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EPA

Clean Lakes Program

1987 Annual Report

Clean Lakes Program

1987 Annual Report

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Office of Water
U.S. Environmental Protection Agency
Washington, DC

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EPA Regional Clean Lakes coordinators contributed the information for this Clean Lakes Program Annual Report. Tom Davenport of Region V compiled the report, which was reviewed by Frank Lapensee, head of the Clean Lakes Program, Carl Myers, chief of the Nonpoint Sources Branch, and Headquarters staff members Terri Hollingsworth and Susan Ratcliffe. Lura K. Taggart of the NALMS office designed and produced the report.

Contents

Introduction

Widespread public support for preserving and protecting our Nation's lakes gave rise to the Clean Lakes Program in 1972. Initiated under the Federal Water Pollution Control Act, the Clean Lakes Program set ambitious goals for defining the causes and extent of pollution problems in the lakes of each State and for developing and implementing effective techniques to restore and protect lake resources. The Clean Lakes Program provided financial assistance to the States to carry out the provisions and objectives of the Act.

Early EPA grants provided funding for a number of research and development activities, as well as for local demonstration projects. As a result, in-lake monitoring and restoration techniques as well as watershed best management practices were developed to meet the needs of lake restoration planners nationwide. In addition, initial research activities provided important baseline data against which the effectiveness of lake restoration projects later could be judged.

Promulgation of the Clean Lakes Regulations in 1980 focused the program by establishing a comprehensive grant assistance program that included grants to the States for the preparation of Classification Surveys, as well as for Phase I diagnostic/feasibility studies and Phase II implementation projects. The purpose of the State lake classification survey was to identify and classify the publicly-owned lakes within each State according to trophic conditions. This activity set the stage for the award of Phase I grants by defining a universe of potential lake water quality projects in each State and by serving to assist in prioritizing lakes for potential funding assistance.

Phase I studies were intended to determine the causes and extent of pollution in particular lakes of each State, to evaluate possible pollution control mechanisms for them, and to recommend the most feasible and cost-effective methods for restoring and protecting lake water quality. Up to 70 percent of the total cost of the project could be awarded by the Federal government, with a maximum of $100,000 awarded to any one study.

The award of Phase II Federal assistance grants translated Phase I lake restoration and protection recommendations into action. Funds provided for Phase II projects were intended for actual implementation of in-lake restoration practices and best management practices (BMP's) in the lake's watershed. Phase II projects required at least a 50 percent non-Federal match. Since 1976, EPA has funded over 350 projects at $102 million.

With the passage of the Water Quality Act of 1987, new directions for the Clean Lakes Program were established within the broader context of State water quality management. The next section of this report discusses these new directions and program activities in 1987. The remainder of the report provides region-by-region status.

Fiscal Year 1987: New Directions for Water Quality and the Clean Lakes Program

The Water Quality Act of 1987 (WQA) offers a special opportunity for regulatory agencies, the regulated community, and the public to implement the ambitious new initiatives in concert with ongoing core Clean Water Act (CWA) programs. States have been actively involved in water quality management planning since before the 1972 CWA, and, under the amendments, need to address important new responsibilities in the areas of surface water toxics, nonpoint source pollution, clean lakes, and estuaries. In addition, wetlands and groundwater represent very important resources that merit protective efforts. The U.S. Environmental Protection Agency (EPA) is actively encouraging States to meet the goals and requirements of the WQA to the fullest extent possible, and to do so in an open, consultative framework using the latest techniques of problem assessment and management. This framework is generally referred to as the State Clean Water Strategy Process.

As each State addresses its ongoing and new responsibilities, it has the opportunity to integrate its Clean Lakes Program into its overall water quality management efforts. The Clean Lakes Program is particularly conducive to a highly integrated and unified approach to water restoration and protection by the States. The natural linkages between Clean Lakes management activities and other environmental programs, is the flexibility afforded both EPA and the States by Section 314; Section 314 and the cross-program and cross-agency relationships, established just recently, combine to encourage an integrated approach.

Specifically, Section 315 of the Water Quality Act of 1987 reauthorized the Clean Lakes Program and mandated a number of new initiatives and requirements. First, in order to remain eligible for Clean Lakes Program grant funds, each State is required to submit biannually to EPA the following:

- Revised Lake Classification Report;
- List of lakes not meeting water quality standards or that will require controls to maintain standards;
- Lake pollution control procedures;
- Restoration plan for degraded lakes;
- Methods and procedures to mitigate the harmful effects of acidity in lakes;
- Assessment of the status and trends of lake water quality; and
- A list of threatened and impaired lakes.

As required by the Act, the 305(b) Report will be the mechanism for reporting this information, as well as for reporting information concerning nonpoint sources of pollution and toxics.

Second, under the new Act, EPA is required to establish a Clean Lakes demonstration program that will enhance the current scientific database regarding the causes of lake degradation and the effectiveness of various lake restoration techniques. This initiative will include a study of the causes and extent of lake acidification nationwide, resulting in the development of mitigation techniques for affected lakes. However, no funds were either requested or provided for this program. As such, demonstration projects will be incorporated within the framework of the existing program guidance and regulations.

Third, EPA was required to develop a lake restoration guidance manual and distribute it to the States. This manual must be revised and updated every two years. The manual has been completed by EPA's Office of Research and Development and published and distributed by the Office of Water; subsequent updates will be the responsibility of the Office of Water.

Finally, in accordance with Section 518(e) of the Water Quality Act of 1987, EPA's administrator is authorized to treat qualified Indian tribes as States. Therefore, a special effort will be made to involve Indian tribes in Clean Lakes Program activities and initiatives in the future.

A Year of Progress

During fiscal year 1987, the Clean Lakes Program made significant progress toward meeting the new goals set forth by the reauthorized Water Quality Act. In May 1987, EPA convened a Clean Lakes Work Group that included representatives of the States, Regional EPA Offices, Indian tribes, a lake managers' association, and others. From these discussions evolved the Clean Lakes Program Guidance document (December 1987) that describes procedures for complying with the requirements of the new Act. The Guidance stresses an integrated program approach and development of a State Clean Water Strategy integrating the Clean Lakes Program into the States overall water quality management efforts. As outlined in several of the success stories in this report, cross programs and cross agency relationships were established providing an integrated Clean Water Strategy approach.

EPA funded several projects that will expand the base of scientific knowledge in lake restoration/protection methodology for subsequent updates to the Lake Restoration and Reservoir Guidance Manual. Projects included funds to conduct a National Conference on State Lake Management Programs, remote sensing studies of nonpoint source impact on lakes, production of the Monitoring Section of the Technical Supplement to the Lake & Reservoir Restoration Guidance Manual, research on how grass carp reduces aquatic vegetation in lakes, and further development of a computer model (AGNPS) to estimate nutrient loadings from watersheds to lakes and wetlands.

Program Implementation

In fiscal year 1987, $4.5 million was appropriated for the Clean Lakes Program. These funds were allocated to the EPA Regions based upon two factors: the number of active Clean Lakes projects and population.

To ensure that projects were designed to attain program goals, the Regions were given three specific objectives:

1. Select projects that maximize benefits to the environment;
2. Select projects that maximize benefits to the public; and
3. Follow an integrated program approach.

The Regions then selected projects submitted by the States that met these objectives. Forty-nine applicants qualified: 32 Phase I diagnostic/feasibility studies totalling $2,220,716, and 17 Phase II projects totalling $2,477,284. Figures 1 and 2 show the distribution of funds and projects by Region. Figure 3 shows the distribution of the Clean Lakes restoration activities funded for 1987. Figure 4 shows the States which received Clean Lakes grants in 1987.

