Section I

National Summary of Water Quality Conditions

The Quality of Our Nation's Water

Introduction

The National Water Quality Inventory Report to Congress is the primary vehicle for informing Congress and the public about general water quality conditions in the United States. This document characterizes our water quality, identifies widespread water quality problems of national significance, and describes various programs implemented to restore and protect our waters.

The *National Water Quality Inventory Report to Congress* summarizes the water quality information submitted by 58 States, American Indian Tribes, Territories, Interstate Water Commissions, and the District of Columbia (hereafter referred to as States, Tribes, and other jurisdictions) in their 1996 water quality assessment reports. As such, the report identifies water quality issues of concern to the States, Tribes, and other jurisdictions, not just the issues of concern to the U.S. Environmental Protection Agency (EPA). Section 305(b) of the Clean Water Act (CWA) requires that the States and other participating jurisdictions submit water quality assessment reports every 2 years. Most of the survey information in the 1996 Section 305(b) reports is based on water quality information collected and evaluated by the States, Tribes, and other jurisdictions during 1994 and 1995.

It is important to note that this report is based on information submitted by States, Tribes, and other jurisdictions that do not use identical survey methods and criteria to rate their water quality. The States, Tribes, and other jurisdictions favor flexibility in the 305(b) process to accommodate natural variability in their waters, but there is a trade-off between flexibility and consistency. Without known and consistent survey methods in place, EPA must use caution in comparing data or determining the accuracy of data submitted by different States and jurisdictions. Also, EPA must use caution when comparing water quality information submitted during different 305(b) reporting periods because States and other jurisdictions may modify their criteria or survey different waterbodies every 2 years.

Cliff Haac, Chapel Hill, NC

For over 10 years, EPA has pursued a balance between flexibility and consistency in the Section 305(b) process. Recent actions by EPA, the States, Tribes, and other jurisdictions include implementing the recommendations of the National 305(b) Consistency Workgroup and the National Water Quality Monitoring Council. These actions will enable States and other jurisdictions to share data across political boundaries as they develop watershed protection strategies.

EPA recognizes that national initiatives alone cannot clean up our waters; water quality protection and restoration must happen at the local watershed level, in conjunction with State, Tribal, and Federal activities. Similarly, this document alone cannot provide the detailed information needed to manage water quality at all levels. This document should be used together with the individual Section 305(b) reports (see the inside back cover for information on obtaining the State and Tribal Section 305(b) reports), watershed management plans, and other local documents to develop integrated water quality management options.

Index of Watershed Indicators

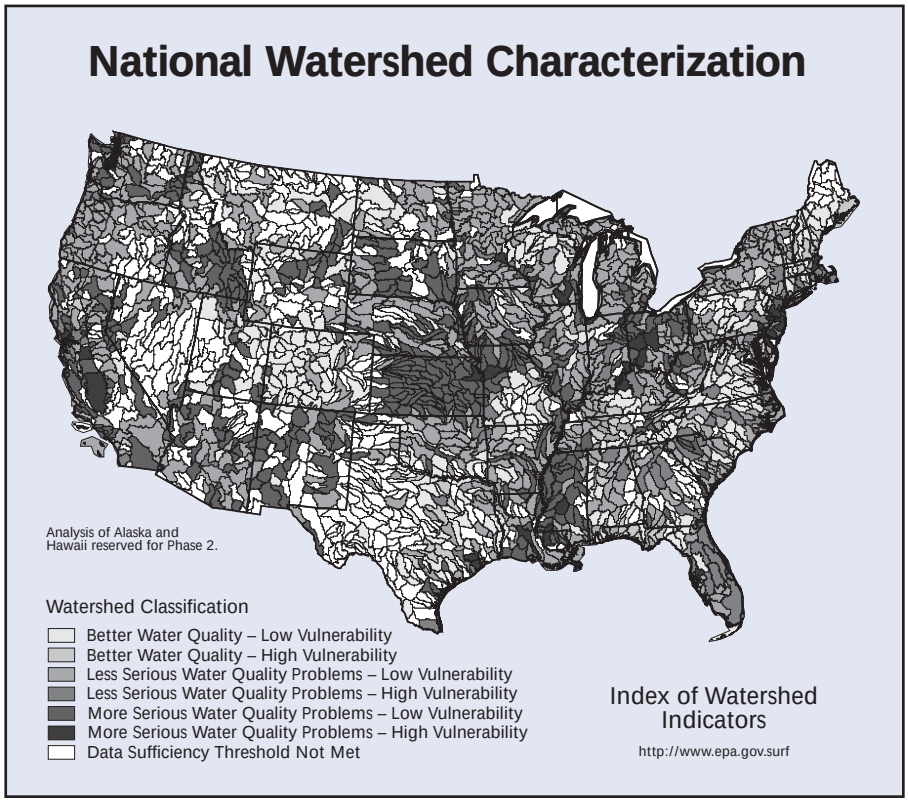
The Index of Watershed Indicators (IWI) is a compilation of information on the condition of aquatic resources in the United States. Using data from many sources, IWI maps 15 indicators on a watershed basis. Together these indicators point to whether these watersheds are "healthy" and whether activities on the surrounding lands are making these waters more vulnerable to pollution (see map).

While this new assessment tool is broader and more inclusive than the National Water Quality Inventory, State 305(b) assessment information is the most important data source in the IWI.

State 305(b) information is included as one of the 15 indicator maps in IWI as: Assessed Rivers Meeting All Designated Uses Set in State/Tribal Water Quality Standards. The IWI uses data compiled on a watershed basis from a number of national assessment programs from several EPA programs, from U.S. Department of Agriculture (USDA), National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), the Corps of Engineers, and the Nature Conservancy, and from the States, Tribes and other jurisdictions. Six other indicator maps show EPA's rating of the condition of watersheds; eight additional indicator maps show EPA's rating of the vulnerability of watersheds. Vulnerability factors include, for example, the rate of population growth, the potential of various forms of nonpoint source pollution, and compliance facility permits. Using this approach, the IWI characterizes nearly three-quarters of the 2,111 watersheds in the 48 contiguous States.

The IWI was released in October 1997 and is updated periodically. In October 1997, 16% of the watersheds had good water quality problems, 36% had moderate water quality problems, 21% had more serious problems, and sufficient data were lacking to fully characterize the remaining 27%. In addition, 1 in 14 watersheds in all areas was vulnerable to further degradation from pollution, primarily from urban and rural runoff.

The IWI enables managers and community residents to understand and help protect the watershed where they live. The information is easily available on the Internet at **http://www.epa.gov/surf/iwi**.



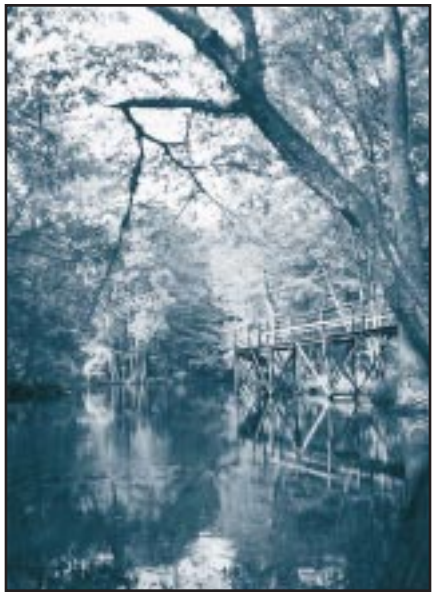
Key Concepts

Measuring Water Quality

The States, participating Tribes, and other jurisdictions survey the quality of their waters by determining if their waters attain the water quality standards they established. Water quality standards consist of beneficial uses, numeric and narrative criteria for supporting each use, and an antidegradation statement:

■ **Designated beneficial uses** are the desirable uses that water quality should support. Examples are drinking water supply, primary contact recreation (such as swimming), and aquatic life support. Each designated use has a unique set of water quality requirements or criteria that must be met for the use to be realized. States, Tribes, and other jurisdictions may designate an individual waterbody for multiple beneficial uses.

■ **Numeric water quality criteria** establish the minimum physical, chemical, and biological parameters required to support a beneficial use. Physical and chemical numeric criteria may set maximum concentrations of pollutants, acceptable ranges of physical parameters such as flow, and minimum concentrations of desirable parameters such as dissolved oxygen. Numeric biological criteria describe the expected attainable community attributes and establish values based on measures such as species richness, presence or absence of indicator taxa, and distribution of classes of organisms.



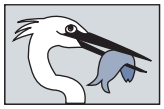
Georgia Minnich, Durham, NC

■ **Narrative water quality criteria** define, rather than quantify, conditions and attainable goals that must be maintained to support a designated use. Narrative biological criteria establish a positive statement about aquatic community characteristics expected to occur within a waterbody. For example, "Aquatic life shall be as it naturally occurs," or "Ambient water quality shall be sufficient to support life stages of all indigenous aquatic species." Narrative criteria may also describe conditions that are desired in a waterbody, such as, "Waters must be free of substances that are toxic to humans, aquatic life, and wildlife."

■ **Antidegradation statements**, where possible, protect existing uses and prevent waterbodies from deteriorating even if their water quality is better than the fishable and swimmable goals of the Act.

The CWA allows States, Tribes, and other jurisdictions to set their own standards but requires that all beneficial uses and their criteria comply with the goals of the Act. At a minimum, beneficial uses must provide for "the protection and propagation of fish, shellfish, and wildlife" and provide for "recreation in and on the water" (i.e., the fishable and swimmable goals of the Act), where attainable. The Act prohibits States and other jurisdictions from designating waste transport or waste assimilation as a beneficial use, as some States did prior to 1972.

Section 305(b) of the CWA requires that the States biennially survey their water quality for attainment of the fishable and swimmable goals of the Act and report the results to EPA. The States, participating Tribes, and other jurisdictions measure attainment of the CWA goals by determining how well their waters support their designated beneficial uses. EPA encourages States, Tribes, and other jurisdictions to survey waterbodies for support of the following individual beneficial uses:



Aquatic Life Support

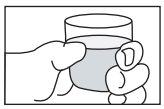
The waterbody provides suitable habitat for protection and propagation of desirable fish, shellfish, and other aquatic organisms.

Fish Consumption

The waterbody supports fish free from contamination that could pose a human health risk to consumers.

Shellfish Harvesting

The waterbody supports a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.



Drinking Water Supply

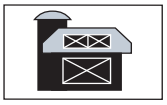
The waterbody can supply safe drinking water with conventional treatment.

Primary Contact Recreation – Swimming

People can swim in the waterbody without risk of adverse human health effects (such as catching waterborne diseases from raw sewage contamination).

Secondary Contact Recreation

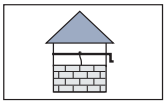
People can perform activities on the water (such as boating) without risk of adverse human health effects from ingestion or contact with the water.



Agriculture

The water quality is suitable for irrigating fields or watering livestock.

States, Tribes, and other jurisdictions may also define their own individual uses to address special concerns. For example, many Tribes and States designate their waters for the following beneficial uses:



Ground Water Recharge

The surface waterbody plays a significant role in replenishing ground water, and surface water supply and quality are adequate to protect existing or potential uses of ground water.

Wildlife Habitat

Water quality supports the waterbody's role in providing habitat and resources for land-based wildlife as well as aquatic life.

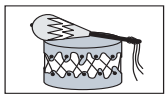
Tribes may designate their waters for special cultural and ceremonial uses:

Water Quality Monitoring

Water quality monitoring consists of data collection and sample analysis performed using accepted protocols and quality control procedures. Monitoring also includes subsequent analysis of the body of data to support decisionmaking. Federal, Interstate, State, Territorial, Tribal, Regional, and local agencies, industry, and volunteer groups with approved quality assurance programs monitor a combination of chemical, physical, and biological water quality parameters throughout the country.

- Chemical data often measure concentrations of pollutants and other chemical conditions that influence aquatic life, such as pH (i.e., acidity) and dissolved oxygen concentrations. The chemical data may be analyzed in water samples, fish tissue samples, or sediment samples.
- Physical data include measurements of temperature, turbidity (i.e., light penetration through the water column), and solids in the water column.
- Biological data measure the health of aquatic communities. Biological data include counts of aquatic species that indicate healthy ecological conditions.
- Habitat and ancillary data (such as land use data) help interpret the above monitoring information.

Monitoring agencies vary parameters, sampling frequency, and sampling site selection to meet program objectives and funding constraints. Sampling may occur at regular intervals (such as monthly, quarterly, or annually), irregular intervals, or during one-time intensive surveys. Sampling may be conducted at fixed sampling stations, randomly selected stations, stations near suspected water quality problems, or stations in pristine waters.



Culture

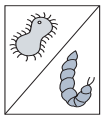
Water quality supports the waterbody's role in Tribal culture and preserves the waterbody's religious, ceremonial, or subsistence significance.

The States, Tribes, and other jurisdictions assign levels of use support to each of their waterbodies (Table 1). If possible, the States, Tribes, and other jurisdictions determine the level of use support by comparing monitoring data with numeric criteria for each use designated for a particular waterbody. If monitoring data are not available, the State, Tribe, or other jurisdiction may determine the level of use support with qualitative information. Valid qualitative information includes land use data, fish and game surveys, and predictive model results. **Monitored assessments** are based on recent monitoring data collected during the past 5 years. **Evaluated assessments** are based on qualitative information or monitored information more than 5 years old.

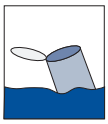
For waterbodies with more than one designated use, the States, Tribes, and other jurisdictions consolidate the individual use support information into a summary use support determination:

Good/Fully Supporting All Uses – All designated beneficial uses are fully supported.

