for fish and sediment varied throughout the reporting years. Data for fish and sediments were gathered in as many drainage regions as permitted by program capacity in any year. To provide a better representation of each drainage region, all the samples for all the available years (2008-2010 for fish and 2007-2011 for sediment) were used to calculate the indicators.

3.5 Data timeliness
There is a time lag of one to two years between the sampling date and the publication of this indicator. This time lag is due to the time required to perform the monitoring, compile the data, and validate (quality assurance and control), analyze, review and report on the indicators.

4 Methods

4.1 Indicators calculation
The PBDEs in Fish and Sediment indicators present drainage regions by whether FEQGs have been exceeded for PBDEs in fish and sediment.

Monitoring for PBDEs in fish was conducted in 11 drainage regions between 2008 and 2010, and in 10 drainage regions for sediments between 2007 and 2011. Samples with PBDE concentrations above the guidelines are defined as an exceedance. Because PBDE guidelines are set by subgroup (PBDE homologue), the exceedances are presented by subgroup (see Tables 5 and 6).

Table 5: Sample size and number of fish per drainage region exceeding the PBDE FEQG by subgroup, 2008 to 2010

Sampled drainage regions	Sample size				
		tri BDE	tetra BDE	penta BDE	hexa BDE
Pacific Coastal (1)	19	0	0	1	0
Columbia (4)	26	0	0	26	0
Yukon (5)	40	0	0	16	0
Peace–Athabasca (6)	44	0	0	36	0
Lower Mackenzie (7)	29	0	0	4	0
Assiniboine—Red (12)	24	0	0	16	0
Lower Saskatchewan—Nelson (14)	53	0	0	20	0
Churchill (15)	80	0	0	58	0
Great Lakes (19)	149	0	6	149	0
St. Lawrence (21)	30	0	0	30	0
Maritime Coastal (24)	28	0	0	0	0

Note: Samples measurements were conducted in representative predatory fish (Lake Trout, Walleye, Cutthroat Trout, Rainbow Trout or Brook Trout). The numbers in parentheses refer to the number identifier of the drainage region in Figure 1.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

Table 6: Sample size and number of sediment samples per drainage region exceeding the PBDE FEQG by subgroup, 2007 to 2010

Sampled drainage regions	Sample size			
		triBDE	tetraBDE	pentaBDE
Pacific Coastal (1)	5	0	0	2
Okanagan—Similkameen (3)	2	0	0	0
Columbia (4)	2	0	0	0
Yukon (5)	1	0	0	0
Assiniboine–Red (12)	2	0	0	0
Lower Saskatchewan—Nelson (14)	3	0	0	2
Great Lakes (19)	34	0	0	14
St. Lawrence (21)	78	0	0	13
Maritime Coastal (24)	6	0	0	0
Newfoundland—Labrador (25)	2	0	0	0

Sampled drainage regions	Sample size			
		hexaBDE	octaBDE	decaBDE
Pacific Coastal (1)	5	0	0	1
Okanagan—Similkameen (3)	2	0	0	0
Columbia (4)	2	0	0	0
Yukon (5)	1	0	0	0
Assiniboine—Red (12)	2	0	0	0
Lower Saskatchewan–Nelson (14)	3	0	0	0
Great Lakes (19)	34	0	0	11
St. Lawrence (21)	78	0	0	14
Maritime Coastal (24)	6	0	0	0
Newfoundland—Labrador (25)	2	0	0	0

Note: Samples consist of surface sediment. The numbers in parentheses refer to the number identifier of the drainage region in Figure 1.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

More information on the sample sizes, frequency and the exceedances by location and year can be found in Appendices A and B.

To summarize the PBDEs in Fish and Sediment indicators, drainage regions with at least one exceedance are categorized as a "drainage region with at least one sample above the guideline." These indicators are summarized in Tables 7 (fish) and 8 (sediment). The number of drainage regions lower or equal to the FEQGs are also presented as supplementary information in these tables.