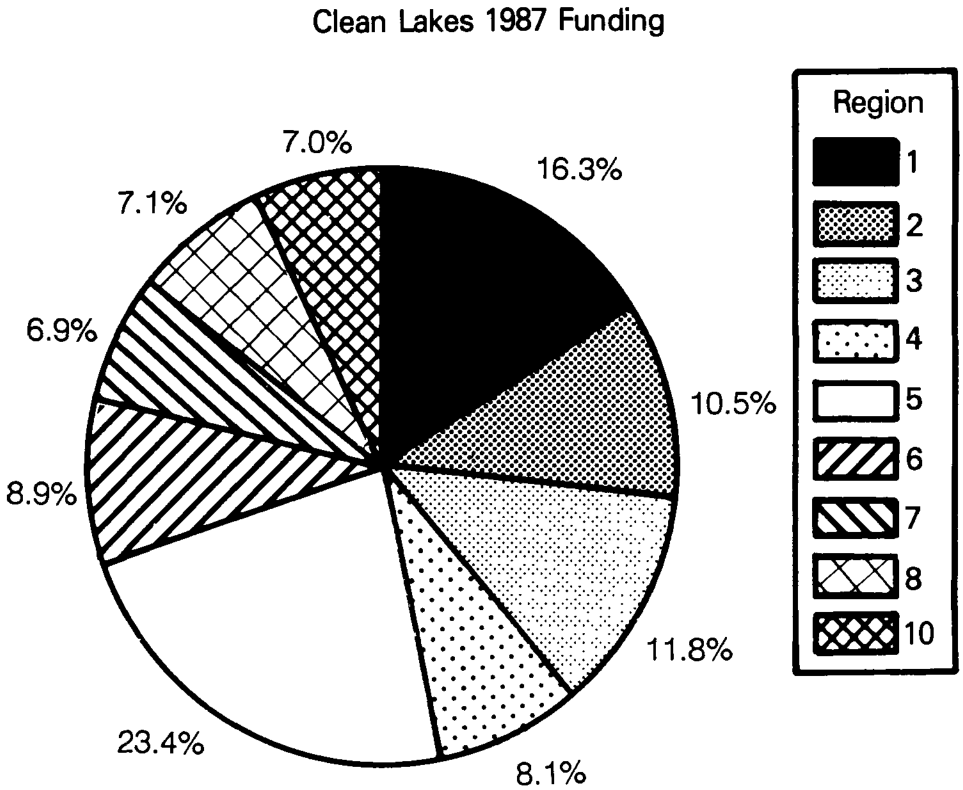

Figure 1.

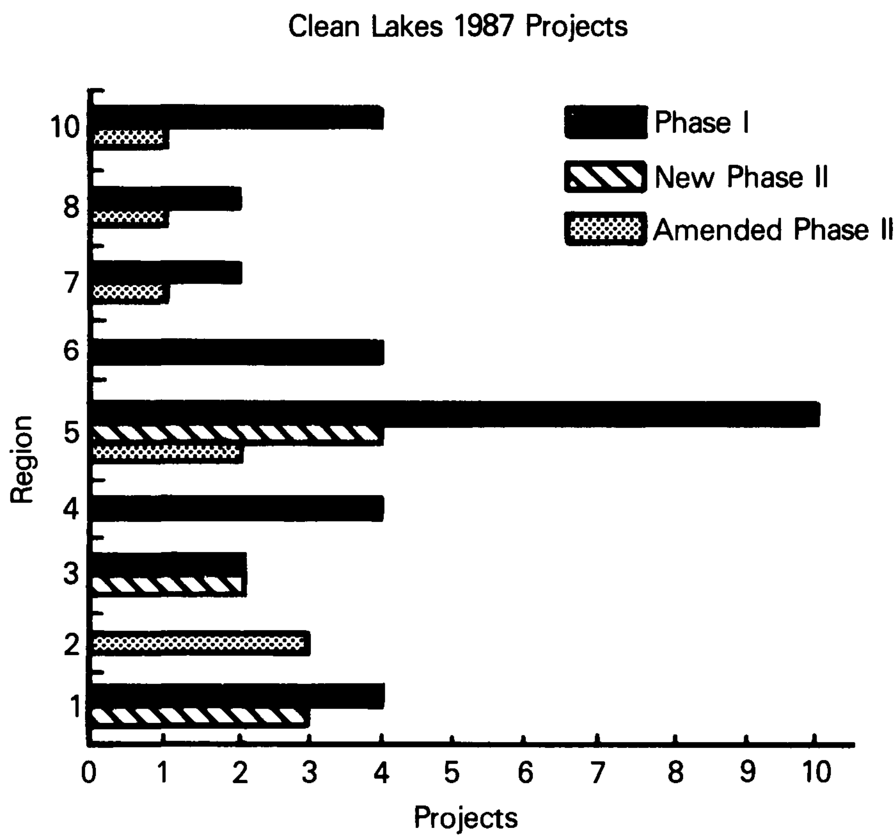

Figure 2.

FY 87 Restoration Activities

Region	Lake/State	Watershed Management				In-lake Activities					
		Agricultural BMPs	Shore/Stream Stabilization	Stormwater * Management	Wetlands	Dredging	Harvest	Alum Treatment	Water level Management	Hypolimnetic Aeration	Biomanipulation
I	Threemile, ME	●						●			
	Hills, MA		●	●		●			●		
	Sluice/Flax, MA			●			●	●			
II	Hopatcong, NJ		●	●			●		●		
	Saratoga, NY	●		●			●	●	●		
	Van Cortlandt Park, NY		●	●		●					
III	Nockamixon, PA	●	●	●							
	Wallenpaupack, PA	●	●	●							
V	Como, MN			●						●	●
	Big Stone, MN	●	●	●					●		
	Clear, MN			●				●			
	Medicine, MN			●						●	●
	Springfield, IL	●				●					
	Delevan, WI	●		●				●	●		●
VII	Blackhawk, IO	●				●				●	
VIII	Deer Creek, VT	●									
X	Devil's, OR	●									●

* Includes detention/sedimentation basin, wetlands, diversion culverts, waterways, filtration, porous pavement

Figure 3.