Good/Threatened for One or More Uses – One or more designated beneficial uses are threatened and the remaining uses are fully supported.

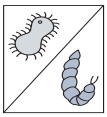
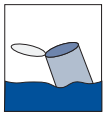


Impaired for One or More Uses – One or more designated beneficial uses are partially or not supported and the remaining uses are fully supported or threatened. These waterbodies are considered impaired.



Not Attainable – The State, Tribe, or other jurisdiction has performed a use-attainability analysis and demonstrated that use support of one or more designated beneficial uses is not attainable due to one of six biological, chemical, physical, or economic/social conditions specified in the *Code of Federal Regulations* (40 CFR Section 131.10). These conditions include naturally high concentrations of pollutants (such as metals); other natural physical features that create unsuitable

Table 1. Levels of Summary Use Support

Symbol	Use Support Level	Water Quality Condition	Definition
	Fully Supporting All Uses	Good	Water quality meets designated use criteria.
	Threatened for One or More Uses	Good	Water quality supports beneficial uses now but may not in the future unless action is taken.
	**Impaired for One or More Uses**	Impaired	Water quality fails to meet designated use criteria at times.
	**Not Attainable**	_____	The State, Tribe, or other jurisdiction has performed a use-attainability analysis and demonstrated that use support is not attainable due to one of six biological, chemical, physical, or economic/social conditions specified in the *Code of Federal Regulations*.

aquatic life habitat (such as inadequate substrate, riffles, or pools); low flows or water levels; dams and other hydrologic modifications that permanently alter waterbody characteristics; poor water quality resulting from human activities that cannot be reversed without causing further environmental degradation; and poor water quality that cannot be improved without imposing more stringent controls than those required in the CWA, which would result in widespread economic and social impacts.

■ **Impaired Waters** – Waterbodies either partially supporting uses or not supporting uses.

The EPA then aggregates the use support information submitted by the States, Tribes, and other jurisdictions into a national assessment of the Nation's water quality.

How Many of Our Waters Were Surveyed for 1996?

National estimates of the total waters of our country provide the foundation for determining the percentage of waters surveyed by the States, Tribes, and other jurisdictions and the portion impaired by pollution. For the 1992 reporting period, EPA provided the States with estimates of total river miles and lake acres derived from the EPA Reach File, a database containing traces of waterbodies adapted from 1:100,000 scale maps prepared by the U.S. Geological Survey. The States modified these total water estimates where necessary. Based on the 1992 EPA/State figures, the national estimate of total river miles doubled in large part because the EPA/State estimates included nonperennial streams, canals, and ditches that were previously excluded from estimates of total stream miles.

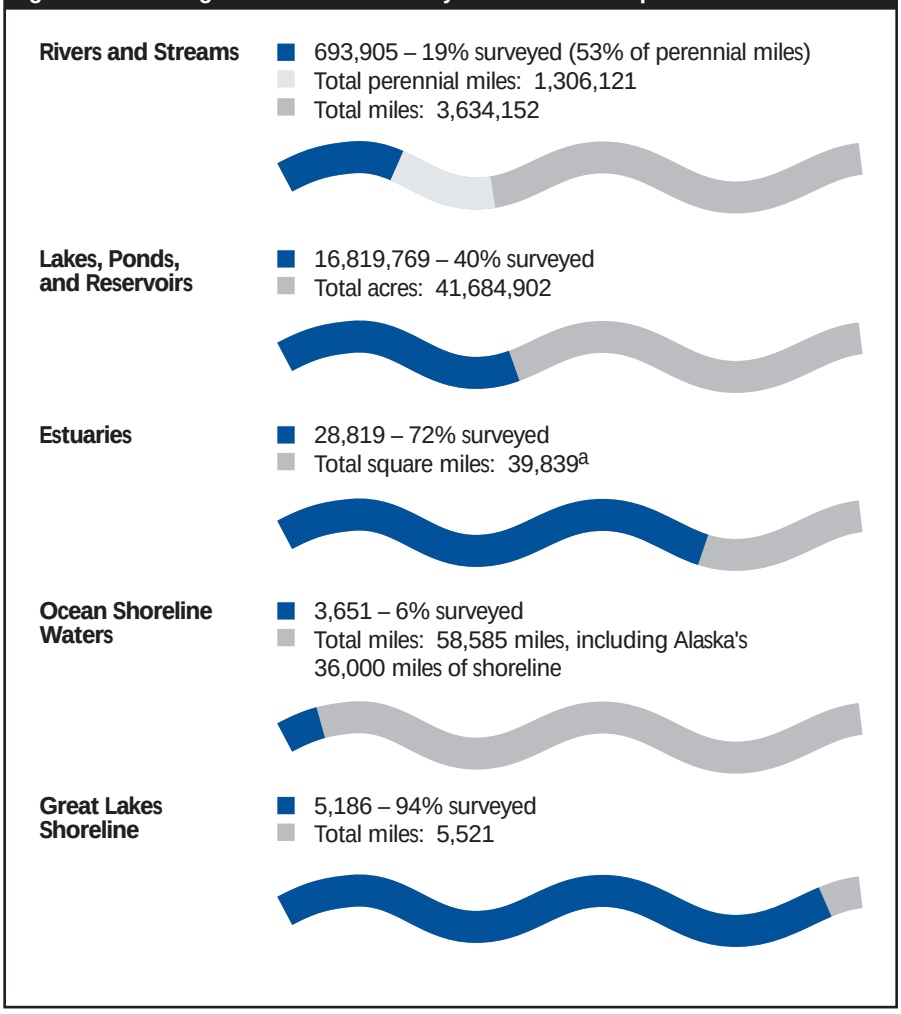
Estimates for the 1996 reporting cycle are a minor refinement of the 1992 figures and indicate that the United States has:

■ More than 3.6 million miles of rivers and streams, which range in size from the Mississippi River to small streams that flow only when wet weather conditions exist (i.e., nonperennial streams)

■ Approximately 41.7 million acres of lakes, ponds, and reservoirs

■ About 39,839 square miles of estuaries (excluding Alaska)

Figure 1. Percentage of Total Waters Surveyed for the 1996 Report



Source: 1996 Section 305(b) reports submitted by the States, Tribes, Territories, and Commissions.

[a]Excluding estuarine waters in Alaska because no estimate was available.

- More than 58,000 miles of ocean shoreline, including 36,000 miles in Alaska
- 5,521 miles of Great Lakes shoreline
- More than 277 million acres of wetlands such as marshes, swamps, bogs, and fens, including 170 million acres of wetlands in Alaska.

Most States do not survey all of their waterbodies during the 2-year reporting cycle required under CWA Section 305(b). Thus, the surveyed waters reported in Figure 1 are a subset of the Nation's total waters. In addition, the summary information based on surveyed waters may not represent general conditions in the Nation's total waters because States, Tribes, and other jurisdictions often focus on surveying major perennial rivers, estuaries, and public lakes with suspected pollution problems in order to direct scarce resources to areas that could pose the greatest risk. Many States, Tribes, and other jurisdictions lack the resources to collect use support information for nonperennial streams, small tributaries, and private ponds. This report does not predict the health of these unassessed waters, which include an unknown ratio of pristine waters to polluted waters.

The National Water Quality Monitoring Council

In 1992, the Intergovernmental Task Force on Monitoring Water Quality (ITFM) convened to prepare a strategy for improving water quality monitoring nationwide. The ITFM was a Federal/State partnership of 10 Federal agencies, 9 State and Interstate agencies, and 1 American Indian Tribe. The EPA chaired the ITFM with the USGS as vice chair and Executive Secretariat as part of their Water Information Coordination Program pursuant to OMB memo 92-01.

The mission of the ITFM was to develop and aid implementation of a national strategic plan to achieve effective collection, interpretation, and presentation of water quality data and to improve the availability of existing information for decisionmaking at all levels of government and the private sector. A permanent successor to the ITFM, the National Monitoring Council provides guidelines and support for institutional collaboration, comparable field and laboratory methods, quality assurance/quality control, environmental indicators, data management and sharing, ancillary data, interpretation and techniques, and training.

The National Monitoring Council is also producing products that can be used by monitoring programs nationwide, such as an outline for a recommended monitoring program, environmental indicator selection criteria, and a matrix of indicators to support assessment of State and Tribal designated uses.

For a copy of the first, second, and final ITFM reports, contact:

The U.S. Geological Survey
417 National Center
Reston, VA 22092
1-800-426-9000

Pollutants and Processes That Degrade Water Quality

Where possible, States, Tribes, and other jurisdictions identify the pollutants or processes that degrade water quality and indicators that document impacts of water quality degradation. The most widespread pollutants and processes identified in rivers, lakes, and estuaries are presented in Table 2. Pollutants include sediment, nutrients, and chemical contaminants (such as dioxins and metals). Processes that degrade waters include habitat modification (such as destruction of streamside vegetation) and hydrologic modification (such as flow reduction). Indicators of water quality degradation include physical, chemical, and biological parameters. Examples of biological parameters include species diversity and abundance. Examples of physical and chemical parameters include pH, turbidity, and temperature. Following are

descriptions of the effects of the pollutants and processes most commonly identified in rivers, lakes, estuaries, coastal waters, wetlands, and ground water.

Low Dissolved Oxygen

Dissolved oxygen is a basic requirement for a healthy aquatic ecosystem. Most fish and beneficial aquatic insects "breathe" oxygen dissolved in the water column. Some fish and aquatic organisms (such as carp and sludge worms) are adapted to low oxygen conditions, but most desirable fish species (such as trout and salmon) suffer if dissolved oxygen concentrations fall below 3 to 4 mg/L (3 to 4 milligrams of oxygen dissolved in 1 liter of water, or 3 to 4 parts of oxygen per million parts of water). Larvae and juvenile fish are more sensitive and require even higher concentrations of dissolved oxygen.

Many fish and other aquatic organisms can recover from short periods of low dissolved oxygen availability. However, prolonged episodes of depressed dissolved oxygen concentrations of 2 mg/L or less can result in "dead"waterbodies. Prolonged exposure to low dissolved oxygen conditions can suffocate adult fish or reduce their reproductive survival by suffocating sensitive eggs and larvae or can starve fish by killing aquatic insect larvae and other prey. Low dissolved oxygen concentrations also favor anaerobic bacterial activity that produces noxious gases or foul odors often associated with polluted waterbodies.

Oxygen concentrations in the water column fluctuate under natural conditions, but severe oxygen depletion usually results from human activities that introduce large quantities of biodegradable organic materials into surface waters. Biodegradable organic materials contain plant, fish, or animal matter. Leaves, lawn clippings, sewage, manure, shellfish processing waste, milk solids, and other food processing wastes are examples of oxygen-depleting organic materials that enter our surface waters.

In both pristine and polluted waters, beneficial bacteria use oxygen to break apart (or decompose) organic materials. Pollution-containing organic wastes provide a continuous glut of food for the bacteria, which accelerates bacterial activity and population growth. In polluted waters, bacterial consumption of oxygen can rapidly outpace oxygen replenishment from the atmosphere and photosynthesis performed by algae and aquatic plants. The result is a net decline in oxygen concentrations in the water.

Toxic pollutants can indirectly lower oxygen concentrations by killing algae, aquatic weeds, or fish, which provides an abundance of food for oxygen-consuming bacteria. Oxygen depletion can also result from chemical reactions that do not involve bacteria. Some pollutants trigger chemical reactions that place a chemical oxygen demand on receiving waters.

Other factors (such as temperature and salinity) influence the amount of oxygen dissolved in water. Prolonged hot weather will depress oxygen concentrations and may cause fish kills even in clean waters because warm water cannot hold as much oxygen as cold water. Warm conditions further aggravate oxygen depletion by stimulating bacterial activity and respiration in fish, which consume oxygen. Removal of streamside vegetation eliminates shade, thereby raising water temperatures, and accelerates runoff of organic debris. Under such conditions, minor additions of pollution-containing organic materials can severely deplete oxygen.

Nutrients

Nutrients are essential building blocks for healthy aquatic communities, but excess nutrients (especially nitrogen and phosphorus compounds) overstimulate the growth of aquatic weeds and algae. Excessive growth of these organisms, in

Table 2. Five Leading Causes of Water Quality Impairment

Rank	Rivers	Lakes	Estuaries
1	Siltation	Nutrients	Nutrients
2	Nutrients	Metals	Bacteria
3	Bacteria	Siltation	Priority Toxic Organic Chemicals
4	Oxygen-Depleting Substances	Oxygen-Depleting Substances	Oxygen-Depleting Substances
5	Pesticides	Noxious Aquatic Plants	Oil and Grease

Source: Based on 1996 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

turn, can clog navigable waters, interfere with swimming and boating, outcompete native submerged aquatic vegetation (SAV), and, with excessive decomposition, lead to oxygen depletion. Oxygen concentrations can fluctuate daily during algal blooms, rising during the day as algae perform photosynthesis, and falling at night as algae continue to respire, which consumes oxygen. Beneficial bacteria also consume oxygen as they decompose the abundant organic food supply in dying algae cells.

Lawn and crop fertilizers, sewage, manure, and detergents contain nitrogen and phosphorus, the nutrients most often responsible for water quality degradation. Rural areas are vulnerable to ground water contamination from nitrates (a compound containing nitrogen) found in fertilizer and manure. Very high concentrations of nitrate (>10 mg/L) in drinking water cause methemoglobinemia, or blue baby syndrome, an inability to fix oxygen in the blood.

