A REPORT TO THE DEPUTY ADMINISTRATOR

POLLUTION CONTROL IN THE U.S. --
SOME EXAMPLES OF RECENT ACCOMPLISHMENTS

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Acknowledgments

Many individuals have played major roles in the eight month period during which this report has been assembled. The most important part was played by the ten Deputy Regional Administrators who directed the assembling of the Regional submissions. These constituted the bulk of the material going into this report. Countless Regional staff members responded to the DRAs' call and performed admirably under very tight deadlines.

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Thanks go as well to Jack Waugh, who bore the brunt of the responsibility for weaving the materials received into a fluent, cohesive whole.

TOWARD A REACHABLE GOAL

The Environmental Protection Agency came in with the Seventies on the wave of environmental concern already sweeping the country.

Its mission was to carry out the complex, precedent-setting air and water legislation then beginning to issue from the Congress. Those first six years have been years of sometimes slow, sometimes rapid progress against the worst forms of pollution that stress the water, land, and air.

And the years have proved one major fact: that workable pollution controls do exist and that where they are used, they improve the environment.

The struggle for a cleaner, healthier environment did not begin with the birth of the EPA in December, 1970. It was being waged long before that by the states and by the EPA's predecessor agencies in the Federal Government. And most of the improvement since the advent of the EPA has been a triumph not of the EPA alone, but of a close Federal, State and local partnership.

In many cases the Agency's role has simply been to set a tone, create a presence, devise a strategy, or simply establish a climate in which others -- State and local agencies, private corporations, the courts, citizen groups and individual citizens -- could continue to do the work already underway.

This report is an attempt to show with individual case histories how this partnership has made the environment better, qualitatively and quantitatively. It is a brief look at some of the specific victories of the last half decade -- and before. It is an effort to record the good news, to show where there have been successes, signs of hope for a stressed and threatened environment.

It is not intended to be a catalog of every pollution control accomplishment, nor is it intended to be a comprehensive survey of progress nationwide. It does not go into much detail on problems remaining that are yet to be addressed fully, and it does not indicate even in the cases described whether improvements have occurred as rapidly as the public had hoped or as our statutes have required. It attempts simply to present a glimpse, a picture, of some of the accomplishments.

Our picture is by no means complete -- nor is the job finished. There are few unqualified successes and hard-won gains are always subject to unexpected setbacks. Progress is

still ahead are large. The unresolved problems are legion, and new ones are being discovered almost monthly.

As the examples in this report show, some gains are impressive -- even dramatic. Others are modest. Hopes have not always been realized. Execution has sometimes failed to match expectation. Nor has the effort been without friction between members of the partnership itself.

Cleaning up the environment is not only a slow, difficult process demanding wide cooperation and involvement, it is also expensive. The examples in this report, however, show that both the money and the time spent are paying off. The record is full of specific, day-by-day victories, both large and small.

The campaign against the major point-sources of air and water pollution is now well underway nationwide. Standards have been promulgated. Key strategies have been shaped and implemented. And needed shifts of emphasis for the future are becoming apparent.

From the start the EPA, an amalgam of various executive units and agencies brought together under a single umbrella by Executive Reorganization Plan No. 3 in 1970, has faced a often difficult, at times seemingly impossible, challenge. It has had to strike a delicate balance between firm central control and decentralized implementation -- often in the face of ongoing changes in the enabling legislation itself. The challenge would have been a large one for any agency, but it was especially so for one in its administrative infancy.

In the EPA's first half decade, the overriding concern was to eliminate the most obvious and damaging pollution as rapidly as possible. That is where the attack has centered. The challenge now is to chart the preventive strategies for the future and to deal with the more subtle aspects of pollution.

The Agency has but one goal: cleaner air, cleaner water, and a more healthful and wholesome environment for all of us. This catalog of individual accomplishments of the past several years shows it is a reachable goal.

HOW TO TELL IF IT'S PROGRESS

It is not always easy to tell if pollution control is working.

The EPA deals in a half-dozen major areas of pollution -- air, water, solid waste, pesticides, radiation, and noise. And often change for the better cannot be seen until long ater the pollution control effort has begun. Sometimes, in the case of persistent pollutants, it cannot be seen until long after the pollution itself has been stopped. Pollution that has been decades in the making is not cleaned up overnight.

However, there are three ways to know when the environment is better or likely to become better:

First, the evidence can be seen or felt first hand: There are fewer human deaths and illnesses linked to pollution. Fish and animals return to once polluted rivers or regions. The economic losses decline -- fewer farm crops are damaged and fewer businesses hurt. Or the air is simply clearer, the water visibly cleaner, or there is no longer an unpleasant odor or an irritating, unnecessary noise.

Second, the concentrations of pollutants actually in the air or water or on the land are diminished.

Third, the volume of pollutants being released into the air or dumped into the water is less.

The most certain sign that the environment is better is the first -- when improvement can actually be seen and felt. That is conclusive evidence. But we must often be satisfied with other indications that the environment is better -- without actually being able to "see" that it is. When the levels of pollutants in the air and the water or the amounts being dumped into them are diminished, we assume -- and reasonably so -- that conditions are improving.

Whenever possible, have tried to document the cases in this report with conclusive, first hand, visible evidence of improvement. Where that has not been possible, then with carefully documented evidence that fewer pollutants are in the environment or fewer are entering it.

These case histories show, above all, that the environment can be made better and that in large and small ways, throughout the country, people are working to make it better. And not only that: they are succeeding.

The report that follows includes examples from nearly every area of pollution control effort. It tells of how water has been made cleaner and air clearer and where solid waste management has been improved. It talks of the steps taken in response to major spills that sometimes threaten entire communities. It tells of industries that have pioneered in pollution control. It describes some of the many triumphs of the States and cities as well as presenting outstanding examples of individual and collective citizen action. It recounts cases where innovative technology has worked and in which some of the most rare and threatened of our wildlife and natural wonders have been preserved. And it talks of the enormous challenges still ahead.

CLEANING THE NATION'S WATERS

Water pollution became a problem with the tremendous industrial and population booms of the last one hundred years.

The pollution quickened and the problem worsened in the years following World War II, when man-made chemicals began to assume a role of new, massive importance in our lives. Industries and cities used rivers as dumping grounds for their wastes and many of the Nation's streams began to run heavy with pollution.

By the mid-Seventies, however, a nationwide attack on the problem was beginning to turn the tide. Many rivers, lakes, bays, and estuaries are still heavily polluted. But where the States and cities have acted and where EPA strategies and standards have been applied, less waste is being dumped and the waters are cleaner. In some cases the changes are dramatic -- water bodies thought to be dying are seeing new life.

What the Law Says

Congress in 1972 passed the Federal Water Pollution Control Act Amendments (Public Law 92-500). That Act now governs the EPA's water quality strategies and programs. It was tough legislation that gave the Agency broad responsibility and authority to oversee the clean-up of the Nation's waters.

Under the Act the Agency issues effluent guidelines which are used in setting discharge limitations on industrial and municipal polluters. There are two stages to this process: the first stage is to be implemented by July 1, 1977; the second by July 1, 1983.

The Act gives as its interim goal that the Nation's waters be "fishable" and "swimmable" by 1983. The Law also calls for an ultimate goal of no discharge of pollutants into these waters. However, unlike all other provisions of the Act, these "goals" do not carry the force of law.

Every industrial or municipal pollution source must have a permit limiting its discharge. The permits are issued either by the Federal Government -- under a program called the National Pollution Discharge Elimination System (NPDES) -- or by the States that have assumed this responsibility.

The Agency has developed effluent guidelines for most major industries. The States, in turn, have set water

quality standards that must be met -- even if that means treatment requirements more stringent than those called for in the EPA effluent guidelines.

The EPA administers a multi-billion dollar Federal grants program to cities and States for construction of the municipal treatment plants necessary to meet the discharge requirements. And the Agency oversees the regionwide and statewide planning called for in the Act.

Two Spoilers of Water Quality

After the century or more of quickening municipal and industrial water pollution, two problems in particular needed immediate attention: pathogens -- disease causing organisms -- and dissolved oxygen.

Pathogens enter the Nation's waters largely through municipal sewage, but also from feedlot and pasture runoff.

Fecal coliform bacteria, though benign themselves, are a widely used indicator of the number of pathogens present in sewage. They are present in the intestines of warm-bodied animals and are also invariably present in their excrement. High levels of fecal coliform are a sign of contamination by sewage and indicate an unacceptably high likelihood that disease-causing organisms from sewage are also present.

Dissolved oxygen (DO) is a problem when its levels drop so low that fish are unable to breathe. Low dissolved oxygen can cause extensive fish kills. DO levels decline in the face of oxygen-demanding pollutants carried in municipal sewage or industrial wastewater with high BOD (biological oxygen demand) and in discharges from industry with high COD (chemical oxygen demand).

A GALLERY OF NORTHERN RIVERS

A region that has struggled with the problems of pathogens and low DO longer perhaps than any other is the heavily industrial, densely populated Northeast.

For more than two centuries people have built their cities and industries on the banks of the rivers of the Nation's northeastern tier. From New England to New York to the Delaware Valley people have brought industry and pollution. And in their wake in the 1960's and the 1970's have followed the efforts -- largely by the States in the region -- to repair the environmental damage done.

Seven from New England

For decades industrial wastes flowed untreated into the rivers of New England. The towns and cities, many of them but villages to begin with, contributed to the load. And pollution, bringing with it high fecal coliform and low DO readings, steadily but surely grew.

The stories of pollution reduction on many of those New England rivers are now cause for satisfaction. Among them, seven are particularly notable.

Two Connecticut rivers, the Naugatuck and the Housatonic into which it empties, shared polluted lives for decades. Now they are sharing the benefits of a major cleanup.

For years the Naugatuck was one of the most severely polluted rivers in New England. Historically it has had poor quality throughout most of its length. It was long a dumping ground for untreated municipal sewage and industrial wastes.

Connecticut residents can remember when no fish could survive on certain reaches of the river. It was a losing struggle there even for most insect larvae. Along the 28 miles before the Naugatuck emptied into the Housatonic, seven cities and 57 industries, among them metal forming and electroplating firms, were poisoning the water with raw sewage and heavy metals. Much of this legacy flowed on to the Housatonic, which already had pollution problems of its own.

In 1967, the State of Connecticut initiated a major industrial pollution abatement program. Now approximately

95 percent of the Naugatuck's heaviest polluting industries have some kind of pollution control. Among the towns on the river, there are seven new wastewater treatment plants, paid for in part by EPA construction grant funds. More than 95 percent of the industries on the Housatonic also have controls.

Bluefish now swim from Long Island Sound as far as 15 miles up the Housatonic. Menhaden and blue shell crabs are back. The oyster industry in the Housatonic, wiped out in a 1951 storm and kept out for years thereafter by pervasive pollution, is now back to its former strength.

On the Naugatuck, the water that would support little life five years ago, now has smallmouth bass, bluegills, bullheads, and whitesuckers. Damsel fly larvae, fish fly larvae, worms, and sowbugs, which are indicators of good water quality and which were gone for so long, are back. There are still high levels of lead, zinc, and manganese in the bottom sand. But the river is no longer sterile, and it is on a course toward the day when its waters will once again be swimmable and fishable throughout its length.

Three New England rivers with reputations as fine trout streams in years gone by, also became casualties of the massive pollution of the 20th century. One, the Willimantic, is in Connecticut. The other two, the Pemigewasset and the Contoocook, are in New Hampshire.

In 1963 the Connecticut fish and game agency stopped stocking the Willimantic with trout altogether because the pollution was killing them. That powerful and graceful river, which flows through the thinly populated northeastern side of the State, had become a dumping ground for upstream textile mills and for the toxic wastes of the metal-plating industry. Soapsuds began to boil on the river downstream of its waterfalls, sludgy residues clogged the bottom, and odors fouled the air. There were devastating fish and insect kills in the river.

The Pemigewasset, by the mid-sixties, had declined to the lowly status of a stream fit only to transport sewage and industrial wastes. Recreation was all but eliminated and the value of the river for water supply virtually ended. The once beautiful stream, which ran through the heart of a prime New Hampshire vacation area, was discolored and ugly.

To the south, the Contoocook River was faring little better. It still had adequate dissolved oxygen levels,

despite three paper mills on its banks, and it was reasonably free of urban and agricultural runoff. But it had towering bacteria counts and was virtually a condemned river.

Cleanup campaigns opened on all three of these once highly fishable rivers at about the same time.

On the Willimantic in the early Seventies, 32 industries were issued NPDES permits and started cleaning up their wastewaters before discharging them. One municipal sewage treatment plant was upgraded and another was replaced. In 1973, the State of Connecticut seeded the river with 1700 trout. The next year it was stocked with 4,000 more. No fish kills have been reported.

One paper mill on the Pemigewasset closed down. Another adopted a closed wastewater system. And newer industries with sophisticated pollution controls replaced some of the older ones. Five towns on the river have put in secondary wastewater treatment. Today more than 55 miles of the Pemigewasset have been reclaimed from nuisance status. Obnoxious fumes, odors, and color are gone. The river, remarkably, has been lifted to a condition fit for every kind of recreation.

Major industrial dischargers on the Contoocook River have either had to improve their existing pollution controls or install treatment for the first time. Three paper mills now have the treatment required by their NPDES permits. Both the tannery and the fiber plant are tied into a municipal treatment facility. Only four small communities on the river are left without treatment and they have municipal plants on the drawing boards. Local residents now are using the river for swimming and boating. Some of the most challenging stretches of white water in all of New England can now be used without fear of pollution.

And all three of those rivers are once more living up to past reputations -- they are prime trout streams.

The problem on the Stevens Branch of the Winooski River in Vermont was different from the others. It was degraded by fine granite powder that made it look like a long milky way.

For years the granite and gravel industries had dumped indiscriminately into the stream. The granite powder caused gill scour in fish and smothered their spawning beds. Abrasives, including silicon carbide, carborundum, tin oxide, aluminum oxide, and steel shot from wire saws and polishers, flowed untreated into the water.

In 1971, the EPA awarded the State a $61,000 grant to develop an economical method to treat the problem and the sludge residue born of it. The State developed a lagoon settling method using a ferric chloride solution. Then the industry was given until August 1973 to install controls. Today all industries on the Stevens Branch are recycling their liquid wastes and have no wastewater discharge at all.

The river, which at one time was classified over parts of its length as fit only for industrial use, is now suitable for swimming and other water contact sports.

The Androscoggin River begins in the heavily forested chain of lakes high on the Maine-New Hampshire line and flows 161 miles through Maine to Merrymeeting Bay, where it joins the Kennebec and flows out to the sea. It was once listed among the 10 most polluted rivers in America. Today it is on its way to a dramatic cleanup.

As the Androscoggin flows toward the sea, it runs into its first big load of pollution at Berlin, N.H., where this town of 18,000 people dumps raw sewage into its waters. Brown Paper Company's huge plant at the edge of town adds 158,000 pounds of BOD daily.

But construction of a secondary treatment plant for Berlin and its sister community, Gorham, is due to begin in 1977. The paper company's secondary treatment plant went on line in late 1976, about six months ahead of schedule. New Hampshire's total BOD discharge will be cut by 80 to 90 percent by that one plant alone.

The next major source of pollution in the Androscoggin is across the stateline in Maine, at Rumford and Mexico, with 14,000 more people and another mill -- that of the Oxford Paper Company. The river, which has partially recovered from the heavy pollution load it picked up at Berlin, is hit there with another major discharge. Both the towns and the mill, however, will soon open secondary treatment plants.

At Lewiston, the biggest city on the Androscoggin, the river widens and slows and the heavy wastes sink to the bottom. Their decay, with summer's warm water temperatures, often dropped dissolved oxygen levels below what was necessary to sustain fish and other aquatic life. When the LewistonAuburn municipal and industrial treatment plant opened in 1974, however, much of that problem was solved.

One by one, the more than 25 major sources of pollution on the Androscoggin are being cleaned up. Several completed wastewater treatment facilities were going through final start-up operations by the end of 1976. The river now stands to be one of the first to meet the EPA's discharge requirements for 1977.

A Trio of New York Rivers

Three great New York rivers famous in fact and legend -- the Mohawk, the Hudson, and the upper Susquehanna -- were also heavily polluted and are now to some degree rejuvenated.

Since they run through the heaviest concentration of people and industry in the country, they have presented enormous challenges. But from the effort have come the first signs of success.

The Mohawk

The Mohawk flows through the heavily industrialized Utica-Rome region eastward to the Hudson.

Today it is reasonably clean. More than 75 percent of the river's industrial wastewater discharges are now being treated. Largemouth and smallmouth bass, walleye, perch, sunfish, and even trout, have returned to waters they once were forced to leave. The rough fish that took their place -- carp, bullheads, and suckers -- are in decline.

This represents a comeback, because the river at one time was severely polluted. Behind the improvement stands a major effort by New York State, with its Pure Waters Program, a strong local commitment, and the EPA.

One point on this important river that exemplifies the change is the portion of the mid-Mohawk at Fonda, N.Y., which is dominated by the urban and industrial complexes of the Johnstown-Gloversville area.

Before 1972, the wastewater discharged into Cayadutta Creek above Fonda was treated only by an ancient and overloaded secondary treatment plant built in 1912. It was only ineffectively dealing with the sewage from the urban area around it and with the wastewater from a booming leather and tannery industry.

The EPA put up half of the money that upgraded treatment was estimated to cost. And when the plant was finished, the water quality in the Mohawk began to improve. Further upgrading is now contemplated for the plant to meet more fully the requirements of Public Law 92-500. Although there is still far to go, the raw wastewater discharges into that stretch of the river have ended, and today dissolved oxygen levels in the water are on the rise.

The Hudson

The deterioration by the mid-1940's of the waters of the strong, deep, fast-flowing Hudson River marked the end of a way of life.

Nowhere was this more strikingly true than in the 13 miles of the Lower Hudson's shoreline in Bergen County. In the early decades of this century swimming in that reach of the Hudson, with its beaches and overhanging cliffs, was the height of fashion. The beaches were lined with stone bath houses, fancy restaurants, dancing halls, diving boards, life guards, and bathing beauties. More than 300,000 bathers came down to the cliff-side beaches along that stretch of the Hudson in the summer of 1935 alone, many of them riding ferries up river from New York City. It was a swimming hole 13 miles long.

Then came World War II and with it industrial development and industrial wastes. By the time the war was over the beaches were unsafe for swimming and were closed. They haven't opened since.

When the bathers stopped coming, the ferries stopped running. Since the pollution had also driven away the fish, the fishermen left, too. Oil gradually colored the sands of the beaches and the old stone bathhouses were abandoned and vandalized. The river along the beachfront became so polluted by the Sixties that some officials no longer even bothered to monitor its pollution levels.

But wastewater treatment also started coming to the towns along the Hudson in the Sixties. Some 160 sewage treatment plants have now been built, or soon will be, along the river and its tributaries.

Progress in ridding the Hudson of the more traditional forms of pollution has been remarkable, thanks to New York State's billion dollar Pure Waters campaign, dating from the mid-Sixties.

But now the Hudson has been dealt a new, and even more serious blow. PCB's (polychlorinated biphenols), a nearly indestructible and highly toxic group of industrial compounds, have been discovered in the flesh of many fish in the river.

An estimated 500,000 pounds of PCB's lie menacingly on the bottom of the river in the 50-mile stretch between Hudson Falls and Albany, many miles to the north of Bergen County. That is the biggest concentration of PCB's at large in the environment anywhere in the world.

The PCB's come from the big General Electric Company capacitators below Hudson Falls. This pollution is such a threat that all fishing, which had been on the rise in the otherwise much cleaner Hudson, was banned in February 1976 -- for the first time in history.

Stringent action against the PCB problem followed. General Electric has not discharged any significant quantities of PCB's into the Hudson in a year. And by next summer it will stop using the compounds altogether. Meanwhile, a $6 million joint GE-New York State effort to rid the river bottom of the material is underway.

The PCB setback came just as fish life was beginning to flourish again on the Hudson. Crabs were returning to the Bergen County shoreline. Fishermen were catching shad that no longer tasted of oil. Bluefish had returned. And there was even talk -- unthinkable for 30 years -- of swimming again off the beaches under the overhanging cliffs.

The PCB's are not the only problem the Hudson faces. It is still contaminated in some reaches by the more traditional pollutants. More than 225 million gallons of poorly treated and often toxic sewage still flush into the water near the Statue of Liberty whenever it rains. And each day New York City still dumps 200 million gallons of untreated sewage into the river. But the $1 billion North River project, when finished, will be the largest sewage treatment complex ever built. It should sharply reduce the massive load of pollution into the lower Hudson.

Along much of the rest of the river the State's Pure Waters program has already taken hold. The Hudson, once it is rid of its PCB's, faces a far cleaner future.

The Susquehanna

The stretch of the Susquehanna between Binghampton and Smithboro, N.Y., is also gradually recovering from a long era of decline.

Its rejuvenation is an example of the now familiar cycle of an inpouring of money, the construction of massive municipal wastewater treatment plants, and visible evidence of a river improving in quality.

An $11 million Binghampton-Johnson City treatment plant was finished in 1975. The EPA funded almost half of it. A $4 million facility at Endicott went on line in 1973.

And now monitoring stations all along that reach of the Susquehanna are reporting cleaner water. The station at Vestal reports oxygen depletion cut by half and the level of bacterial contamination reduced many fold -- from a total fecal coliform count of 8,000 per 100 milliliters of water to 200. This is a remarkable improvement. Even the Smithboro station, farthest downstream from the new municipal treatment plants, reports marked decreases in coliform bacteria counts. The Owego monitoring station also reports a drop in total suspended solids.

Such fish as walleyed pike, smallmouth bass, and muskellunge are back in numbers. That stretch of the Susquehanna, once mired in pollution, is again taking on the characteristics of a healthy river.

High fecal coliform levels like those previously found on the Susquehanna, have long been a problem nationwide. It is still a significant problem in many areas, but as new municipal treatment plants are built, it is gradually being alleviated.

As Figure 1 reveals, fecal coliform levels are now acceptably low in the Northwest, in the Upper Great Lakes and in portions of Florida and Colorado. High levels are still found in much of the Midwest, the East and South.

Among areas showing general improvement in fecal coliform levels are Colorado, Nebraska and Minnesota (Figure 2). The turnaround in coliform trends has not yet occurred along the lower Missouri and the middle Ohio.

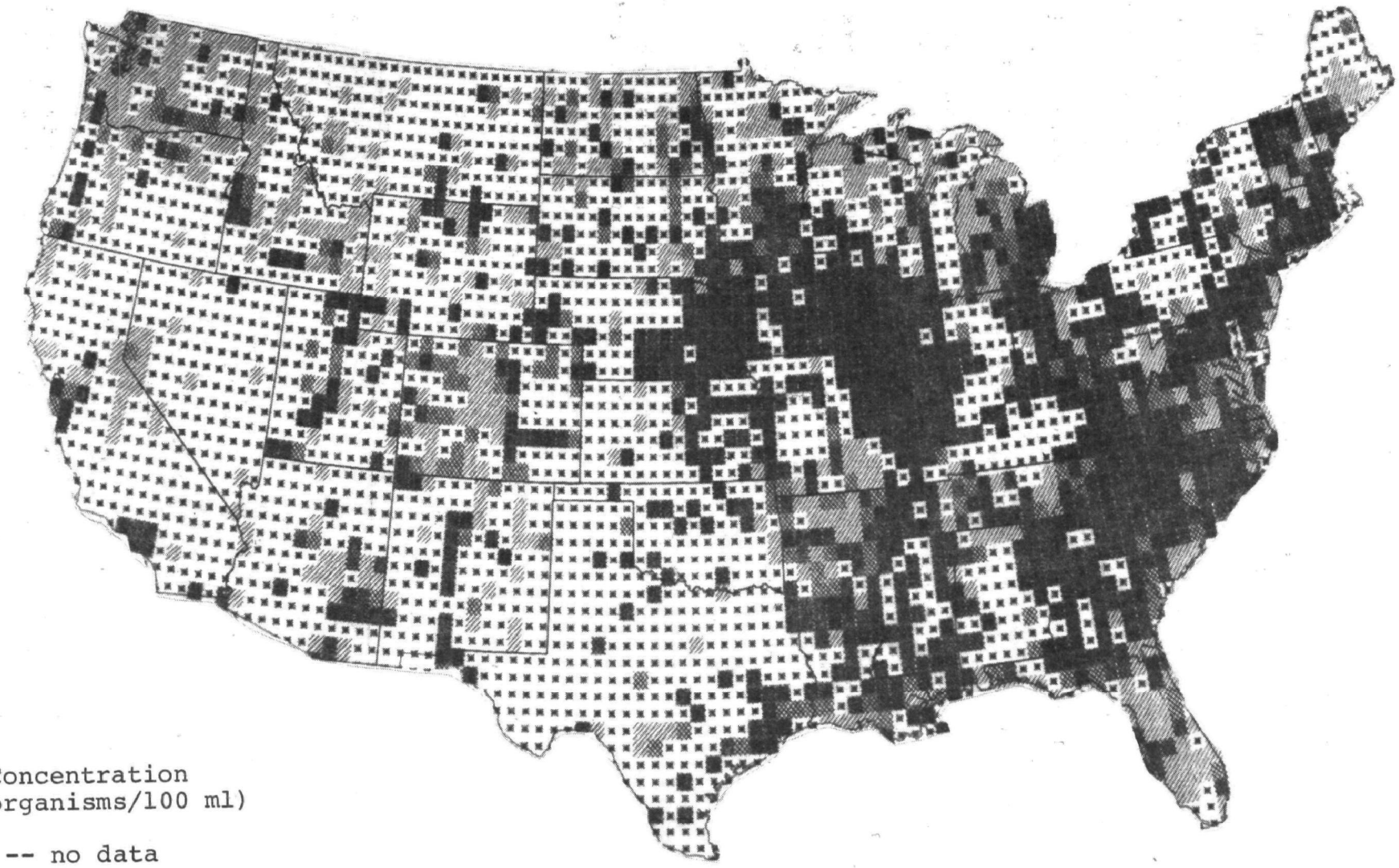
The Urban Rivers of New Jersey

In the last five years two important urban river systems in New Jersey have also started the long climb back from contamination.

Figure 1

Environmental Protection Agency
STORET SYSTEM

Fecal Coliform in Water, 1973-1975, 85th Percentiles



Concentration
(organisms/100 ml)

* -- no data
-- 0-200
-- 200-400
-- 400-800
-- 800 or more

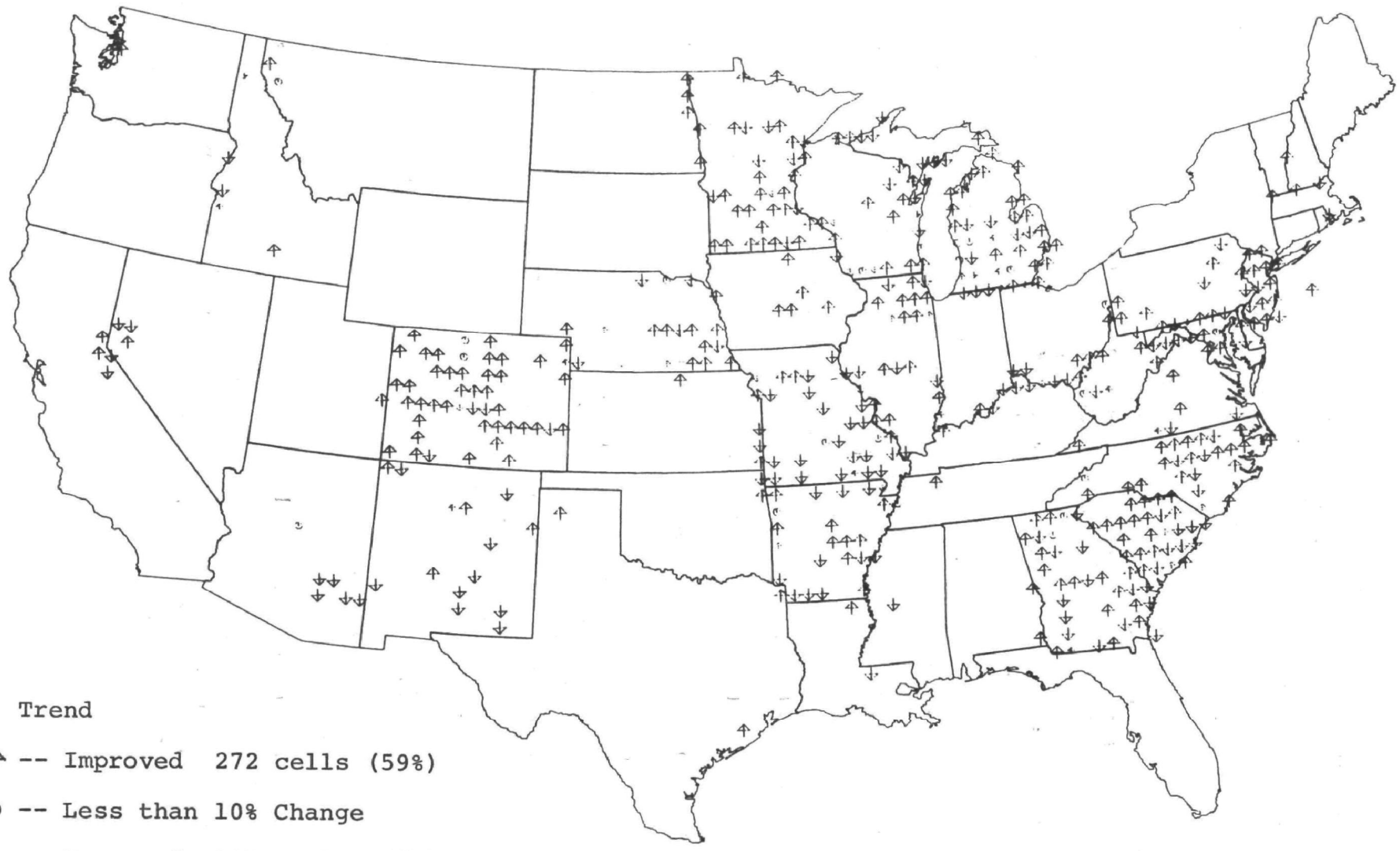
Cells included are those for which data has been supplied to EPA. Cells are approximately 25 by 35 miles.

Source: **Monitoring and Data Support Division, OWPS, EPA**

Figure 2

Environmental Protection Agency
STORET SYSTEM

Trends in Fecal Coliform, 1967-69 to 1973-75



Trend

↑ -- Improved 272 cells (59%)

o -- Less than 10% Change

↓ -- Worsened 167 cells (36%)

Small arrows (barely visible) indicate less improvement.

Source: Monitoring and Data Support Division, OWPS, EPA

The Hackensack, which rises in Haverstraw, N.Y., and flows languidly southward into Newark Bay, was heavily polluted. Near its mouth the river widens, flowing at a nearly indiscernable rate through a swampy marsh called the Meadows, which is filled with garbage, rusting auto bodies, industrial oil slicks, and cattails.

By 1971 the Hackensack bore all the symptoms of a stream in the last stages of deterioration. The Hackensack Meadowlands Development Commission issued a report calling it a "highly disturbed and truncated ecosystem" which is "virtually dead." Many of the fish, the shellfish and crustaceans, that had populated it for thousands of years had, over the span of a mere 40 years, been driven out.

A long five-year effort to revive the Hackensack is now starting to pay off. The development commission in 1976 was able to report that the river "is coming back." Dissolved oxygen levels are up. Ribbed mussels have been introduced into its waters and have survived. Blue claw crabs are back in abundance. Wild fowl and shore wading birds now frequent its banks, and stripers, alewife, and herring are turning up in seining nets again.

A sister system of the Hackensack, the Navesink and Shrewsbury Rivers, the waters of which had also once been rich and clean but had become heavily polluted, is now making a come-back.

In the late Fifties commercial clammers in Raritan Bay, the estuary into which these two rivers empty, could still take a good day's catch. The waters were rich in shellfish. The hardshell and softshell crabs and oysters were perhaps the finest in New Jersey. People swam without fear in all reaches of the two rivers.

Then, in 1961, there was an outbreak of hepatitis -- from contaminated clams taken from Raritan Bay. It was a turning point in the fortunes of the two rivers and their estuary. The swimming and the shellfish harvesting abruptly stopped.

The pollution had been building for years, intensified by the residues of waste from the flow of millions of gallons of untreated sewage into the Hudson-Raritan estuarine system. People and industry over the years had moved into the two river valleys and gradually displaced much of the farm land of less polluted times.

The drainage basins of the Shrewsbury and Navesink were beset by overflows from malfunctioning household septic tanks, by runoff from new shopping centers and roads, and by inadequately treated wastewater from antiquated and overloaded treatment plants.

Three major projects were built with EPA help -- a 15 mile outfall line and two treatment plants.

Today more than five million gallons of effluent that once emptied into those rivers each day no longer do. The two rivers and the estuary have not regained their high water quality of earlier times, but they are improved. Four years ago all the waters were closed to shellfishing. Now two-thirds of Raritan Bay's 25,250 acres are open on a restricted scale to some forms of shellfish harvesting. So are nearly all of the waters of the Navesink and Shrewsbury Rivers.

RIVERS OF THE SOUTH

Many major rivers of the South, no less than of the North, have experienced the familiar pattern of gradual, choking pollution. Some of them, too, have been witness to urgent calls for cleanup. And many have made striking comebacks. Among the many, here are a handful of notable examples.

The Pearl

One day in 1960 a diver donned a face mask and wet suit and slipped into Bogue Lusa Creek, a tributary of the Pearl River in Louisiana, to examine the impeller of a fixed aerator at a paper company outfall. Every part of his body not protected by his wet suit suffered severe chemical burns.

Two years later a young employee of the Louisiana State Department of Health came down to the edge of the Bogue Lusa, barren now of all vegetation and devoid of all signs of life and dipped a thermometer in the water. When he pulled it out, he was unable to read the temperature because all of the paint on the thermometer had been stripped away.

At about the same time, the Pearl River in Mississippi, just below Jackson, was so heavily polluted that even pollution-tolerant bloodworms, virtually the only life still in the water, were forced to leave the river and re-establish themselves in springs along its edge.

Parts of the Pearl and stretches of the Bogue Lusa had become as polluted as rivers can get. Yet the Pearl once had run fast, beautiful and clear for 475 miles from east central Mississippi south through Louisiana to the sea. It ran through country timbered with southern pine. Mink, deer, turkey, and waterfowl populated its banks, and catfish swam in its waters.

But at the turn of this century, a small sawmill was built on Bogue Lusa Creek. During World War I, it became the largest pine sawmill in the world, giving birth to the City of Bogalusa. In 1917, another paper plant settled on the creek and grew in size through the years. A large chemical company moved onto the Pearl upstream. The cities, the paper mills, and the chemical company used the river and its tributary at will to dispose of their wastes.

Papermill wastewater was pumped into Bogue Lusa Creek untreated. The city of Bogalusa discharged raw sewage.

The creek became little more than a channel for carrying undiluted wastes to the Pearl River. Sludge deposits settled on the bottom. Gas rose and bubbled constantly in the creek and oily wastes clung to any object on the banks.

Only the most pollutant-resistant of life forms could survive in the creek and life was perilous for fish in the Pearl River downstream of where the creek entered it. In 1960, dead and dying fish floated in the Pearl River as far as 30 miles below Bogalusa.

In 1963, citizens in the area had had enough. The first interstate conference on pollution of the Pearl River convened in New Orleans and the chief sources of pollution on the Bogue Lusa were pinpointed -- the Crown Zellerbach paper mill and the City of Bogalusa itself.

Crown Zellerbach was dumping an average of 76,167 pounds of BOD into the river every day. The city's untreated sewage was building up bacterial pollution over 150 times more dense than the maximum considered safe for water contact sports, and over 30 times more than is acceptable for general recreation.

Even before the conference convened, however, Crown Zellerbach had begun moving to clean up its discharges. A treatment plant was already in the works and would be in operation the next year. By 1972 the company's discharges were down to 20,000 pounds of BOD a day.

The City of Bogalusa moved less rapidly. It had one primary treatment plant in operation in 1963. In 1967, the voters defeated a $2,300,000 bond issue to build additional primary and secondary treatment facilities.

In 1971, EPA served the city with a 180-day notice for discharging inadequately treated municipal wastes into the water in violation of Federal-State standards. Finally, in 1972, a referendum was passed by the electorate. A $4.6 million treatment plant was started -- 75 percent of it financed with EPA funds. It was finished in 1975.

At about the same time, Jackson, upstream of the Pearl River, opened a new wastewater treatment system, built with the financial help of the State and the EPA.

Slowly the river and its tributary have begun to return from the shadows of pollution. Bogue Lusa Creek's color has improved. Fish have returned -- free of the turpentine taste that once permeated their flesh. Bream, white perch, trout, and catfish are back in the creek and in the river below.

Downstream from Jackson, floating sewage and odors are gone. River sludge deposits appear to have been flushed out. Dissolved oxygen levels have risen over the last six or seven years. There is now hope for the river.

Dissolved oxygen problems of the sort that plagued the Bogue Lusa and the Pearl were once the most common of all water pollution problems in the U.S. But with the construction of municipal treatment plants and the control of discharge from such industrial dischargers pulp and paper mills, these problems are rapidly being eliminated. DO levels are now general high --which is desirable -- in most areas of the country. (Figure 3).

Undesirably low DO levels are still found along the Gulf and Atlantic Coasts from Louisiana to New Jersey. Low levels in the swampy bayous of the South may be due in great part to natural decay of dead plants and organic material in the warm stagnant waters. Low DO levels are also found in Ohio, and Indiana and in sections of Wisconsin, Minnesota, Washington and Maine.

DO levels have been improving noticeably in several areas including the Carolinas and Virginia., Illinois and Michigan, Nebraska and Texas. (Figure 4).

Sope Creek

The Chattahoochee River's Sope Creek was hardly better off in the Sixties and early Seventies than the Pearl's Bogue Lusa.

Flowing through metropolitan Atlanta, Ga., and beset by a surge of suburban development, the Sope became little more than a foul-smelling open sewer. Abandoned by all pollution-sensitive aquatic life, it had been left largely to a growing population of unsightly bloodworms.