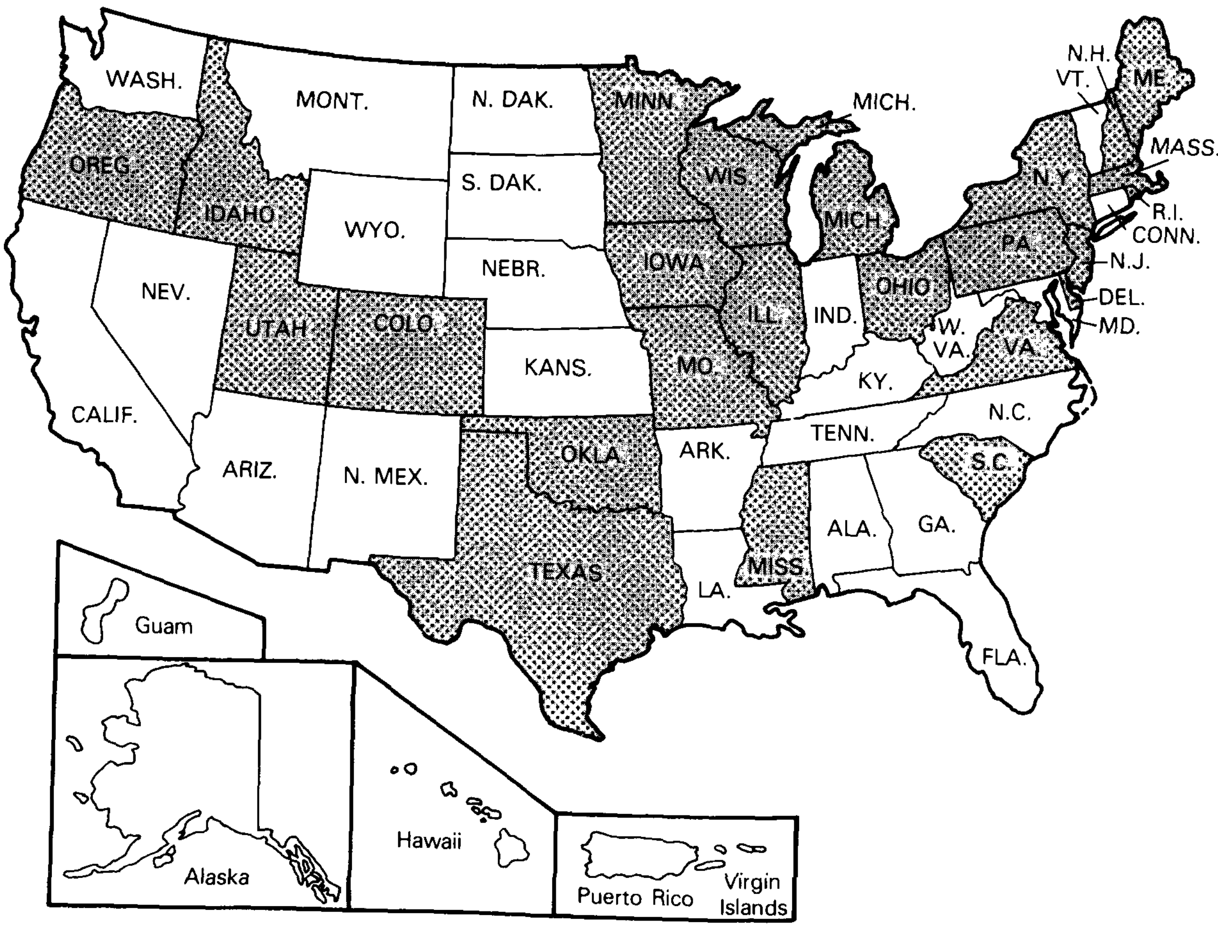

Figure 4. States receiving FY 87 Clean Lakes grants indicated by shaded area.

During fiscal year 1987, Region 1 received nine Clean Lakes applications. Two applications were rejected at the regional level because they did not meet the regional guidance criteria established for all projects requesting fiscal 1987 Clean Lakes funds.

The Region requested and received approval to award seven Clean Lakes grants for the following projects:

Lake	Grant	Type of Project
Threemile Pond, ME	$130,000	Restoration/Protection
Long Lake, ME	$68,836	Diagnostic/Feasibility
Sluice, Flax and Floating Bridge Ponds, MA	$170,356	Restoration/Protection
Hills Pond, MA	$70,050	Restoration/Protection
Mendums Pond, NH	$99,971	Diagnostic/Feasibility
Webster Lake, NH	$99,787	Diagnostic/Feasibility
Olney Pond, RI	$100,000	Diagnostic/Feasibility
TOTAL	$734,000	

The Region now has 17 active projects.

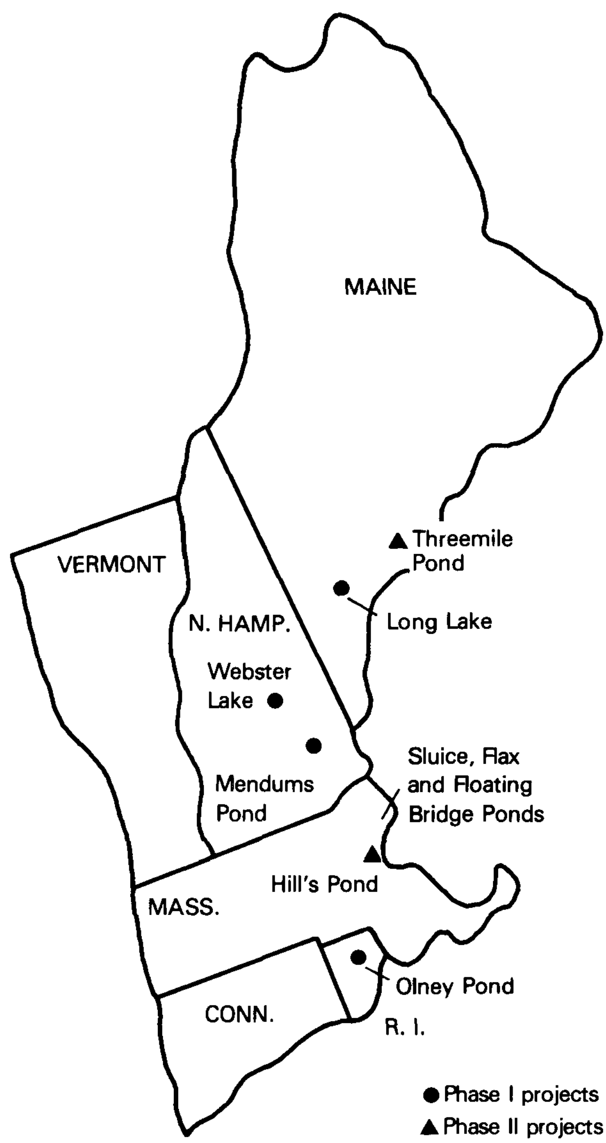

Figure 5. Region I FY 87 Clean Lakes project grants.

Success Story: Lake Morey

An example of a successful lake restoration program in Region I is Lake Morey, a 218.62-hectare lake in Fairlee, VT. The lake, an important recreational site, had a long-standing problem of excessive algae growth that often severely interfered with recreational use of the lake. At times, blooms of blue-green algae and other algal types formed extensive scum on the surface of the lake. In 1985, collapsing algal bloom caused a major fish kill involving yellow perch.

Early studies indicated that phosphorus leaching into the lake from failing shoreline septic tanks caused Lake Morey's eutrophication problem. However, subsequent modeling analyses indicated that internal phosphorus loading from lake sediments might be a significant contributor. Uncertainty over the cause of the excessive phosphorus levels led to a Phase I Diagnostic/Feasibility study on Lake Morey by the State of Vermont.

Central to the study, which was completed in 1984, was an extensive sampling program that directly measured phosphorus inputs to the lake from tributary streams, groundwater (including septic systems), and precipitation. In addition, internal phosphorus loading was evaluated through detailed mass balance calculations.

The results clearly indicated that internal phosphorus loading from anoxic hypolimnetic lake sediments was the main cause of the elevated phosphorus levels in the lake. Paleolimnological analysis of a dated sediment core from the lake suggested how the problem might have started. Evidence preserved in the core indicated that from 1880-1920, when most of the lakeshore development took place, soil erosion and sewage discharges may have contributed a massive load of phosphorus to the lake that had been recycled internally ever since.

Feasibility studies for restoring Lake Morey focused on techniques to break the cycle of internal phosphorus loading. Treatment of the hypolimnetic sediments with alum and sodium aluminate was chosen as the preferred restoration method because it provided the best opportunity to control the problem over the long term.

A Phase II lake restoration project began on Lake Morey in 1986 by treating the entire 133.8-ha sediment area with 175,000 gallons of liquid alum and sodium aluminate at a cost of $177,000. The chemicals were injected during a 19-day period in May-June 1986 at a depth of 8 meters from a barge equipped with chemical storage tanks, adjustable booms, and a spray manifold.

