Evaluation of the Effectiveness of Risk Management Measures for Lead

Executive Summary

Lead is a toxic substance under the *Canadian Environmental Protection Act, 1999* (CEPA), based on clear evidence of its negative effects on human health and the environment. Lead is found naturally in rock and soil, and it also has many uses in industry. Because of these natural and human-made sources, lead can be found all through the environment in Canada, in air, bodies of water, and soil, as well as in food and drinking water.

Over many years, the Government of Canada has worked to manage the risks for Canadians and the environment resulting from exposure to lead. In particular, these federal government efforts have been directed toward mining, steel manufacturing, smelting and refining of base metals, fuels, consumer products, cosmetics, drinking water, food, natural health products, therapeutic products, tobacco, and various environmental media, including household dust, soil and air.

This report reviews the performance of risk management activities on lead. It provides the status of emissions and releases of lead from human activities, outlines trends in environmental and food monitoring data and human biomonitoring data, and discusses how well the different actions taken by the Government to manage the risks of lead performed overall. The results presented in this report demonstrate that the federal risk management actions taken to reduce exposures to lead have led to considerable achievements toward minimizing the presence of lead in the Canadian environment and the exposure of Canadians to lead. Key findings include:

1. **Progress has been made in reducing releases of lead to the environment from human activities.** Between 2009 and 2017, Canadian emissions of lead to air decreased by 30%, and releases to water and land decreased by 44% and 56%, respectively. These substantial reductions in releases of lead have been achieved through numerous federal risk management measures focused on various industrial and other sectors.

2. **Lead concentrations in the environment have declined over time.** Monitoring data show that, overall, the amount of lead in air has declined since 2009 and that lead concentrations are not a concern in the water at any of the long-term monitoring sites. There have been mixed results regarding exposure of wildlife to lead. While lead levels in fish were lower at most locations, there were increases in some fish populations at certain sites. The causes for these increases are not fully understood, but the continued use of lead sinkers and jigs for fishing and lead shot for hunting may be a contributing factor.

3. **Canadians' exposure to lead has been reduced.** Considerable progress has been made in minimizing human exposure to lead through federal risk management measures focused on consumer products, foods, and other sources. Canadians' dietary exposure

to lead from foods sold in Canada decreased by approximately 8 fold between 1981 and 2000 and has remained at low, stable levels since that time. Biomonitoring studies confirm that blood lead levels, and therefore exposures to lead, in the general Canadian population are steadily decreasing. Between the 1970s and the first cycle of the Canadian Health Measures Survey (2007-2009) blood lead levels in the general population declined by over 70%. Between the first and fifth cycle of the Canadian Health Measures Survey (2009-2017), there was a statistically significant decline in blood lead levels. However, some northern and Inuit communities still have higher exposures, with lead-containing ammunition used for game hunting being the major source of exposure.

4. **Domestic controls have contributed to meeting the Government of Canada's overall risk management objective to reduce exposure to lead to the greatest extent feasible.** Success in reducing exposures to lead is evidenced by reductions in releases of lead to the environment, decreasing levels of lead in the environment from monitoring studies, and decreases in exposures to Canadians as shown by biomonitoring studies. The combination of the effects from the numerous domestic risk management measures have contributed to these reductions in exposure. In addition, evaluations of the performance of some individual risk management actions have demonstrated their contributions to reduce lead releases. For example, the goal of the *Pollution Prevention Notice for Base Metals Smelters* was met, with all facilities reaching their emission reduction targets. Monitoring of other domestic measures is ongoing in order to verify that the overall objective continues to be met.

5. **Additional risk management actions and ongoing performance measurement and monitoring activities are important to further protect Canadians and their environment from the harmful effects of lead.** Lead still poses some risk to the environment and human health in Canada. This is supported by the fact that current science cannot identify a level under which lead is no longer associated with adverse health effects. Domestic controls are reducing the risks of lead to the environment and human health, and these and other planned measures, should continue this trend. In support of this, environmental monitoring and human biomonitoring are important to assess how well these risks are being managed. In addition, performance measurement is important in determining the success of federal risk management actions and potential areas for improvement.

Based on the results in this report, the Government of Canada will continue its efforts in three main areas: monitoring lead levels in key environmental media as well as biomonitoring, managing risks associated with lead, and communicating with the public.

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1 Introduction

1.1 Sources and Exposure

Lead is a toxic substance under the *Canadian Environmental Protection Act, 1999* (Government of Canada, 1999) based on clear evidence of its harm to human health and the environment. Lead is found naturally in rock and soil, and is used in industrial processes. Due to a long history of global industrial and consumer use, and its naturally-occurring presence, lead can be found across Canada; in air, water, soil, as well as food and drinking water.

Exposure of Canadians to lead can occur from many different sources. The main route of exposure for the general adult population is ingestion from food and drinking water, followed by inhalation (ATSDR, 2007a; EFSA, 2010; Health Canada, 2013a). Inhalation is an important route of exposure for individuals living in the vicinity of a point source, that is, an identifiable local source of lead, such as an industrial stack (UNEP, 2010). Infants and children have different behaviours from adults, including crawling, greater frequency of hand-to-mouth contact, and mouthing behaviour (a tendency to eat non-food items such as soil or paint). Therefore, for infants and children, ingestion of non-food items contaminated with lead (e.g., household dust, lead-based paint, soil, consumer products), along with dietary intake through food and water, are the greatest sources of environmental exposure to lead.

Specific sources that may also contribute to lead exposure for the general population include ingestion of wild game harvested using lead ammunition and oral intake from products that could contain lead (e.g., costume jewellery, leaded crystal ware - that is glassware that contains lead, and art supplies). Other circumstances which could contribute to exposure to lead include living in or frequently visiting older buildings that contain deteriorating lead-based paint or lead water pipes, or that are undergoing renovation activities; living with someone with occupational (i.e., fire arm use) or recreational (i.e., stained glass-making, home-made ammunition or fishing weights) lead exposure; ingestion of certain vegetables grown in lead-contaminated soils, and behaviours such as smoking (CoEH, 2005; ATSDR, 2007a,b; Bushnik et al., 2010).

It is important to reduce exposure to lead and much as possible because the health effects of lead may occur even at low exposures. Lead can be harmful to the health of people of all ages, but children, infants and fetuses are most at risk because of their developing brains. The health effects of being exposed to lead are effects on neurological development and behavior in children, including reduction of intelligence quotient (IQ), and increased blood pressure and kidney problems in adults.

Fish and wildlife are also exposed to lead in the environment. Lead poisoning in these species can lead to blindness, muscle paralysis, reduced ability to reproduce, seizures and death (Scheuhammer, A.M., 2003). While industrial discharges of lead to water and air are a factor, the use of lead in products such as ammunition and fishing gear also contributes to exposure for fish and wildlife. Fish and birds may be exposed to lead when they mistake the small lead fishing sinkers and jigs for food, or when larger scavenger birds feed on wildlife remains left by

hunters using lead ammunition. This report will demonstrate the reduction of lead exposure from industrial sources in Canada and discuss ongoing work to reduce fish and wildlife exposure from products.

1.2 Government Approach to Lead Risk Management

Since the 1970's, the Canadian federal government has been working to reduce the risks for Canadians and the environment resulting from exposure to lead (Annex 1A). These federal government efforts have, in particular, been directed toward mining, steel manufacturing, smelting and refining of base metals, fuels, consumer products, cosmetics, drinking water, food, natural health products, therapeutic products, tobacco, and environmental media, including household dust, soil and air. Concentrations of lead in the environment and in food have been extensively measured and reported through national, provincial or municipal initiatives across Canada. The results have shown that levels of lead in food and most environmental media have declined over the past few decades. In addition, although lead is still widely detected in the Canadian population, levels in blood, which reflect Canadians exposure to lead, have fallen dramatically over this time. This decline since the 1970s can be attributed to the successful phase-out of lead in gasoline, paints, and solder used in food cans in addition to other government regulations and industry actions.

In 2013, Health Canada published its *Final Human Health State of the Science Report on Lead* (Health Canada, 2013a). This report documented the many harmful effects that lead causes on human health — including effects on the brain, heart, and kidneys, and to reproduction — at lower blood lead levels than previously thought. The report also showed that there was evidence that harm from lead can occur at blood lead levels below 5 µg/dL (micrograms per decilitre), and in some cases, as low as 1–2 µg/dL, which are levels within the range found in many Canadians. The report's conclusion was that additional measures were needed to further reduce exposures of Canadians to lead, with a particular focus on vulnerable populations. This led to the publication of the Government of Canada's *Risk Management Strategy for Lead* (the Strategy) (Health Canada, 2013b). The Strategy's goals are to protect Canadians and their environment from the risks of lead by reducing, as much as possible, both the lead that people are exposed to, and the lead that goes into the environment.

Following publication of the Strategy, the Government has continued to move forward with actions to further reduce lead. The current report evaluates the overall performance of risk management instruments for lead, and whether progress has been made in achieving the main objective of protecting Canadians and their environment. In particular, it reviews information collected on releases of lead into the environment, monitoring of lead in the environment, humans, consumer and other products, food, and drinking water. It also provides updates on key measures for managing the risks of lead from human activities with the largest environmental emissions and releases, such as in base metals smelting and refining, fuels, and commercial products, and discusses how well the different actions taken by the Government to manage the risks of lead have performed overall.

2 Emissions and Releases of Lead from Human Activities in Canada

Lead from human sources such as industrial processes, products containing lead, and waste can affect the amount of lead in the environment over time. The Strategy first looked at emissions and releases from 1970 to 2009. For this current report, to see how much lead was in the environment since 2009, Environment and Climate Change Canada collected information on these emissions and releases from the 2019 Air Pollutant Emissions Inventory (Environment and Climate Change Canada, 2019a) and the National Pollutant Release Inventory (Environment and Climate Change Canada, 2019b). Overall, the amount of lead released from human activities has declined over this period.

2.1 Air Emissions

Canada's Air Pollutant Emission Inventory is a comprehensive inventory of air pollutants at the national, provincial and territorial level. It compiles emissions of 17 air pollutants contributing to smog, acid rain and poor air quality with records beginning in 1990. According to the 2019 Air Pollutant Emissions Inventory Canadian lead emissions went down by 28% between 2009 and 2017, from 257.66 tonnes to 184.53 tonnes (Table 1). The likely cause of these reductions is the closure of plants that emitted significant amounts of lead, the use of new technologies to reduce emissions, and more use of best management practices. In both 2009 and 2017, most lead emissions to air were from non-ferrous (non-iron) smelting and refining; the next highest lead emissions were from airplane fuel (Figure 1).

The non-ferrous smelting and refining sector, the largest contributor of lead emissions, reported emissions of 158.05 tonnes in 2009, and 130.58 tonnes in 2017.

Lead emissions from the iron and steel and iron ore sectors were lower in 2009 due to lower than normal production levels for the sector, which may be attributed to the effect of the 2008-2009 economic recession.

Table 1. National lead emissions

Category/Sector	2009 (tonnes)	2017 (tonnes)	% Change
Air Transportation	40.52	31.78	-22%
Coal-Fired Electric Power Generation	2.07	1.09	-48%
Other Fuel Use[a]	2.29	1.94	-15%
Incineration and Waste	0.49	0.40	-18%
Manufacturing	11.48	3.66	-68%
Oil & Gas	1.28	0.52	-60%
Ores and Mineral Industries	197.03	142.48	-27%
Iron and Steel & Iron Ore[b]	*5.67*	*8.91*	*+57%*
Non-Ferrous Smelting & Refining	*158.05*	*130.58*	*-17%*
Mining & Rock Quarrying	*30.87*	*1.21*	*-96%*
Other[c]	*2.44*	*1.78*	*-27%*
Home Firewood Burning	2.47	2.61	+6%
Miscellaneous	0.03	0.05	+71%

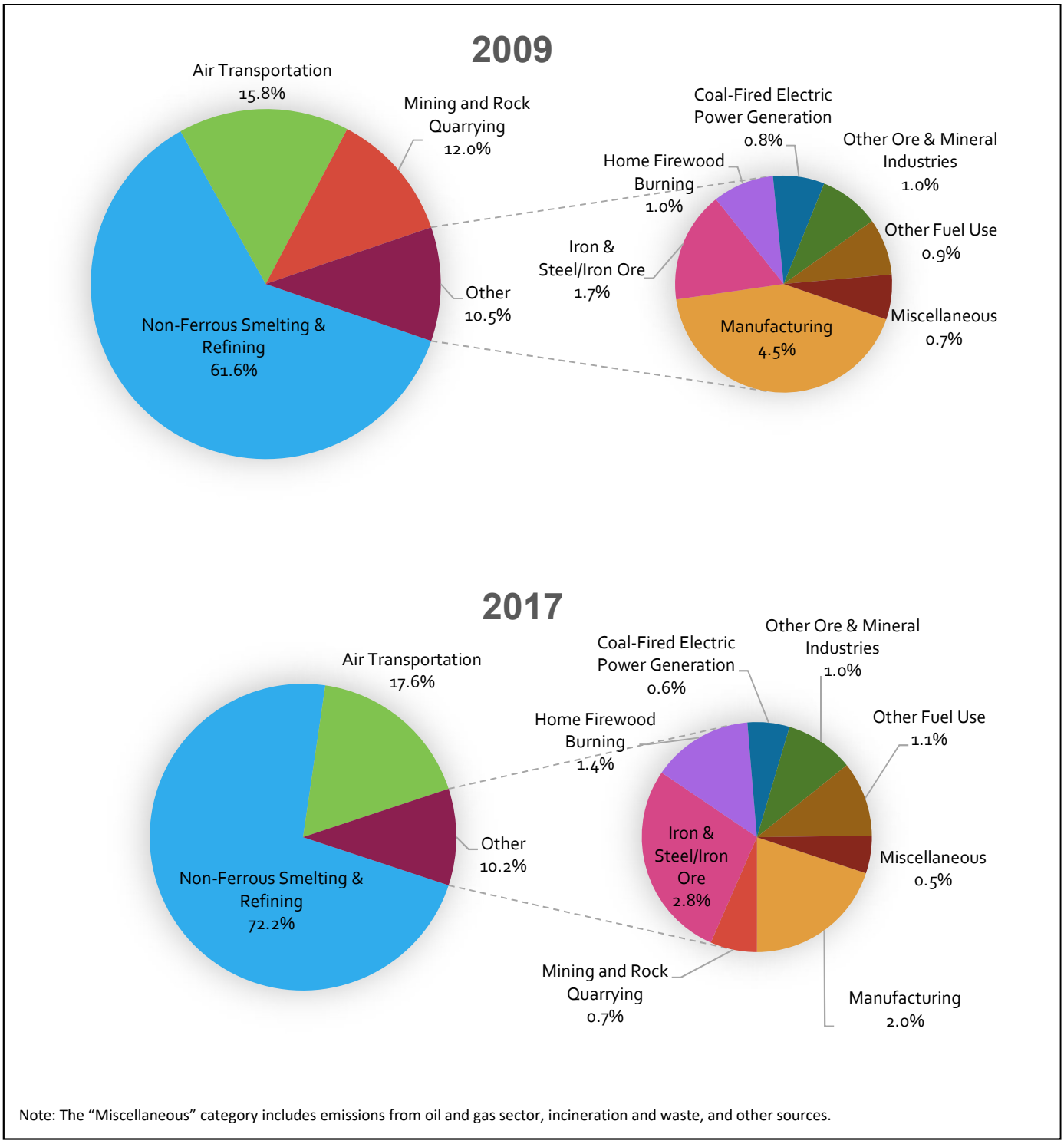
Total	**257.66**	**184.53**	**-28%**

Source: Environment and Climate Change Canada (2019a).

