

Progress Toward Restoration

Governments and stakeholders in the Great Lakes basin have initiated or completed a wide variety of remedial actions in various Areas of Concern in the United States and Canada, representing considerable investment with some well-documented successes, such as the following.

- The governments no longer consider Collingwood Harbour and Severn Sound (Ontario) to be Areas of Concern because conditions have improved to the point that beneficial uses have been restored (Box 4). The Commission concurred.

- The two governments have recognized Spanish Harbour in

Ontario and Presque Isle Bay in Pennsylvania as Areas of Concern that are in a recovery stage (Box 4).

Box 4

Restoration Achievements Noted in Both Canada and the United States

Recently, the U.S. Environmental Protection Agency recognized Presque Isle Bay as an Area of Concern in a Recovery Stage—the first such designation of an Area of Concern in the United States. In Canada, Collingwood Harbour and Severn Sound have been designated as restored and have been delisted as Areas of Concern, and Spanish Harbour has been recognized as an Area of Concern in a recovery stage.

Progress in improving water quality in this bay surrounded by Erie, Pennsylvania, is a microcosm of work done basinwide. In this case, for example, \$100 million (USD) has been invested to upgrade Erie's sewer system, and pollution from major industrial sources and runoff was stopped.

In Presque Isle Bay, as in many Canadian Areas of Concern, natural recovery has been chosen as the consensus strategy for dealing with contaminated sediment because widespread low levels of pollutants do not pose a direct threat to the biota living in the bay.

Source Control

- The United States government has reported that at a cost of nearly \$130 million (USD), more than 1.27 million cubic meters (1.6 million cubic yards) of sediment contaminated with polychlorinated biphenyls (PCBs) have been removed from the Kalamazoo River, Manistique River, Maumee River, Rouge River, Saginaw River, Saginaw Bay, and the United States side of the St. Lawrence River.

Much of the contaminated sediment inventory in the Great Lakes basin exists because of inputs from municipal and industrial sources that predate point source regulation. Although these point sources have been strictly regulated, continued inputs to receiving waters can occur through uncontrolled waste sites and the transport of contaminated material from upland areas including industrial and agricultural sites. Achieving suitable reductions in such sources is referred to as “source control.” Failure to address significant inputs of contaminants precludes the successful use of other management options. Because of the wide range of activities that may need to be undertaken to achieve acceptable source control, cost estimates are highly site-specific.

Natural Recovery (Attenuation)

Physical, chemical or biological processes that result in a reduction of mass, toxicity, mobility, volume or concentration of contaminants are referred to as “natural attenuation.” These processes include burial through sedimentation, volatilization, dispersion and biodegradation. Burial with clean sediment is one process that most often results in risk reduction. Natural attenuation in and of itself has no cost, but is preceded by assessment and followed by monitoring.

Thick-Layer Capping

Thick-layer capping is an onsite management technique that involves placing a 20 centimeter (eight inch) to one meter (three feet) thick layer of clean material over the area of contaminated sediment. To date, there have been limited demonstrations of capping in the Great Lakes basin. Based on one proposal of full-scale capping, the cost was estimated at \$50–\$60 (USD) per cubic yard of contaminated sediment⁴.

Environmental Dredging

Environmental dredging is the most commonly used sediment remediation technique. Dredging of contaminated sediment in the Great Lakes basin is accomplished through hydraulic or mechanical dredging. Typical costs are in the range of \$100–\$200 (USD) per cubic yard⁵. These costs are several times those of navigational dredging. Hydraulic dredging minimizes sediment resuspension, but requires treatment of large quantities of water. Enhanced designs of mechanical dredges have resulted in improved performance with low volumes of excess water being produced.

- The Canadian government reports that approximately \$270 million (CAD) has been invested by the federal and provincial governments over the last 10 years to

improve the condition of wastewater infrastructure in various Canadian Areas of Concern. The United States government reports investing \$3.4 billion (USD) to upgrade wastewater infrastructure in two United States Areas of Concern.

