Lake Superior
Binational Program
2007

Contents

Photo: Matt Hudson, Great Lakes Indian Fish and Wildlife Commission.

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 Zero Discharge Demonstration Program (ZDDP) targeted at The Nine pollutants. The Lake Superior Binational Program 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 Lake Superior Binational Program as a management strategy for Lake Superior and currently guides the implementation of the ZDDP.

The Nine pollutants are mercury, PCBs, dioxin, hexachlorobenzene, octachlorostyrene and 4 pesticides: dieldrin, chlordane, DDT and toxaphene. The ZDDP targets only Lake Superior basin sources of The Nine. While out-of-basin sources may contribute significantly to the presence of these substances in the lake, these are beyond the ability of the Lake Superior Binational Program to directly influence. These out of basin sources make it difficult to be sure of the effect of local toxic reductions on environmental concentrations in Lake Superior. Despite this, the ZDDP is an important step in taking local action to "clean up our own backyard" with respect to The Nine and other pollutants of concern. As its name implies, the ZDDP is also a model that demonstrates the progress and benefits of multi-sector cooperation to address a global problem.

In 1999, the Lake Superior Binational Program 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.

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%

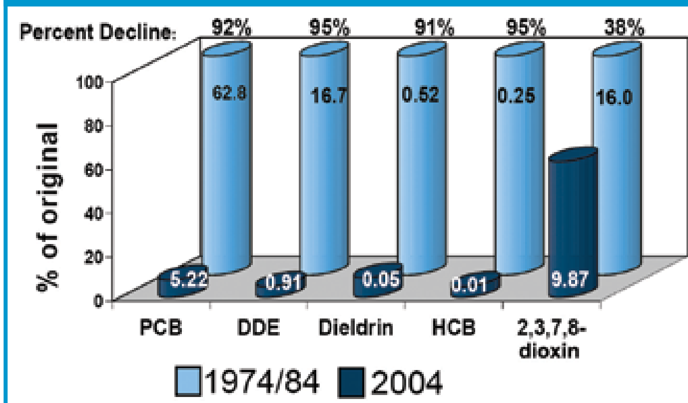
[1] The Binational Program lists 2,3,7,8-TCDD (dioxin) for the Zero Discharge Demonstration Program. By convention, dioxin is measured and reported as toxic equivalents (TEQ).

[2] The 4 pesticides included in the ZDDP are dieldrin, chlordane, DDT and toxaphene.

Fate of The Nine Pollutants in the Lake Superior Ecosystem

In general, the presence of The Nine pollutants has declined in the Lake Superior ecosystem over the past 30 years. Figure 1 shows an example of this decline, using concentrations of several chlorinated substances found in Lake Superior herring gull eggs over the time period that the Canadian Wildlife Service has been regularly measuring them. However, the rate of environmental decline of these pollutants has slowed in recent years. In addition, The Nine continue to impair lake use locally and lakewide by contributing to fish consumption advisories and loss of fish and wildlife habitat, among other impairments. For example, PCBs, mercury, dioxin and some pesticides remain above levels that limit consumption of fish from Lake Superior. Figure 2 shows total mercury and total PCB concentrations in fillet tissue compared to fish length for some species of Lake Superior fish.

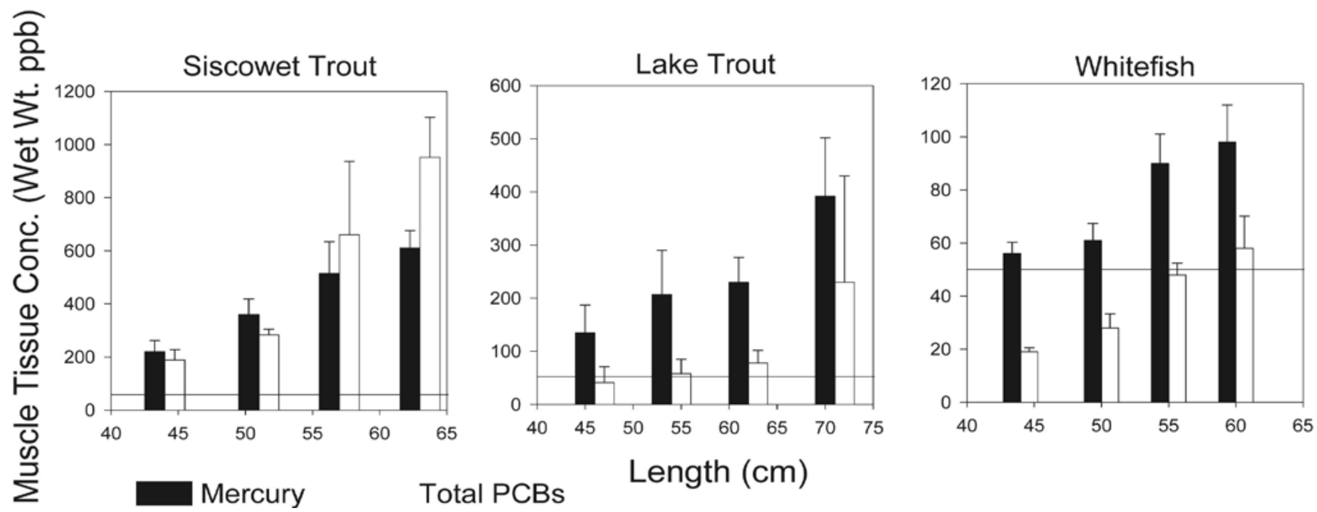
Figure 1 - Percent Decline in Mean Concentrations of a Set of Chlorinated PBT Chemicals in Herring Gull Eggs Collected from Two Sites on Lake Superior Between 1974 or 1984 and 2004.*