The two-year post-treatment monitoring program showed a dramatic improvement in the lake's water quality. Total phosphorus concentrations in surface waters remained below 10 milligrams per liter (mg/L) during most of 1986 and 1987, compared with previous levels averaging 20-40 mg/L. During the summers of 1986 and 1987, hypolimnetic phosphorus concentrations were below 50 mg/L, down sharply from pre-treatment levels of 200-500 mg/L. The spring 1987 level was only 9 mg/L, compared with average annual spring phosphorus levels of 37 mg/L before treatment.

Algae levels and water clarity also improved after treatment. Average chlorophyll concentrations during the summer of 1986 were the lowest in nine years, and no significant algal blooms have occurred since treatment. Water clarity reached all-time highs during 1987.

Aluminum levels in the lake, while somewhat elevated immediately after treatment, soon returned to pre-treatment levels. No deaths of fish or other aquatic life were observed following exposure, although a decline in the condition of yellow perch was observed. Fisheries data are currently being examined to determine whether temporary aluminum exposure caused the decline.

During fiscal year 1987, the State of New York submitted two applications and the State of New Jersey submitted one application. All three applications were for amendments to Phase II projects.

Lake	Grant	Type of Project
Lake Hopatcong, NJ	$265,000	Restoration/Protection
Saratoga Lake, NY	$154,241	Restoration/Protection
Van Cortlandt Park Lake, NY	$52,759	Restoration/Protection
TOTAL	$472,000	

The grants for New Jersey's Lake Hopatcong and New York's Saratoga Lake, multi-year projects that involve weed harvesting and watershed management, complete Federal funding for those projects. The grant for New York's Van Cortlandt Park Lake $7 million project includes stormwater diversion, dredging, and upstream detention basins. Locations of these projects within the Region are shown in Figure 6. Fourteen projects are now active in Region II.

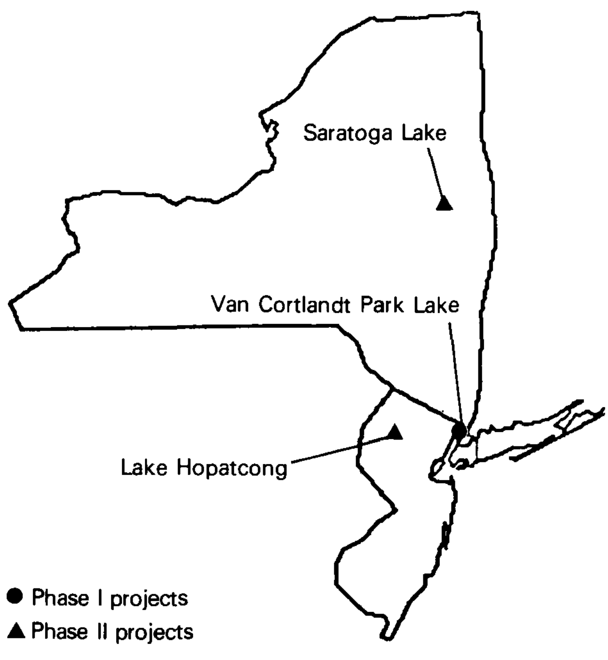

Figure 6. Region II FY 87 Clean Lakes project grants.

Success Story: Iroquois Lake and Duck Pond

Iroquois Lake and the Duck Pond are shallow, urban bodies of water located in Central Park, Schenectady, NY. The lake provides the means for several water-related activities, such as boating, fishing, and swimming in the summer months; and ice-skating and ice-hockey in the winter. Surrounding the lake are many walkways, grassy areas and picnic tables which allow for a variety of recreational activities around the lake.

Historically, recreational uses of the lake had been impaired by a deterioration of the lake water quality. Macrophyte growth was extensive throughout the summer due to organic and nutrient-rich sediments. The sediments also stimulated the overgrowth of plankton and algae in the summer. Odors, as a result of the seasonal die-off of aquatic plants, and repeated winter fish kills also diminished the aesthetics of the lake and impaired its use.

A Phase I diagnostic/feasibility study indicated that urban stormwater runoff was the primary source of nutrients to the lake and pond. As a result of this study, the Phase II restoration project included the following:

1. Drawdown and excavation of nutrient-rich sediments from the lake and pond;
2. Bottom sealing of the lake and pond with clay-soil liner to prevent excess exfiltration of water;
3. Development of a stormwater retention area for control of watershed drainage to the lake/pond system;
4. Installation of a seepage pit to control street runoff to the lake;
5. Rehabilitation of the Iroquois Lake Fountain to recirculate lake water, and make operable by direct water line connection to the City Water Supply, to enable periodic dilution and flushing of the lake.

Post-restoration monitoring began in January 1986. The results of the sampling indicated the level of success of the restoration project. Total phosphorus, Kjeldahl nitrogen, suspended solids, and chlorophyll *a* concentrations were reduced as a

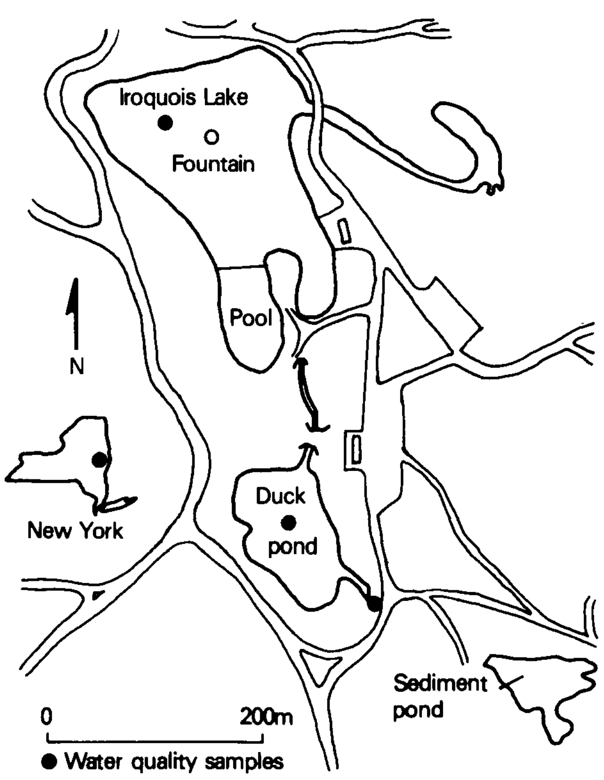

Figure 7. Sampling stations for Iroquois Lake and Duck Pond projects.

result of the project. Total phosphorus concentrations of Iroquois Lake fell 63.4 percent; Kjeldahl nitrogen concentrations fell 54.4 percent; suspended solids dropped 59.6 percent; and chlorophyll *a* concentrations were 27.4 percent below pre-restoration levels. Similar patterns were noted in Duck Pond.

Dissolved oxygen measurements indicated that oxygen levels were at or near saturation values throughout the 11-month monitoring period in both surface and bottom waters; at no time was there any indication of a return to the depleted oxygen conditions of the past. Measurements also indicated the absence of significant photosynthetic activities. As a result, no fish kills or algal blooms have occurred since the restoration.

The project also successfully reduced the density of macrophyte species. Some macrophytes have recurred in shallow portions of the lake and pond which provide a suitable habitat for the new fish population but have not impaired the recreational aspects of the lake.

During fiscal year 1987, Region III received $530,400 in allocated funds. Two Phase I studies were funded: Silver Lake in Dover, DE at a cost of $21,000 and Big Cherry Reservoir in Big Stone Gap, VA at a cost of $30,000. Two Pennsylvania restoration efforts received Phase II funding of $239,000 each: Lake Wallenpaupack in Paupack, and Lake Nockamixon in Quakertown. The partial funding will permit implementation of the highest-priority restoration methods, which are mostly agricultural best management practices. Four projects are active in Region III.

