travel through navigational channels. Contaminated sediment problems are being addressed at many sites throughout the Great Lakes Basin and their cleanup is another essential element of addressing toxic contamination. The IJC has estimated that in the period covering 1986 to 1999, over $580 million has been spent on 38 remediation projects in 19 AOCs throughout the Basin. EPA and its Federal and State partners have a program for remediating these sites, using a wide range of regulatory approaches and an increasing emphasis on partnerships. Since 1995, remedial activities have been completed or are currently underway at 21 new sites.

Navigational Dredging

Through its navigational dredging program, the Corps conducts a comprehensive monitoring program of sediment quality. The Corps' sediment quality database is used extensively by RAPs and LaMPs. During FY 1998 and FY 1999, the Corps collected sediment quality data from approximately 20 Great Lakes harbors.

Navigational dredging supports Great Lakes shipping and boating as well as helping to monitor water quality.

The Corps monitors water quality at dredged material disposal operations and at disposal facilities to assure compliance with water quality standards. Disposal facilities are also monitored for biological activity to protect wildlife that inhabit or visit these facilities.

Great Lakes navigational dredging in the last 2 years by the Corps is summarized in Table 3.

	FY 1998 (actual)	FY 1999 (estimated)
Number of projects	32	36
Volume (cubic yards)	3,254,000	3,742,000

Table 3. Great Lakes Navigational Dredging. (Source: U.S. Army Corps of Engineers, 1999)

Although not conducted for environmental restoration purposes, navigation dredging has removed over 4.5 million cubic yards of contaminated sediments from Great Lakes AOCs.

The Corps has joined into partnerships with Federal, State and local agencies to develop facilities for the disposal of contaminated sediments dredged from Great Lakes AOCs for navigation and environmental restoration purposes. The Corps is planning and designing multi-purpose confined disposal facilities at the following AOCs: Ashtabula River, Ohio; Indiana Harbor/Grand Calumet River, Indiana; and Waukegan Harbor, Illinois.

The Great Lakes Dredging Team, established in 1996, continues to provide a mechanism for the coordination and decision-making among local, State, Tribal, and Federal agencies responsible for maintaining and regulating dredging-related activities on the Great Lakes.

Cleanup Dredging

In the Great Lakes Basin, remedial efforts have traditionally been catalyzed by enforcement actions. In an attempt to move even more sites towards remediation, the use of partnerships between government agencies, industry, and citizen groups has been encouraged as an alternative and/or in addition to enforcement or litigation. During the last two years, large amounts of contaminated sediments were removed from the Great Lakes in remedial cleanup actions. Some of these projects are highlighted below.

About 8,000 cubic yards of sediments containing 56,000 pounds of PCBs were dredged from the Unnamed Tributary to the Ottawa River, which drains into Lake Erie at Toledo, Ohio. This had

been one of the major sources of PCBs to Lake Erie. This cleanup was carried out under a public-private partnership which included the City of Toledo, Ohio EPA, EPA, U.S. Fish and Wildlife Service (FWS), and GenCorp, Inc.

Ottawa River cleanup site, completed under a unique public/private partnership.

In September 1999, EPA and the Corps completed a time-critical removal action at the Bryant Mill Pond portion of the Allied Paper site, at the Allied Paper, Inc./Portage Creek/ Kalamazoo River Superfund site in Kalamazoo and Allegan Counties, Michigan. This site comprises the uppermost reach of PCB contamination on the Kalamazoo River. PCB concentrations have been found to be as high as 1,000 ppm in these sediments. The entire Kalamazoo River has been impacted by PCBs, and fish advisories cautioning people to limit or restrict eating fish caught from the river have been in effect for many years. Approximately 150,000 cubic yards of PCB-contaminated residual paper pulp waste, soil, and sediment (20,000 pounds of PCBs by mass) were removed from the 22-acre area. The removed material was dewatered, solidified in-place, and graded for drainage.

Dredging of 450,000 cubic yards of PCB-contaminated sediment and soil (which included 440,000 pounds of PCBs) from the Willow Run Creek, Huron River, Michigan was completed in 1998. This work has been performed by the Willow Run Cleanup Group, a consortium of private and public interests, including the Michigan DEQ.

At the Fox River in Wisconsin, dredging was completed in Fall 1999 at Deposit N near the city of Kimberly, completing dredging that occurred in 1998 at this site. This project removed most of the remaining PCBs at this location by removing another 3,500 cubic yards of contaminated sediment. This is in addition to the 100 pounds of PCBs removed last year along with 5,000 cubic yards of contaminated sediment. This clean up was managed by the Wisconsin DNR, while jointly funded by the State and EPA-GLNPO.