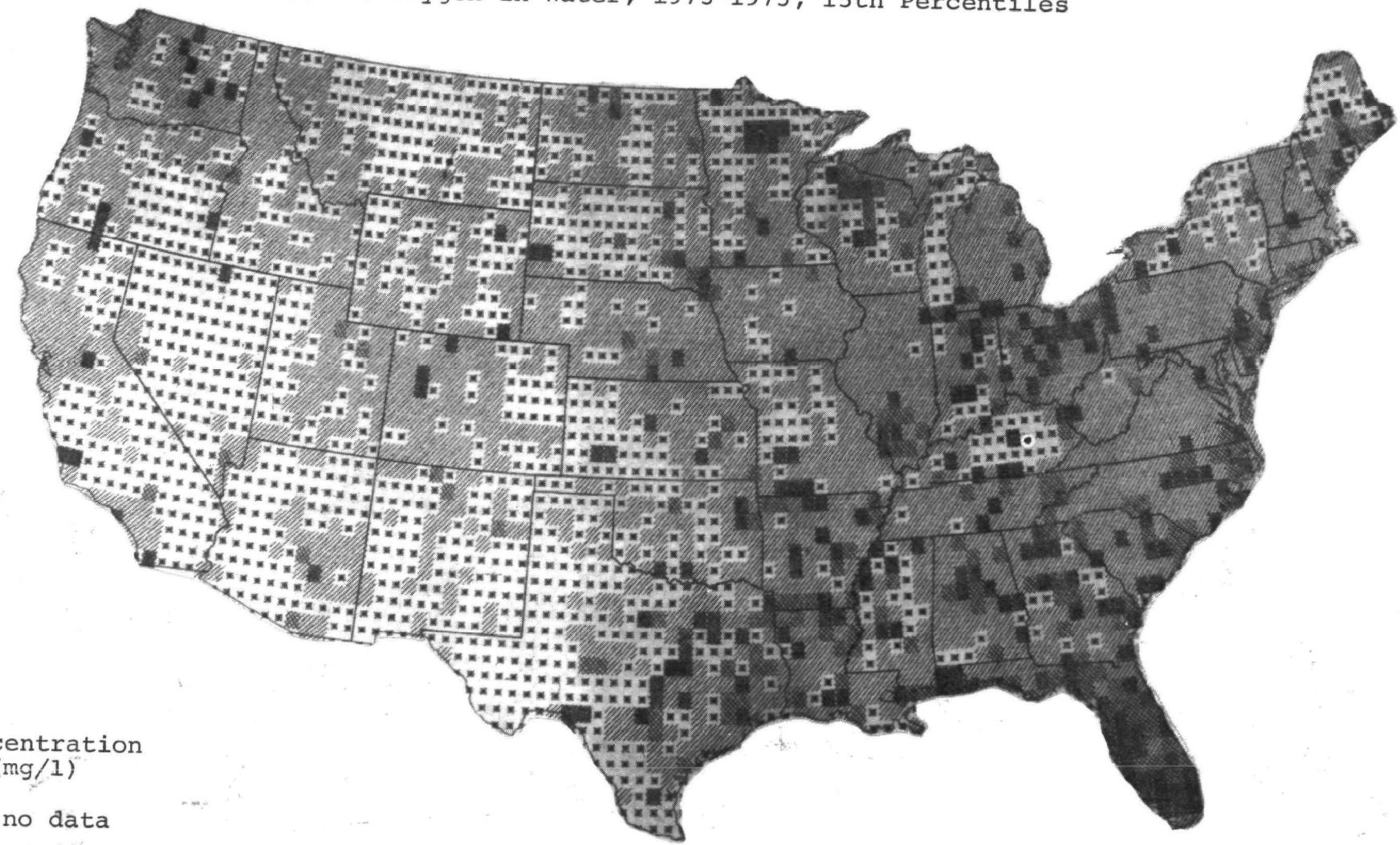
Along the same lush river banks where Chief Sope and his Cherokee nation once encamped, swimming, fishing, and picnicking were no longer allowed.

Sope Creek's problem was caused by inadequately treated wastewater dumping into it from one major sewage treatment plant and five smaller package plants. The treatment provided, which had been more than adequate when the Sope was a tumbling, splashing and picturesque stream on the outskirts of the city, was no longer adequate. In the Sixties, the basin had developed faster than anyone had anticipated, and the plants were consequently operating well beyond their design capacities.

Figure 3

Environmental Protection Agency
STORET SYSTEM

Dissolved Oxygen in Water, 1973-1975, 15th Percentiles



Concentration
(mg/l)

* -- no data
-- greater than 5
-- 4-5
-- 2-4
-- less than 2

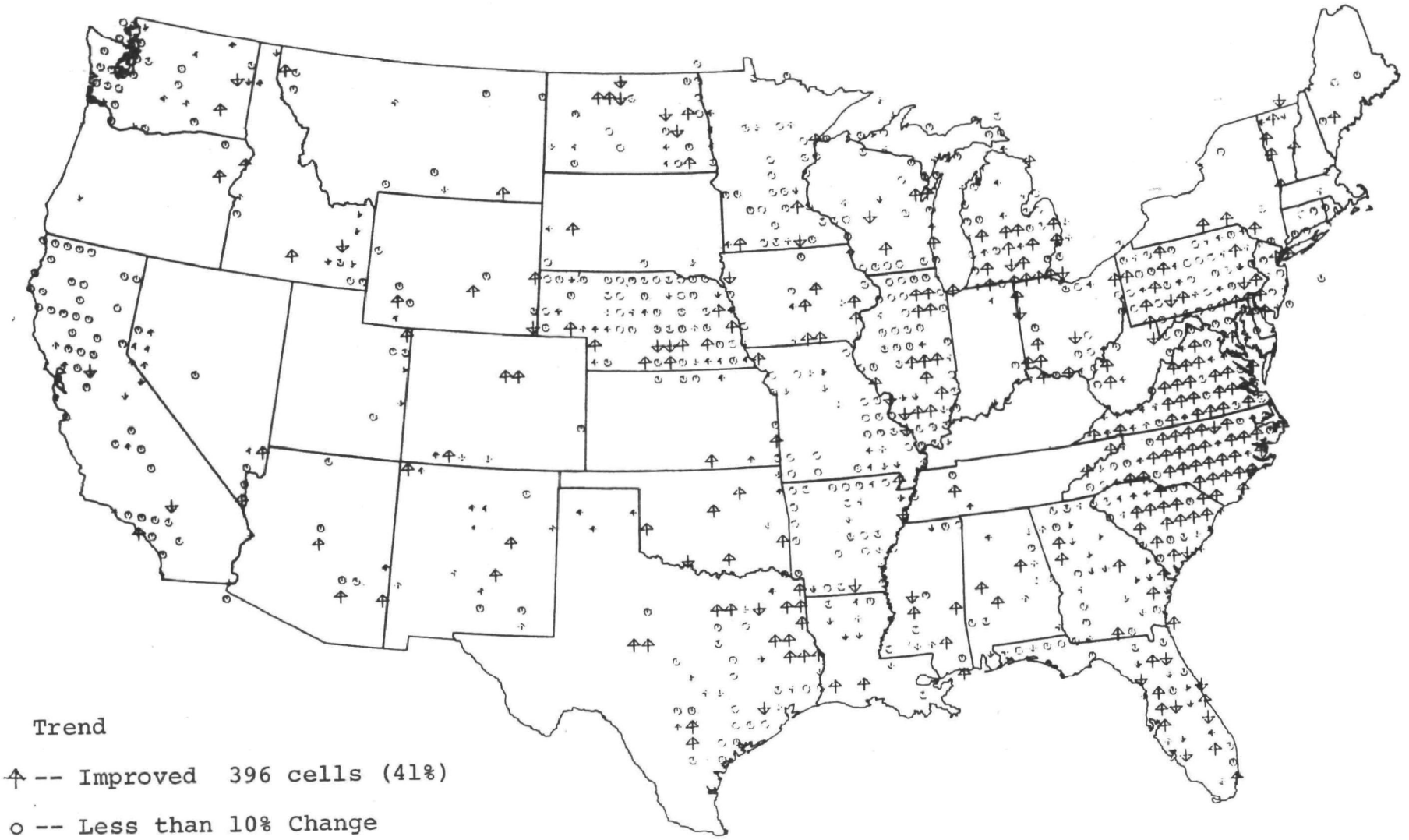
Cells included are those for which data has been supplied to EPA. Cells are approximately 25 by 35 miles.

Source: Monitoring and Data Support Division, OWPS, EPA

Figure 4

Environmental Protection Agency
STORET SYSTEM

Trends in Dissolved Oxygen, 1967-69 to 1973-75



Trend

↑ -- Improved 396 cells (41%)

o -- Less than 10% Change

↓ -- Worsened 140 cells (14%)

Small arrows (barely visible) indicate less improvement.

Source: Monitoring and Data Support Division, OWPS, EPA

In 1967, an EPA predecessor agency had funded a project to build a secondary wastewater treatment plant on Sope Creek. In the early Seventies the EPA increased the grant to include necessary interceptor sewers. The treatment plant was finished in 1973, the interceptor sewers were nearly finished by October 1975, and most of the package plants had been eliminated.

Change for the better in Sope Creek was almost immediately evident. Within two months all bloodworms had disappeared, and the odors that residents had complained of had been eliminated. The shoals in midstream have changed back to their natural color, and algae that had built up in the creek are gone. The common bluegill bream, the warmouth bream, and largemouth bass are back in the creek and being caught by fishermen. The creek is now beginning to look like the stream that had once been so pleasing when the Cherokees camped by its side.

The Arkansas

The Arkansas was a river beset by another major enemy of water quality -- turbidity.

A measure of water's murkiness, turbidity is generally caused by suspended or dissolved solid particles -- sediment -- from municipal and industrial sources or from such nonpoint sources as farming, construction, and logging.

Much of the country (Figure 5) enjoys very low levels of turbidity. Exceptions are the Pacific Northwest, Idaho, Michigan, Florida, New York, Delaware, most of Pennsylvania, the Susquehanna and the Monongahela Rivers, and certain streams in central Vermont.

The Missouri-Mississippi River system along its entire length is naturally turbid. Turbidity levels are also high in the Rio Grande as far upstream as northern New Mexico and in the tributaries of the Gila in Arizona and the Red River of the South. The Kansas River and the Scioto River in central Ohio are also turbid.

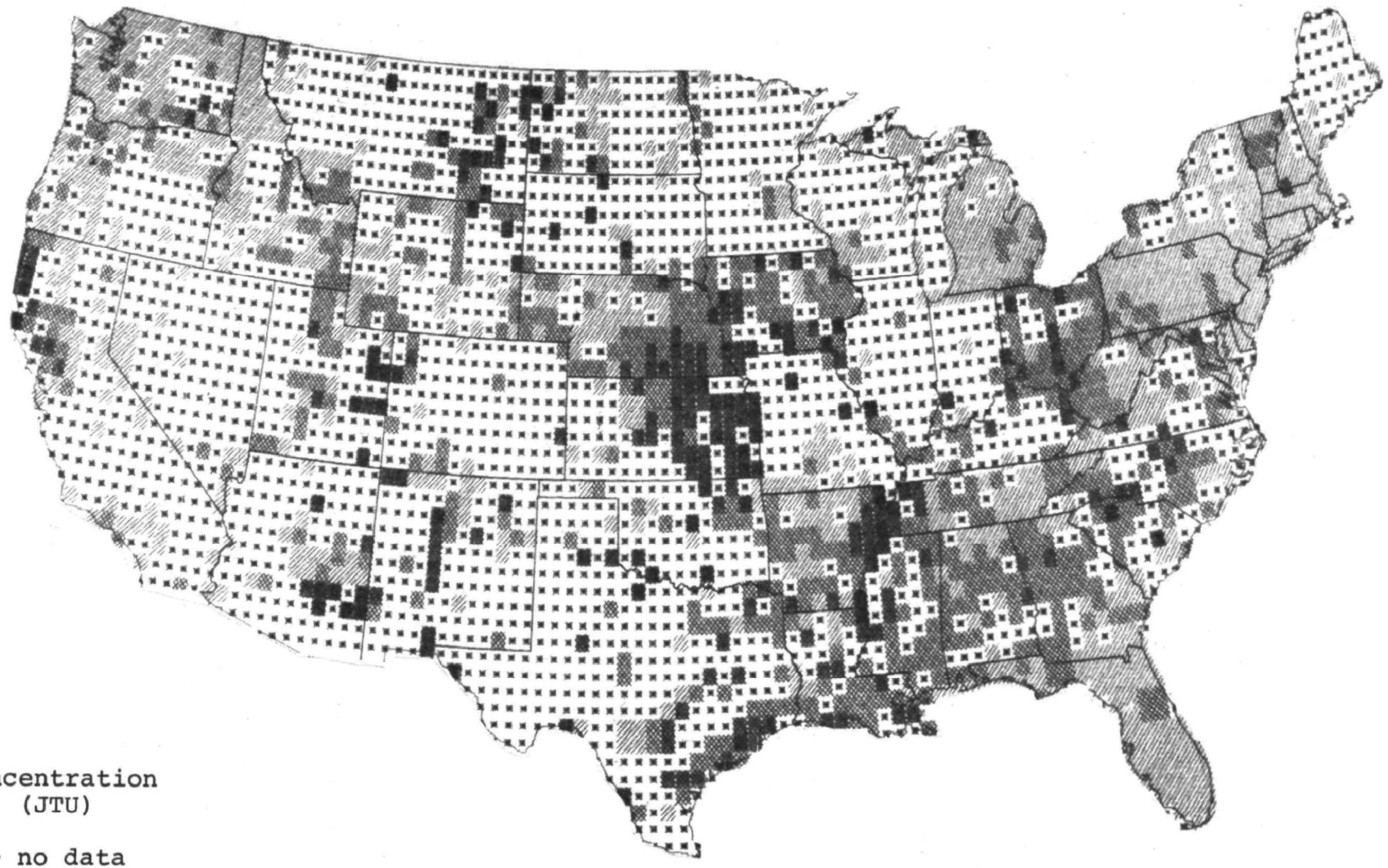
And so is the Arkansas. For decades silt had settled in the river as it ran its course through Oklahoma and Arkansas. Sediment came down from the arid regions of Oklahoma and Kansas, aggravated by the same farming practices that triggered the dust bowl in the Thirties.

And during the same period, salt became a major problem. Sodium chloride and gypsum draining down out of the natural salt flats and salt springs contributed more than half of

Figure 5

Environmental Protection Agency
STORET SYSTEM

Turbidity of Water, 1973-1975, 85th Percentile



Concentration
(JTU)

* -- no data
-- 0-25
-- 25-100
-- 100-200
-- greater than 200

Cells included are those for which data has been supplied to EPA. Cells are approximately 25 by 35 miles.

Source: Monitoring and Data Support Division, OWPS, EPA

the river's high salt content. Much of the rest came from the oil fields, where the quickest and cheapest way to get rid of the salt water pumped up with the oil was to dump it into the nearest river. The Arkansas got more than its share.

By 1955, the river was so heavily choked with silt that people were saying it was "too thick to pump and too thin to plow." In the summer the river often ran nearly dry. In the winter and spring it rampaged. The treacherous, unpredictable currents and raw sewage from over half a million people made swimming impossible and boating improbable.

The river was already in such a polluted condition from the salt and the silt, that the cities and industries rising on its banks simply wrote it off for any use except receiving wastes.

But the river was too important for that. Two-thirds of the land area of Oklahoma drained directly or indirectly into it. The people in its basin wouldn't let it go for a sewer. They began to pressure officials, and a combine of Federal, State, and local agencies, joined by the industries themselves, responded. The effort has saved the Arkansas.

With Federal financial help, the two biggest cities, Tulsa and Oklahoma City, have installed new wastewater treatment plants. Town after town along the river's course has either done the same, or soon will -- Webbers Falls, Wagoner, Sand Springs, El Reno, Stillwater, Norman, Okmulgee, Tahlequah, Miami, and Ponca City.

In Arkansas, Little Rock has built a new facility. North Little Rock, Fort Smith, Van Buren, Ozark, Clarksville, Dardanelle, and Morrilton, among others, are acting to lessen their contamination of the river.

Industry, under Public Law 92-500, is cleaning up its discharges. And the McClellan-Kerr Arkansas River Navigation project has made the river navigable from its mouth to the Port of Tulsa. The project stabilized the banks of the river with a series of locks and dams on the Arkansas itself and with dams for silt entrapment and flood control on the major tributaries.

The total amount of water coming down the river is unchanged. But the flow now is more evenly distributed. Likewise, the salt load is still high, but there is more water to dilute it during critical low flow periods. So the peak concentration is lower.

The tide of other forms of pollution has also turned in the Arkansas. The river's dissolved oxygen content is better and its bacterial count lower than ever before. And the fish are returning -- among them the sauger, a fish fastidious in its water quality requirements, and the big-mouth bass.

The entire length of the river now is suitable for a variety of water uses. Much of it, including the 50-mile reach upstream from Little Rock, is clean enough for swimming and water skiing. Below Little Rock, fecal coliform counts have plummeted -- from 15,094 organisms per 100 milliliters of water in 1972 to 184 in 1974. At another point below the city the count dropped from 29,738 in 1972 to 584 in 1974.

Officials in the two states are saying now that the Arkansas is now cleaner than it has ever been.

A Mountain River

In the mountains of western North Carolina in the 1950's another southern river, the French Broad, was being polluted by an unchecked flow of wastes from two major industries and a city.

The Olin Corporation, American Enka Company, and the City of Asheville had dumped raw sewage, suspended solids, and heavy metals into the river until the dissolved oxygen along its entire reach from Pisgah Forest to Asheville had, on occasion, dropped almost to zero.

Together those three sources, by the early Seventies, were dumping an average of 55,323 pounds of BOD, 61,977 pounds of suspended solids, and large quantities of metal precipitates and salts into the river every day. Many portions of the stream reeked with foul odors and ran black under a cover of foam. There was little life left in the water.

The EPA, together with the State of North Carolina, developed effluent limitations and compliance schedules to diminish the flow of wastes from the three major polluters. By September 1974, all three had been issued NPDES permits to control their waste discharges. Even before that, the EPA had given American Enka Company a demonstration grant to help build an innovative treatment facility to curb the zinc content of its effluent.

Both companies were receptive. They took the actions called for by the State and the EPA and were soon in compliance with their permit requirements. The Olin Corporation completed

a biological treatment plant in March 1976. American Enka Company is upgrading its present wastewater treatment plant and has changed production processes to reduce the levels of heavy metal in its discharge.

The city, however, had trouble living up to its permit requirements. Only after a meeting with the EPA in early 1976 did it begin to make satisfactory progress. Now it also is in compliance.

Already these steps are reflected in the condition of the river. The odors and the foam are gone and the water's natural color is returning. Dissolved oxygen levels have reached 60 to 70 percent of saturation and fish have started to reappear.

The Lower Escatawpa

The lower six miles of the Escatawpa River in Mississippi was one of the most grossly polluted estuaries in the Southeast.

A paper mill, an organic chemical plant, three fish meal processing plants, and the towns of Moss Point and Escatawpa were discharging inadequately treated wastewaters into the river. Low river flow in the summer months and poor natural flushing of the estuary were aggravating the condition. In 1964, the Mississippi Game and Fish Commission reported extensive fish kills. Fishery prospects on the river were judged nil.

The five industries and the Jackson County Board of Supervisors took some initial steps after the publication of the Commission's report. The International Paper Company installed primary treatment. Thiokol Chemical put in minimal treatment, and the three fishmeal companies started recycling their process wastewaters. Secondary treatment facilities were built to handle the municipal wastes from Moss Point and Escatawpa.

But still the river was polluted. The EPA in 1972 reported that the lower portion of the estuary registered zero dissolved oxygen. Sediment deposits were heavily contaminated and little life existed in the water.

Since then, the Jackson County Port Authority has built a secondary treatment system for International Paper Company wastes. Thiokol is injecting its concentrated wastes into deep wells, and all three fishmeal companies now have essentially closed wastewater systems.

Fish are returning to the estuary and the water quality in the critical summer months is notably improved.

The Lower Savannah

The Savannah River runs for 310 miles through the heart of the South on its way to the Atlantic. It is one of the main interstate waterways of the Southeast, forming the boundary between Georgia and South Carolina.

Citizens requested an interstate conference on the Savannah in the early 1960s. Many of them complained that the river's heavily urbanized and industrialized lower 22 miles had become a threat to the health of residents in the area. In 1963, an EPA predecessor agency within the Department of Health, Education and Welfare convened a conference with the water pollution control agencies of Georgia and South Carolina. It was decided there that HEW should study the problem.

HEW's study confirmed everyone's suspicions. Only one-fifth of all the sewage from a population of 146,000 people on the 22-mile reach received even primary treatment. The other four-fifths of the sewage ran directly into the river untreated. Industries on the lower Savannah discharged processed wastes, cooling water, and chemical wastes equivalent in impact to the raw sewage of an estimated 1,000,000 people.

Consequently, the dissolved oxygen content of the lower reach of the river was low. Game fish and commercial fish had become scarce and 11,000 acres of coastal waters in the Savannah area were closed to shellfishing. All the symptoms of an imperiled river were present.

As they have done on many rivers, the existing Federal agencies, and later the EPA, joined with the States to attack the problem. Making use of persuasion together with the limited enforcement authority available to them, they saw to it that adequate wastewater treatment facilities were built and put in operation. By 1975 all major dischargers of organic wastes into the lower Savannah were in compliance with their effluent limitations.

BOD discharges from point sources in the river have dropped by 90 percent. In 1975, for the first time on record, there were no reported dissolved oxygen violations at the Fort Jackson monitoring site. Aquatic life was quickening on the river reach once again and fish were swimming where they had not been seen in many years.

A ROLL CALL OF RIVERS

No list of polluted rivers on which some degree of clean-up has now been achieved can possibly be complete.

Under Public Law 92-500 every river must be brought back, so the attack is broad, reaching to every polluted stream in the country. And the role of the EPA varies from river to river. Because every river is different, the rate of progress and the degree of success already achieved on each varies considerably.

Some efforts, as we have seen, border on the spectacular. Other rivers improve only slowly, and some not at all. The quality on a few is still worsening somewhat. But as the cases above show, the progress, where it has occurred, is heartening, sometimes impressive. And the prospects for more improvement are good. For many streams, higher water quality depends only on the completion of projects now underway. On others, where municipal wastewater treatment plants are required, construction merely awaits the availabilty of Federal funding.

The EPA disburses the $18 billion earmarked by the Congress in P.L. 92-500 for the States and cities to use in building municipal treatment plants. The Federal share of such construction is 75 percent.

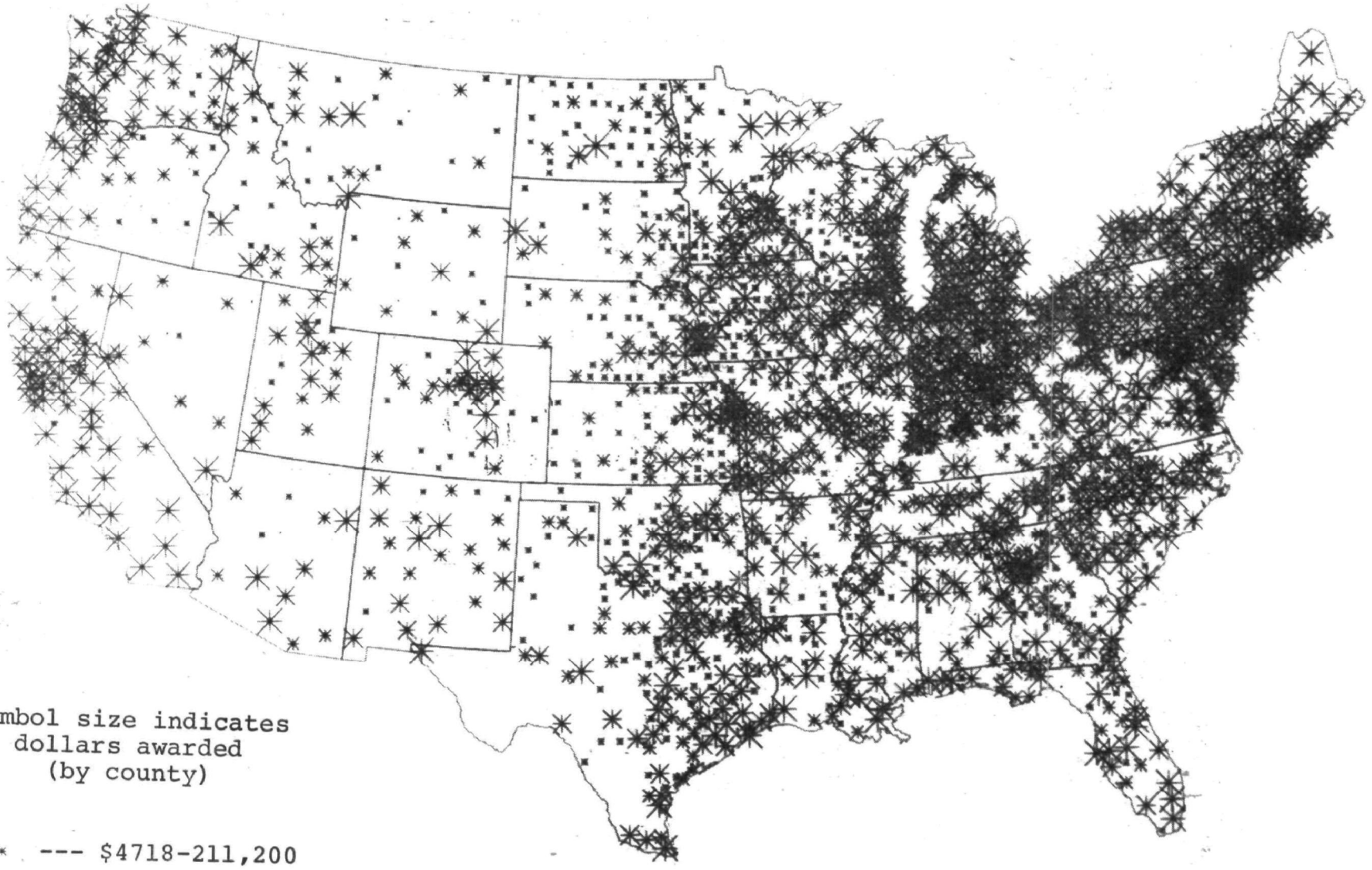
Figure 6 shows the dollar amounts awarded for construction nationwide, by county, since January 1970. Figure 7 shows the total dollars spent on treatment plants completed since then. The two maps show that the distribution of dollars compares well with the distribution of fecal coliform and DO problems (Figures 1 and 3), and also with the distribution of population.

Meanwhile, from rivers and streams all over the country, some famous, some little known, there come signs that as treatment plants are funded and built and as industries comply with discharge requirements, the quality of the water improves. Some examples:

- On the mighty Ohio, 891 miles long and touching six states, 97 percent of the sewered population is served by wastewater treatment of some kind. Nevertheless, 54 percent of this treatment is less than secondary and must be upgraded. The PCB's recently discovered in the river also require

Figure 6

GRANT DOLLARS AWARDED FOR CONSTRUCTION OF MUNICIPAL WASTEWATER TREATMENT WORKS, JANUARY 1,1970 - JUNE 30,1976



Symbol size indicates dollars awarded (by county)

* --- $4718-211,200

* --- $211,200-839,906

* --- $839,906-3,632,753

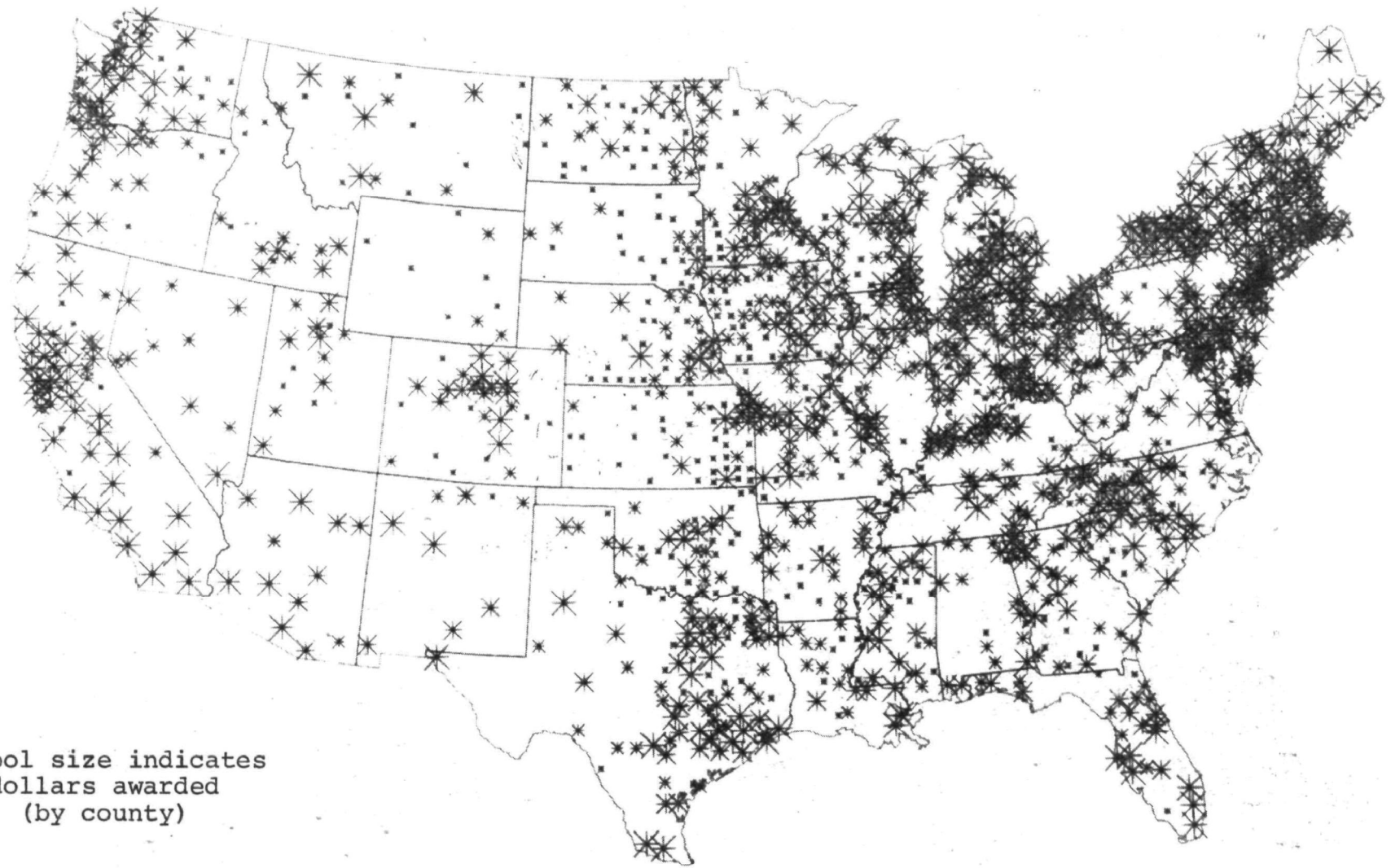
* --- $3,632,753-167,527,500

Total grant dollars awarded, by county. Counties in the Western STates are larger and fewer in number than are counties in the Eastern States. Symbols are located at county centroids, not at sites of treatment works.

Source: Grants Administration Division and Monitoring and Data Support Division, EPA

Figure 7

GRANT DOLLARS AWARDED FOR MUNICIPAL WASTEWATER TREATMENT WORKS COMPLETED IN THE PERIOD JANUARY 1,1970 - JUNE 30,1976



Symbol size indicates dollars awarded (by county)

- --- $4718-100,703
- --- $100,703-300,250
- --- $300,250-974,270
- --- $974,270-36,728,000

Grant dollars awarded, by county. Counties in the Western States are larger and fewer in number than are counties in the Eastern States. Symbols are located at county centroids, not at sites of treatment works.

Source: Grants Administration and Monitoring and Data Support Divisions, EPA

action. But the water quality has improved enough so that, in 1975, 100 successful bass tournaments could be held on the upper reaches of the Ohio in West Virginia. That would have been unthinkable five years before.

- West Virginia's heavily industrialized Kanawha River, though still far from clean, has had its dissolved oxygen content rise from below standards to acceptable levels. Fish and fish food organisms generally associated with cleaner water are beginning to return. Among the fish species sighted now in the river are crappies, spotted bass, white bass, and saugar.

- On the Neches River in southeast Texas, the bass are back after 15 years, and as one fisherman reports, they are "scrappy ones, and tasty, too."

- Tar Creek, a little prairie stream in northeastern Oklahoma, was once a water lifeline for buffalo. But it became heavily polluted in this century. Its cleanup is now underway and the long absent wildlife are beginning to return to its banks.

- Not far to the south, Oklahoma's Little Deep Fork, once a clear stream rolling down to Lake Eufaula, was also running dark and discolored by mid-century. A new treatment plant went on line in the town of Bristow last year and the waters of the stream are clear again and free of odor.

- Wisconsin's Maunesha River near Waterloo was heavily polluted in the mid-Sixties by wastes from a sauerkraut and pickle cannery, a cheese factory, a slaughter house, and from the town itself. Four miles of the river were without life of any kind. A treatment plant was built to handle wastes from all the dischargers. Now a balanced community including pollution-intolerant organisms once more lives in the river.

- Dry Auglaize Creek runs through Lebanon, Missouri and which empties into the Missouri River has been saved in its downward slide into pollution by a new EPA funded treatment plant, which went on line in April 1976.

- In 1970, the Mobile-Tombigbee River system in Alabama was contaminated by mercury and closed to commercial fishing. The flesh of many bass carried concentrations more than four times higher than the allowable limit in food for human consumption. Alabama and the EPA moved jointly against the contamination. The chloralkali plants in the area pared the quantities of mercury they were discharging. Mercury concentrations in fish and in the bottom sediments declined, and the ban on commercial fishing was lifted.

- Chester and Campbell Creeks in Anchorage, Alaska, in 1970 were posted for no swimming, no body contact, and no recreation. Only 8 percent of the sewage then flowing into the creeks was treated. And because of the high cost of building treatment plants in Alaska, nothing was being done. The EPA and the State of Alaska, in consort, funded a cleanup effort and the local communities began to act. Now, though the problem is still not fully solved, 78 percent of the waste is being treated. And the creeks are beginning to clear.

- Ten years ago the Calumet River in the heart of Chicago was little better than an oily open sewer where industry dumped its wastes. Pressed hard by the Illinois Environmental Protection Agency and the Federal EPA, the industries -- including four steel mills -- spent $100 million to clean the Calumet. A decade ago it was considered the dirtiest of the nine or 10 important streams in Cook County. Today it is rated by the State as the second cleanest.

THE GREAT LAKES

The five Great Lakes are the world's largest reservoir of fresh water -- 95,000 square miles. They were also a major setting for the American industrial revolution, that enormous outpouring of energy and people and power and production, which brought pollution to the lakes to match their size.

For more than a century the wastes poured in: raw and inadequately treated sewage and runoff from the cities; chemicals -- sulfates, chlorides, phenols, and ammonia; oil and heavy metals from industry and shipping; and pesticides, herbicides, and chemical fertilizers from agriculture.

Even so vast a reservoir of water as the Great Lakes can take only so much effluent. Lake Erie became overloaded with nutrients, largely from municipal wastes and rural runoff -- but also from industrial wastes and urban runoff. Much of its waters became clogged with decaying nuisance plants that used up the oxygen necessary to support other aquatic life, and the lake began to age prematurely.

Parts of Lakes Ontario and Michigan also became heavily polluted, Lakes Superior and Huron less so. In some parts of the hardest hit lakes, pollution exceeded levels considered safe for humans. It also jeopardized the continued existence of many native species of fish.

Most beaches on Lakes Erie, Michigan, and Ontario were closed. Many fish died. And some fish pulled from the lakes and its tributaries even today are still not considered safe to eat, because of the high levels of industrial, agricultural, and municipal discharges that they carry.

In 1972, the two Nations that share the Great Lakes -- the United States and Canada -- signed the Great Lakes Water Quality Agreement to continue jointly a long-term attack on the pollution.

In the most severely polluted lakes -- Erie, Ontario, and Michigan -- big problems still exist. But in the last few years, in the lakes and along some of their tributaries, the States, backed by the Federal Government, have pressed their part of the cleanup effort. The bulk of the job still lies ahead. But there are signs even now that point to progress.

Lake Erie -- The Beginnings of Comeback

A decade ago, Lake Erie, a 20,000 year-old inland sea, was held up as the most tragic case of pollution in the Nation.

From the beginning, Erie has been the shallowest of the Great Lakes. It was also farthest along in the natural process of eutrophication in which, over time, a young, clean body of water ages, taking on sediment and wastes and growing shallower until it first becomes a marsh or swamp, then a meadowy grassland, and finally a forested woodland.

In the early 1800's man began accelerating this natural process in Lake Erie, until by the middle of this century, he had telescoped it alarmingly.

First, the early farmers with their plows began stripping away the natural protective cover from the rich farmlands. Sediment began working down Erie's tributaries and piling up in the lake's already shallow western basin.

Then industry followed agriculture along the banks of the lake's main tributaries -- the Detroit, the Maumee, the Cuyahoga, and the Niagara. With industry came the booming big cities -- Cleveland, Detroit, Buffalo -- bursting along its shoreline. And into Erie came pouring the nutrients -- primarily nitrates and phosphates--that hurry the aging process.

The nitrate and phosphate pollution fed the algae blooms that began to lay down blankets of green slime across parts of the lake. And as the algae spread it consumed the oxygen needed to keep other forms of life alive. By 1966, 65 percent of the bottom water in the lake's central basin was without oxygen in the summer months. Beaches on the shores of the States that ring Lake Erie -- Michigan, Ohio, Pennsylvania, and New York -- were closed because of high bacteria counts from sewage discharges, or not used because of the algae in the water.

Before the EPA was formed, the deteriorating condition of the lake was already moving State agencies and private citizens to act. Gradually the concern of the middle and late Sixties began to be translated into money and programs. Then in the Seventies came the EPA, the joint Canada-U.S. campaign against pollution in all the lakes, and the tough

new amendments to the Federal Water Pollution Control Act. A major effort was launched jointly by the States, the EPA, industry, and private citizens.

Phosphate detergents were banned or limited in four states bordering the Great Lakes -- Indiana, Michigan, Minnesota, and New York. In the two-year span from 1972-73 phosphate treatment of wastewater was improved and the phosphorus load dumping into Lake Erie was reduced by about 46 million pounds. DDT use was curtailed, industrial pollution was reduced, and municipal sewage systems were improved.

Then came the first signs that conditions in the open waters of Lake Erie were improving -- or at least not worsening. Aircraft pilots began to notice that the sheets of shimmering green algae were receding. Clear water game fish planted in the lake survived. A few years before they would have died. Some beaches that had been closed for more than a decade began to reopen. And in 1975, only 6 percent of the deep water in the lake's central basin was reported without oxygen, instead of the 65 percent of 10 years before.

This does not mean that Lake Erie is no longer "aging." The natural processes still go on. And people are still contributing to it. Some dischargers continue to violate established requirements. But the headlong nutrient input that was hurrying the process appears to have been slowed. The cleanup effort is having some effect.

Lake Erie's waters are far from being the only ones experiencing severe nutrient problems. Indeed, with the increasingly successful control of other pollutants, nutrients remain, with toxics, one of the few classes of pollutants yet to be addressed satisfactorily nationwide.