Table 7: Comparison between PBDE subgroup concentrations in fish and guidelines, 2008 to 2010

Sampled drainage regions	triBDE	tetraBDE	pentaBDE	hexaBDE
Pacific Coastal (1)	✓	✓	×	✓
Columbia (4)	✓	✓	×	✓
Yukon (5)	✓	✓	×	✓
Peace—Athabasca (6)	✓	✓	×	✓
Lower Mackenzie (7)	✓	✓	×	✓
Assiniboine—Red (12)	✓	✓	×	✓
Lower Saskatchewan-Nelson (14)	✓	✓	×	✓
Churchill (15)	✓	✓	×	✓
Great Lakes (19)	✓	×	×	✓
St. Lawrence (21)	✓	✓	×	✓
Maritime Coastal (24)	✓	✓	✓	✓
Total number of drainage regions	**11**	**11**	**11**	**11**
Number of drainage regions ≤ FEQG	**11**	**10**	**1**	**11**

Legend	
✓	No sample collected in the drainage region returned a concentration reading above the guideline.
×	At least one sample collected in the drainage region returned a concentration reading above the guideline.

Note: The numbers in parentheses refer to the number identifier of the drainage region in Figure 1.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

Table 8: Comparison between PBDE subgroup concentrations in sediment and guidelines, 2007 to 2011

Sampled drainage regions	tri BDE	tetra BDE	penta BDE	hexa BDE	octa BDE	deca BDE
Pacific Coastal (1)	✓	✓	×	✓	✓	×
Okanagan—Similkameen (3)	✓	✓	✓	✓	✓	✓
Columbia (4)	✓	✓	✓	✓	✓	✓
Yukon (5)	✓	✓	✓	✓	✓	✓
Assiniboine-Red (12)	✓	✓	✓	✓	✓	✓
Lower Saskatchewan-Nelson (14)	✓	✓	×	✓	✓	✓
Great Lakes (19)	✓	✓	×	✓	✓	×
St. Lawrence (21)	✓	✓	×	✓	✓	×
Maritime Coastal (24)	✓	✓	✓	✓	✓	✓
Newfoundland—Labrador (25)	✓	✓	✓	✓	✓	✓
Total number of drainage regions	**10**	**10**	**10**	**10**	**10**	**10**
Number of drainage regions ≤ FEQG	**10**	**10**	**6**	**10**	**10**	**7**