Nutrients are difficult to control because lake and estuarine ecosystems recycle nutrients. Rather than leaving the ecosystem, the nutrients cycle among the water column, algae and plant tissues, and the bottom sediments. For example, algae may temporarily remove all the nitrogen from the water column, but the nutrients will return to the water column when the algae die and are decomposed by bacteria. Therefore, gradual inputs of nutrients tend to accumulate over time rather than leave the system.

Suzanne Unger, Chapel Hill, NC

Sedimentation and Siltation

In a water quality context, sedimentation usually refers to soil particles that enter the water column from eroding land. Sediment consists of particles of all sizes, including fine clay particles, silt, sand, and gravel. Water quality managers use the term “siltation” to describe the suspension and deposition of small sediment particles in waterbodies.

Sedimentation and siltation can severely alter aquatic communities. Sediment may clog and abrade fish gills, suffocate eggs and aquatic insect larvae on the bottom, and fill in the pore space between bottom cobbles where fish lay eggs. Suspended silt and sediment interfere with recreational activities and aesthetic enjoyment at waterbodies by reducing water clarity and filling in waterbodies. Sediment may also carry other pollutants into waterbodies. Nutrients and toxic chemicals may attach to sediment particles on land and ride the particles into surface waters where the pollutants may settle with the sediment or detach and become soluble in the water column.

Rain washes silt and other soil particles off of plowed fields, construction sites, logging sites, urban areas, and strip-mined lands into waterbodies. Eroding stream banks also deposit silt and sediment in waterbodies. Removal of vegetation on shore can accelerate streambank erosion.

Bacteria and Pathogens

Some waterborne bacteria, viruses, and protozoa cause human illnesses that range from typhoid and dysentery to minor respiratory and skin diseases. These organisms

may enter waters through a number of routes, including inadequately treated sewage, stormwater drains, septic systems, runoff from livestock pens, and sewage dumped overboard from recreational boats. Because it is impossible to test waters for every possible disease-causing organism, States and other jurisdictions usually measure indicator bacteria that are found in great numbers in the stomachs and intestines of warm-blooded animals and people. The presence of indicator bacteria suggests that the waterbody may be contaminated with untreated sewage and that other, more dangerous organisms may be present. The States, Tribes, and other jurisdictions use bacterial criteria to determine if waters are safe for recreation and shellfish harvesting.

Paul Kazyac, Maryland Department of Natural Resources

Toxic Organic Chemicals and Metals

Toxic organic chemicals are synthetic compounds that contain carbon, such as polychlorinated biphenyls (PCBs), dioxins, and the pesticide DDT. These synthesized compounds often persist and accumulate in the environment because they do not readily break down in natural ecosystems. Many of these compounds cause cancer in people and birth defects in other predators near the top of the food chain, such as birds and fish.

Metals occur naturally in the environment, but human activities (such as industrial processes and mining) have altered the distribution of metals in the environment. In most reported cases of metals contamination, high concentrations of metals appear in fish tissues rather than the water column because the metals accumulate in greater concentrations in predators near the top of the food chain.

pH

Acidity, the concentration of hydrogen ions, drives many chemical reactions in living organisms. The standard measure of acidity is pH, and a pH value of 7 represents a neutral condition. A low pH value (less than 5) indicates acidic conditions; a high pH (greater than 9) indicates alkaline conditions. Many biological processes, such as reproduction, cannot function in acidic or alkaline waters. Acidic conditions also aggravate toxic contamination problems because sediments release toxicants in acidic waters. Common sources of acidity include mine drainage, runoff from mine tailings, and atmospheric deposition.

Habitat Modification/ Hydrologic Modification

Habitat modifications include activities in the landscape, on shore, and in waterbodies that alter the physical structure of aquatic ecosystems and have adverse impacts on aquatic life. Examples of habitat modifications to streams include:

- Removal of streamside vegetation that stabilizes the shoreline and provides shade, which moderates instream temperatures
- Excavation of cobbles from a stream bed that provide nesting habitat for fish
- Stream burial
- Excessive suburban sprawl that alters the natural drainage patterns by increasing the intensity, magnitude, and energy of runoff waters.

Hydrologic modifications alter the flow of water. Examples of hydrologic modifications include channelization, dewatering, damming, and dredging.

Other pollutants include salts and oil and grease. Fresh waters may become unfit for aquatic life and some human uses when they become contaminated by salts. Sources of salinity include irrigation runoff, brine used in oil extraction, road deicing operations, and the intrusion of sea water into ground and surface waters in coastal areas. Crude oil and processed petroleum products may be spilled during extraction, processing, or transport or leaked from underground storage tanks.

Sources of Water Pollution

Sources of impairment generate the pollutants that violate use support criteria (Table 3). Point sources discharge pollutants directly into surface waters from a conveyance. Point sources include industrial facilities, municipal sewage treatment plants, and combined sewer overflows. Nonpoint sources deliver pollutants to surface waters from diffuse origins. Nonpoint sources include urban runoff, agricultural runoff, and atmospheric deposition of contaminants in air pollution. Habitat alterations, such as hydromodification, dredging, and streambank destabilization, can also degrade water quality.

Throughout this document, EPA rates the significance of causes and sources of pollution by the percentage of impaired waters impacted by each individual cause or source (obtained from the Section 305(b) reports submitted by the States, Tribes, and other jurisdictions). Note that the cause and source rankings do not describe the condition of all waters in the United States because the States identify the causes and sources degrading some of their impaired waters, which are a small subset of surveyed waters, which are a subset of the Nation's total waters. For example, the States identified sources degrading some of the 248,028 impaired river miles, which represent 36% of the surveyed river miles and only 7% of the Nation's total stream miles.

Table 3. Pollution Source Categories Used in This Report

Category	Examples
Industrial	Pulp and paper mills, chemical manufacturers, steel plants, metal process and product manufacturers, textile manufacturers, food processing plants
Municipal	Publicly owned sewage treatment plants that may receive indirect discharges from industrial facilities or businesses
Combined Sewer Overflows (CSOs)	Single facilities that treat both storm water and sanitary sewage, which may become overloaded during storm events and discharge untreated wastes into surface waters.
Storm Sewers/ Urban Runoff	Runoff from impervious surfaces including streets, parking lots, buildings, and other paved areas.
Agricultural	Crop production, pastures, rangeland, feedlots, animal operations
Silvicultural	Forest management, tree harvesting, logging road construction
Construction	Land development, road construction
Resource Extraction	Mining, petroleum drilling, runoff from mine tailing sites
Land Disposal	Leachate or discharge from septic tanks, landfills, and hazardous waste sites
Hydrologic Modification	Channelization, dredging, dam construction, flow regulation
Habitat Modification	Removal of riparian vegetation, streambank modification, drainage/filling of wetlands

"The term 'point source' means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture."

Clean Water Act, Section 502(14)

Table 4 lists the leading sources of impairment related to human activities as reported by States, Tribes, and other jurisdictions for their rivers, lakes, and estuaries. Other sources cited include removal of riparian vegetation, forestry activities, land disposal, petroleum extraction and processing activities, and construction. In addition to human activities, the States, Tribes, and other jurisdictions also reported impairments from natural sources. Natural sources refer to an assortment of water quality problems:

- Natural deposits of salts, gypsum, nutrients, and metals in soils that leach into surface and ground waters
- Warm weather and dry conditions that raise water temperatures, depress dissolved oxygen concentrations, and dry up shallow waterbodies
- Low-flow conditions and tannic acids from decaying leaves that lower pH and dissolved oxygen concentrations in swamps draining into streams.

With so many potential sources of pollution, it is difficult and expensive for States, Tribes, and other jurisdictions to identify specific sources responsible for water quality impairments. Many States and other jurisdictions lack funding for monitoring to identify all but the most apparent sources degrading waterbodies. Local management priorities may focus monitoring budgets on other water quality issues, such as identification of contaminated fish populations that pose a human health risk. Management priorities may also direct monitoring efforts to larger waterbodies and overlook sources impairing smaller waterbodies. As a result, the States, Tribes, and other jurisdictions do not associate every impacted waterbody with a source of impairment in their 305(b) reports, and the summary cause and source information presented in this report applies exclusively to a subset of the Nation's impaired waters.

Table 4. Five Leading Sources of Water Quality Impairment Related to Human Activities

Rank	Rivers	Lakes	Estuaries
1	Agriculture	Agriculture	Industrial Discharges
2	Municipal Point Sources	Unspecified Nonpoint Sources	Urban Runoff/ Storm Sewers
3	Hydrologic Modification	Atmospheric Deposition	Municipal Point Sources
4	Habitat Modification	Urban Runoff/ Storm Sewers	Upstream Sources
5	Resource Extraction	Municipal Point Sources	Agriculture

Source: Based on 1996 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

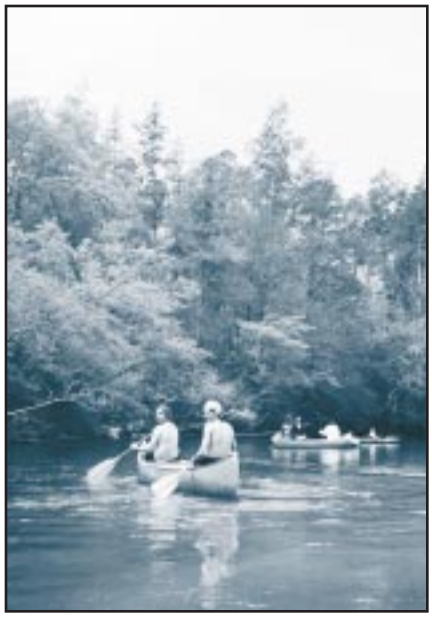
Rivers and Streams

Rivers and streams are characterized by flow. **Perennial** rivers and streams flow continuously, all year round. **Nonperennial** rivers and streams stop flowing for some period of time, usually due to dry conditions or upstream withdrawals. Many rivers and streams originate in nonperennial headwaters that flow only during snowmelt or heavy showers. Nonperennial streams provide critical habitats for nonfish species, such as amphibians and dragonflies, as well as safe havens for juvenile fish to escape from predation by larger fish.

The health of rivers and streams is directly linked to habitat integrity on shore and in adjacent wetlands. Stream quality will deteriorate if activities damage shoreline (i.e., riparian) vegetation and wetlands, which filter pollutants from runoff and bind soils. Removal of vegetation also eliminates shade that moderates stream temperature as well as the land temperature that can warm runoff entering surface waters. Stream temperature, in turn, affects the availability of dissolved oxygen in the water column for fish and other aquatic organisms.

Overall Water Quality

For the 1996 Report, 54 States, Territories, Tribes, Commissions, and the District of Columbia surveyed 693,905 miles (19%) of the Nation's total 3.6 million miles of rivers and streams (Figure 2). The surveyed rivers and streams represent 53% of the 1.3 million miles of perennial rivers and streams that flow year round in the lower 48 States.



Georgia Minnich, Durham, NC

Altogether, the States and Tribes surveyed 78,099 more river miles in 1996 than in 1994. Although most States surveyed about the same number of river miles in both reporting cycles, Illinois, Maryland, North Dakota, and Tennessee collectively account for an increase of over 75,000 surveyed river miles. Since 1994, Illinois, North Dakota, and Tennessee have refined their stream estimates, increasing the mileages associated with surveyed streams.

The following discussion applies exclusively to surveyed waters and cannot be extrapolated to describe conditions in the Nation's rivers as a whole because the States, Tribes, and other jurisdictions do not consistently use statistical or probabilistic survey methods to characterize all their waters at this time. EPA is working with the States, Tribes, and other jurisdictions to expand survey coverage of the Nation's waters and expects future survey information to cover a greater portion of the Nation's rivers and streams.

Figure 2. River Miles Surveyed

Total rivers = 3.6 million miles
Total surveyed = 693,905 miles

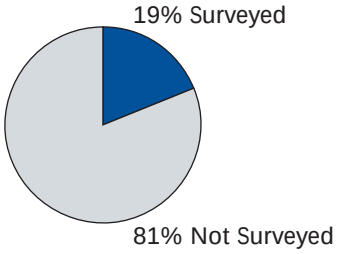
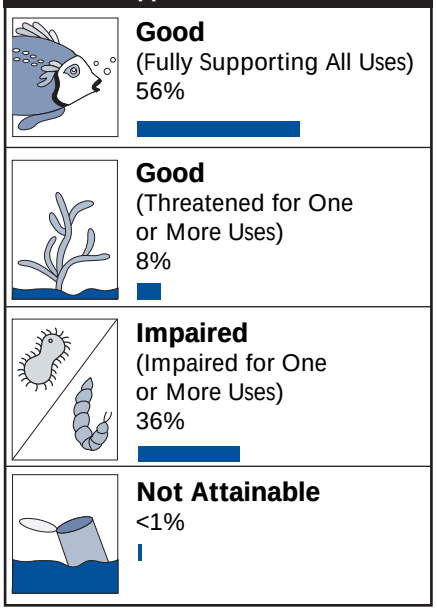


Figure 3. Levels of Overall Summary Support – Rivers



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Of the Nation's 693,905 surveyed river miles, the States, Tribes, and other jurisdictions found that 64% have good water quality. Of these waters, 56% fully support their designated uses, and an additional 8% support uses but are threatened and may become impaired if pollution control actions are not taken (Figure 3). Some form of pollution or habitat degradation prevents the remaining 36% (248,028 miles) of the surveyed river miles from fully supporting a healthy aquatic community or human activities all year round.

What Is Polluting Our Rivers and Streams?

The States and Tribes report that siltation, composed of tiny soil particles, remains one of the most widespread pollutants impacting rivers and streams, impairing 126,763 river miles (18% of surveyed river miles (Figure 4).

Siltation is the most widespread pollutant in rivers and streams, affecting 18% of the surveyed river miles.