[a] Sum of APEI categories: Electric Power Generation (Diesel, Natural Gas, Waste Materials, Other), Transport (Marine Transportation & Rail transportation), Agriculture (Fuel Use), Commercial and Institutional (Fuel Combustion (Construction Fuel Combustion Commercial and Institutional Fuel Combustion, and Residential Fuel Combustion).

[b] Sum of APEI categories: Iron and Steel Industry, Iron Ore Mining and, from NPRI data, Iron Ore Pelletizing Industry.

[c] Sum of APEI categories: Asphalt Paving Industry, Cement and Concrete Industry, Foundries.



Note: The "Miscellaneous" category includes emissions from oil and gas sector, incineration and waste, and other sources.

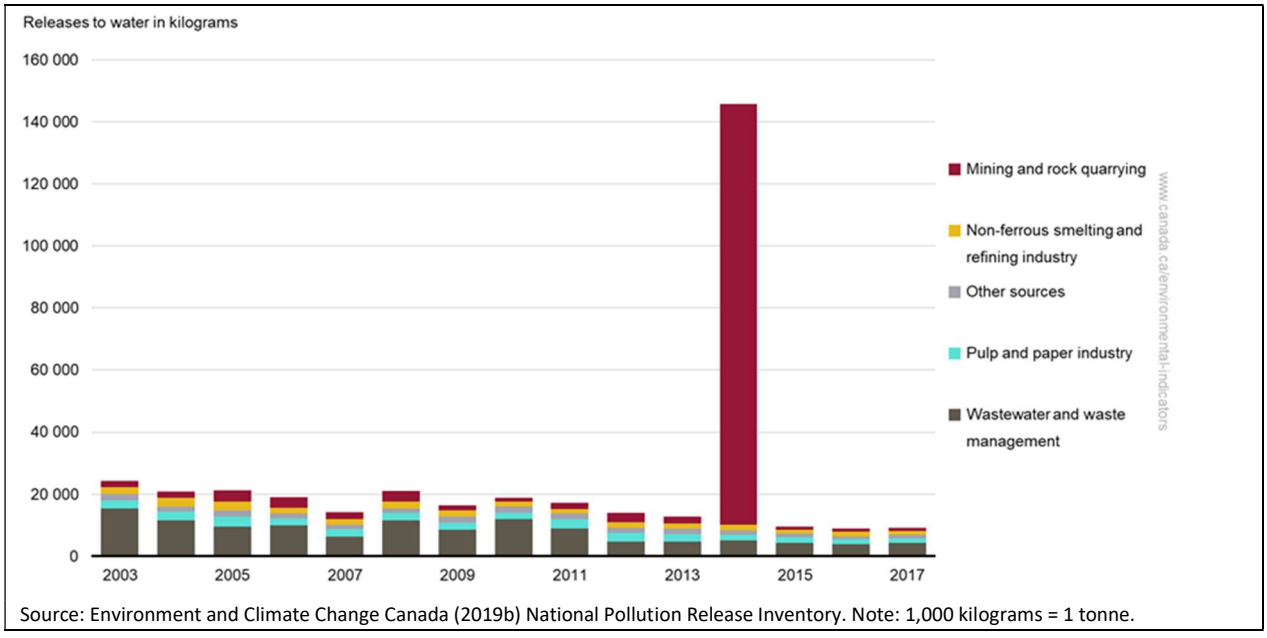
Figure 1. Lead emissions to air from sources in Canada in 2009 (257.66 tonnes) and 2017 (184.53 tonnes) (Environment and Climate Change Canada, 2019a)

2.2 Water Releases

Established in 1992, the National Pollutant Release Inventory is Canada's legislated, publicly accessible inventory of pollutant releases, disposals and recycling from industrial, commercial and institutional facilities. It collects information on more than 320 substances from over 7,000 reporting facilities.

According to the National Pollutant Release Inventory, the amount of lead released to water decreased by 44% between 2009 and 2017, from 16.46 tonnes to 9.15 tonnes. However, releases of lead were exceptionally high in 2014, at 145.71 tonnes. This was attributed to a dam break at the Mount Polley mine in central British Columbia, releasing mine waste contained in a tailings pond and causing 134.24 tonnes of lead to enter the environment.

In both 2009 and 2017, the largest source of releases of lead to water were wastewater treatment plants (Figure 2). It is important to note that wastewater treatment plants do not generate lead; the source of lead in wastewater treatment plant effluent is typically from industrial discharges to sewers. As old lead pipes corrode, they leach lead into the water supply which also add to the levels of lead in wastewater. The next largest sources of releases of lead to water were the pulp and paper and metals sectors. Between 2009 and 2017, releases of lead from both the wastewater and waste management sector and the non-ferrous smelting and refining industry declined by 48%, accounting for 4.11 tonnes and 1.03 tonnes respectively.



Source: Environment and Climate Change Canada (2019b) National Pollution Release Inventory. Note: 1,000 kilograms = 1 tonne.

Figure 2. Lead released to water.

2.3 Land Releases

Lead also enters the environment from releases to land, with the largest contribution to these being the use of lead ammunition at military shooting ranges (96% in 2017) (Environment and

Climate Change Canada, 2019b). Between 2009 and 2017, the National Pollutant Release Inventory indicates that reported lead releases to land were reduced by 56% from 159.79 tonnes to 70.81 tonnes. This reduction is largely due to the fact that military shooting ranges reduced their lead releases by 52% over this period (from 140.42 tonnes to 67.68 tonnes). Other reductions in releases of lead to land between 2009 and 2017 were achieved by explosives manufacturing facilities (from 17.64 to 0.09 tonnes), wastewater treatment facilities (from 0.85 to 0.36 tonnes) and the pulp and paper sector (from 2.25 to 1.06 tonnes) (Environment and Climate Change Canada, 2019b).

2.4 Conclusion

In summary, total releases of lead to air, water and land from human activities in Canada have decreased significantly since 2009. Ongoing management actions (Annex 1A) are expected to continue to result in further reductions from key sectors.

3 Monitoring of Lead in the Environment

Environment and Climate Change Canada regularly monitors the levels of lead in air, water, and wildlife across Canada by taking samples through several monitoring programs and in partnership with provinces and territories (Figure 3). In a country as large as Canada, it is not feasible to monitor lead levels everywhere. As a result, Environment and Climate Change Canada follows a risk-based approach. This means that sampling sites are often selected near areas likely to have impacts from current or historic sources of pollution, such as the Columbia River and Great Lakes area. Sites are also selected to help measure how well the Government's actions to manage the risks of chemicals from specific sectors are working.

The most up-to-date data are provided in this report, but because of how monitoring sites are selected as well as other limitations, it was not always possible to provide data for every year. Additionally, there were challenges in using data collected under current monitoring programs to find out if there are regional or national patterns and trends for lead levels in the environment. However, information from current monitoring can help us understand lead concentrations in air, water, and land, and provide a baseline, or reference point, that can be used in the future to assess how levels of lead in the environment change over time.

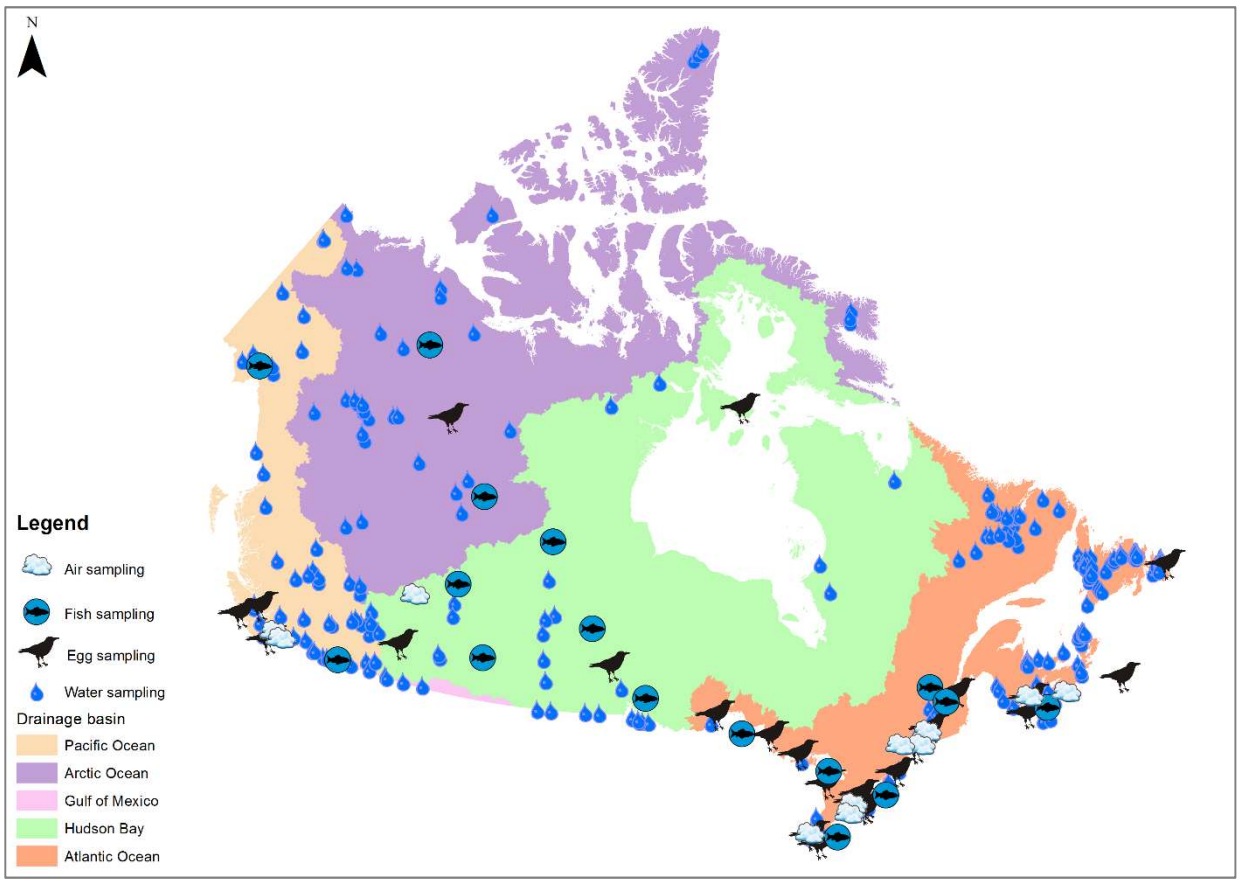


Figure 3. Lead monitoring locations in water, air, fish, and bird eggs.

3.1 Air

Most lead in the atmosphere is found in tiny particles (particulate matter or PM) that are 2.5 micrometres (µm) — that is, 2.5 millionths of a metre or smaller ($PM_{2.5}$). Under the National Air Pollution Surveillance Program, there are 14 monitoring sites that analyse metal concentrations in these tiny particles in a 24 hour period and can detect lead at very low levels.

Metals were analysed in $PM_{2.5}$ at five sites continuously between 2010[1] and 2018 (Saint John, NB; Montreal, QC; Windsor, ON; Burnaby, BC; and Edmonton, AB). The median concentration of lead in $PM_{2.5}$ at these sites combined declined by 50% over this time (Table 2). Using all measurements over the 2010 to 2018 timeframe, Windsor, ON had the highest median concentration of lead in $PM_{2.5}$ at 2.59 nanograms[2] per cubic metre (ng/m^3); while Saint John, NB had the lowest median concentration of lead at 0.55 ng/m^3.

The difference in lead levels in the air between locations and over time is due to many different factors, including surrounding land use and the movement of lead by wind and air

[1] The National Air Pollution Surveillance Program changed the way data was reported in 2010 and data prior to 2010 is not directly comparable with data after 2010. For this reason, 2010 was used as the starting year.

[2] A nanogram is equivalent to 1 billionth of a gram

currents. For example, it takes much longer for lead levels in the air to decrease in and around areas where lead has collected over many years. Lead particles in the air can also travel short distances before being deposited. One shortcoming of this analysis is that there are few monitoring stations in Prairie provinces and none in Northern Canada, resulting in information gaps for those areas. Another observation is that not all of the sites were active during the entire 2010–2018 time-period, and the trends in lead concentration in $PM_{2.5}$ can only be compared between sites that have data for the same years.

Table 2. Annual median lead concentrations in air from $PM_{2.5}$ (ng/m^3), 2010–2018

	2010	2011	2012	2013	2014	2015	2016	2017	2018
Halifax, NS			1.02	0.81	0.74	0.73	0.58	0.60	0.49
Saint John, NB	0.63	0.64	0.63	0.66	0.64	0.53	0.45	0.51	0.35
Montreal, QC	2.88	2.39	2.93		1.84	2.16	1.95	2.08	1.65
Saint-Anicet, QC					0.97	1.46	1.24	1.03	
Ottawa, ON			1.32	1.20	0.87	1.40	0.95	1.18	0.87
Windsor, ON	3.24	2.87	2.87	3.09	2.88	2.65	2.05	2.26	2.09
Hamilton, ON				2.09	2.02	2.59	1.65	1.68	1.74
Simcoe, ON					0.91	1.41	1.00	1.17	1.13
Toronto, ON (Downsview)								1.55	1.10
Toronto, ON (401 Roadside)								1.59	1.38
Edmonton, AB	0.86	0.76	0.76	0.66	0.88	0.54	0.35	0.43	0.38
Burnaby, BC	1.67	1.80	1.63	1.76	1.58	1.79	1.17	1.16	1.24
Abbotsford, BC			1.45	1.10	0.83	1.07	0.68	1.04	0.73
Vancouver, BC								1.35	1.31

Source: Environment and Climate Change Canada (2020a) National Air Pollutant Surveillance Program

There has also been a federal air monitoring program in the Great Lakes Region. Monitoring from this program shows that levels of lead in PM_{10} (particles that have a diameter of 10 µm or smaller) have been going down since 1988. In particular, between 2009 and 2017, average concentrations at the Point Petre monitoring station in Prince Edward County, Ontario fell from 1.8 ng/m^3 to 1.0 ng/m^3 (Environment and Climate Change Canada, 2020b).

There are no Canada-wide guidelines for lead in air. However, Alberta, Manitoba, Ontario, Quebec, and Newfoundland and Labrador have each established air quality standards for lead. Average measurements of lead in the air are compared to the standard developed by each province. The standards cannot always be directly compared because the period of time over which lead concentrations in the air are averaged varies from province to province.