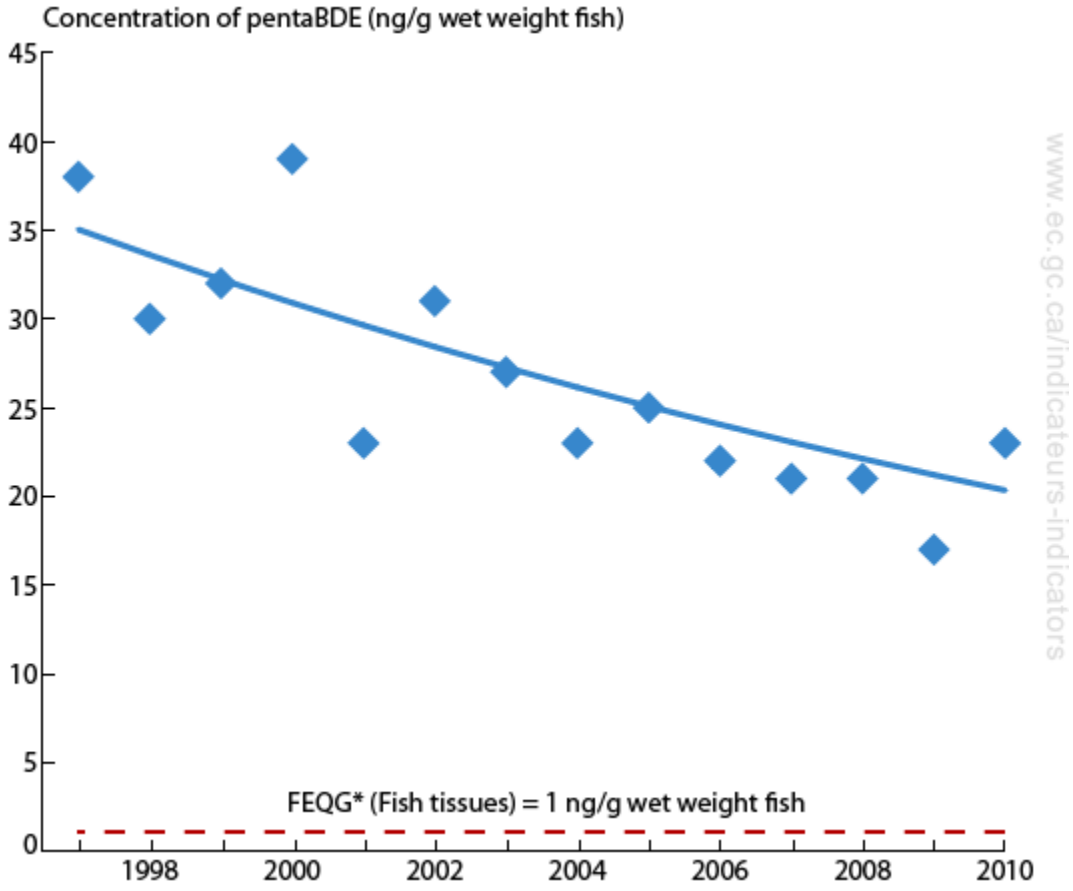
Legend	
✓	No sample collected in the drainage region returned a concentration reading above the guideline.
×	At least one sample collected in the drainage region returned a concentration reading above the guideline.

Note: The numbers in parentheses refer to the number identifier of the drainage region in Figure 1.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

4.2 PBDEs trends in fish from Lake Ontario

A retrospective analysis of PBDE concentrations in Lake Trout from Lake Ontario was completed using samples preserved in the National Aquatic Biological Specimen Bank, in order to extend the monitoring timeline back to 1997 (http://www.ec.gc.ca/inre-nwri/default.asp?lang=En&n=D488F7DE-1). Annual average concentrations of PBDE homologues were determined in whole Lake Trout samples. Only the pentaBDE levels exceeded the FEQGs.

Figure 2: PentaBDE concentrations in Lake Trout tissues from Lake Ontario, 1997 to 2010



Note: A statistically significant trend line is reported at the 95% confidence level. The trend curve line is $Y = 6.294218787 \bullet 10^{37} \bullet e^{(-0.0418X)}$ and the correlation coefficient is $R^2 = 0.618$.
* In 2010, Environment Canada has developed Federal Environmental Quality Guidelines (FEQGs) for PBDEs to assess the ecological significance of levels of PBDEs in the environment.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

The annual geometric average for pentaBDE concentration in Lake Trout is shown with a 95% confidence level. A statistically significant log-linear trend curve line is also provided. This line shows a 4% annual decreasing trend for the concentration of pentaBDE in fish tissues for the period 1997-2010.

Table 9: Average concentrations of pentaBDE in Lake Trout tissues from Lake Ontario, 1997 to 2010

Year	Number of samples	Average concentrations (ng/g wet weight)
1997	4	38
1998	4	30
1999	8	32
2000	7	39
2001	4	23
2002	4	31
2003	8	27
2004	8	23
2005	12	25
2006	14	22
2007	11	21
2008	24	21
2009	24	17
2010	10	23

Note: Geometric means were used for the average concentrations for pentaBDE.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

5 Caveats and limitations

Monitoring and surveillance of PBDEs in lakes and rivers under the CMP began in 2007 (except for Lake Ontario, which was initiated in the 1990s [retrospective study 1997-2010]) (http://www.chemicalsubstanceschimiques.gc.ca/plan/index-eng.php). As monitoring is not necessarily performed at the same location each year, because of challenges in obtaining fish or sediment samples due to remoteness, staffing issues, shipping logistics and resource constraints, a comparison from one year to the next at the national level is not yet possible. To address this limitation, the PBDEs in Fish and Sediment indicators are estimated by grouping the samples for all available years by drainage area (2008-2010 for PBDEs in fish and 2007-2011 in sediment).