Siltation alters aquatic habitat and suffocates fish eggs and bottom-dwelling organisms. Excessive siltation can also interfere with drinking water treatment processes and recreational use of a river.

In addition to siltation, the States and Tribes also reported that nutrients, bacteria, oxygen-depleting substances, habitat alterations, and metals impact more miles of rivers and streams than other pollutants and processes. Often, several pollutants and processes impact a single river segment. For example, a process, such as removal of shoreline vegetation, may accelerate erosion of sediment and nutrients into a stream.

Where Does This Pollution Come From?

The States and Tribes reported that agriculture is the most widespread source of pollution in the Nation's surveyed rivers (Figure 4). Agriculture generates pollutants that degrade aquatic life or interfere with public use of 173,629 river miles (25% of the surveyed river miles) in 50 States and Tribes.

Twenty-four States reported the size of rivers impacted by specific types of agricultural activities:

- Nonirrigated Crop Production – crop production that relies on rain as the sole source of water.
- Irrigated Crop Production – crop production that uses irrigation systems to supplement rainwater.
- Rangeland – land grazed by animals that is seldom enhanced by the application of fertilizers or pesticides, although managers sometimes modify plant species to a limited extent.
- Pastureland – land upon which a crop (such as alfalfa) is raised to feed animals, either by grazing the animals among the crops or harvesting the crops.
- Feedlots – facilities where animals are fattened and confined at high densities.
- Animal Operations – generally livestock facilities other than large cattle feedlot operations.
- Animal Holding Areas – facilities where animals are confined briefly before slaughter.

The States reported that nonirrigated crop production impaired the most river miles, followed by irrigated crop production, rangeland, feedlots, pastureland, and animal operations.

Many States reported declines in pollution from sewage treatment plants and industrial discharges as a result of sewage treatment plant construction and upgrades and permit controls on industrial discharges. Despite the improvements, municipal sewage treatment plants remain the second most common source of pollution in rivers (impairing 35,087 miles) because population growth increases the burden on our municipal facilities.

Agriculture is the leading source of impairment in the Nation's rivers, contributing to impairment of 25% of the surveyed river miles.

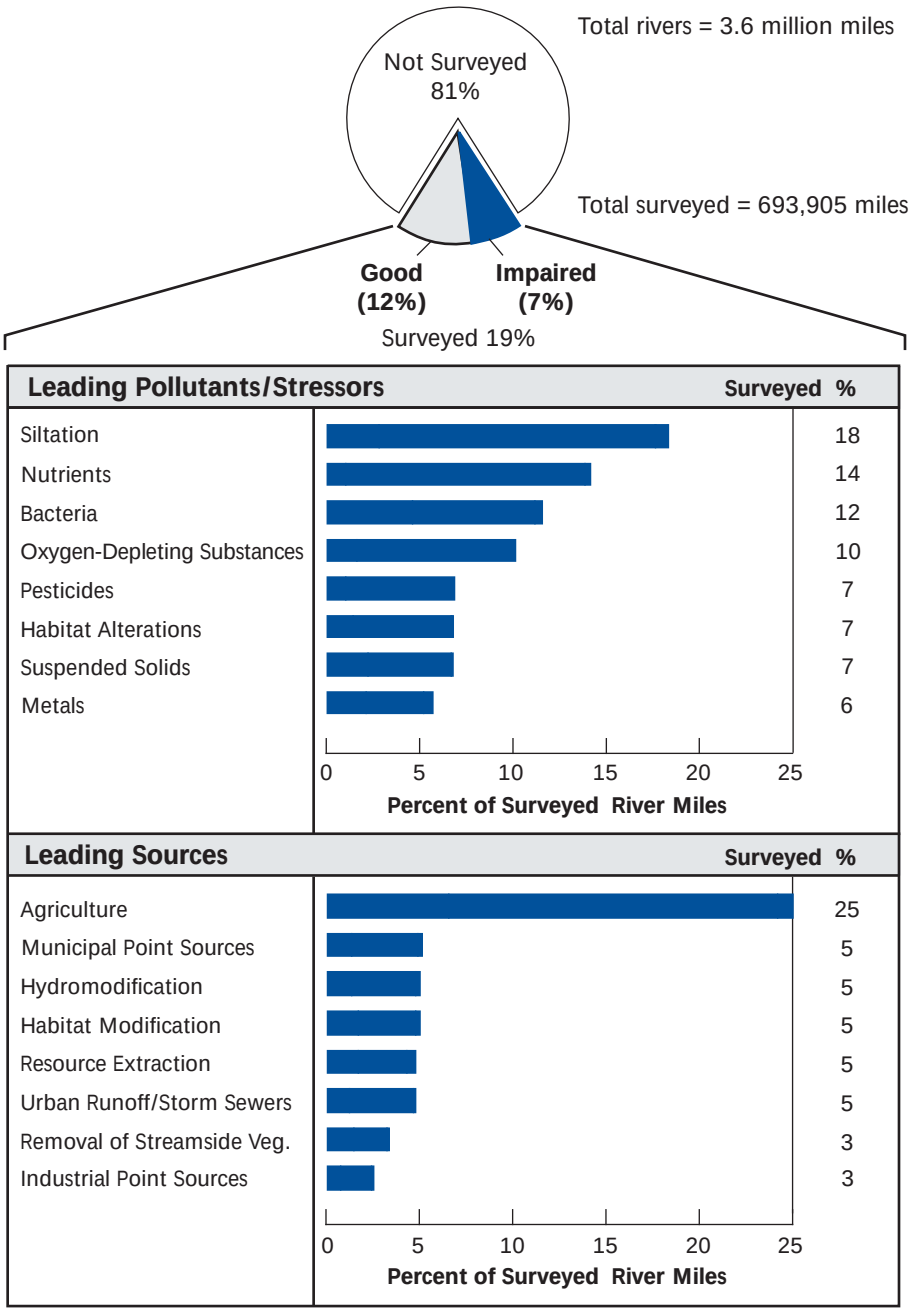
Hydrologic modifications and habitat alterations are a growing concern to the States. Hydrologic modifications include activities that alter the flow of water in a stream,

such as channelization, dewatering, and damming of streams. Habitat alterations include removal of streamside vegetation that protects the stream from high temperatures and scouring of stream bottoms. Additional gains in water quality conditions will be more subtle and require innovative management strategies that go beyond point source controls.

The States, Tribes, and other jurisdictions also reported that resource extraction impairs 33,051 river miles (5% of the surveyed rivers), and urban runoff and storm sewers impair 32,637 river miles (5% of the surveyed rivers).

The States, Tribes, and other jurisdictions also report that "natural" sources impair significant stretches of rivers and streams. "Natural" sources, such as low flow and soils with arsenic deposits, can prevent waters from supporting uses in the absence of human activities.

Figure 4. Surveyed River Miles: Pollutants and Sources



Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Note: Percentages do not add up to 100% because more than one pollutant or source may impair a river segment.

Lakes, Ponds, and Reservoirs

Lakes are sensitive to pollution inputs because lakes flush out their contents relatively slowly. Even under natural conditions, lakes undergo eutrophication, an aging process that slowly fills in the lake with sediment and organic matter (see sidebar on next page). The eutrophication process alters basic lake characteristics such as depth, biological productivity, oxygen levels, and water clarity. Eutrophication is commonly defined by a series of trophic states as described in the sidebar.

Overall Water Quality

Forty-five States, Tribes, and other jurisdictions surveyed overall use support in more than 16.8 million lake acres representing 40% of the approximately 41.7 million total acres of lakes, ponds, and reservoirs in the Nation (Figure 5). For 1996, the States surveyed about 300,000 fewer lake acres than in 1994.

The number of surveyed lake acres declined because several States faced funding constraints that limited the number of lakes sampled.

The States and Tribes reported that 61% of their surveyed 16.8 million lake acres have good water quality. Waters with good quality include 51% of the surveyed lake acres fully supporting uses and 10% of the surveyed lake acres that are threatened and might deteriorate if we fail to manage potential sources of pollution (Figure 6). Some form of pollution or habitat degradation impairs the remaining 39% of the surveyed lake acres.

Greg Despopoulos, Raleigh, NC

What Is Polluting Our Lakes, Ponds, and Reservoirs?

Forty-one States, the District of Columbia, and Puerto Rico reported the number of lake acres impacted by individual pollutants and processes.

The States and Puerto Rico identified more lake acres polluted by nutrients and metals than other pollutants or processes (Figure 7). The States and Puerto Rico reported that metals and extra nutrients pollute 3.3 million lake acres (51% of the impaired lake acres). Healthy lake ecosystems contain nutrients in small quantities, but extra inputs of nutrients from human activities unbalance lake ecosystems. States consistently report metals as a major cause of impairment to lakes. This is mainly

Figure 5. Lake Acres Surveyed

Total lakes = 41.7 million acres
Total surveyed = 16.8 million acres

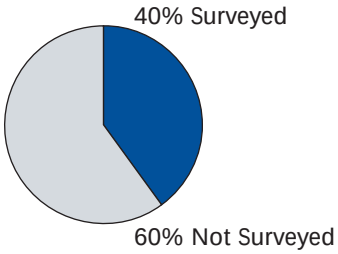
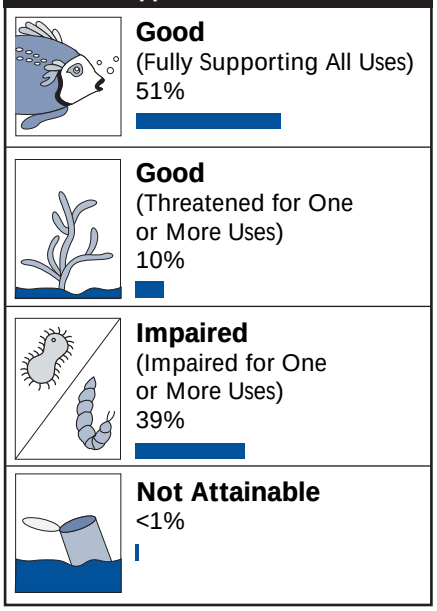


Figure 6. Levels of Summary Use Support – Lakes



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

due to the widespread detection of mercury in fish tissue samples. States are actively studying the extent of the mercury problem, which is complex because it involves transport from power-generating facilities and other sources.

In addition to nutrients and metals, the States, Puerto Rico, and the District of Columbia report that siltation pollutes 1.6 million lake acres (10% of the surveyed lake acres), enrichment by organic wastes that deplete oxygen impacts 1.4 million lake acres (8% of the surveyed lake acres), and noxious aquatic plants impact 1.0 million acres (6% of the surveyed lake acres).

States reported more impairments due to metals and nutrients than other pollutants.

Thirty-seven States also surveyed trophic status, which is associated with nutrient enrichment, in 8,951 of their lakes. Nutrient enrichment tends to increase the proportion of lakes in the eutrophic and hypereutrophic categories. These States reported that 16% of the lakes they surveyed for trophic status were oligotrophic, 38% were

Trophic States

Oligotrophic	Clear waters with little organic matter or sediment and minimum biological activity.
Mesotrophic	Waters with more nutrients and, therefore, more biological productivity.
Eutrophic	Waters extremely rich in nutrients, with high biological productivity. Some species may be choked out.
Hypereutrophic	Murky, highly productive waters, closest to the wetlands status. Many clearwater species cannot survive.
Dystrophic	Low in nutrients, highly colored with dissolved humic organic matter. (Not necessarily a part of the natural trophic progression.)

The Eutrophication Process

Eutrophication is a natural process, but human activities can accelerate eutrophication by increasing the rate at which nutrients and organic substances enter lakes from their surrounding watersheds. Agricultural runoff, urban runoff, leaking septic systems, sewage discharges, eroded streambanks, and similar sources can enhance the flow of nutrients and organic substances into lakes. These substances can overstimulate the growth of algae and aquatic plants, creating conditions that interfere with the recreational use of lakes and the health and diversity of native fish, plant, and animal populations. Enhanced eutrophication from nutrient enrichment due to human activities is one of the leading problems facing our Nation's lakes and reservoirs.

Acid Effects on Lakes

Increases in lake acidity can radically alter the community of fish and plant species in lakes and can increase the solubility of toxic substances and magnify their adverse effects. Eighteen States reported the results of lake acidification assessments. These States assessed pH (a measure of acidity) at 5,269 lakes and detected acidic conditions in 194 lakes and a threat of acidic conditions in 1,087 lakes. Most of the States that assessed acidic conditions are located in the Northeast, upper Midwest, and the South.

Only 13 States identified sources of acidic conditions. Maine and New Hampshire attributed most of their acid lake conditions to acid deposition from acidic rain, fog, or dry deposition in conjunction with natural conditions that limit a lake's capacity to neutralize acids. Alabama, Kansas, Maryland, Oklahoma, Tennessee, and West Virginia reported that acid mine drainage resulted in acidic lake conditions or threatened lakes with the potential to generate acidic conditions.

mesotrophic, 36% were eutrophic, 9% were hypereutrophic, and less than 1% were dystrophic. This information may not be representative of national lake conditions because States often assess lakes in response to a problem or public complaint or because of their easy accessibility. It is likely that more remote lakes—which are probably less impaired—are underrepresented in these assessments.