Lake	Grant	Type of Project
Silver Lake, DE	$21,000	Diagnostic/Feasibility
Big Cherry Reservoir, VA	$30,000	Diagnostic/Feasibility
Lake Nockamixon, PA	$239,700	Restoration/Protection
Lake Wallenpaupack, PA	$239,700	Restoration/Protection
TOTAL	$530,400	

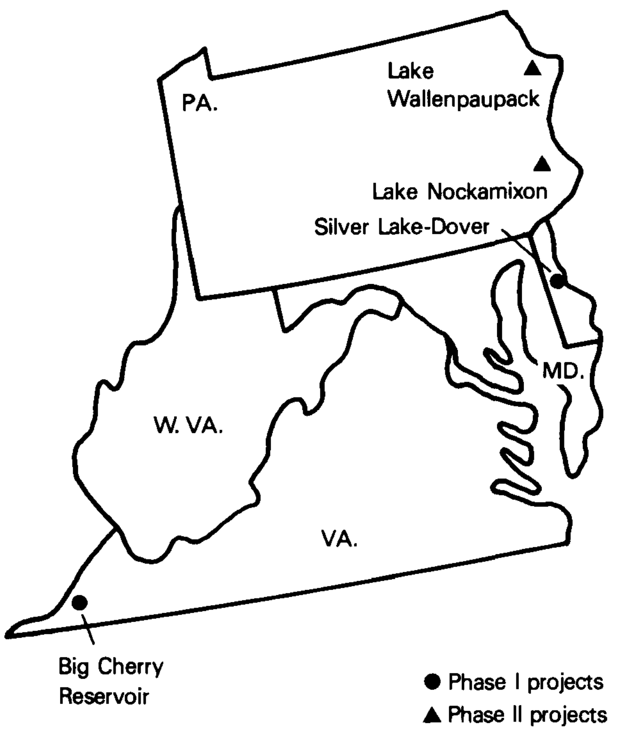

Figure 8. Region III FY 87 Clean Lakes project grants.

Success Story: South Fork Rivanna Reservoir

The South Fork Rivanna Reservoir is located in the Upper James River Basin near Charlottesville, VA in Albemarle County. The reservoir covers 1.58 square kilometers and receives drainage from a 629-square-kilometer watershed. The mean depth is 4.5 meters and the mean residence time is eight days.

Algal blooms, fish kills, and problems with taste and odor commonly occur in this reservoir. A 1977 watershed management study concluded that the lake was highly eutrophic. Of the land around the watershed, 61 percent is undeveloped; of the rest, 4 percent is developed, 8 percent is cropland, and 27 percent is pasture land. Nonpoint sources were found to contribute nearly all of the suspended solids and 76 percent of the phosphorus load to the reservoir.

Reports funded through the Section 314 Clean Lakes and Section 208 programs have recommended the following activities to restore and manage the reservoir:

1. Implementation of a strict runoff control ordinance;
2. Implementation of agricultural, roadway, and other best management practices;
3. Implementation of streambank erosion controls;
4. Construction of a regional detention basin;
5. Employment of a watershed manager.

The Rivanna Water and Sewer Authority, Albemarle County, and the City of Charlottesville, together with funding and support from EPA and the Virginia State Water Control Board, have implemented almost all of these recommendations.

EPA provided an $800,000 Clean Lakes Phase II grant in 1981, which has helped to finance completion of 85 percent of the project. Most of the implemented BMPs have been agricultural and represent about 75 different contracts; the highway BMP program has been limited by budget restrictions in the Virginia Highway Department. A watershed manager has been hired and a runoff control ordinance was developed and implemented. The regional detention basin remains under consideration due to rising construction costs.

Monitoring of the reservoir is showing positive results. Total phosphorus, suspended solids and chlorophyll levels are down 10 to 25 percent from pre-restoration levels. The project is expected to continue for up to four more years, and more reductions in algae growth and loadings are expected.

This southeastern Region encompasses eight States: Kentucky, Tennessee, North and South Carolina, Georgia, Alabama, Mississippi, and Florida. The Region is managing three active projects, and this year, funded four Phase I diagnostic/feasibility studies.

Lake	Grant	Type of Project
Lake Edgar A. Brown, SC	$64,048	Diagnostic/Feasibility
Wolf Lake, MS	$100,000	Diagnostic/Feasibility
Moon Lake, MS	$100,000	Diagnostic/Feasibility
Lake Washington, MS	$100,000	Diagnostic/Feasibility
TOTAL	$364,048	

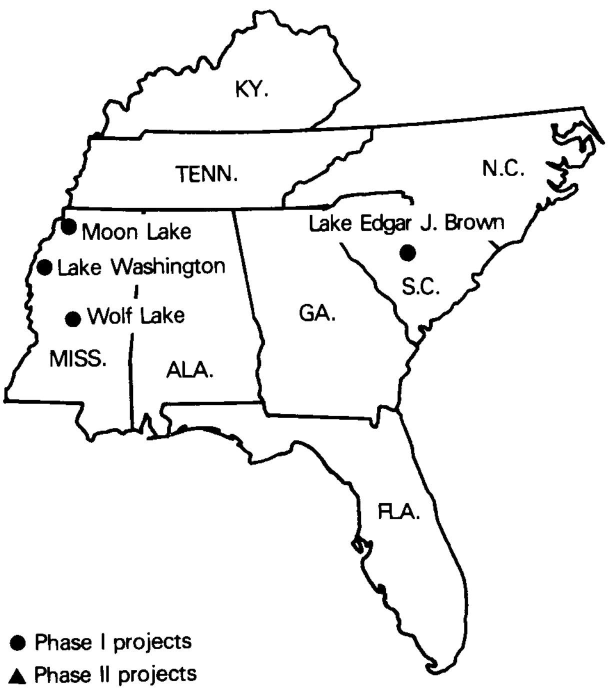

Figure 9. Region IV FY 87 Clean Lakes project grants.

Success Story: Lake Jackson

Lake Jackson is a 1,619.4-ha solution lake located near Tallahassee, FL. Comprehensive studies of the water quality of Lake Jackson during 1974 and 1977 led to increased awareness of pollution in the lake resulting from stormwater drainage. Rapid urbanization in the Megginnis Arm watershed (902.8 ha) of the lake resulted in greater drainage with increased nutrient and sediment loads, and subsequently accelerated the eutrophication of both the watershed and the lake.

As the result of a cooperative effort by EPA (which provided $1.6 million in Section 314 funding), the Florida Department of Environmental Regulation, and the Northwest Florida Water Management District, a stormwater treatment facility was built along a natural inflow stream to Megginnis Arm. This facility, which began operating in the fall of 1984, incorporates proven and innovative techniques to treat the stormwater drainage that enters the watershed.

Stormwater drainage enters a 163,000 cubic meter detention pond (Fig. 10), and passes through a 1.8-ha intermittent underdrain filter that removes solids and nutrients. Immediately downstream, the flow is diverted into a 2.5-ha marsh, which has an average depth 0.5 meters, except for a 2.5-meter deep settling basin near the outfall. The marsh impoundment is divided into three cells, each of which contains a different kind of macrophyte.