The status of activities directed toward remediation of contaminated sediment, wastewater infrastructure, and fish and wildlife habitat and restoration of other beneficial uses are discussed in the following sections of this report.

Contaminated Sediment

Sediment in Areas of Concern is often contaminated with industrial or agricultural pollutants, such as PCBs, DDT, mercury or polycyclic aromatic hydrocarbons, presenting both financial and ecological challenges to agencies and communities. Most pollutants in sediment within Areas of Concern were released into the environment long ago and constitute a “legacy of pollution.” Other contaminants continue to enter the environment, such as through the burning of fossil fuels and from runoff from agricultural and urban areas.

Toxic chemicals in sediment can enter the food chain and threaten the health of fish, wildlife and humans. For example, contaminated sediment is the major source of contaminants found in fish and results in fish consumption advisories. The risk of adverse health effects from eating contaminated fish is particularly high for pregnant women, fetuses and infants. From an economic standpoint, contaminated sediment can

prevent or delay dredging, limiting navigation and recreational boating⁶. Contaminated sediment also can reduce property values and threaten the multi-billion dollar commercial and sport fish industries⁷.

Upon confirmation by Remedial Action Plan participants that contaminated sediment at a site poses an unacceptable risk to human or ecosystem health, the practitioners evaluate an array of potential remedial measures for possible use to reduce that risk. These potential measures include source control and natural recovery (attenuation), thick-layer capping and sediment removal through hydraulic or mechanical dredging (Box 5). In addition to these remedial options, there are a variety of dredged material treatment technologies such as thermal desorption, solvent extraction and soil washing. Though they provide a permanent solution, the thermal and nonthermal technologies are costly and are not likely to compete on a cost basis with the disposal of dredged material in a confinement facility⁸.

To date, it is difficult to assess progress in addressing the sediment remediation problem (Figure 2). In Canada, more than 100,000 cubic meters (132,000 cubic yards) of contaminated sediment have been dredged from its Areas of Concern, and in the United States, more than 1.27 million cubic meters (1.6 million cubic yards) have been dredged from its Areas of Concern for remedial purposes. According to the United States government, “Great Lakes agencies have completed or are currently addressing the remediation of more than 3 million cubic yards of contaminated sediment in the Basin⁹.”

At this time, the governments are not able to clearly define either their cleanup targets for contaminated sediment or the volumes of sediment still requiring active remediation. The lack of a framework for making prioritized decisions regarding remediation was identified by the Commission in 1997 as an obstacle to progress¹⁰. Without endpoints, progress cannot be assessed.

Figure 2. Status of Contaminated Sediment Remediation

***Box 6
Risk Management Is Helping Target Cleanups in Both the United States and
Canada***

Researchers in both the United States and Canada are developing methods to assist in making decisions regarding the management of contaminated sediment. These methods help set priorities and assist partners in determining cleanup targets. For example, Canadian researchers have developed the Benthic Assessment of Sediment (BEAST) model to determine whether sediment requires remediation¹¹.

The U.S. National Research Council (NRC) publication "A Risk-Management Strategy for PCB-Contaminated Sediments¹²." provides advice pertinent to contaminated sediment decision making. Decisions for specific contaminated sediment sites must be based on a consideration of the advantages and disadvantages of available options and by balancing the various risks, costs and benefits associated with each option. Of particular relevance to the Commission is the NRC's recommendation that the first priority must be the management of overall risks to humans and the environment rather than the selection of a remediation technology (e.g. dredging, capping or natural attenuation).