Source: Weseloh and Havelka, Environment Canada.

*Dioxin monitoring began in 1984 and all other listed contaminants have been monitored since 1974. Dioxin concentrations are reported in parts per trillion (pg/g) and all other pollutants are reported in parts per million (µg/g).

Figure 2 - Total Mercury and Total PCB Concentrations in Fillet Tissue of Lake Superior Siscowet Trout (*Salvelinus namaycush siscowet*), Lake Trout (*Salvelinus namaycush namaycush*), and Whitefish (*Coregonus clupeaformis*).**



Source: Great Lakes Indian Fish and Wildlife Commission 1999-2005, unpublished data.

**Lines represent the most restrictive fish tissue concentrations (50 ppb) for total mercury and PCBs currently used by one or more jurisdictions around Lake Superior to trigger fish consumption advice and limits on the consumption of fish.

ZERO DISCHARGE AT WORK

Tracking the Release of The Nine Pollutants

In the Lake Superior basin, the year 2005 marked the midpoint between the ZDDP baseline year of 1990 and the 2020 goal for virtual elimination of The Nine pollutants. The following pages provide an overview of the release reduction success achieved in the first half of the program. This is a summary of the 2005 Critical Chemical Reduction Milestones report which contains over 200 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 2010. The successes of the program over the last 15 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 Lake Superior Binational Program. The importance of the involvement of the citizens of the Lake Superior basin cannot be overstated.

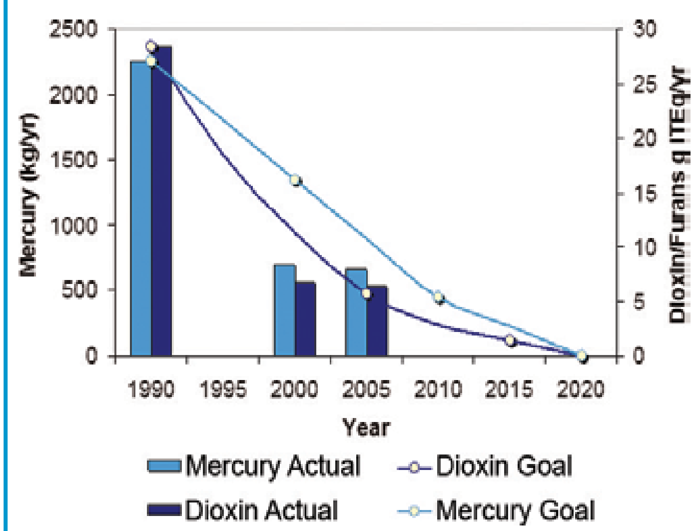
This is an example of an agricultural product which contains mercury. Photo: Minnesota Department of Agriculture.

In 2005, 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 Lake Superior Binational Program to calculate the change in release of The Nine pollutants since 1990. Figure 3 shows actual release along with the release reduction targets for mercury and dioxin in the Lake Superior basin over the time frame of the program.