About 400,000 cubic yards of sediment contaminated with low levels of PCBs were removed from Newburgh Lake, a 100 acre recreational impoundment located on the Middle Rouge River near the cities of Livonia and Plymouth in Wayne County, Michigan, and were disposed of in a state licensed landfill. The project was completed in 1998 at a cost of $11,000,000. Excavation of the sediments also resulted in the deepening of the impoundment for enhanced recreational use in this urbanized area. As part of the restoration, 10 acres of aquatic vegetation were established, 30,000 pounds of contaminated and undesirable fish were removed, structural fish habitat and fish spawning beds were created, and a new boat ramp and docks were constructed.

Approximately 21,500 cubic yards of the contaminated sediments exceeding 3,000 ppm total DDT were removed from the Pine River, St. Louis, Michigan. Approximately 430,400 pounds of DDT will be removed by the end of 1999. Pine River sediments contain total DDT concentrations as high as 32,600 ppm and are also contaminated with polybrominated biphenyls near the site of Velsicol Chemical.

During 2000, about 350,000 cubic yards of contaminated sediments were removed from the Saginaw River using a special clamshell bucket that greatly reduces the water and potential resuspension of sediments compared to a conventional dredging bucket. This remediation is being accomplished through a partnership of the Michigan DEQ, FWS, the Corps, and General Motors.

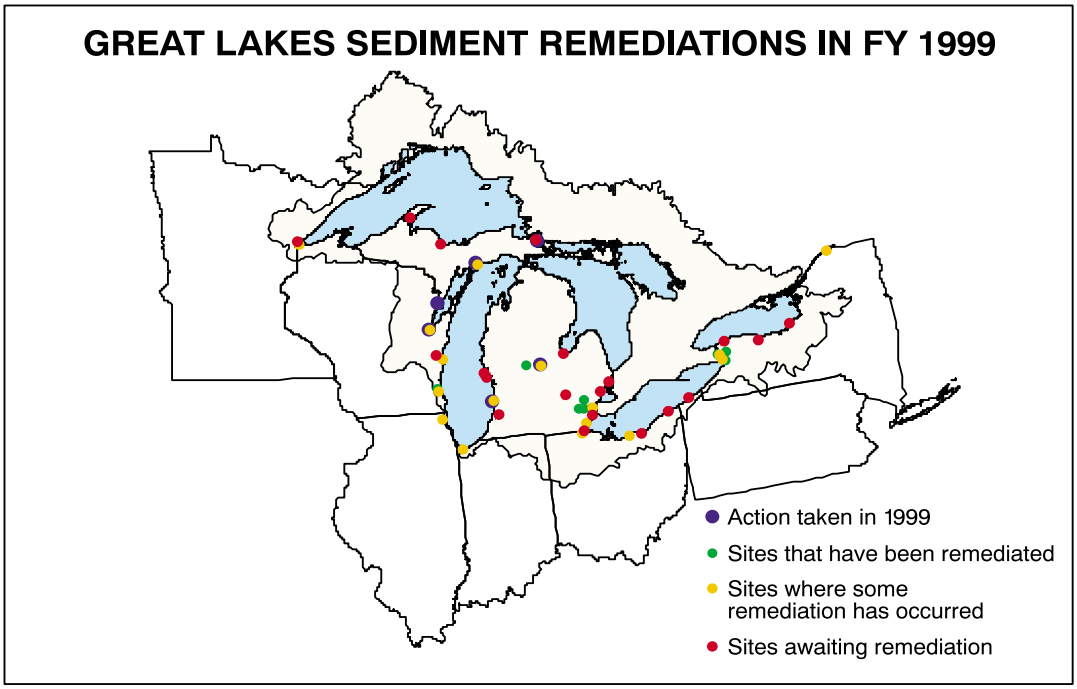

Figure 16. Great Lakes sediment remediations in FY 1999 (Source: EPA-GLNPO, 1999).

Sediments in the River Raisin, which has the highest concentrations of PCBs in Michigan, were remediated in 1998 by EPA Superfund, in co-operation with the Michigan DEQ, the Corps, and Ford.

In 1998, at the Monguagon Creek in Michigan, a tributary to the Detroit River (an AOC), the Michigan DEQ oversaw the potentially responsible party remediation of 25,000 cubic yards of contaminated sediment using stabilization and excavation techniques.

