Lake Superior Binational Program 2012

Contents

Photo: Roger Eberhardt, Michigan Office of the Great Lakes.

Lake Superior Zero Discharge Demonstration Program and Critical Chemical Reduction Milestones

What is the Lake Superior Zero Discharge Demonstration Program?

The goal of the Zero Discharge Demonstration Program (ZDDP) is to achieve zero release of certain designated persistent bioaccumulative toxic substances in the Lake Superior basin. In 1990, the International Joint Commission challenged the governments of Canada and the United States to develop a program to virtually eliminate a group of "The Nine" persistent, bioaccumulative and toxic pollutants. The governments responded to this challenge by creating the "Binational Program to Restore and Protect the Lake Superior Basin." This program guides the ZDDP targeted at The Nine pollutants. The Lake Superior Binational Program (LSBP) is administered by federal, provincial, state and tribal agencies through the Superior Work Group and Task Force with the assistance of a public involvement and outreach group known as the Lake Superior Binational Forum. The Lake Superior Lakewide Management Plan (LaMP) was developed by the LSBP as a management strategy for Lake Superior and currently guides the implementation of the ZDDP.

In 1999, the LSBP mapped out a two-decade release reduction plan for The Nine pollutants. The plan identified targets for staged reductions of these pollutants, with 1990 as the baseline year and 2020 as the year where virtual elimination will be achieved. Table 1 shows the reduction schedules and targets set out in the release reduction plan.

The Nine Pollutants Targeted by the ZDDP

The Nine pollutants are mercury, PCBs, dioxin, hexachlorobenzene, octachlorostyrene and 4 pesticides: dieldrin, chlordane, DDT and toxaphene.

Table 1 - Summary of Release Reduction Targets for Lake Superior ZDDP

	Summary of Release Reduction Targets for Lake Superior ZDDP				
Pollutant	2000	2005	2010	2015	2020
Mercury	60%		80%		100%
PCBs	33%	60%	95%		100%
Pesticides[2]	100%				
Dioxin[1], HCB, OCS		80%		90%	100%

[1] The Binational Program lists 2,3,7,8-TCDD (dioxin) for the Zero Discharge Demonstration Program. By convention, dioxin is measured and reported as toxic equivalents (TEQ).

[2] The four pesticides included in the ZDDP are dieldrin, chlordane, DDT and toxaphene.

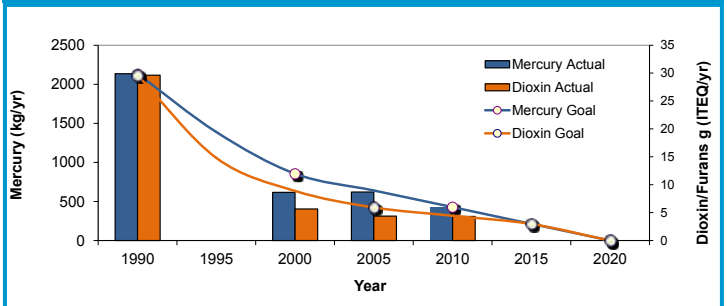
Progress Toward the ZDDP Release Reduction Targets

In 2010, emission inventories for The Nine pollutants were updated for both the United States and Canadian portions of the Lake Superior basin. These inventories allow the LSBP to calculate the change in release of The Nine pollutants since 1990. Figure 1 shows actual releases compared to reduction targets for mercury and dioxin in the Lake Superior basin over the time frame of the program.

Notable achievements include:

- 80% reduction in mercury releases basin-wide;
- 85% reduction in dioxin releases basin-wide;
- Significant reductions of PCBs materials in Ontario and the Lake Superior states;
- The ongoing collection and safe disposal of waste pesticides around the basin;
- Numerous chemical reduction and outreach activities undertaken by stakeholders;
- Establishment of new government regulations and policies that affect releases of The Nine pollutants.