Table 3. Air quality standards for lead in Canadian provinces

Province	1-hour standard (ug/m^3)	24-hour standard (ug/m^3)	30-day standard (ug/m^3)	Yearly standard
Alberta[a]	1.5			

Manitoba[b]		2.0	0.7	
Ontario[c]		0.5	0.2	
Quebec[d]				0.1
Newfoundland and Labrador[e]		2.0	0.7	

[a] Government of Alberta, 2019;
[b] Government of Manitoba, 2005;
[c] Government of Ontario, 2016;
[d] Ministère de l'Environnement et de la Lutte contre les changements climatiques, 2018;
[e] Government of Newfoundland, 2004

Between 2010 and 2018, there were no lead concentrations in Canada recorded by any National Air Pollution Surveillance Program station above any of the 24-hour guidelines out of 5,267 samples collected. Since the National Air Pollution Surveillance Program typically measures concentrations averaged over a 24-hour period every three days, it is only possible to compare data collected under this program with provinces who have a 24-hour standard.

3.2 Water

The Freshwater Quality Monitoring and Surveillance (FWQMS) program monitors water quality over long periods of time at hundreds of sites on federal lands, transboundary watersheds (areas of land that separate waters flowing to different rivers or other bodies of water that cross international boundaries), and inland waters in Canada. This work supports a number of departmental programs including the Chemicals Management Plan, a Government of Canada program to reduce the risks posed by chemicals to Canadians and the environment. Data collected from the FWQMS program are organized by drainage basins, which are areas of land where water from different sources runs into one water body, usually a large lake or ocean. Canada has five major drainage basins: Atlantic, Hudson Bay, Gulf of Mexico, Pacific, and Arctic.

Between 2009 and 2018, total lead (that is combined total of lead dissolved in the water and lead attached to particles in the water) was monitored at 312 sites across Canada. Both the number of sampling locations and how often the sampling is done vary from year to year, based on risk management factors. Sampling at some sites is done in rotation and does not happen every year. At 90 of these sites, samples were also analysed only for dissolved lead. Dissolved lead concentrations better represent the portion of total lead that can be readily absorbed by plants and animals, and so was of greater interest than total lead for this performance evaluation.

Water samples from all sites where dissolved lead, dissolved organic carbon (matter containing carbon that can pass through a very fine filter between 0.22 and 0.7µm), and pH (a measure of how acidic the water is) were measured and compared against the draft *Federal Water Quality Guideline* (described in section 5.11). The Guideline requires data on dissolved organic carbon and pH, which scientists consider to be the main influences in determining the toxicity of lead in water. Of more than 7,030 samples taken between 2009 and 2018, dissolved lead concentrations were higher than the guidelines only twice — both of these samples were taken at one Arctic drainage basin site with naturally occurring high levels of metals. For this

reason, these two high lead readings do not suggest that added risk management actions are needed.

3.3 Wastewater

Wastewater treatment plants are sampled under the Government of Canada's Chemicals Management Plan Environmental Monitoring and Surveillance Program. From 2009 to 2011, a total of 191 raw influent (wastewater flowing into treatment plants) and 191 samples of final effluent (treated wastewater released into bodies of water) were analyzed for total lead in wastewater. Lead was found in 62% of the raw influent samples (maximum concentration, 47.8 µg/L) and 26% of the final effluent samples (maximum concentration, 4.94 µg/L). These results show that while wastewater sometimes contains lead, typical wastewater treatment processes remove most of it. However, the lead that is removed from wastewater ends up in sludge (biosolids) during wastewater treatment processes and may reach the environment if the sludge is spread on agricultural land as fertilizer, or incinerated.

3.4 Fish and Wildlife

3.4.1 *Aquatic Monitoring and Surveillance*

Fish are monitored for contaminants on a rotating basis at many places across Canada through the Chemicals Management Plan Environmental Monitoring and Surveillance Program. At each monitoring site, 10–20 top predator fish (typically trout and walleye) are caught and their tissues are analyzed.

Between the 2009 and 2015 monitoring periods, median lead concentrations in fish tissue went down at 10 out of 15 sites sampled by Environment and Climate Change Canada (Table 4). The decreases were statistically significant at all sites except for Cold Lake, Great Bear Lake, Lake Winnange, and Lake Diefenbaker. No changes in lead concentration were found at Kusawa Lake. The four sites where median lead concentration went up were Lake Superior, Lake Erie, Lake Winnipeg, and the St. Lawrence River. The increases were statistically significant in Lake Superior, Lake Erie, and the St. Lawrence River.

How lead behaves chemically and how it moves through the environment are both complex questions. Without further investigation of each sampling location, it will remain unclear whether the higher lead tissue concentrations found in some species of fish in certain water bodies in 2014/15 compared to the 2009/10 sampling period are suggestive of longer-term increases in lead levels or were one-off events. Since there are no tissue guidelines to provide context for lead levels in fish, it is difficult to draw conclusions at present on how lead concentrations in fish tissue affect the long-term health and survival of the fish. There is also the question of how concentrations in fish relate to concentrations of dissolved lead found in the surrounding environment.

Table 4. Median lead concentrations (mg/kg) in fish tissue in 2009/10 and 2014/15

	2009/10	2014/15	Change

		mg/kg ± IQR	*n*	mg/kg ± IQR	*n*	mg/kg
Trout	Cold Lake, AB	0.007 ± 0.010	*20*	0.002 ± 0.002	*10*	**-0.005**
	Great Bear Lake, NWT	0.005 ± 0.005	*20*	0.004 ± 0.003	*10*	**-0.001**
	Kejimkujik Lake, NS	0.279 ± 0.152	*10*	0.079 ± 0.045	*7*	**-0.200***
	Kusawa Lake, YT	0.005 ± 0.011	*10*	0.005 ± 0.002	*10*	**0**
	Lake Athabasca, SK/AB	0.011 ± 0.015	*40*	0.004 ± 0.006	*10*	**-0.007***
	Lake Erie, ON	0.014 ± 0.012	*17*	0.007 ± 0.004	*10*	**-0.007***
	Lake Huron, ON	0.011 ± 0.005	*11*	0.007 ± 0.006	*17*	**-0.004***
	Lake Ontario, ON	0.011 ± 0.010	*61*	0.004 ± 0.008	*30*	**-0.007***
	Lake Superior, ON	0.010 ± 0.007	*52*	0.016 ± 0.011	*20*	**+0.006***
	Lake Winnange, ON	0.008 ± 0.004	*4*	0.007 ± 0.012	*15*	**-0.001**
	Reindeer Lake, SK/MB	0.012 ± 0.008	*21*	0.003 ± 0.006	*10*	**-0.008***
Walleye	Columbia River, BC	0.033 ± 0.020	*10*	0.017 ± 0.011	*10*	**-0.016***
	Lake Diefenbaker, SK	0.014 ± 0.018	*10*	0.011 ± 0.003	*10*	**-0.003**
	Lake Erie, ON	0.008 ± 0.003	*26*	0.016 ± 0.009	*19*	**+0.008***
	Lake Winnipeg, MB	0.003 ± 0.008	*10*	0.009 ± 0.003	*10*	**+0.006**
	St Lawrence River, QC	0.003 ± 0.002	*10*	0.007 ± 0.008	*7*	**+0.004***

Source: ECCC internal data; * indicates that lead concentrations in fish tissue concentrations changed significantly ($p < 0.05$) between 2009/10 and 2014/15; n = sample size; IQR= Inter-quartile ratio, which represents the range for the middle 50% of sample values (an indication of the range or spread of values measured at a site).

3.4.2 *Monitoring and Surveillance on Land*

Government of Canada studies on land-based lead effects were done mostly in the 1990s. Between 1983 and 1995, an estimated 29% of common loon deaths in Ontario and the Atlantic provinces were the result of lead poisoning or swallowing lead sinkers or jigs (Scheuhammer, 2003). In Ontario, British Columbia and the Prairies there have been studies that monitored lead in the livers and kidneys of dead birds of prey from the late 1980s to early 2000s. These studies found many cases of lead poisoning (Martin et al. 2018; Wayland, et al., 2003; Scheuhammer et al., 2003). This was the case for 23% (10/43) of the bald eagles examined in Ontario, and for 6.4% of 546 bald and golden eagles in western Canada, although 15% of them had elevated levels of lead in their tissues (Wayland et al., 2003). The high levels of lead in dead birds of prey is likely due to the use of lead ammunition in upland hunting[3] since these birds eat animal remains left behind by hunters.

In 2018, a new cross-Canada study led by the federal government was initiated to see if there has been a change over time in lead levels and poisonings in land-based scavenger birds such as eagles and vultures. This is of particular interest compared to the use of lead shot in waterfowl, which was banned in 1999, to the continued use of lead ammunition in upland hunting in Canada.

[3] Upland hunting refers to hunting of non-waterfowl birds including quail, pheasant, grouse, and others.

3.5 Conclusion

The evidence presented indicates a considerable reduction in levels of lead in ambient air across Canada since 2010. Regarding water quality, monitoring shows that lead concentrations in water bodies throughout Canada are generally below the draft *Federal Water Quality Guideline*. Wastewater treatment plants have also demonstrated their effectiveness in removing most of the lead from the wastewater that they treat; however, the lead removed ends up in sewage sludge, which can still enter the environment if it is spread over land or incinerated. While lead levels in fish decreased at most sampling locations in Canada from 2009 to 2015, it is not possible to draw conclusions on trends in lead concentrations in fish at the current time. Trends in lead levels in scavenger birds are being studied in the cross-Canada survey initiated in 2018.

The monitoring data outlined above show that there has been progress in achieving the goal of minimizing lead in the environment, but that more work needs to be done. Long-term monitoring activities are needed to better understand the trends in lead levels observed in the environment, particularly if observed trends in lead levels are linked to human activities or if they are due to natural ecosystem cycling. Future performance measurement assessments will also need long-term monitoring data to show further progress in reducing lead in the environment.

4 Biomonitoring of Lead

4.1 General Canadian Population

The most direct way to measure the amount of lead that people in Canada have been exposed to is through human biomonitoring (monitoring of a substance in the human body). Biomonitoring measures the total exposure from various routes and sources of exposure to lead. The biomonitoring studies described below show that the amount of lead that Canadians have in their bodies has been decreasing significantly over the past several decades.

Exposure to lead is commonly evaluated using levels of lead in blood. In Canada, blood lead levels are measured as part of the ongoing Canadian Health Measures Survey (CHMS), which typically includes 5,000–6,000 Canadians. From 2007 to 2009, the first cycle of the CHMS, the survey measured blood lead levels at the national level for the first time in 30 years, with the results published in August 2010 (Bushnik et al., 2010; Health Canada, 2010). The geometric mean blood lead level for Canadians aged 6–79 was 1.3 µg/dL. These results showed a large decline — over 70% — in blood lead levels since the 1970s, and that under 1% of Canadians aged 6–79 had blood lead concentrations at or above the Health Canada intervention level of 10 µg/dL, compared to about 27% in the 1970s. This decline can be linked to the phase-out of lead in gasoline, lead-based paints, and lead solder used in food cans, in addition to other government and industry actions over the past 30 years.

Blood lead levels in the Canadian population aged 6–79 years declined significantly between 2007 and 2017. Data from the second (2009–2011), third (2012–2013), fourth (2014–2015), and most recently fifth (2016–2017) cycles of the CHMS show geometric means of 1.2, 1.1,

0.96, and 0.94 µg/dL (Figure 4a). Beginning in the second cycle, the CHMS included children aged 3–5 years. Blood lead results for Canadians aged 3–79 years, as well as separately for ages 3–5, 6–11, 12–19, 20–39, 40–59, and 60–79 years are available in the second (Health Canada, 2013c), third (Health Canada, 2015), fourth (Health Canada, 2017), and fifth (Health Canada, 2019a) reports on human biomonitoring of environmental chemicals in Canada (Figure 4b). The significance of measuring levels in separate age groups is that each group has significantly different behavioural and physical metrics which can make lead exposure more impactful.

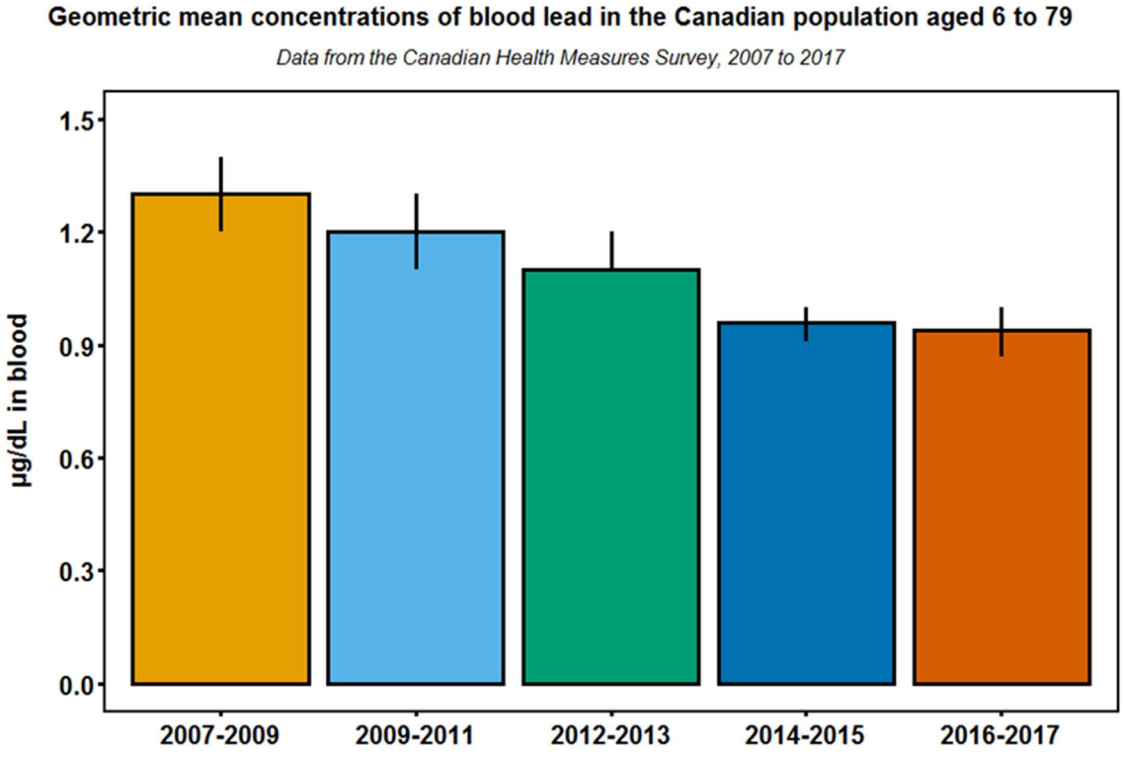


Figure 4a. Comparison of geometric mean blood lead levels in the Canadian population.