6 References and further reading

Environment Canada (2010) Risk Management Strategy for Polybrominated Diphenyl Ethers (PBDEs). Retrieved in June 2012. Available from http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=34DCDBA9-9C86-4EB2-AA93-81B6755321F9.

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McGoldrick DJ et al (2010) Canada's national aquatic biological specimen bank and database. Journal of Great Lakes Research 36(2):393-398. Available from: www.sciencedirect.com/science/article/pii/S0380133010000407.

Appendix A - Number of samples, and samples that exceed the FEQGs per location for fish

Table A1: Number of fish samples and exceedances per location, 2008

Sampled drainage regions	Location	Sample size	tri BDE	tetra BDE	penta BDE	hexa BDE
Pacific Coastal	Frederic Lake	19	0	0	1	0
Columbia	Columbia River	14	0	0	14	0
Yukon	Lake Kusawa	20	0	0	6	0
Peace—Athabasca	Lake Athabasca	14	0	0	11	0
Lower Mackenzie	Great Bear Lake	19	0	0	4	0
Assiniboine—Red	Lake Diefenbaker	14	0	0	7	0
Lower Saskatchewan—Nelson	Codette Reservoir	9	0	0	9	0
	Lake Winnipeg	14	0	0	0	0
Churchill	Cold Lake	20	0	0	20	0
	Reindeer Lake	20	0	0	10	0
Great Lakes	Lake Superior	12	0	0	12	0
	Lake Huron	12	0	0	12	0
	Lake Erie	12	0	0	12	0
	Lake Ontario	24	0	2	24	0
St. Lawrence	Lake Champlain	10	0	0	10	0
	St. Lawrence River	10	0	0	10	0
Maritime Coastal	Lake Kejimkujik	13	0	0	0	0

Note: Concentrations were measured in representative predatory fish samples (Lake Trout, Walleye, Cutthroat Trout, Rainbow Trout or Brook Trout).
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

Table A2: Number of fish samples and exceedances per location, 2009

Sampled drainage regions	Location	Sample size	tri	tetra	penta	hexa

			BDE	BDE	BDE	BDE
Pacific Coastal	Frederic Lake	-	-	-	-	-
Columbia	Columbia River	12	0	0	12	0
Yukon	Lake Kusawa	10	0	0	5	0
Peace—Athabasca	Lake Athabasca	20	0	0	15	0
Lower Mackenzie	Great Bear Lake	10	0	0	0	0
Assiniboine–Red	Lake Diefenbaker	10	0	0	9	0
Lower Saskatchewan—Nelson	Codette Reservoir	10	0	0	10	0
	Lake Winnipeg	10	0	0	0	0
Churchill	Cold Lake	10	0	0	10	0
	Reindeer Lake	10	0	0	4	0
Great Lakes	Lake Superior	8	0	1	8	0
	Lake Huron	10	0	0	10	0
	Lake Erie	10	0	0	10	0
	Lake Ontario	21	0	1	21	0
St. Lawrence	Lake Champlain	-	-	-	-	-
	St. Lawrence River	10	0	0	10	0
Maritime Coastal	Lake Kejimkujik	15	0	0	0	0

Note: Concentrations were measured in representative predatory fish samples (Lake Trout, Walleye, Cutthroat Trout, Rainbow Trout or Brook Trout).
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