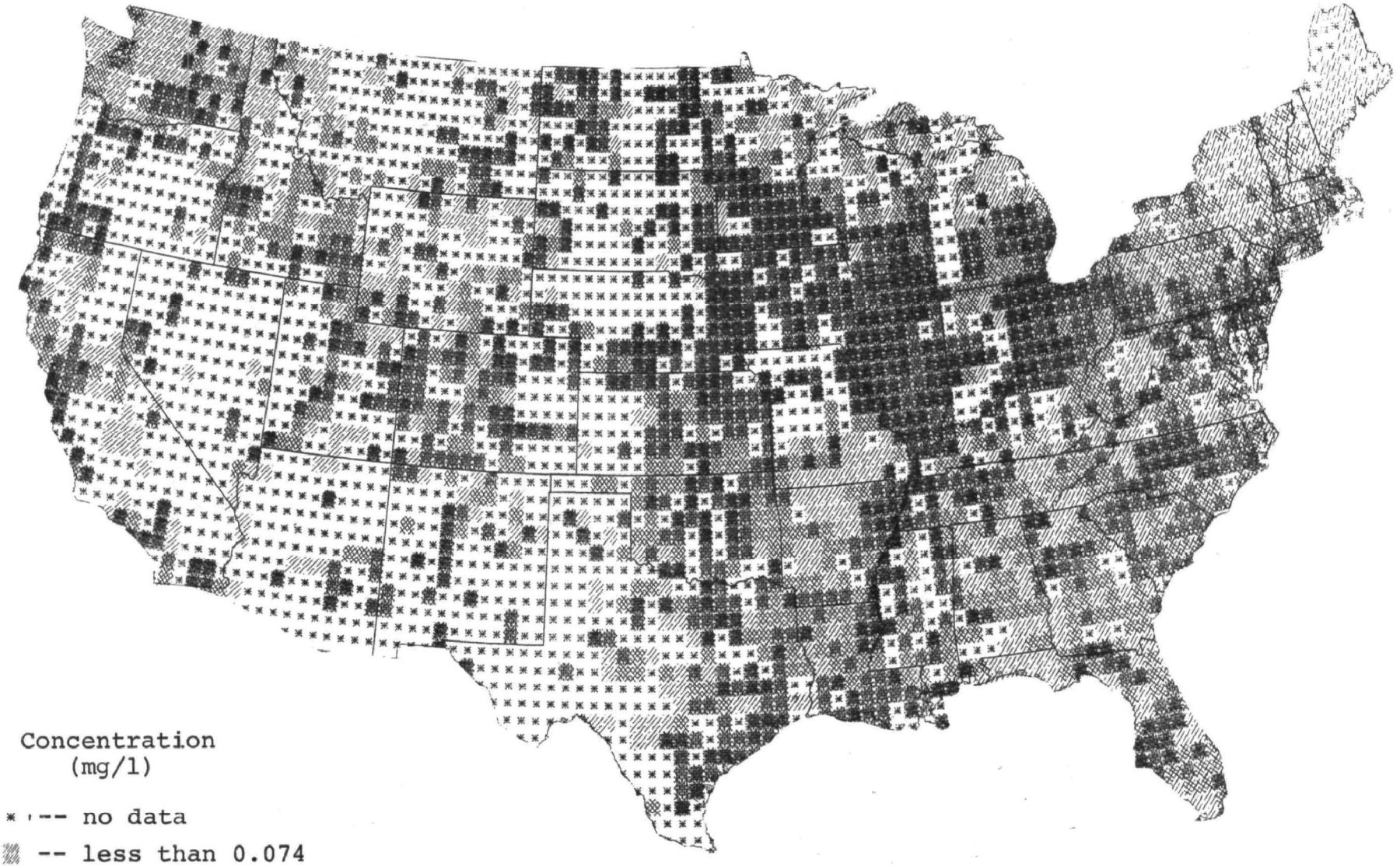
For there to be a nutrient problem in any given waters, two separate pollutants must be present in overabundance --- phosphorus and nitrogen, each in any one of its many forms. On any given stream or lake, nutrients are best controlled by limiting discharges of the specific pollutant in least supply. On Lake Erie, as we have seen, this meant control of phospohrus; elsewere nitrogen compounds -- nitrates especially -- are in least supply and control of nitrates is critical.

As Figure 8 indicates, phosphorus levels are now at reasonable levels in the Northeast, the Northwest and the

Figure 8

Environmental Protection Agency
STORET SYSTEM

Total Phosphorus in Water, 1973-1975, 85th Percentiles



Concentration
(mg/l)

-- no data
-- less than 0.074
-- 0.075-0.160
-- 0.161-0.379
-- greater than 0.379

Cells included are those for which data has been supplied to EPA. Cells are approximately 25 by 35 miles.

Source: Monitoring and Data Support Division, OWPS, EPA

Upper Great Lakes. Levels are still high in the Missouri River Basin and in Illinois and Ohio generally. The current low levels on much of the Great Lakes are due to control efforts over the last few years. (Figure 9). Little has been achieved elsewhere, and several major rivers -- the Ohio, the Mississippi and the Missouri -- show worsening conditions.

Lakes Michigan and Ontario

Progress on the other Great Lakes, as on Erie, is just beginning. The same degradation, the same outpouring of wastes from industry and agriculture, and raw sewage from the cities, has blighted the other lakes as well and require massive cleanup efforts.

Lake Ontario, next to Erie the hardest hit, also began showing the telltale signs of diminished oxygen content in its deeper waters. And there has been little progress against euthrophication in that lake since 1967.

Lake Michigan at its southernmost tip had neither the great depth nor the strong currents necessary to absorb and dilute the wastes flowing into it from the greater Chicago area. The lake's slow flushing time made it a virtual cul-de-sac for pollution. The new Chicago Sanitary and Ship Canal has diverted much of Chicago's pollution into the Mississippi River system, which, when required treatment is in place, will be better able to absorb it.

On both of those lakes there are the first faint signs of progress. Federal grants for municipal treatment of wastewater on the various tributaries, and the NPDES permits limiting industrial discharges have made inroads. The water quality is improving. Lake Michigan's shoreline had improved enough so that 11 beaches on the Illinois North Shore were able to reopen in 1975 for the first time in six years. Ontario Beach Park in Rochester, N.Y., reopened in 1976, after being officially closed for a decade.

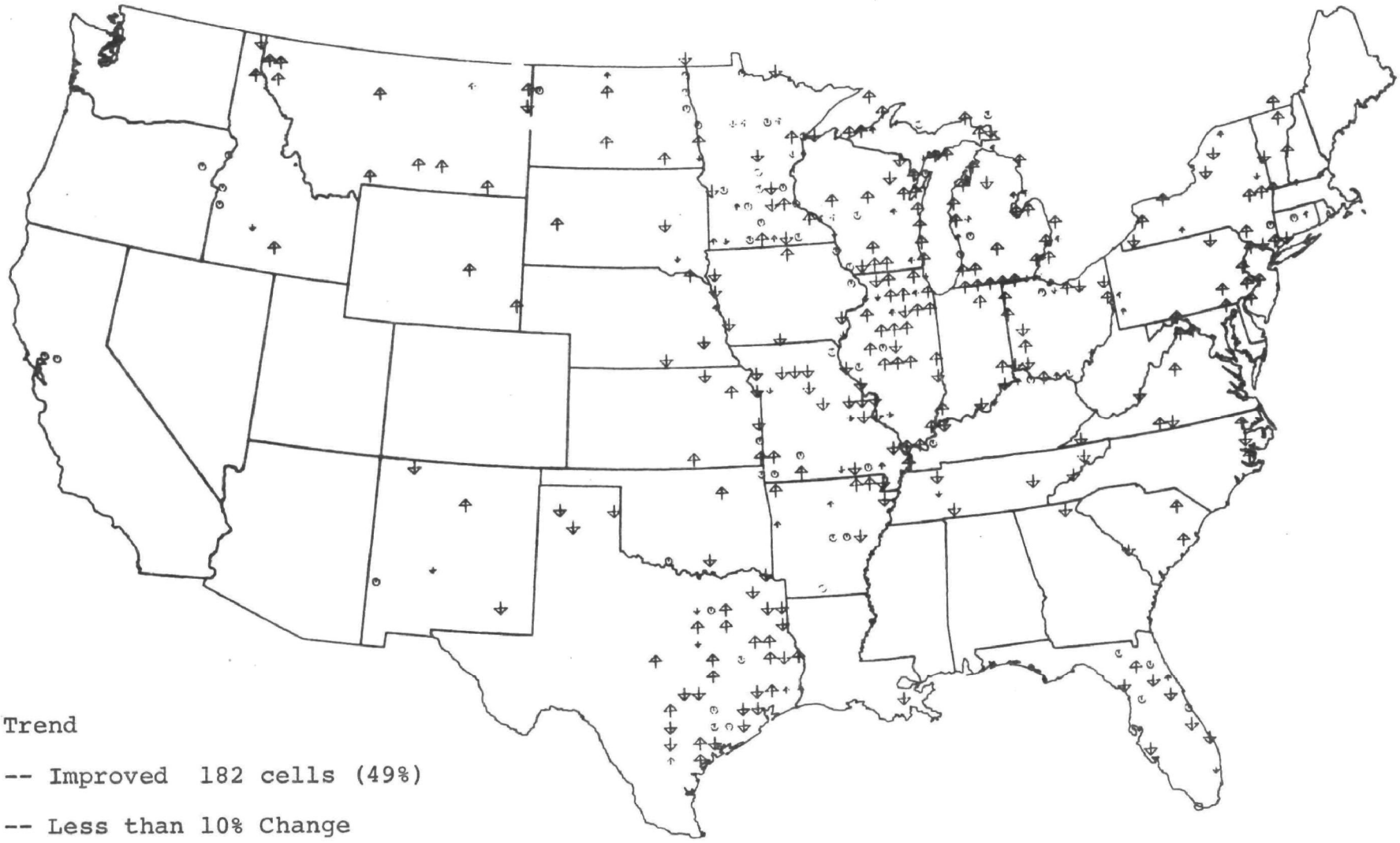
The Tributaries

The rivers that empty into the Great Lakes have played pivotal roles both in polluting the lakes and in the success so far in cleaning them up. Like the lakes themselves, the tributaries illustrate various degrees of accomplishment.

Figure 9

Environmental Protection Agency
STORET SYSTEM

Trends in Phosphorus, 1967-69 to 1973-75



Trend

↑ -- Improved 182 cells (49%)

o -- Less than 10% Change

↓ -- Worsened 129 cells (35%)

Small arrows (barely visible) indicate less improvement.

Source: Monitoring and Data Support Division, OWPS, EPA

The Cuyahoga

No river in the United States has a more notorious national reputation than the Cuyahoga, which flows through Akron and Cleveland on its way to Lake Erie.

The Cuyahoga, called "crooked waters" by the early Indians, was fed by pollution from the steel and chemical industries along its banks and by raw or inadequately treated municipal wastes. It was running muddy brown in color by the 1960's. Into it, from the industrial canyon along the last five miles of its course, poured 155 tons a day of chemicals, oil, iron, and acid wastes. Gas from decaying organic material fermenting along its bottom rose and burst into bubbles on its surface. It had a bacteria count -- particularly after a heavy rainfall -- matching that of raw sewage. It became known nationwide as the oil-slicked river that was so polluted that it had caught fire and burned.

The Cuyahoga has attracted considerable EPA attention and assistance. Since the beginning of the Seventies the Agency has issued grants for 17 municipal sewage treatment projects in the Cuyahoga Basin -- projects worth nearly $148 million.

The visible oil, which made the Cuyahoga a fire hazard, has nearly disappeared. In 1967, a reporter from the Chicago Tribune dunked his hand into the river and pulled it out coated with oil. Last year he dipped it in again and it came out oil-free. BOD, cyanide, and phenol levels are also down. A report by the Cleveland Utilities Department also reports a substantial drop in phosphorus (reduced 45-51 percent) and in various forms of nitrogen.

But dissolved oxygen levels, a prime measure of the health of a river, are still low. And some debris and sewage still float on its surface. An EPA study predicted that the lower Cuyahoga, even with the municipal and industrial treatment programs scheduled to be completed by 1978, will still have difficulty supporting anything but the most pollution-tolerant forms of aquatic life forms.

The Detroit

The main Erie tributary -- the Detroit River -- is being acclaimed nationally as a major, if still incomplete, cleanup success.

The fast-running 30-mile long river, which ties Lake St. Clair and the upper Great Lakes to Lake Erie, runs past the

City of Detroit. From the day the great French explorer, Cadillac, founded the city in 1701 until the Civil War, the Detroit River was admired as perhaps the most beautiful and pure in the Midwest.

In it sported the most delicate of freshwater fish -- trout, whitefish, muskellunge, smallmouth bass, perch, sturgeon, and the little emerald shiner, a bait fish susceptible to the slightest pollution.

But after the Civil War, in the tumult of the industrial revolution, the river became a vessel for the wastes of the industries and the cities that burgeoned on its banks. An appalling tide of effluents, sewage, chemicals, waste oils, acids, garbage, trash, and sludge from paper plants poured into the river.

By the late 1940's, the pollution had reached a zenith. Thirty-five thousand gallons of oil were being dumped every day into its waters. A quarter-inch thick coating of oil covered its shoreline. Grease balls eight and 10 inches across washed up on its banks. And tons of unseen phosphorus were being washed down the river into Lake Erie.

In the cold winter of 1948, in the most dramatic episode illustrating the extent of the river's deterioration, 20,000 ducks diving into openings in the ice came up oil-soaked and died. Massive duck kills, with as many as 40,000 dying a year, continued on into the Sixties.

The Detroit's most industrialized tributary, the River Rouge, flowed rich orange from the thousands of gallons of pickle liquor, a steel processing acid, that was dumped into it. But its surface was so coated with oil that the orange showed only momentarily in the wake of passing boats. A State of Michigan biologist once drew a bucketful of water from the Rouge, and in an hour and a half, acids had eaten away the bucket's bottom.

Environmental concern began to stir along the Detroit River for the first time in the 1920's. In 1929, Michigan passed its first basic water quality law. But it wasn't enough. In the early 1960's, the Lake Erie Cleanup Committee, an active and vocal citizen group, began to press hard for a full scale cleanup of the river.

In 1962, the first joint Federal-State conference on the Detroit convened and out of it came effluent limits for

its major industries and municipalities. When the 1972 amendments to the Federal Water Pollution Control Act were passed, the State of Michigan, supported by the EPA, began issuing permits limiting discharges into the water.

The City of Detroit in 1969 began building major additions to its enormous sewage treatment plant. By 1976, $345 million had been spent on the project. When the work is finished in the mid-1980's, $714 million will have been spent, $452 million of it in construction grants from the EPA. The 60 industries on the Detroit waterfront have already spent between $300 million and $400 million on new equipment to treat or recycle wastewater.

Today the oil that had been dumped for so long into the river is virtually gone. The 35,000 gallons a day in the 1940's were reduced to 3,600 gallons by the Sixties. Now it is down to 651 gallons. Chloride and phosphorus discharges have been cut in half since 1966.

In late 1975, Detroit Mayor Coleman A. Young led a fishing expedition out on the river. He droped his line in water that was once again blue-green in color. Fishermen looking down could see the boat's propeller four feet below and could remember when they couldn't see four inches. Some fishermen again are calling the Detroit River "the world's biggest trout stream."

There have been no major duck kills since 1968. Even the River Rouge, which ran orange and black with pickle liquor and oil only a decade ago, is flowing green again. And the egrets are returning to its banks.

The Grand

Three rivers that empty into Lake Michigan also stand as successes or partial successes in water pollution control. Of the three, two -- the Grand and the Kalamazoo -- run through Michigan. The third, the Fox, flows into the lake from Wisconsin.

In the mid 1960's, despite vigorous cleanup efforts by State and local agencies and several citizen groups, the Grand was still heavily polluted. In the summer as it made its way past the three biggest cities on its banks -- Jackson, Lansing, and Grand Rapids -- it gave off a strong and disagreeable odor. For 21 miles downstream of the Grand Rapids-Wyoming-Grandville municipal-industrial

complex, it had serious dissolved oxygen problems. Untreated sewage poured into it at Ionia. Grand Rapids had only primary treatment. The river ran brownish-green in color. In August 1966, thousands of minnows and carp were killed by cyanide that entered the river through storm drains. In October 1976, another kill wiped out 2,000 salmon, a substantial part of the season's run.

Weeds and other vegetation in the river complicated the problem. Tannery wastes and accidental spills from the metal-plating industries in Grand Rapids fouled its waters.

In the summer of 1968, the newly created Grand River Watershed Council joined the Michigan Water Resources Commission to address the crisis on the river. Plans were blueprinted to upgrade treatment to secondary levels basin-wide. Grand Rapids adopted an ordinance to control the discharges of its industries, including its more than 40 metal-plating companies.

In 1974, primary sewage treatment plants at Spring Lake and Grand Haven were replaced by a large complex providing secondary treatment. The town of Wyoming finished an activated sludge treatment system in 1976. Grandville had its secondary system on line by 1973. And by that same year, the amount of metals discharged by industry had dropped by 90 percent since 1966.

As those things happened, the fish began to return. Fishermen now come out in force to catch the salmon migrating to spawning grounds up river. By 1972 the Izaak Walton League was reporting a successful trout fishing contest, a certain sign that the Grand no longer ran as polluted as it once did.

The Kalamazoo

Not so many years ago, observers from the air said the Kalamazoo River, meandering westerly through southeastern Michigan, looked like a thick milk shake.

It had a reputation as Michigan's filthiest stream. In the 1940's, one of the largest fish kills on record hit the river. During the summers of 1950 and 1951 there was no measurable dissolved oxygen in the water over a section 10 to 20 miles below the city of Kalamazoo.

By 1951, an attack that had been mounted by the Michigan Water Resources Commission on the pollution of the Kalamazoo

River started to bear fruit. A primary treatment plant was built near the city of Kalamazoo. But that was only a beginning: a 1956 survey called for still further reductions in the waste loads being dumped into the river.

Paper mills were ordered to cut back their oxygen consuming discharges. And in 1963, the State, the City of Kalamazoo, five paper making companies, and a pharmaceutical company joined in a program of water pollution control. By 1967, a high rate activated sludge plant that treated both industrial and municipal wastes was built.

By the time the EPA entered the picture in the early 1970's, the oxygen-consuming wastes discharged into the river at the City of Kalamazoo had been cut by 75 percent. All the way from Battle Creek to Kalamazoo the water began to run clearer -- clean enough and with oxygen enough to support game fish.

However, Michigan officials in early 1976 discovered that the Kalamazoo River is the State's single largest source discharging PCB's into Lake Michigan. Coping with that problem and obtaining the advanced wastewater treatment now required for Kalamazoo and Battle Creek are the challenges ahead for the State and the EPA.

The Fox

The Fox is the largest river that flows into Lake Michigan. It originates in central Wisconsin and flows through Lake Winnebago and into the southernmost tip of Lake Michigan's Green Bay.

Before the turn of the century several paper mills were already operating on the Lower Fox downstream from Lake Winnebago. Today the Fox supports the heaviest concentration of paper manufacturing in the United States.

Eighteen paper mills and 11 municipal sewage systems were discharging into a 39 mile stretch of the lower Fox, and their discharges were devastating portions of the river. Until recent times it was one of the most polluted streams in America. Phosphates, ammonia, phenols, and other organic contaminants pouring into this big river had at times wiped out dissolved oxygen for distances exceeding 20 miles.

In its era of heaviest pollution, massive fish kills were a yearly disaster. As recently as 1974 a kill left dead fish strewn from one end of the river to the other.

In the past five years municipal and paper mill discharges of oxygen consuming wastes have been cut from 400,000 pounds of BOD a day to less than 100,000. The City of Green Bay has installed an innovative and effective wastewater treatment system. The portion of Green Bay hardest hit by diminished oxygen levels has shrunk from 150 square miles to 50. Bay Beach, a park and beach area near the mouth of the Fox at the City of Green Bay, had been closed in 1936 because of bacterial contamination. It was reopened in the summer of 1976 for the first time in 40 years.

The cleanup of the Fox River, however, is only beginning. Many industries have cooperated beyond what was expected of them. But others haven't. And the oxygen-depleting waste loads in the middle stretch of the river may have to be reduced 40 percent beyond the 1977 requirements because the loadings will still exceed the capacity of the river to absorb them. Most cities on the Fox have sewer systems that bypass the sewage treatment plants during heavy rainfalls. That sewage needs to be collected and treated. And PCB's that contaminate the river and southern Green Bay must still be brought under control.

Those are reminders that while the Fox is on the way back from overburdening pollution, it still has far to go.

The Indiana Tributaries

Another system of tributaries enters Lake Michigan from the Indiana side. At least three of those streams -- Trail Creek, Salt Creek, and the Grand Calumet River -- run cleaner than they did five years ago.

In the fall of 1972, many chinook salmon attempting to migrate up Trail and Salt Creeks were killed. The same thing happened again in 1973.

Investigators soon found that the stretch of Salt Creek downstream from the Valparaiso municipal wastewater treatment plant was critically degraded. At times migrating salmon simply could not survive the low concentrations of dissolved oxygen and the high concentrations of ammonia and

reach clear water above the town. The same situation held on Trail Creek downstream from where Michigan City's treated wastewater and combined sewer overflows were entering the water.

Both cities were issued NPDES permits and ordered to take the first steps toward installing advanced treatment systems. The Indiana Stream Pollution Control Board meanwhile started a systematic stop-gap upgrading program that employed various improved treatment techniques and emphasized better use of chemical additives.

During the 1975 migrating season, salmon moved unharmed up Salt Creek past Valparaiso. On Trail Creek the number of fish kills dropped sharply. But the final triumph lies ahead, when full scale advanced treatment becomes a reality on both of those Lake Michigan tributaries.

The Grand Calumet River, which flows via the Indiana Harbor Channel through Gary and Hammond and then into Lake Michigan, and which is in many ways the twin of the Calumet River in Chicago, was once considered "grossly polluted." Chemical pollution still persists and oily film can still be seen occasionally, but there are no longer the big chunks of grease and oil that floated in the water in the early Seventies. The Grand Calumet today is a much cleaner river.

A New Threat

To date, the joint efforts of the Great Lakes States, the Government of Canada, and the EPA, have centered on the pollution that everybody thought constituted the central problem -- the raw wastes from industry and the raw sewage from the cities.

But recently a new and perhaps more ominous threat -- that of toxic chemicals -- has begun to loom large, much of it from a new and unexpected source, the sky.

High levels of PCB's have been found in fish in Lakes Ontario, Huron, and Michigan. Mercury contamination of fish is a problem in the western basin of Lake Erie. PCB's, mercury, and high concentrations of asbestos fibers have been found in Lake Superior. Arsenic has appeared. DDT, while not the problem it once was, still persists. And even mirex, an insecticide used in the southern United States to kill fire ants, has been found in fish and bottom sediments in Lake Ontario. Mirex comes to the Lake in discharges from a chemical plant at Niagara Falls.

Some scientists now suggest that much of the Great Lakes pollution may not come directly from sources on the shore, but from the atmosphere. Particles of phosphorus, heavy metals, pesticides, and toxic industrial compounds from industrial processes and incinerators escape into the air and enter the lakes with the rain and snow, and as "dust."

Toxics, however they reach the Great Lakes, have become a pressing environmental challenge that must be met. The toxics problem there takes its place beside the lakes' still unresolved nutrient problem as one of the two most severe forms of pollution yet to be dealt with adequately.

BAYS, HARBORS, OCEANS AND LAKES

Of all waters, perhaps none are as vulnerable to pollution as those where the land meets the sea -- in the nation's bays, harbors and estuaries.

The home of the most delicate of marine ecosystems, many of them have been ravaged by pollution. But most of them are now on their way to eventual recovery. The Nation has clamped restrictions on ocean dumping. The EPA, the States, local governments, and citizen groups have again and again allied themselves into a force for cleanup. And their impact on pollution in those important waters has been felt. The cases that follow stand as reminders that improvement is possible --and is happening.

Escambia River Basin

In 1968, the Escambia River Basin on the Gulf Coast of Florida appeared to be polluted beyond hope of recovery. One local resident mourned the deterioration of this one-time haven for commercial fishermen, sun-worshipers, and sport-fishermen in this way:

> "Once my whole family enjoyed swimming in the clear water with sandy bottoms and sandy beaches where now you would wade in sludge. We caught in half an hour enough speckled trout for supper on the beach. Now there is no clean water to swim in. I cannot let my dog wade in the shallows because he develops a skin eruption. There are no oysters. There are no speckled trout in the area. After one of those fish kills..., about 25 egrets, little blue herons, and great blues were wiped out from eating these fish. It is rather heartbreaking to see the old lovely bay become a death trap."

By all signs, the 140 square mile estuary was in an advanced state of eutrophication. In Pensacola Bay, commercial shrimp landings were down 99 percent. The commercial oyster business had virtually ceased to exist and porpoises, once common, had disappeared.

Fish kills were rampant. Forty-one kills in Escambia Bay and 32 in Pensacola Bay and the adjoining bayous of the Santa Rosa Sound wiped out millions of fish. The biggest kill, in September 1971, had to be measured in square miles of dead fish. And the gulf menhaden, a small commercial fish, was hardest hit of all.

The principal polluters were the industries that had mushroomed in the basin since the 1950's and were dumping millions of gallons of untreated or virtually untreated wastewater into the river and its bays. BOD loadings from fertilizer production wastes, alcohol, ammonia, polyvinyl chloride, and nylon fibers were strangling the marine ecosystem.

Effluent from a Pensacola sewage plant was being discharged after inadequate treatment. Sewage from neighboring Alabama and Florida municipalities travelled down the Conecuh-Escambia River into the bay. The eventual build-up of organic as well as, nitrogenous and phosphorus wastes became intolerable.

Heated water from a major manufacturer and a power company added to the problem. Temperature increases in the Escambia River surpassed limits recommended by EPA's National Technical Advisory Committee -- a 4 degree (F) increase from September through May and 1.5 degrees from June through August. Hot water discharges by the manufacturer and the power company had raised the surface temperatures of the Escambia River by increments of 18.5 degrees and 12.25 degrees, respectively, immediately below their outfalls.

Pollutants are not easily flushed from Escambia Bay. Shallow areas and topographic features limit a free interchange between the estuarine waters and the gulf. Consequently, extensive sludge deposits developed. The L&N (Louisville and Nashville) Railroad bridge bisecting Escambia Bay further restricted flow. When bridge pilings needed replacement the railroad installed new ones without removing the old ones. A virtually impenetrable barrier was eventually built across Escambia Bay.

By the late 1960's the situation had become urgent. In December 1969, Florida Governor Claude Kirk called on an EPA predecessor agency in the U.S. Department of the Interior for help. A conference, convened in January 1970, drew up a blueprint for action.

The plan called for a 94 percent reduction of organic and nitrogenous waste discharges into the basin, a 90 percent reduction in phosphorus discharges, immediate removal of all settleable solid wastes, reconstruction of the L&N railway bridge by January 1973, and the eventual goal of zero discharge of pollutants into the bays.

At Florida's request, EPA established an Escambia River Recovery Study in 1972. It was to monitor and assist in enforcing standards set by Florida, Alabama, and the Federal Government, and to investigate other ways to accelerate recovery in the bays. The City of Pensacola was awarded an EPA construction grant for an advanced sewage treatment plant.

The impact of these actions has been substantial. Since 1969 industries and municipalities have drastically reduced waste discharges. In the five year period between September 1969 and January 1974, BOD discharges have fallen by 57 percent, nitrogen discharges by 73 percent, and phosphorus discharges by 92 percent. By January 1977, when all dischargers must meet effluent limitations, BOD, nitrogen, and phosphorous should be reduced by at least 88, 88, and 89, percent respectively.

Today, thanks to State, private, and Federal cooperation, the water is clearing. Fish kills are down more than 75 percent since 1970. Shrimp, oysters, and menhaden are returning. In April 1975, more than a million striped bass were released in the Escambia River Delta. Authorities expect that more than half the fish will survive. Of those that do not, more will be eaten by other fish than will die because of polluted water.

The Escambia, Pensacola, and East Bays had recovered enough by July 1, 1975, for the EPA to terminate its recovery study. The Escambia estuary system may never recover to its original state, but it is clearly an example of what can be accomplished when private citizens, the State, and the Federal Government work together.

Gulf of Mexico

The Gulf of Mexico ranks fifth in size among the seas of the world -- 582,100 square miles. It has served as a long-time shipping port and as an invaluable source of seafood.

During the last few decades, a quickening tourist trade and a myriad of corporations such as DuPont, Shell Chemical, GAF, and Ethyl Corporation have added new dimensions to the area's economy. However, as the economy boomed, the gulf's fragile marine ecosystem began to run the serious risk of becoming a dead sea -- a dumping ground for toxic wastes.

There is scant documentation on the volume of industrial wastes discharged into the gulf before the Marine Protection and Sactuaries Act was passed in 1973. However, the Council on Environmental Quality reported in 1970 that 696,000 tons of industrial wastes were believed to have been dumped in 1968 alone. And, while the number of companies and the types of wastes involved are unknown, the EPA believes that the volume of ocean dumping between 1968 and 1973 more than doubled and could have reached a high of 2,000,000 tons a year. It is known that wastes were dumped as close to shore as 10 miles, and, in some cases, very near to or on top of several unique and valuable coral reefs in the northwestern gulf.

In 1971, several drums of toxic wastes were washed near shore and were caught in the trawls of commercial shrimpers. The EPA's Region VI and the State of Texas launched investigations. The need for stringent controls became evident. Partially decomposed wastes from the U.S. and Mexico were being washed about in the gulf and were often deposited on shore. So the EPA, under the authority of the Marine Protection and Sanctuaries Act, issued the following regulations:

- Ocean Dumping was to cease or be strictly regulated until companies and municipalities could build adequate treatment or disposal facilities;
- Ocean disposal of toxics was to stop as soon as possible;
- Industrial polluters were to cut ocean dumping by 80 percent; and
- Inspection and chemical analyses of wastes would be required before barges departed to offshore dumping sites.

Those and other regulations have brought substantial progress. In just two years, the EPA and industry have reduced dumping in the gulf by more than 90 percent. A comparison the amount of ocean dumping in 1973, 1974, and 1975 follows:

Company	Place	1973 Year Tons	1974 Tons	1975 Tons
DuPont	La Place, La.	250	0	0
	La Porte, Tx.	540,000	268,000	38,400
	Beaumont, Tx.	480,000	307,000	0
	Belle, W. Va.	90,000	90,000	0

Company	Place	1973 Year Tons	1974 Tons	1975 Tons
Shell Chemical	Deer Park, Tx.	81,000	66,000	100,000*
GAF Corp.	Texas City, Tx.	216,000	216,000	0
Ethyl Corp.	Baton Range, La.	1,680	1,680	1,680
		1,408,930	948,680	140,080

*Sludge only

Levels in 1976 are expected to fall to approximately 127,000 tons

Virtually all toxics have been eliminated. Only non-toxic sodium- and calcium-bearing sludge and biological sludge remain. In order to achieve these reductions, all dischargers into the gulf have had to develop alternative methods to dispose of toxics and sludge. One alternative currently being used experimentally is ocean incineration. In 1974 and 1975, Shell Chemical burned chlorinated hydrocarbon at sea under two research permits and two interim permits. Monitoring conducted aboard the vessel and in the surrounding air revealed a 99.9 percent destruction of chlorinated hydrocarbons, with no detectible air or marine pollution. It was not conclusively proved, however, that oxidation was complete and that all of the products of the burn were less dangerous than the original waste material itself. For this reason, in October 1976, Shell was issued a special three-year permit to continue its testing of ocean incineration. The company, however, must still meet certain ocean dumping criteria.

Central to all the efforts to keep the gulf as free from pollution as possible was a vigorous public demand that it be protected. The gulf has clearly profited from this strong public attention.

Delaware Coast

Just as the Marine Protection and Sanctuaries Act halted toxic dumping in the Gulf of Mexico, it also forced action on the Delaware Coast.

In 1971, the Food and Drug Administration, fearing that commercial shellfish harvesting areas off the coast might become contaminated, ordered them closed as a precautionary measure.

After the Marine Sanctuaries and Protection Act passed the Congress in 1973, the EPA ordered the two cities most heavily involved -- Camden, N.J., and Philadelphia, Pa. -- to move their sewage sludge dumping sites 40 miles offshore. They had been dumping only 12 miles out, where the combination of shallow depths and ocean currents brought the sludge back toward the shore.

Lowered pollution levels due to the relocation of the dumping sites made possible the reopening of the shellfish harvesting areas in January 1975. The next step is to halt dumping altogether. Camden is now under an EPA order to stop all its ocean dumping by 1979, and Philadelphia by 1981. To help them meet those deadlines, the EPA is fostering development of ways to make use of the sludge generated in the waste treatment processes. Camden is working on composting processes that could end its ocean dumping earlier -- within 18 months.

Kodiak Harbor

Foul odors hung particularly heavy over Kodiak, Alaska, during the warm August of 1971. And this wasn't new. Since 1967 the citizens of Kodiak had complained of strong smells in the air over the town and its small boat harbor.

Ironically, the source of these acrid odors was also the economic backbone of the community. The 15 seafood processing plants operating in Kodiak Harbor and Gibson Cove processed over 110 million pounds of shrimp, salmon, crab, scallops, clams, halibut, and herring every year.

But untreated wastes from the canneries were polluting the harbor. In 1971, an estimated 72 million pounds of untreated waste solids, including decomposed fish and shellfish, were dumped under the docks and into the inner harbor. Dissolved oxygen levels fell as low as 1.3 milligrams-per-liter, well below the levels required for a healthy marine community. The normal range of DO levels for those waters is 9 to 14 milligrams-per-liter.

Dumping reached such staggering proportions that 50 acres of harbor bottom were "matted" over with a black, foul-smelling sludge. The toxic and noxious hydrogen sulfide gases given off by the decomposition of the sludge bubbled to the water's surface. Floating wastes contributed to the aesthetic degradation and the water grew murky.

In 1969, after two years of citizen protests, the Federal Water Pollution Control Administration, an EPA predecessor agency, issued a study showing DO levels in Kodiak Harbor to be abnormally low. Water quality continued to decline, and the EPA called an enforcement conference in September 1972. One month later, Congress adopted Public Law 92-500, and in 1973 the EPA issued its first NPDES permits to the canneries requiring that the quantities of solid waste discharged into Kodiak Harbor and Gibson Cove be substantially reduced.

Processors began to install appropriate equipment. One company built a facility to convert solid seafood waste into a dry packaged protein meal for export as animal feed.

Water quality began to improve. A 1974 EPA study showed significant reductions in the amount of sludge and hydrogen sulfide gas in the harbor. While DO levels rose, they were not yet high enough in 1974 to meet Alaska's water quality standards for marine life protection. Sludge beds persisted in near-shore areas where water circulation was poor. Permits were revised in 1975 to require relocation of wastewater discharge sites away from existing sludge beds to zones where water conditions were better. When permit requirements are met in 1977, Kodiak Harbor should meet water quality standards.

But even now, the seafood processors have drastically reduced the solid waste pollution in the harbor. Mounds of waste no longer rot on the harbor floor as they did five years ago, and escaping gas no longer bubbles to the Harbor's surface. The citizen protests are paying off.

Pearl Harbor

In 1969, Pearl Harbor, one of the nation's most beautiful and renowned harbors was suffering from high volumes of pollution discharge. More than 7 million gallons of raw and primary-treated sewage poured into it every day.

Since World War II, the harbor had been closed to the public, partly for security reasons and partly because it was so heavily polluted.

Spreading over nine square miles of the island of Oahu, Pearl Harbor is a combination of three locks or embayments, originally drowned river valleys that have been modified over the course of time. Its waters had fallen prey to sewage, sediment, and debris; nearby open burning dumps also contributed leachates. The harbor's oyster beds had been covered with human sewage and municipal refuse. Wastes from power plants, from sugar processing, from burning dumps, and from naval operations added to the bacterial build-up, nutrient loadings, sediment, and debris.

A 1970 Executive Order required all Federal facilities to meet environmental standards, and the Navy gave priority to Pearl Harbor. In concert with the Army and the Air Force, the Navy moved quickly to control many of its waste problems. A sewage treatment plant was completed in 1971.

In September of that year, EPA called an enforcement conference to review the harbor's municipal and industrial discharge problems. NPDES permits and Federal grants for sewage treatment plant construction mandated by Public Law 92-500 were brought to bear. To win public support for the cleanup program, the Navy opened the harbor. By 1976, conditions had improved. The open burning dumps were closed. Sewage discharges were controlled and a regional sewer system to remove discharges from critical harbor areas was under construction.

While conditions are improved, much is still to be done. As is often true in clean-up situations, early efforts brought dramatic change, and later progress has been slower. But further progress is still being made. The public can now safely swim, boat, and fish in much of the harbor.

Charleston Harbor

Charleston Harbor in South Carolina, as famous for the sound of shot and shell as Pearl Harbor, is also experiencing remarkable environment improvement.

For many years the old harbor, where so much history has been written, had suffered from heavy pollution. Before 1970, discharges of raw sewage added 30,000 pounds of BOD loadings a day to the waters. Fish kills were common. Boaters, water skiers, and fishermen found conditions in the harbor steadily deteriorating. Scum and a film of oil often covered portions of its surface.

Revitalizing the harbor has cost in excess of $37 million. The EPA has contributed $12 million of that total. Virtually all of Charleston's raw sewage had been discharged by outfall pipes running across the tidal flats. Today the pipes have been plugged, and sewage is collected in tunnels deep beneath the city and the harbor floor, then piped to the Plum Island Sewage Treatment Plant. Sewage from North Charleston and the U.S. naval base is treated in an even larger plant. And there are new facilities at St. Andrews, at Mt. Pleasant, and at Sullivan's Island.

Fishermen, boaters, and skiers now find the water free of scum and oil, and less murky. Fishing is improved: flounder, trout, bluefish, jack, and even mackeral and cobia are being caught in increasing numbers. Shrimp are also returning to formerly polluted areas. Daily levels of BOD

discharge have been pared by nearly 50 percent -- to about 17,000 pounds. Eventually they will be cut to about 4,500 pounds.

Conditions in Charleston Harbor might be worse today had it not been for some late 19th century foresight. In 1895-96 the city's sewage commissioners started planning an innovative system of separated wastewater and stormwater sewers. The brick and masonary structures they built are still in use today. This foresight saved the old city from the sewer separation problems now plaguing many of the Nation's older cities.

However, the ancient sewers are causing another problem. Old age has set in. The system is leaky and it lets in the sea water. At high tide the flow to the treatment plant often is triple that at low tide. That means the sewer is presently acting much like a sieve. Since most of the sewers are in the older section of the historical district, they will be difficult and costly to replace.

However, the city now has an EPA grant to correct such infiltration-inflow problems and to build a secondary municipal treatment plant. Meanwhile, most of the industrial wastes now receive the equivalent of secondary treatment or better.

Two Western Harbors

Two harbors, both in Washington State, are also cleaner today than they were two decades ago.

One of them, Port Angeles Harbor, is a beautiful bay on the Straits of Juan de Fuca. This harbor historically had supported an abundant and varied marine life, with large populations of clams, shrimp, bottom fish, and crabs. Migrating salmon also ran in the harbor.

By the 1950's, however, industrial development in the area had severely degraded the harbor's waters.

Three pulp and paper mills contributed heavily to the economy of the area but they also discharged large quantities of wastes directly into the harbor. The natural flow patterns prevented adequate flushing of the wastes. The waters became toxic to some marine life, oxygen levels fell below acceptable minimums, and large cellulose fiber sludge deposits covered much of the bottom. The harbor was no longer a suitable habitat for the various species of fish and shellfish that had long lived there.

During the 1960's, the State of Washington and the Federal Government initiated regulatory actions to eliminate the pollution problems. These actions were stengthened by the formation of the EPA and passage of P.L. 92-500.

One of the pulp mills was shut down for economic reasons. And since 1970, the remaining two mills have substantially reduced waste discharges going into the harbor. The mills are not yet in compliance with final treatment requirements and in fact are strongly opposing them. But the benefits of the waste reductions achieved to date are becoming evident. Water clarity in the harbor has improved and fish and shrimp are returning. A strong trend to higher water quality is evident. The next few years should see the harbor regain much of its former value as an important marine resource.

Water Quality in Grays Harbor, to the south of Port Angeles, directly reflects the contributions from its upstream tributaries and industries. And unlike many other estuarine systems, Grays Harbor is greatly affected by both point and nonpoint sources.