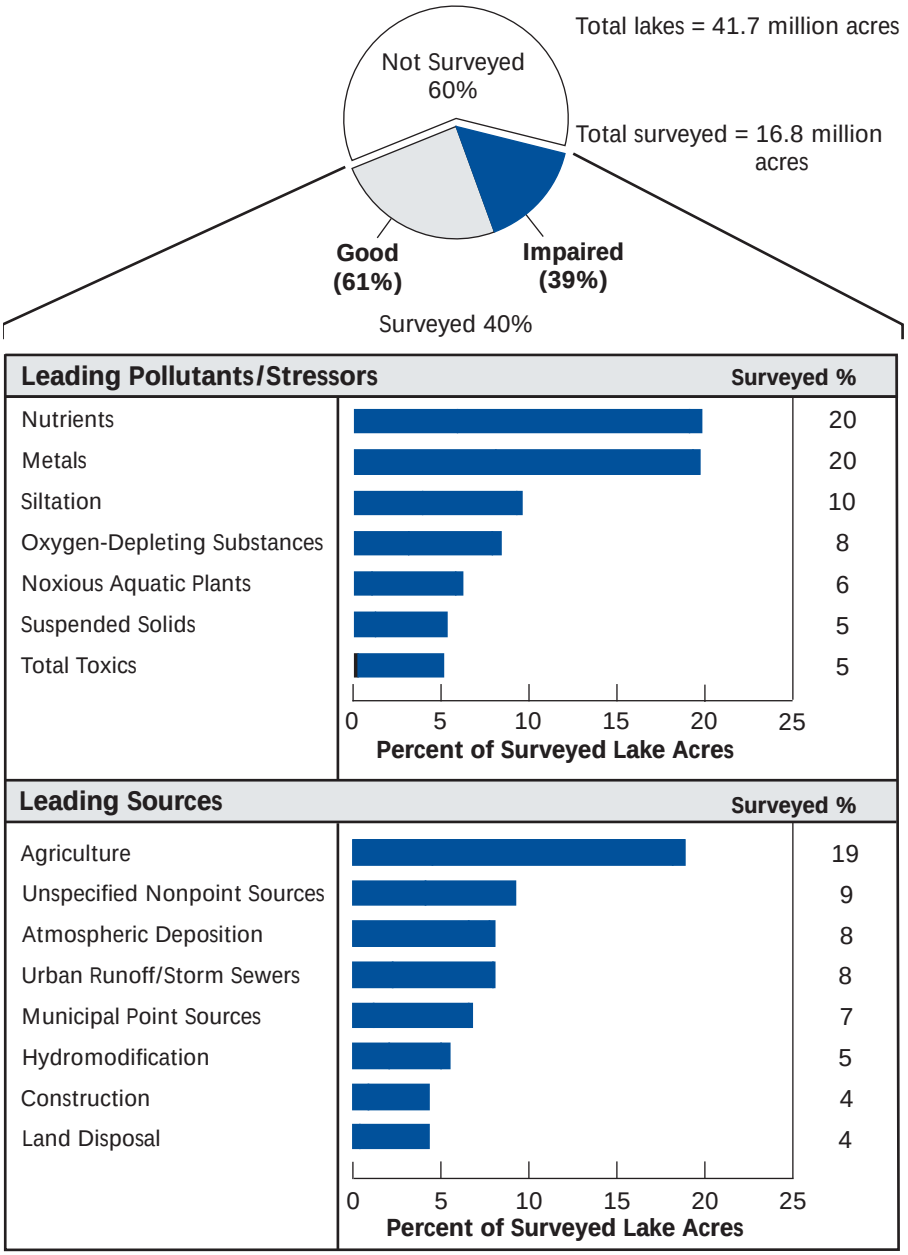
Where Does This Pollution Come From?

Forty-one States and Puerto Rico reported sources of pollution in some of their impacted lakes, ponds, and reservoirs. These States and Puerto Rico reported that agriculture is the most widespread source of pollution in the Nation's surveyed lakes (Figure 7). Agriculture generates pollutants that degrade aquatic life or interfere with public use of 3.2 million lake acres (19% of the surveyed lake acres).

Agriculture is the leading source of impairment in lakes, affecting 19% of surveyed lake acres.

The States and Puerto Rico also reported that unspecified nonpoint sources pollute 1.6 million lake acres (9% of the surveyed lake acres), atmospheric deposition of pollutants impairs 1.4 million lake acres (8% of the surveyed lake acres), urban runoff and storm sewers pollute 1.4 million lake acres (8% of the surveyed lake acres), municipal

Figure 7. Surveyed Lake Acres: Pollutants and Sources



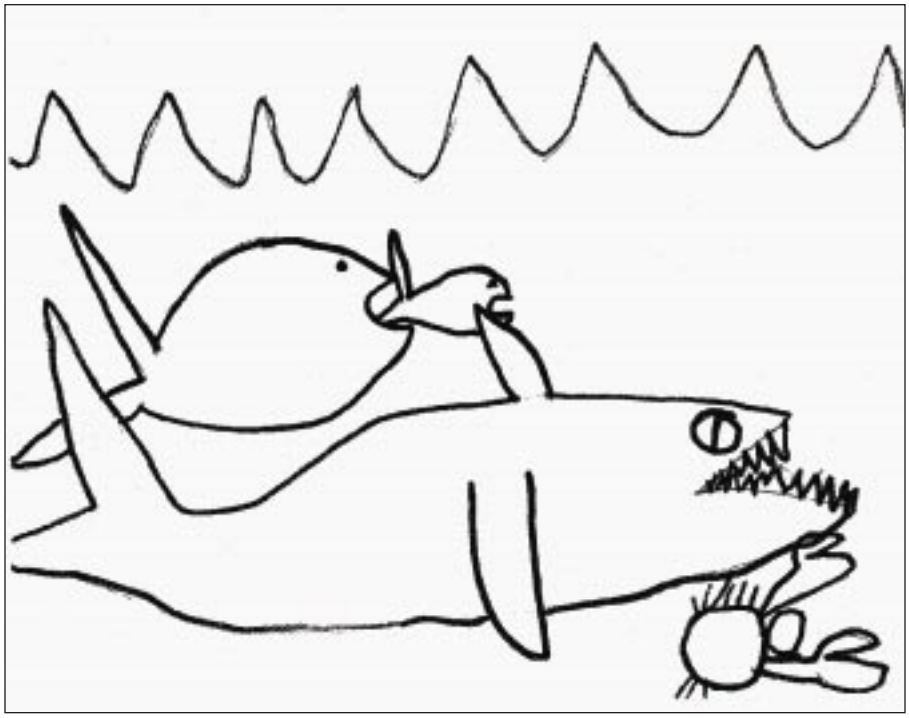
Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Note: Percentages do not add up to 100% because more than one pollutant or source may impair a lake.

sewage treatment plants pollute 1.2 million lake acres (7% of the surveyed lake acres), and hydrologic modifications degrade 924,000 lake acres (5% of the surveyed lake acres). Many more States reported lake degradation from atmospheric deposition in 1996 than in past reporting cycles. This is due, in part, to a growing awareness of the magnitude of the atmospheric deposition problem.

The States and Puerto Rico listed numerous sources that impact several hundred thousand lake acres, including land disposal of wastes, construction, industrial point sources, onsite wastewater systems (including septic tanks), forestry activities, habitat modification, flow regulation, contaminated sediments, highway maintenance and runoff, resource extraction, and combined sewer overflows.

Ed Carney, Kansas Department of Health and Environment



Sam Baskir, 1st grade, Estes Hills Elementary, Chapel Hill, NC

The Great Lakes

The Great Lakes contain one-fifth of the world's fresh surface water and are stressed by a wide range of pollution sources, including air pollution. Many of the pollutants that reach the Great Lakes remain in the system indefinitely because the Great Lakes are a relatively closed water system with few natural outlets. Despite dramatic declines in the occurrence of algal blooms, fish kills, and localized "dead" zones depleted of oxygen, less visible problems continue to degrade the Great Lakes.

John Theilgard, Bynum, NC

Overall Water Quality

The States surveyed 94% of the Great Lakes shoreline miles for 1996 and reported that fish consumption advisories and aquatic life concerns are the dominant water quality problems, overall, in the Great Lakes (Figure 8). The States reported that most of the Great Lakes nearshore waters are safe for swimming and other recreational activities and can be used as a source of drinking water with normal treatment. However, only 2% of the surveyed nearshore waters fully support designated uses, and 1% support all uses but are threatened for one or more uses (Figure 9). About 97% of the surveyed waters do not fully support designated uses because fish consumption advisories are posted throughout the nearshore waters of the Great Lakes and water quality conditions are unfavorable for supporting aquatic life in many cases. Aquatic life impacts result from persistent toxic pollutant burdens in birds, habitat degradation and destruction, and competition

Figure 8. Great Lakes Shore Miles Surveyed

Total Great Lakes = 5,521 miles
Total surveyed = 5,186 miles

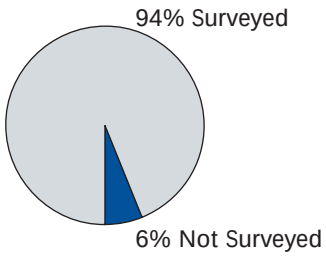
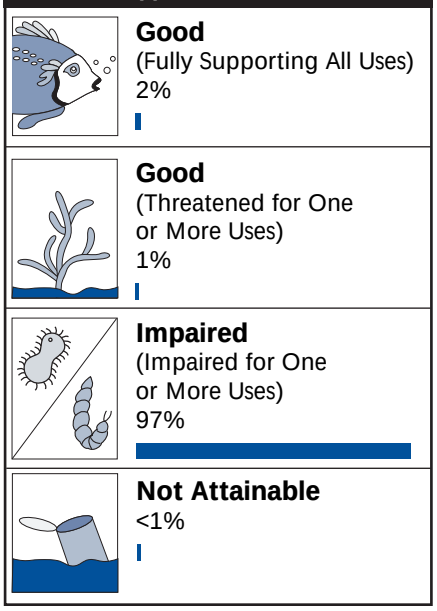


Figure 9. Levels of Summary Use Support – Great Lakes



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

and predation by nonnative species such as the zebra mussel and the sea lamprey.

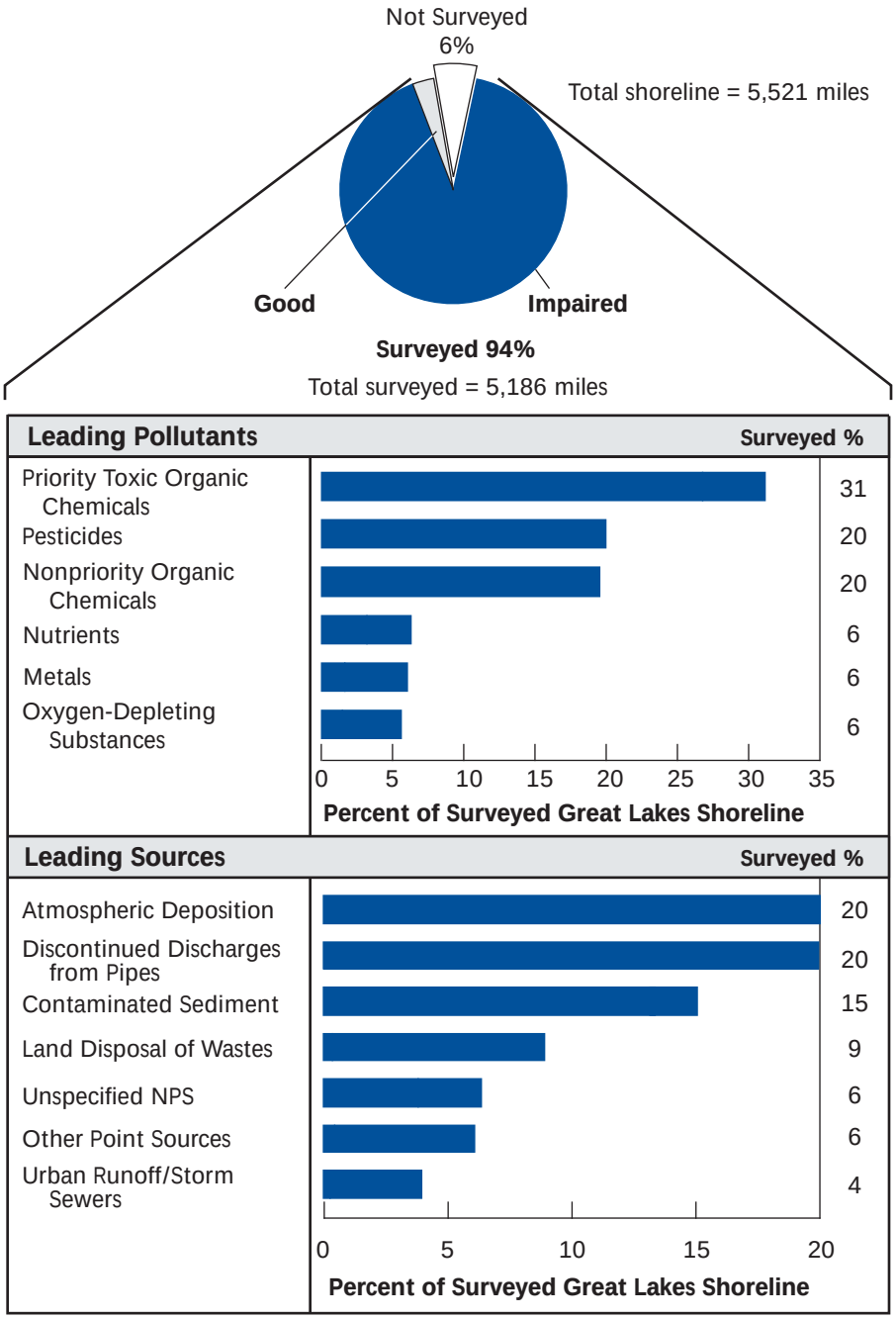
Considerable progress has been made in controlling conventional pollutants, but the Great Lakes are still subject to the effects of toxic pollutants.