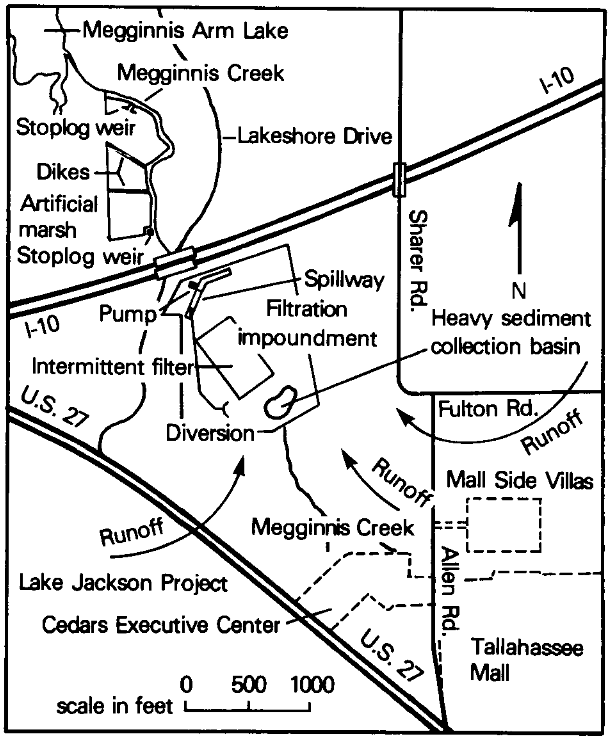

Figure 10. Location of detention pond.

Based on three years of post-project water quality monitoring by Florida State University's Department of Oceanography, the impoundment/filter bed can remove 91 to 98 percent of the suspended solid load from the stormwater drainage while the marsh removes 75 percent of the remaining load. All other loading parameters show reductions ranging from 37 to 90 percent under normal operating conditions.

In 1987, the project was named the Outstanding Restoration Project of the year by the North American Lake Management Society (NALMS).

Region V

In April 1987, Region V issued fiscal year 1987 Funding Guidance for the Clean Lakes Program. This Regional Guidance was based on the National Guidance, and Regional priorities.

In response to this guidance, over 50 potential projects were identified. Five States submitted applications for a total of 17 projects for possible Clean Lakes funding, of which 16 received approval. Of the approved projects, 10 were Phase I studies and six were Phase II restoration projects (see Fig. 11).

Figure 11. Region V FY 87 Clean Lakes project grants.

In addition to the 16 grant actions mentioned above, the Region continued to manage 35 active projects. The Region conducted field reviews of 20 active and new projects as well as three potential projects during fiscal year 1987.

To ensure efficient and effective management of its Clean Lakes projects, the Region developed a data management system to facilitate the tracking of projects and to assist in responding to inquiries concerning the Clean Lakes Program and water quality problems. Regional personnel also participated in the Illinois, Ohio, and Wisconsin Annual State Lake Association Meetings, and cosponsored and participated in the first Regional NALMS meeting in Columbus, OH.

Lake	Grant	Type of Project
Chicago Park Lagoon, IL	$50,000	Diagnostic/Feasibility
Coldwater–Marble Chain, MI	$25,000	Diagnostic/Feasibility
Lake Ripley, MN	$28,283	Diagnostic/Feasibility
Lake Pittsfield, IL	$23,166	Diagnostic/Feasibility
Tanner's Lake, MN	$39,556	Diagnostic/Feasibility
Indian Lake, OH	$50,000	Diagnostic/Feasibility
Lake Sallie & Detroit Lakes, MN	$41,239	Diagnostic/Feasibility
Lake Springfield, IL	$219,708	Restoration/Protection
Clear Lake, MN	$70,039	Restoration/Protection
Medicine Lake, MN	$135,268	Restoration/Protection
Delavan Lake, WI	$153,449	Restoration/Protection
Upper & Lower Prior Lakes, MN	$36,017	Diagnostic/Feasibility
Big Kandiyohi Lake, MN	$19,588	Diagnostic/Feasibility
Como Lake, MN	$76,078	Restoration/Protection
Sauk River Chain, MN	$33,725	Diagnostic/Feasibility
Big Stone Lake, MN	$51,473	Restoration/Protection
TOTAL	$1,052,589	

Success Story: Lake Le-Aqua-Na

Lake Le-Aqua-Na, located in Lake Le-Aqua-Na State Park in Stephenson County, IL, was formed in 1956 by the damming of Waddams Creek. Of the lake's 951.4-ha watershed, 31 percent is owned by the State; the rest is in small private holdings, most of which are agricultural.

The lake and surrounding State park are managed by the Illinois Department of Conservation (IDOC) for a wide variety of recreational uses, including fishing, boating, canoeing, camping, picnicking, hiking, water sports, and swimming. Park attendance peaked at 530,000 in 1976; by 1981, attendance had declined by approximately 43.4 percent. This decline seemed partially related to the lake's deteriorating water quality.

A 1981-83 Phase I study identified the following major problems in the lake:

1. High nutrient levels;
2. Nuisance algal blooms;
3. Excessive aquatic macrophytes;

4. Dissolved oxygen depletion;
5. Turbidity and sedimentation.

Since most of the lake's problems stemmed from excessive nutrient and sediment loading from the watershed, the State decided not to pursue Phase II funding until watershed controls were implemented.

Using the results of the Phase I study as the key component of a public awareness and information program, the local Soil Conservation Service, Soil and Water Conservation District, and Cooperative Extension Service developed interest in the project among watershed landowners. The Agricultural Stabilization and Conservation Service (ASCS) County Committee determined that there was sufficient landowner interest to propose a special national conservation tillage land treatment project within the watershed. The objective of the project was to cut cropland soil erosion by 42 percent, using a variable cost-share rate as an incentive.

Within six months, all landowners in the project area had signed either "no-till" or reduced tillage contracts for 1984. Consequently, soil erosion fell 46 percent, and sediment yield to the lake fell 31 percent.

The successful implementation of the special conservation tillage project helped the State obtain a Phase II grant. The grant helped finance installation of a lake destratification system, harvesting of aquatic macrophytes, algal control, lake shoreline stabilization, lake monitoring, and installation of resource management systems designed to control priority nonpoint source areas within the watershed.

Additional ASCS and supplemental Phase II funding financed completion of the watershed work and supported another year of lake water quality monitoring. After implementation of all watershed management activities, soil losses were down 69 percent and sediment yields had fallen 57 percent from pre-restoration levels. Continued monitoring of dissolved oxygen data and visual examination indicates that in-lake water quality is continuing to improve.

Region VI

During fiscal year 1987, Clean Lakes Program funding for Region VI totaled $400,000. All of the projects were Phase I diagnostic/feasibility studies; each received $100,000 of funding. Two of the projects were located in Oklahoma, the other two in Texas.

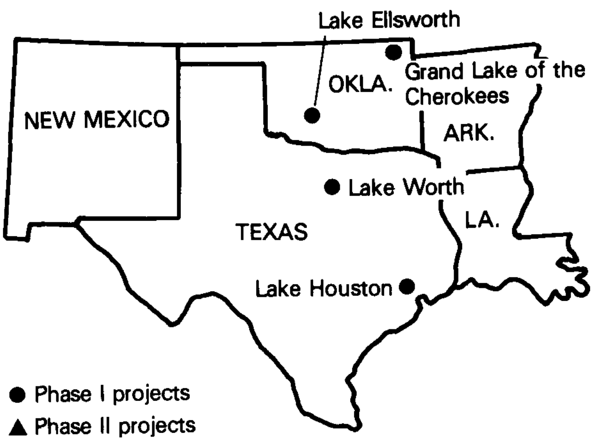

Figure 12. Region VI FY 87 Clean Lakes project grants.

Lake	Grant	Type of Project
Lake Houston, TX	$100,000	Diagnostic/Feasibility
Lake Worth, TX	$100,000	Diagnostic/Feasibility
Lake Ellsworth, OK	$100,000	Diagnostic/Feasibility
Grand Lake of the Cherokees, OK	$100,000	Diagnostic/Feasibility
TOTAL	$400,000	

The Region also conducted field reviews of existing Clean Lakes projects. During fiscal year 1987, the region managed five Phase II projects: four in Oklahoma and one in Louisiana. Regional personnel visited the Louisiana project during the fiscal year. The Region also participated in the Regional Workshop sponsored by the North American Lake Management Society in Austin, Tex.