Wastes from the wood products industry are the single most important factor in the water quality of the area. Besides the large quantities of wastewater discharged from the local pulp mills, the waters are also influenced by runoff from woodwaste landfills, by log storage wastes, and by erosion resulting from poor forest management practices.

Bacterial contamination in Grays Harbor is caused in part by inadequately treated sewage from four major upstream treatment plants. Raw sewage overflows and discharges are common during periods of heavy rainfall. These, together with pulp mill wastes that are held for high flow releases, join the other contaminants entering the river and the harbor.

Point source discharges from local fish and shellfish processors also pollute the harbor. Lumber companies and cranberry processors add to the problem. And there is the seasonal influence from ocean upwelling, from the input of the Chehalis River system, and from agricultural wastes and septic tank leachate.

In years past, pulp mill wastes helped lower dissolved oxygen concentrations to the point that migrating salmon could not pass through to their spawning grounds. Recent pollution controls, however, have nearly doubled the dissolved oxygen concentrations, and salmon once again can safely pass.

A comprehensive program to reduce point source pollution, including plans to upgrade the area's sewage treatment, is now underway at Grays Harbor. A nonpoint source abatement program will also be necessary, and is under development.

Two Northern Lakes

A pair of high and beautiful northern lakes, one in Maine and one in Minnesota, both of which have become severely polluted, have also started back on their way to recovery.

Prior to 1972, the Annabessacook in Maine was a notoriously polluted lake. Algae blooms lasted 70 days a year, and it was rare to look into the lake and be able to see more than three feet beneath its surface.

The trouble at Annabessacook was easily traced. The lake had been the long-time victim of four major polluters -- the towns of Winthrop and Monmouth, the Carleton Woolen Mills, and Globe Albany, a wool finishing plant. These four polluters together dumped more than 30,000 pounds of virtually untreated wastes into the lake each year.

Both Winthrop and the Carleton Woolen Mills had wastewater treatment. However, Winthrop's antiquated sewage treatment system was inadequate and the Woolen Mills facility was only marginally efficient. Even worse, Monmouth had no existing municipal wastewater plant at all, and Globe Albany discharged its wastes entirely untreated.

In 1968, Maine's Department of Environmental Protection classified Annabessacook as one of the four most severely polluted lakes in the State. Conditions had deteriorated to the point where action was essential.

Several possible solutions were investigated for cost as well as for environmental effectiveness. And after much deliberation a direction that had initially been considered bizarre and unworkable was selected. It called for the cooperative efforts of the cities of Monmouth, Winthrop, Manchester, Hallowell, and Augusta. The wastes from all five were to be collected and transported to a proposed secondary wastewater treatment facility in Augusta, treated, and then discharged into the Kennebec River. The political, institutional, financial, and legal problems of negotiating with five communities and their associated industries at first seemed formidable. But the plan proved to be the least costly and the most environmentally sound. So it was adopted.

In 1971, the Winthrop to Augusta interceptor was completed. Since then the improvements in the quality of the Annabessacook's waters have been striking. Phosphorus levels are down by 80 percent and nitrate levels by 44 percent.

It is possible to see nine feet down into the lake instead of three, and algae blooms now last no more than 15 days a year.

Now that the Monmouth to Winthrop to Augusta interceptor has been finished, there is every reason to believe that Annabessacook's restoration is assured. But the story does not end there. The Augusta-Cabbessee regional agency is now making plans to preserve the lake's entire watershed. Controls on growth and development are expected permanently to insure Annabessacook Lake's environmental integrity.

Perhaps none of Minnesota's 10,000 lakes is more celebrated than Lake Minnetonka. It was the "Shining Big-Sea Water" of Longfellow's Hiawatha. It was also a victim of 20th century urban development.

Minnetonka, 15 miles west of Minneapolis, is the State's 10th largest lake. It is a series of bays, points, and islands with 31 interconnecting channels covering 14,310 acres, with 110 miles of shoreline. Its waters are favored by small-craft sailors and its northern pike, bluegill, walleye, and largemouth bass attract hundreds of fishermen. Aside from its 60 marinas and private and public launch sites, the area contains many picnic areas, parks, golf courses, schools, and resort hotels.

By the early 1960's, however, the lake's quality had become unacceptable to sportsmen. Green scum and weeds were abundant. Several fish kills had occurred. Many species of bottom organisms important in the food web -- snails among them -- had disappeared.

A few decades before, many lake homes had used on-site septic tanks for sewage treatment. And often during high water levels some tanks overflowed and contaminated the lake. To deal with this recurring problem, seven of the lake's local municipalities built secondary treatment plants in the mid-1950's. For the next decade, plants dumped their treated effluent into the lake without apparent ill effect. But by 1963, the abundance of nitrates and phosphates had caused severe euthrophication. Weeds and algae grew and consumed the dissolved oxygen so necessary to fish life.

Despite Minnetonka's nutrient problem, adjacent Minnehaha Creek, because of its swift-moving waters, did not become severely polluted. But there were other complications. Spring floods were a common threat and in late summer and early fall the creek often dried up.

With 12 separate municipalities around the lake and six along Minnehaha Creek, no single one of them on its own would have been able to clean up and control the pollution. Consequently, a watershed district of 27 municipalities, 4 townships, and 2 counties was formed. Pollution and flood problems were studied, and population projections and hydrological and engineering studies were performed to help develop an overall water management plan.

A water flow control plan evolved and a dam was built a half mile downstream from the point where Minnehaha Creek joins the lake. Flood-plain zoning was adopted in order to curb unwanted development, and the Minnehaha Creek Watershed District endorsed a Metropolitan Sewer Board plan to divert all sewage effluents away from Minnetonka to the Minnesota River, which could better handle the flow. The diversion plan called for abandoning the seven secondary waste treatment plants and diverting sewage to the Blue Lakes central treatment plant.

The effluents were diverted in 1971-72. Today nutrient levels are dropping and surface algae are disappearing. Lake Minnetonka and adjoining Minnehaha Creek are gradually recovering.

Lake Minnetonka and Minnehaha Creek serve an example of those areas with nutrient problems where nitrates as well as phosphorus must be controlled. A more common situation with regard to nutrient is that in which nitrate levels alone are critical.

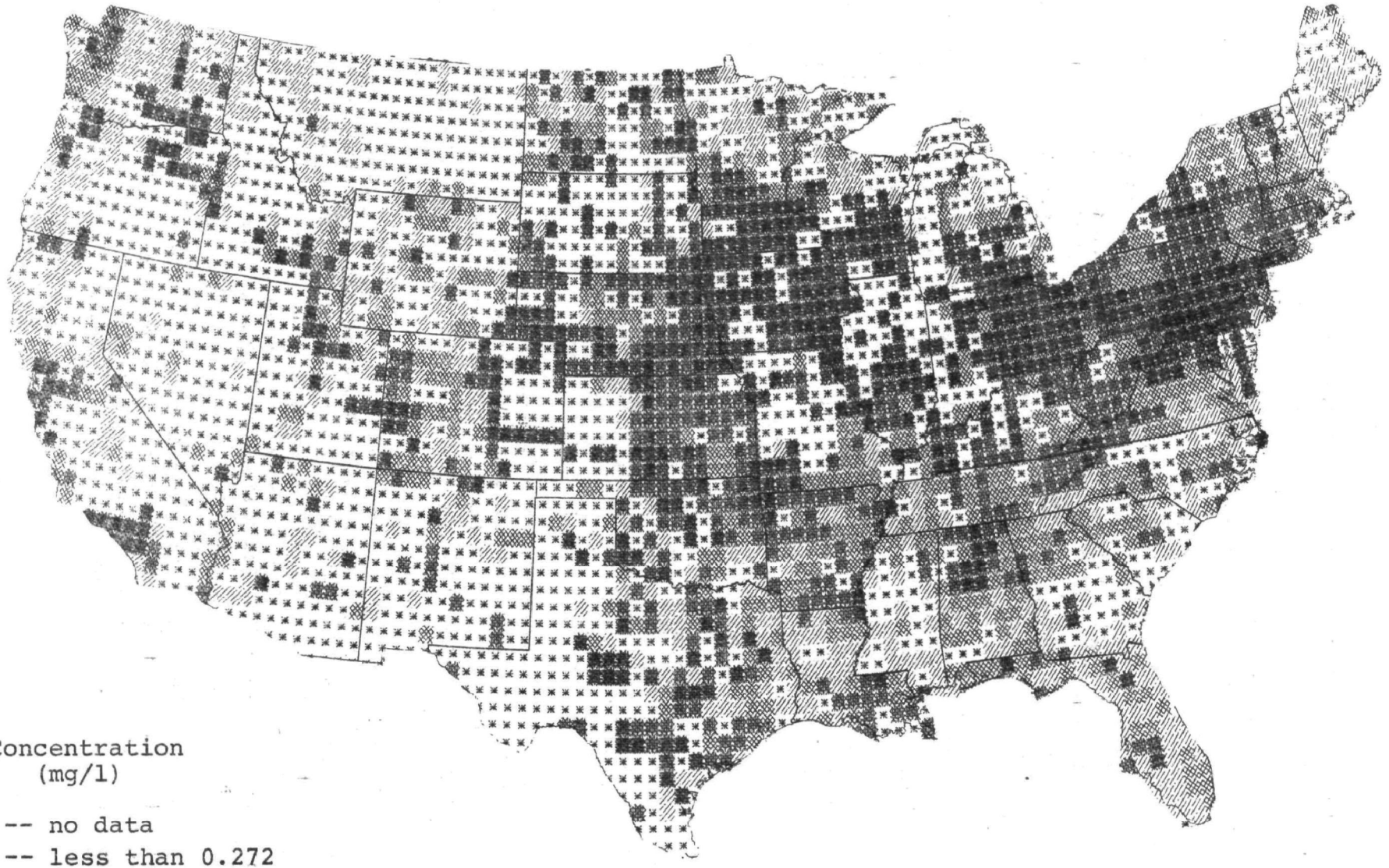
Figure 10 reveals that there are high nitrate levels on the lower Missouri, the middle Mississippi and the entire Ohio River. High levels are also found in such areas as the Northeast Coast, Northern Alabama and on the Willamette and Snake Rivers in the Northwest. Low levels are common on the upper Great Lakes in northern New England and in most of the Southeast.

As was the case for phosphorus (Figure 9), nitrate conditions are, for the most part, worsening. (Figure 11). With regard to nitrate levels, Florida, California and Washington State are among the few areas showing general improvement.

Figure 10

Environmental Protection Agency
STORET SYSTEM

Nitrate in Water, 1973-1975, 85th Percentiles



Concentration
(mg/l)

* -- no data
-- less than 0.272
-- 0.272-0.690
-- 0.690-1.48
-- greater than 1.48

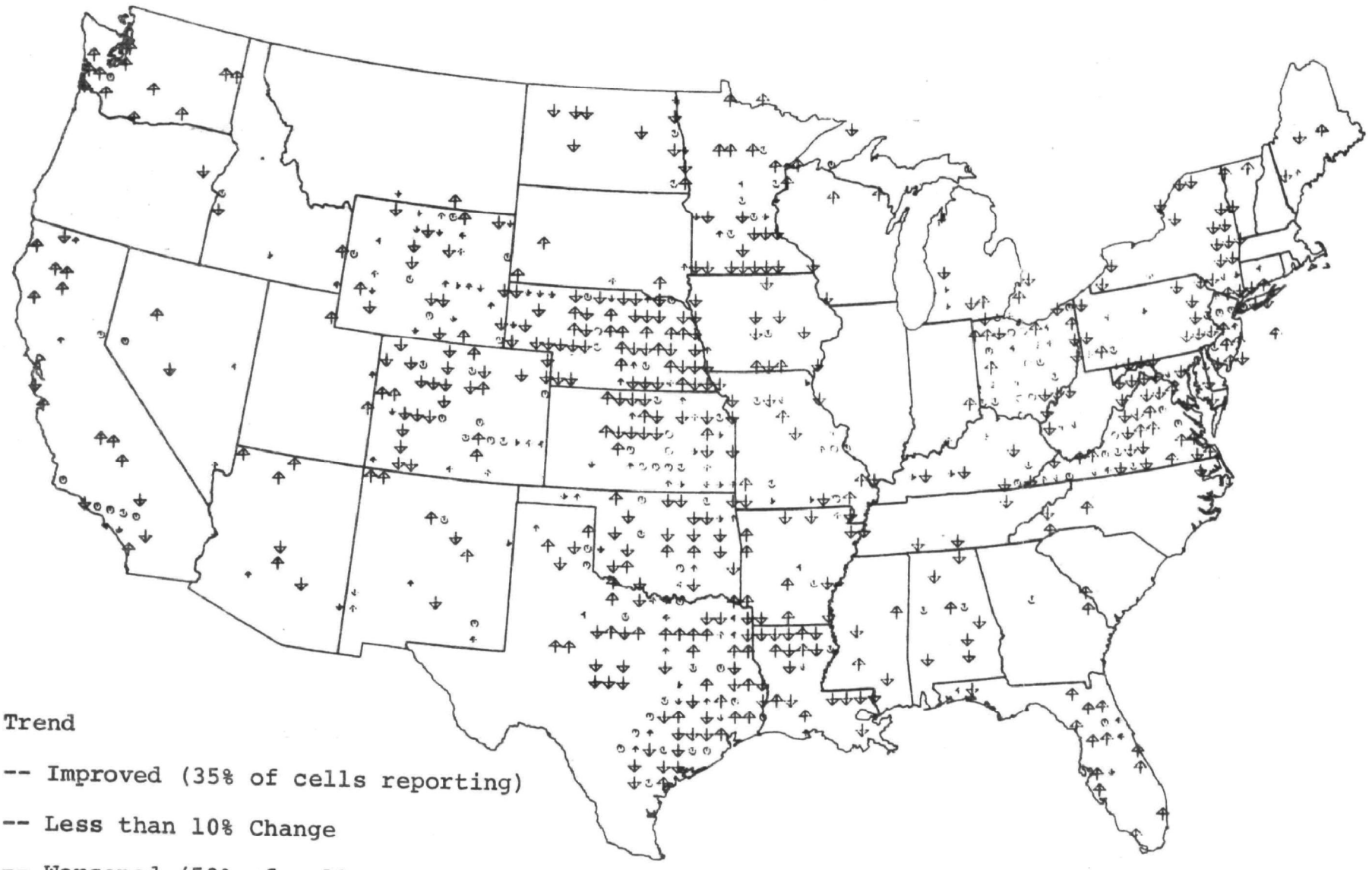
Cells included are those for which data has been supplied to EPA. Cells are approximately 25 by 35 miles.

Source: Monitoring and Data Support Division, OWPS, EPA

Figure 11

Environmental Protection Agency
STORET SYSTEM

Trends in Nitrate, 1967-69 to 1973-75



Trend

↑ -- Improved (35% of cells reporting)

o -- Less than 10% Change

↓ -- Worsened (50% of cells reporting)

Small arrows (barely visible) indicate less improvement.

Source: Monitoring and Data Support Division, OWPS, EPA

WATERS MADE BY MAN

The Nation in its exuberance to grow, has not only polluted natural waters, it has also hewn out manmade waters and polluted them as well.

And, as with all its waters, it must now clean them up. Two examples are well known -- the Houston Ship Channel and the Las Vegas Wash. Two others, Stockton Lake and Dillon Reservoir, are important manmade lakes in mid-continent.

Houston Ship Channel

President Woodrow Wilson went to Houston in 1914, and to the booming accompaniment of cannon, pushed the button that officially opened the Houston Ship Channel. It was an act that turned Houston, until then a mid-sized inland city of 160,000 people, into a port.

No one could have foreseen it then, but Houston was destined to become the third largest port in the Nation and the ship channel one of the Nation's filthiest streams.

Houston itself exploded. In less than 20 years its population doubled. Then came World War II and during the Forties it nearly doubled again -- from 384,514 to 596,219.

In the early years few were worried about pollution in the channel. Buffalo Bayou, which winds through the city and forms the channel's upper reaches, was a lazy little stream notable for its Sunday swimming and canoe races.

It wasn't until the mid Sixties that people realized the ship channel had gradually become mired in pollution. By 1968 the BOD load dumped into it by the city and the industrial giants along its banks, was 406,000 pounds a day.

In December 1967, a group gathered at the edge of the channel in downtown Houston to mourn its death. They conducted a mock funeral service and issued a death certificate: death due to strangulation. The EPA was later to call the channel one of the 10 most polluted major waterways in the United States.

Wastes were being dumped raw into the ship channel. The only agency then trying to stem the tide was an understaffed and underfunded Texas Water Pollution Control Board. It had a stream monitoring program and water quality standards and permit procedures. But there were no enforcement teeth.

In September 1967, the Texas Legislature created the Texas Water Quality Board, adequately funded it, and authorized it to look after the quality of the waters throughout the State.

By 1970, the BOD being dumped into the channel had been pared from over 400,000 pounds a day to 300,000. By 1972 the load had dropped to 123,675 pounds a day.

The first signs of a reawakening of fish life in the channel appeared. Shrimp and crabs and other marine life were being found at water intake pipes five miles below the Channel's turning basin. Officials were delighted. One company, Diamond Shamrock, threw a party and served ship channel shrimp.

But the victory was difficult to sustain. People were still flocking into Houston at a rate of 2,000 new residents a month. And in 1973, the BOD level had jumped back to 175,000 pounds a day. But the loading is now down again -- to 90,000 pounds a day -- and headed towards a hoped-for 41,000 pounds by 1979.

The City of Houston has been a major offender in the pollution of the Channel. It is the source of 75 percent of the BOD load dumped into the belabored waterway, and the State's attorney general has filed suit against it for contaminating Clear Lake. Houston, however, has now started to expand and modernize its wastewater treatment facilities with the help of EPA construction grants.

When the EPA came on the scene in the early Seventies, it joined the Texas Water Quality Board to put all dischargers under the strict discharge permits mandated by the new amendments to the Federal Water Pollution Control Act.

Plankton now inhabit the entire 25-mile course of the channel from Houston to Galveston Bay. Tarpon have been caught within five miles of the turning basin, and dolphins appear now in the lower end of the channel. In 1972, the Texas Water Quality Board collected six species of marine life on screens in the channel. A year later it gathered 22 different species. There has even been talk of constructing a $3 million hotel and tourist center on Brady Island, only two miles from the turning basin, where the water once ran foul and toxic.

The channel is unlikely ever again to run as clean as it did the day Woodrow Wilson dedicated it. But it appears to have a future far cleaner than its recent past.

Las Vegas Wash

This little stream in the middle of the parched Nevada desert is unique.

It was hewn originally from the bone dry environment by storms, and for years flowed only intermittently. But with the establishment and growth of Las Vegas, it now flows constantly, due primarily to the wastewaters discharged into it. Flowing easterly from the City of Las Vegas into Lake Mead on the Colorado River, its waters at one time carried the waste discharges of three towns and nine industries.

It attracted some 171 species of birds, 40 percent of which lived there permanently. Fish also came to swim in the wash and it became the water supply for amphibians, reptiles, coyotes, bobcats, kit foxes, raccoons, skunks, and other mammals.

But as the population of the Las Vegas basin boomed, as industry grew, and as wastewater treatment works aged, the wash began to be overburdened with pollution. Its already salty waters became laden with nitrogen, phosphorus, and dissolved solids. Its pollution reached to Lake Mead and the Colorado River downstream. Algae began to bloom in that part of the lake below the wash, lowering dissolved oxygen levels, throwing off odors, contaminating the water, and threatening the wildlife.

In 1967, citizens in the basin and Federal, State and local agencies began to worry collectively about pollution in the wash. There was much planning and discussion, but little else was done. It was not until 1971, when the EPA threatened enforcement action, that the three municipalities and nine industries settled on a strategy. A conference was convened. Legally-binding timetables for halting the pollution were developed and later incorporated in the NPDES permits demanded by P.L. 92-500.

Today six of the nine industries discharging into the wash have halted all discharges entirely. The remaining three are on schedules to reduce or eliminate their discharges. That part of the industrial wastewater flows that entered groundwater and then seeped into the wash has also been stopped. In addition, plans for tertiary wastewater treatment for the municipalities on the wash are already underway.

It will take several years to complete the program. But when it is finished the wash will be a clean manmade stream.

Two Reservoirs

Stockton Lake is a 25,000-acre reservoir 50 miles northwest of Springfield, Mo., and 135 miles southeast of Kansas City. It was built by the Army Corps of Engineers for flood control and power generation.

On July 25, 1970, only seven months after it was built, fish kills were reported in the Sac River just below the reservoir. The water being released from the new manmade lake was so low in dissolved oxygen that it couldn't sustain the river's pollution-sensitive fish life. Low DO was reported again on August 1 and August 5. Along one three-mile segment of the stream more than 20,000 fish lay dead.

The low DO condition had developed at that time of the year when the lake became thermally stratified. Thermal stratification is a natural process which occurs in many lakes. The organisms living in the depths of Lake Stockton depleted the oxygen there, and the stratification prevented oxygen replenishment from the oxygen-rich, surface layers of water. The intakes for the water releases necessary to generate power lay at the levels of the oxygen-depleted water.

The Corps successfully halted fish kills temporarily by installing siphons, which discharged high-oxygen-content water from the surface layer of the reservoir into the river at the same time that any low DO water was released. Concerned parties then went to work on a long term solution. The Federal Bureau of Sport Fisheries and Wildlife, the Missouri Water Pollution Control Board, the Department of Conservation and the Federal Water Quality Administration -- an EPA predecessor agency -- were all consulted. And on October 6, 1970, the Federal Water Quality Administration decided to take permanent steps to prevent future fish kills.

At a meeting the following August, several alternatives were discussed. And on October 13, 1971, it was agreed that a skimming weir would be the most economical and effective solution for Lake Stockton's DO problem. A weir is a manmade obstruction put in a stream to create an artificial cascade. As the water tumbles over the cascade, oxygen from the air is drawn in and mixed with it, increasing the concentration of dissolved oxygen in the water downstream.

Completed in 1973, the weir in Lake Stockton now provides adequate water quality when water is released for power

generation during periods of thermal stratification, and the warm water fishery downstream is thriving. Since installation of the weir, the oxygen content of water released during power generation has been maintained and no further fish kills have been reported. The problem is considered solved.

Only a similar concert of Federal, State, and local action saved Colorado's Dillon Reservoir from pollution.

When it was built to supply Denver with high quality water for domestic use, few thought that the reservoir, high on the Continental Divide, would ever be threatened by pollution. It lay at 9,000 feet in a rural watershed that had seen little human traffic since the gold mining era. The U.S. Forest Service owned 80 percent of the drainage area, and the private lands consisted mostly of old, abandoned mining claims.

But three things happened to change the situation. The reservoir itself became a major recreational area. The use rate, measured in visitor days, soared from 43,000 in 1966 to 1,000,000 by 1976. Three major ski resorts were built in the area. And Interstate 70 was laid across the Continental Divide, making the reservoir even more accessible.

Along with the resorts came people and more construction. In the early 1960's, fewer than 2,000 people inhabited the basin; in 1972 there were 55,000 housing units already built, under construction, or planned for the watershed. The pace of events outran the available treatment facilities, and water quality in the reservoir was suddenly threatened by man-made pollution.

Colorado officials were worried enough in 1972 to call a joint State-EPA conference to study the problem and recommend strategies to deal with it.

It was soon apparent that the threat was real and a basin-wide plan calling for advanced wastewater treatment, including phosphorus removal, was drawn up and adopted. Two EPA grants were forthcoming. Four of the existing 10 wastewater treatment facilities in the Dillon complex now provide advanced treatment, and four others have been phased out in the upgrading process.

A potentially serious eutrophication and public health problem was headed off. By 1975 EPA's National Eutrophication Survey found that the reservoir had the highest quality water of 13 lakes studied in Colorado.

To keep it that way plans are now underway to deal with the sludge problems that are the product of the new advanced treatment processes. Control measures for nonpoint run-off are now also under study. EPA grants have either been applied for or awarded for both projects.

INNOVATIVE TECHNOLOGY -- FINDING SOMETHING BETTER

There are few secret weapons in the war on pollution. Mostly it just takes determination, time, and money. But there have been some new, innovative ideas -- especially for treating the billions of gallons of sewage per day that is the spinoff of a burgeoning population. A major effort is underway nationally to develop new technology leading to better systems of advanced wastewater treatment.

Advanced treatment is not a good thing for everyone everywhere since it is generally very expensive to build and operate. In most areas, a well run secondary treatment plant of adequate capacity can handle all current pollution abatement needs. In some areas, however, advanced or tertiary treatment is necessary to remove nutrients, heavy metals or any of a variety of other pollutants that just can't otherwise be handled adequately.

The cases that follow show some of the innovative techniques developed to obtain tertiary treatment when necessary.

Muskegon County's Better Idea

The citizens and community leaders of Muskegon County in Michigan, went to advanced wastewater treatment to solve their water pollution problems.

Near the end of the 1960's, each of the many independent communities in the county were trying to deal separately with their own municipal and industrial wastewaters in small, overburdened treatment facilities. Several of the main industries and principal communities were still discharging inadequately treated wastewater directly into the county's lakes.

The three main recreational lakes were being polluted. The resulting problems included severe algal blooms, encroaching weeds and periods of foul odor. Swimming and boating were becoming unpleasant and unsafe. Older industries were closing or leaving rather than rebuilding and new industries and businesses were not coming to replace them.

Muskegon County's solution was first to persuade its many independent communities to agree on a unified approach to the problem -- then to develop a common wastewater treatment system. Working with authorities at the State and Federal levels, they designed and built a large scale spray irrigation system that would reliably and safely handle up to 43 million gallons of wastewater per day.

This land treatment system has removed about 98 percent of the BOD, suspended solids, and phosphorus and 70 percent of the nitrogen from the 27 million gallons of wastewater treated daily in the county. It is protecting and enhancing the county's lakes and streams as well as benefiting Lake Michigan. In 1975, the system also used its treated wastewater to irrigate over a quarter million bushels of corn grown on what had been sandy, unproductive soil. The project has served as a keystone in the county's effort to revitalize its economy.

Although the primary purpose of the Muskegon system is wastewater treatment, corn watered with the effluent yielded an average of 60 bushels per acre. That nearly equals the average 65 bushel-per-acre of corn yielded by Muskegon County's privately owned farms -- and the land treatment site has some of the poorest soil in the county. Sales from the grain reduced the cost of treating the wastewater by $700,000.

Land application of wastewater has been practiced in the United States and in Europe for decades. But the Muskegon project is the first major effort of its kind in this country using Federal money. Of the some $44 million in construction costs, EPA funded approximately 45 percent.

The cost of treating the wastewater in 1975 was only 24 cents per 1000 gallons. This included repayment on the bond indebtedness and all operating costs, and is low compared with many other more conventional wastewater treatment systems.

It is EPA's hope that the Muskegon success may serve as an example for other communities. A well-designed and well-managed land application system for municipal wastewater treatment, where it can be maintained without contaminating the land with heavy metals and other toxic substances, should be as safe as conventional treatment systems. And it has an advantage over conventional systems: it reinforces the resource recovery ethic. It could revitalize and augment parkland and recreation areas, renew groundwater, and help supply nutrients for the growth of forests, grasslands, and even crops.

Lake Shagawa

The citizens of Ely, Minnesota, were faced with a problem similar to that of Muskegon County. Ely sits on the shores

of Shagawa Lake, which is the gateway to the Boundary Waters Canoe Area, a million-acre wilderness on the border with Canada that has been set aside as a canoeing preserve.

However, Ely's growing recreational traffic has also generated higher pollution loads. The first sewage treatment plant was a primary facility installed in 1912 to treat wastewater before discharging it into Lake Shagawa. But by 1932, pollution in the lake was so serious that a pipeline was installed to bring drinking water down from another lake a few miles upstream. In 1954, a trickling filter plant was built to treat the rising pollution load. It was modified in 1963.

But there was still a problem. The nutrient load that was reaching Lake Shagawa began to create ugly and foul-smelling algae blooms. The swimming beaches were closed and the overflow from the increasingly polluted waters drained into parts of the wilderness area and into Canada. Ely's pollution was in danger of killing the recreation boom that is its major economic resource.

Working with State and Federal officials, the city in 1971 received an EPA research grant to design, develop, and run an advanced wastewater treatment plant that would remove most of the nutrient from its wastewater discharge.

The 1.5 million gallon per day plant was built and started operating in April 1973. The new facility has been 98 percent effective in removing nutrients, and the phosphorus levels have been held consistently to less that 0.05 milligrams per liter, a level too low to support algae growth.

The public is noticing the improvement. The Shagawa Lake swimming beach was open for a full season in 1975 for the first time in many years.

Ely's experimental treatment plant is more expensive than the town can afford to operate without further financial help. But it points to another technically innovative system capable of solving a difficult pollution problem -- if it can be rendered less costly.

Jasper

The little town of Jasper, in the Ozarks, lies in a setting as beautiful as Ely's. Through it flows the Buffalo National River, a stream whose pristine waters and tree-lined banks provide a wilderness setting and support an eco-system unique in the mid-South.

Several dwellings within the town limits were using outdoor privies or septic tanks that operated ineffectively in the porous limestone rock formations of northwest Arkansas. The wastes were seeping into open ditches and from them into the Little Buffalo River, which empties into the Buffalo National River.

Like other communities in the Ozarks, Jasper recognized the increasing health hazard created by inadequate septic tanks. Something had to be done and the town rose to the occasion.

Not only did Jasper build a treatment plant -- with the help of the EPA -- but it was transformed from an unsewered community, with septic tank seepage and raw sewage runoff, into a community with an advanced system capable of serving projected population growth for years to come.

An advanced treatment facility for a small town is out of the ordinary. Lower levels of treatment under normal conditions would be quite adequate. But the people of Jasper, the State of Arkansas, and the EPA, had reasons for tertiary treatment in the little Ozark town. The high quality of water in the Buffalo National and Little Buffalo Rivers had to be maintained. Lower levels of treatment wouldn't do the job.

Jasper's plant went into full operation in 1974. The two rivers running through it are now assured of continued high water quality.

St. Petersburg

In 1972, the State of Florida required advanced wastewater treatment with essentially complete nutrient removal for the critically polluted areas around Tampa Bay.

St. Petersburg responded with a solution that at the same time was an important first step towards conserving scarce drinking water.

Before the 1940's the city drew its potable water from wells in southern Pinellas County, but with the rapid population growth and the increasing drain on fresh water supplies, the ground water aquifer was soon overpumped. Salt-water intrusion followed, and the aquifer had to be abandoned as a source of fresh water. Since then the city has drawn its water from northern Pinellas County by pipeline, and faces future needs it could not supply.

The city combined the solution to its wastewater disposal problem with a step towards relieving its water shortage: it decided to use modified secondary treatment together with spray irrigation. The treated effluent will be sprayed on golf courses, parks, and school yards in the city, saving scarce fresh water for more important uses.

The effluent will be treated to safe levels before it is sprayed on sites accessible to the public. And the actual irrigation will occur during hours when there is no public access. A stand-by deep well storage system will store the treated effluent during periods when irrigation is unnecessary.

The St. Petersburg effort is one of the first real attempts in the South to undertake a major recycling program for treated effluent, complete with effluent distribution, spray irrigation, and underground storage.

Largo

The town of Largo, in Florida, was under the same pressure as St. Petersburg to upgrade its treatment. Like St. Petersburg, Largo chose spray irrigation, but it went one innovative step further.

While wrestling with the problem of what to do with the 10 tons per day of dry sludge generated by the new treatment plant, the city's consulting engineer discovered that dried sludge was being imported to the nearby Port of Tampa from Houston and Chicago and used as a soil-conditioning base for fertilizer. It was estimated that approximately 100,000 tons of dried sludge are imported into Florida each year.

Therefore, the city's consulting engineer devised an innovative and cost-effective system to dewater the wet sludge mechanically and dry it in a rotary kiln. The end product is a sludge material in a dust-free granular form salable as a soil conditioner because of its high organic and nutrient content.

The advantages of Largo's sludge handling process are many. It recycles and reuses the sludge itself. It eliminates a less desirable means of sludge disposal. And sale of the end product will reduce the net cost of the sludge handling to a figure considerably below that of the other possible approaches.

Military Innovations

Many military bases once contributed significantly to pollution levels. That is now changing. With the focus now on clean-up, several bases have adopted spray irrigation of their treated effluents.

Tyndall Air Force Base, in Florida, was notified by EPA in 1971 that its sewage treatment facilities were outmoded and completely inadequate to meet State and Federal requirements.

The EPA and the State of Florida agreed that advanced wastewater treatment would be required at the base's main plant before discharge to the adjacent beach area on the Gulf of Mexico. Those waters and the beach had been marked for recreation and were to be suitable for fish and wildlife propagation. Effluent limitations were set for BOD and suspended solids. And wastewater from a second sewage treatment plant was no longer permitted to empty into Pearl Bayou, a tributary of St. Andrews Bay and a haven for shellfish.

After a series of negotiations and consultations, the Air Force designed and built a spray irrigation system. Completed in 1975, the system has completely eliminated all discharges from the base into the Gulf of Mexico and St. Andrews Bay.

Eglin Air Force Base is on Florida's Choctawhatchee Bay near Fort Walton Beach, a prime recreational and fishing area.

In 1970 Eglin's wastewater disposal system could not provide the degree of treatment required by Florida's Department of Environmental Regulation. The EPA, the State, and the Air Force consulted and decided that spray irrigation in the air base's undeveloped sandy woodlands was the best solution. The system was completed in early 1975. Since then the Air Force has also helped Okaloosa County authorities design a spray irrigation system for itself that also is to use Federal lands.

The Eglin system has eliminated wastewater discharges into Choctawhatchee Bay and Santa Rosa Sound, allowing those waters to be used for recreation. They will also eventually be suitable for shellfish. The system eliminated three outfalls and enhanced the quality of the gulf beaches in the Fort Walton area.

Georgia's Dobbins Air Force Base and its industrial Air Force Plant #6 were discharging sewage and industrial wastewater into Rottenwood and Nickajack Creeks, tributaries of the Chattahoochee River. Rottenwood Creek enters the Chattahoochee just above Atlanta's drinking water intake.

In 1966, an interstate enforcement conference was held to advise all dischargers to the Chattahoochee River that, by 1971, secondary treatment or its equivalent would be necessary for all wastewater discharges.

For Dobbins and its industrial complex, the requirements were more strict than that. The proposed treatment process was to be a three-stage system, which had been approved by EPA and the State in 1970.

The system for the industrial plant was completed and put in operation in 1972. The existing wastewater treatment plant was upgraded, and the facilities for a new third stage of treatment were finished in May 1976.

This advanced waste treatment system now produces effluent of a quality approaching that of drinking water. Reuse of the water for industrial purposes is currently being studied. And the discharge site for the effluent from Dobbins has been moved to a point on the Chattahoochee River well below Atlanta's water supply intake.

Hobbs -- Selling a City's Wastewater

Hobbs, New Mexico, is one of the few towns in America that markets wastewater -- and at a price equal to what it gets for drinking water.

It took a court fight and a lot of doing, but Hobbs eventually changed a serious pollution problem into an environmental and economic asset. The court fight was due to contamination of the Ogallala groundwater formation, from which the city draws its water supply.

In the end, the water supply was protected, wastewater treatment facilities were improved, and a market -- temporary at least -- for treated wastewater was found in a nearby oil field.

Hobbs' environmental success story, like many others, is the product of the cooperative efforts of Federal and State agencies, the city, and others -- lawsuits notwithstanding.

In 1970, the New Mexico Environmental Improvement Agency, while conducting a routine sampling, found that high nitrate concentrations were present in water supply wells near the Hobbs wastewater treatment plant.

Additional sampling and flow measurements showed that a dome of wastewater approximately two miles across and 40 feet high had built up in the alluvium formation south and east of the city. Some shallow wells in a low-income area adjacent to the wastewater treatment facility were found to be contaminated.

The courts ordered Hobbs to provide a potable water system for all homeowners in the affected area, to pump the contaminated water out of the dome, and to stop the discharge of the polluted water into the Ogallala formation.

Publicity generated by the litigation attracted the attention of the oil industry, which approached the city council and offered to buy the wastewater. The oil companies wanted to inject the water into a deep geologic formation as part of a secondary oil recovery operation.

It is estimated that the dome of contaminated water, together with sand-filtered sewage, can be pumped out and used by the industry for a period of about eight years, at a net profit to the city. Hobbs has worked out a fee schedule equal to the rates charged for its potable water. Water lines have also been laid in the area to serve all persons whose water supply wells were contaminated.

Now the City has reapplied for EPA and State construction grants to reach the treatment level necessary during times when the oil field cannot use the wastewater, and later when the oil recovery is completed.

NONPOINT SOURCES

Many activities important to the life and economy of the Nation over the years -- construction, farming, mining, and forestry -- have had another, environmentally negative, side: they have often set in motion processes of erosion and runoff harmful to the environment.

The wastes from these sources have added substantially to the pollution of the Nation's waters. And they constitute the nonpoint source problem that as yet knows no fully adequate solution. They present themselves now as a major environmental challenge of the future. But in some places the problem has been attacked already -- with some success.

The Monongahela -- Pollution from the Mines

The clean-up of the upper two-thirds of the Monongahela River is an example. The rugged, scenic Monongahela begins at the confluence of the West Fork and Tygart Rivers in West Virginia and flows for 128 miles northward into Pennsylvania, joining the Allegheny at Pittsburgh to form the Ohio River.

Its coal-rich basin is one of the most intensively mined regions in the world.

During the 19th century, the Monongahela supported a profitable fishing industry. Aquatic studies in 1886 identified 40 fish species, including the pollution-sensitive walleye and muskellunge. But by the early 20th century, acid mine drainage from active and abandoned coal mines had ravaged the small tributary streams and polluted the upper reaches of the Monongahela from Fairmont, West Virginia, to Charleroi, Pennsylvanis. Heavy industrial development from Charleroi to Pittsburgh had killed off virtually all fishlife in the river.

By 1950, the Monongahela had become an aquatic wasteland. Acid mine drainage -- runoff from active and abandoned mines -- on the upper river brought low pH levels, severe turbidity, bottom deposits of chemical precipitates, and high concentrations of iron, manganese, and sulfate. Boats, dams, and instream facilities were plagued by corrosion.

Steel mills and coke plants on the lower river near Pittsburgh dumped untreated phenols, oils, greases, cyanide, organic coal tars, ammonia, and suspended solids into the water.

In 1957, the Ohio River Valley Sanitation Commission and the University of Louisville conducted a fish resource study. At a typical monitoring station on the Monongahela, 50 miles downstream from the West Virginia border, only two small bluegill sunfish were found. The pH levels at the station were unacceptable -- the water was high in acids -- and the river was pale chartreuse in color.

The major turning point in the campaign to save the Monongahela came on December 17 and 18, 1963, when conferees met in Pittsburgh to discuss the pollution of the river and its tributaries. It was agreed that the major problem was acid drainage from active and abandoned mines.

Indeed, mine drainage is the principal cause of acidic conditions nationwide. Acidity is measured using the pH scale: 7 indicates neutral -- harmless -- water. Numbers less than 7 indicate acidic water, with smaller numbers indicating inceasingly acidic conditions: water with a pH of 6 is slightly acidic, water with a pH of 4 is very acidic. A pH greater than 7 indicates alkaline conditions, which are the opposite of acidic. Although aquatic organisms are more tolerant of alkalinity than of acidity, highly alkaline waters (with pH greater than 10) are just as undesirable -- and as caustic -- as acidic waters. As Figure 12 reveals, highly acidic conditions are associated primarily with the Appalachian mining regions. Acidic conditions are also found in the Southeast generally and in New England. Highly alkaline conditions are almost non-existent.