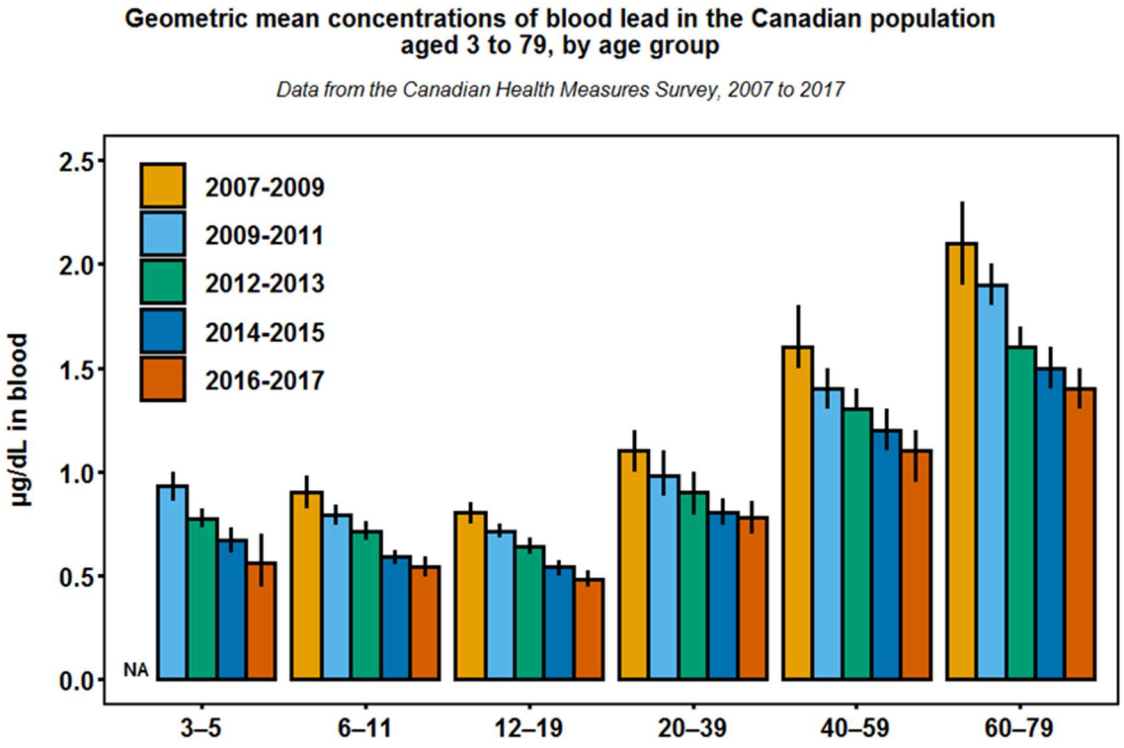


Figure 4b. Comparison of geometric mean blood lead levels in the Canadian population, by age group.

Information about blood lead levels in pregnant women is being provided by another national-level study. This is the Maternal–Infant Research on Environmental Chemicals Study (MIREC), which recruited pregnant women between 2008 and 2011. The results of this national-level cohort study of close to 2,000 women across Canada, showed a median first trimester maternal blood lead concentration of 0.6 µg/dL, which dropped to 0.56 µg/dL by the third trimester (Arbuckle et al., 2016). Cord blood also showed elevated lead levels over that of maternal blood, with a median level of 0.77 µg/dL. These results possibly suggest a transfer of lead stored in mothers' bones into her blood, due to increased calcium demand during pregnancy, and subsequent transfer of this lead over time to the foetus. In addition, a comparison of blood metal concentrations (including lead) in pregnant women from various countries, with those of the MIREC study, showed that the Canadian subjects tended to have among the lowest geometric means. Among children 2-5 years (average age 3.25 years), the blood lead concentrations ranged from 0.14 to 5.49 µg/dL, with a median concentration of 0.66 µg/dL (Ashley-Martin et al., 2019).

In addition, results of a study on bone lead, supported by Canada's Chemicals Management Plan, were published in 2017 (Behinaein et al., 2017). The cross-sectional study recruited participants between the ages of 1 and 82 from the general population living in Toronto, between 2009 – 2011. This study confirmed that there were differences in tibia bone lead, heel bone lead and whole blood lead concentrations in those over 50 years of age (Behinaein

et al., 2017). In addition, the study also suggests a marked decline, by over 50%, in population bone lead levels in Canada over the past two decades (McNeil et al., 2018).

At the same time, a pair of studies supported by the Chemicals Management Plan focussing on women of child-bearing age in Canada who were born in Asia, particularly South Asia, have shown higher blood lead levels than Canadian-born women. The exposure was related to the use of imported cosmetics, jewellery and other traditional products containing lead (Dix-Cooper and Kosatsky, 2018; Parnia et al., 2018). In the MIREC Study, pregnant women born in Canada had significantly lower geometric mean blood lead concentrations than women born in Africa, Asia, the Caribbean, Eastern Europe and Europe (Arbuckle et al. 2016).

4.2 Indigenous Communities

Exposure to lead in northern Canadian communities is also decreasing. The Northern Contaminants Program has funded human health and biomonitoring since the late 1990s. Results from baseline studies undertaken in the late 1990s showed that 3%–19% of participating pregnant Inuit women in the Inuvialuit Settlement Region, Nunavut, and Nunavik had blood lead levels above the blood lead intervention level of 10 µg/dL (Donaldson et al., 2010). In follow-up studies conducted between 2004 and 2007 (and up to 2013 in Nunavik), blood lead levels in mothers declined in these Arctic regions over this time period, with none of the levels exceeding the blood lead intervention level (Donaldson et al. 2010; AMAP, 2015). No exceedances were observed in women of child bearing age in the 2007-2008 Inuit Health Survey, except for Nunavut (2.2%) (AMAP, 2015).

In addition to blood lead biomonitoring among pregnant women, biomonitoring data for adult Inuit men and women were collected during the Inuit Health Survey 2007-2008 (Inuit Health Survey, 2012; Canadian Arctic Contaminants Assessment Report, 2017) in three regions of the Inuit Nunangat, specifically the Inuvialuit Settlement Region, Nunavut, and Nunatsiavut. Blood lead levels were typically higher in adult men compared to adult women. Similar findings have been observed in Nunavik (Gibson et al. 2016). While percentages vary by region, overall exceedances of the blood lead intervention level (10 µg/dL or 100 µg/L) were observed among 10.1% of men (18-89 years), and 5.5% of women (18-90 years) (AMAP 2015). In a follow-up study, Fillion et al. (2014) found a mean blood lead level of 4.3 ug/dL in Nunavik.

There is sufficient evidence to describe lead blood level trends over time in Nunavik. These data show declines of blood lead levels in Inuit mothers (see Figure 5) and in Inuit men and women (Donaldson et al., 2010; AMAP, 2015). Monitoring of Inuit mothers in Nunavik between 2007 and 2013 indicates that average blood lead levels remain steady, below the current intervention level, and appear similar to levels observed in 2004 (AMAP, 2015). In a study of three Nunavik Inuit communities, it was observed that there was a significant decrease of cord blood lead concentrations after a public health intervention to reduce the use of lead shot for hunting in the 1990s (Levesque et al., 2003).

Lead exposure remains an issue in the north, particularly with respect to the continued use of lead ammunition for hunting. In a study in Nunavut, Fillion et al. (2014) found major

exposures traced to lead input into house dust from lead paint and ammunition. In addition, the presence of industrial facilities on or immediately adjacent to an Indigenous community, can also be a source of exposure to pollutants including lead.

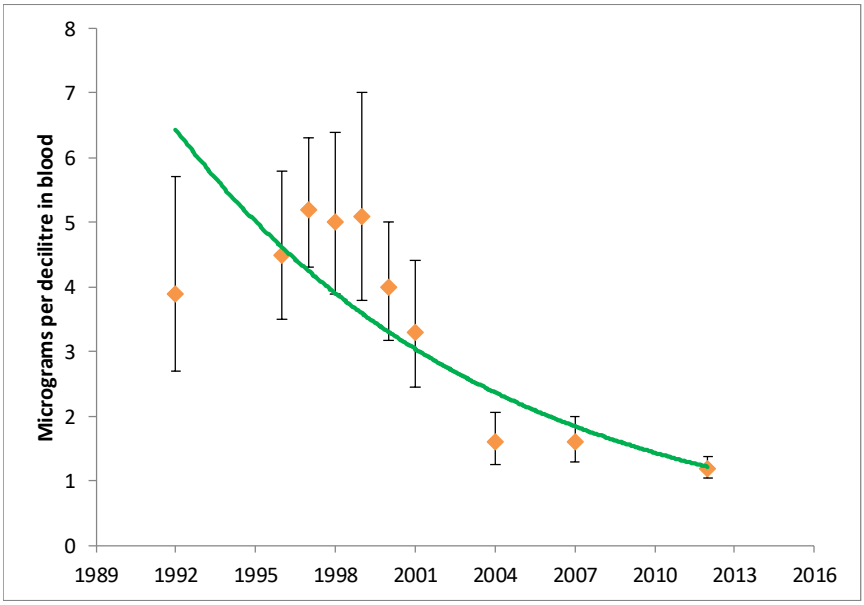


Figure 5: Trends in lead concentrations (ug/dL) in pregnant Inuit women from Nunavik, Canada (AMAP, 2015).

Blood lead data have also been collected for First Nations peoples. The First Nations Biomonitoring Initiative gathered data on First Nations adults (those over 20) living on reserves with the goal of identifying additional risks to vulnerable groups in this population. The JES!-YEH! First Nations Youth, Environment and Health Pilot Project of four communities in Québec was conducted in 2015. All 198 participants (3-19 years) had blood lead levels below the blood lead intervention level of 10 µg/dL. However, due to the study design requiring the use of volunteers, the data for the population aged 3-19 years in these communities is not necessarily representative and should be interpreted with caution (Lemire et al., 2019).

Another project, the First Nations Food Nutrition and Environment Study (2018), has released results from British Columbia (2008/2009), Manitoba (2010), Ontario (2011/2012), the Atlantic Region (2014), Alberta (2013), Saskatchewan (2015), and Quebec (2016). The study has found that, in each region, there are elevated levels of lead in game meat hunted with lead shot. This is consistent with another recent study of a First Nations community in Ontario, which found lead exposure 1.7 times higher than in the general Canadian population, with lead-containing ammunition being a major source of this exposure (Juric et al., 2018).

4.3 Conclusion

The biomonitoring studies have shown progress toward the goal of minimizing Canadians' exposure to lead, as evidenced by the significant reduction in the body burden of lead in

Canadians over the past several decades. Between the 1970s and the first cycle of the Canadian Health Measures Survey (2007-2009), blood lead levels in the general Canadian population declined by over 70%. Between the first and fifth cycle of the Canadian Health Measures Survey (2007-2017), blood lead levels have continued to decline. As well, exposure to lead in northern Canadian communities is also decreasing as evidenced by regional Inuit health studies and the Northern Contaminants Program-funded projects.

5 Progress on Domestic Risk Management Actions

As part of the *Risk Management Strategy for Lead*, the Government of Canada outlined existing risk management actions and proposed additional measures. The full list of domestic risk management actions is provided in Annex 1A. The following section gives an overview on the progress of risk management actions since 2009.

5.1 Base Metals Smelting and Refining

Base metals smelting and refining is the extraction and refining, generally through high-temperature chemical processes, of at least one of cobalt, copper, lead, nickel and zinc from raw materials that come primarily from ore. Primary smelting and refining processes produce metals directly from ore concentrates, while secondary processes produce metals from scrap and process waste. Base metals smelting and refining facilities release particulate matter (that is, particles) containing lead and other metals into the air. Because of the composition of the particulate matter that this sector releases, the Government has been working to reduce pollution from it since the mid-1970s.

5.1.1 *Pollution Prevention Planning Notice*

In 2006, the Government of Canada published its *Notice requiring the preparation and implementation of pollution prevention plans in respect of specified toxic substances released from base metals smelters and refineries and zinc plants* under the *Canadian Environmental Protection Act, 1999*. This notice required the base metals smelting and refining sector to prepare and implement "pollution prevention plans" by December 31, 2015. These plans were to use the best available techniques to prevent and control pollution in order to avoid or minimize pollutants and waste, and reduce risk to the environment or human health. Substances covered by the plans included lead. Under this pollution prevention planning notice, annual air release limit targets for particulate matter were identified for specific facilities for 2008 and 2015. Some facilities applied for, and were granted extensions (*Canada Gazette*, Part 1, Vol. 150, No. 5) until December 31, 2018 to implement their pollution prevention plans. Particulate matter can contain metals, including lead.

In developing and implementing their pollution prevention plans, facilities needed to consider the recommendations of the *Strategic Options for the Management of Toxic Substances from the Base Metals Sector*. The report recommended that total releases of metals (arsenic, cadmium, lead, mercury and nickel) from the sector be reduced from 1988 levels by 80% as of 2008, and by 90% beyond 2008. A total metals reduction of 86% was achieved in 2008 and has been greater than 90% since 2010.

As part of the Notice, facilities were also required to consider and report annually on progress towards implementing the 38 recommendations of the *Environmental Code of Practice for Base Metal Smelters and Refineries*. Annual reports from 2015 indicated that 5 facilities implemented 70% of the recommendations, and 3 facilities that had previously implemented their pollution prevention plans had implemented 83% of the recommendations. As of December 31, 2018, all the facilities had considered the factors listed in the Notice and implemented their plans air release limit targets.

Facility reports for the notice show that between 2005 and 2017, releases of lead from the base metals smelting sector declined by 29% and releases of particulate matter declined by 62%. A final report, showing progress to the end of 2018, is under preparation.

5.1.2 *Performance Agreements*

On January 5, 2018, Environment and Climate Change Canada published Performance Agreements that focus on air pollutants from 11 base metals facilities owned by 5 companies. These agreements, part of Canada's Air Quality Management System, were intended to implement the base-level industrial emissions requirements for base metals smelting and refining facilities, for sulfur dioxide and particulate matter. Specific agreements between Environment and Climate Change Canada and these 5 companies are in effect from January 5, 2018 to December 31, 2025.

These companies have agreed to achieve and maintain the emissions requirements for sulphur dioxide and particulate matter. They will make continual improvements (where reasonably feasible). In addition, these companies committed to reducing emissions of metals and fugitive particulate matter (that is, particulate matter which escapes into the atmosphere rather than being released in a controlled way). The companies also agreed to continue to implement recommendations from the *Environmental Code of Practice for Base Metals Smelters and Refineries*. Achieving the facility-specific particulate matter targets is expected to reduce overall particulate matter containing metals (including lead).

Reports submitted to Environment and Climate Change Canada in 2018 for the 2017 reporting year showed that the eight facilities with a due date of January 5, 2018, met their particulate matter intensity targets (intensity targets were defined as kilograms of particulate matter released per metric tonne of product). The remaining three facilities have a due date of January 1, 2019 to meet their particulate matter intensity targets (reports will be provided later in 2020). Although more data is needed to see how well these agreements have worked, annual reports will help to measure progress in meeting the base-level industrial emissions requirements. Continuing implementation of these agreements is expected to result in further reductions of lead and particulate matter.

5.1.3 *Secondary Lead Smelter Release Regulations*

The *Secondary Lead Smelter Release Regulations* set limits on the concentration of particulate matter containing lead and the concentration of lead released to the air by secondary lead smelters that recycle scrap lead (e.g., used lead-acid batteries). These regulations are

currently being reviewed under Environment and Climate Change Canada's Regulatory Stock Review Plan.