States in the Region also identified several potential Clean Lakes projects. One is Beaver Lake, AR, which was identified in Section 315 of the 1987 Water Quality Act as a demonstration project. However, no commitment for local matching funds has yet been secured. Other potential projects include two in Oklahoma, Grand Lake of the Cherokees and Lake Ellsworth, and two in Texas, Lake Houston and Lake Worth.

Success Story: Ada City Lake

Ada City Lake, part of Wintersmith Park in Ada, OK, is a popular recreational lake among local residents. But residential development from the mid-1950s through the early 1970s accelerated the aging of the 4.7-ha lake, speeding up the growth of weeds and algae that eventually died, decomposed, and settled with the sediments at the bottom of the lake. Construction around the lake also displaced soil, which ran down into the lake. Nitrogen fertilizers applied to new lawns accelerated the growth of macrophytes, resulting in algae and aquatic plants that choked the lake and its tributaries.

In 1981, the City of Ada established restoration of the lake as a priority in its budget, and pledged $80,000 as its share of cleanup costs. The Oklahoma Water Resources Board completed preliminary studies and secured approval of a restoration plan for the lake.

In February 1984, dredging to increase the depth of the lake began, after pipelines and pumps were installed and pits prepared for storing and dewatering the thick, black slurry from the lake. Dredging was completed in June 1985, and water drained from the sediments was returned to the lake.

Sampling by State personnel for one year after completion of the restoration indicates that the quality of the lake water has improved dramatically. The now-clear water replaces vast patches of algae and weeds, and fish stock has been added to the lake. The success of the Ada City Lake cleanup process was the subject of an article in the April 1987 edition of *Oklahoma Water Quality News*.

Region VII

During fiscal year 1987, Region VII received a target allocation of $311,000 for the Clean Lakes Program. This amount funded three projects in the Region: two new Phase I studies and extension of an ongoing Phase II project. The two Phase I projects are located in Iowa and Missouri; the Phase II is in Iowa.

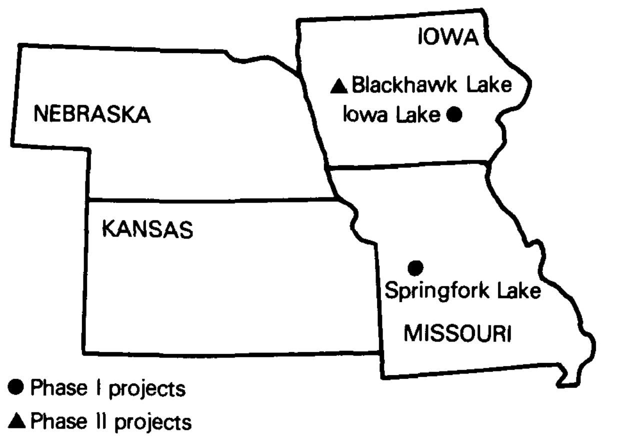

Figure 13. Region VII FY 87 Clean Lakes project grants.

The two Phase I projects, Iowa Lake in IA and Springfork Lake in MO, are evaluating nonpoint source controls. The Iowa Lake project includes a substate agreement with Iowa State University's Center for Agricultural Resource Development; the Springfork Lake watershed has been selected for special State funding for implementing erosion control measures.

Lake	Grant	Type of Project
Spring fork Lake, MO	$35,000	Diagnostic/Feasibility
Iowa Lake, IA	$10,600	Diagnostic/Feasibility
Blackhawk Lake, IA	$265,400	Restoration/Protection
TOTAL	$311,000	

The Phase II project, Blackhawk Lake in IA, probably will be completed for substantially less than the $1 million estimated cost to the Federal government. Watershed nonpoint source controls have been targeted more directly than was believed possible to critical areas, and the actual costs of management practices have been below the original estimates.

The Region manages nine projects, and Regional personnel are assisting with preparations for NALMS Regional Workshop in Denver.

Success Story: Green Valley Lake

Effective use of best management practices has substantially improved the water quality of Iowa's Green Valley Lake since 1980.

Built in 1952 as an impoundment near the headwaters of the Platte River, the 390-acre Green Valley Lake began to demonstrate major problems in the 1970's that affected both aquatic life and recreational use. Sedimentation had reduced the lake area by about 10 percent, and nutrients in watershed runoff stimulated excessive algal growth (the blue-green Aphanizomenon).

The runoff from the 5,198-acre watershed – more than 72 percent in cropland – was found to be the source of these water quality problems.

A Clean Lakes grant of $569,100 in 1980 addressed three goals:

- Reduce sediment/nutrient delivery to the lake to acceptable levels by installing best management practices on croplands in the watershed.
- Reduce resuspension of nutrients within the lake bed by deepening shallow water areas.
- Monitor chemical, physical, and biological parameters.

The landowner contracted the construction of the approved BMP's and was reimbursed for 75 percent of the cost using 50 percent Federal funds and 25 percent State funds.

The Iowa Department of Natural Resources coordinated the project, whose participants included (in addition to the landowners and EPA Region VII), U.S. Soil Conservation Service in Des Moines, Iowa Department of Agriculture and Land Stewardship, Union County Soil Conservation District, Union County Agricultural Stabilization and Conservation Service, Area Extension Office (Creston), and the University Hygienic Laboratory (Iowa City).

Table 1.—Practices constructed at Green Valley Lake Watershed 1981–1987.

Practice	Number Jobs	Installed	Cost
Grade Stabilization Structures	3	3	$12,277.43
Tile Intake Terraces	39	108,068 ft.	363,297.14
Diversions	1	1,245 ft.	1,948.00
Grassed Waterways	6	9,660 ft.	11,078.82
Water Sediment Control Basins	16	13,897 ft.	57,476.50
		Total Cost	$446,077.99

Analysis of data from six years of monitoring at Green Valley Lake revealed significant improvement in the annual means for the following key water quality parameters:

- Total phosphate concentration systematically declined to nearly one-fourth of that found in 1981 at the deep water station and about half at the shallow water station.
- Chlorophyll *a* was markedly reduced at both stations to nearly one-third that recorded in 1981.
- Dissolved oxygen fell by nearly 50 percent at both stations.

No summer fish kills attributable to dissolved oxygen sags have occurred since 1981. Algal blooms have been noticeably less intense in recent years, nor has the public complained of taste and odor problems in fish during 1985 and 1986. However, water clarity has declined during the six-year project period, probably because of the lake's expanding population of bottom-feeders, such as bulkhead and carp.

Conservation practices in the watershed has reduced delivery of sediments to the lake by 5,500 tons annually, reducing loss in lake volume by half, from approximately 7 acre-feet per year pre-project to about 3 1/2 acre-feet at this time.

During fiscal year 1987, Region VIII received a $319,893 for its grants. The Region received four applications for Clean Lakes Program funding, of which three were approved. The three projects approved were Bear Creek Reservoir, Pineview Reservoir, and Deer Creek Reservoir. Deer Creek is a Phase II project that received $149,493; the other two are Phase I studies that received $100,000 each. The Region manages eight projects.