Once it was agreed that the mines were responsible for the acidity problems along the Monongahelia, all of the mines were inventoried. Then, in 1965, the active coal mines were required to treat their discharges to make them alkaline rather than acidic and thus compensate for the prevalent acidity. Discharges were also to contain no more than 7 milligrams per liter of iron. Pennsylvania and West Virginia stepped up enforcement procedures and State funds were earmarked for research and development.

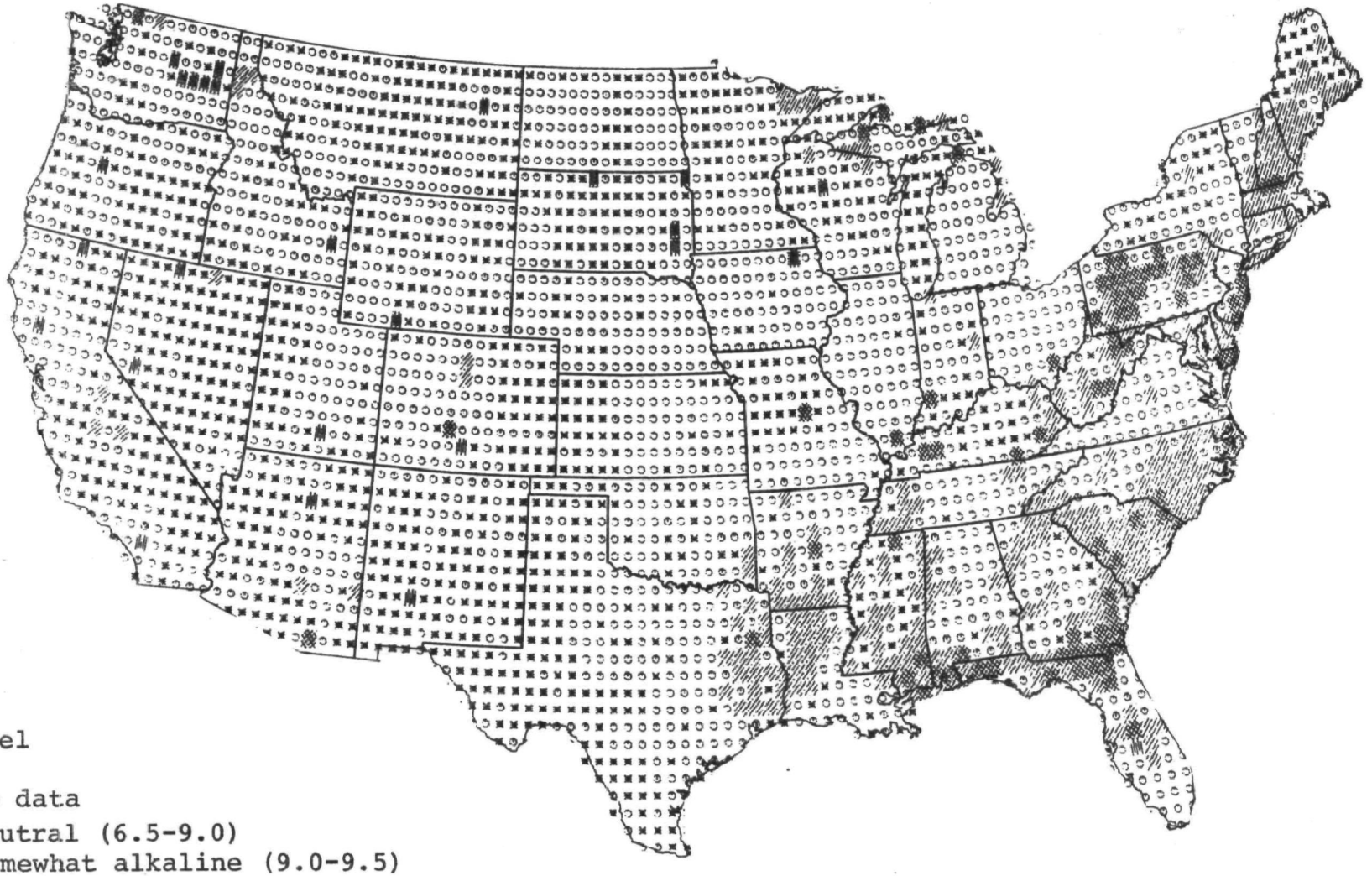
Conditions improved. Water quality monitoring records from the late 1960's and early 1970's showed higher pH levels, and thus less acidity, in the river's upper reaches. Pollution-sensitive fish returned -- among them largemouth bass, catfish, and emerald shiners.

The lower reaches of the river, while vastly improved, still have far to go. Discharges from the heavy industry and the active and abandoned mines between Charleroi and Pittsburgh continue to result in violations of water quality standards. But even that stretch is improving: carp and bullheads have returned. The EPA and the States have issued permits to the majority of point-source dischargers, and most of the polluters will meet their 1977 deadlines.

Figure 12

Environmental Protection Agency
STORET SYSTEM

pH in Water, 1973-1975, 15th & 85th Percentiles



pH Level

* -- no data
o -- neutral (6.5-9.0)
-- somewhat alkaline (9.0-9.5)
-- somewhat acidic (5.5-6.5)
-- highly alkaline (9.5 or greater)
-- highly acidic (5.5 0r less)

Cells included are those for which data has been supplied to EPA. Cells are approximately 25 by 35 miles.

Source: Monitoring and Data Support Division, OWPS, EPA

There are exceptions. The steel industry appealed the deadline and the effluent limitations in its permits, and a round of negotiations followed. The EPA in September 1976, reached an agreement with U.S. Steel, the largest industrial discharger on the lower Monongahela, calling for final discharge limitations on 72 of 87 outfalls by July 1, 1977. The remaining outfalls will follow, under a phased compliance schedule, by November 30, 1981. While there is still a legal question whether the EPA can set a compliance date after July 1, 1977 -- the deadline set in P.L. 92-500 -- the agreement is considered a major accomplishment.

Since 1970, the EPA has awarded 16 Pennsylvania communities $22 million to construct secondary wastewater treatment facilities. The EPA awarded another $26 million to the Allegheny County Sanitary Authority for the big secondary treatment plant servicing Pittsburgh. On line since 1973, it serves 1.25 million people from McKeesport to Pittsburgh and treats 200 million gallons of municipal and industrial discharges daily. Additional EPA planning grants authorized in Section 208 of P.L. 92-500 have been issued to study industrial discharges, ground water contamination, and sewer problems.

Dents Run watershed, on the Monongahela near Morgantown, West Virginia, shows how pollution can be controlled at both active and abandoned mines. As a joint demonstration project by the EPA, the West Virginia Department of Natural Resources, and the Consolidation Coal Company, the Dents Run project has worked well. It has reclaimed over 400 acres of strip-mined land, at a cost of $2 million. Smoldering gob piles have been reshaped, covered with fertile soil, and replanted. The pH in the 14.6 square-mile watershed has risen from an average of 3 (highly acidic) to 6 (slightly acidic). And local residents have reported minnows in the upper portion of the watershed. Hydrated lime treatment plants have eliminated much of the acid mine drainage and the bright-orange color in the water.

The Monongahela's revival has been a team effort. The West Virginia Department of Natural Resources, the Pennsylvania Department of Environmental Resources, Pennsylvania's mining industry, and the EPA worked together with success -- particularly on the river's upper reaches.

Today there are bass tournaments on the West Virginia portion of the Monongahela. Muskellunge frequent the river's lower reaches, and hikers and boaters are again a common sight on its banks on warm summer days.

Considered a "dead" river for 70 years, the Monongahela now has new life.

The Colorado -- A Salt Problem

The Colorado is the classic case of a river that has been over-used.

Salt enters the river as a product of natural weathering and decomposition of rock formations and soil in the basin. The process is accelerated and the salts are concentrated by irrigation, evaporation from reservoirs, and the "exporting" of the river's water to metropolitan areas. The salinity worsens as the river winds downstream from its headwaters.

Three states that rely on the lower Colorado -- California, New Mexico, and Arizona -- have especially felt the sting of this brand of pollution. Mexico has also been affected. Salinity has cost California and Arizona alone an estimated $50 million a year in lower crop yields and for treatment of public drinking supplies.

The seven states in the Colorado basin, the EPA, and the Interior Department agreed on a salinity control policy in December 1973:

- Salinity levels in the lower main stream would be maintained at or below 1972 concentrations, which the States and the Federal Government had earlier agreed were acceptable;

- Numerical criteria for specified points on the river were to be set by October 18, 1975; and

- The States involved were to develop salinity control plans.

The 1974 Colorado River Basin Salinity Control Act provided funding and technical assistance to help curb salinity. The Act also authorized programs to implement the policy and to improve the quality of water reaching Mexico.

The problem is complex. Natural processes, irrigation, and other water use practices all come into play. Solutions are also complex, involving control of natural pollution sources as well as costly changes in water use practices.

There has been progress -- much of it in water conservation. There have also been successful irrigation demonstration

projects. Solutions to several runoff problems have been found. Irrigation scheduling has cut water use and raised crop yields. In some places trickling filter irrigation has replaced sprinklers. These and other techniques are now all at work in the basin.

So far, the 1972 salinity levels have been maintained in the lower Colorado. Programs to improve the quality of water going into Mexico are on schedule. And the public has accepted as the first priority the need for new irrigation practices to conserve water and minimize pollution. That growing public acceptance is perhaps the most important achievement of the Colorado salinity control effort to date.

A Metropolitan Lake

Water quality sampling reported severe nonpoint problems in Lake Quinsigamond in Massachusetts in the late 1960's and early 1970's. Algae blooms flourished in the summer months. Coliform counts were abnormally high, often forcing swimming areas to close.

Located between the densely populated towns of Worcester and Shrewsbury, the lake is bisected by two major east-west arteries -- Routes 9 and 290. Failing septic tanks, direct discharges from homes, and contaminated runoff were the major sources of pollution.

Federal, State, and local authorities faced the problem head on. Worcester constructed new sewer lines, eliminating discharges of raw household wastes. Shrewsbury, Worcester, and the State built catch basins and storm sewers. Winter salting on Routes 9 and 290 was reduced, and the State and the local communities shared the cost of applying copper sulfate to control the remaining algae at the lake's lower end. The Lake Quinsigamond Commission sponsored spring and summer street cleanup days.

All of that has helped. DO levels now meet standards, and suspended solids, ammonia, nitrates, phosphorus, and coliform counts are all within acceptable levels. Fishing, boating, and swimming are all on the increase.

DRINKING WATER

Congress passed the Safe Drinking Water Act of 1974 (P.L. 93-523) to assure that public water supply systems meet minimum national standards for the protection of public health. The act authorized the EPA to establish a joint Federal-State system to implement the standards and to safeguard underground sources of drinking water. The act also provided for Federal grants to aid States in surveillance and enforcement.

It is too early to see the impact of the new law, since the national interim primary drinking water regulations recently issued by the Agency do not become effective until June 24, 1977. But some cities and towns have already faced drinking water problems and acted to correct them.

One group of pollutants commonly linked with drinking water is phenols. They are organics that come from certain types of industrial activity and give drinking water an unpleasant odor and taste. Since they are not widespread in the environment, they are measured only in those areas of the country where they are a problem. (Figure 13). Where they do show up they are troublesome.

Cambridge and the Lead Problem

There are other serious drinking water problems as well. Lead is one of them.

The EPA's standard for lead in drinking water is 50 micrograms per liter. Too much lead may severely damage the human nervous system: lead poisoning in its advanced stages has caused irreversible brain damage, especially in children.

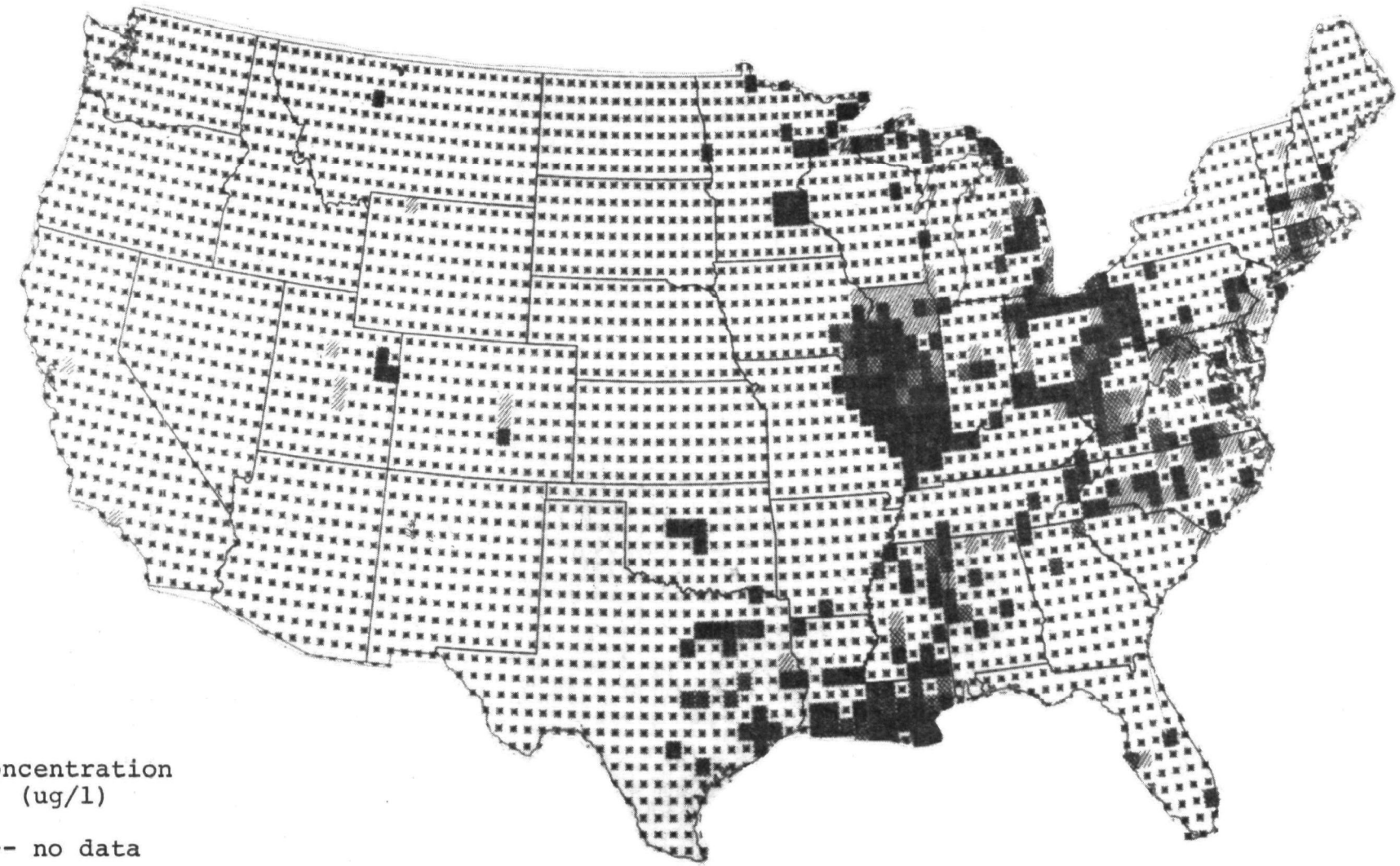
A 1974 sampling of 10 homes in Cambridge, Massachusetts, found lead levels in the drinking water ranging from 51 to an alarming 276 micrograms per liter. The Agency discovered the source of the lead through extensive sampling of 383 households in Cambridge and neighboring Somerville and Boston -- it was leaching into the drinking water from corroded plumbing. Lead exceeded standards in 25 percent of the homes tested in Boston, 30 percent in Somerville, and 14 percent in Cambridge.

Boston and Somerville draw their water from the Boston Metropolitan District Commission (MDC). Following the EPA study, the MDC began adding a zinc-phosphate compound to reduce the lead pipe corrosion.

Figure 13

Environmental Protection Agency
STORET SYSTEM

Phenols in Water, 1973-1975, 85th Percentiles



Concentration
(ug/l)

* -- no data
-- less than 1
-- 1-2
-- 2-4
-- greater than 4

Cells included are those for which data has been supplied to EPA. Cells are approximately 25 by 35 miles.

Source: Monitoring and Data Support Division, OWPS, EPA

Cambridge, which has its own reservoir, added sodium hydroxide to the water to reduce its pipe corrosion. The concentration of lead in drinking water fell substantially. A sampling in November 1975, found no detectable lead in eight of the 10 homes studied earlier, and only 20 micrograms per liter -- less than half the standard -- in the other two.

Huron and the Chloroform Problem

The EPA's 1975 National Organic Reconnaissance Survey found that the drinking water in Huron, in South Dakota, contained the highest concentration of bromodichloromethane, a suspected carcinogen, and the second highest concentration of chloroform of all the 80 cities sampled. Both compounds have caused tumors in rats and mice and may pose a cancer risk to humans.

Public concern in the State led to an EPA grant to the South Dakota School of Mines to study the problem. The study indicated that these organic compounds were being formed at the point of chlorination in the water supply's pretreatment plant, and that the amount formed was highly pH dependent.

When the point of pre-chlorination was moved and the pH was adjusted, the amount of chloroform in the treated water dropped by 75 percent.

Two Villages in Alaska

Seventy percent of Alaska's natives live in small villages where safe drinking water is often a luxury.

In summer, the drinking water is simply rainwater, or water drawn from often stagnant or contaminated streams and ponds. In winter, unproductive wells send villagers to the ice fields literally to cut out their drinking water and melt it in contaminated fuel drums. Either way, in either season, the drinking water is a health hazard.

Harsh weather conditions, annual flooding, the rugged terrain, and poor soil conditions render simple waste disposal methods nearly impossible in the Arctic North. A strong smell of decomposing wastes along the shore is common in the summertime.

In 1976, the average life expectancy of a rural Alaskan was half that of other Americans. Thus, the need to improve rural Alaska's environmental health conditions, including the quality of its drinking water, is urgent.

Since the cost of doing anything in Alaska is higher than in most other places, the Federal Government began sponsoring the Alaska village demonstration projects called for in Public Law 92-500. Two projects, in the villages of Emmonak and Wainwright, are especially notable.

Local natives, with the help of the U.S. Public Health Service and the State of Alaska, put a specially-designed multipurpose facility on line in Emmonak in early 1975. It effectively provided safe drinking water, sanitary bathing conditions, and adequate waste treatment, as well as laundromat services and health education and training programs. The inhabitants of the village were scheduled to assume ownership of the facility in late 1976. A similar facility in Wainwright, destroyed by fire, is being rebuilt and will be ready in late 1977.

Drinking water in Emmonak, which is 130 miles south of Nome, now meets Public Health Service standards. School attendance is also up -- an indication of decline in childrens' disease. The Emmonak example has worked so well that the idea is now spreading to other Alaskan villages. The Canadian Government has also become interested.

Whether the program succeeds over the long run depends on how successful Alaskan villages, still hard pressed economically, are in winning some degree of financial independence. That problem is still far from solved.

AIR POLLUTION -- SEEN AND UNSEEN

Air pollution evokes the image of something that can be clearly seen -- a dingy haze hanging over a city, bringing with it foul odors and smarting eyes. That, in the public mind, is air pollution at its worst. Yet what can't be seen is often more dangerous than what can be seen.

One pollutant -- carbon monoxide (CO) -- can neither be seen nor smelled. Yet in high concentrations it is far more lethal than other pollutants that are visible and foul-smelling, but otherwise harmless.

The Mandate

The mandate for attacking the nation's air pollution, visible and invisible, is embodied in the Clean Air Act of 1970. That precedent-setting legislation empowered the EPA to establish ambient air quality standards to protect the public health and welfare -- then see that they are enforced.

The Agency works in close consort with the States, which draft and enforce implementation plans subject to EPA review. If necessary, the Agency itself prepares and enforces its own plan. The EPA also sets emission standards for new pollution sources and for all sources of especially hazardous pollutants. And it sets and enforces limits for emissions of carbon monoxide, hydrocarbons, and oxides of nitrogen from the Nation's automobiles, trucks, and motorcycles.

To carry out the law's strict requirements, the EPA has established two kinds of standards for the most common air pollutants. One set -- the primary standards -- has been drawn to protect human health. The other -- the secondary standards -- is more restrictive and has been established to clean the air of visible pollutants and to prevent corrosion, crop damage, and other impacts stemming from polluted air.

The National Accomplishment

What battles have been won against air pollution have been fought largely by the States and cities. And there have been major victories. In city after city there is a strong downward trend in the volume of emissions escaping into the air, the ambient concentrations are diminished, and the air has become clearer.

How about 20? BOQ motor vehicle blowby control nationally in 1963 (13 years) and tailpipe in 1968

Air pollution control on a nationwide scale has been underway only for the last five and a half years. In that time the effort has concentrated on curbing emissions of the most widespread, best understood, and most troublesome pollutants.

Some since 1905 = 70 more since 1945 = 30 years

Particulates, perhaps the most widespread of all, have been sharply curtailed. (Figure 14). The technology for curbing particulate emissions was already available before the national effort began. The States and cities had been at work on the problem for 20 years. But the Federal Clean Air Act gave them new weapons to use in their fight.

There is still much work to do. Figure 14, a map showing the current status for particulates nationwide, shows which of the 247 Air Quality Control Regions (AQCR's) are not yet meeting the standards. The map also shows, with a "+" or a "-", what the general trends are in each state.

The map paints a general picture of particulate air quality, but it has limitations. Some AQCR's, especially in the West, are very large. For example, most of Nevada is one AQCR. So is Nebraska. Wyoming has one AQCR that embraces much of that State.

Such large areas can be classified as non-attaining because of a single monitor in one heavily polluted area, or "hot spot," even though the air quality in the rest of the region is excellent. Conversely, areas not shaded in do not necessarily have excellent air quality everywhere. It simply means that no monitor now in operation in the area is registering a standards violation.

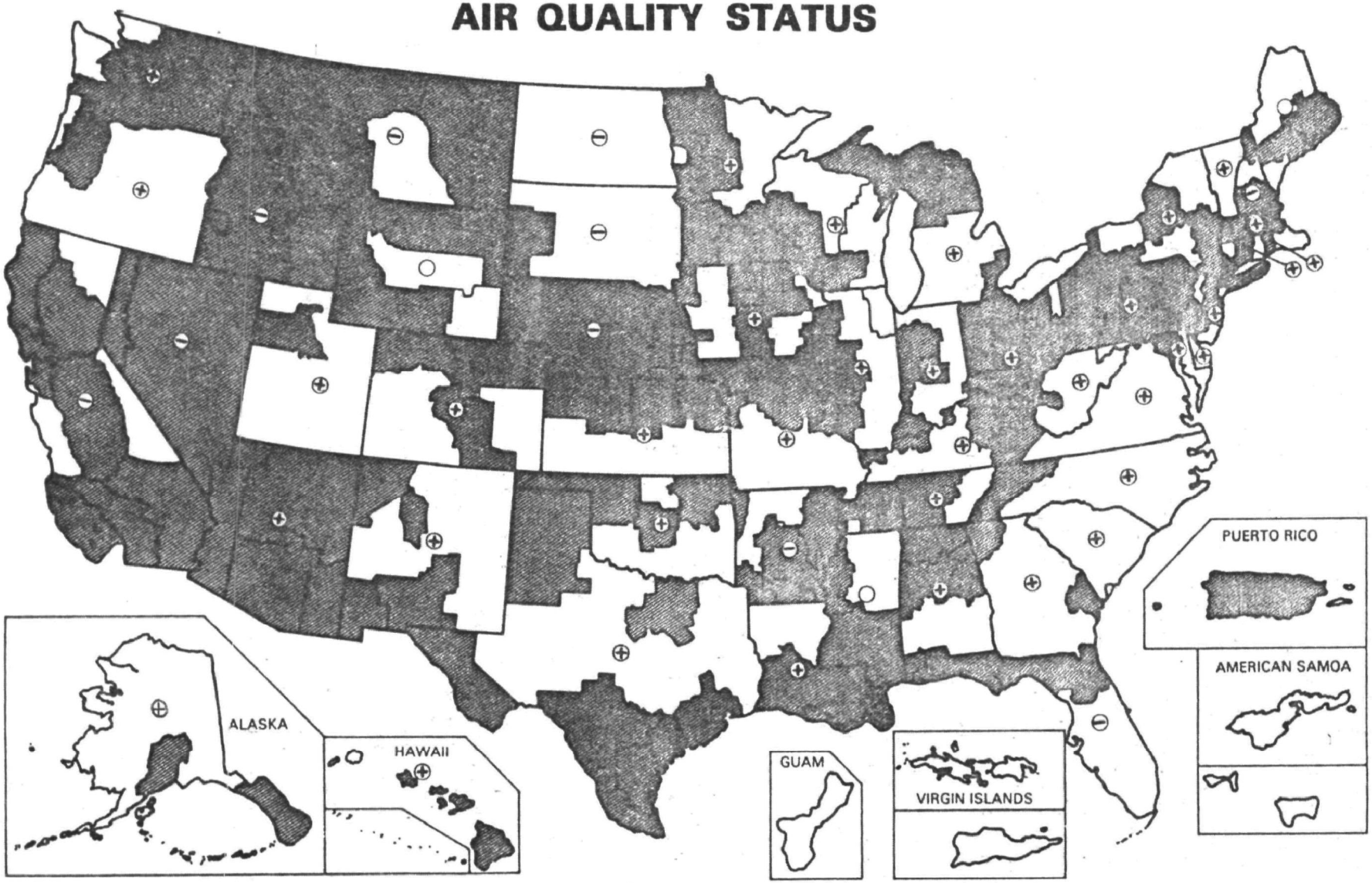
Figure 14 shows that particulate levels throughout the U.S. are either already good or improving.

- Particulate problems east of the Mississippi are generally associated with industry. The levels are improving in all eastern States except Florida and New Hampshire, where levels are low, but gradually rising, and Maine and Mississippi, where there is no significant change.

- Particulate air quality in the northern Great Plains appears to be deteriorating somewhat. But the air quality there is still very good, except in scattered hot spots.

Figure 14

TOTAL SUSPENDED PARTICULATE AIR QUALITY STATUS



KEY: ▓▓▓▓ — REGIONS NOT MEETING PRIMARY ANNUAL AMBIENT AIR QUALITY STANDARDS

⊕ STATE — AMBIENT LEVELS AT MORE MONITORS IN STATE IMPROVING THAN DETERIORATING 1970-1975

⊖ STATE — AMBIENT LEVELS AT MORE MONITORS IN STATE DETERIORATING THAN IMPROVING 1970-1975

SOURCE: OAQPS, EPA DATA

NOTE: Some of the shaded regions, especially in the Southwest, have only one site violating standards; the air elsewhere is "pristine." The designations indicated are not current for NM,TX,AR and LA.

- In the West and Southwest the problems are generally associated with hot spots or fugitive dust. Levels are improving except in Idaho, Nevada, and California.

- In most metropolitan areas, high particulate levels are due primarily to readily controlled major point sources. In these areas, where the particulate problem was generally the worst five years ago, the nationwide trend is decidely downward. (Figure 15).

Sulfur dioxide (SO2) levels are another major air quality concern. There is still some dispute over the best way to reduce SO2 emissions. Some dischargers have turned to low sulfur fuels, to lower their SO2 levels. Where scrubbers have been required, however, widespread industry opposition has brought delay. Irregular trends in SO2 levels across the Country are the result. (Figure 16).

Nitrogen dioxide (NO2) levels are currently a serious problem in only two or three metropolitan areas, and motor vehicles contribute the bulk of that pollutant. There are technical tradeoffs between controlling NO2 and controlling CO and hydrocarbons from motor vehicles. Since the last two were given priority, NO2 emission were at first allowed to rise somewhat. That helps explain why NO2 levels, as shown in Figure 17, rose somewhat in certain metropolitan areas between 1970 and 1974. There is, however, a general downward trend, which will quicken as NOx emissions standards for new motor vehicles are tightened.

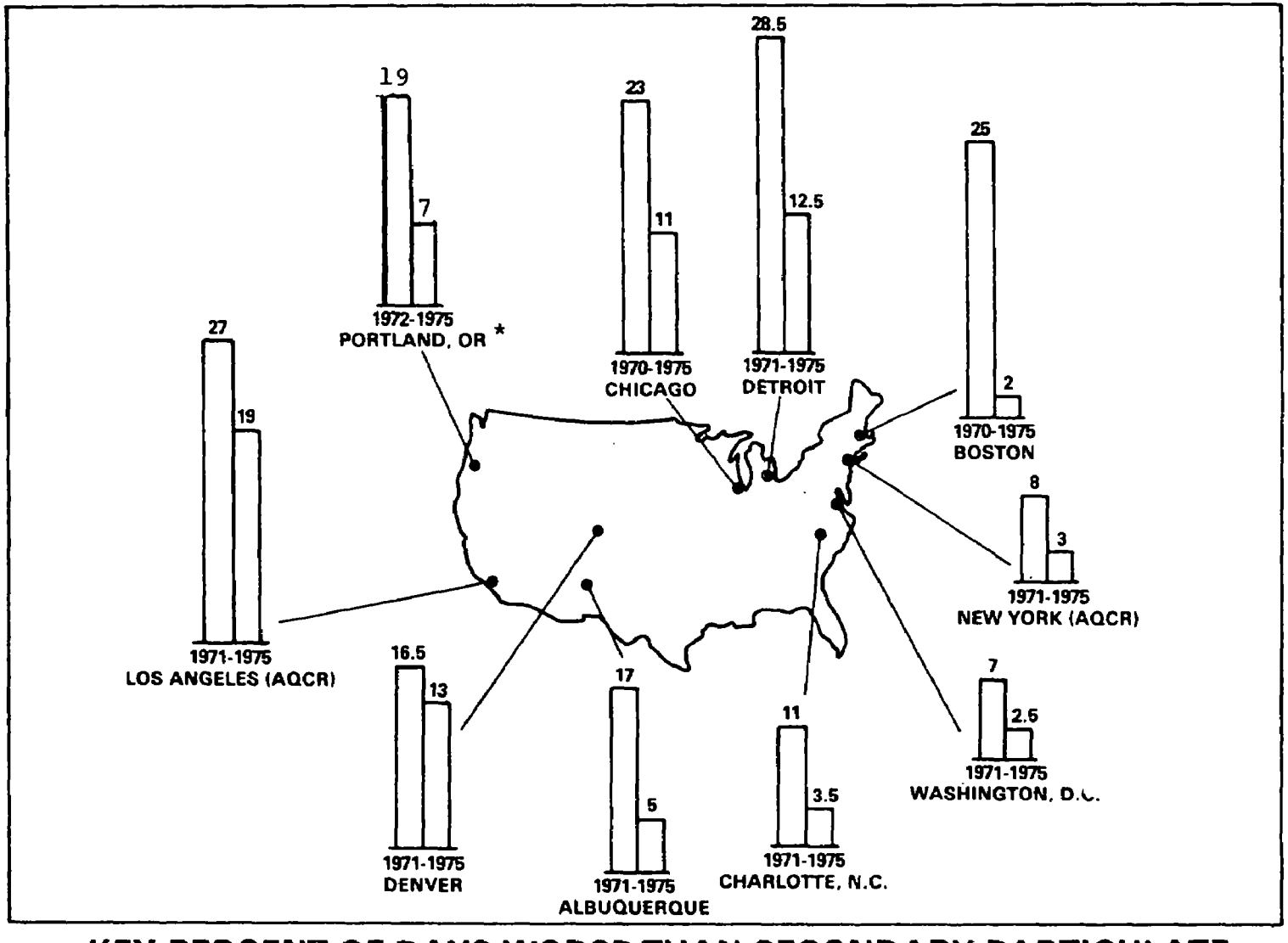
Photochemical oxidants are the most prominent pollutants that result from motor vehicle emissions. They are formed in the atmosphere from the reaction of hydrocarbons and oxides of nitrogen, both of which come primarily from auto exhausts. When oxidant levels are examined in the shorter term, as in Figure 18, no clear nationwide trends are apparent. In the longer term there have been decided downward trends. (See Figure 22).

When the substantially stricter auto emissions standards of 1975 and 1976 begin to take hold in the next two or three years, oxidant levels are expected to decline in major cities throughout the country. Widespread violations of oxidant standards in rural areas, however, may continue to be a problem.

Lead is another air pollutant that has passed under tighter control over the last three years. Lead emissions

Figure 15

PARTICULATE TRENDS FOR SELECTED CITIES



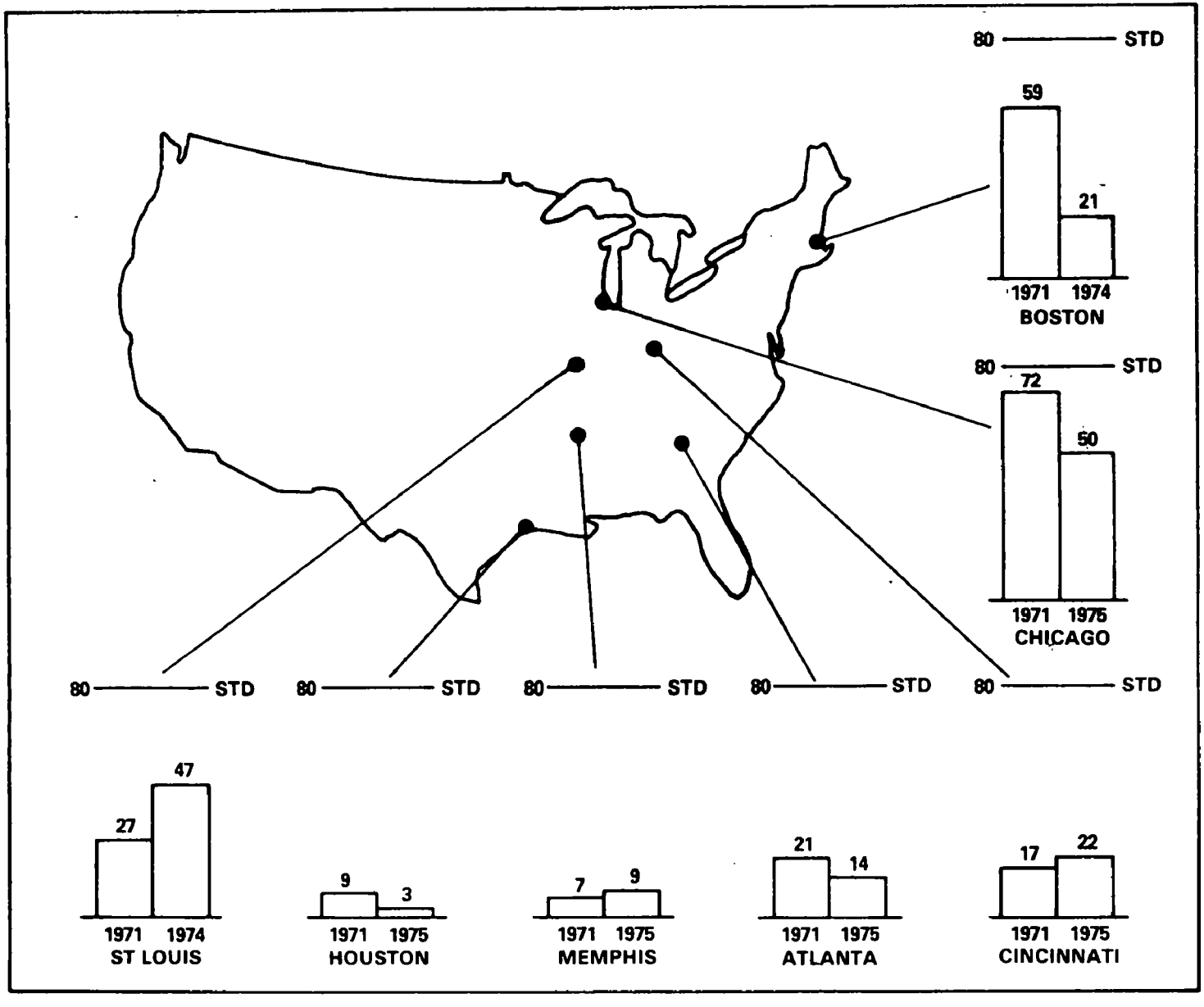
KEY:PERCENT OF DAYS WORSE THAN SECONDARY PARTICULATE STANDARDS FOR SELECTED YEARS

* EPA Region X data

Source: State data -- provided by Monitoring and Data Analysis Division, OAQPS, EPA

Figure 16

SULFUR DIOXIDE TRENDS FOR SELECTED CITIES



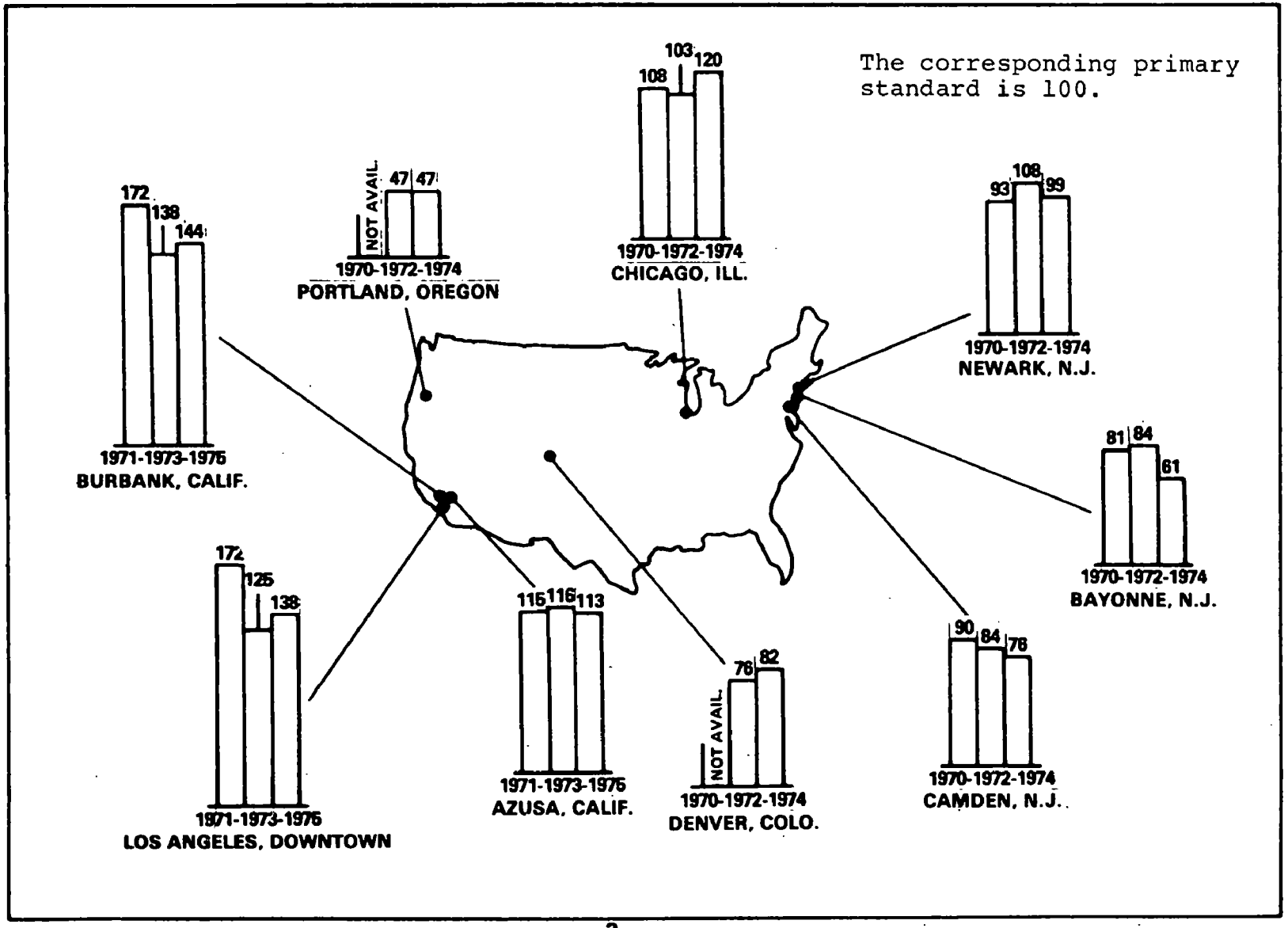
KEY: ANNUAL MEAN SO_2 – BUBBLER DATA

NOTE: The corresponding air quality standard (80) is indicated by the horizontal line above each graph.