The cleanup of the Cannelton Industries, Inc. Superfund site began in May 1999 and was completed in October of the same year. The cleanup was supervised by EPA with the assistance of the Corps. The site lies on the shore of the St. Mary's River AOC in Michigan. A total of 33,000 tons of tannery waste and other material were removed and disposed of at an off-site landfill. Contaminants included chromium, cadmium, lead, arsenic, and mercury. Natural attenuation of the contaminants with monitoring was the remedy selected for the Tannery Bay area in the river and the wetland area. A monitoring program is in place in Tannery Bay to confirm that erosion of sediments do not become a concern; biological monitoring of the sediments will also be conducted for comparison with a baseline study which was designed and conducted by NOAA in 1997 for EPA.

Ansul Inc. of Marinette, WI recently completed the removal of 12,329 cubic yards of arsenic contaminated sediment from the Eighth Street Slip as part of an agreement with EPA for conducting corrective action at the site. Sediments from the slip are highly contaminated with arsenic, with concentrations as high as 22,000 ppm, a level that resulted in these sediments being classified as a hazardous waste pursuant to the Resource Conservation and Recovery Act (RCRA). The sediments were treated on-site to nonhazardous levels and sent for disposal off-site in a solid waste landfill. Carriage return water from the dredging operation was pumped back into the Eighth Street Slip for treatment at a later date. An on-site wastewater treatment plant will be constructed in early 2000 for treatment of the contaminated water and discharged under permit to the Menominee River.

Many of these and similar efforts have been highlighted in EPA reports, which cover remedial activities achieved through a number of partnerships with Federal, State and Tribal agencies. These reports include *"Moving Mud"*

a synopsis of EPA's Great Lakes National Program Office's sediment grants program; and *"Realizing Remediation,"* a summary of 33 past or current sediment remediation projects, led by either EPA or by a State environmental agency. These reports are available on the Internet at:

www.epa.gov/glnpo/sediments.html

Assessment

EPA's GLNPO has been responding in a number of ways to the need for gathering high-quality sediment information to assist AOCs in making remedial action decisions. One such route has been through the services of the *R/V Mudpuppy,* a 32-foot flat-bottom boat specifically designed for sediment sampling in shallow rivers and harbors. To date, the *R/V Mudpuppy* has been used to perform sediment assessments at 16 Great Lakes AOCs (see Figure 17 below).

The bulk of this work has been conducted to collect information on the physical, chemical, and biological nature of sediments. Typically, projects use a two-phased sediment assessment approach. The first phase includes a comprehensive sampling of the entire AOC to help pinpoint the location of hot spots. These hot spots are then delineated in the second phase to provide

The *R/V Mudpuppy* conducts sediment assessments throughout the Basin in cooperation with a variety of governmental partners.

information necessary for making remedial decisions. The overall goal of this effort is to generate the information needed to make scientifically defensible remediation decisions.

Sediment Treatment and Beneficial Reuse

A major hurdle to sediment remediation in the Great Lakes is determining the final disposal site for the dredged material. Beneficial reuse of dredged material provides an opportunity to solve the disposal problem by utilizing the processed dredge sediments for soil amendments, industrial