Although priority setting represents a political and institutional challenge, at least three U.S. Areas of Concern—the Kalamazoo River, the Grand Calumet River, and the Lower Green Bay/Fox River—remain severely contaminated and are releasing significant

amounts of PCBs and other persistent toxic substances to the open waters of Lake Michigan. Clean up of these sites should be a priority and the Commission notes that remedial actions in these Areas of Concern are currently underway. The information gathered in the Green Bay Mass Balance Study, and the current Fox River Natural Resources Damage Assessment demonstrate progress in arriving at management decisions. Nearly 453,600 kg (one million pounds) of PCBs have been removed from Waukegan Harbour, the largest source to Lake Michigan, and a \$330 million (USD) settlement will finance the remediation of the Fox River.

Funding for Sediment Remediation

Environment Canada's Great Lakes Sustainability Fund provides \$30 million (CAD) over five years for work in the Great Lakes. Some of this funding may be available for sediment remediation in Areas of Concern. In addition, Ontario has allocated \$50 million (CAD) over five years for the Great Lakes, a portion of which could be made available for sediment remediation in Areas of Concern.

In the United States, the 2002 Great Lakes Legacy Act provides a national focus on Great Lakes sediment remediation. The act amends the Clean Water Act to authorize \$250 million (USD) over five years for the U.S. Environmental Protection Agency to conduct remediation of sediment in the Areas of Concern. Local cost-sharing would provide an additional \$87 million (USD). The act also authorizes additional funds for information dissemination and research. The United States president's fiscal year 2004

budget includes \$15 million to support the Great Lakes Legacy Act and the clean up of contaminated sediment.

Wastewater Infrastructure Maintenance and Upgrades

The maintenance of and improvements to sewage treatment plants and wastewater

Box 7 ***Wastewater Treatment and Discharges to the Great Lakes***

Depending on the extent to which wastewater is purified, sewage treatment is classified as primary, secondary or tertiary. **Primary treatment** removes floating and heavier suspended solids but does not reduce the concentration of soluble nutrients such as phosphorus. In seven Ontario Areas of Concern some municipalities have primary treatment plants

Secondary treatment uses biological methods in which bacteria break down the dissolved organic matter. The wastewater is then allowed further settling to remove particles. Metal salts are added to remove phosphorus. With **tertiary** or advanced wastewater treatment, all but a negligible amount of bacteria and organic matter can be removed. Sand filters or additional basins can be used to improve the quality of treated water released. Dechlorination is sometimes needed to minimize environmental impacts. Secondary treatment is the general treatment standard in the Great Lakes.

Although the quality of effluent discharged by most sewage treatment plants in the Great Lakes basin has greatly improved, combined sewer and sanitary sewer overflows continue to severely degrade the waters near many urban Area of Concern. Combined sewers were designed to carry both raw sewage and storm water to sewage treatment plants. Overflows of untreated water and sewage occur during or after severe storm events and are discharged directly into the waterways. Sanitary sewer overflows are discharges of raw or inadequately treated sewage from separate sanitary sewer systems. Industrial waste that has been discharged to the sewer system also can be present in these overflows.

Such overflows often result in beach closings because of bacterial pollution. They can also affect the quality of drinking water and can cause excessive growth of aquatic plants. Costs associated with even partial treatment are considerable. For example, even though the cost of a deep tunnel system in Milwaukee exceeded \$2 billion (USD), an estimated 49.2 billion litres (13 billion gallons) of untreated wastewater has been released since the project was completed^{13, 14}.

infrastructure, together with the need to reduce sanitary sewer and combined sewer overflows, represent a costly challenge in many Areas of Concern (see Box 7). Although such maintenance and improvements are essentially a municipal or regional responsibility, funding can come from higher levels of government, depending in part on the ability of the municipal government to finance the improvements.