Source: State data -- provided by Monitoring and Data Analysis Division, OAQPS, EPA

Figure 17

NITROGEN DIOXIDE TRENDS FOR SELECTED CITIES

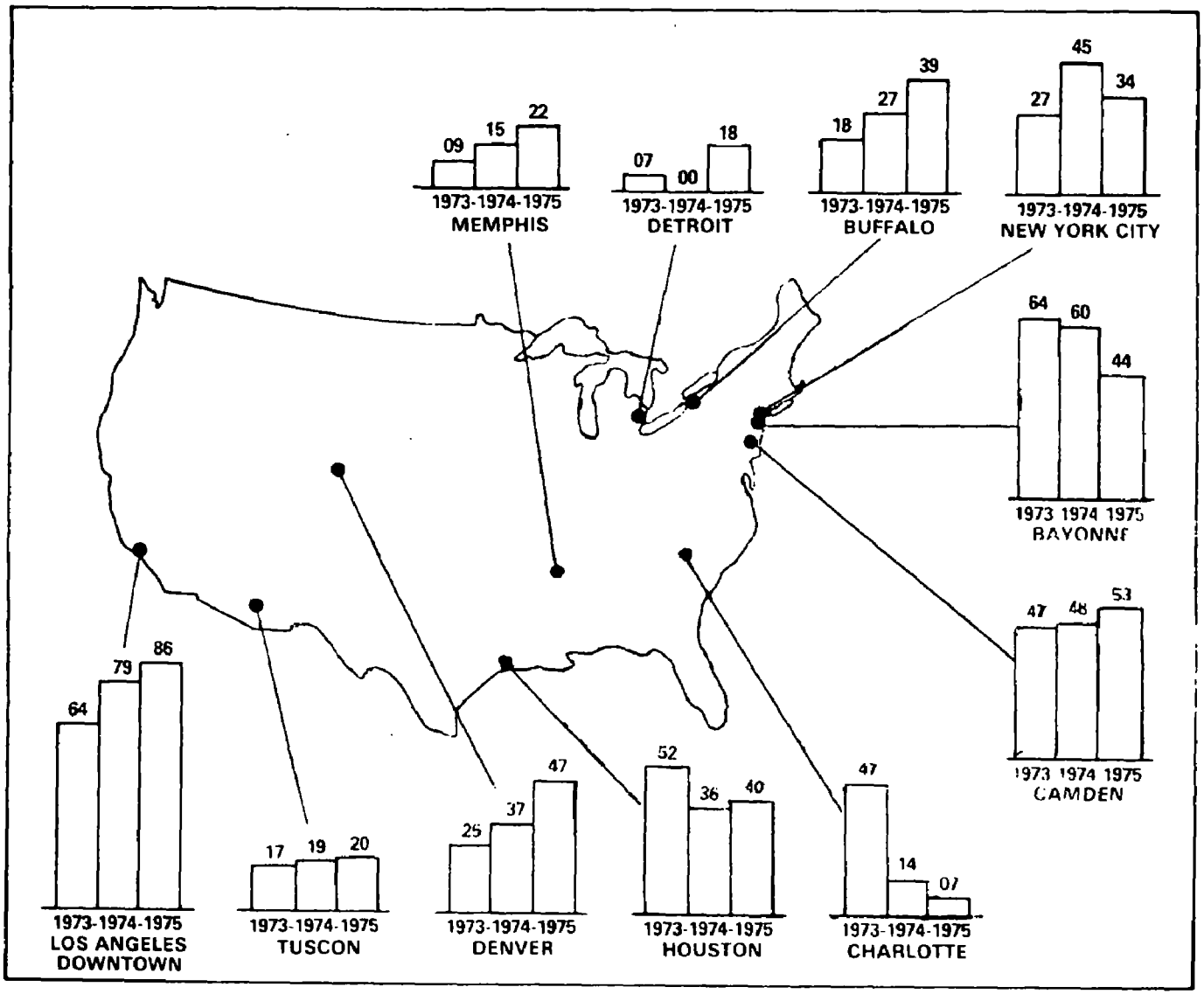


KEY: ANNUAL MEAN NO_2—MICROGRAMS PER M^3

Source: State data -- provided by Monitoring and Data Analysis Division, OAQPS, EPA.

Figure 18

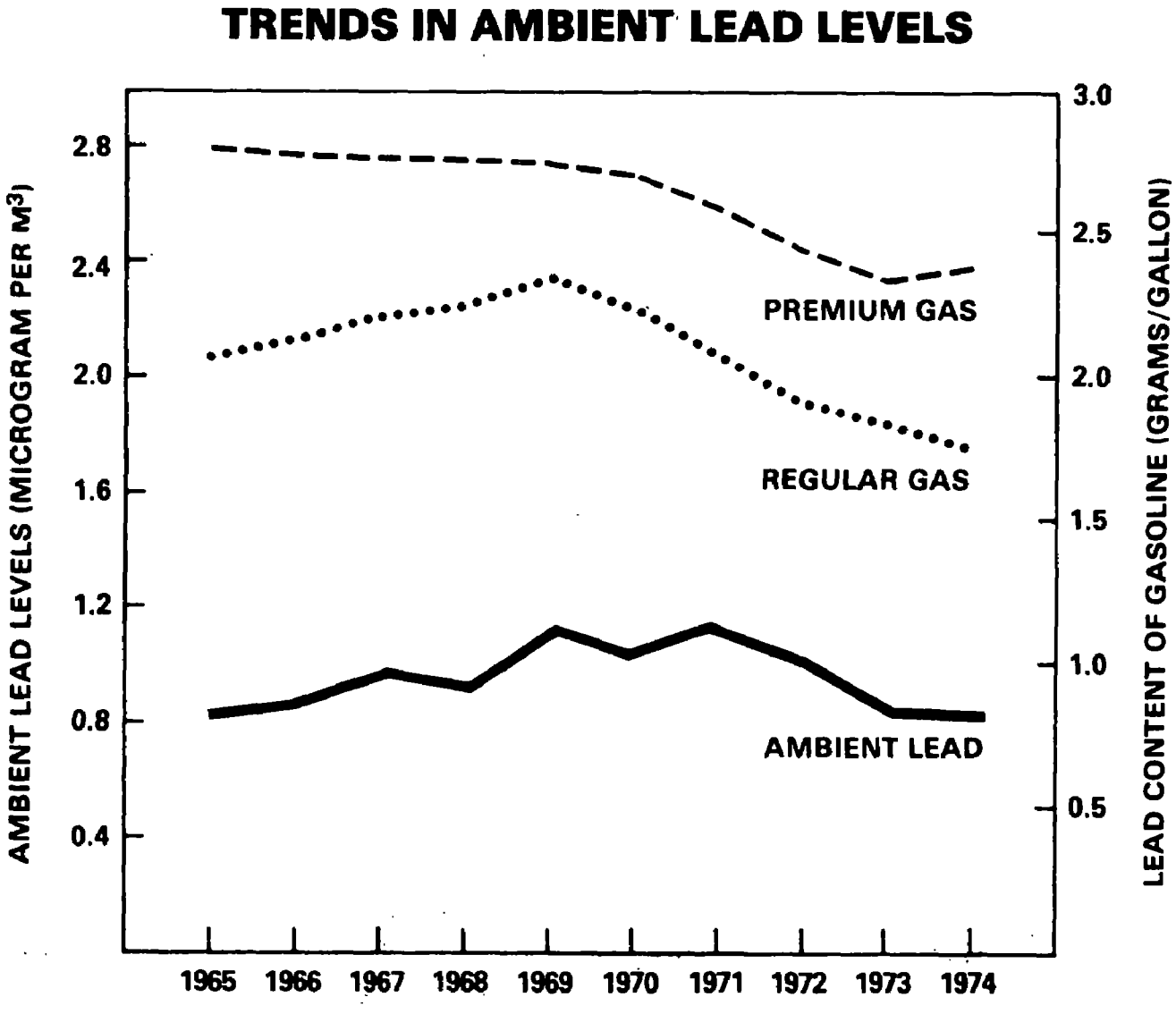
OXIDANT TRENDS FOR SELECTED CITIES



KEY: PERCENT OF DAYS AT OR ABOVE THE OXIDANT OZONE STANDARD (.08 ppm 1-hr) THIRD QUARTER

Source: State data -- provided by Monitoring and Data Analysis Division, OAQPS, EPA

Figure 19



Source: Office of Research and Development, EPA

also escape into the air primarily from automobile tail pipes; it is used as an anti-knock additive in most high octane gasolines. With the required use of low-lead and unleaded fuels, the lead levels in the air have started to recede (Figure 19). Ambient levels of lead are now as low as they were in 1965, and are continuing to decline, despite the larger number of cars on the road.

SO2 and Particulates -- Twin Problems

Two of the major pollutants that hang in the air over the Nation's cities are sulfur dioxide, which is colorless, and suspended particulates, which are highly visible. Both are unpleasant to breathe and harmful in high concentrations.

Suspended particulate matter is airborne dust and grime in all its forms. It lies on the air as a dark haze that dirties all exposed surfaces. Houses in cities where particulates are a problem must be painted more often than elsewhere. Moreover, particulates can become dangerous to health when they enter the lungs.

SO2, when it mixes with water vapor and oxygen, is converted to sulfurous and sulfuric acids, both of which are corrosive and capable of pitting metallic surfaces. SO2 and its related compounds are especially damaging to human tissue. The lungs are particularly vulnerable, even more so when the pollutant and its compounds have become attached to particulates

The hazards of SO2 and particulates are especially pronounced because they tend to be formed at the same time -- with the combustion of most coal and some fuel oils. However, efforts to control levels of SO2 and particulates have produced some of the finest achievements in pollution control of the last five years.

The Big Three

Among all classes of stationary sources, three stand out as pre-eminent contributors of particulate and sulfur dioxide emissions:

- Coal-fired power plants.
- Coal-burning industrial and commercial boilers -- i.e., heating plants for specific factories or buildings.
- Integrated iron and steel mills and coke plants, which transform coal into industrial coke for use in steel mills.

In 1970, these three classes of sources emitted 35 percent of all particulate emissions nationwide and 62 percent of all SO2 emissions.

Figure 20 shows how potential and actual emissions from these sources changed from 1970 to 1974. It also shows how far they still must go to comply fully with the emission limits of the State implementation plans.

In each graph, the total height of the bar reflects what total emissions would be if the industry had no pollution controls. The shaded portion of the bar indicates actual emissions. The unshaded portion shows the amount of emissions prevented by applied pollution control technology. The "1975 levels" show where the industry should have been, not where it actually was.

The Chart reveals that particulate emissions from power plants and steel mills were already fairly well controlled in 1970. Some further reductions have been achieved by power plants, but very little by steel mills. Considerably more will be required if air quality goals are to be met. Without a strong pollution control program, the new power plants and steel mills built between 1970 and 1974 would have raised the spectre of still higher emissions. But current pollution control requirements have caused emissions actually to decrease, despite a larger number of sources.

Particulate emissions from industrial boilers, which were high in 1970, were cut substantially by 1974. Further reductions are still required.

Not So!

There was little control of SO2 emissions in 1970 for any of the three classes of sources. But by 1974 the emissions had been curbed substantially. Reductions in power plant and industrial boiler emissions brought these sources within reach of the full compliance goals. Further reductions will now require scrubbers and will be harder to accomplish.

Reductions in SO2 emissions from steel mills by 1974, although significant, still left these sources far from their full compliance levels.

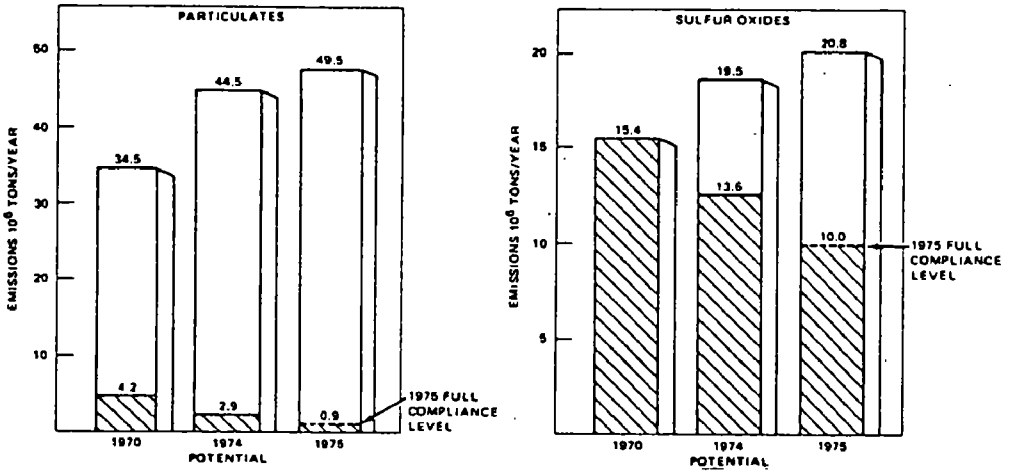
Places Where the Air Is Clearer

Most meteorologists and experts in air pollution control maintain that overall trends in air pollution levels can best be measured over a span of five years or longer. Much of the

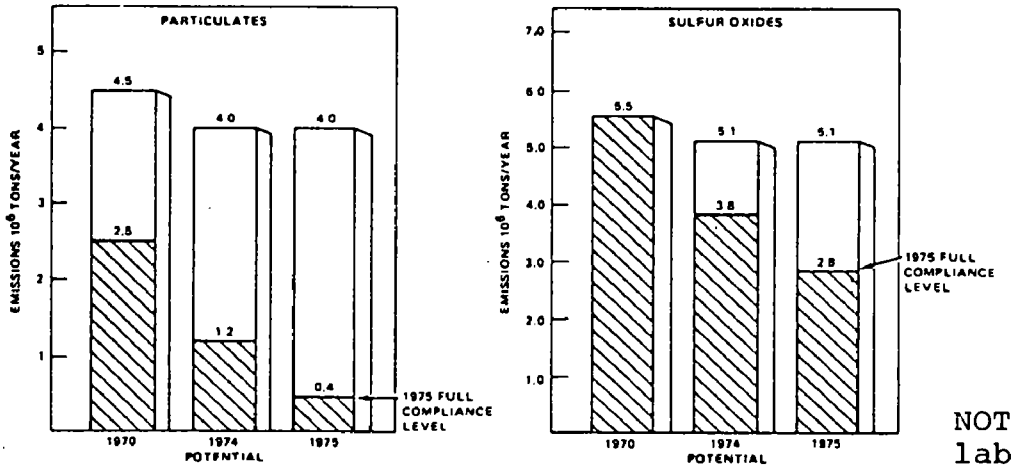
Figure 20

EMISSIONS REDUCTIONS ACHIEVED BY SELECTED INDUSTRIES 1970-1974 PARTICULATES AND SULFUR DIOXIDE

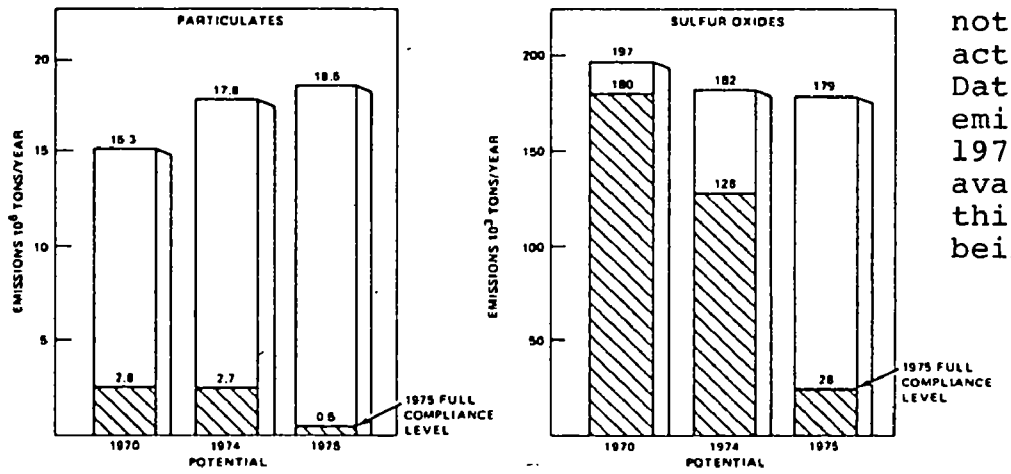
COAL FIRED POWER PLANTS



COAL FIRED INDUSTRIAL/COMMERCIAL BOILERS



INTEGRATED IRON AND STEEL MILLS AND COKE PLANTS



☐ CONTROLLED EMISSIONS ▨ ACTUAL EMISSIONS

SOURCE: DSSE, EPA DATA

NOTE: Bars labelled "1975" show target levels for that year, not the level actually attained. Data on actual emissions for 1975 were not yet available when this report was being prepared.

data we cite in this section does not meet that criterion. But in the data that is available, there are encouraging signs that the clean-up efforts are working.

The New England States are among those that have won a striking victory over air pollution. The primary standard for SO2 is no longer violated in Rhode Island, Massachusetts, Vermont, New Hampshire or Maine.

Plants in those States are permitted to burn only low-sulfur fuels. However, if the regulations are relaxed to allow burning of higher sulfur fuels (and the EPA believes that they should be in some cases), SO2 levels may increase -- unless stack gas cleaning devices or fuel-cleaning technologies are used.

Particulate emissions have also been curbed substantially in these States. Ten incinerators in Massachusetts that once emitted 17,451 tons of particulate matter a year now emit only 106 tons -- a reduction of over 99 percent. That has more than halved total particulate emissions in the areas of the State where the incinerators are located. Six paper mills in New Hampshire and Maine once emitted 40,153 tons of particulate per year. Those levels have also been cut by 99 percent -- a 70 percent reduction in particulate emissions in the areas where the mills are located.

In the greater Portland, Oregon area, particulate standards were violated in 1970 by emissions from a variety of sources. Wood processing plants alone accounted for 40 percent of the particulates in the air. Industrial fuel combustion, grain loading facilities along the Columbia and Willamette Rivers, and a large aluminum processing plant also contributed substantially. Control of those sources helped Portland meet the primary standard for particulates in 1973, and the secondary standard in 1975.

An air quality maintenance plan is now being drafted that will assure that particulates never return to their former, unacceptably high levels in the city.

In Springfield, Missouri, the local pollution control agency in 1970 opened a vigorous attack on the sources of particulate emissions, most of which were industrial. Ambient standards violations were traced to wood preserving activities, gray iron casting, chemical lime manufacturing, and electric arc furnaces and boilers using wood chips and saw dust for fuel.

All sources are now in compliance. As in Portland, no primary standard violations have occured since 1973 and no secondary standards violations since 1975.

In some areas -- designated by the EPA and the States as Air Quality Control Regions -- primary standards are not, as yet, fully met. But air quality is nonetheless substantially better.

One such region is the New York metropolitan area. Figure 21 shows how sections of the city exposed to primary standards violations have been reduced markedly from 1970 to 1974. The current situation is still not totally satisfactory, since primary standards are still being violated. But further control actions are underway by State and local agencies, with the support of the EPA, and the already small part of the city still subject to standards violations will continue to shrink.

The situation is similar in Detroit, Michigan, and in surrounding Wayne County: as late as 1971, air pollution was a serious problem. At some locations the air was irritating to breathe. Since 1971, particulate emissions have been reduced from 139,000 tons per year to 82,000. SO2 emissions have dropped from 490,000 tons per year to 250,000. Eighty-five percent of the major sources are in full compliance with emissions limitations. Smoke from burning rubbish and from apartment and home furnaces have also been curbed substantially, and the air in Wayne County is consequently cleaner.

The enforcement effort, however, continues. In 1975, some 42 Detroit area firms made additional changes in their operations, mostly adding new pollution control equipment, and that has reduced emission levels still further.

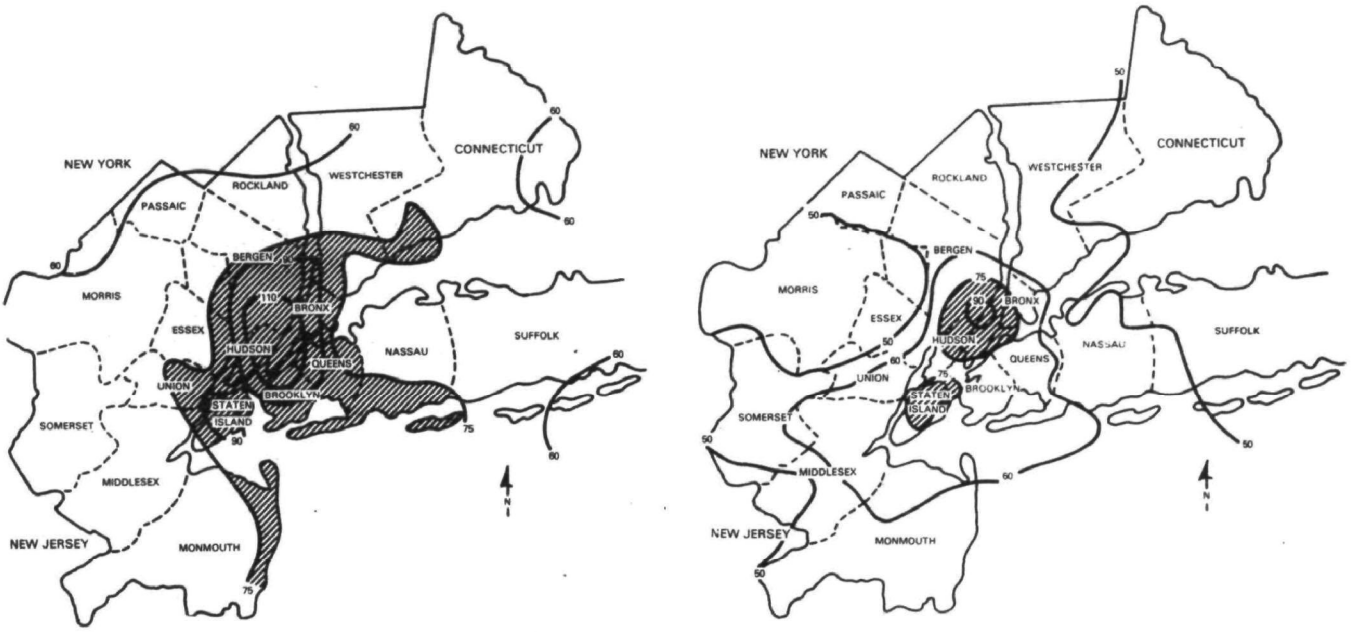
Gary, Indiana, was notorious for its heavy industrial pollution. For years its skies were clouded and red with smoke and soot -- particulates -- largely from the mills and plants of the United States Steel Corporation.

Over the last few years that has started to change. In 1965, particulate levels in Gary were almost 2 1/2 times the primary standard. By 1970, they had been reduced to 1 1/2 times the standard. In mid-1976, although the primary standard was still routinely being violated, the extent of the area exposed to unacceptably high pollution levels has shrunk. Industry, however, still has far to go to keep pollution at safe levels in the city.

In Chicago, in 1970, two of every five monitoring stations showed violations of the annual standard for SO2. In 1975, there were no violations at all. In the same period, particulate levels fell significantly. In 1970 every monitor showed a violation of the particulate standard; in 1975, only half the stations recorded violations. Chicago once was considered a "dirty-shirt town" because of the soot-laden air. It is still far from a clean-air city, but with the success of past and present pollution control efforts, Chicago is losing the stigma of its old reputation.

Figure 21

Population Exposure to Particulates
New York Metropolitan Area
1971-1974



9.9 MILLION PEOPLE EXPOSED
1971

2.9 MILLION PEOPLE EXPOSED
1974

— AREAS WORSE THAN ANNUAL STANDARD (75$\mu g/m^3$)

SOURCE: OAQPS, EPA DATA

In Cincinnati, Ohio, in 1970, 85 percent of the monitoring stations reported violations of the annual standard for particulates. In 1975, fewer than 15 percent did.

Birmingham, Alabama, in 1972, registered annual average particulate levels 2 1/3 times the primary health standards. By 1975 the highest level had been reduced by 23 percent--to 1.8 times the primary standard. Further reductions are expected in the next two years. As of mid-1976, annual particulate emissions had been lowered 83 percent from 1972 levels -- from 155,000 tons per year to 26,350 tons. A drop of 10,000 tons more a year is planned by 1977. The days are now gone when Birmingham was perpetually enveloped in a smokey haze.

In Las Vegas, Nevada, particulate pollution came from an entirely different source than in the big cities of the South and the North. Emissions from two power plants were fully matched by the combined particulate emissions of five major mining operations, which produce mineral lime, gypsum, and titanium.

In the last few years, one of the power plants and the five mining firms have reduced their particulate emissions by more than 95 percent, from 5,450 pounds per hour to between 160 and 230 pounds.

In Chattanooga, Tennessee, and its surrounding valley, particulates have also been a severe problem. Tight control of several classes of sources, however, has lowered emissions from 14,848 tons a year in 1970 to 4,800 tons in 1976. And air quality levels have improved. In 1975, only two of twelve monitors operated by Hamilton County recorded annual ambient air quality levels above the standard.

In Philadelphia, municipal refuse incinerators once contributed nearly a tenth of all particulate emissions. Two of the six incinerators have been equipped with electrostatic precipitators and the rest have been converted to transfer stations from which refuse is hauled to landfills. Ninety-nine percent of the emissions from the incinerators has been eliminated.

In Pennsylvania and the other Mid-Atlantic States, power plants remain a prime contributor to particulate and SO2 levels. In the period 1970 to 1975, the States of Virginia, West Virginia, Maryland, Delaware, and Pennsylvania have lowered power plant particulate emissions by 462,559 tons per year -- a 58.6 percent reduction from those sources over the last five years. The reduction has contributed significantly to lowered levels of ambient particulate. Average levels in these States dropped from 4 percent above the primary standard in 1970 to 16 percent below the standard in 1974.

Pollutants from the Exhaust Pipe

Motor vehicles emit several major classes of pollutants, including hydrocarbons, carbon monoxide, and oxides of nitrogen. The hydrocarbons and oxides of nitrogen join in the air to form photochemical oxidants -- which form the infamous smog of Southern California. Motor vehicles are also the primary source of carbon monoxide emissions.

Photochemical smog first became a severe problem in Los Angeles County because of the early dependence on the automobile and the especially adverse meteorological conditions in the basin. Now photochemical oxidants have become perhaps the most widespread and troublesome of all air pollutants nationwide.

California, appropriately, was the first State to begin controlling emissions from motor vehicles in earnest. The State's emission standards for new motor vehicles date to 1966, two years before the Federal program began. The first benefits of control actions were felt there as well (Figure 22). And the State continues to set emission standards more stringent than elsewhere in the U.S.

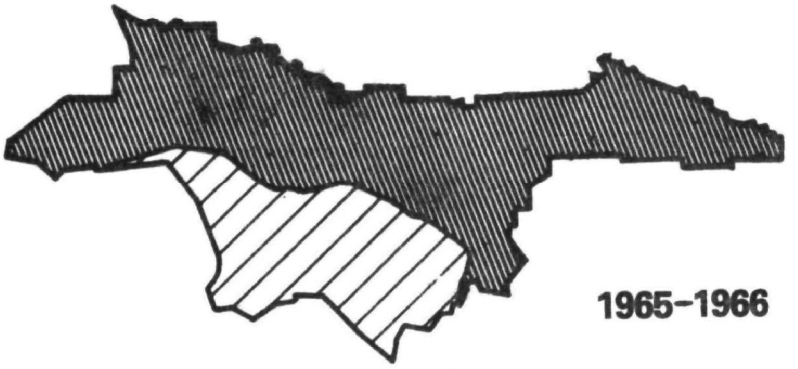
While the changes are significant, they are no cause for complacency. Oxidant levels several times the standard still occur regularly in suburban areas to the east of Los Angeles. And virtually every person in the metropolitan area is still exposed to air in violation of standards. Although short term patterns, such as shown in Figure 18 for the Los Angeles downtown site, may conflict with the general downward trend, violations are not as frequent or as severe as they were five years ago.

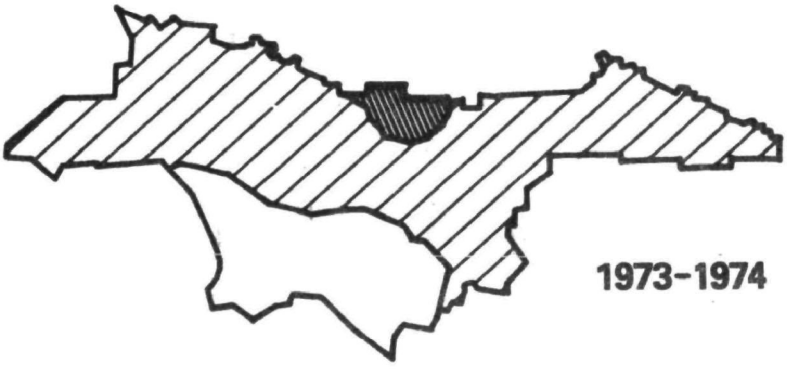
Emission controls on vehicles have also lowered carbon monoxide levels in California. In the last five years, the magnitude of the highest one hour carbon-monoxide concentration was decreased by 21 percent in metropolitan Los Angeles, by 13 percent in the San Francisco Bay Area, and by 55 percent in San Diego County.

Although emission controls on cars help, it is now clear that alone they will not be enough to achieve oxidant air quality standards in the most severly polluted areas. If air quality standards are to be met universally, something will have to be done -- especially in urban areas -- to diminish the heavy American reliance on the personal automobile as the primary mode of transportation.

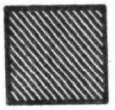
Figure 22

Population Exposure to Oxidants
Los Angeles Metropolitan Area
1965-1974



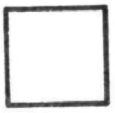


Shading indicates fraction of days each year on which standards violations occurred:



more than 50%

20-50%



fewer than 20%

SOURCE: OAQPS, EPA DATA

The Street Campaign Against Auto Pollutants

Changing so basic a pattern of transportation takes time. Meanwhile, vehicle related pollution must be dealt with in the interest of public health. The EPA, in concert with State and local governments, has looked for answers in four directions: vapor recovery at the gas pump, inspection and maintenance programs for vehicles on the road, reduced vehicle use, and, to a lesser extent, more efficient traffic patterns.

Vapor Recovery

The wavy fumes floating from a gas tank when a car is being filled are hydrocarbons -- gasoline vapors -- escaping into the air. Vapor recovery aims to recapture those hydrocarbons at various fuel transfer points where they are likely to be emitted -- at ship and barge onloading and offloading docks, at truck terminals, at storage tanks, and at service station gas pumps. Controlling such emissions is a difficult and expensive process.

There are two steps to vapor recovery: control of bulk transfer losses, and control at the gas pump. The EPA promulgated Stage I and Stage II regulations, which specify the nature of those controls, in late 1973. The District of Columbia made control of bulk transfer losses mandatory in 1974, and nine states set a uniform deadline of March 1, 1976. Six of those States, and the District, are also scheduled to introduce gas pump controls by May 1, 1977.

Controls on escaping vapors can, in some cases, deliver emission reductions great enough to bring an urban area's air into compliance with ambient standards. Vapor recovery can be implemented by local ordinances, as they are in San Diego, San Francisco, and the District. The ordinance then becomes part of the State Implementation Plan.

Colorado's approach was to form a vapor recovery task force. On it sit representatives of the EPA regional office, the State Air Pollution Control and Oil Inspection Divisions, local fire departments, and the gasoline marketing industry. The task force smoothed the way for installation of recovery systems now operating at all seven bulk gasoline terminals and at some 1100 gas stations in Denver. These efforts are expected to recapture 3000 tons of vapor in 1976 -- almost a million gallons of gasoline.

The deadline for gas station controls in the city is May 1, 1977. The task force is now ironing out the cost and safety wrinkles of a system that will eliminate the estimated 2,500 tons of vapor lost yearly at the pump.

California is committed to controlling service station vapors in all of its major metropolitan areas. The San Francisco Bay Area, not without some difficulty, began a two step program in 1973. It completed the first stage, bulk transfer control, in 1974. The second stage, pump recovery, began on January 1, 1976, after several delays. Vapor recovery systems at the Bay Area's 2,500 service stations will capture some 3.5 million gallons of gasoline a year.

A recent EPA-commissioned study suggests that the onus of installing recovery systems might be burdensome for small bulk plants. The $5000 cost per station for San Francisco gas pump systems -- which will cost the consumer about 1.2 cents a gallon more for gas -- was objected to by many operators. Some have sought court orders suspending the regulation indefinitely.

While recovery costs money, it also clearly saves gasoline. An EPA study in Texas estimates that emission reductions at gasoline storage tank loading sites in 1976 was 2,500 tons in the Houston-Galveston area and 919 tons in San Antonio. That will mean savings of 1.7 million gallons of gasoline a year. That same control, plus pump control, in other areas of Texas could save another 13,000 tons a year -- an estimated 8.2 million gallons.

Controlling Auto Emissions

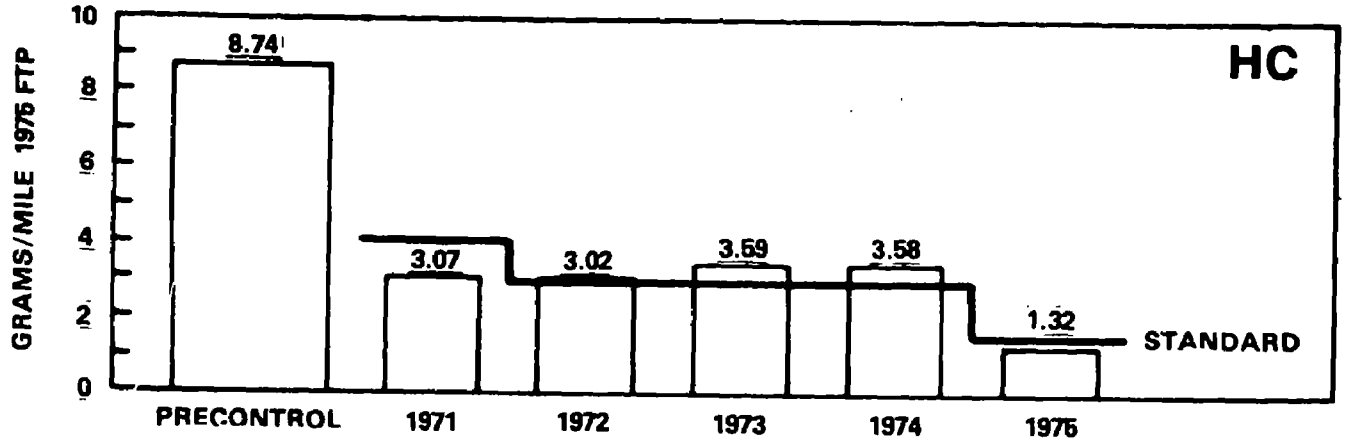
The strict emissions standards that Congress originally required new-car manufacturers to meet by 1975 were essentially technology-forcing. The standards have been adjusted on a continuing basis since 1968. Even with the cleaner new cars, meeting the goals of the Clean Air Act in heavily polluted areas will require controlling emissions of vehicles already on the road. If the original new-car standards for 1975 had been met, hydrocarbons would have been cut only in half by 1977 because of the continuing use of older cars. Moreover, while automobile control systems are capable of the required reductions, experience shows that even controlled vehicles are not meeting standards throughout their useful lives. In part this is because they are not properly maintained.

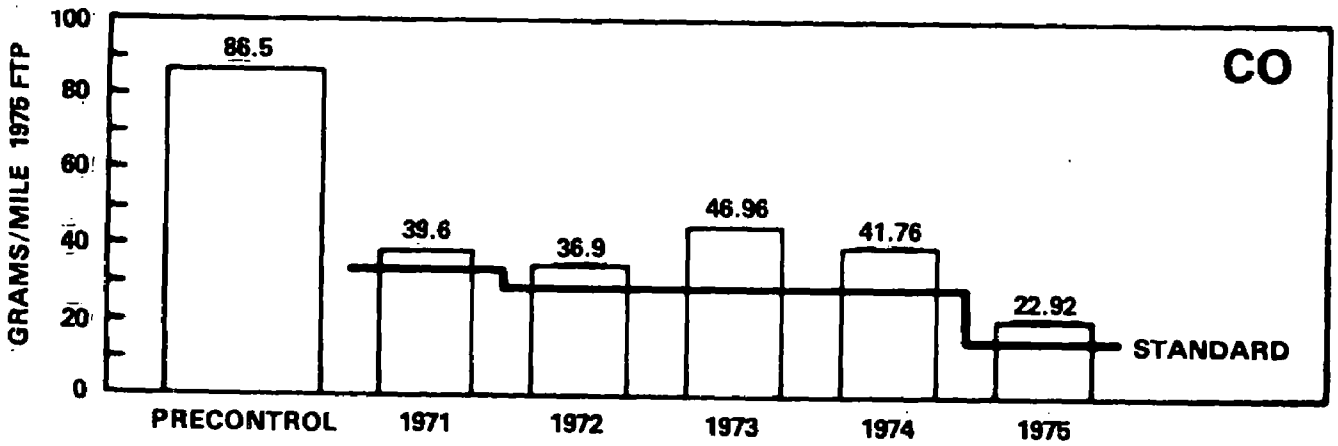
Cars are required to meet standards for 50,000 miles, but as Figure 23 shows, emissions have been increasing as the car grows older. Even after one year of operation, the majority of cars do not meet their emissions standards.