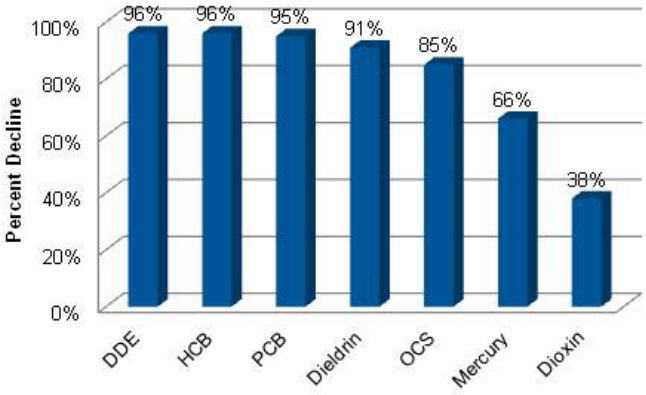
Figure 1 - Actual Release and Release Reduction Targets for Mercury and Dioxin in Lake Superior Basin from 1990 to 2020.



Fate of The Nine Pollutants in the Lake Superior Ecosystem

Concentrations of The Nine pollutants have generally declined in the Lake Superior ecosystem over the past 30 years. Figure 2 presents the percent decline of several chlorinated substances found in Lake Superior herring gull eggs over the time period that the Canadian Wildlife Service has been measuring them regularly. The most recent data show that in the last decade (1997-2007) there was no significant decline in most of these legacy contaminants, and many concentrations appear to be at or approaching a plateau. The levels of many contaminants in fish in Lake Superior and surrounding inland waters remain at concentrations sufficient to trigger fish consumption advisories. Figure 3 presents contaminant concentrations in whole lake trout collected at Apostle Islands compared to the most restrictive limits that trigger fish consumption advisories in the Lake Superior basin. Lake Superior's unique physical, thermal and biological characteristics make it particularly sensitive to retaining The Nine pollutants. As a result, chemical contaminants continue to impair lake use, and prevention of further chemical inputs is critical to the protection of Lake Superior.

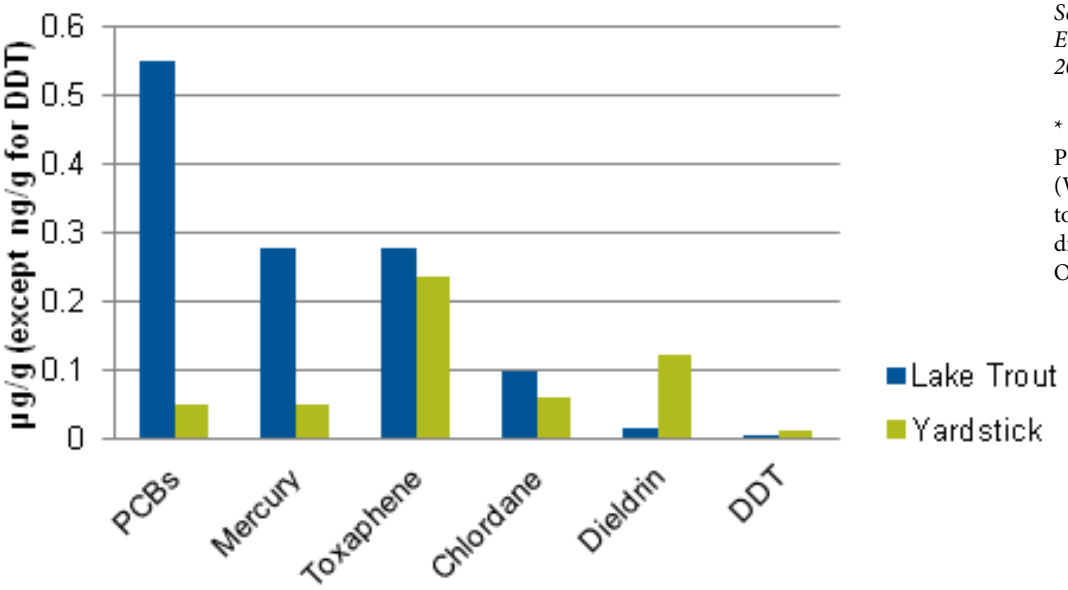
Figure 2 - Percent Decline in Legacy PBT Chemicals in Herring Gull Eggs Collected at Two Lake Superior Sites Between 1974/84 and 2004/2007/2009.*



Sources: Weseloh and Havelka, 2005 & 2009; Weseloh et al., 2006; Weseloh et al., 2011.