5.2 Electrical Power Generation

5.2.1 *Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations*

These *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations* were published in September 2012 and came into force on July 1, 2015. They set a performance standard of 420 tonnes of carbon dioxide per gigawatt hour of electricity produced. The standard applies to new coal-fired electricity plants commissioned on or after July 1, 2015 and to existing units that have reached the end of their useful life as defined by the Regulations (generally 45 to 50 years). Because lead is released during the combustion of coal, lead will also be reduced when facilities close.

In December 2018, the Government of Canada published amendments to these regulations to speed up the phase-out of traditional coal-fired electricity by 2030. By then, most facilities are expected to be shut down, transitioned to firing or co-firing with lower emitting fuels, or converted to a carbon capture and storage system in order to meet the standard. In most cases, the more likely option is the closure of facilities, which would mitigate emissions of lead.

Environment and Climate Change Canada estimates that over the 2019-2030 period, coal-fired power plant closures have the potential to prevent the release of approximately 6 tonnes of lead to air, water and land (cumulative). The majority of emissions reductions will occur in the period of 2020-2030, with only relatively small reductions having occurred before then.

More data are needed to evaluate the success of these regulations. Emissions from this sector will continue to be monitored through reporting required under the National Pollutant Release Inventory, and the Air Pollutants Emissions Inventory will be kept updated for coal-fired electric power generation until this activity is phased out in Canada.

5.3 Lead in Gasoline

Lead has historically been added to gasoline as a way to prevent engine damage. As evidence of the negative impacts of lead exposure on human health has become clearer over the past few decades, the use of lead in gasoline has been reduced or eliminated.

5.3.1 *Gasoline Regulations*

The *Gasoline Regulations* came into force on December 1, 1990, and set a maximum concentration of lead in gasoline produced, imported or sold in Canada at 5 mg/L, among other requirements. Since then, lead emissions from gasoline have been reduced significantly. In addition, the widespread use of unleaded gasoline has led to new technologies (e.g., catalytic converters) that have significantly reduced releases of smog-causing pollutants. Currently, 99.8% of gasoline in Canada is estimated to be lead-free.

The 1990 regulations exempted certain uses of lead in gasoline: use in piston-engine aircraft (because of technical requirements) and use in competition vehicles, which was exempted from 1994 to 2009. The end date to this temporary exemption was removed in the 2010 *Regulations Amending the Gasoline Regulations,* although it was accompanied by a Government of Canada commitment to encourage the racing industry to voluntarily reduce and phase out leaded racing fuel. To support this commitment, Environment and Climate Change Canada developed a work plan (available upon request) that identified actions to be undertaken by the Department, including monitoring trends, assessing new technologies and fuels, and working with the racing industry on reducing and phasing out leaded racing fuel.

Work to date has focused on monitoring trends and assessing technologies and fuels. Reporting under the federal *Gasoline Regulations* indicates that volumes of leaded gasoline for competition vehicles remain at about 1 million litres per year. Leaded gasoline continues to be used in competition vehicles as certain types of amateur racing (dragsters, off-road racing) still allow leaded gasoline, and a suitable replacement has not yet been found. However, Environment and Climate Change Canada will be assessing whether the efforts of the Piston Aviation Fuels Initiative to find a suitable replacement for leaded aviation gasoline (as described below) can be applied to competition vehicles. In this work, Environment and Climate Change Canada will be collaborating with the U.S. EPA, U.S. state governments, and the racing community on the phase-out of leaded racing gasoline.

Currently, gasoline used in general aviation also remains exempt from lead limits. It is only aircraft used in general aviation, the majority of which are piston-powered, that use leaded gasoline. This is because these aircraft engines require high octane fuel, which is still only produced with lead additives. Since serious safety and airworthiness concerns are raised by the use of a grade of fuel different from that for which the aircraft engine was designed, such concerns have remained a higher priority than the reduction of lead in these fuels.

However, there have been efforts to develop and use an unleaded aviation gasoline for the existing piston-engine aircraft fleet by the government-industry Piston Aviation Fuels Initiative which was created in 2012 by the U.S. Federal Aviation Administration (U.S. Federal Aviation Administration, 2019). Canada's National Research Council have actively engaged with the Piston Aviation Fuels Initiative with the support of Transport Canada, Environment and Climate Change Canada, and the Canadian Owners and Pilots Association, as well as conducted some independent tests to find a suitable unleaded replacement fuel for use in piston engine aircraft. This has involved full-scale engine testing in the National Research Council altitude chamber and flight testing with the National Research Council Harvard aircraft. The testing has involved evaluating the effects of the fuel on engine/aircraft performance, operability and emissions.

Despite these efforts, the Government of Canada is not planning to remove the exemption for the leaded gasoline used in piston-powered aircraft until a suitable replacement for the lead in this gasoline becomes available and these aircraft and their engines are certified to use it.

The Government of Canada will continue to monitor and support international efforts to phase out lead in gasoline used in piston-powered aircraft.

5.4 Lead in Commercial Products

Lead is useful for manufacturing many commercial products such as pipes and sheeting and for use as filler in the automobile body industry. In Canada, the major use of lead is for lead-acid batteries used in automobiles; these batteries account for the most significant proportion of global lead consumption. Lead is also used in ammunition, fishing weights, and solder. Lead pigments are added to glass to prevent radiation exposure from television and computer screens, to storage containers for nuclear waste, and to x-ray shielding aprons.

Products containing lead must be disposed of carefully to avoid contaminating the environment. When products such as waste oil, coloured newsprint, battery casings or lead-painted wood are burned, lead fumes or particles are released into the air and may be inhaled. Lead particles are also released into the air from the use of lead ammunition. In addition, when batteries and leaded paint scrapings are thrown out and make their way into landfills, or when lead ammunition, sinkers and jiggers are left in the environment, they create a lead reservoir that slowly leaches into soils, sediments, and water.

5.4.1 *Lead Ammunition and Sinkers and Jigs*

In response to recommendations made in the *Risk Management Strategy for Lead*, Environment and Climate Change Canada commissioned two studies on lead in certain products in Canada, which were both completed in March 2017. One study reviewed the use of lead ammunition and non-lead alternatives in non-military activities [PDF], while the other study was on lead sinkers and jigs and their non-lead alternatives [PDF]. The two studies gathered use pattern, cost, toxicity and background information on lead ammunition and sinkers and jigs, respectively. The studies found that each year, approximately 5,200 tonnes of lead is released to the environment from shooting activities, and about 460 tonnes of lead enters the environment from fishing. Fishing represents the largest source of lead releases to the aquatic environment. Both studies found that lead products still dominate the Canadian market, even though lead-free alternatives are now available. The studies were published in the spring of 2018 to allow the public to provide feedback by June 1, 2018. Environment and Climate Change Canada intends to publish responses to comments received on the studies along with consultation documents on options for reducing lead releases from the use of ammunition and from the use of lead sinkers and jigs in 2020.

Some commenters on the ammunition study questioned whether lead from recreational shooting ranges was actually bioavailable — that is, taken into, processed, or stored in the body. This question was addressed in another study that Environment and Climate Change Canada commissioned, which was completed in December 2018. This study looked at what is known about the bioavailability of lead that enters the environment from ammunition used at recreational shooting ranges — including its bioavailability in soil and other media. This study showed that spent lead ammunition at recreational shooting ranges may indeed pose a risk to the environment. The study also highlights how the risks posed by lead from shooting ranges

involve many different physical, chemical, and environmental factors, some specific to a site. The lead bioavailability study will be published in 2020.

5.4.2 *Lead Wheel Weights*

Environment and Climate Change Canada is developing *Regulations Prohibiting the Manufacture and Import of Lead Wheel Weights in Canada*, which ban the manufacture and import of wheel weights containing more than 0.1% lead by weight for use on motor vehicles in Canada. These regulations are expected to reduce lead emissions by 114 tonnes per year. Environment and Climate Change Canada anticipates that the proposed regulations will be published in *Canada Gazette,* Part I, in 2020.

5.4.3 *Lead Sheeting in the Building Industry*

Lead sheeting has a number of uses. In Canada, it is used mainly for radiation protection, although it is also used in the building industry, for flashing, cladding and roofing. For radiation protection, lead sheeting remains the cheapest and most effective material to meet the standards set in various building and safety codes. Lead used for these applications can also generally be recovered and recycled.

For health and safety reasons especially, lead sheeting is expected to remain the most common material for radiation protection, with demand expected to remain constant over the next 5–10 years. However, according to a study on use patterns, market conditions, and environmental and health effects of lead sheeting used in the Canadian construction industry, there are already alternatives to lead sheeting for flashing, roofing and cladding. As a result, industry has begun moving to these alternatives where they are technically and economically feasible; and the Canadian demand for lead sheeting in building applications is expected to decline further over the next 10 years. Given the small amounts and the limited exposure potential in the current Canadian context, the Government of Canada is not planning to take further action at the moment on lead sheeting in the building industry.

5.5 Lead in Consumer Products

Health Canada sets stringent lead content limits for consumer products under the *Canada Consumer Product Safety Act* (CCPSA) and its regulations, including products intended for use in learning or play (toys) for children under three years of age, children's jewellery, consumer paints and other surface coatings, products whose normal use involves mouth contact, kettles, corded window coverings, and glazed ceramic and glass foodware, as well as for applied surface coatings on toys, children's furniture and other articles, cribs, cradles, bassinets, carriages, strollers, pencils, and artists' brushes. The CCPSA also prohibits the manufacture, import, advertisement or sale of consumer products that are a danger to human health or safety.

Recently, additional measures to further reduce exposures of Canadian children to lead were brought forward. Under its Lead Risk Reduction Strategy for Consumer Products, the Government expanded and increased its lead content restrictions for products that are most likely to pose an exposure risk to children, namely toys for children aged 3 to 14, children's

jewellery, child care products, and children's clothing and accessories. Regulatory initiatives were published for stakeholder consultations in the *Canada Gazette*, Part I, on December 3, 2016. On May 2, 2018, the new *Consumer Products Containing Lead Regulations* as well as the updated *Children's Jewellery Regulations* were published in the *Canada Gazette*, Part II. Both regulations improve protection of children from lead exposure in consumer products.

5.6 Lead in Natural Health Products

Health Canada had set a tolerable limit (that is, an absolute limit on the acceptable amount) for lead in finished natural health products of 0.29 µg/kg of body weight per day (Health Canada, 2007). This is based on the daily intake standard of 0.02 mg/day that was established by NSF International (formerly the National Sanitation Foundation) (NSF/ANSI 173, 2010). The product licence holder is responsible for ensuring that each batch of a natural health product is tested to meet Health Canada's requirements before the product is sold. If the amount of chemical contaminants exceeds Health Canada's tolerance limits the product is considered contaminated and may not be sold.

Subsequently, the Canadian *Quality of Natural Health Products Guide* lowered the limit for lead to under 10 µg/day (or 0.14 µg/kg of body weight per day), based on new international guidance.

Currently, Health Canada Guidance is being further revised to align with the newest internationally accepted levels for lead focused on health impacts on newborn to 7 year old children. This could potentially result in the adoption of a less than 5 µg/day limit, which is half the current limit for lead in finished natural health products. While revisions (to guidance of this nature) would serve to lessen potential risks posed by current natural health products, these would be subject to the normal consultative process prior to implementation by Health Canada.

5.7 Lead in Food

5.7.1 *Commercial Food*

Due to its natural presence in the environment, lead occurs naturally at low levels in foods due to its uptake from soil into plants, from water and sediments into fish, and animals that consume them. Health Canada continues to monitor the concentrations of various chemicals, including lead, in foods through its ongoing Total Diet Study surveys (TDS) and also conducts targeted surveys of lead in specific foods. Additionally, the Canadian Food Inspection Agency carries out monitoring and surveillance work for lead in foods, including those commonly consumed by infants and children.

Canadians' dietary exposure to lead from foods available for sale in Canada (i.e., retail foods) decreased by approximately 8-fold between 1981 and 2000 and has remained at low, stable levels since that time (Health Canada, 2019b). Ongoing monitoring data collected through Health Canada's TDS and by the Canadian Food Inspection Agency also demonstrates that levels of lead in retail foods have remained consistently low since the early 2000's. As outlined

in the *Risk Management Strategy for Lead*, Health Canada continues to work to ensure that dietary exposure to lead is as low as reasonably achievable by, for example, monitoring the levels of lead in foods and assessing trends in dietary lead exposure over time, identifying and controlling specific sources of lead contamination in the food supply, and updating existing maximum levels (MLs) for lead in food.

Health Canada's *List of Contaminants and Other Adulterating Substances in Foods* includes MLs for lead in foods sold in Canada, under the *Food and Drug Regulations*. Health Canada updated the MLs for lead in fruit juice, fruit nectar, and water in sealed containers (bottled water) in 2018. In 2020, Health Canada updated the ML for infant formula. The Department is systematically working to lower the other existing MLs for lead in foods included in this list in accordance with international guidelines.

5.7.2 *Additional Sources of Lead in Food*

Lead may also be introduced to foods from the use of lead-containing dishware such as lead-glazed pottery or lead crystalware. The preparation of foods with water containing lead can also introduce lead to foods. Consuming wild game that has been shot with lead bullets is another potential source of dietary lead exposure. Reducing the use of lead ammunition is especially important for managing exposure to lead in Indigenous communities which harvest and eat wild game. In addition, the Government of Canada's website *Reduce Your Exposure to Lead* advises people to use non-lead ammunition and shot when hunting for food, and not to eat wild game that has been shot with lead ammunition.

5.8 House Dust

Health Canada initiated a study on the development of dust screening concentrations for a number of substances, including lead, for residential and commercial settings that may be affected by contaminated sites. This work is intended to provide a national baseline to be used for a guideline on acceptable lead levels in residential dust, helping to identify increased exposure to lead in indoor environments and subsequent needs to reduce the risk posed by this exposure.

In 2013, the *Canadian House Dust Study* provided nationally representative dust lead concentrations, floor dust lead loadings and lead loading rates (that is, the amount of lead deposited in dust on a surface area over a certain amount of time). These population-based percentile values for concentrations of lead and other substances in household dust were required for the development of dust screening concentrations (Rasmussen et al., 2011; 2013). The Canadian finding that dust mass (rather than lead concentration) has the greater influence on lead load (Rasmussen et al., 2013) was consistent with a previous study in high-risk urban communities in California, and supports Health Canada's recommendations to minimize dust levels in order to reduce lead exposure.

The national baseline levels for lead in settled dust provide a basis for comparison for local residential or individual studies. Comparison values are important tools for determining the need for risk management for substances like lead for which current science cannot identify a

level under which lead is no longer associated with adverse health effects. Health Canada's survey led to work with the US Environmental Protection Agency (US EPA) in 2014-2015 to combine the Canadian House Dust Study data with two smaller US sets of data. The combined set of data was first used to support the 2014 U.S. EPA *Framework for Identifying and Evaluating Lead-Based Paint Hazards from Renovation, Repair, and Painting Activities in Public and Commercial Buildings* (US EPA, 2015), and other US EPA publications. Subsequently, in 2018 a new U.S. lead-loading guideline of 10 µg/ft^2 for floors was proposed, along with outreach efforts to inform architecture groups and the general public about the risks of exposure to lead in dust.