Notable achievements include:

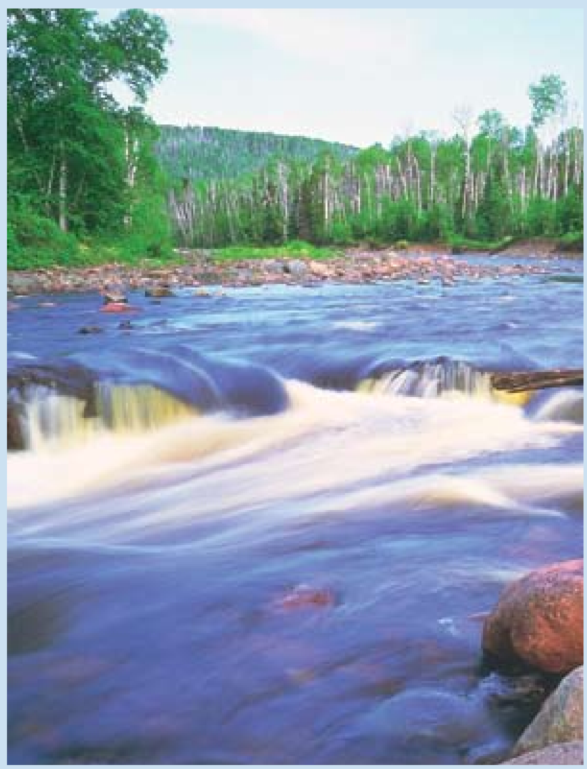
- 71% reduction in mercury releases basin-wide;
- 76-79% reduction in dioxin releases basin-wide;
- Significant reductions of PCB materials basin-wide;
- The ongoing collection and safe disposal of waste pesticides around the basin, with more than 12,700 kg (28,000 pounds) collected between 1992 and 2004 in Minnesota and Wisconsin alone.

Figure 3 - Actual release and release reduction targets for mercury and dioxin in Lake Superior Basin from 1990 to 2020.



Top 12 Ways You Can Protect Lake Superior Everyday

- 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 plants that are native to the region.
- 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!



A Lake Superior tributary. Photo: Ron Leonetti.

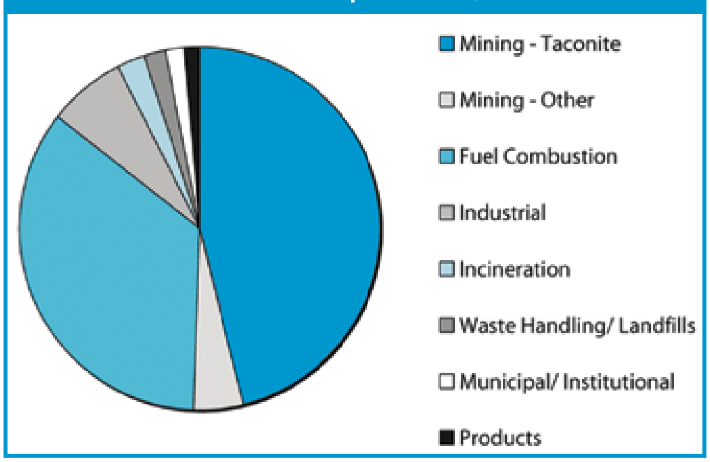
ZERO DISCHARGE POLLUTANTS

2005 Reduction Milestone for Mercury

In a year 2000 report it was estimated that mercury discharges and emissions declined 69% in the Lake Superior basin between 1990 and 2000. By 2005, the total reduction since 1990 had increased to 71%. The greatest reduction as a result of the ZDDP was a 96% reduction in the release of mercury from products. The largest overall reductions have been due to the closures of the White Pine copper smelter in Michigan and the Algoma sintering plant in Wawa, Ontario, which were not related to the ZDDP.

In order to meet the next mercury reduction milestone of 80% by 2010, 2005 loads must be reduced by an additional 200-207 kg/yr. While emissions continued to decline between 2000 and 2005, the rate of decline appears to have slowed (see Figure 3). The largest remaining sectors for mercury emissions are mining and fuel combustion, which together account for greater than 85% of the mercury emissions within the basin. Figure 4 shows the main sources of mercury in 2005. Currently, taconite mines in the Minnesota portion of the basin are the largest single sector for mercury emissions.

Figure 4 - Relative contribution of Mercury Releases from Different Sectors in the Lake Superior Basin, 2005.



Above: Jamie Harvey uses a Lumex unit to test for mercury at an industrial site. Photo: D. Hansen, Minnesota Pollution Control Agency.

Below: Mercury levels in certain fish caught in the Lake Superior basin remain high enough to cause fish consumption restrictions. Photo: Michigan Travel Bureau.