*Dioxin monitoring began in 1984. All other contaminants have been monitored since 1974. The most recent data is 2009 for mercury; 2007 for DDE, HCB, PCB, and OCS; and 2004 for dieldrin and dioxin. Dioxin concentrations are reported in parts per trillion (pg/g) and OCS in parts per billion (ng/g). All other pollutants are reported in parts per million (µg/g). Concentrations reported are the average of two Lake Superior sites: Agawa Rocks and Granite Island.

Figure 3 - Contaminant Concentrations in Whole Lake Superior Lake Trout *(Salvelinus namaycush)* Collected at Apostle Islands (2008) Versus the Most Restrictive Jurisdictional Limits That Trigger Fish Consumption Advisories.*



Source: Data provided by Elizabeth Murphy, U.S. EPA, 2011, personal communication.

* Yardsticks for mercury and PCBs are from the U.S. states (WI, MI, MN). Yardsticks for toxaphene, chlordane, dieldrin, and DDT are from Ontario (OMOE).

ZERO DISCHARGE AT WORK

Tracking the Release of The Nine Pollutants

In 2010, the Lake Superior ZDDP reached the 20-year mark, and many notable accomplishments were achieved. However, much more remains to be done to reach the 2020 goal of virtual elimination of The Nine pollutants. The *2010 Critical Chemical Reduction Milestones* report documents progress in reducing The Nine pollutants between the ZDDP baseline year of 1990 and 2010. The following pages provide a summary of the *2010 Critical Chemical Reduction Milestones* report, which contains over 250 pages of in-depth information on reductions in the release of The Nine pollutants and the challenges that lie ahead for reaching the next reduction target in 2015. The successes of the program over the last 20 years have been due to collaboration and commitment by the wide range of stakeholders including business and industry, non-governmental organizations, and municipal, state, tribal, First Nation, provincial and federal agencies actively engaged in the LSBP. The importance of the involvement of the citizens of the Lake Superior basin in achieving the reductions described below cannot be overstated.

Lake Superior's colder water temperatures and larger volume relative to the other Great Lakes may affect the rates of decline of The Nine Pollutants. Photo: N. Stadler-Salt, Environment Canada.

Top 12 Steps You Can Take to Protect Lake Superior

- Create an energy efficient home.
- Install water saving devices.
- Never burn garbage.
- Try to reduce, reuse, recycle and repair.
- Take household hazardous materials to hazardous waste collections.
- Never pour oil or other used liquids into a storm drain.
- Put your lawn on a chemical-free diet.
- Inspect your boat and trailer and remove any plants and animals before leaving a boat access.
- Landscape with native plants.
- Plant trees to capture carbon dioxide and prevent erosion.
- Use a rain barrel for gardening and washing the car.
- And most importantly, love Lake Superior!

For more information, visit www.superiorforum.org/outreach/lake-superior-day

Shovel Point, Minnesota. Photo: Carri Lohse-Hanson.

ZERO DISCHARGE POLLUTANTS

2010 Reduction Milestone for Mercury

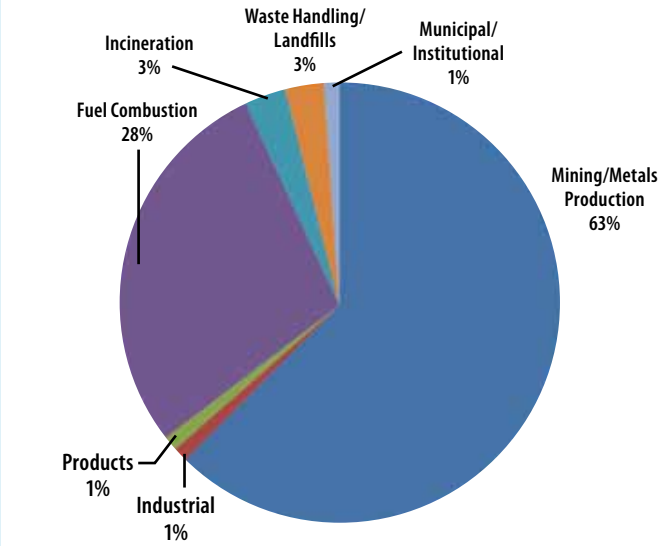
Mercury releases to the Lake Superior basin were estimated to decline 80% between 1990 and 2010, meeting the ZDDP mercury reduction target for 2010. The greatest reduction achieved was a 98% reduction in the release of mercury from products. All source sectors except fuel combustion have reduced mercury releases by more than 80% since 1990.