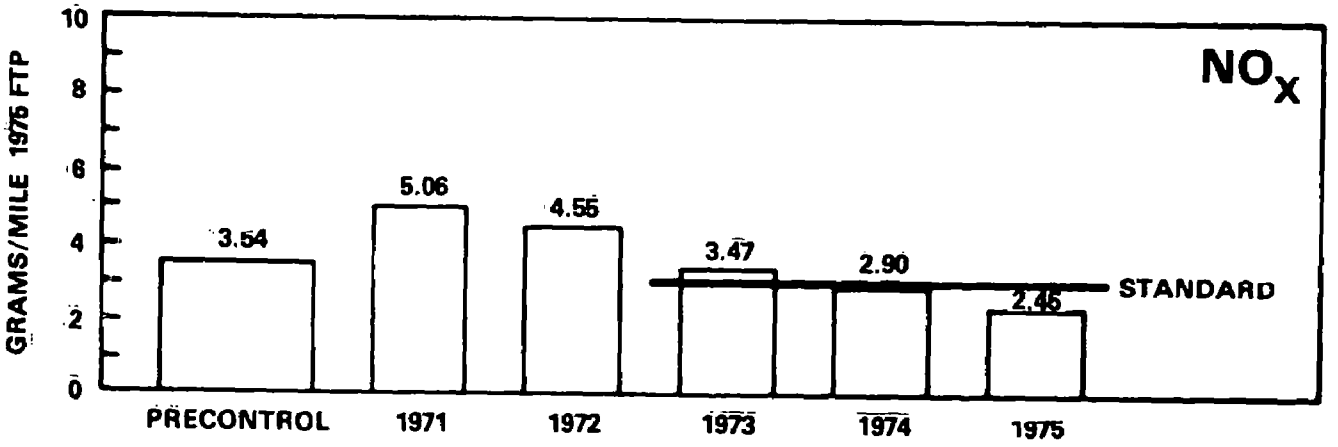
Inspection and maintenance (I/M) programs are one way to bridge this performance gap. The States and the EPA continue to press Detroit to produce better control systems for the future. But I/M is still considered a critical part of the overall strategy.

Figure 23

AVERAGE EMISSION LEVELS FOR AUTOMOBILES AFTER 1 YEAR OF USE







NOTE: (1) Although vehicles tested were considered to be "one year old," the average mileage of the vehicles tested varied from 8,800 to 15,600.

(2) The data for 1974 and 1975 are preliminary.

Such programs are in operation now in various States and cities. Chicago, Cincinnati, New Jersey, Arizona, Nevada, and Oregon are all implementing one of a variety of systems. Riverside, California, has a pilot program that is expected eventually to encompass the Los Angeles area. The Riverside program is unique in providing extensive diagnostic data about the engine -- down to the condition of a particular spark plug. This not only could help meet air quality requirements, it could help prevent major individual breakdowns and improve gas mileage.

Curbing Vehicle Use

The third thrust in the offensive against vehicle-related pollution would reduce the number of vehicle miles traveled. At least 63 urban areas will require more than just cleaner cars to attain standards by 1985. Ways will have to be found to assure that even the cleaner cars are driven less. A spectrum of incentives and disincentives to reduce vehicle use are possible.

Discouraging driving with more attractive alternatives is one approach. New Jersey has been a leader in that effort. Regulations issued in 1974 called on large employers in certain parts of the State to design programs to inspire employees to use mass transit and carpooling instead of individual cars. So far, 149 companies have filed such plans, which include a mix of car-pooling, company transportation, and mass transit promotion strategies. Six New Jersey companies and one New Jersey State official have been awarded certificates of appreciation by the EPA's regional office for their outstanding efforts in the program.

The six companies are Bell Telephone Laboratories, Hoffman-LaRoche, Inc.; Sandoz, Inc.; Insurance Company of America's Corporate Information Services Division; Prudential Insurance Company of America; and the Singer-Kearfott Division of Aerospace and Marine Systems.

Spreading out the Traffic

Emissions can also be reduced by more efficient vehicle routing.

In Lincoln, Nebraska, air quality monitoring in 1974 showed eight violations of the one-hour carbon monoxide standard (40 milligrams per cubic meter) and 328 violations of the eight hour standard (25 milligrams per cubic meter). The monitoring station is located near the central business district -- on the city's principal traffic artery.

The Lincoln-Lancaster County Health Department, was notified of the violations by the regional EPA office. When it learned they were traffic related, the department went to the city council and the city traffic planners and devised a plan to re-route traffic and synchronize signals to reduce traffic congestion at stop lights.

Carbon monoxide data analyses are not complete for 1975. But the data now available suggest success: they show a descending curve of carbon monoxide emissions at the monitoring station.

SOLID WASTE -- STEMMING THE TIDE

"Solid waste" includes most of the discards of our high consumption society: garbage, empty bottles and plastic wrappings, animal carcasses, worn out tires, junked refrigerators and cars, and old newspapers and magazines -- an endless list of items no longer needed or wanted. The outpouring of waste has quickened since World War II with the proliferation of plastics and disposable packaging of all kinds.

The traditional method for disposing of solid waste was to "dump" it -- either in an "organized" site on unused land, or else at random on a vacant lots, in stream beds, or along the roadsides. The case histories that follow will show what has been done by the States -- with EPA support -- to change this throw-away tradition.

The Campaign against Open Dumps

A site on St. Thomas in the Virgin Islands is an extreme example of the environmental drawbacks of the traditional open dump. It also shows how enlightened solid waste management practices can make a difference.

Managers of the main dump on St. Thomas burned the solid waste regularly, creating significant air pollution and odor problems. Bulldozers would level the dump and push the remaining refuse into the adjoining waters of the Atlantic Ocean, thereby extinguishing any lingering flames and extending the dump area seaward. When coastal winds and current shifted, waste would be scattered along the southwestern shore of the island.

When it rained, the rain water percolating into the ground would carry contaminants from the exposed refuse down with it. The resulting leachate threatened to undermine the quality of the local drinking water.

Moreover, the dump site, in operation for 15 years, covered 15 acres next to the Virgin Islands' principal airport. The smoke restricted pilot visibility, making an already tricky airport a much more hazardous place to land.

In 1973, the EPA threatened to use the 1899 Refuse Act to close the dump. So Virgin Island officials re-routed the flow of wastes to a landfill on the southeastern side of St. Thomas. While the new operation does not conform completely to recommended practices, it is still a great improvement over the old open dump.

The EPA has continued to press for even better solid waste disposal practices in the Virgin Islands. The Agency has funded programs to help develop a solid waste management plan, to institute training programs for operators of solid waste facilities, and to establish and staff a solid waste planning office.

While threatened EPA enforcement action played a decisive role in the Virgin Islands, improvements in waste management elsewhere have rarely stemmed from direct Federal intervention. In most places, State, not Federal, officials have forced the decisive improvements of the last five years. The EPA's role has been limited -- by Federal law -- to granting small amounts of "seed money" and significant amounts of technical and planning assistance. However, with EPA encouragement and support, State programs since 1970 have become stronger and substantially more effective.

Wisconsin is an example of how an action-oriented State agency armed with the necessary authority can make things happen. The State, like many others, has concentrated on promoting properly engineered sanitary landfills.

As the name implies, landfills are well-controlled land disposal sites for solid wastes. In a sanitary landfill, wastes are first spread and compacted in layers a few feet thick. They are then covered daily with a layer of earth and again compacted. In such sites, potential odors, fires, and wind blown wastes are controlled. The site is also prevented from becoming a breeding ground for flies, rats, and other potential disease carriers.

Once landfill operations are terminated, the site is suitable for recreational uses. Many of them have been made into golf courses or parks.

Local authorities in Wisconsin, working with the State's Department of Natural Resources, accomplished these things:

- Closed a dump in the City of Washburn that had allowed surface runoff to empty into an adjacent ravine. The site was re-engineered, sloped, covered with topsoil, and seeded to stop the runoff problem. A new site was opened in a more suitable location and is being run now as a sanitary landfill.

- Re-engineered an abandoned dump in the City of Merrill to stop further serious leaching into the groundwater. They also improved operations at the current site to eliminate runoff problems.

- Converted a large open, burning dump in Lincoln County into a sanitary landfill and were then able to close many small dumps.

- Selected a geologically suitable site for a new landfill in LaCrosse County. The topography and soil type at the site now prevent runoff or leachate from polluting streams or groundwater.

- Developed a landfill design adequate to prevent runoff and leachate in Juneau County, where no naturally suitable sites were available. The design includes a clay liner beneath the site and a leachate collection system. Several landfills in the county without such design features and with documented leachate and runoff problems are being closed.

The cumulative impact of these efforts, and many more like them, has been to cut to a minimum the polluting effect of solid waste disposal in the State.

Other States have also done exceedingly well, particularly in the Midwest. Among them:

- Iowa in 1970 had 800 open dumps. In July, 1976, it had only 240. In 1970, there were only 10 sanitary landfills, serving 10 percent of the State's population. There are now 109 serving 93 percent of the population.

- In Missouri, from 1970 to 1976, the population served by approved landfills jumped from 10 percent to 82 percent.

- In Kansas the increase was from 20 percent to 91 percent.

In all four of these midwestern States the changes have come with tougher State-wide solid waste legislation and better staffed State agencies. When the Federal Solid Waste Disposal Act was adopted in 1965, a total of two persons staffed these four State agencies; there are now 40. In the intervening years the number of open dumps in the four States has diminished from an estimated 2400 to 744, and vigorous efforts to improve land disposal practices are continuing.

Sludge -- A New Worry

Household and commercial wastes -- trash and garbage --

are only part of the solid waste problem. Another, of mounting concern, is sludge, the residue generated by air and wastewater treatment operations. The pollutants that were prevented from entering the air or water become the sludge. Since indiscriminate dumping of sludge into the water or air is no longer allowed, ridding ourselves of it has become a major land disposal problem.

The most troublesome sludge -- because it is so abundant -- comes from municipal sewage treatment plants. It will become an even more acute problem as more and more wastewater treatment plants go on line under the new, stricter water quality laws. Municipal sludge is a particularly vexing problem because it frequently carries highly toxic metals and organics, which, when disposed of on land, can be taken up by crops or leach into groundwater and contaminate drinking supplies.

The EPA has established a multi-disciplinary task force to help States, localities, and industry find the best ways to dispose of their hazardous wastes. In the meantime, localities have been approaching sludge disposal in various ways and with various degrees of success.

Lake County, Illinois, for instance, designed a special landfill for sludge disposal. The 271 acre site consists of an access road, a sludge storage building, and a leachate collection system. Ten monitoring wells have also been constructed, at a cost of $12,000, to help verify that leachate does not pollute the local groundwater. If such pollution is detected, the county will take steps to correct it. The cost of the facility, including the land, trucks, and machinery, came to $860,000. By comparison, one rejected alternative was a $5 million incinerator. When the site is totally filled, as projected, in 25 years, it will be turned into a park.

Another Way to Do It

Land disposal must for a while remain the principal method for dealing with most solid waste. However, two other solid waste management techniques are beginning to emerge:

- recycling, also known as resource recovery, which reuses rather than discards the material in unneeded items, and

- waste reduction, which entails redesign of consumer products or packaging so that less waste is generated in the first place.

Resource recovery is especially promising and it benefits in two ways: first, it fosters conservation, rather than disposal, of potentially valuable resources; second, it reduces the volume of waste to be disposed of in landfills, and thereby cuts land disposal costs.

Certain grades of paper, some metals, and energy have all been recovered successfully from municipal wastes.

Energy is recovered by burning the "organic" portion of solid waste, such as paper that can't otherwise be recycled, plastics, and food scraps. Energy recovery alone can substantially reduce waste volume: as little as 5-15 percent of the initial waste remains afterwards. Moreover the revenue from energy recovery can more than pay for itself.

Energy from Wood Wastes

While widespread recovery of paper, metals, and energy holds promise, it is still in the demonstration stage. Alternatives less comprehensive, however, are already in operation. Among them is energy recovery from wood wastes.

A system developed by the American Walnut Company is a notable example. The company's Kansas City, Kansas, plant saws and processes walnut wood for gun stocks and other wood products. It generates, as unwanted byproducts, large quantities of sawdust, wood chips, and other wood waste.

The company originally burned such wastes in a teepee burner, which created a dense plume of black smoke. When cited for violating local air pollution ordinances, the company modified the burner design. Not only did that fail to reduce pollution sufficiently, it increased the plant's consumption of natural gas. The company then attempted, unsuccessfully, to find a buyer for its wood waste. Finally it decided to construct a starved-air type boiler that generates steam by burning the waste. That worked. Part of the steam, formerly generated by a gas-fueled boiler, is used to cure wood. The remainder is sold locally to other users of steam.

The net result: a twin advantage -- less air pollution and less consumption of natural gas.

Recycled Paper

The Federal Government itself is one of the leading practitioners of the art of recycling -- and selling -- high grade waste paper.

In Denver alone, 30 Federal agencies, under the direction of the Federal Regional Council, have reclaimed 361 tons of waste paper in less than a year and sold it to a Wisconsin firm for $38 a ton. EPA guidelines now call for the program to be extended to Federal agencies nationwide. It is estimated that 223,000 tons of high grade paper fiber a year will be recovered, recycled, and sold. The operation will save the government $7.4 million a year in waste disposal costs and allow 3,791,000 trees to remain unlogged.

Energy savings are a further benefit. Paper can be made from recovered fibers with 60 percent less energy than from virgin materials.

Salvaging Abandoned Cars

Market demand and market price alone are often reasons enough to recover energy or waste materials. But sometimes they aren't. Salvaging abandoned automobiles, for instance, is not always profitable.

In Montana, the distance of the State from scrap markets is so great that auto salvage isn't profitable for a private salvage company. State lawmakers have therefore adopted legislation to help underwrite the cost of removing auto hulks. The program is financed by nominal fees: $2 on transfer of vehicle title and fifty cents at the time of annual re-registration.

These funds have been used to establish and maintain county graveyards for junked cars. When 200 hulks have accumulated in one of these yards, the State advertises for bids to haul them away for scrap metal.

An unanticipated benefit of this program is the energy it saves. Producing a ton of steel from auto scrap takes 8500 kilowatt-hours less energy than producing the same amount of steel from iron ore. In some areas of the country that much energy could supply the electrical needs of an average household for an entire year. The program thus has not only eliminated a blight on the Montana countryside, but it is saving energy.

The Bottle Bills

Waste reduction means not just recovering useful materials from the waste stream, but preventing them from entering that stream in the first place.

For instance, instead of "recycling" bottles -- collecting them after they are discarded, then melting them down and using the glass to make new bottles -- they can be designed to be returned and reused. This saves the cost and energy of having to remanufacture the bottles between each use. Since bottles and other packaging items make up a large share of America's waste stream, the savings can be significant.

In Oregon, a bottle bill was passed by the State legislature in 1971 and took effect in October 1972. It banned the sale of beer and soft drinks in pull-tab cans. It imposed a minimum two cent deposit on beer and soft drink bottles of a standard design reusable by more than one bottler, and a five cent deposit on non-standard bottles reusable by only one company.

Oregon legislators viewed the bottle bill chiefly as a litter-control measure, although the people who lobbied for it were also aware of its potential as an energy saver. The idea was that Oregonians would return bottles to grocery stores to recover their deposits rather than throw them out their car windows. Pull-tab cans simply would not be available to throw away.

Oregon's bottle bill has been popular and effective.

- Roadside litter has been drastically reduced. Studies and surveys show that beverage related litter has declined by 83 percent.

- Consumers are returning a surprisingly high percentage of the beverage bottles to retailers to redeem their deposit money. On the average, four out of every five bottles leaving stores are coming back.

- Consumer prices for beer and soft drinks have remained competitive with those of neighboring Washington State, which does not have a bottle law.

- Consumers overwhelmingly approve of the bottle bill. In polls taken throughout the state since it was passed, 90 percent said they favored it. A similar percentage said that returning bottles to the store was not an inconvenience, which claim is borne out by the fact that they are buying more beer and soft drinks than ever.

- The switch to returnable containers in Oregon saves energy sufficient to heat the homes of slightly over 2 percent of Oregon's population -- or some 40,000 people.

The idea shows some prospect of spreading. Vermont soon followed Oregon with similar legislation. Bottle bills were on the ballot in four other states in 1976 -- Maine, Michigan, Massachusetts and Colorado. They passed in Maine and Michigan.

RISKS, SPILLS AND DISASTERS

In the early morning hours of a day late in October 1973, fifteen cars of an eastbound freight train careened off the track and plunged into a gully near the village of Rush, Kentucky. Hearing the crash from his wooden frame house across the road from the wreckage, Bobby Joe Middleton saw fire spreading under the cars and hurried his wife and three children through the rain and darkness to a neighbor's home a few hundred yards away. As he watched, 10 minutes later, a tank car exploded, sending flames 50 feet high, destroying his car and truck and the surrounding trees, blistering the paint on his house, and melting the window panes.

Two of the derailed cars were filled with acrylonitrile, a highly flammable liquid used in making plastics, which can give off cyanide gas when exposed to air. Forty-three thousand gallons of the highly poisonous fluid gushed into Williams Creek, killing fish and setting it afire. Several car loads of coke burned fiercely on both sides of the track. A car filled with metallic sodium, also highly reactive, lay ruptured on its side.

State policemen and members of the Boyd County Rescue Squad arrived and spread out across a broad area surrounding the wreck, warning residents not to drink the water and to keep livestock away from the stream. The EPA regional office in Atlanta sent an on-scene coordinator and undertook to evacuate the valley. An area three miles in diameter was cordoned off.

Earthen dams were built across the creek, peat moss was applied as a filtering agent, and stream water was sprayed upward for aeration. The chemical remaining in the cars was allowed to burn off, to prevent cyanide contamination and further explosions.

Since Williams Creek runs into a tributary of the Ohio River, scientists feared contamination of that major waterway. The EPA initiated several weeks of intensive monitoring, while railway cleanup crews cleared the debris, to ensure that drinking wells and the Ohio itself had not been poisoned. When concentration of acrylonitrile dropped rapidly in the vicinity, it was decided that the area was once again safe for the local residents. A cooperative effort by State and local authorities, railroad crews, and the EPA had headed off what might have been a major environmental disaster.

Dealing with Crises

One EPA function is to act in environmental emergencies such as that. It is in the business of scaling down environmental risks, whatever their form. That means keeping a watchful eye on whatever degrades the quality of life -- and doing so in such a way that the local community and its economy are disturbed as little as possible.

Where risks must be evaluated, the Agency draws on its centralized store of experience and technical resources to recommend the safest operating procedures. When an accident such as the one in Kentucky does occur, EPA's role is to help the States and localities cope with the consequences.

The Agency runs a vigorous spill prevention and control program. Since its oil pollution prevention regulation was issued in late 1973, more than 7,100 Spill Prevention Control and Countermeasure (SPCC) plans have been reviewed.

In the Southeast alone several thousand on-site inspections were made at oil storage facilities. The U.S. Coast Guard and State agencies joined in the inspection and review effort, and by 1975 only 692 oil storage facilities in the Southeast -- about 10 percent of the total -- were not in full compliance.

The measures have paid off. U.S. Coast Guard records show a gradual, steady decline in spills from those facilities. In 1973, 2,660,000 gallons escaped; in 1974, 1,524,936 gallons were spilled; by 1975, the figure was down to 1,149,113 gallons, half what it had been three years before.

An EPA Midwest regional office has received seven spill reports in petroleum operations since January 1975. Each spill was contained by folowing the procedures specified in the local SPCC plan, with no resulting damage.

Public Law 92-500 put the onus of preventing and cleaning up pollution accidents largely on industry itself. The oil industry, responded in many areas across the country by forming spill response cooperatives to help bear that burden at least cost.

The Southeast Wyoming Spill Cooperative, for example, was formed in 1972 by twenty-one companies from all phases of the oil business -- exploration, drilling, refining, and pipeline transmission. The Co-op has stockpiled materials for cleanup and containment at strategic locations within its area

of coverage, from which they can be quickly dispatched to a spill site.

The company responsible for a spill is the first line of defense against it, not only by law but by proximity. Once a spill occurs, every minute counts. Even with jet aircraft, response time from the the EPA regional office in Denver to a remote Wyoming site would be counted in hours.

A 16,000 gallon spill into the Powder River near Kaycee, Wyoming, and a second spill, which dumped over a quarter-million gallons of crude oil into Casper Creek, did only negligible environmental damage, thanks to the Co-op, which moved swiftly to clear the oil from the waterway. Without such immediate on-the-spot action the spill could have been a disaster.

A Santa Barbara in Kansas

On one hot July night in 1975, a corroded oil line in central Kansas ruptured, sending 588,000 gallons of crude oil flowing downhill toward the Saline River, three miles away.

The immense magnitude of the spill, the largest in Kansas history, matched that of the 1969 catastrophe in the Santa Barbara Channel in California. The black torrent was discovered by an unfortunate cat, which returned in the early morning hours to farmer Fred Obermueller's house, wailing and with its fur slicked down.

By this time the oil had advanced to within a mile of the river. Amoco, owner of the pipeline, was notified and an all-out race to prevent the oil from reaching the waterway followed. Huge pits dug across the oil's path quickly filled to depths of 12 feet. The Kansas Department of Health and the regional EPA office both sent investigators and supervisory personnel to the spill site. The oil was pumped into transport trucks and stored nearby, while the remaining oil in the dry wash was burned or soaked up with prairie hay. Contaminated ground was plowed under or scraped off and buried.

The only damage from the incident: the loss of four small apple trees by farmer Obermueller and temporary contamination of the dry wash and some wheat fields that had already been harvested. Amoco's on-site cleanup chief predicted the fields would yield a poor crop during the next season, but a better than average one the year after when the oil in the earth will have decomposed and begun to act as a fertilzer.

A Chemical Spill in Kentucky

Ready access to the right information is critical in any environmental spill. It helped avert a catastophe near Lowe, Kentucky, on May 20, 1976.

The EPA was informed that a train carrying industrial chemicals had derailed outside of town. Cars were damaged and ruptured: 40,000 gallons of methylene chloride and carbon tetrachloride had poured into an adjacent stream, killing all fish and damaging its remaining biota. Other tank cars containing ethylene oxide, trichloroethylene, ethylene glycol and hydrofluoric acid lay tangled and leaking.

The EPA immediately notified the Kentucky State authorities and responsible railroad officials. Drawing upon the Technical Assistance Data System, a data bank set up to help in such emergencies, the Agency was able quickly to determine and to alert all concerned of the hazards of each of the toxic substances that had been spilled and how to handle them. Two-hundred fifty people were evacuated from the sparsely populated area, which was completely cordoned off.

For the next several days, EPA's on-scene coordinator continued to work closely with State, local, and railway officials to neutralize the spill and limit further damage. Several techniques, including aeration and filtration, were used to prevent wider contamination of the nearby water. Because of the EPA's experience in spill control and access to critical information and thanks especially to the diligence of State and local personnel, the efforts were successful.

Rescue At Clarksburg Pond

When the EPA's regional emergency response branch received a call in the summer of 1974 from the New Jersey Pesticides Project reporting hundreds of dead bluegill, sunfish, and bass floating in Clarksburg Pond, it sent an investigating team.

The investigators found a toxic herbicide called DNBP (dinitrobutylphenol) concentrated in the water. It had been used in an adjoining parking lot as a weed killer and had been washed into the pond by a heavy rain.

The Clarksburg pond holds about 3 million gallons of water and covers only slightly more than an acre of land. But the area's wildlife depends on the pond for its water. The toxic substance also threatened to contaminate the groundwater, and since the pond empties into a tributary of the

Delaware River, the Delaware was threatened as well. The spill into Clarksburg pond posed dangers that couldn't be ignored.

A unique device that had not even left the factory yet was hurriedly shipped from Wisconsin on a wide, flatbed trailer and reached the pond after two days of non-stop driving. Developed under a research contract from EPA, the huge unit, employing carbon column filters, began pumping the water out of the pond at 200 gallons per minute. Five filters, the first two sand and anthracite to trap suspended solids and algae, the other three each containing three tons of activated carbon, absorbed the bulk of the DNBP that had washed into the pond. After 90 cubic yards of gravel were removed from the lot, the area was flushed and the runoff put through the filtering unit as well.

Frequent samples of tap water taken from local homes since then have shown the groundwater to be unaffected. Today the pond is again filled with fish life. Birds, amphibians and insects are present in abundance.

A pesticide called toxaphene also sent the treatment trailer lumbering southward from Washington, D.C., the following spring. A bag of the highly toxic poison had been dumped in a pond near Plains, Virginia, and threatened to contaminate the Manassas water supply, which serves 40,000 people. After more than a month of cleanup operations, including filtration of the entire pond, most of the toxaphene was removed and the community was saved from harm.

The Clarksburg incident was the maiden voyage for the carbon-column filter -- and its first victory. It has since seen service not only at Manassas, but in a PCB spill in Seattle as well.

Toxics in the Duwamish

A 250 gallon dose of PCB accidently spilled into the Duwamish Waterway near a Seattle industrial-commerical complex in mid-September 1974. A Westinghouse electrical transformer containing the substance and owned by the Department of Defense was dropped in the water while being loaded aboard a barge.

Within two days an EPA field team had collected bottom samples and traced the spread of the toxic material. Most of the PCB had stayed near the dock where it had spilled, but there was a second pocket farther out in the waterway.

The EPA had three choices. It could send down hard-hat divers to pump the contaminated water and mud into a Navy barge; it could remove it through a 22-inch pipeline dredge onto Kellogg Island offshore; or it could use small hand held dredges to pump the water and spill material into pre-settling tanks and then use the physical-chemical treatment trailer from New Jersey.

It chose the third alternative, and by late October had recovered 80 to 90 gallons of the contaminant. The Army Corps of Engineers was then ordered into the emergency by the Department of Defense. In March, as the engineers dredged, the EPA continued to monitor the PCB in the waterway.

The substance, for the most part, had penetrated only a foot deep into the bottom mud. But at the spill site itself there were still dangerous levels up to four feet deep. Dredgers finally had to dig all the way to bedrock -- 10 to 12 feet deep -- in their efforts to recover as much PCB as possible.

Another 140 to 150 gallons of PCB's were removed by March 13. All together, 220 to 240 gallons of the original 250 gallons spilled had been removed. Most of the danger was past.

The PCB Search

PCB's were only recently recognized to be persistent and widespread threats to the environment. They can cause birth defects, even when present in low levels. They can accumulate in the food web, and they are harmful to fish and shellfish, which absorb high quantities of the substance from polluted waters.

First manufactured in 1929, PCB's have been used in paints, castings, hydraulic fluids, and in refrigeration and electrical systems. In 1970, Monsanto, the only U.S. producer, voluntarily restricted its sale of PCB's to those using it in transformers and other "closed systems." The company cut its annual production from 70 million to 40 million pounds.

The Los Angeles County Sanitation District in 1970-73 began to investigate several hundred industrial discharges in a search for the sources of PCB's in that area. By 1975, district investigators found there were only four significant sources remaining -- all rebuilders of transformers. The district worked with the companies to stop the PCB's from entering the sewers. Separate work areas were set up for equipment containing the chemicals, and even workmen's clothes were kept separated for eventual disposal in a special landfill for hazardous wastes.

Speedy detection of the PCB sources was only possible because Los Angeles County requires industries to have "separation boxes," which allow samples of industrial effluents to be taken before they enter the sewer and mix with the effluents from other dischargers.

PCB levels in the district's combined effluents had already been reduced dramatically -- from 76 parts per billion (ppb) in 1970, to 16 ppb in 1972 (reflecting Monsanto's voluntary control effort) to below 0.02 ppb by 1975. And now, since the district's work with the rebuilders of transformers, PCB levels have dropped below the limits of detectibility.

Irreparable Harm

At times, the environmental damage from a toxic substance as persistent as PCB can be irreparable.

In March 1973, some 1500 gallons of a PCB and a second, very similar compound, were spilled when the driver of a truck, noticing a leak from the liquid cargo, dumped the entire load on the roadway in a rural area near Kingston, Tennessee. The chemical was absorbed into the soil over a wide area.

The substances were Aroclor 1254 and polychlorinated benzenes, both highly persistent and very toxic. Three days after the dumping, the EPA began the first round of a sampling program that lasted several months. Initial data pointed up the presence of the substances in both the groundwater and the soil.

Massive cleanup operations initiated by EPA were carried out by the companies bearing legal responsibility. Contaminated soil was packed and sealed in metal drums and shipped from the spill site. Almost 12,000 drums were filled from trenches and excavations in three areas. When safe levels of the chemical had been reached in both the water and the soil, the landscape was restored by sealing and backfilling.

The cost of the cleanup was a million dollars, plus many thousands of dollars later paid in suits brought by local residents. Two years after the initial spill, the EPA studied the fate of the spilled materials. The findings showed the chemicals to be highly tenacious. The PCB and polychlorinated benzenes had not undergone any significant amount of biodegradation, and while the levels still present at the site are not considered hazardous, they will remain there for many years to come.

Fishing Expeditions

It is one thing to track down a known quarry, but quite another to go hunting without knowing what you're looking for. EPA does such "reconnaisance monitoring" periodically, to detect unwanted elements in the water or air. It does not always return empty handed.

While analyzing water samples as part of its national drinking water study in 1975, the EPA found concentrations of the suspected carcinogen BCEE (bis-chloroethylether) in Philadelphia's water supply. Its source was traced to the Rohm and Haas Company's Bridesburg Plant, which temporarily halted its manufacture and immediately started to install treatment equipment. Within the year the levels had dropped low enough to meet EPA guidelines.

In April 1976, a citizen's group discovered a toxic and carcinogenic component of rocket fuel in Baltimore's air. The EPA traced the source to the FMC Fairfield Works. The Agency then cooperated with the Maryland Bureau of Air Quality to bring about the voluntary shutdown of the process that was letting the toxic into the air.

In the same year, the Dupont plant in Belle, West Virginia, was discovered discharging DMN, a toxic and carcinogenic chemical, into both the air and the water. It was a byproduct of the manufacture of certain organic chemicals. Dupont eliminated the water discharge, and is now working with the West Virginia Air Pollution Control Commission to install control equipment to eliminate the air emissions.

Detective Story

Locating the source of a pollutant is not always so easy. When the EPA received a letter from a Harrodsburg, Kentucky, citizen complaining of a recurring odor from the town's major spring and creek, it consulted with the Kentucky Department of Natural Resources, which requested the Agency to investigate further.

State investigators had already conducted dye tracer studies and found a connection between the Harrodsburg spring and a sinkhole into which the Corning Glass Works discharged its wastewater.

The State had also concluded that the odor was caused by decomposition of Sphaerotilus, microrganisms that feed on nutrients in the water. For some as yet undetermined reason, the Sphaerotilus were dying, leaving behind a malodorous slime.

But why were they dying? And was the connection with the Corning sinkhole responsible? Compounds of strontium and the rare earth element cerium were found in water samples from the spring, in sediment collected from Town Creek, and in wastewater discharged by Corning. Since these elements are not native to Kentucky soil, and were present in Corning's discharge, the State and the EPA considered the source found and the mystery solved.

Corning agreed to install additional treatment equipment and alter manufacturing techniques to improve the quality of its discharge. It has worked. Citizens report no further odor from the spring, and the slime growth that plagued the creek has disappeared.

Repairing the Damage

No amount of planning and prevention can reduce environmental risks to zero, or prevent the inevitable moments when the EPA is faced with a "fait accompli." The steps that follow a disaster or potential disaster then become critical: ending the destruction, saving what remains to be saved, and making sure it won't happen again.

Utah's Ogden Bay lies along the eastern edge of the Great Salt Lake on a major flyway for migratory waterfowl. It is a beautiful, fragile, and incredibly varied eco-system with extensive nesting and feeding areas.

But for several years, until the summer of 1974, a veritable death trap -- a five and one half acre waste lagoon -- lay a scant half-mile away from the refuge. The lagoon contained oil residues and acid sludge from an oil recovery operation conducted for a railroad in the late Sixties.

Even after the operation was abandoned, the waste continued to be dumped into the natural drainages and was contained by poorly constructed dikes. A combination of precipitation, runoff, and high ground water left a lagoon system containing three layers of waste material: an oil/water emulsion on top, a strongly acidic, oil-contaminated water layer, and, on the bottom, acid sludge and contaminated filter cake.

The lagoon became an irridescent, polluted pond. Its glistening surface attracted and trapped hundreds of waterfowl, including Canadian Geese and several varieties of ducks. On one occasion the bodies of eight sheep were also found floating in the stagnant liquid.

The major threat to wildlife, however, was not entrapment in the lagoon itself; it was the imminent danger of a massive failure of the dikes. More than a million gallons of oil emulsion and contaminated water would then flow into the refuge itself.

State and Federal officials were alarmed. In October 1973, EPA Administrator Russell E. Train declared the lagoon to be an imminent and substantial threat to the environment, and requested that the United States attorney for the district of Utah seek relief in the courts. Attempts to encourage the owners of the property and the owners and operators of the re-refinery to cleanup the lagoon dragged on for several months, with no action.

In 1974, a Federal team began to work hand-in-hand with Utah State and county agencies to initiate a cleanup plan. It soon became evident that immediate emergency action was required. The lagoon was dangerously full -- scant inches remained between the oil surface and the top of the dike. The annual peak of precipitation was imminent, and this, combined with spring snow runoff, could lead to overtopping and catastrophic failure of the dike.

As a first stop-gap measure, emergency contractors placed sandbags in the eroded and weakened portions of the dike and constructed an oil-skimming pond to contain the emulsion in the event of a break. A road had to be built up and a work area constructed. Irrigation pumps skimmed waste oil from behind the weakened dike into another, higher section of the lagoon. Screens at the pump inlets were required to prevent bird carcasses from clogging the pipes.

It was decided to "land farm" the top two layers of polluted liquid. The liquid would be spread out in a thin layer on specially prepared Air Force land nearby and covered with a relatively impermeable clay. The process of emptying the pond and stabilizing the area then began. The bottom layer of sludge was treated in place. A clay liner was built around it and cross dikes were built to stabilize it. Then tons of alkaline soil were mixed with it and an 18-inch cap of clay was compacted over the area to seal it against erosion.

The capped and lend farmed oil has now decomposed to form a kind of artificial fertilizer today, local plant growth is re-established on the lagoon cap, and on the land farm there has also been an extensive regrowth of native vegetation. Graceful Canadian Geese still share the skies with the soaring flocks of seagulls, and herons and tiny wading birds continue to frequent the bay.

INDUSTRY -- MAJOR ACTORS IN THE ANTIPOLLUTION DRAMA

Industry, because it has played such a major role in polluting the environment, has also had to play a major role in cleaning it up.

Many companies have lagged. Some have had to be forced to take the necessary -- and expensive -- steps to undo the environmental damage done. Some have been more successful than others. A handful have pioneered new pollution control techniques and in doing so have accomplished far more than was expected of them.

The record is full of such efforts by industry. Four examples of where the struggle has been difficult or expensive, but also fruitful, are those of the pulp and paper, copper, power, and food processing industries.

Paper Mills

Pulp and paper mills historically have been among the worst water polluters. But new treatment facilities are changing that.

The paper industry in New York State is a good example. The 65 paper mills, which produce 6,500 tons of pulp daily, form the single largest group of industrial polluters in the State. In the early sixties, the industry was dumping a half-million pounds of organic waste (BOD) into State waterways every day, and it was consuming much of the lifegiving oxygen on which the fishlife depends.

The industry in New York was at first slow to act. But after State and Federal permits based on the new effluent guidelines were issued, 39 new treatment plants were built, 16 mills were hooked up to municipal systems, and steps were initiated for the other mills as well. This resulted in a record of accelerated pollution abatement in the 1970's unmatched by that of any other industry in the State.

Since the mid-60's, the BOD level in New York rivers has fallen from 500,000 to 165,000 pounds per day under the State's Pure Waters program. Plant expansions, closures, and new plant openings have left a net loss of six plants. Total production, however, remains about the same, despite a 66 percent reduction in discharged waste.

The technological breakthrough by the Gulf States Paper Corporation in the South may be a portent of things to come in the paper industry nationally. Its Tuscaloosa plant on Alabama's Black Warrior River is the oldest mill in the State, built when discharges into the river were virtually unregulated. The intervening decades saw the river further channeled for navigation and dammed for power production. Water flow sometimes dropped to 12 hours a week in the critical summer months. At times dissolved oxygen levels reached zero.

The company decided that a highly efficient effluent control system was required. It would take eight years of research to develop, but the outcome would be a tertiary wastewater treatment system no longer dependent on the river.

Today that system is a reality. A four-stage activated sludge process first removes 85-90 percent of the plant's BOD. Ultimately, the process removes over 90 percent of the color and most of the remaining BOD. The result exceeds the requirements of the toughest EPA effluent guidelines -- and they didn't have to be met until 1983.

In 1934, Gulf States Paper Corporation produced 45,000 tons of paper per year and discharged over 25,000 pounds of BOD per day. Today production is four times greater -- 180,000 tons per year -- yet the discharge has been reduced 94 percent to 1,500 pounds of BOD per day. The rate of discharge per ton of paper produced is now less than 2 percent of what it was in 1934.

Gulf States Corporation won a special award in 1976 from the Alabama Environmental Quality Association for its color removal system. And it received the American Paper Institute's 1975 environmental improvement award. The National Wildlife Federation also honored the company with a special conservation award -- only the third ever presented by the Wildlife Federation to a manufacturing company.

Copper Smelters

Copper smelters also generate a disproportionate share of pollution in some States. Seven smelters in Arizona, which represent about one half of the nation's copper processing capacity and contribute substantially to that State's economy, also emit most of the State's sulfur dioxide.

Many of the smelters were built decades ago when pollution controls were not considered essential. Inspiration Copper Company's old furnace in Miami, Arizona, for instance, was built in 1915.

The State of Arizona now has regulations to control SO2 emissions and is currently proposing to tighten them. But the Inspiration Copper Company did not wait for the State to tighten its regulations. The company began looking for alternative controls as early as 1970. By March 1971, it had decided to replace its old fuel-fired reverberatory furnace with an electric furnace that would allow 100 percent of process gases to be put through a double-contact sulfuric acid plant. This is the best system available for capturing sulfur pollutants that would otherwise be released into the air.

The system went on line in 1974 at a cost of $54 million. It has cut emissions -- both SO2 and particulates -- more than 90 percent and has virtually eliminated visible air pollution from the company's smelter operations.

Power Plants

Power plants, through sheer numbers, have the potential for enormous environmental impact. They can emit large quantities of SO2 and particulate matter, severely reduce visibility, and generally degrade air quality. But some companies have dealt with the problem effectively.

The Dairyland Power Co-op in Alma, Wisconsin, lowered its SO2 emissions by 80 percent after the Wisconsin Department of Natural Resources required it to switch to low sulfur fuels in 1974. The Co-op also installed an electrostatic precipitator that brought matching reductions in total suspended particulates. Ambient standards are now being met.

Fuel switching of that sort, however, is not always practicable. Other approaches permit use of less expensive forms of energy. The Kansas City Power and Light Company and the Kansas Gas and Electric Company built an 820 megawatt steam electric generating plant at LaCygne, Kansas, that uses such a process.

The plant is located near a large coal deposit, which straddles the Kansas-Missouri stateline. The coal is of low quality, containing up to 6.5 percent sulfur and 24 percent ash (which, after combustion, becomes particulate). If burned without controls, it would generate and emit 97,000 pounds per hour of SO2.

The company decided to install limestone slurry scrubbers, designed to remove 80 percent of the sulfur oxides from the flue gases. This plant was the first of its size to use flue gas desulfurization and is the largest such system in operation in the world today. The cost of its air pollution control equipment came to $45.4 million.

The Nashville Thermal Transfer Company takes the search for fuel economy a step further. The facility burns municipal solid wastes as its primary fuel to produce steam and chilled water for a limited number of buildings in downtown Nashville. The facility, therefore, doubles as a power plant and a facility for resource recovery.

Following its start-up in 1974, a number of severe mechanical, operational, and financial problems surfaced. An unfortunate cost-cutting decision allowed the plant to begin operating with equipment that could emit 2,036 tons of air polluting particulates a year.