No information was provided by the United States government regarding wastewater infrastructure (Figure 3) for most United States Areas of Concern. Data was available for the United States Detroit River and Milwaukee Estuary Areas of Concern, where \$1 billion (USD) and \$2.2 billion (USD), respectively, already have been invested in upgrading wastewater infrastructure. According to the United States government, these two Areas of Concern have a remaining need of at least \$2.4 billion (USD) and \$1 billion (USD), respectively, to complete the upgrade of their wastewater systems, and the Cuyahoga River Area of Concern (Cleveland, Ohio) has a remaining need of \$1 billion (USD). No other information was available regarding the amount already spent or the amount needed to be spent to complete upgrades necessary to restore beneficial uses.^d

Approximately \$270 million (CAD) has been spent over the past 10 years by federal and provincial governments for wastewater infrastructure improvements in Canadian Areas of Concern. Environment Canada notes that remaining wastewater infrastructure improvements across Canadian Areas of Concern will require approximately \$1.8 billion (CAD). The Hamilton Harbour Area of Concern alone has an estimated need of \$545–\$600 million (CAD).

^d As of February 2003, the United States Environmental Protection Agency informed the Commission that work is in progress to consolidate this information

**Figure 3. Status of Wastewater Infrastructure
Investments**

Fish and Wildlife Habitat

Progress in habitat restoration within Areas of Concern has been described by the governments in terms of the number and cost of projects. For the Canadian Areas of Concern, the government reports that 187 projects have been completed at a total cost of \$80.26 million (CAD). Although habitat work is underway in the United States portion of the Great Lakes basin, the United States government was not able to report on progress within most of its Areas of Concern.

In Canada, the restoration of fish and wildlife habitat is progressing more rapidly than are more complex projects such as sediment remediation and infrastructure improvements. However, the benefits to fish and wildlife populations are not well quantified and are infrequently reported¹⁵.

Few participants involved in Remedial Action Plan development and implementation on both sides of the border could quantify the extent to which fish and wildlife habitat and populations have been restored, despite a considerable number of projects designed to enhance and protect habitat. The quantification of progress requires more than a catalogue of dollars expended and hectares or acres of habitat protected or

rehabilitated.^e It requires restoration targets, clearly defined endpoints and estimates of the degree to which those targets are being met.

The Commission acknowledges that work is proceeding but without the above information the Commission cannot evaluate to what degree the actions reported by the governments contribute to the full restoration of beneficial uses.

Waste Sites and Nonpoint Source Pollution

The remediation of hazardous waste sites that contribute contamination to the Areas of Concern is necessary to reduce the exposure of fish, wildlife and human populations to persistent toxic substances because land-based sites can leach contaminants into groundwater and surface water or release contaminants to the atmosphere. There are multiple hazardous waste sites in several United States Areas of Concern. The cost to date for remediation on the United States side of the Niagara River Area of Concern alone has been \$382 million (USD), and future outlays are estimated at \$249 million (USD), excluding long-term operation, maintenance and monitoring costs for the sites. Hazardous waste sites identified in United States Areas of Concern are illustrated in Figure 4^f. Because the geographic boundaries of some of the United States Areas of Concern are uncertain, it is not possible to determine how many such sites are located within the Areas of Concern. Canada has reported that contaminant levels are such that

^e The two governments recognize this but were unable to report on the degree to which beneficial uses were restored

^f This figures only identifies Superfund National Priority List hazardous material sites. Information on other sites addressed by other programs was not provided to the Commission.

remedial actions related to hazardous waste sites are not necessary in Canadian Areas of Concern¹⁶.

Figure 4. Hazardous waste sites within U.S. AOCs.

Reductions in phosphorus and sediment inputs from agricultural nonpoint sources have been a part of government-funded programs in both countries since the mid-1980s. Environment Canada reports spending over \$20 million (CAD) since the inception of the Remedial Action Plan program to curtail these types of inputs within Canadian Areas of Concern. Although there are several United States federal programs supporting reductions of nonpoint source pollution, the United States government has not identified expenditures within its Areas of Concern. As previously noted, because the geographic boundaries of Areas of Concern in the United State are not clearly defined, the extent of nonpoint source pollution in the Areas of Concern is difficult to determine.