Figure 4 shows the main sources of mercury in the Lake Superior basin in 2010. Currently, the largest sectors of mercury releases are mining/ metals production and fuel combustion, which together account for 91% of mercury emissions in the basin. Within these two sectors, taconite mines and coal-fired utilities are the largest sources. Future reductions in mercury releases from the fuel combustion sector may be expected as a result of a projected decline in energy consumption and potential closures or conversions of coal-fired power plants to natural gas. The potential for mercury reductions in the taconite industry is difficult to project at present. In order to meet an extrapolated mercury reduction milestone of 90% by 2015, an additional 204 kg/yr of mercury must be reduced from the estimated 417 kg released in 2010.

Below: Taconite plants in the Lake Superior basin are currently running at or near capacity, and demand for taconite is expected to remain strong. Photo: Nelson French.

Above: Container of mercury collected during the Keweenaw Bay Indian Community's (KBIC) June 2011 Household Hazardous and Electronic Waste collection event. A total of 19 pounds of mercury was collected during two collection events in 2011.
Photo credit: KBIC Response Program Specialist, Katie Kruse.

Figure 4 - Percentage of Mercury Releases from Different Sectors in the Lake Superior Basin, 2010.



ZERO DISCHARGE POLLUTANTS

2010 Reduction Milestones for Dioxin, Hexachlorobenzene and Octachlorostyrene

Dioxin

Dioxin releases were estimated to decline 86% between the ZDDP baseline year of 1990 and 2010, meeting the extrapolated goal of 85% for 2010 (halfway between the 80% goal for 2005 and the 90% goal for 2015). The largest reduction was achieved in the municipal/institutional sector. For the two largest sources of dioxin, incineration and fuel combustion, little change in dioxin releases occurred between 2005 and 2010. Incineration includes landfill fires, small incinerators, and unpermitted burning of trash (backyard burning). Figure 5 shows the contribution of various sectors to dioxin releases in the Lake Superior basin.

In order to meet the 90% reduction goal by 2015, an additional 4% reduction of dioxin from 1990 levels (or 1 g I-TEQ/yr) is needed; this can be seen in Figure 1 above. Unpermitted burning is a preventable source of dioxin that could be targeted to help reach the 90% reduction goal by 2015.

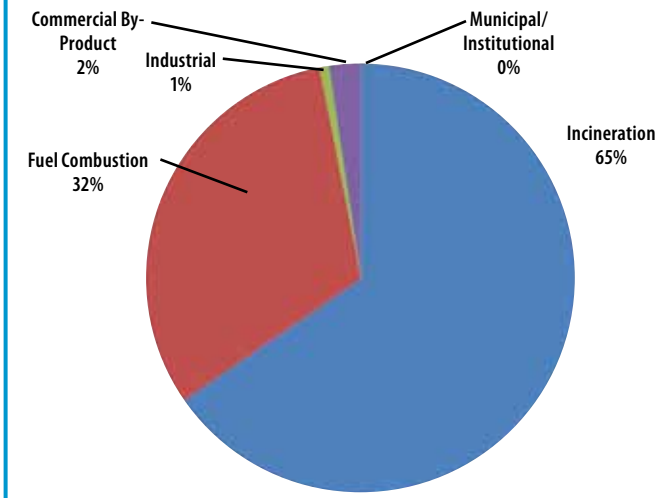
Hexachlorobenzene

Estimates of hexachlorobenzene (HCB) reductions are difficult due to limitations of the inventory. Currently available information suggests that the primary sources of HCB on the Canadian side of the Lake Superior basin are on-site residential waste combustion (burn barrels) and leaching from utility poles treated with pentachlorophenol. Releases from these sources are not expected to drop significantly over the next five years. On the U.S. side, open burning of trash is estimated to be the largest source of HCB, followed by mobile sources.