Data on Canadian homes from the Canadian House Dust Study were compared against the new U.S. lead-loading guideline of 10 µg/ft^2. Given that 94% of the Canadian homes were below the new U.S. guideline, it was concluded that the new U.S. lead loading guideline of 10 µg/ft^2 for floors also provides a meaningful national baseline threshold suitable for a residential lead guideline in Canada.

Currently, Health Canada is developing a Canadian House Dust Study data repository that will enable researchers and risk managers to combine information about the Canadian House Dust Study homes, such as a house's age, heating style, construction materials, floor coverings, and environmental setting, with the lead datasets. This will allow the identification of exposure sources and trends. As well, data on nationally-representative levels of contaminants, such as lead, both concentrations and loadings, will help estimate general population exposures, as well as exposures to vulnerable populations, especially children.

5.9 Blood Lead Guidance

The Federal-Provincial-Territorial (FPT) Committee on Health and the Environment (CHE) initiated a revision of the *1994 Update of Evidence for Low-Level Effects of Lead and Blood Lead Intervention Levels and Strategies* (Health Canada, 1994). This revision was triggered by new evidence which indicates that adverse effects are occurring at levels of exposure below the current intervention level of 10 µg/dL published in the 1994 document. The revised guidance will provide health care practitioners and public health officials with guidance on choosing actions that are appropriate for the management of specific blood lead levels. Anticipatory and preventive measures that can be taken to effectively decrease blood lead levels at the individual, sub-population, and community level will be proposed for use, when interventions to reduce atypical exposures to lead are indicated.

The revision is being led by a committee of medical practitioners, an ad-hoc working group of the FPT CHE, with review and input from Health Canada. Since 2013, this group has been working with Health Canada toward the finalization of the blood lead guidance documentation. The draft guidance documentation, *Blood Lead Testing - Indications and Interpretation: A Guide for Health Care Providers*, was endorsed in 2016 by the Council of Chief Medical Officers of Health and is still currently under development.

5.10 Drinking Water Guidelines and Standards

As current science cannot identify a level under which lead is no longer associated with adverse health effects, the risk management objective in this effort is that lead concentrations in drinking water should be kept as low as reasonably achievable (ALARA). In Canada, lead is not usually found in natural water or in water from drinking water treatment plants. However, lead can enter drinking water if it is released from parts of distribution or plumbing systems. An important consideration for reducing exposure to lead is to address leaching from these materials through health-based and plumbing standards. Health Canada has been an active participant on the technical committee of the American Society of Mechanical Engineers, and the Canadian Standards Association (CSA), for the development of plumbing and supply fitting standards (CSA 2018a,b). The 2012 version of these standards included low-lead requirements which were incorporated into the 2015 National Plumbing Code. In addition, the most recent versions of CSA standards for thermoplastic pressure piping and backflow preventers now include the low-lead requirement. Health Canada continues its active participation in the development and revision of plumbing standards. The lead content and lead leaching requirements continue to be implemented by certification bodies when certifying products to these standards.

Health Canada establishes and periodically reviews and updates guidelines for contaminants, including lead, in Canadian drinking water, and publishes them in the *Guidelines for Canadian Drinking Water Quality*. Accordingly, several years ago, Health Canada initiated a review of its then current guideline value or maximum acceptable concentration (MAC) for lead of 10 µg/L. This review specifically addressed exposure from drinking water, including sampling and monitoring strategies, and was conducted in collaboration with the *Federal-Provincial-Territorial Committee on Drinking Water*, to include peer review and public consultation.

The public consultation concluded on March 15, 2017 and consultation comments were addressed. This guideline technical document reviewed and assessed all identified health risks associated with lead in drinking water, including new studies and approaches and took into consideration the availability and limitations of appropriate treatment and analytical technologies. The revised MAC of 5 µg/L (0.005 mg/L) for total lead in drinking water was published on March 8, 2019 and is based on a sample of water taken at the tap and using the appropriate protocol for the type of building being sampled (Health Canada, 2019c).

5.11 Environmental Quality Guidelines

Environmental quality guidelines set a threshold value for lead, which is the maximum amount of lead that can be present in the environment where it is unlikely to have harmful effects on plants and animals. By comparing environmental monitoring data to this value, it is possible to see if the Government of Canada is meeting its goal of reducing lead in the environment and if lead is posing any risk to the environment.

The Canadian Council of Ministers of the Environment, which is made up of federal, provincial and territorial environment ministers, issues the *Canadian Environmental Quality Guidelines* for water, sediment, tissue, and soil quality (including groundwater and soil vapour). The

guidelines may be applied across Canada; however, individual provinces and territories are encouraged to develop their own Environmental Quality Guidelines to meet their specific needs and are advised to follow the Canadian Council of Ministers of the Environment methodologies for guideline development to the greatest extent possible.

Another set of guidelines, the *Federal Environmental Quality Guidelines*, are created by Environment and Climate Change Canada. These are similar to the Canadian Council of Ministers of the Environment Guidelines in that they are benchmarks for environmental quality based on toxicological effects data (data related to the harmful effects of a particular substance). The *Federal Environmental Quality Guidelines* help to:

- prevent pollution by setting targets for environmental quality;
- assess whether concentrations of certain chemicals in the environment are significant; and
- assess the effectiveness of the risk management actions for lead and other chemicals.

5.11.1 *National Water Quality Guidelines for Lead*

The *Canadian Water Quality Guidelines* were first published by the Canadian Council of Resource and Environment Ministers[4] in 1987 as national guidelines for total lead concentrations in Canadian surface water. There are different values for waters of different hardness (the concentration of calcium carbonate, $CaCO_3$, in water) (Table 5) because lead is less toxic in waters with high water hardness values.

Table 6. *Canadian Water Quality Guidelines* values (µg/L) for total lead in water for the protection of aquatic life at selected hardness values

Concentration of lead (µg/L)	**Hardness (mg/L as $CaCO_3$)**
1	0-60 (soft)
2	60-120 (medium)*
4	120-180 (hard)*
7	> 180 (very hard)

*For water hardness between 60 and 180, the guideline value is calculated using the equation [lead µg/L] = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$

The draft Federal Water Quality Guideline for Lead is specific to dissolved lead. It was developed to support government initiatives such as the *Risk Management Strategy for Lead* and other monitoring activities. Since dissolved organic carbon and water hardness can change how toxic lead is, the guideline is calculated specifically for each site (Table 7) and the value of water hardness (Environment and Climate Change Canada, 2019c). These values are fully protective of all forms of aquatic life. The values are currently draft, but are not expected to change, and should be finalized in May 2020.

Table 7. Draft *Federal Water Quality Guideline* values (µg/L) for dissolved lead in water for the protection of aquatic life at selected dissolved organic carbon and hardness values

Dissolved	**Hardness (mg/L as $CaCO_3$)**					
Organic	**50**	**100**	**200**	**300**	**400**	**500**

[4] The Canadian Council of Resource and Environment Ministers became the Canadian Council of Ministers of the Environment

Carbon (mg/L)						
0.5	2.5	2.8	3.3	3.6	3.8	4.0
2	5.0	5.8	6.7	7.3	7.8	8.2
5	8.0	9.3	10.8	11.7	12.5	13.1
10	11.4	13.3	15.4	16.8	17.8	18.7
20	16.3	18.9	22.0	24.0	25.5	26.7
30	20.0	23.3	27.0	29.5	31.4	33.0

The draft *Federal Water Quality Guideline* is calculated using the following equation: exp(0.514[ln(DOC)] + 0.214[ln(Hardness)] + 0.4152)

5.11.2 *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health*

The *Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health* help to minimize human exposure to lead in soil. In 1999, Canada's soil quality guidelines for protecting human health were 140 mg/kg for residential and 740 mg/kg for industrial land soils. It should be noted that the Canadian Council of Ministers of the Environment is in the process of updating the guidelines for lead in soil.

5.11.3 *Environmental Quality Guidelines at Contaminated Sites*

The Federal Contaminated Sites Action Plan is a program that started in 2005 to reduce the risks to the environmental and human health from federal contaminated sites. The program funds management activities at federal contaminated sites that pose the highest risk, as well as creates and maintains guidance and guidelines for remediating and risk managing contaminated sites.

The Federal Contaminated Sites Action Plan applies to contaminated sites on land that the Government of Canada owns or is responsible for. The Federal Contaminated Sites Inventory lists information on all known or suspected federally contaminated sites[5]. The government departments or agencies responsible for each site (known as custodians) use the guidelines published by the Canadian Council of Ministers of the Environment when they are available. Alternatively, custodians may use guidelines from other jurisdictions or create site-specific criteria.

In 2019, there were about 7,000 sites on the Federal Contaminated Sites Inventory with the "metal, metalloid and organometallic" contaminant type. Of these, about 190 sites are suspected to be contaminated, about 3,200 sites are active and undergoing assessment and/or remediation, and about 3,700 sites have been closed. Sites are closed when they pose no further risk to the environment or human health. Of the 3,200 active sites, about 1,800 are undergoing assessment, and about 1,400 are being cleaned up or in long-term monitoring.

[5] The Federal Contaminated Sites Inventory does not include sites where contamination has been caused by private individuals, firms or other levels of government and which is under the control of one of these entities. The inventory does not include lead as a specific contaminant type but instead in the broader category "Metal, metalloid and organometallic".

5.12 Conclusion

The preceding section describes many of the federal risk management measures undertaken over the past decades to reduce exposures to lead, and in particular, the progress made since 2009 in risk management efforts for lead. Collectively, they have targeted a wide variety of sources identified as contributors to these exposures. The data generated subsequent to the implementation of these measures indicate considerable achievement toward minimizing the presence of lead in the Canadian environment and exposure of Canadians.

6 International Activities

The Government of Canada participates in a number of international efforts targeting lead and other chemicals. Efforts related to lead seek to achieve international goals to prevent exposure to lead from consumer products and to minimize human-caused releases of lead. Another important basis for collaboration is to mitigate transboundary movement of substances such as lead. These actions will help to protect human health and the environment. Annex 1B provides a list of the international efforts in which Canada participates.

7 Communicating with Canadians

The Government of Canada has many online materials to communicate with Canadians about lead, such as the webpages listed below. These provide information on environmental and health concerns related to lead, and especially on the dangers of lead for children. The webpages describe products containing lead, including lead-based paint, plumbing, and consumer products such as jewellery, which pose a particular hazard to young children, as well as lead in drinking water and provide recommendations to the public to keep their homes safe and to reduce lead exposure from these sources. These materials also describe federal government regulations and other efforts to reduce the dangers of lead to people and the environment.

- *Reduce Your Exposure to Lead* (2016)
- *Lead and Cadmium in Children's Jewellery* (2018)
- *Lead-Based Paint* (2017)
- *Lead* (2019)
- *Lead Crystalware and Your Health* (2005)
- *Drinking water: what about lead?* (2018)

Health Canada has also communicated about lead and consumer products on its Healthy Canadians channel on Facebook, @GovCanHealth on Twitter, and Health Canada/Santé Canada on LinkedIn. Examples of these social media posts are included in Annex 2.

Environment and Climate Change Canada posts information on lead and risk management on its Toxic Substances page for Lead. This page includes background information on lead, links to risk management actions, and Government of Canada studies on products containing lead.

8 Conclusions

This evaluation of the Government of Canada's risk management of lead has allowed the consolidation of the results of various actions. In addition, a process has been established to track the progress made in achieving the objectives of the *Risk Management Strategy for Lead* published in 2013. Key conclusions from this evaluation are:

1. **There has been progress in minimizing human-caused releases of lead to the environment**
   - releases from industrial and other sources were reduced substantially between 2009 and 2017
   - Canadian lead emissions to air decreased by 30% between 2009 and 2017, from 256.46 tonnes to 180.76 tonnes, likely due to the closure of plants that emitted significant amounts of lead, the use of new technologies to reduce emissions, and more use of best management practices
   - the amount of lead released to water decreased by 44% between 2009 and 2017, from 16.46 tonnes to 9.15 tonnes, mainly due to improvements in wastewater treatment plant technologies, which accounted for 4.11 tonnes of the 7.31 tonne reduction in lead releases to water
   - total lead releases to land were also reduced by 56% from 160 tonnes to 71 tonnes. This achievement was due to major reductions in lead releases from military shooting ranges
   - ongoing risk management actions are expected to result in further reductions in lead releases from key sectors

2. **Lead concentrations in the environment have declined over time**
   - monitoring data show that, overall, the amount of lead in air has declined since 2009 and that lead concentrations were not a concern in the water at any of the long-term monitoring sites
   - while lead levels in fish decreased at most sampling locations in Canada from 2009 to 2015, it is not possible to draw conclusions on trends in lead concentrations in fish or scavenger birds at the current time. This highlights the need for additional environmental monitoring to better understand the factors involved in determining lead concentrations in the environment, particularly in wildlife
   - in general, monitoring data shows that while some progress is being made toward the goal of minimizing lead in the environment, efforts should continue to ensure results are achieved

3. **There has been progress in minimizing human exposure to lead from various sources**
   - substantial reductions in lead exposure have been achieved through federal risk management measures focused on exposures from consumer products, foods and other sources
   - notably, Canadians' dietary exposure to lead from foods sold in Canada has decreased significantly over the past decades and has remained at low, stable levels

- biomonitoring studies confirm that blood lead levels, and therefore exposures to lead, in the general Canadian population are steadily decreasing, although some groups in Canada still have higher exposures to lead. In particular, blood lead levels in northern Canadian communities, though declining, remain higher than in the general population

4. **Domestic controls have contributed to meeting the Government of Canada's overall risk management objective to reduce exposure to lead to the greatest extent feasible**
   - success in reducing exposures to lead is evidenced by reductions in releases of lead to the environment, decreasing levels of lead in the environment from monitoring studies, and decreases in exposures to Canadians as shown by biomonitoring studies
   - the combination of the effects from the numerous domestic risk management measures have contributed to these reductions in exposure
   - In addition, evaluation of the performance of some individual risk management actions were conducted to determine the effectiveness of these actions, in particular
     - the goal of the *Pollution Prevention Notice for Base Metals Smelters* was met, with all facilities reaching their emissions targets. This success contributed to the progress made in achieving the overall environmental objective by reducing the amount of particulate matter released by base metal smelters, and thereby reducing the amount of lead in the air
   - there is not yet enough information available to evaluate the effectiveness of the *Performance Agreements for the Base Metals Smelters* or the *Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations* in reducing lead concentrations in the environment.
   - new regulations on lead-containing products will further contribute to environment lead reductions and reductions in Canadians' exposures to lead

5. **In light of the results and discussion presented in this performance evaluation, current and planned risk management efforts should continue in order to further reduce risks associated with lead. Performance measurement and monitoring activities play an important role in Canada's risk management efforts and should also continue**
   - the *Risk Management Strategy for Lead* and this performance measurement report have proven useful because they offer a holistic perspective on how collective risk management actions are working together to reduce the risks of lead to the environment and human health
   - domestic controls are working to reduce the risks of lead to the environment and human health. Risk management actions should continue, and planned risk management efforts should also be put in place to further reduce the risks of lead. This is supported by the fact that current science cannot identify a level under which lead is no longer associated with adverse health effects. Furthermore, recent studies have highlighted new human health sensitivities regarding lead exposure, and biomonitoring results discussed in this report highlight sub-populations within Canada with higher exposures to lead. Both of these factors point to the need for continued risk management of lead exposure for the protection of human health in Canada

- monitoring trends over time and space in water, air and other media is important for assessing the effectiveness of risk management actions and for understanding how lead enters and behaves in the Canadian environment
- performance measurement helps to identify the overall success of the Government of Canada's risk management actions and areas for improvement. The results of this report indicate that while progress has been made to reduce the risks of lead to the environment and human health, actions to lower the amount of lead in some Canadian populations and wildlife need to continue

9 Moving Forward

Continued action on lead is needed to protect the health of Canadians and their environment from the risks of lead by reducing, as much as possible, both the lead that people are exposed to, and the lead that goes into the environment. Based on the results in this report, the Government of Canada will continue its efforts in three main areas: monitoring lead levels in key environmental media as well as biomonitoring, managing risks associated with lead, and communicating with the public.