These figures do not address water quality conditions in the deeper, cleaner, central waters of the Lakes.

What Is Polluting the Great Lakes?

The States reported that most of the Great Lakes shoreline is polluted by toxic organic chemicals—primarily PCBs—that are often found in fish tissue samples. The Great Lakes States reported that toxic organic chemicals impact 32% of the surveyed Great Lakes shoreline miles. Other leading causes of impairment include pesticides, affecting 21%; nonpriority organic chemicals, affecting 20%; nutrients, affecting 7%; metals, affecting 6%; and oxygen-depleting substances, affecting 6% (Figure 10).

Figure 10. Surveyed Great Lakes Shoreline: Pollutants and Sources



Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Where Does This Pollution Come From?

Only three of the eight Great Lakes States measured the size of their Great Lakes shoreline polluted by specific sources. These States have jurisdiction over one-third of the Great Lakes shoreline, so their findings do not necessarily reflect conditions throughout the Great Lakes Basin.

■ Wisconsin identifies atmospheric deposition and discontinued discharges as a source of pollutants contaminating all 1,017 of their surveyed shoreline miles. Wisconsin also identified smaller areas impacted by contaminated sediments, nonpoint sources, industrial and municipal discharges, agriculture, urban runoff and storm sewers, combined sewer overflows, and land disposal of waste.

■ Ohio reports that nonpoint sources pollute 86 miles of its 236 miles of shoreline, contaminated sediment impacts 33 miles, and land disposal of waste impacts 24 miles of shoreline.

■ New York identifies many sources of pollutants in their Great Lakes waters, but the State attributes the most miles of degradation to contaminated sediments (439 miles) and land disposal of waste (374 miles).

Barry Burgan, U.S. EPA

Estuaries

Estuaries are areas partially surrounded by land where rivers meet the sea. They are characterized by varying degrees of salinity, complex water movements affected by ocean tides and river currents, and high turbidity levels. They are also highly productive ecosystems with a range of habitats for many different species of plants, shellfish, fish, and animals.

Many species permanently inhabit the estuarine ecosystem; others, such as shrimp, use the nutrient-rich estuarine waters as nurseries before traveling to the sea.

Estuaries are stressed by the particularly wide range of activities located within their watersheds. They receive pollutants carried by rivers from agricultural lands and cities; they often support marinas, harbors, and commercial fishing fleets; and their surrounding lands are highly prized for development. These stresses pose a continuing threat to the survival of these bountiful waters.

Overall Water Quality

Twenty-three coastal States and jurisdictions surveyed 72% of the Nation's total estuarine waters in 1996 (Figure 11). The States and other jurisdictions reported that 62% of the surveyed estuarine waters have good water quality that fully supports designated uses (Figure 12). Of these waters, 4% are threatened and might deteriorate if we fail to manage potential sources of pollution. Some form of pollution or habitat degradation impairs the remaining 38% of the surveyed estuarine waters.

©Meg Turville-Heitz, Madison, Wi, 1996

What Is Polluting Our Estuaries?

The States identified more square miles of estuarine waters polluted by nutrients than any other pollutant or process (Figure 13). Eleven States reported that extra nutrients pollute 6,254 square miles of estuarine waters (57% of the impaired estuarine waters). As in lakes, extra inputs of nutrients from human activities destabilize estuarine ecosystems.

Twenty-one States reported that bacteria pollute 4,634 square miles of estuarine waters (22% of the impaired estuarine waters). Bacteria provide evidence that an estuary is contaminated with sewage that may contain numerous viruses and bacteria that cause illness in people.

Figure 11. Estuary Square Miles Surveyed

Total estuaries = 39,839 square miles
Total surveyed = 28,819 square miles

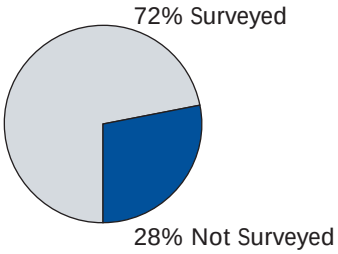
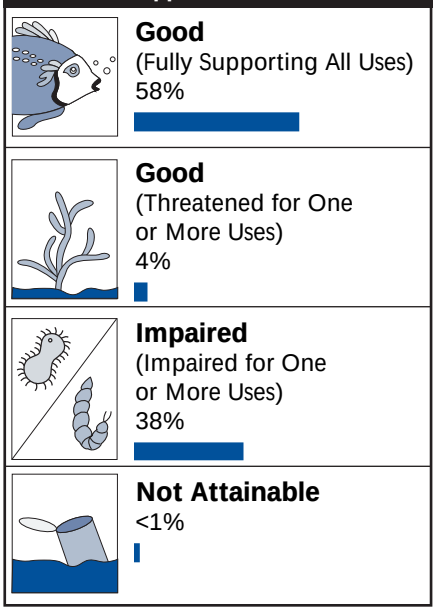
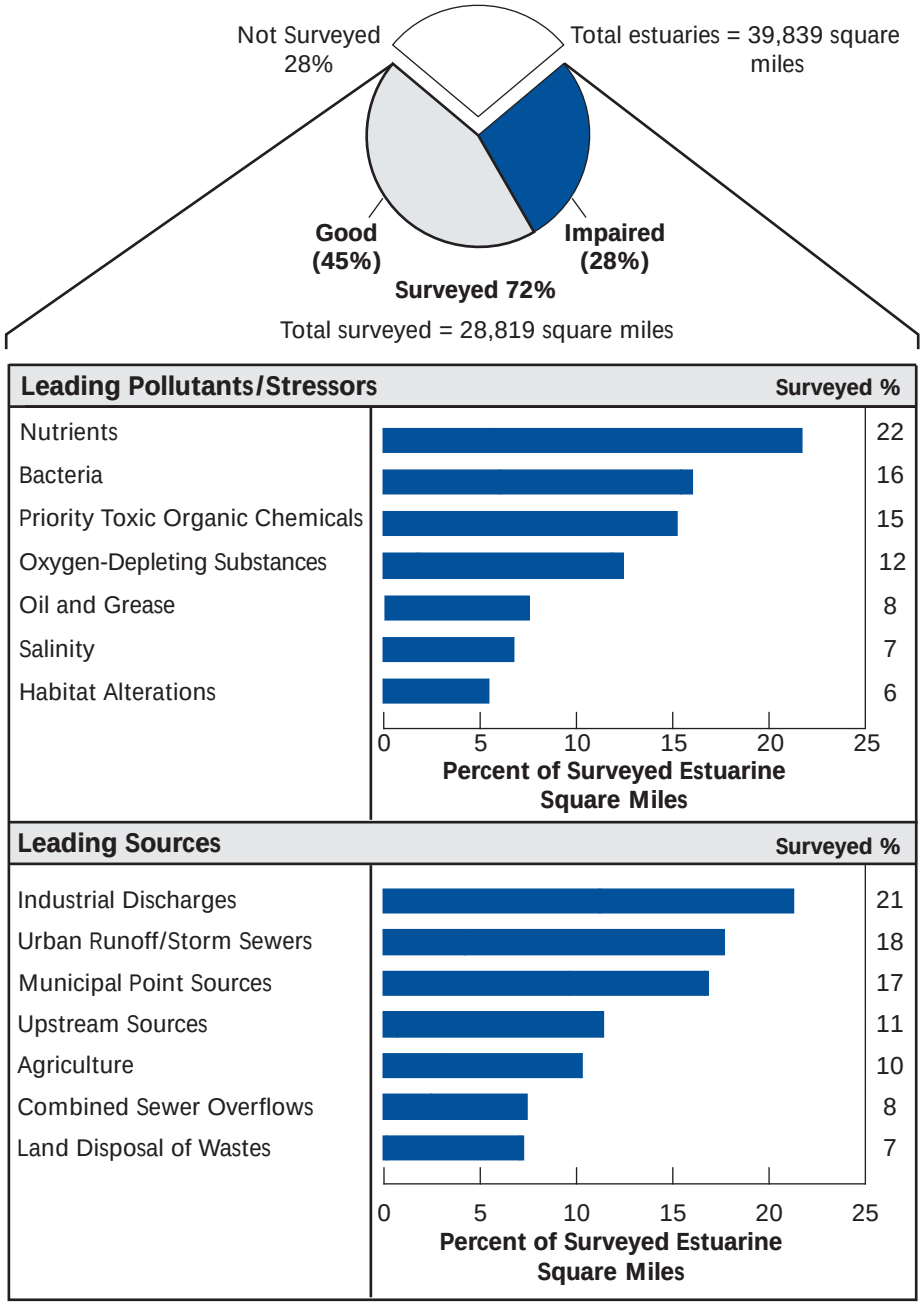


Figure 12. Levels of Summary Use Support – Estuaries



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Figure 13. Surveyed Estuaries: Pollutants and Sources



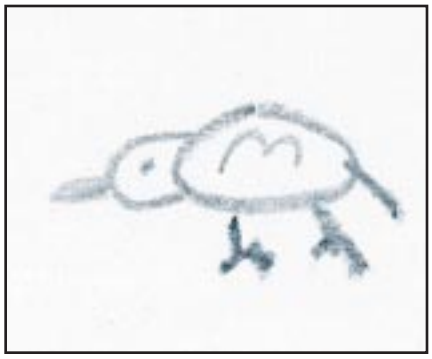
Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Note: Percentages do not add up to 100% because more than one pollutant or source may impair an estuary.

The States also report that priority organic toxic chemicals pollute 4,398 square miles (15% of the surveyed estuarine waters); oxygen depletion from organic wastes impacts 3,586 square miles (12% of the surveyed estuarine waters); oil and grease pollute 2,170 square miles (8% of the surveyed estuarine waters); salinity, total dissolved solids, and/or chlorine impact 1,944 square miles (7% of the surveyed estuarine waters); and habitat alterations degrade 1,586 square miles (6% of the surveyed estuarine waters).

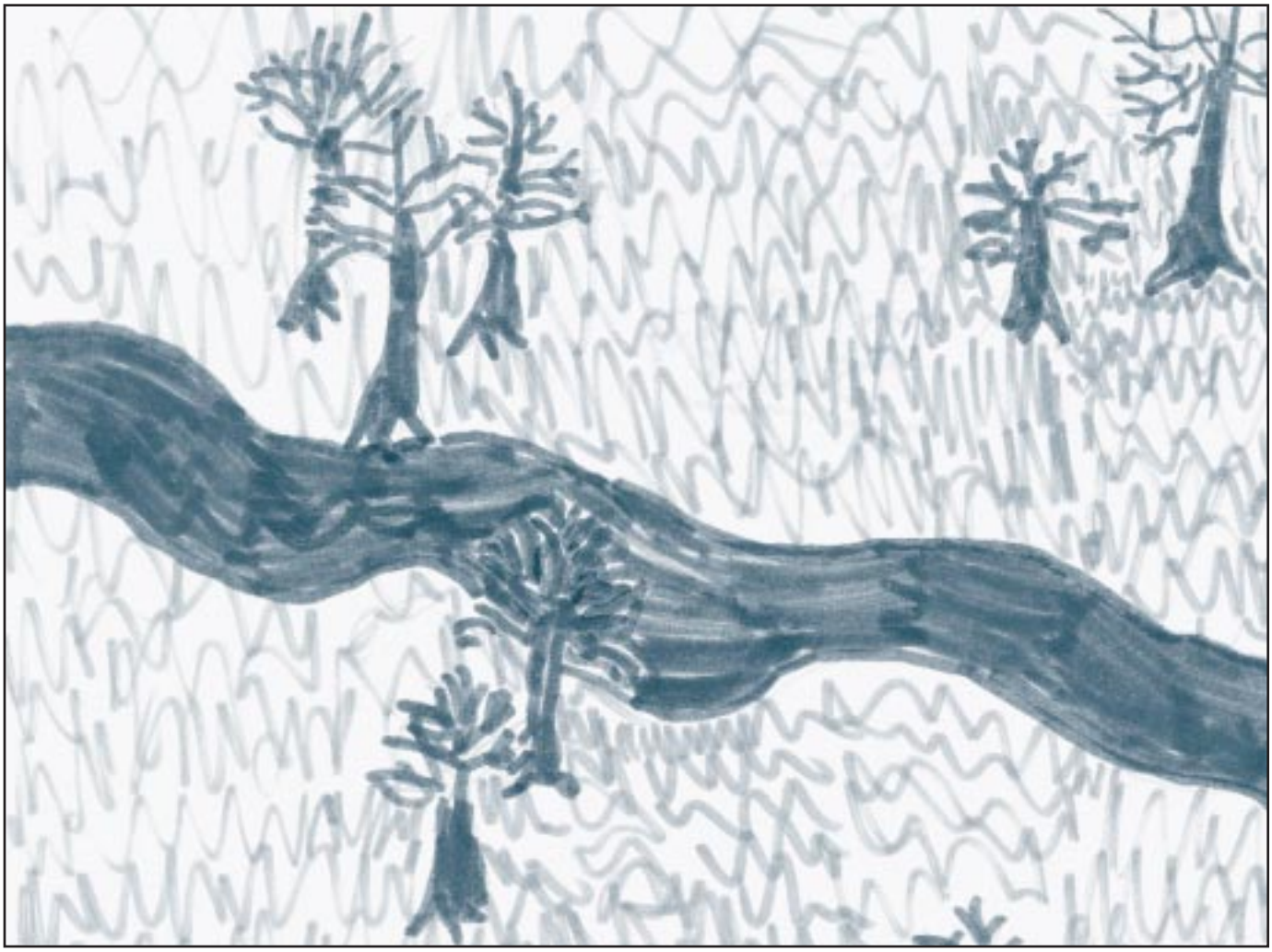
Where Does This Pollution Come From?