Octachlorostyrene

Environmental monitoring data in the Great Lakes have shown a decline in levels of octachlorostyrene (OCS), and no large source of OCS is believed to exist within the Lake Superior basin. However, since OCS may form under similar conditions as dioxin and HCB, better information about the release of OCS in the basin may be obtained by improving the basin inventories for dioxin and HCB.

Figure 5 - Percentage of Dioxin Releases from Different Sectors in the Lake Superior Basin, 2010.



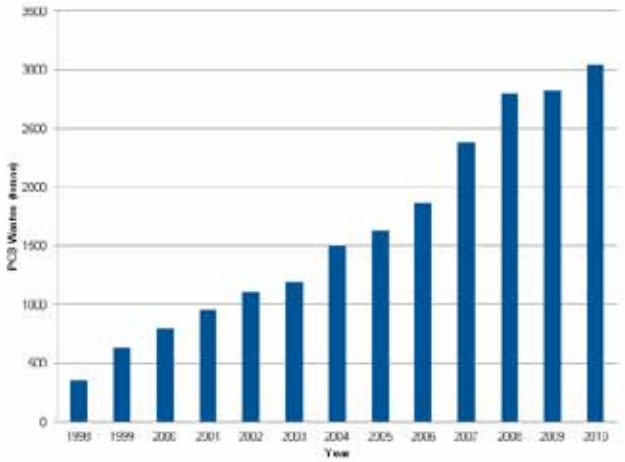
Backyard burning (burn barrels) is largely a preventable source of dioxin and HCB emissions that could be targeted for elimination to help reach ZDDP goals.
Photo: Courtesy of Patrick Atagi.

ZERO DISCHARGE POLLUTANTS

2010 Reduction Milestones for PCBs

Measuring progress toward the ZDDP reduction target for PCBs has not been possible due to a lack of baseline data on in-use PCBs in the Lake Superior basin. However, information available in Minnesota and Ontario suggests that progress is being made. Figure 6 presents the cumulative total of PCB wastes disposed from facilities in the Minnesota portion of the Lake Superior basin. It appears that the rate of PCB disposal has not tapered off. Quantities of PCB wastes in storage at sites in the Ontario portion of the Lake Superior basin have declined substantially over the last 20 years, indicating that stored PCBs are being destroyed. Further reductions of PCBs in use and storage in Ontario are expected as Canada's 2008 PCB regulations are implemented. Progress toward reducing in-basin PCBs will continue to be measured by tracking trends of PCB storage and disposal from available data sources.

Figure 6 - Cumulative Total of All PCB Wastes Disposed from Minnesota Lake Superior Facilities, 1998 – 2010 (tonne/yr).*



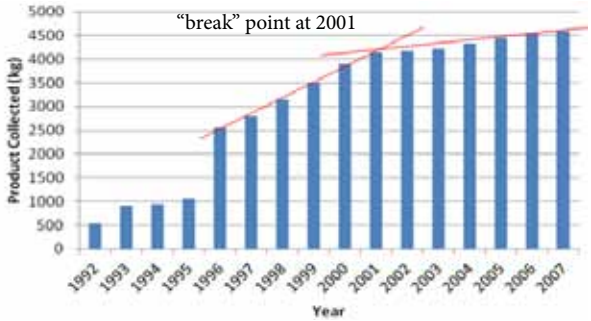
*PCB-contaminated material that resulted from an incident at a recycling facility in 2004 was omitted for graphing purposes (2 million tonnes). Instead, a normal average of 230 tonnes of PCB waste was approximated for the facility where the incident occurred.

ZERO DISCHARGE POLLUTANTS

2010 Reduction Milestones for Pesticides: Dieldrin, Chlordane, DDT and Toxaphene

The ZDDP goal was to collect all remaining stores of dieldrin, chlordane, DDT and toxaphene by 2000. As shown in Figure 7, a significant amount of pesticides had been collected by 2000. Pesticide products (those targeted by the ZDDP and those that may be contaminated by dioxin) continue to be collected in the Lake Superior basin, although at a much slower rate since 2001, suggesting that known pesticide stockpiles have been depleted. However, the presence of a continuing disposal pattern indicates the need for waste pesticide collections to continue, even in non-agricultural areas.