Data from biomonitoring and environmental monitoring initiatives have provided important information for assessing the performance of efforts to reduce exposures to lead. For this reason, human biomonitoring should continue for both the general population and for vulnerable populations, complimented by dietary surveys. In particular, lead will be monitored in the general population through the Canadian Health Measures Survey and, can also be monitored in the North, through studies funded by the Northern Contaminants Program.

Increased monitoring of lead concentrations in key environmental media would allow for an assessment of the risk to animals and humans from lead and a determination of the spatial and temporal trends of lead in Canada. Additional collaboration with monitoring programs in provinces and territories may also help to fill gaps and present a more complete picture of lead levels in the environment in Canada. A review of long-term monitoring activities for lead in the environment should be done so that future performance evaluations have enough data to interpret trends based on the data in this report.

Domestic efforts to manage the risks associated with lead products and waste are ongoing. These include developing a path forward in terms of risk management on the use of lead ammunition and sinkers and jigs, and supporting the research into alternatives to the use of leaded gas in aviation and competition vehicles.

Environmental quality guidelines are useful for seeing if the levels of lead in the environment are too high. The development of guidelines for additional environmental media such as air or fish would further enhance the ability to assess how well the risks of lead to the environment are being managed.

Finally, the Government of Canada plays a role in informing Canadians about health and environmental risks associated with lead. This allows Canadians to make educated choices

related to lead. Messaging focusing on the importance of minimizing exposure to lead of children and pregnant women is also a priority.

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Annex 1A – Risk Management Initiatives on Lead by the Government of Canada

This annex is a comprehensive list of the initiatives undertaken by the Government of Canada to manage the risks of lead to the environment and human health.

ENVIRONMENT

Migratory Birds Regulations **(1917, last amended in 2018)** (http://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._1035/FullText.html) These regulations implement the *Migratory Birds Convention Act* according to its prescribed prohibitions against the harming of migratory birds, their nests and their eggs, including the deposit of harmful substances in any waters or any area frequented by migratory birds. The regulations also provide for the issuance of permits or authorizations for certain activities according to specified criteria and conditions. In order to ensure the sustainable harvest of migratory game birds, the hunting provisions of the Regulations, which specify open hunting seasons as well as bag and possession limits, are amended on a biennial basis. In June 2019, the *Regulations Amending the Migratory Birds Regulations* were published in the *Canada Gazette*, Part I. The current and proposed regulations require that only non-toxic shot is used for the hunting of migratory game birds in Canada except for the following species: American Woodcock, Band-tailed Pigeon, Eurasian-collared Dove, Mourning Dove, and Murres. However, the regulations prohibit the use of toxic shot for these species as well in certain wildlife areas or jurisdictions.

Secondary Lead Smelter Release Regulations **(1976; last amended in 1991)** (https://laws-lois.justice.gc.ca/eng/regulations/SOR-91-155/page-1.html) These regulations under CEPA limit the concentration of particulate matter and the concentration of lead emitted into the ambient air from secondary lead smelters. The concentration of particulate matter released into the ambient air shall not exceed 0.046 g/m^3 or 0.023 g/m^3, depending on the furnace type, and the concentration of lead in particulate matter shall not exceed 63% by weight of the particulate matter; and no particulate matter shall be released to air from the storing of lead and lead scrap.

Wildlife Area Regulations **(1977, last amended in 2018)** (https://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._1609/FullText.html) Under the *Canada Wildlife Act*, these regulations identify prohibited activities in designated National Wildlife Areas listed under Schedule 1, unless a permit has been issued to authorize the activity in order to allow for the conservation of migratory birds and other wildlife and their habitat. In June 2019, the *Regulations Amending the Wildlife Area Regulations and Other Department of the Environment Regulations* were published in the *Canada Gazette, Part I*. The current and proposed regulations prohibit the possession of sinkers and jigs weighing less than 50 g and containing more than 1% of lead by weight while fishing in National Wildlife Areas and prohibit the use of toxic shot (including lead shot) for hunting where this activity is authorized in National Wildlife Areas.

Fuels Information Regulations, No.1 **(1979; last amended in 2017)** (https://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._407/page-1.html) Under CEPA, these regulations

require every person who produces or imports more than 400 cubic metres of listed fuel to submit quarterly reports on the quantities produced or imported.

Gasoline Regulations **(1990)** (https://laws-lois.justice.gc.ca/eng/regulations/sor-90-247/index.html) Under the *Canadian Environmental Protection Act, 1999* these regulations set a maximum concentration of lead in gasoline produced, imported or sold in Canada at 5 mg/L. The regulations also specify the acceptable analytical methods for determining the concentration of lead and phosphorous in gasoline and impose record-keeping and reporting obligations about leaded gasoline. Gasoline use in piston-engine aircraft (avgas) is exempt from these regulations.

Contaminated Fuel Regulations **(1991)** (http://laws.justice.gc.ca/eng/regulations/SOR-91-486/FullText.html) These regulations under CEPA prohibit the import and export of contaminated fuel, except for the purpose of destruction, disposal and recycling.

National Guidelines for the Use of Hazardous and Non-hazardous Wastes as Supplementary Fuels in Cement Kilns **(1996)**
(https://www.ccme.ca/files/Resources/waste/hazardous/pn_1201_e.pdf) These guidelines developed by CCME provided operating and performance standards for cement kilns using wastes as supplementary fuels. They provided guidance on the criteria for the selection of wastes; handling and storage of wastes; testing, monitoring, and reporting requirements; solid residue management; and they set emission limits. These guidelines have been withdrawn from active circulation but remain available for reference and historical purposes.

The National Parks of Canada Fishing Regulations **(1997, last amended in 2018)**
(https://laws-lois.justice.gc.ca/eng/regulations/C.R.C.,_c._1120/page-1.html) These regulations under the *Canada National Parks Act* prohibit the use of possession of lead sinkers and jigs under 50 g while fishing in National Parks.

National Emission Guideline for Cement Kilns **(1998)**
(https://www.ccme.ca/files/Resources/air/emissions/pn_1284_e.pdf) This guideline developed by CCME provides a consistent national basis for restricting emissions of nitrogen oxides and other pollutants, while encouraging greater energy efficiency in the industry. The Guideline indirectly targets lead by addressing fine particulate dust (to which lead can be bound).

Disposal at Sea Regulations **(2001; last amended 2014)** (https://laws-lois.justice.gc.ca/eng/regulations/SOR-2001-275/index.html) Under CEPA all disposal at sea is prohibited without a permit. Permits can only be considered for a small list of low risk wastes or other matter and then only after the material intended for disposal has been assessed. The small list includes dredged material from clearing navigation channels. Since this may contain lead and other contaminants, the permit application for this material must provide information about contaminants.

Environmental Codes of Practice for Integrated Steel Mills and for Non-integrated Steel Mills **(2001)** (https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/code-practice-integrated-steel-mills.html; http://www.ec.gc.ca/lcpe-cepa/71FE839D-5371-44FB-8ACB-908CE018D373/ani-nism-eng.pdf) These Codes under CEPA recommend good environmental protection practices for preventing

and controlling atmospheric emissions and wastewater effluents and wastes from iron and steelmaking operations. They contain concentration limits for lead releases in effluent and recommended release limits for particulate matter emissions.

Metal and Diamond Mining Effluent Regulations **(MDMER) (2018; previously *Metal Mining Effluent Regulations, 2002)*** (https://laws-lois.justice.gc.ca/eng/Regulations/SOR-2002-222/index.html) The MDMER were created under the *Fisheries Act* and authorize the deposit of effluent into waters frequented by fish. All effluent must meet concentration-based limits for arsenic, copper, cyanide, lead, nickel, zinc, suspended solids and radium-226, as well as a minimum and maximum allowable pH, and not be acutely lethal. For lead, the MDMER establish a maximum authorized monthly mean concentration of 0.20 mg/L; a maximum concentration of 0.30 mg/L in a composite sample; and a maximum concentration of 0.40 mg/L in a grab sample. Beginning on June 1, 2021, the regulations establish more stringent limits for existing metal mines on lead. The regulations also impose more stringent limits for lead for new mines that become subject to the regulations after June 1, 2021.

Environmental Emergency Regulations **(2019)**
(https://laws.justice.gc.ca/eng/regulations/SOR-2019-51/) These regulations under CEPA require any person who owns or has the charge, management, or control of specified toxic or hazardous substances located at a facility at or above the specified quantity or concentration thresholds to provide certain information about the substances and facility to Environment and Climate Change Canada. The facility is also required to have environmental emergency plans in place when certain conditions are met.

Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations **(2005; last amended 2016)** (https://laws-lois.justice.gc.ca/eng/Regulations/SOR-2005-149/index.html) These regulations under CEPA control the cross-border movement of hazardous waste and hazardous recyclable materials including those containing lead or lead compounds. These regulations help ensure that hazardous wastes and hazardous recyclable materials containing lead or lead compounds crossing international borders are characterized and managed properly in accordance with international law.

Notice requiring the preparation and implementation of pollution prevention plans in respect of specified toxic substances released from base metals smelters and refineries and zinc plants **(2006)** (http://www.gazette.gc.ca/rp-pr/p1/2006/2006-04-29/pdf/g1-14017.pdf#page=13) This notice, under CEPA, required base metals smelters and refineries and zinc plants to prepare and implement pollution prevention plans for specified toxic substances that they release by 2015. The notice specifies a reduction target for total releases of metals (including lead) of 80% of 1988 levels by 2008 and 90% beyond 2008 through the application of technically and economically feasible methods.

Environmental Code of Practice for Base Metals Smelters and Refineries **(2006)**
(https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/code-practice-base-metals-smelters.html) This code under CEPA recommends environmental protection practices to prevent and control emissions into the air, land, and water from base metals smelting and refining operations.

Transportation of Dangerous Goods Regulations **(2008)** (http://www.tc.gc.ca/eng/tdg/clear-tofc-211.htm) These regulations under the *Transportation of Dangerous Goods Act* require risk management measures to be put in place for the transport of numerous lead compounds. These measures cover numerous lead compounds and dictate the mode and quantity of transport.

Environmental Code of Practice for Metal Mines **(2009)** (https://www.ec.gc.ca/lcpe-cepa/documents/codes/mm/mm-eng.pdf) This code applies to the complete life cycle of mining, from exploration to mine closure, and recommends environmental management practices to reduce environmental concerns. The practices that this code recommends include the development and implementation of environmental management tools, the management of wastewater and mining waste, and the prevention and control of environmental releases to air, water, and land.

Export of Substances on the Export Control List Regulations **(2013; last amended 2018, formerly Export Control List Notification Regulations (2000))** (https://pollution-waste.canada.ca/environmental-protection-registry/regulations/view?Id=115) These regulations require exporters to provide notice to the Minister of Environment for all substances listed on Schedule 3 of CEPA (the Export Control List). For some substances, a permit must be granted by the Minister of Environment prior to export. This ensures that the procedures for the export of chemicals dictated by international conventions are followed. Three lead-containing substances are listed in Schedule 3.

Code of Practice to Reduce Fugitive Emissions of Total Particulate Matter and Volatile Organic Compounds from the Iron, Steel and Ilmenite Sector **(2016)** (https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/publications/code-practice-reduce-pm2-5-iron-ilmenite.html) This Code of Practice outlines best practices to reduce fugitive emissions of total particulate matter (TPM) and volatile organic compounds (VOCs) from the iron, steel and ilmenite sector. The sector is subdivided into three sub-sectors: integrated mills, mini-mills and ilmenite smelting facilities. There are 30 recommended practices that can be used by this industry, regulatory agencies and the general public as sources of technical and policy guidance, and the recommendations do not negate any regulatory requirements.

Performance Agreements for base metals facilities for the implementation of Base Level Industrial Emissions Requirements **(2018)** (https://www.canada.ca/en/environment-climate-change/services/environmental-performance-agreements/base-metal-smelters-overview.html) As part of Canada's Air Quality Management System, on January 5, 2018, Environment and Climate Change Canada published Performance Agreements concerning air pollutants from eleven base metals facilities owned by five companies. The objective of the agreements is to implement the base level industrial emissions requirements developed for the base metals smelting and refining sector. Base level industrial emissions requirements were developed for sulfur dioxide (SO_2) and particulate matter (PM). Specific agreements were negotiated between the five base metal smelting and refining companies and Environment and Climate Change Canada. These agreements are in effect from January 5, 2018 to December 31, 2025.

Regulations Prohibiting the Manufacture and Import of Lead Wheel Weights in Canada **(Anticipated 2020)** The proposed regulations under CEPA will establish a general prohibition on the manufacture and import of wheel weights used in motor vehicles containing more than 0.1% by weight of lead in Canada. The proposed regulations are anticipated to be published in the *Canada Gazette,* Part I, in 2020.

ENVIRONMENTAL RESEARCH

Reduction of lead emissions from the use of leaded aviation gasoline **(2012)** In 2012, the U.S. Federal Aviation Administration established a collaborative industry-government initiative called the Piston Aviation Fuels Initiative to facilitate the development and deployment of an unleaded aviation gas with the least impact on the existing piston-engine aircraft fleet (US Federal Aviation Administration, 2019). Canada's National Research Council, with the support of Transport Canada, Environment and Climate Change Canada, and the Canadian Owners and Pilots Association, have actively engaged in the Piston Aviation Fuels Initiative testing to find a suitable unleaded replacement fuel for use in piston engine aircraft.

Study to Gather Use Pattern Information on Lead Sinkers and Jigs and Their Non-Lead Alternatives in Canada **(2018)**
(http://publications.gc.ca/collections/collection_2018/eccc/En14-308-2018-eng.pdf)
Environment and Climate Change Canada commissioned a study to gather socio-economic information as well as data on use patterns, cost and environmental releases of lead sinkers and jigs and their non-lead alternatives. The study revealed that each year approximately 460 tonnes of lead enters the environment from fishing – representing the largest source of lead releases to the aquatic environment, and although alternative products are available, lead products are dominant in the Canadian market. This study was published for stakeholder comment in April 2018. In 2020, Environment and Climate Change Canada intends to publish the responses to comments received on the study along with a consultation document on potential options to reduce releases of lead from the use of lead sinkers and jigs. Stakeholder comments received during the consultation period will be considered in the development of an appropriate path forward to manage the risk associated with use of these products.