Twenty-one States reported that industrial discharges are the most widespread source of pollution in the Nation's surveyed estuarine waters. Pollutants in industrial discharge degrade aquatic life or interfere with public use of 6,145 square miles of estuarine waters (21% of the surveyed estuarine waters) (Figure 13).



Sydney Locker, Quaker Ridge School, Scarsdale, NY

The States also reported that urban runoff and storm sewers pollute 5,099 square miles of estuarine waters (18% of the surveyed estuarine waters), municipal discharges pollute 4,874 square miles of estuarine waters (17% of the surveyed estuarine waters), and upstream sources pollute 3,295 square miles (11% of the surveyed estuarine waters). Urban sources contribute more to the degradation of estuarine waters than agriculture because urban centers are located adjacent to most major estuaries.



Dana Soady, 4th Grade, Burton GeoWorld, Durham, NC

Ocean Shoreline Waters

Paul Goetz, Cary, NC

Although the oceans are expansive, they are vulnerable to pollution from numerous sources, including city storm sewers, ocean outfalls from sewage treatment plants, overboard disposal of debris and sewage, oil spills, and bilge discharges that contain oil and grease. Nearshore ocean waters, in particular, suffer from the same pollution problems that degrade our inland waters.

Overall Water Quality

Ten of the 27 coastal States and Territories surveyed only 6% of the Nation's estimated 58,585 miles of ocean coastline (Figure 14). Most of the surveyed waters (3,085 miles, or 87%) have good quality that supports a healthy aquatic community and public activities (Figure 15). Of these waters, 315 miles (9% of the surveyed shoreline) are threatened and may deteriorate in the future. Some form of pollution or habitat degradation impairs the remaining 13% of the surveyed shoreline (467 miles).

Only six of the 27 coastal States identified pollutants and sources of pollutants degrading ocean shoreline waters. General conclusions cannot be drawn from this limited source of information. The six States identified impacts in their ocean shoreline waters from bacteria, turbidity, nutrients, oxygen-depleting substances, suspended solids, acidity (pH), oil and grease, and metals. The six States reported that urban runoff and storm sewers, land disposal of wastes, septic systems, municipal sewer discharges, industrial discharges, recreational marinas, and spillls and illegal dumping pollute their coastal shoreline waters.

Figure 14. Ocean Shoreline Waters Surveyed

Total ocean shore = 58,585 miles including Alaska's shoreline
Total surveyed = 3,651 miles

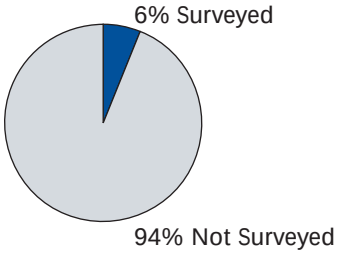
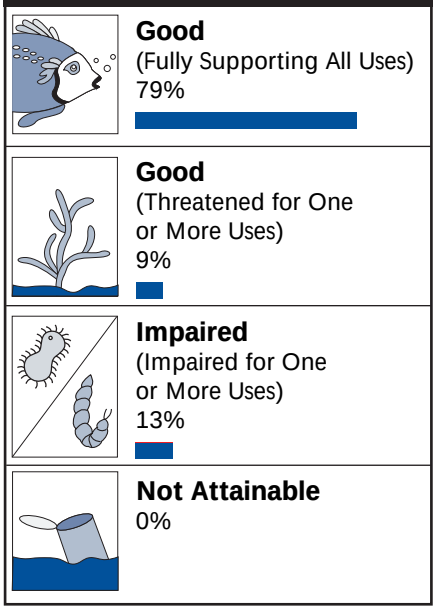


Figure 15. Levels of Summary Use Support – Ocean Shoreline Waters



Source: Based on 1996 State Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

Note: Percentages may not add up to 100% due to rounding.

Wetlands

Wetlands are areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support (and that under normal circumstances do support) a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands, which are found throughout the United States, generally include swamps, marshes, bogs, and similar areas.

Wetlands are now recognized as some of the most unique and important natural areas on earth. They vary in type according to differences in local and regional hydrology, vegetation, water chemistry, soils, topography, and climate. Coastal wetlands include estuarine marshes; mangrove swamps found in Puerto Rico, Hawaii, Louisiana, and Florida; and Great Lakes coastal wetlands. Inland wetlands, which may be adjacent to a waterbody or isolated, include marshes and wet meadows, bottomland hardwood forests, Great Plains prairie potholes, cypress-gum swamps, and southwestern playa lakes.

In their natural condition, wetlands provide many benefits, including food and habitat for fish and wildlife, water quality improvement, flood protection, shoreline erosion control, ground water exchange, as well as natural products for human use and opportunities for recreation, education, and research.

Wetlands help maintain and improve water quality by intercepting surface water runoff before it reaches open water, removing or retaining nutrients, processing chemical and organic wastes,

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and reducing sediment loads to receiving waters. As water moves through a wetland, plants slow the water, allowing sediment and pollutants to settle out. Plant roots trap sediment and are then able to metabolize and detoxify pollutants and remove nutrients such as nitrogen and phosphorus.

Wetlands function like natural basins, storing either floodwater that overflows riverbanks or surface water that collects in isolated depressions. By doing so, wetlands help protect adjacent and downstream property from flood damage. Trees and other wetlands vegetation help slow the speed of flood waters. This action, combined with water storage, can lower flood heights and reduce the water's erosive potential. In agricultural areas, wetlands can help reduce the likelihood of flood damage to crops. Wetlands within and upstream of urban areas are especially valuable for flood protection because urban development increases the rate and volume of surface water runoff, thereby increasing the risk of flood damage.

Wetlands produce a wealth of natural products, including fish and shellfish, timber, wildlife, and wild rice. Much of the Nation's fishing and shellfishing industry harvests wetlands-dependent species. A national survey conducted by the Fish and Wildlife Service (FWS) in 1991 illustrates the economic value of some of the wetlands-dependent products. Over 9 billion pounds of fish and shellfish landed in the United States in 1991 had a direct, dockside value of $3.3 billion. This served as the basis of a seafood processing and sales industry that generated total expenditures of $26.8 billion. In addition, 35.6 million anglers spent $24 billion on

freshwater and saltwater fishing. It is estimated that 71% of commercially valuable fish and shellfish depend directly or indirectly on coastal wetlands.

Overall Water Quality

The States, Tribes, and other jurisdictions are making progress in developing specific designated uses and water quality standards for wetlands, but many States and Tribes still lack specific water quality criteria and monitoring programs for wetlands. Without criteria and monitoring data, most States and Tribes cannot evaluate use support. To date, only nine States and Tribes reported the designated use support status for some of their wetlands. Only Kansas used quantitative data as a basis for the use support decisions.

EPA cannot derive national conclusions about water quality conditions in all wetlands because the States used different methodologies to survey only 3% of the total wetlands in the Nation. Summarizing State wetlands data would also produce misleading results because two States (North Carolina and Louisiana) contain 91% of the surveyed wetlands acreage.

What Is Polluting Our Wetlands and Where Does This Pollution Come From?

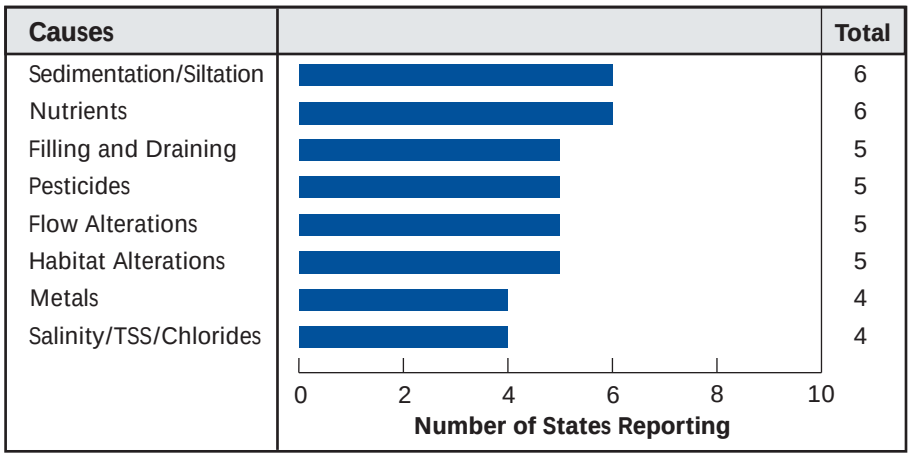
The States have even fewer data to quantify the extent of pollutants degrading wetlands and the sources of these pollutants. Although most States cannot quantify wetlands area impacted by individual causes and sources of degradation, nine States identified causes and sources known to degrade wetlands integrity to some extent. These States listed sediment and nutrients as the most widespread causes of degradation impacting wetlands, followed by draining and pesticides (Figure 16). Agriculture and hydrologic modifications topped the list of sources degrading wetlands, followed by urban runoff, draining, and construction (Figure 17).

Wetlands Loss: A Continuing Problem

It is estimated that over 200 million acres of wetlands existed in the lower 48 States at the time of European settlement. Since then, extensive wetlands acreage has been lost, with many of the original wetlands drained and converted to farmland and urban development. Today, less than half of our original wetlands remain. The losses amount to an area equal to the size of California. According to the U.S. Fish and Wildlife Service's *Wetlands Losses in the United States 1780's to 1980's*, the three States that have sustained the greatest percentage of wetlands loss are California (91%), Ohio (90%), and Iowa (89%).

According to FWS status and trends reports, the average annual loss of wetlands has decreased over the past 40 years. The average annual loss from the mid-1950s to the mid-1970s was 458,000 acres, and from the mid-1970s to the mid-1980s it was 290,000 acres. Agriculture was responsible for 87% of the loss from the mid-1950s to the mid-1970s and 54% of the loss from the mid-1970s to the mid-1980s.

Figure 16. Causes Degrading Wetlands Integrity (10 States Reporting)



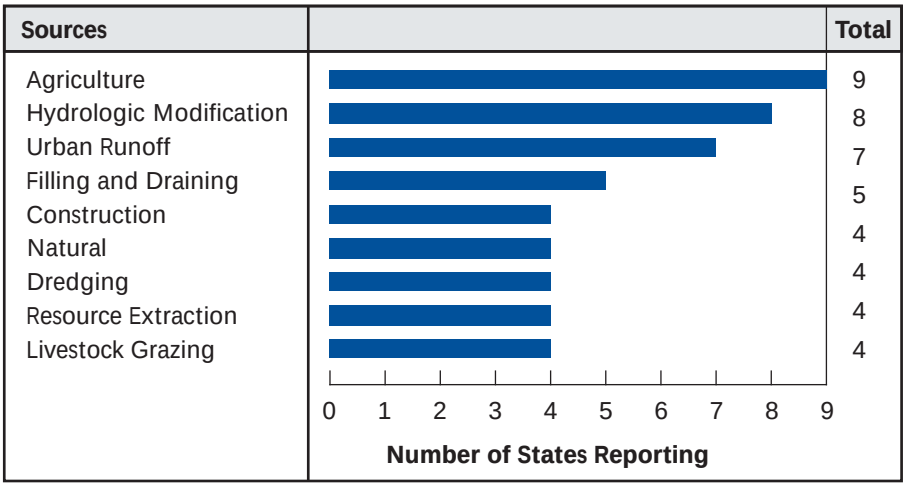
Source: Based on 1996 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.

A more recent estimate of wetlands losses from the National Resources Inventory (NRI), conducted by the Natural Resources Conservation Service (NRCS), indicates that 792,000 acres of wetlands were lost on non-Federal lands between 1982 and 1992 for a yearly loss estimate of 70,000 to 90,000 acres. This net loss is the result of gross losses of 1,561,300 acres of wetlands and gross gains of 768,700 acres of wetlands over the 10-year period. The NRI estimates are consistent with the trend of declining wetlands losses reported by FWS. Although losses have decreased, we still have to make progress toward our interim goal of no overall net loss of the Nation's remaining wetlands and the long-term goal of increasing the quantity and quality of the Nation's wetlands resource base.

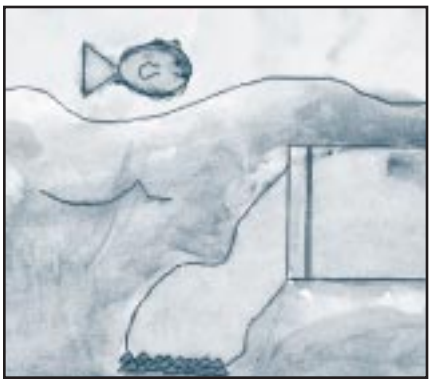
The decline in wetlands losses is a result of the combined effect of several trends: (1) the decline in profitability in converting wetlands for agricultural production; (2) passage of Swampbuster provisions in the 1985, 1990, and 1996 Farm Bills that denied crop subsidy benefits to farm operators who converted wetlands to cropland after 1985; (3) presence of the CWA Section 404 permit programs as well as development of State management programs; (4) greater public interest and support for wetlands protection; and (5) implementation of wetlands restoration programs at the Federal, State, and local level.

Twelve States listed sources of recent wetlands losses in their 1996 305(b) reports. Residential development and urban growth was cited as the leading source of current losses. Other losses were due to agriculture; construction of roads, highways, and bridges; hydrologic modifications; channelization; and industrial development. In addition to human activities, a few States also reported that natural sources, such as rising lake levels, resulted in wetlands losses and degradation.