Accountability and Responsibility for Remedial Action Plans

In verifying the list of federal, state, provincial and local Area of Concern contacts provided by the Parties, the Commission discovered numerous cases where the named contact was no longer employed by the agency, retired, or no longer responsible for the Area of Concern.

The Commission believes that for the governments to effectively address the multi-billion dollar remediation challenge, management responsibilities across a broad range of programs must be clearly defined. Government agencies should ensure that:

- technical input and oversight are provided;
- information is managed effectively and is coordinated among a variety of government and nongovernment organizations; and
- public engagement, which supports and sustains the momentum for Remedial Action Plan implementation, continues.

Governments also should ensure that those who work or live in Areas of Concern know:

- the individual who is responsible for each Area of Concern;
- the direction of the program; and
- progress toward restoring beneficial uses.

United States Approach

Of the 31 United States and binational Areas of Concern, 27 have federal contacts and 26 have state coordinators. In some United States Areas of Concern, including many in Michigan, agencies view local community groups as being responsible for Remedial Action Plan implementation, while the community groups view the agencies as being responsible.

Recognizing concerns about Remedial Action Plan management and coordination, the United States Great Lakes Strategy ¹⁷ made reform a key objective, promising to “accelerate the pace of sediment remediation, working to overcome barriers to progress identified at each site.”

Canadian Approach

The presence of a federal or provincial coordinator was reported by the government for 14 of the 15 Canadian and binational Areas of Concern, and all Areas of Concern have been assigned a government contact. However, the assignment of a coordinator was not always known by the community contacts, revealing a lack of communication between local participants and the government. The 2002 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem¹⁸ commits the province to take the lead in many Areas of Concern, noting in part:

“Canada and Ontario will co-lead Remedial Action Plan management in Toronto and Region, Severn Sound (delisted January 2003), St. Marys River, St. Clair River and Detroit River Areas of Concern. Canada will lead the process in Thunder Bay, Hamilton Harbour, Port Hope, and the St. Lawrence River Areas of Concern.

“Ontario will lead the process in Nipigon Bay, Jackfish Bay, Peninsula Harbour, Spanish Harbour, Wheatley Harbour, Niagara River and the Bay of Quinte Areas of Concern.”

Community-based Alliances

In Canada and the United States, cases exist where community-based groups have developed formal agreements with different levels of government and/or business/industry to take the coordinating role (e.g. Toronto and Region, Ashtabula River). These Remedial Action Plan participants have demonstrated promising results and effective management practices. The community groups are active and knowledgeable and are dedicated to restoring beneficial uses. In particular, community representatives receive help from such alliances in developing project proposals, acquiring matching funding and generating more technical data in support of project development and implementation.

Confirming the Status of Restoration Efforts

Implementation efforts can often exceed 10- to 20-year periods, during which environmental conditions and scientific understanding can change. Because environmental monitoring can reveal the response of ecosystems to remedial actions that have been designed to restore beneficial uses, the Remedial Action Plans may need to be adjusted based on the observed environmental responses.

As scientific knowledge advances, restoration targets, where they exist, also change. For example, environmental and health impacts of new contaminants, or lower doses of already known contaminants, are the subject of numerous studies and government directives, including fish advisories. Accordingly, restoration targets must be updated to reflect the latest research, and remedial strategies may need to be adapted to accommodate new knowledge.

Environmental monitoring is clearly required to ensure that remedial measures are resulting in the intended ecosystem recovery. As the Commission sought information for this report, it became evident that few Remedial Action Plan practitioners could estimate the degree to which the local environment was responding to remedial actions taken, partly because monitoring is insufficient to provide this information.

Approximately three-quarters of the United States Areas of Concern do not have restoration targets against which to compare changes in environmental conditions. Without these restoration targets, it is impossible for the Commission to evaluate progress or to assess restoration efforts.