ZERO DISCHARGE POLLUTANTS

2005 Reduction Milestones for Dioxin, Hexachlorobenzene and Octachlorostyrene

Dioxin

Release of dioxin is estimated to have declined 75-78% between the ZDDP baseline year of 1990 and year 2000. However, the bulk of these reductions were due to the closure of the Algoma sintering plant, an event which was not related to the ZDDP. Little change, if any, has occurred in dioxin releases since 2000, with current estimates of total release reduction since 1990 at 76-79%. Currently residential open burning of garbage is the largest source of dioxin on both sides of the border. Fuel combustion is the second largest source of in-basin dioxin. Projected trends for dioxin emission from 2005-2010 are unknown due to changing control technology at coal-fired utilities and demand for electricity. Figure 5 shows the contribution of various sectors to dioxin release.

In order to meet the 90% reduction goal by 2015, an additional 4.32 to 4.46 g I-TEQ/yr of dioxin must be reduced from the 2005 load; this can be seen in Figure 3 above. Open burning is a completely preventable source of dioxin, and if all other sources remain unchanged, elimination of open burning by 2015 would achieve the 90% reduction goal.

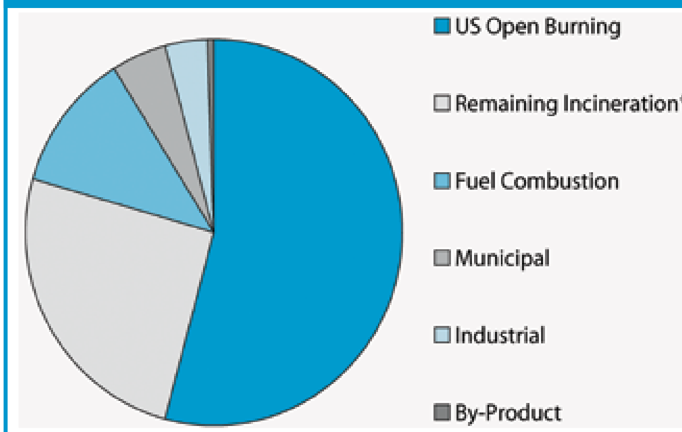
Hexachlorobenzene

Completion of the hexachlorobenzene (HCB) inventory has been challenging. Utility poles and in-use railway ties treated with PCP were the largest identified HCB sources on the Canadian side, followed by residential wood combustion. On the US side, the largest source was open burning of trash, followed by motor vehicle emissions. Since 1990, the pulp and paper industry has been responsible for significant reductions in release of HCB (about 32% of the total) because of their conversion of the bleaching process to chlorine dioxide in place of elemental chlorine.

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, LSBP may get better information about the release of OCS in the basin by improving the basin inventories for dioxin and HCB.

Figure 5 - Contribution of Dioxin Releases from Different Sectors in the Lake Superior Basin, 2005.



*Remaining Incineration includes Canadian open burning, Canadian landfill fires and U.S. small incinerators.

Billboard near Floodwood, MN discourages people from burning garbage, the largest source of dioxin in the Lake Superior basin. Photo: Mary McReynolds, St. Louis County Solid Waste Department.

ZERO DISCHARGE POLLUTANTS

2005 Reduction Milestones for PCBs

Tracking PCB reductions over time has not been possible because data on in-use PCBs in the Lake Superior basin are not available or difficult to access. As an alternative, the LSBP has proposed to track PCB disposal and storage via the Ontario database for PCB storage, the Environment Canada database for PCB disposal and the Minnesota hazardous waste database for PCB disposal. To date the resources have not been available to assess the Wisconsin and Michigan PCB disposal records from facilities in the Lakes Superior Basin in the same way. Storage, disposal, and/or destruction of PCB capacitors, transformers and oil will be analyzed every 5 years for trends and cumulative progress.

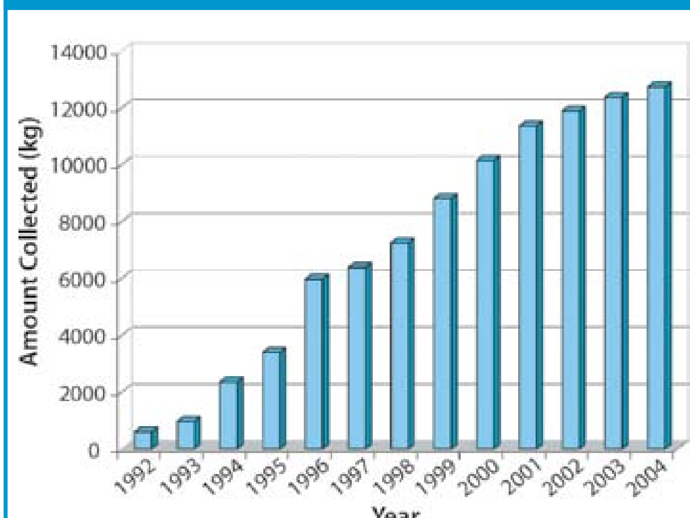
This is an example of an electrical transformer which contains PCBs. Photo: Scott Bohling, Minnesota Pollution Control Agency.