Table A3: Number of fish samples and exceedances per location, 2010

Sampled drainage regions	Sample location	Sample size	tri BDE	tetra BDE	penta BDE	hexa BDE
Pacific Coastal	Frederic Lake	-	-	-	-	-
Columbia	Columbia River	-	-	-	-	-
Yukon	Lake Kusawa	10	0	0	5	0
Peace—Athabasca	Lake Athabasca	10	0	0	10	0
Lower Mackenzie	Great Bear Lake	-	-	-	-	-
Assiniboine–Red	Lake Diefenbaker	-	-	-	-	-
Lower Saskatchewan—Nelson	Codette Reservoir	-	-	-	-	-
	Lake Winnipeg	10	0	0	1	0
Churchill	Cold Lake	10	0	0	10	0
	Reindeer Lake	10	0	0	4	0
Great Lakes	Lake Superior	10	0	1	10	0
	Lake Huron	10	0	0	10	0
	Lake Erie	10	0	0	10	0
	Lake Ontario	10	0	1	10	0
St. Lawrence	Lake Champlain	-	-	-	-	-
	St. Lawrence River	-	-	-	-	-
Maritime Coastal	Lake Kejimkujik	-	-	-	-	-

Note: Concentrations were measured in representative predatory fish samples (Lake Trout, Walleye, Cutthroat Trout, Rainbow Trout or Brook Trout).
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

Appendix B - Number of samples, and samples that exceed the FEQGs per location for sediment

Table B1: Number of sediment samples and exceedances per location, 2007 to 2008

Sampled drainage regions	Location	Sample size	tri BDE	tetra BDE	penta BDE	hexa BDE	octa BDE	deca BDE
Pacific Coastal	Frederick Lake	-	-	-	-	-	-	-
	Deer Lake	-	-	-	-	-	-	-
	Serpentine River	-	-	-	-	-	-	-
	Still Creek	-	-	-	-	-	-	-
Okanagan—Similkameen	Osoyoos Lake	-	-	-	-	-	-	-
Columbia	Columbia River	-	-	-	-	-	-	-
Yukon	Lake Kusawa	-	-	-	-	-	-	-
Assiniboine—Red	Lake Diefenbaker	-	-	-	-	-	-	-
Lower Saskatchewan—Nelson	Codette Reservoir	-	-	-	-	-	-	-
	Lake Winnipeg	-	-	-	-	-	-	-
Great Lakes	Lake Erie	-	-	-	-	-	-	-
	Lake Ontario	23	0	0	10	0	0	9
St. Lawrence	Lake St-François	-	-	-	-	-	-	-
	St. Lawrence R. Corridor	-	-	-	-	-	-	-
	Lake Saint-Pierre	-	-	-	-	-	-	-
	St. Lawrence Estuary	-	-	-	-	-	-	-
Maritime Coastal	Lake Kejimkujik	-	-	-	-	-	-	-
	Little Sackville	-	-	-	-	-	-	-
	Nappan River	-	-	-	-	-	-	-
Newfoundland—Labrador	Waterford River	-	-	-	-	-	-	-

Note: Samples are composed of surface sediment.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

Table B2: Number of sediment samples and exceedances per location, 2008 to 2009

Sampled drainage regions	Location	Sample size	tri	tetra	penta	hexa	octa	deca

			BDE	BDE	BDE	BDE	BDE	BDE
Pacific Coastal	Frederick Lake	1	0	0	0	0	0	0
	Deer Lake	1	0	0	0	0	0	0
	Serpentine River	-	-	-	-	-	-	-
	Still Creek	-	-	-	-	-	-	-
Okanagan–Similkameen	Osoyoos Lake	1	0	0	0	0	0	0
Columbia	Columbia River	1	0	0	0	0	0	0
Yukon	Lake Kusawa	1	0	0	0	0	0	0
Assiniboine—Red	Lake Diefenbaker	-	-	-	-	-	-	-
Lower Saskatchewan–Nelson	Codette Reservoir	-	-	-	-	-	-	-
	Lake Winnipeg	-	-	-	-	-	-	-
Great Lakes	Lake Erie	1	0	0	0	0	0	0
	Lake Ontario	4	0	0	2	0	0	2
St. Lawrence	Lake St-François	-	-	-	-	-	-	-
	St. Lawrence R. Corridor	-	-	-	-	-	-	-
	Lake Saint-Pierre	5	0	0	4	0	0	2
	St. Lawrence Estuary	-	-	-	-	-	-	-
Maritime Coastal	Lake Kejimkujik	1	0	0	0	0	0	0
	Little Sackville	1	0	0	0	0	0	0
	Nappan River	1	0	0	0	0	0	0
Newfoundland—Labrador	Waterford River	1	0	0	0	0	0	0