Keeping the Focus on Beneficial Uses

The Commission notes that many of the actions being implemented in United States Areas of Concern are driven by a multiplicity of programs with different priorities, such

as the U.S. Superfund program. As actions in the United States Areas of Concern approach a point where large-scale projects near completion (such as sediment remediation under a United States Superfund action), the challenge is to revitalize the Remedial Action Plan process and focus on fully restoring beneficial uses. The United States Great Lakes Strategy¹⁹ recognizes this need:

“By 2006, the SOLEC [State of the Lakes Ecosystem Conferences], LaMP [Lakewide Management Plan], and Remedial Action Plan processes will provide clear information on Great Lakes water quality measures, trends, and actions (e.g., water quality trends, fish tissue trends, beach closures, Remedial Action Plan and LaMP implementation, ecosystems restored); will be accessible to the public via the Internet; and will be updated on a regular basis.”

(Note: SOLEC is a binational, biennial initiative organized by Environment Canada and the U.S. Environmental Protection Agency to develop and report on indicators of the state of the Great Lakes ecosystem.)

This United States commitment to the SOLEC process apparently represents a consensus between both governments. On September 25, 2002, Environment Canada and the U.S. Environmental Protection Agency, in cooperation with the Commission, launched a cooperative tracking program designed to more completely account for planning and implementation efforts related to contaminated sediment, wastewater infrastructure, fish and wildlife habitat, and hazardous waste sites in Areas of Concern. This initiative could help the government meet their commitment to SOLEC and Remedial Action Plan reporting.

Because of the centralized coordination in the early 1990s (i.e. oversight through the federal-provincial, multiagency Canada-Ontario Agreement Review Committee), 14 of the 15 Areas of Concern in Canada (including binational sites) had developed restoration targets. Planning participants in 14 of the 15 sites have reassessed the status of beneficial use impairments within the past five or six years²⁰.

The Commission finds that there is confusion or a lack of knowledge on the part of some Area of Concern participants regarding the extent to which beneficial uses are impaired. According to the Canada-Ontario Agreement²¹, Canada and Ontario have committed to make "publicly available environmental monitoring information for evaluating environmental recovery and adjusting remediation strategies."

Considering that the restoration of beneficial uses in Areas of Concern is a goal of Annex 2 of the Great Lakes Water Quality Agreement, the Commission is concerned that the general lack of knowledge regarding the status of beneficial uses by the agencies and the engaged public reflects shortfalls in Remedial Action Plan management, data support, communication and coordination.

Funding for Remediation and Planning Efforts

As previously discussed, based on information supplied by the governments, an estimated \$7.4 billion (USD) will be required to address wastewater infrastructure and sediment improvements necessary to restore beneficial uses in selected Areas of Concern. Values

for the remaining United States Areas of Concern are unknown. Costs for all the Canadian Areas of Concern are presently estimated at \$1.9 billion (CAD). Due in part to the lack of restoration targets, the Commission cannot relate these estimates to the magnitude of real costs. If government, industry, business and local communities are expected to find and invest these resources, governments must provide more accurate and complete information, set priorities and demonstrate progress in restoring Areas of Concern. Securing these resources, whether from public or private sources, is ultimately the responsibility of the federal governments, in cooperation with the state and provincial governments.

Better communication and coordination among Remedial Action Plan practitioners and federal and state project managers of programs that may be operating within Areas of Concern but not covered in the Remedial Action Plan would also improve information exchange on cleanup actions. This would improve the focus on the Remedial Action Plan's purpose to restore beneficial uses.

Corporate/Private Spending on Remediation

Little information is available regarding the level of corporate spending for remedial activities in the Areas of Concern. The Commission does know, however, that corporate expenditures to control contamination from hazardous waste sites in the New York state portion of the Niagara River Area of Concern will exceed \$600 million (USD), excluding operation and maintenance expenses. The Commission believes that such investments by

the private sector be monitored by the governments and that their contribution to the overall cleanup effort be recognized in order to provide the full accounting the Commission and the public deserve.