ZERO DISCHARGE POLLUTANTS

2005 Reduction Milestones for Pesticides: Dieldrin, Chlordane, DDT and Toxaphene

Although the Lake Superior basin is mostly non-agricultural, a significant amount of banned pesticides have been collected in or near the basin since 1992. Although the initial reduction goal was to collect all remaining stores of these pesticides by 2000, it is obvious that these pesticides are still present in the basin and that collections need to continue, even in non-agricultural areas. Figure 6 shows the amounts of pesticides of interest (i.e. those targeted by the ZDDP and those that may be contaminated by dioxin) that have been collected in Minnesota and Wisconsin counties in the Lake Superior basin.

Figure 6 - Cumulative Amount of Pesticides Collected in Minnesota and Wisconsin Counties in the Lake Superior Basin, 1992-2004 (kg).



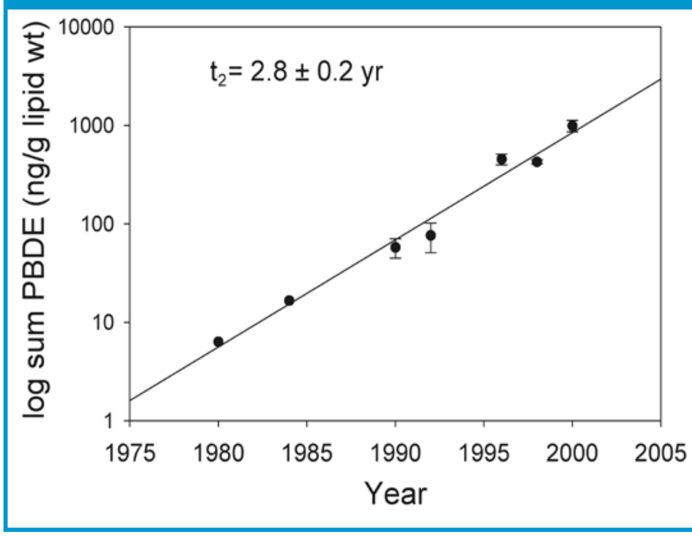
The Future of the Lake Superior Zero Discharge Demonstration Program

Identified challenges include improving our ability to accurately quantify inventories of The Nine pollutants, such as PCBs, and banned pesticides. Chapter 5 of the full Milestones report presents a range of comprehensive strategies to encourage progress towards ZDDP targets. Current trends, particularly increasing mining operations and energy use within the basin, provide a challenge for all partners in the Lake Superior Binational Program to meet the next set of reduction targets.

Recent discoveries of chemicals of emerging concern in the Lake Superior ecosystem also pose a new challenge for the ZDDP. Chemicals of emerging concern include many substances that have common, everyday uses and are being detected in water, fish, and sediments. The potential ecosystem impacts of these chemicals are largely unknown. Polybrominated diphenyl ethers (PBDEs) are one example group of chemicals of emerging concern that has been increasing in Lake Superior lake trout (Figure 5). PBDEs are commonly used as flame retardants in products such as furniture and computers. Other groups of chemicals of emerging concern include pharmaceuticals, personal care products and household pesticides. As a first step in addressing these chemicals, a watch-list has been proposed for those that have been detected in Lake Superior and are under evaluation for potential persistent, bioaccumulative and/or toxic effects. As more becomes known, management strategies will be developed by the Lake Superior Binational Program. In the meantime, the Binational Program will encourage monitoring and pollution prevention of these chemicals.

Although significant pollutant reductions have been made over the past 15 years, predicted future increases in industrial activity, energy demand and increased human population may result in corresponding increases in the release of toxic pollutants in the basin. Since pollution prevention is more cost-effective than degradation followed by restoration, it is preferable to limit the release of toxic pollutants to Lake Superior. Recognizing the evolving nature of the interactions between persistent toxic chemicals and the ecosystem, the Lake Superior Binational Program remains committed to achieving the goals of the ZDDP as part of the larger goal to restore and maintain the health of the Lake Superior basin ecosystem.

Figure 7: Concentrations of Polybrominated Diphenyl Ethers (PBDEs) in Whole Lake Trout from Lake Superior, 1980-2000. Source: Zhu and Hites 2004.



For More Information:

For more information about the Zero Discharge Demonstration Program or the 2005 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:

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