Figure 7 - Cumulative Amount of Pesticide Products Collected in Northeast Minnesota 1992-2007 (kg).*

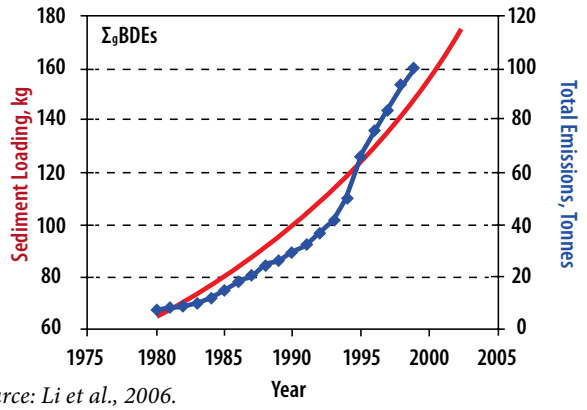


*Includes Carlton, Lake & St. Louis Counties (and Possibly Aitkin, Itasca and Koochiching Counties).

Emerging Contaminants of Concern

Recent discoveries of many chemicals of emerging concern in the Lake Superior ecosystem have led to another important challenge. Chemicals of emerging concern include many substances that have common, everyday uses such as personal care products and pharmaceuticals. Polybrominated diphenyl ethers (PBDEs) are one example group of chemicals of emerging concern that has been increasing in Lake Superior sediments in recent years (Figure 8). The potential toxicity and environmental fate and transport of chemicals of emerging concern are largely unknown. The management challenge lies in deciding which of them should be targeted for monitoring and/or remediation. The LSBP advocates using the precautionary approach through pollution prevention measures to limit the release of chemicals of emerging concern to Lake Superior, with the understanding that prevention is a more cost-effective approach than degradation followed by remediation.

Figure 8 - Sediment Loading and Emissions of Total PBDEs (excluding BDE 209) for the Entire Great Lakes Basin.



Source: Li et al., 2006.

The Future of the Lake Superior Zero Discharge Demonstration Program

The ultimate goal of the ZDDP is zero discharge (100% reduction) of The Nine pollutants by 2020. Most major reduction milestones were met by 2010, including an 80% reduction in mercury releases, 85% reduction in dioxin releases, and the collection and safe disposal of more than 4,800 kg (10,600 pounds) of waste pesticides from the basin. Further efforts are required to reduce discharges and improve inventory information, but the ZDDP has largely been a success, as evidenced by the successful reduction of sources and emissions of toxic chemicals from the Lake Superior basin. Chapter 5 of the full *2010 Critical Chemical Reduction Milestones* report presents a range of comprehensive strategies to encourage progress toward ZDDP targets. Such strategies include research, voluntary actions, recycling, controls, and regulations.

Achieving the ZDDP goals in the next 10 years may prove challenging. One challenge is to obtain better information that allows more accurate emission estimates to be made in 2015 and 2020. Another challenge is to control the atmospheric deposition of critical pollutants to Lake Superior from out-of-basin sources. Current trends in the basin, particularly increasing mining operations, provide a challenge for all partners in the LSBP to meet the next set of reduction targets. The LSBP remains committed to eliminating toxic pollutants from the Lake Superior basin ecosystem. The past successes of the LSBP and its many stakeholders attest to their commitment to protect and restore Lake Superior, and show promise for the future of the ZDDP.

For More Information:

For more information about the Zero Discharge Demonstration Program or the *2010 Critical Chemical Reduction Milestones* report, please view the Lake Superior Binational Program web site at www.binational.net. As the Program has many partners, additional reports and documents relevant to the Program may be found on Partner Agency Sites. Links to those sites can also be found on binational.net or contact:

In Canada:
Rob Hyde
Environment Canada
Phone: (905) 336-4453
rob.hyde@ec.gc.ca

In the U.S.:
Carri Lohse-Hanson
Minnesota Pollution Control Agency
Phone: (651) 757-2535
carri.lohse-hanson@state.mn.us