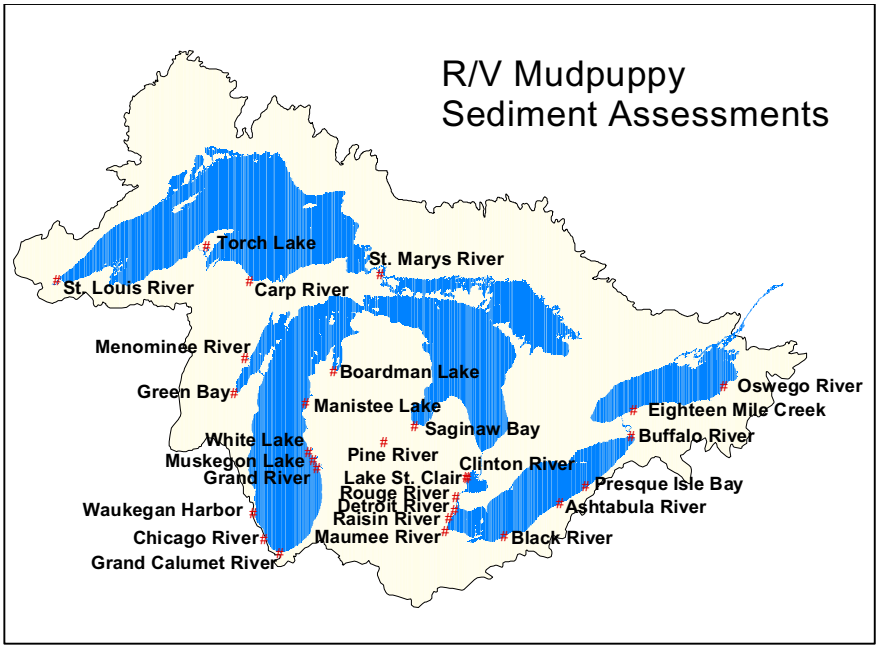

Figure 17. R/V Mudpuppy Sediment Assessment sites in the Great Lakes (Source: EPA-GLNPO, 1999)..

applications, beach nourishment, and other uses. During FY 1998 and FY 1999, the Corps, in cooperation with EPA, conducted demonstrations of technologies for the treatment and recycling of dredged material at confined disposal facilities (CDFs) in Toledo, Milwaukee, Green Bay, and Duluth. The objective was to advance technologies that may allow dredged material in existing CDFs to be reclaimed for beneficial uses offsite. This would prolong the operating life of existing facilities and reduce the need for new CDFs. Technologies being evaluated include composting, oxidation, size fractionation, and creating manufactured soils.

GLNPO is active in investigating beneficial reuse options for dredged sediments. It has provided $650,000 of funding for such projects since FY 1997. Some of these projects are described below.

> **Redevelopment and Expansion of Land-Side Dredge Disposal Facility, Brown County Harbor Commission:** This project funded the redevelopment of the Bayport CDF and the creation of a de-watering cell for de-watering sediments for potential reuse.

> **Soil Separation Technology Development, the Corps Waterways Experiment Station:** The Corps and GLNPO have initiated a joint investigation of technologies for physical separation of dredged material. The project resulted in the preparation of a guidance document on soil separation technology.

> **Mined Land Reclamation, Minnesota DNR:** This project is investigating the use of dredged material from the Erie Pier CDF in Duluth, Minnesota for reclamation of strip mines in northern Minnesota.

> **Contaminated Sediment Management, Corps-Great Lakes and Ohio River Division:** This agreement funds work to investigate the creation of topsoil material from dredged material in Wisconsin. Dredged material will be combined with manure, wood chips, biosolids, and/or other organic material and composted within the CDF. A second work item is the design and acquisition of a hydro-cyclone array for use in mining sand material from Great Lakes CDFs.

> **Michigan DEQ Treatment Technologies Studies:** With funding from GLNPO, the Michigan DEQ reviewed hundreds of sediment treatment technologies from existing databases, and conducted bench-scale tests (approximately 20 gallons) on five technologies, using sediments from hotspots in the Detroit River. They also evaluated the marketing and reuse aspects of three technologies. Michigan DEQ anticipates conducting a sediment treatment demonstration in conjunction with the remediation of the Black Lagoon site on the Detroit River in 2000 (see photograph below).

Site of planned cleanup in the Black Lagoon on the Detroit River where maximum contaminant concentrations include mercury (7.8 ppm) and oil and grease (20,000 ppm).

In addition, a Great Lakes Dredging Team project entitled, “Promoting Beneficial Use of Dredged Material” will inform and promote beneficial uses

of dredged material to the general public. A Regional Beneficial Use Task Force has been established to develop and send the message. In addition, a survey will be conducted to identify and assess the existing beneficial use projects in the Great Lakes Basin and make this information available to the public as part of their effort. Finally, the Task Force will convene the eight Great Lakes states to work with GLNPO to prioritize issues in the development of risk-based guidance materials to advance the beneficial use of dredged material. EPA's National Dredging Team's beneficial use project will entail the development of a beneficial uses database and website which will provide access to the database. NOAA has provided a linkage between these two projects through an offer of its services. Specifically, NOAA will help develop the survey to provide the needed information for both the GLC project and to provide data for the database.

Looking Ahead

In the near future, several major contaminated sediment cleanups are planned, including those described below.

The removal of 700,000 cubic yards of contaminated sediment from the east branch of the Grand Calumet River, Indiana (USX Site) is targeted to begin in 2002, following design and construction of the sediment disposal facility. The cleanup is a result of a $30 million settlement between the Federal government, the State of Indiana, and USX, located in Gary, Indiana. The sediments targeted for cleanup have been highly contaminated with PCBs, heavy metals, benzene, PAHs, and cyanide. The settlement is believed to be the largest sediment cleanup to date in the inland U.S. In addition, a natural resources damage settlement targets the purchase of rare dune and swale wildlife habitat along Lake Michigan and wildlife habitat along Salt Creek. The final cost of this settlement is expected to exceed $50 million.