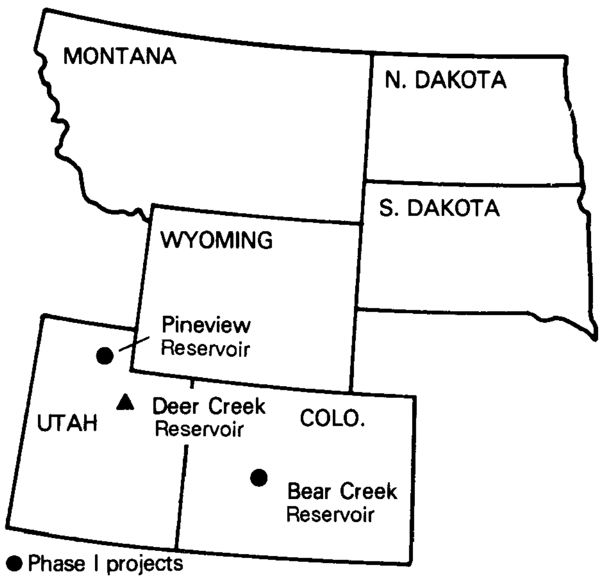

Figure 14. Region VIII FY 87 Clean Lakes project grants.

Lake	Grant	Type of Project
Bear Creek Reservoir, CO	$100,000	Diagnostic/Feasibility
Pineview Reservoir, UT	$100,000	Diagnostic/Feasibility
Deer Creek, Reservoir, UT	$119,893	Restoration/Protection
TOTAL	$319,893	

Success Story: Spiritwood Lake

Spiritwood Lake is a deep natural lake located in east central North Dakota. The lake, which is approximately 1 1/2 miles long and 1/2 mile wide, drains a large land area of 6,032.3 ha, of which runoff from about 3,846.2 ha goes directly into the lake.

Approximately 80 percent of the land area around the watershed is farmed intensively for row crops and small grains. In the past, much of this land was tilled following harvest, leaving bare soil which then washed from the fields during spring runoff.

Primarily because of nutrient and sediment loading, Spiritwood Lake was subject to severe eutrophication by the mid-1970s. During the summer, algal blooms restricted recreational use of the lake. Under a Section 208 plan, the lake was identified as one of 10 in the State to be given priority for nonpoint source controls.

In 1980, the North Dakota State Department of Health began a two-year diagnostic study to identify the causes of the lake's eutrophication. The study concluded that agricultural runoff and internal loading from sediments were the principal sources of the nutrients.

Tests performed during the diagnostic study indicated that nitrogen was the chief nutrient for the algae, but nitrogen control was believed to be difficult because of its solubility, input from the atmosphere, and the presence of algal species capable of nitrogen fixation. In contrast, the largest portion of the phosphorus input to the lake came from soil particles; thus, reducing soil erosion was viewed as a way to significantly diminish phosphorus loading.

Implementation of agricultural best management practices to control soil erosion and nutrient runoff began in 1981 and were essentially completed by the end of 1983. The principal BMPs implemented were tree planting, grassed waterways, no-till cropping, protected fallow land, and techniques to combat wind erosion.

Using Clean Lakes Program funds, a pipeline and pump house to draw water from the lake's hypolimnion were constructed in 1982.

Monitoring of the project indicated reduced levels of phosphorus, nitrogen, and algae. However, the long-term success of the project depends on the success of agricultural BMPs. Some of the BMPs employed thus far have proven inadequate for water quality protection and are being modified.

Region X

During fiscal year 1987, Region X received seven applications: four for Phase I studies, one for a new Phase II project, and two amended Phase II projects. All but the new Phase II and one amended Phase II project were approved (see Fig. 15). The Region now manages nine projects.

Lake	Grant	Type of Project
Lake Pend Oreille, ID	$77,000	Diagnostic/Feasibility
Hauser, Lake, ID	$52,000	Diagnostic/Feasibility
Winchester Lake, ID	$51,000	Diagnostic/Feasibility
Garrison Lake, OR	$74,900	Diagnostic/Feasibility
Devil's Lake, OR	$61,170	Restoration/Protection
TOTAL	$316,070	

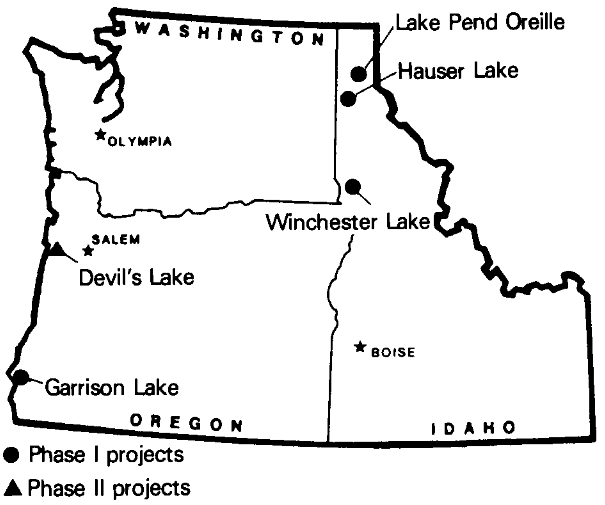

Figure 15. Region X FY 87 Clean Lakes project grants.

The State of Idaho responded to the Region's call for new Clean Lakes applications by submitting three Phase I proposals in fiscal year 1987, after a three-year absence from program activity. The State also has published a lake management manual, initiated a citizen's monitoring program, and is overseeing an aerial survey of seven northern Idaho lakes. The survey, which was completed in January 1988, received a $65,000 grant.

Other accomplishments by Region X include participation by Regional personnel in the newly-formed Washington Lakes Protection Association, negotiation of an interagency work plan for a Congressionally-mandated study of Lake Pend Oreille and the Clark Fork River System; and, receipt of a $30,000 research grant to study feeding preferences of sterile white amur in northwestern habitats.

Success Story: Lake Ballinger

Lake Ballinger is a 40.5-ha eutrophic lake located within the City of Mountlake Terrace, just north of Seattle. In the past, the lake has suffered from excessive nutrient loading, particularly phosphorus, which has resulted in algal growth that has reduced the recreational value and beauty of the lake.

Studies conducted on the lake by the City and other government agencies since the mid-1970s concluded that the best way to restore the lake was to reduce phosphorus loading from both internal sediment loading and external loading from Hall Creek, the main inflow to the lake.

A two-part project was undertaken. Part I entailed the restoration of Hall Creek through the establishment of two sedimentation basins. Part II involved construction of a hypolimnetic discharge/withdrawal system to facilitate the removal of phosphorus-rich hypolimnetic waters and enhance the dissolved oxygen levels.

Restoring Hall Creek reduced erosion and flooding, and cut the phosphorus and sediment loading of the lake. Construction of the two sedimentation ponds resulted in the removal of particulate phosphorus and suspended solids. The improvement in the creek generated an oxidizing environment in which the ammonia in the creek was converted to nitrate-nitrogen, and the water had high dissolved oxygen concentrations.

Hypolimnetic injection and withdrawal prevented hypolimnetic anoxia and limited internal loading of phosphorus from lake sediments. The injection and withdrawal system cut internal phosphorus loading 86 percent from pre-treatment levels and contributed greatly to overall water quality improvement through 1985.

However, phosphorus loading from the creek basin began to increase dramatically in late 1984, resulting in a substantial decline in water quality in 1985 and 1986. This deterioration reflected the effects of accelerated watershed development and stormwater runoff throughout the Lake Ballinger basin. It became clear that long-term improvements in the lake's water quality depended upon successful enhancement of the water quality of the runoff and Hall Creek.

Although the Clean Lakes project for the lake ended monitoring and implementation funding support in 1986, the City of Mountlake Terrace continued the effort. In 1986, the City hired a full-time watershed manager to identify and control potential and actual sources of nutrient loading to the lake. Three ordinances have been passed requiring development construction projects to take steps to reduce nutrient loading through strategies such as grassland swales and erosion control. Lake monitoring and stream rehabilitation are continuing, and a citizen's watch phone number has been established to facilitate citizen reporting and government response to nutrient loading and toxic spills.

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