Study to Gather Information on uses of Lead Ammunition and their Non-Lead Alternatives in Non-Military Activities in Canada **(2018)**
(http://publications.gc.ca/collections/collection_2018/eccc/En14-307-2018-eng.pdf)
Environment and Climate Change Canada commissioned a study to gather socio-economic information as well as data on use patterns, cost and environmental releases of lead ammunition and its non lead alternatives. The study revealed that each year approximately 5,200 tonnes of lead is released to the environment from shooting activities. Although lead free products are available, lead ammunition dominates the Canadian market. This study was published for stakeholder comment in April 2018. In 2020, Environment and Climate Change Canada intends to publish the responses to comments received on the study along with a consultation document on potential options to reduce releases of lead from the use of lead ammunition. Stakeholder comments received on the studies during the consultation period will be considered in the development of an appropriate path forward to manage the risk associated with use of these products.

***Study to Gather Information on Bioavailability of Lead from Spent Ammunition at Recreational Shooting Ranges in Canada* (Anticipated 2020)**
Some of the comments received on the lead ammunition study questioned the bioavailability of lead from spent ammunition at recreational shooting ranges. This led to the commissioning of another study to assess the current scientific knowledge on the bioavailability of lead to the environment resulting from ammunition used at recreational shooting ranges, including a discussion of factors that influence its bioavailability in various media (e.g., soil). This study is complete and is expected to be published in 2020.

***Releases of Lead from Construction Sheeting used in the Canadian Building Industry* (2018)** (https://www.canada.ca/en/environment-climate-change/services/management-toxic-substances/list-canadian-environmental-protection-act/lead/construction-sheeting.html)
Environment and Climate Change Canada commissioned a study to gather use pattern, socio-economic and cost information on the environmental impacts of lead sheeting used in the Canadian construction industry. The study found that there are still some uses of lead sheeting without feasible alternatives. Where alternatives are already available in the Canadian market, and where it is technically and economically feasible, industry has demonstrated efforts to move towards greater use of these alternatives.

HEALTH AND ENVIRONMENTAL GUIDELINES

***Guidelines for Canadian Drinking Water Quality* (Health Canada, 2019)**
(https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/water-quality/guidelines-canadian-drinking-water-quality-summary-table.html) Reduced intake of lead from drinking water. New guideline is 5 µg/dL for drinking water and lower lead limit for plumbing in accordance with the 2015 National Plumbing Code of Canada, the Canadian Standards Association and the NSF (international)/ANSI (U.S.).

***Canadian Environmental Quality Guidelines* (1987-2003)** (http://st-ts.ccme.ca/en/index.html?chems=124&chapters=1,2,3,4,5) These are national recommended goals for the quality of surface water for the protection of aquatic life in water (1987), sediment (1998), and terrestrial (soil, 1999) ecosystems and were developed by CCME. These levels should result in negligible risk to biota, their functions, or any interactions that are integral to sustaining the health of ecosystems and the designated resource uses they support.

***Federal Water Quality Guideline for Lead* (2019)** (https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/federal-environmental-quality-guidelines-lead.html) *Federal Environmental Quality Guidelines* provide benchmarks for the quality of the ambient environment. They are based solely on the toxicological effects or hazards of specific substances or groups of substances. The intent of the Guidelines is to be a tool for risk assessment/risk management of priority chemicals identified in the Chemicals Management Plan or other federal initiatives. Because Dissolved Organic Carbon and pH were significant toxicity modifying factors for lead, the Federal Water Quality Guideline is expressed as an equation where the local water Dissolved Organic Carbon and pH are entered in order to

calculate a site-specific guideline. The Federal Water Quality Guideline for dissolved lead (µg/L) = exp(0.684[ln(DOC)] + 0.924[pH] – 7.323).

Canadian Environmental Quality Criteria for Contaminated Sites **(1991)** (https://www.ccme.ca/files/Resources/csm/pn_1007_e.pdf) These criteria aim to reduce overall exposure to lead from contaminated sites. Site-specific risk-based levels are used for site clean-up, which may in some cases exceed guidelines but which must still be within an acceptable range. In 1999, the CCME integrated all existing environmental quality guidelines and criteria for all media into one document entitled 1999 Canadian Environmental Quality Guidelines. These guidelines replaced the *Canadian Environmental Quality Criteria for Contaminated Sites*.

Screening Concentrations for Substances in Dust in Canadian Residences The *Canadian House Dust Study* (2013) established representative levels and lead loading rates of lead in dust to enable identification of houses and other buildings with levels of lead in dust which exceed these levels for potential and remediation activities.

HEALTH

Consumer Products Containing Lead Regulations [*Canada Consumer Product Safety Act* (CCPSA)] (2018) Reduced oral exposure, especially for children, to lead from consumer products. Limit of 90 mg/kg total lead in accessible parts of:

- products, other than kitchen utensils, that are brought into contact with the user's mouth in the course of normal use with the exception of products subject to the *Glazed Ceramics and Glassware Regulations*;
- clothing or clothing accessories that are intended for use by a child under 14 years of age;
- products intended for use in learning or play by a child under 14 years of age;
- books or similar printed products that are intended for a child under 14 years of age, except if they are printed on paper or cardboard, and printed and bound in a conventional manner using conventional materials; and
- child-care products (whose primary purpose is to facilitate the relaxation, sleep, hygiene, carrying or transportation of a child under four years of age).

Some exemptions exist.

Surface Coating Materials Regulations (CCPSA) (2016) Reduced oral exposure to lead from surface coatings. The total lead content of consumer paints and other surface coatings cannot exceed 90 mg/kg. Some exceptions apply. Products for children and pencils and artists' brushes cannot have an applied surface coating material that exceeds 90 mg/kg of total lead.

Glazed Ceramic and Glassware Regulations (CCPSA) (2016) Reduced oral exposure to lead from glazed ceramic and glassware. Limit the migratable lead content of glazes, coatings or

decorations on ceramics and glassware used for storing, preparing, or serving food or beverages, in accordance with limits set in the regulations.

Kettles Regulations (CCPSA) (2010) Reduced oral exposure to lead from water heated in kettles. Limit the amount of lead (not more than 0.01 ppm w/w) that may be released by kettles when tested in accordance with the test method set out in the regulations.

Corded Window Covering Products Regulations (CCPSA) (2019) Reduced oral exposure of children to lead from corded window coverings. Limit the lead content of any exterior component of the corded window coverings which could be touched or ingested by a young child to 200 mg/kg total lead.

Children's Jewellery Regulations (CCPSA) (2018) Reduced oral exposure of children to lead from children's jewellery. Jewellery items intended primarily for children under 15 years of age must not contain more than 90 mg/kg lead.

Tobacco Reporting Regulations (*Tobacco Act*) (2009) Reduced inhalation exposure to lead from tobacco products. Requires manufacturers to report on the lead content in tobacco and smoke.

Cosmetic Regulations (*Food and Drugs Act*) (2010) Reduced exposure to lead directly from cosmetics. The impurity limit for lead in cosmetics is 10 parts per million (ppm).

Food and Drug Regulations (*Food and Drugs Act*) Reduced exposure to lead from foods. Ongoing updates of maximum limits of lead in several categories of food.

Food and Drug Regulations (*Food and Drugs Act*) (2014) Reduced exposure to lead from drugs. Specific limits on lead in pharmaceuticals.

Natural Health Products Regulations (*Food and Drugs Act*) (2013) Reduced exposure to lead from NHPs. Limit for lead in Quality of Natural Health Products Guide revised to <10 µg/day. Limit for lead in dietary supplements revised to 5 µg/day.

Standard for lead in fertilizer and supplement products (*Fertilizer Act*) (1997) Reduced oral exposure to lead from food. Standards represent the minimum a commercial fertilizer product must meet when sold or imported into Canada.

Action level for lead in total livestock diets (*Feeds Act*) (2012) Reduced oral exposure to lead from food. Action level for lead and other metal contaminants in feeds.

Update of blood lead guidance values (CEOH 1994) Reduction in population blood lead levels to the greatest extent practicable. Document revision on-going. Decrease in blood lead levels at the individual, sub-population and community level, when interventions to reduce atypical exposures to lead are indicated.

Health Canada and Environment and Climate Change Canada webpages. Public communication material focussed on reducing exposure to lead.

Hazardcheck program. Health Canada Hazards in the Home program. The Hazardcheck brochure was published in 2010, and provides information about hazardous chemicals, including lead, in the home.

First Nations and Inuit Environmental Health Guide Program. Includes a focus on reduced exposure to lead among First Nations and Inuit populations.

Annex 1B – International Actions on Lead

This annex describes Canada's international work on lead. These fora allow for collaboration on efforts to control lead and other substances in the environment.

World Health Organization

Canada contributes to the development of many programs under the World Health Organization (WHO), one in particular that focuses on the protection of women's and children's health. Lead exposure is a particular focus of the WHO, and each year, Canada and other countries sponsor activities for the WHO's International Lead Poisoning Prevention Week of Action.

United Nations Environment Programme

Canada continues to participate in work under the United Nations Environment Programme (UNEP) on environmental policy and scientific issues that affect Canadians and that would benefit from collective action (e.g., global action on the elimination of lead in paint). This allows for the pooling of resources from many countries in order to obtain environmental information and scientific data (e.g., water quality monitoring and assessment, marine pollution from land-based activities), and for Canada to influence the wider international environmental agenda and the various institutions involved in environmental issues. Canada participates along with other countries in the joint WHO-UNEP sponsored program, the Global Alliance for the Elimination of Lead Paint.

Arctic Monitoring and Assessment Programme (1991)

Canada continues, along with the other circumpolar countries to monitor pollutants, including lead, in humans and the environment in Arctic regions under the Arctic Monitoring and Assessment Programme, a working group of the Arctic Council, which provides information for risk-management decisions pertinent to those areas.

***Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* (1992)**

Canada has been a party to the *Basel Convention* since 1992. The Convention seeks to minimize the generation of hazardous waste, including hazardous recyclable materials, to ensure they are disposed of in an environmentally sound manner and as close as possible to the source. Waste containing lead or lead compounds, such as lead-acid batteries, is considered hazardous waste. As a Party, Canada actively implements the prior-informed consent, classification and tracking, reporting and other obligations related to the transboundary movement of wastes, as well as promotes the general obligations pertaining to waste minimization and management. Canada also participates in the activities and meetings of Parties to the Convention.

***Convention on Long Range Transboundary Air Pollution* (1998)**

Canada is a Party to the United Nations Economic Commission for Europe's *Convention on Long-Range Transboundary Air Pollution*. Lead is addressed under the Convention's *Protocol on Heavy Metals*, which Canada ratified in 1998. The Heavy Metals Protocol includes

commitments to reduce emissions of lead, cadmium, and mercury to 1990's levels. Canada implements its commitments under this Protocol through existing federal, provincial and territorial instruments, including limiting emissions from listed stationary sources and phasing out of leaded gasoline, and reports annually to the United Nations Economic Commission for Europe on its lead emissions. Note that because by 2008 Canada had reduced its emissions of lead, cadmium, and mercury by more than 50% from its reference year (1990), Canada is exempted from having to apply the emission limit values for new and existing stationary sources and best available techniques for stationary sources.

***Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade* (2002)**

Canada is a party to the *Rotterdam Convention*, aimed at promoting shared responsibility in the international trade in hazardous substances in order to protect human health and the environment. The Rotterdam Convention provides an early warning to countries on a broad range of hazardous chemicals in international trade that have been banned or severely restricted in other countries, and establishes a prior informed consent procedure. The information shared under the Convention enables governments to assess the risks posed by hazardous chemicals in international trade and to make informed decisions on their future import through the prior informed consent procedure established by the Convention. Pesticides containing lead compounds are one of the hazardous chemicals covered by the Convention.

Strategic Approach to International Chemicals Management (2005)

The Strategic Approach to International Chemicals Management (SAICM) is a voluntary international policy framework to support multi-sectoral, multi-stakeholder efforts toward the global goal of sound chemicals management by 2020. Resolutions relevant to lead have been adopted, including establishment of lead in paint as a SAICM Emerging Policy Issue. These resolutions recognize the policy imperatives to address identified concerns, agree on the actions needed, and request specific stakeholders to consider undertaking certain actions.

Canada-Europe Memorandum of Understanding on Chemicals (2010)

In 2010, Canada and the European Chemicals Agency, (the Agency responsible for chemical management in Europe) signed an agreement to cooperate on chemicals management. This Memorandum of Understanding (MOU) was the first bilateral agreement for the European Chemicals Agency. This agreement, based on technical and scientific cooperation, is important because it contributes to sharing expertise and knowledge transfer between Europe and Canada. Through the cooperative work maintained in this engagement, Canada works to improve the efficiency in its domestic risk assessment and risk management of chemicals.

The EU has recently amended its toy safety Directive which introduced stricter limits values for lead in toys. The amendment, which came into force in October 2018:

- tightens the limit of lead in dry, brittle, powder-like pliable toy material, from 13.5 mg/kg to 2 mg/kg;

- lowers the limit of lead in liquid or sticky toy material, from 3.4 mg/kg to 0.5 mg/kg; and
- reduces the value of lead in scraped-off toy material, from 160 mg/kg to 23 mg/kg.

In addition, a list of articles to be included in the proposed restriction of 286 carcinogenic, mutagenic and reprotoxic (CMR) substances, including lead compounds, in consumer textiles and clothing is under development up by the European Commission. The proposed ban would initially target articles that come into direct and prolonged contact with the skin.

Working Party on Resource Productivity and Waste (2011)

The Working Party on Resource Productivity and Waste under the Organisation for Economic Co-operation and Development (OECD) looks at how waste management and resource efficiency practices could be improved across OECD countries and beyond. Participation in this OECD working party is important because it allows Canada to gather information on emerging issues such as management of hazardous waste and adoption of circular economy practices. Canada's on-going involvement in the work of the Working Party on Resource Productivity and Waste continues to reflect Canadian interests and share experiences in the development of policy and science related to waste management, such as transboundary movement of hazardous wastes, including lead, amongst OECD countries. As well, participation in accession and post-accession discussions (that is, discussions with potential and new OECD countries) prepares Canada to effectively manage transboundary waste movement requests from new OECD countries.

Annex 2 – Social Media Communication on Lead

Health Canada has posted about lead and consumer products on its Healthy Canadians channel on Facebook, @GovCanHealth on Twitter, and Health Canada/Santé Canada on LinkedIn. Here are some examples:

Facebook

Facebook post on the sweet taste of lead, October 22, 2014
Facebook post on lead in arts and crafts materials, October 15, 2015

Healthy Canadians Facebook post on lead in drinking water, February 26, 2019
Healthy Canadians Facebook post on lead in drinking water, March 11, 2019

Twitter

Tweet on new regulated limits on lead in children's products, December 3, 2016
Tweet on lead in older plumbing, October 24, 2018

Health Canada and PHAC Tweet on lead paint, October 25, 2018
Health Canada and PHAC Tweet on lead in toys, October 26, 2018

Health Canada and PHAC Tweet on lead in drinking water, February 11, 2019
Health Canada and PHAC Tweet on lead in drinking water, February 26, 2019

Health Canada and PHAC Tweet on lead water guidelines, March 9, 2019
Health Canada and PHAC Tweet on lead in drinking water, March 11, 2019