Approximately 4.65 million cubic yards of contaminated sediment will eventually be removed from the Indiana Harbor Ship Canal, Indiana, with construction of the sediment management facility targeted to begin in 2001 and dredging to follow in 2003. It has been estimated that about 150,000 cubic yards (200 million pounds) of polluted sediments enter Lake Michigan each year from the Indiana Harbor and Ship Canal and the Grand Calumet River. These sediments are highly contaminated with a wide variety of toxicants, including chromium, lead, and PCBs. It will take about 10 years to deepen the navigation channel and harbor. It is expected that an additional 20 years of maintenance dredging will be required.

The Corps is moving forward with a Comprehensive Dredge Material Management Plan for Waukegan Harbor, Illinois, to be completed in September 2000. Currently, the plan calls for dredging 250,000 cubic yards of polluted material, beginning in 2002 or 2003. A critical component of the plan is securing an acceptable site for a CDF.

The Ashtabula River Partnership is a public-private partnership working to dredge PCB-contaminated sediment from the Ashtabula River in Ohio. On September 10, 1999 the Partnership announced the release of the draft plan for remediating the river. Officially called an Environmental Impact Statement, the Corps announced the official Notice of Availability in the *Federal Register*, opening the plan up for a formal 45-day public comment period. The draft plan represents 5 years of work between EPA, Ohio EPA, the Corps Buffalo District, FWS, and the Ashtabula community. This $42.5 million dollar cleanup will remove 700,000 cubic yards of PCB-contaminated sediment from the river and place it into a specially constructed confined disposal landfill. The cleanup project is slated to begin in 2002.

This project has received a $500,000 start-up grant from EPA-GLNPO and will receive funding from the State of Ohio and the 15 or so companies responsible for the pollution of the Fields Brook Superfund Site (Fields Brook is a tributary to the Ashtabula Harbor). The Ashtabula Harbor project is especially significant because it outlines a first-time justification for the use of a new Federal environmental dredging authority (Water

Resources Development Act, Section 205) that provides Federal involvement in such projects.

Additional planned sediment remediations include: approximately 30,000 cubic yards of contaminated sludge from the Black Lagoon (see the photograph on page 44), one of the most contaminated sites on the Detroit River, with 5,000 cubic yards to be turned into a safe cement compound as part of a pilot program jointly funded by EPA, Michigan DEQ, and the Institute of Gas Technology; the Pine River, the White Lake AOC, and Hayton Mill Pond on the Manitowoc River in Wisconsin; and the Grasse River and St. Lawrence River, both in New York. All of these actions are scheduled to be taken in the 1999-2002 time frame.

NONPOINT SOURCE POLLUTION

EPA identifies polluted runoff as the most important remaining source of water pollution and provides for a coordinated effort to reduce polluted runoff from a variety of sources. Previous technology-based controls, such as secondary treatment of sewage, effluent limitation guidelines for industrial sources, and management practices for some nonpoint sources, have dramatically reduced water pollution and laid the foundation for further progress. Over the next several years, States will be developing many Total Maximum Daily Loads (TMDLs) for pollutants entering into water bodies from both point and nonpoint sources. TMDLs will help manage water quality on a watershed scale. States and Tribes, working in full partnership with EPA, will work to establish TMDLs for all listed waters and attempt to ascertain that all load allocations established by TMDLs are implemented by point and nonpoint sources alike.

A significant remaining water quality problem is polluted runoff, or nonpoint source pollution. Nonpoint source pollution, unlike pollution from industrial and STPs, comes from many diffuse sources. It can be caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and man-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water. These pollutants can be pesticides, fertilizers, bacteria and nutrients from animal waste, household chemicals, and petroleum products, such as gasoline and motor oil.

Controlling Polluted Runoff to Further Protect Drinking Water and Waterways

Stormwater is water from rain or snow that runs off of city streets, parking lots, construction sites and residential yards. It can carry sediment, oil, grease, toxicants, pesticides, pathogens and other pollutants into nearby storm drains. Once this polluted runoff enters the storm sewer system, it is discharged, usually untreated, into local streams and waterways. It can contaminate drinking and recreational waters and remains a major source of beach and shellfish bed closures.