One electrostatic precipitator has now been installed, which should allow the plant to operate with one boiler and comply with air pollution emissions by reducing particulate emissions 92 percent. In 1977, a second electrostatic precipitator will be installed, and both waste-burning boilers will be allowed to operate.

Diablo Canyon on California's Pacific coast illustrates the familiar problem of new technology bringing with it new difficulties.

During a 1974 test, Pacific Gas and Electric's 2300 megawatt nuclear facility was found to be discharging large amounts of copper from its cooling water system. The metal was killing marine life in the Diablo cove. Red and black abalone harvested by commercial fishermen and local skindivers were particularly hard hit.

Environmental detective work traced the poisoning of the abalone to corroding copper pipes. Whenever the power plant was shut off and the pipes emptied of water, salt air infiltrated into the system and corroded the pipes.

The California Department of Fish and Game, represented by the State attorney general, initiated legal action against PG&E in mid-1975 requiring the company to halt further pollution in the cove and to repair the damage to the marine

environment. By November the Company had replaced the copper tubes with non-corrosive titanium at a cost of $5 million.

A settlement is now being negotiated in which PG&E will finance construction of an abalone hatchery to be operated by the Department of Fish and Game. Abalone from the hatchery will be used to stock areas where kelp beds and sea otter are being reestablished.

Food Processing

One element is common to almost all food processing: organic waste. Finding environmentally sound methods to dispose of it requires approaches tailored to the unique circumstances of each industry.

Sugar Mills

The environmental impact of uncontrolled sugar wastes was most graphic in Hawaii.

Sugar cane mills produced "trash" (waste foliage) and "bagasse" (fiber left after juice extraction) equal in weight to 50 percent of the total harvest. The cane harvesting and sugar extracting process were also stripping substantial amounts of top soil away and into the sea. At the same time, the extraction process was failing to recover much of the sugar from the sugar cane.

Traditionally all of these wastes -- plant fiber, stripped top-soil, and organic wastes -- were discharged directly into the Pacific Ocean with the plant wastewaters. Huge floating mats of decomposing fiber were formed, sometimes washing up on nearby beaches. Thick sludge banks accumulated on the ocean floor. Red plumes of water fanned out in a thin film over the sea. Five sugar mills on the northeast coast of the big island of Hawaii dumped 4-5,000 tons a day of this flotsam into the ocean. Sixty to 70 miles of Hawaiian coastline were littered with bagasse.

State efforts to check it were unsuccessful, so the EPA started enforcement action against the mills in late 1972. This led to a consolidation of operations into five mills, eliminating three sources of pollution.

Permits called for an end to trash and bagasse discharges entirely, and for reduced suspended solids in the mill effluents. By the beginning of the 1976 season, all of the mills had achieved substantial compliance, and the water is now clear of the debris.

Still to come are steps to reduce the amount of suspended solids in cane washwater, and to find non-polluting means of disposing of the bagasse, which can be used as fuel to generate electricity. Two sugar mill companies already use it for that purpose. They sell the excess power they generate to the Hawaiian Electric Company. Adopted before the energy crisis, the process is already producing a significant percentage of Hawaii's electric power.

Other companies use the cane wastewater to reclaim land for cultivation. The soil and organic material from the wastes make a fertile mantle when laid over the porous volcanic rock so common on the Islands. Higher recovery of sugar from the wastewater has also paid off in more product per ton of cane harvested.

The pollutants, as frequently happens, have turned out to be of benefit when recovered and put to use.

Cattle Feedlots

Cattle and other animals raised for food generate wastes potentially damaging to an ecosystem.

Such a situation existed on an island feedlot in Idaho's Snake River, close to the town of Payette. The island was subject to annual flooding, which flushed organic matter, bacteria, and nutrients into the river.

The result was low dissolved oxygen and generally eutrophic conditions in both the Brownlee Reservoir and the river downstream. Fisheries and recreation were impaired and heavy algal growths appeared seasonally throughout the Hell's Canyon area. Odor from the feedlot discharges also afflicted area residents downriver.

A consent decree with the owner-operator in 1973 relocated the facility to an offstream site remote from waterway. This action focused the concern of the entire industry.

The Idaho Cattle Feeders Association was active in developing national effluent guidelines and in assisting its members to comply with them. The Dairymans Association, the Soil Conservation Service, the Extension Service, and the Food Producers of Idaho cooperated to greatly accelerate the installation of control systems.

Permits were issued to 73 feedlots with a total population of 400,000 animals. A large percentage of those feedlots were discharging process or runoff effluent to the

waters of the State. Complete compliance has been achieved by 69 of the feedlots, and the four remaining, with 14,000 head, are on acceptable clean-up schedules.

Potato Processing

Cattle feedlots were not the only source plying Idaho's rivers with organic wastes. Potato processing operations throughout southern Idaho also burdened the State's waterways in the 1960's and early 1970's.

The J.R. Simplot plant at Caldwell, Idaho, once a problem, today stands as a model of what a company can do.

Wastewater from the Caldwell plant carried high concentrations of nutrients, suspended solids, and BOD. It was given primary treatment in holding ponds, then discharged to the Boise River. This daily outpouring of 2,500 pounds of ammonia, 593 pounds of phosphorus, 7,500 pounds of suspended solids, and 41,000 pounds of BOD fed the algae and the sludge banks, and severely depleted the river's dissolved oxygen. The nutrients flowed on to create excessive algal concentrations in the Snake River's reservoirs from the Brownlee Reservoir on down.

Seasonal low flows in the Boise River prevented the company from using conventional biological treatment systems -- they just were not good enough. The Idaho Department of Health and Welfare worked with Simplot to arrive at a plan to meet the stringent water quality standards demanded in the discharge permit issued by the State in 1972.

J.R. Simplot elected to end its problems by ending its discharge altogether -- with a system combining primary treatment and spray irrigation. Prodded by a 1974 deadline, Simplot hurried construction of the system, and on September 6, 1973, advised the EPA that the Caldwell plant no longer discharged wastewater.

A study by the U.S. Soil Conservation Service and Agricultural Research Service indicated that virtually all of the 40,000 pounds of BOD, the nutrients, and suspended solids have been eliminated from both stream and groundwater. Dissolved oxygen levels have improved, and the sludge banks are disappearing.

Moreover, nutrients in the wastewater are now sprayed on the land to produce high protein forage, which is combined with other solid wastes from the plant to feed 26,000 yearling steers. The waste heat in the effluent now sprayed on the land allows a 10-11 month growing season and an annual yield nearly twice that of normal crop lands in the area.

Citrus Industry

In Florida, three thousand miles from the Snake River, another industry is demonstrating that waste products can be converted from a liability to an asset.

For many years, Florida's citrus processors dumped their liquid wastes into the nearest waterway, overloading the receiving water with organic material. The solid wastes were piled up on the ground. Like so many pollution problems, it developed because no one knew what else to do with the waste. The results were depressed oxygen levels, discolored waters, fish kills, and odors, which grew worse as the industry expanded.

The first attempts to seek alternative methods of disposal came shortly after World War II. The industry began producing cattle feed from waste peelings and orange pulp. By 1950, all of this solid waste was being converted into cattle feed.

In the early 1960's, however, a State of Florida study found that citrus waste was one of the most significant sources of pollution in Lake Apopka. Prodded by threats of legal action, the citrus industry started a long-term effort to treat those portions of its waste stream that were resulting in the greatest contamination.

In 1968 a Federal grant funded the construction of an innovative activated sludge plant at the Winter Garden Citrus Cooperative. This technology proved successful and additional systems were built at other sites. Some of these facilities are presently disposing of their treated effluent by spray irrigation.

Experimental spraying of citrus waste directly back on the orange groves is underway and results indicate that it can be done without damage to the trees or fruit. NPDES permits issued to most citrus processors in 1974 have spurred industrial programs to recycle cooling water and to use additional spray fields. The end result may be total reuse and zero discharge.

Today many of the formerly polluted lakes in Central Florida have returned to their original purity.

SAVING THE RARE AND THREATENED

Certain bird and animal species, stands of rare and valuable trees, national parks, and wetlands in general fall easy prey to pollution. They are finite -- and unique. They are easily wiped out and, once gone, they are gone forever.

For many years, before the tide of pollution became so alarming, little thought was devoted to protecting such forms of life and such areas of national value and beauty. But in recent years some have come so near to destruction or extinction that the danger to them could no longer be ignored. In many cases action came just in time. Here are a handful of examples.

Four Vanishing Birds

The osprey, peregrine falcon, bald eagle and brown pelican, four great and picturesque birds, were--until recently --all in serious danger of extinction.

Pesticides had affected the calcium metabolism in all of these birds, rendering their eggshells so thin that they broke under the weight of nesting birds, making reproduction virtually impossible. Recent bans on DDT, dieldrin, and restrictions on other chlorinated hydrocarbons, will diminish that threat. Pesticides, however, were not the only factor driving the birds toward extinction. In many cases their natural habitat was also being destroyed.

The osprey, an eagle-like fish hawk, had nearly been exterminated. Now it is slowly making a comeback. Some 130 young osprey were born in 1976 along Eastern Long Island Sound, the best brood in 20 years.

There have been massive cooperative efforts on behalf of the osprey by Cornell University, the New York Zoological Society, the Carolyn Foundation, the New York State Department of Environmental Conservation, and one private corporation, the Northeast Utilities Company. These concerned organizations have transplanted uncontaminated eggs and chicks from the Chesapeake Bay area to previously unsuccessful nests on Long Island and the Connecticut coast. Transplants were made in 1968, 1971, and 1973 and each time the eggs and chicks were readily accepted as their own by the adult osprey in the new location.

Cornell ornithologists started breeding the peregrine falcon in captivity in 1970. By 1973, the offspring of captive falcons were surviving. And in 1975, they were being

released regularly into the wild. This was a major milestone, since the peregrine falcon had not been seen in the skies over the eastern United States in 20 years. Now the goal is to release enough young birds so they can breed and re-establish themselves naturally on the eastern seaboard.

The bald eagle was also on the brink of extinction. Today there are several thousand new-born eagles in the United States. Alaska, Puget Sound, Chesapeake Bay, and the Mississippi River area all report rebounds in their eagle populations.

The bald eagle's return is no accident. In 1972, the Federal government, with the help of Seven-Eleven Inc., Hunt Wesson, and Anheuser Busch, set aside a 4000-acre eagle preserve in the upper Midwest. The Wisconsin Eagle Valley Environmentalists launched a campaign in 1976 to raise $2.5 million to help manage the preserve. The National Wildlife Federation set up a computer data bank as a clearing house for eagle information. Egg transplants between Minnesota and Maine are now common. And forest activities, such as timber cutting and snowmobiling, as well as overhead plane routes have been altered or restricted with the eagles in mind.

Brown pelicans are also returning to the coasts of Southern California and the Northwest Baja Peninsula in Mexico. Only four young fledglings were hatched in 1969. The number rose to 1185 in 1974. While their productivity is still too low to maintain population stability, their numbers have grown steadily since 1971. The increased breeding is probably due to the availability of more anchovies and the arrival of new birds from the more successful pelican colonies to the south. The higher fledgling rates reflect improved egg-shell conditions.

With continued strict control over toxic pesticides, all four of these once endangered birds should soon be a common sight again.

Mangroves -- Father to an Ecosystem

Mangrove trees are an essential component of Puerto Rico's sensitive ecosystem. As the mainstay of the transition zone between the land and sea, these trees, which grow in marshes, serve as protective barriers in stormy weather.

They are also a source of shelter and nourishment for an enormous variety of marine and terrestrial life. Their roots form a tangled web at the water's edge to trap sediment, leaves, twigs, and other flotsam, which compact into a firm

surface essential to sponges, sea anemones, oysters, and limpets. Such commercial species as the majarra, jack, snapper, and ladyfish spend at least part of their lives in the channels that lace the mangrove forests.

The detritus formed from their leaves, twigs, and bark is the basis for a food web essential to the marine community. Microorganisms feed on the detritus. Marine and insect larvae feed on the microorganisms. And juvenile fish feed on the larvae.

Many rare and endangered birds have been attracted to the peace and tranquility of the mangrove forests. It is not uncommon to spot a snowy egret, a peregrine falcon, or a little blue heron.

But the mangroves are in serious danger. More than 80 percent of them have been destroyed. Of Puerto Rico's original 64,000 acres, less than 12,000 remain. And, today the remaining forests are still threatened by public and private development projects.

The need to intervene was obvious when it became known that PFZ Properties, Inc., planned to develop the 266 acre Vacia Talega apartment-hotel complex eight miles east of San Juan. Of the 266 acres to be used for the complex, 170 are mangrove wetlands.

The EPA saw the danger and in September 1974, issued a notice of violation, ordering PFZ to cease discharging rock, sand, and dredged soils into the mangrove marshes without a permit. PFZ countered by challenging the order in court. And, in January 1975, the case was tried in the U.S. District Court in the District of Columbia.

The United States, in its case against PFZ, argued that:

- The mangrove wetlands are navigable waters since they have "historic navigability" and are connected to a navigable lagoon;

- The wetlands are therefore waters of the United States and;

- The Vacia Talega project would eliminate a mangrove forest in these waters vital the coastal ecosystem.

In short, EPA lawyers argued that the mangrove forests fell under the protective umbrella of the Federal Water Pollution Control Act.

The court ruled in favor of the EPA. It was a landmark decision, the first to expand Federal regulatory jurisdiction to wetlands. Using its authority under Public Law 92-500, the EPA has succeeded in protecting the mangrove swamps, at least for the time being.

PFZ has recently applied for a Corps of Engineers discharge permit, and a comprehensive environmental impact statement is now being prepared.

Yellowstone

American tourism boomed in the 1960's. And the National Parks were overwhelmed by sightseers. Yellowstone, one of the Nation's most magnificant natural showcases and the first of its national parks, absorbed a 50 percent increase in visitors. Each year, more than 2 million people flocked to enjoy the natural wonders of the great park.

An area naturally unsuited for extensive human use became, in the summer season, a burgeoning population center. Yellowstone began to share many of the problems familiar to the Nation's sprawling suburbs. The overload on existing wastewater treatment plants and sewer systems was tremendous. And the U.S. Park Service faced a dilemma: how to upgrade tourist facilities and still maintain the natural state of the park's waters. The future of the park's pristine streams and lakes, as well as that of the Yellowstone River, which originates in them, was at stake. Something had to be done.

In the late 1960's, a consultant evaluated the existing sewer systems and prepared a blueprint for a waste water treatment and disposal system. The Federal Water Pollution Control Administration made other pollution control studies and found these problems:

- Continued sewage discharge into Yellowstone Lake;
- raw sewage overflows from existing facilities; and
- existing treatment facilities not meeting established Federal requirements.

Once the Park Service had adopted a plan to alleviate these problems, Congress authorized $5 million for construction of necessary pollution controls. Small sewage systems were incorporated into the existing regional plants. Today, the systems serving the major population centers are complete, or nearly so. Virtually all direct discharges to surface lakes and streams have been eliminated. Land application of the treated efluent has been accomplished with spray irrigation and rapid infiltration.

However, there is still work to be done. Seasonal variations in both weather and tourism complicate operation of the treatment plant. So EPA has offered aid in the on-going construction of two new plants to cope with seasonal loads. The National Park Service is also currently evaluating the impact of non-point source pollution from campgrounds, motels, restaurants, and visitor areas.

But preservation of the natural beauty of Yellowstone now seems assured.

TWO CITIZEN TRIUMPHS

Often an environmental victory is a tribute to the actions, collectively or individually, of citizens. Rarely are such people able to employ the sanctions of legal authority or power of any kind; they must instead rely on a tireless resolve and a will to see an environmental wrong righted. If not for them, the work might not have been done, or if done, certainly not as quickly as it was.

Two examples shine through in the recent history of river clean-up efforts. One centers on a big western river, the Willamette, and is a tribute to collective citizen action. The other concerns an eastern river, the Buffalo, polluted to the extreme, and which now, on the way to rejuvenation, stands as a testimonial to the persistence of one man and a responsive State agency.

The Willamette

The Willamette, a giant of a river, the Nation's 12th largest in water flow, is a stream of great beauty and many uses.

Within its watershed stands much of Oregon's timber and farm land. Two-thirds of the state's population lives within its basin. And the basin contributes an equal proportion of the State's industrial output. It is a major source of domestic and industrial water supply and the mainstay of irrigation, navigation, power production, fishing, fish propagation, and recreation in the Pacific Northwest.

Today all known municipal and industrial wastewater sources on the Willamette are meeting Federal and State environmental requirements. The river is alive with migratory salmon, native trout, and other game fish. It is used for every form of water recreation -- fishing, swimming, boating, and canoeing.

It was not always so.

In the early 1920's, the Oregon State Board of Health found the Portland harbor area of the lower Willamette severely polluted. All industries and municipalities on the river were then dumping their wastes into the water untreated.

In 1927, the Portland City Club called the Willamette "ugly and filthy." It got to the point that construction workmen refused to work along its banks. A study conducted then by the Oregon Agriculture College --- now Oregon State University --- showed that levels of dissolved oxygen in the

river were dropping below 0.5 parts per million at Portland where the Willamette joined the Columbia. Five parts per million is the minimum desirable levels to support life on the river.

As late as 1967 the Izaak Walton League was describing the lower Willamette as a "stinking slimy mess, a menace to public health, aesthetically offensive and a biological cesspool."

Sulfite waste liquors toxic to fish were entering the water from paper mills and were lowering oxygen levels dangerously close to those lethal for migrating salmon. Rafts of sludge up to six feet across, buoyed by gases of decomposition, flecked the river upstream from Portland Harbor. Downstream from Willamette Falls, globs of stringy bacterial slime attached to floating wood fibers were befouling the river.

Oregonians, however, were not willing to put up with such conditions.

The story of active citizen concern for the welfare of the Willamette begins nearly as far back as the pollution itself. In the late 1920's, the Portland City Club surveyed local people and found 48 percent of them favored anti-pollution legislation for the river.

But it was a decade before this concern could overcome desultory and largely ineffective efforts and be translated into action. In 1938, after the State legislature failed to act, the Oregon electorate passed, by a 3 to 1 vote, a referendum creating a State Sanitary Authority and a comprehensive water quality control law.

Within nine years the first muncipal sewage treatment plant was on stream on the Willamette. In the next decade all cities in the valley built primary treatment plants. And by 1969 all of the plants had been upgraded and pollution from domestic sewage wastes had been reduced by 85 percent. But still the river was dirty. The main polluters now remaining were the pulp and paper mills.

What was to happen in the five years following 1967 is a story of collective citizen action unmatched anywhere.

Cleanup of the Willamette became a major issue in the 1966 gubernatorial campaign. Both candidates were pledged to it. And the man who won, Tom McCall, later personally chaired the 8-month long water quality standard-setting sessions of the Oregon Sanitary Authority. In that brief period the Authority set standards not only for the Willamette, but also

for all the other interstate and intrastate waters of Oregon, standards that were to be among the first in the country to win Federal approval under the new 1965 National Water Quality Act.

In 1967, the Oregon Legislature, riding the environmental wave sweeping the electorate, completely rewrote and streamlined the State's water quality laws. In 1969, it strengthened them further. By the time P.L. 92-500 was passed in 1972, Oregon was already closing in on the target set five years before for a revitalized Willamette.

Since 1973 the State has issued the permits necessary for all industrial and municipal facilities dumping into the river.

There are no more sludge rafts nor is there bacterial slime on the Willamette. Every "unsafe for swimming" sign has disappeared. Dissolved oxygen levels have risen above the 5 parts per million minimum in Portland Harbor.

By 1974, record salmon runs were coursing up the river. Crayfish no longer crawled out on the banks to die. Bass had reappeared in large numbers. Catfish, perch, and crappies were abundant. The sturgeon was as abundant as it had been at the turn of the century.

On the momentum of this citizen success, there is a continuing drive to make the river a model for the Nation. Plans for a greenway along the river's bank from Eugene to Portland are well underway. Work is started to further improve the water quality along certain stretches of the river. The State and three regional councils of government are now addressing the remaining problems of urban stormwater runoff and pollution from agriculture and forestry operations. The EPA has already made a grant of more than $3 million toward that work.

Wastewater treatment beyond the secondary level now prevailing in every city and industry on the river may eventually be necessary in the fast-growing Willamette valley. But if the past is any indication, Oregonians will demand it.

The Buffalo

When the nation was born, the Buffalo River was but a narrow, shallow stream emptying into the Niagara. It was a stream small enough that it could be worked with, shaped, contoured and controlled.

In 1818, it was dredged deeper upstream and its flow redirected. A century later it was straightened, widened further, and dredged still further upstream. And with the constant widening and deepening, it ran progressively slower.

It was shaped and reshaped and changed into the 1960's, until, during the summer months, when evaporation was high and precipitation was low, there was little or no discharge from the river at all. Indeed, it sometimes flowed upstream as water backed into it from Lake Erie.

By 1968, the river was an environmental disaster. A study found no oxygen and little life in it throughout most of its length. One of the biggest concentrations of heavy industry in America straddled its banks in South Buffalo. The river was so polluted by steel, chemical, petrochemical, and coke plants that its ink-black, oil-befouled surface broke into flames four separate times. It was poisoned by oil spills, phenols, iron, and unoxidized steel wastes, and by nutrients from municipal wastes.

In 1953, the New York State Water Pollution Control Board held a public hearing to classify all New York State streams. They were to be put in categories from Class AA (drinking water pure) to Class D (fit only for agricultural and industrial use).

Industrial spokesmen argued at the hearing that a classification between C and D was fitting for the Buffalo River and that Class C was unattainable. What they preferred was a classification that would permit industry to continue to discharge into the Buffalo's surface waters with minimum treatment.

In the audience at that hearing sat a retired Buffalo jeweler and realtor named Stanley P. Spisiak. He was not new to the conservation struggle. For 20 years he had been waging a one-man campaign against defilement of Lake Erie and its tributaries. At the end of the public hearings he demanded a second hearing in 60 days to permit a careful weighing of industry's evidence. It was granted.

Spisiak came to the second hearing armed with support from hundreds of people and organizations, data from the U.S. Public Health Service, and the backing of the Canadian Government.

When the hearing was over the Niagara and certain upper reaches of its tributary, the Buffalo, had been assigned a Class A rating. That meant that from then on the water

quality of the Buffalo had not only to be maintained at its current level, but drastically improved.

There followed in the train of that one-man victory, a two-decade long struggle against pollution of the river. In 1965, the City of Buffalo issued bonds to finance the multi-million dollar Buffalo River Improvement Project. The cost was to be amortized by the five major industries on the river over a 20-year span. The project came on line in 1967.

In 1965, each industry along the river was told by the Federal Water Pollution Control Administration, an EPA predecessor agency, to submit wastewater abatement plans with a target date of 1970 for achievement of planned pollution controls.

Primary responsibility for locating the sources of pollution on the river and finding the best ways to treat it fell to Eugene F. Seebald, the Regional Director of the New York State Department of Environmental Conservation for the Buffalo area and now Director of the State's Division of Pure Waters. In 1966, he surveyed the river by helicopter and boat and traced the discharges.

Seebald organized a joint task force of Federal, State, county, and city representatives for cooperative surveillance of the river -- one of the first of its kind in the country. The task force met biweekly until it had adequate knowledge of the nature of the pollution, its sources, and its effect on the river.

Then, armed with a carrot and a stick -- tax incentives to industries that agreed to build their own treatment plants and legal authority to compel pollution abatement if necessary -- the Buffalo Region launched an all-out campaign to clean up the river.

Conditions slowly began to change -- which was remarkable considering the degree and duration of the pollution. In 1968, no bottom organisms could be found over half the length of the Buffalo. By 1970 dissolved oxygen was beginning to return, and pollution-tolerant organisms were reappearing. Two years later, dissolved oxygen could be measured in the river at every depty, and a fish was caught in the Buffalo River for the first time in 30 years -- a sheepshead. That catch made the front and editorial pages of newspapers throughout Western New York and the Niagara Peninsula.

The waters of the Buffalo River have now changed from black to brownish-green in color and are growing cleaner. A new waterfront city has emerged at the mouth of the river, at Buffalo Harbor. A new marina sits at the river's entrance, and a hotel is proposed for the immediate shoreline. A new water-front complex, including a tree-lined walkway and a fishing area, now exists. Midway up the river, a park wildlife sanctuary has materialized on the site of a former city dump.

After ten years of water pollution control work under the State's Pure Waters Program the river has gone from a "bad" rating below 50 in 1968 to its current "medium" rating in the 65 to 70 point range (based on a 0 to 100 scale).

Today Stanley Spisiak can say: "There are substantial numbers of fish in the Buffalo River now for the first time in 75 years, even as far as the Harlem Road Bridge. Why, you can see men from Republic Steel and National Aniline on their lunch hour fishing for carp near the South Park Bridge."

The river is still polluted. Municipal sewage is still a major problem. And the river's problems with residual toxic substances, although under intensified attack, have not yet been eliminated. But the Buffalo is no longer the oil-covered, methane-belching, stagnant, and flammable cesspool it was less than seven years ago.

And Stanley Spisiak is a recognized environmental hero. Newspapers have paid him editorial tribute and the EPA has honored him with a special award. His is a classic case of a single citizen's triumph.

CONCLUSION

Progress in the environment has resulted from collective effort. In every case it has been possible only because a group of citizens or agencies or industries has acted -- often all of them in concert. For the most part dischargers of pollutants have voluntarily complied with the requirements set by the EPA and the States. And the record of compliance is impressive.

To meet the goals of the air and water legislation, dischargers have had to reduce their emissions and effluents to meet EPA regulations and State Implementation Plans.

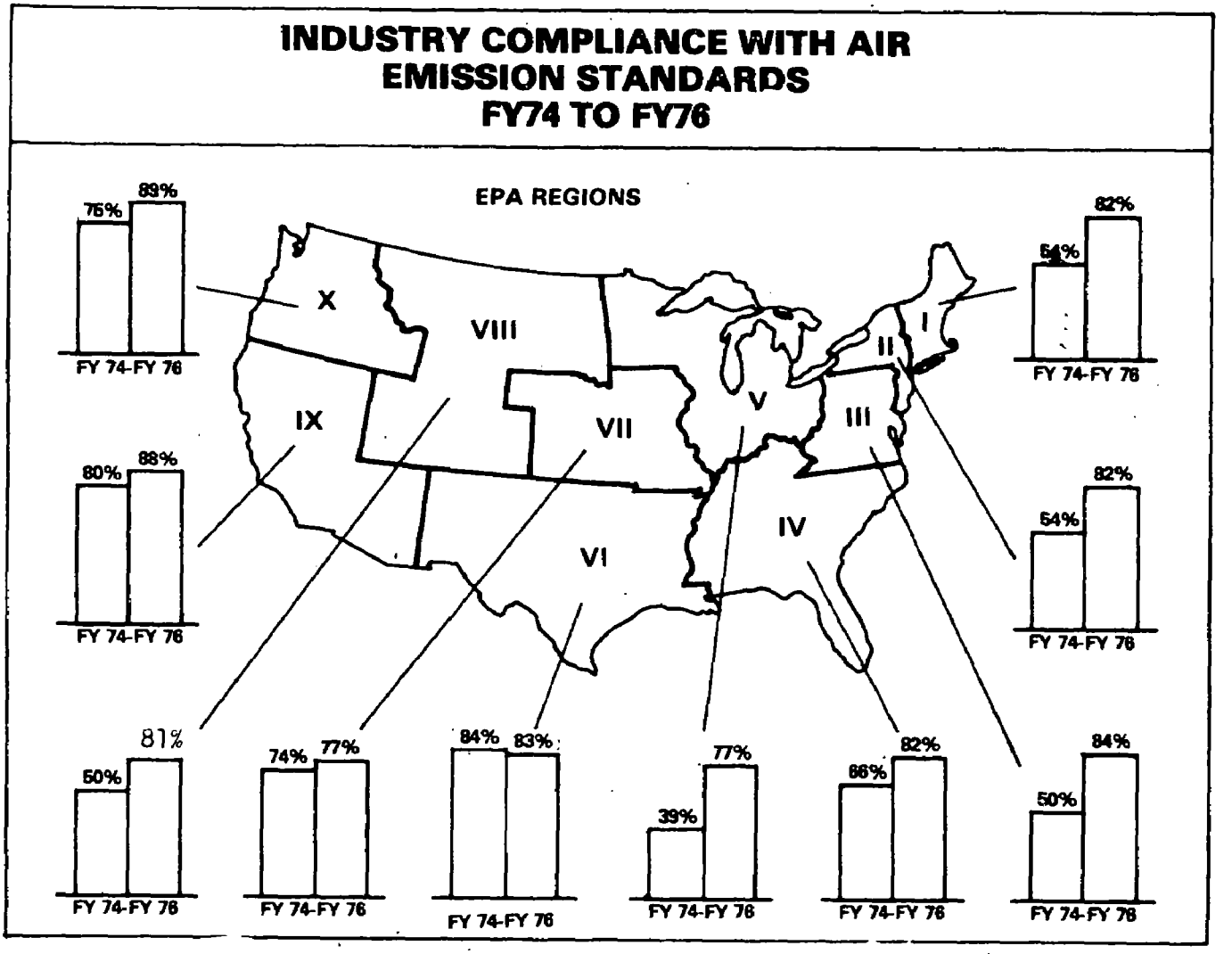
Figure 24 reflects increasing compliance by major air pollution sources throughout the country. In June 1974, there was 63 percent compliance by the 16,558 sources then identified as capable of emitting over 100 tons per year. In June 1976, the number of sources so identified had increased to 21,948 and their compliance was at 82 percent.

Municipal and industrial sources of water pollution have been issued permits limiting their discharges. Most permits detail specific steps -- milestones to be met -- towards full compliance by July 1977. Figure 25 shows the level of compliance of major municipal and industrial point sources with milestone commitments for different areas of the country.

As of June 1976, about 86 percent of the 4,566 major industrial permittees in the Nation were meeting the milestones in their compliance schedules. It is anticipated that more than 50 percent of the municipal permittees, however, will fail to achieve secondary treatment in 1977 as the law requires. That is primarily because of a shortage of construction grant funds.

Some enforcement has been necessary. Figure 26 shows that the number of EPA enforcement actions has climbed gradually over the last six years. Federal enforcement activities, however, represent only a portion of the total enforcement effort, since the task is shared with State and local governments. In most instances, the primary environmental regulation is at the State or local level, with EPA personnel and resources playing only a backup role.

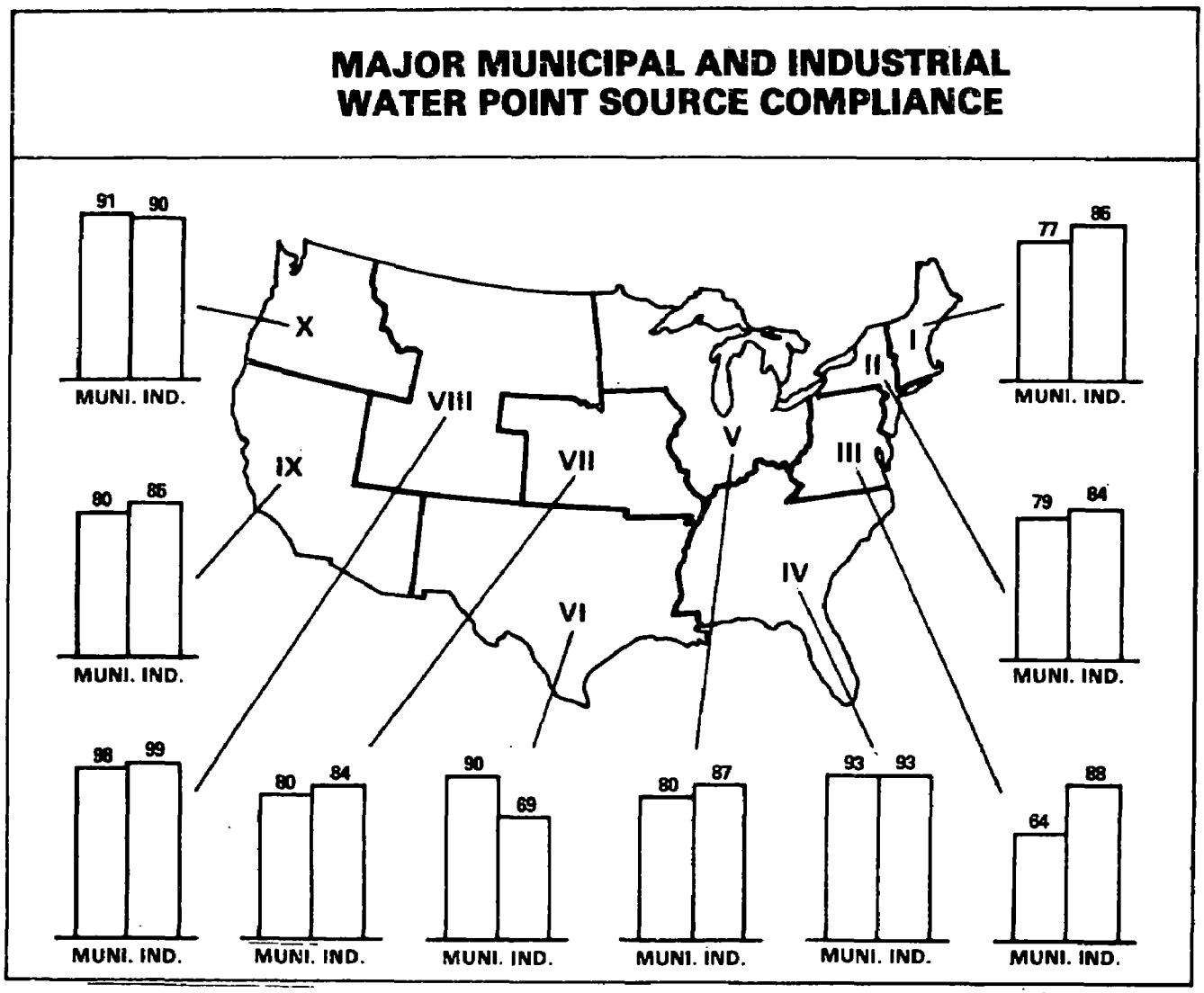
Figure 24



KEY: Percentage of major point sources in compliance with emissions limitations. Major sources are those with potential emissions of 100 tons per year or more.

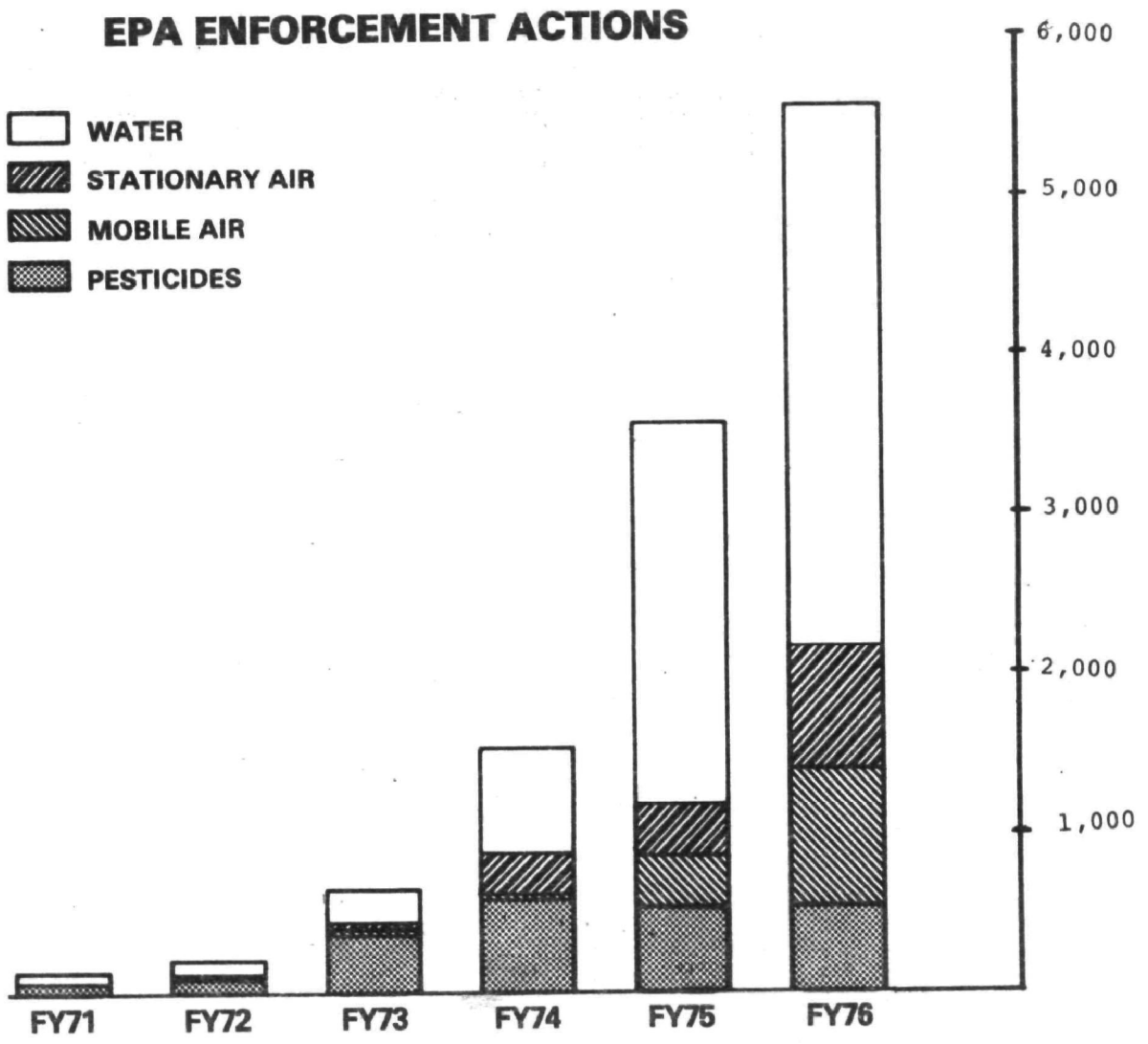
SOURCE: EPA Regional Reports of June 1974 and June 1976

Figure 25



Note: More than 50% of municipal point sources are expected to fail to attain secondary treatment in 1977 as required by law.

Figure 26



SOURCE OE, EPA—FOR CLARIFICATION ON ACTIONS SEE EPA ENFORCEMENT—"A PROGRESS REPORT"

The Future

The cases in this report have dealt, for the most part, only with the Nation's first generation of pollution problems. Tomorrow's environmental efforts will concentrate on a different set of problems with their own unique and peculiar characteristics -- problems an order of magnitude more difficult to grapple with than those of the past. For some of them adequate techniques to solve them have not yet been developed. Solutions will require imagination, commitment and continued effort -- from the Congress, from Federal, State and local governments, from industry, and from the public.

The EPA's experiences over the last half decade demonstrate that, in water pollution control, point sources are only part of the problem. Nonpoint sources are an even more formidable factor, and there will be a signal shift of effort in that direction in the future.

The Agency must also close in on the equally difficult problem of controlling the myriad minor sources of air pollution. It must as well move vigorously to find new technologies and innovative ways to deal with solid wastes. It must act decisively against the sometimes deadly perils of hazardous pollutants and toxics in the environment, and against noise and radiation pollution. It may even be necessary to take steps to abate pollution of the upper atmosphere.

And ultimately it must look beyond pollution abatement to the more sophisticated arena of pollution prevention -- the identification and control of potential pollutants before they actually damage the environment.

These are some of the challenges that still awaits us.

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