Note: Samples are composed of surface sediment.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

Table B3: Number of sediment samples and exceedances per location, 2009 to 2010

Sampled drainage regions	Location	Sample size	tri BDE	tetra BDE	penta BDE	hexa BDE	octa BDE	deca BDE
Pacific Coastal	Frederick Lake	1	0	0	0	0	0	0

Sampled drainage regions	Location	Sample size	tri BDE	tetra BDE	penta BDE	hexa BDE	octa BDE	deca BDE
	Deer Lake	-	-	-	-	-	-	-
	Serpentine River	1	0	0	1	0	0	0
	Still Creek	1	0	0	1	0	0	1
Okanagan—Similkameen	Osoyoos Lake	1	0	0	0	0	0	0
Columbia	Columbia River	1	0	0	0	0	0	0
Yukon	Lake Kusawa	-	-	-	-	-	-	-
Assiniboine—Red	Lake Diefenbaker	2	0	0	0	0	0	0
Lower Saskatchewan—Nelson	Codette Reservoir	2	0	0	2	0	0	0
	Lake Winnipeg	1	0	0	0	0	0	0
Great Lakes	Lake Erie	6	0	0	2	0	0	0
	Lake Ontario	-	-	-	-	-	-	-
St. Lawrence	Lake St-François	32	0	0	1	0	0	3
	St. Lawrence R. Corridor	1	0	0	0	0	0	0
	Lake Saint-Pierre	6	0	0	6	0	0	5
	St. Lawrence Estuary	-	-	-	-	-	-	-
Maritime Coastal	Lake Kejimkujik	-	-	-	-	-	-	-
	Little Sackville	1	0	0	0	0	0	0
	Nappan River	2	0	0	0	0	0	0
Newfoundland—Labrador	Waterford River	1	0	0	0	0	0	0

Note: Samples are composed of surface sediment.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

Table B4: Number of sediment samples and exceedances per location, 2010 to 2011

Sampled drainage regions	Location	Sample size	tri BDE	tetra BDE	penta BDE	hexa BDE	octa BDE	deca BDE
Pacific Coastal	Frederick Lake	-	-	-	-	-	-	-

	Deer Lake	-	-	-	-	-	-	-
	Serpentine River	-	-	-	-	-	-	-
	Still Creek	-	-	-	-	-	-	-
Okanagan—Similkameen	Osoyoos Lake	-	-	-	-	-	-	-
Columbia	Columbia River	-	-	-	-	-	-	-
Yukon	Lake Kusawa	-	-	-	-	-	-	-
Assiniboine—Red	Lake Diefenbaker	-	-	-	-	-	-	-
Lower Saskatchewan—Nelson	Codette Reservoir	-	-	-	-	-	-	-
	Lake Winnipeg	-	-	-	-	-	-	-
Great Lakes	Lake Erie	-	-	-	-	-	-	-
	Lake Ontario	-	-	-	-	-	-	-
St. Lawrence	Lake St-François	-	-	-	-	-	-	-
	St. Lawrence R. Corridor	14	0	0	2	0	0	4
	Lake Saint-Pierre	-	-	-	-	-	-	-
	St. Lawrence Estuary	20	0	0	0	0	0	0
Maritime Coastal	Lake Kejimkujik	-	-	-	-	-	-	-
	Little Sackville	-	-	-	-	-	-	-
	Nappan River	-	-	-	-	-	-	-
Newfoundland–Labrador	Waterford River	-	-	-	-	-	-	-

Note: Samples are composed of surface sediment.
Source: Environment Canada (2012) Chemicals Management Plan Environmental Monitoring and Surveillance Program.

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