EPA announced it would reduce stormwater runoff from construction sites between 1 and 5 acres and municipal storm sewer systems in urbanized areas serving populations of less than 100,000 through the issuance of permits. This new stormwater rule builds on the existing program to control stormwater runoff from municipalities with populations greater than 100,000 and 11 industrial categories, including construction disturbing over 5 acres. Under the expanded program, sediment discharges from approximately 97.5 percent of the acreage under development across the country will be controlled through permits.

Another measure to address polluted runoff is the new stormwater Phase II rule. This rule is structured for maximum flexibility and is expected to make approximately 3,000 more river miles safe for boating and protect up to 500,000 people a year from illness due to swimming in contaminated waters. It will prevent beach closures, make fish and seafood safer to eat, and reduce costs of drinking water treatment.

The joint EPA-NOAA Coastal Nonpoint Source Control Program (Coastal Nonpoint Program) requires State Coastal Management Programs to develop Coastal Nonpoint Programs to reduce nonpoint sources of pollution flowing into coastal waters. EPA has continued to work with NOAA

and the State Coastal Management Programs and their counterpart state water quality programs to develop and implement state Coastal Nonpoint Programs. This is another important partnership with EPA that builds on the Clean Water Act Section 319 Nonpoint Source Management Program and advances our nationwide efforts to reduce polluted runoff, especially in coastal waters and river tributaries to coastal waters.

The coastal programs in Michigan and Wisconsin have received conditional approval of their Coastal Nonpoint Programs, and EPA and NOAA are working with Indiana, Minnesota, and Ohio to develop their nonpoint programs. The programs have resulted in faster implementation of nonpoint control measures and have significantly improved communication and coordination across different state agencies.

Eliminating Eutrophication Problems

One of the consequences of nonpoint source pollution is the eutrophication of bodies of water. Eutrophication, or the presence of high levels of nutrients in a lake, has several symptoms, often including large "blooms" of undesirable algae. A second symptom of eutrophication is a decrease in the amount of oxygen dissolved in the water, particularly at near-bottom depths in lakes.

Much work has been done to prevent eutrophication of lakes. The 1997 State of the Great Lakes Report reviewed nutrient data since 1994 and concluded that no appreciable change has occurred in the nutrient status of the lakes.

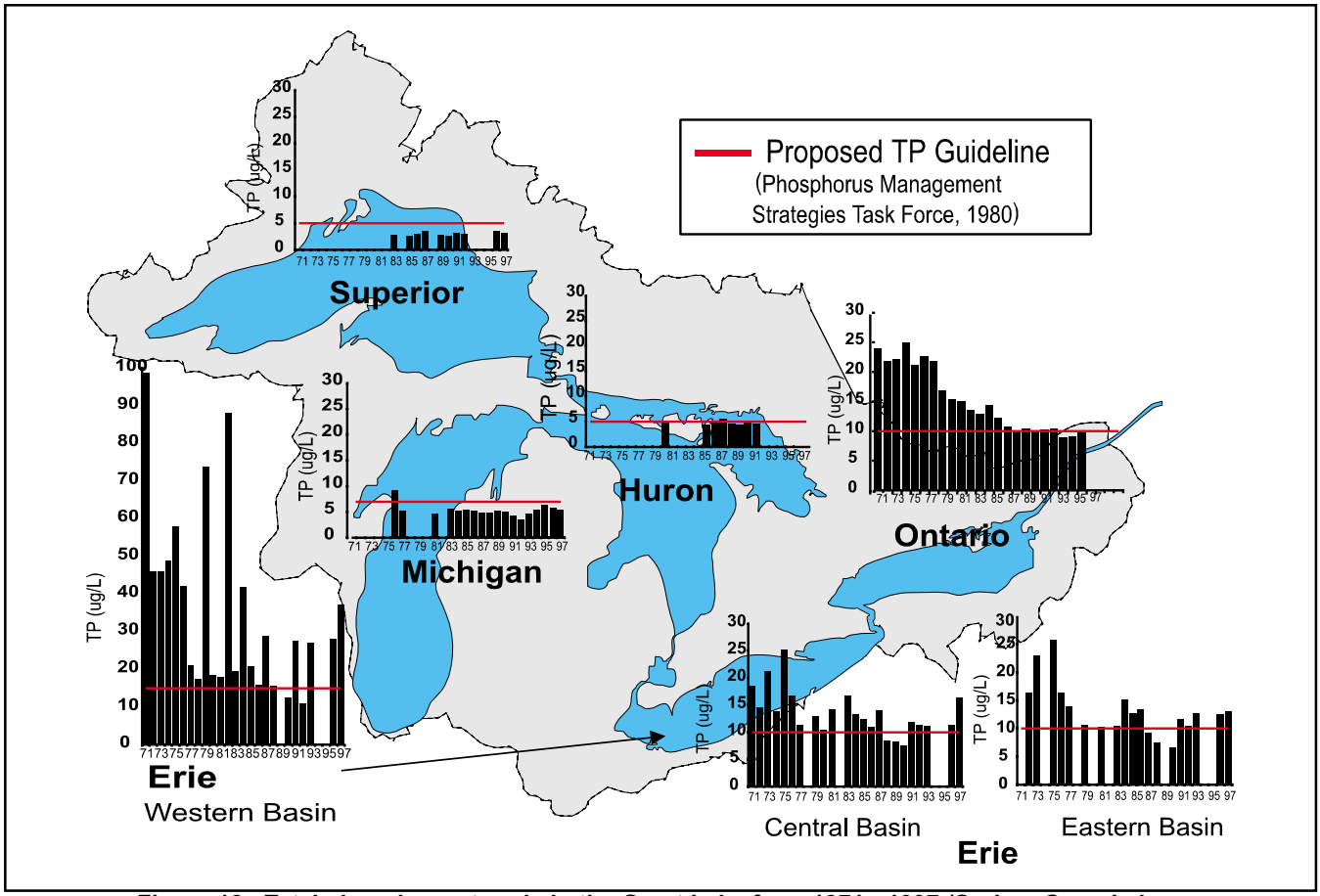

Figure 18. Total phosphorus trends in the Great Lake from 1971 - 1997 (Spring, Open Lake Surface); Blank indicates no sampling (Source: Environmental Conservation Branch, Environment Canada and the Great Lakes National Program Office, U.S. EPA).

Current phosphorus loads are clearly below the target loads of the Agreement for Lakes Superior, Huron, and Michigan and are at or near target limits for Lakes Erie and Ontario. While total loadings of phosphorus have decreased from 28,000 tons in 1968 to 11,000 tons in recent years, Lake Erie still is experiencing brief periods of anoxia in some areas in its central basin.

Phosphorus target levels in open lake waters have been achieved through efforts to improve the performance of STPs, reducing levels of phosphorus in detergents, and implementing agricultural BMPs, which include programs to control soil erosion, sedimentation, and other forms of nonpoint source control. Because of this concerted effort, eutrophication is no longer a problem for the open lake waters of the Great Lakes, although there are concerns regarding nutrient levels in Lake Erie, which will continue to be assessed.

Managing Animal Wastes

The management of animal waste from animal feeding operations will help to protect and enhance water quality in the Great Lakes.

The Great Lakes Basin has a high concentration of agricultural enterprises where animals are kept and raised in confined environments. Polluted runoff from animal feeding operations is a leading source of water pollution in some watersheds. Potential impacts include the absence or low levels of dissolved oxygen in surface water, harmful algae blooms, fish kills, and contamination of drinking water from nitrates and pathogens.

On March 9, 1999, EPA and the U.S. Department of Agriculture (USDA) announced a joint strategy to control agricultural waste runoff. In order to minimize water quality and public health impacts from animal feeding operations (AFOs) and land application of animal waste, this strategy is based on a national performance expectation that all AFO owners and operators will develop and implement technically sound and site-specific Comprehensive Nutrient Management Plans (CNMPs). CNMPs may include the following components: feed management, manure handling and storage, land application of manure, record keeping, and other operations. The Strategy sets out a desired outcome that all AFOs will have CNMPs by 2009.

For the vast majority of AFOs, voluntary efforts will be the principal approach to assist owners and operators in developing and implementing site-specific management plans. Impacts from higher risk, confined animal feeding operations (CAFOs), such as sites with the equivalent of 1,000 beef cows, are addressed through National Pollutant Discharge Elimination System (NPDES) permits under the authority of the Clean Water Act. About 5 percent of all animal feeding operations are expected to require permits. On August 6, 1999, EPA issued a Draft Guidance Manual for the development of permits for CAFOs.

EPA and the National Pork Producers Council (NPPC) negotiated a voluntary compliance program to reduce environmental and public health threats to the nation's waterways from runoff of animal wastes from pork-producing operations. The program was formally announced on November 25, 1998. The NPPC plans assessments for more than 10,000 pork production facilities. NPPC developed the assessment program at a cost of $1.5 million, and will fund the training of independent inspectors and the program's oversight. EPA has provided a $5 million grant to America's Clean Water Foundation to assist with the assessments.

The compliance audit program provides an incentive for pork producers to take the initiative to

find and correct Clean Water Act violations and prevent discharges to waterways without compromising the ability of EPA or states to enforce the law under this initiative. Participating pork producers will have their operations voluntarily assessed for Clean Water Act violations by certified independent inspectors. Producers who promptly disclose and correct any discovered violations from these audits will receive a much smaller civil penalty than they might otherwise be liable for under the law.

Controlling Pesticide and Soil Nutrient Runoff

Innovative programs such as USDA's Conservation Reserve Program (CRP), National Conservation Buffer Initiative, and Environment Quality Incentive Program (EQIP) provide a "systems approach" for addressing agricultural nonpoint source pollution to the Great Lakes. This approach allows for sustainable production of food and fiber products while maintaining environmental quality and a strong natural resource base. In addition, EPA has several standing programs (e.g., Section 319 nonpoint source pollution control) to address soil erosion and sedimentation within the basin.

State	CRP Acres	CRP Contracts
Illinois	None in GL watershed	None in GL watershed
Indiana	118,402	3,944
Michigan	284,452	3,927
Minnesota	796	24
New York	50,733	1,487
Ohio	175,683	6,592
Pennsylvania	4,840	140
Wisconsin	174,755	7,236
Total	**809,661**	**23,350**

Table 4. Great Lakes States CRP Acres and Contracts as of June 1998 (Source: USDA-Farm Services Agency, 1998).

The CRP Program reduces soil erosion by encouraging farmers to convert highly erodible cropland or other environmentally sensitive acreage to

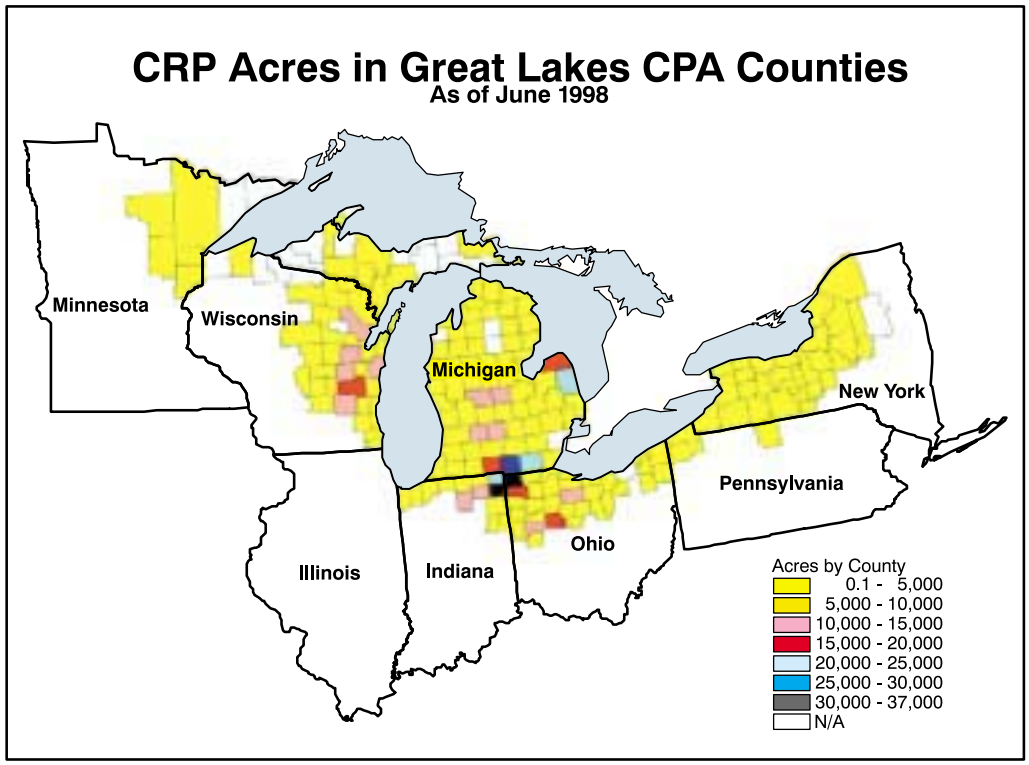

Figure 19. The Conservation Reserve Program is reducing soil erosion through the Great Lakes Basin (Source: USDA-Farm Services Agency, 1998).