Figure 17. Sources Degrading Wetlands Integrity (9 States Reporting)



Source: Based on 1996 Section 305(b) reports submitted by States, Tribes, Territories, Commissions, and the District of Columbia.



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More information on wetlands can be obtained from the EPA Wetlands Hotline at 1-800-832-7828.

Ground Water

Although 75% percent of the earth's surface is covered by water, only 3% is fresh water available for our use. It has been estimated that more than 90% of the world's fresh water reserve is stored in the earth as ground water. Ground water—water found in natural underground rock formations called aquifers—is a vital national resource that is used for myriad purposes. Unfortunately, this resource is vulnerable to contamination, and ground water contaminant problems are being reported throughout the country.

To ascertain the extent to which our Nation's ground water resources have been impacted by human activities, Section 106(e) of the Clean Water Act requests that each State monitor ground water quality and report the findings to Congress in their 305(b) State Water Quality Reports. Recognizing that an accurate representation of our Nation's ambient ground water quality conditions required developing guidelines that would ultimately yield quantitative data, EPA, in partnership with interested States, developed new guidelines for assessing ground water quality. It was these guidelines that were used by States for reporting the 1996 305(b) ground water data.

Despite variations in reporting style, the 1996 305(b) State Water Quality Reports represent a first step in improving the assessment of State ambient ground water quality. Forty States, one Territory, and two Tribes used the new guidelines to assess and report ground water quality data. For the first time, States provided quantitative data describing ground water quality.

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Furthermore, States provided quantitative information pertaining to contamination sources that have impacted ground water quality.

Ground Water Contamination

Not too long ago, it was thought that soil provided a protective "filter" or "barrier" that immobilized the downward migration of contaminants released on the land surface and prevented ground water resources from being adversely impacted or contaminated. The discovery of pesticides and other contaminants in ground water demonstrated that ground water resources were indeed vulnerable to contamination resulting from human activities. The potential for a contaminant to affect ground water quality is dependent upon its being introduced to the environment and its ability to migrate through the overlying soils to the underlying ground water resource.

Ground water provides drinking water for 51% of the population.

Ground water contamination can occur as relatively well defined plumes emanating from specific sources such as spills, landfills, waste lagoons, and/or industrial facilities. Contamination can also occur as a general deterioration of ground water quality over a wide area due to diffuse nonpoint sources such as agricultural fertilizer and pesticide applications, septic systems, urban runoff, leaking sewer networks, application of lawn chemicals, highway deicing materials, animal feedlots, salvage yards, and mining activities. Ground water quality degradation from diffuse nonpoint sources affects large areas, making it difficult to specify the exact source of the contamination.

Ground water contamination is most common in highly developed areas, agricultural areas, and industrial complexes. Frequently ground water contamination is discovered long after it has occurred. One reason for this is the slow movement of ground water through aquifers, sometimes on the order of less than an inch per day. Contaminants in the ground water do not mix or spread quickly, but remain concentrated in slow-moving plumes that may persist for many years. This often results in a delay in the detection of ground water contamination. In some cases, contaminants introduced into the

subsurface more than 10 years ago are only now being discovered.

Ground Water Contaminant Sources

As reported by States, it is evident that ground water quality may be adversely impacted by a variety of potential contaminant sources. In 1996, EPA requested each State to indicate the 10 top sources that potentially threaten their ground water resources. The list was not considered comprehensive and States added sources as was necessary based on State-specific concerns. Factors that were considered by States in their selection include the number of each type of source in the State, the location of the various sources relative to ground water used for drinking water purposes, the size of the population at risk from contaminated drinking water, the risk posed to human health and/or the environment from releases, hydrogeologic sensitivity (the ease with which contaminants enter and travel through soil and reach aquifers), and the findings of the State's ground water protection strategy and/or related studies.

Thirty-seven States provided information related to contaminant sources. Those most frequently reported by States include:

■ **Leaking underground storage tanks**. Leaking underground storage tanks (USTs) were cited as the highest priority contaminant source of concern to States. The primary causes of leakage in USTs are faulty installation and corrosion of tanks and pipelines. As of March 1996, more than 300,000 releases from USTs had been confirmed. EPA estimates that nationally 60% of these leaks have impacted ground water quality, and, in some States, the percentage is as high as 90%.

■ **Landfills**. Landfills were cited by States as the second highest contaminant source of concern. Landfills are used to dispose of sanitary (municipal) and industrial wastes. Municipal wastes, some industrial wastes, and relatively inert substances such as plastics are disposed of in sanitary landfills. Common materials that may be disposed of in industrial landfills include plastics, metals, fly ash, sludges, coke, tailings, waste pigment particles, low-level radioactive wastes, polypropylene, wood, brick, cellulose, ceramics, synthetics, and other similar substances. States indicated that the most common contaminants associated with landfills were metals, halogenated solvents, and petroleum compounds. To a lesser extent, organic and inorganic pesticides were also cited as a contaminant of concern.

■ **Septic systems**. Septic systems were cited by 29 out of 37 States as a potential source of ground water contamination. Ground water may be contaminated by releases from septic systems when the systems are poorly designed (tanks are installed in areas with inadequate soils or shallow depth to ground water), poorly constructed; have poor well seals; are improperly used, located, or maintained; or are abandoned. Typical contaminants from domestic septic systems include bacteria, nitrates, viruses, phosphates from detergents, and other chemicals that might originate from household cleaners.

Ground Water Quality Assessments

Thirty-three States reported data summarizing ground water quality. In total, data were reported for 162 specific aquifers and other hydrogeologic settings. States used data from ambient monitoring networks, public water supply systems (PWSs), private and unregulated wells, and special studies. Nationally, more States reported data for nitrates, metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) than any other parameter grouping. Nitrates, metals, SVOCs, and VOCs generally represent instances of ground water degradation resulting from human activities.

Due to the importance of ground water as a drinking water resource, many of the aquifers that were evaluated for 1996 are used to supply water for public and private consumption. The aquifers are also used for irrigation, commercial, livestock, and industrial purposes. In general, water quality problems affected irrigation, commercial, livestock, and industry uses less frequently than drinking water. This may reflect the high water quality standards set for drinking water.

Water Quality Protection Programs

Although significant strides have been made in reducing the impacts of discrete pollutant sources, our aquatic resources remain at risk from a combination of point sources and complex nonpoint sources, including air pollution. Since 1991, EPA has promoted the watershed protection approach as a holistic framework for addressing complex pollution problems.

The watershed protection approach is a place-based strategy that integrates water quality management activities within hydrologically defined drainage basins–watersheds–rather than areas defined by political boundaries. Thus, for a given watershed, the approach encompasses not only the water resource (such as a stream, lake, estuary, or ground water aquifer), but all the land from which water drains to the resource. To protect water resources, it is increasingly important to address the condition of land areas within the watershed because water carries the effects of human activities throughout the watershed as it drains off the land into surface waters or leaches into the ground water.

Under the Watershed Protection Approach (WPA), a "watershed" is a hydrogeologic area defined for addressing water quality problems. For example, a WPA watershed may be a river basin, a county-sized watershed, or a small drinking water supply watershed.

John Theilgard, Bynum, NC

EPA's Office of Water envisions the watershed protection approach as the primary mechanism for achieving clean water and healthy, sustainable ecosystems throughout the Nation. The watershed protection approach enables stakeholders to take a comprehensive look at ecosystem issues and tailor corrective actions to local concerns within the coordinated framework of a national water program. The emphasis on public participation also provides an opportunity to incorporate environmental justice issues into watershed restoration and protection solutions.

In May of 1994, the EPA Assistant Administrator for Water, Robert Perciasepe, created the Watershed Management Policy Committee to coordinate the EPA water program's support of the watershed protection approach. Since then, EPA's water program managers, under the direction of the Watershed Management Policy Committee, evaluated their programs and identified additional activities needed to support the watershed protection approach in an action plan.

EPA's Office of Water will continue to promote and support the watershed protection approach and build upon its experience with established place-based programs, such as the Chesapeake Bay Program and the Great Lakes National Program to eliminate barriers to the approach. These integrated programs laid the foundation for the Agency's shift toward comprehensive watershed management and continue to provide models for implementing the "place-based" approach to environmental problem-solving.

The Clean Water Act

A number of laws provide the authority to develop and implement pollution control programs. The primary statute providing for water quality protection in the Nation's rivers, lakes, wetlands, estuaries, and coastal waters is the Federal Water Pollution Control Act of 1972, commonly known as the Clean Water Act.

The CWA and its amendments are the driving force behind many of the water quality improvements we have witnessed in recent years. Key provisions of the CWA provide the following pollution control programs.

Water quality standards and criteria – States, Tribes, and other jurisdictions adopt EPA-approved standards for their waters that define water quality goals for individual waterbodies. Standards consist of designated beneficial uses to be made of the water, criteria to protect those uses, and antidegradation provisions to protect existing water quality.

Effluent guidelines – EPA develops nationally consistent guidelines limiting pollutants in discharges from industrial facilities and municipal sewage treatment plants. These guidelines are then used in permits issued to dischargers under the National Pollutant Discharge Elimination System (NPDES) program. Additional controls may be required if receiving

The Watershed Protection Approach (WPA)

Several key principles guide the watershed protection approach:

- **Place-based focus** – Resource management activities are directed within specific geographic areas, usually defined by watershed boundaries, areas overlying or recharging ground water, or a combination of both.
- **Stakeholder involvement and partnerships** – Watershed initiatives involve the people most likely to be affected by management decisions in the decision making process. Stakeholder participation ensures that the objectives of the watershed initiative will include economic stability and that the people who depend on the water resources in the watershed will participate in planning and implementation activities. Watershed initiatives also establish partnerships between Federal, State, and local agencies and nongovernment organizations with interests in the watershed.
- **Environmental objectives** – The stakeholders and partners identify environmental objectives (such as "populations of striped bass will stabilize or increase") rather than programmatic objectives (such as "the State will eliminate the backlog of discharge permit renewals") to measure the success of the watershed initiative. The environmental objectives are based on the condition of the ecological resource and the needs of people in the watershed.
- **Problem identification and prioritization** – The stakeholders and partners use sound scientific data and methods to identify and prioritize the primary threats to human and ecosystem health within the watershed. Consistent with the Agency's mission, EPA views ecosystems as the interactions of complex communities that include people; thus, healthy ecosystems provide for the health and welfare of humans as well as other living things.
- **Integrated actions** – The stakeholders and partners take corrective actions in a comprehensive and integrated manner, evaluate success, and refine actions if necessary. The watershed protection approach coordinates activities conducted by numerous government agencies and nongovernment organizations to maximize efficient use of limited resources.

waters are still affected by water quality problems after permit limits are met.

Total Maximum Daily Loads – The development of Total Maximum Daily Loads, or TMDLs, establishes the link between water quality standards and point/nonpoint source pollution control actions such as permits or Best Management Practices (BMPs). A TMDL calculates allowable loadings from the contributing point and nonpoint sources to a given waterbody and provides the quantitative basis for pollution reduction necessary to meet water quality standards. States, Tribes, and other jurisdictions develop and implement TMDLs for high-priority impaired or threatened waterbodies.

Permits and enforcement – All industrial and municipal facilities that discharge wastewater must have an NPDES permit and are responsible for monitoring and reporting levels of pollutants in their discharges. EPA issues these permits or can delegate that permitting authority to qualifying States or other jurisdictions. The States, other qualified jurisdictions, and EPA inspect facilities to determine if their discharges comply with permit limits. If dischargers are not in compliance, enforcement action is taken.

Loans – The Clean Water State Revolving Fund (CW-SRF) is an innovative water quality financing program that is designed to provide low-cost project financing to solve important water quality problems. The SRF program is made up of 51 state-level infrastructure funds (Puerto Rico has one, too) that operate much like banks. These funds were created by the 1987 Amendments to the Clean Water Act and are intended to provide permanent and independent sources of funding for municipal sewage treatment, nonpoint source, and estuary projects. EPA and the States are capitalizing or providing "seed money" to establish these revolving funds. The goal is to capitalize the 51 programs so that they can provide in excess of $2 billion in loans for water quality projects each year for the foreseeable future. The CW-SRF is, by far, the most powerful financial tool available to the water quality program.

The 1996 Amendments to the Safe Drinking Water Act (SDWA) created the new Drinking Water State Revolving Fund (DW-SRF) program. The primary purpose of this program is to upgrade drinking water infrastructure to facilitate compliance with the SDWA. Congress has appropriated $2 billion to begin the capitalization of this program. The long-term strategy is to continue capitalization of this program so that the SRFs will be able to provide in excess of $500 million each year in assistance for priority drinking water projects. In January 1997, EPA released the first Drinking Water Needs Survey, which identified $138.4 billion in needs over the next 20 years. EPA is currently working with the States to set up their drinking water SRFs.

Grants – EPA provides States with financial assistance to help support many of their pollution control programs. The programs funded include water quality monitoring, permitting, and enforcement; nonpoint source; ground water; National Estuary Program; and wetlands.

Nonpoint source control – EPA provides program guidance, technical support, and funding to help the States, Tribes, and other jurisdictions control nonpoint source pollution. The States, Tribes, and other jurisdictions are responsible for analyzing the extent and severity of their nonpoint source pollution problems and developing and implementing needed water quality management actions.

The CWA also established pollution control and prevention programs for specific waterbody categories, such as the Clean Lakes Program. Other statutes that also guide the development of water quality protection programs include:

- **The Safe Drinking Water Act**, under which States establish standards for drinking water quality, monitor wells and local water supply systems, implement drinking water protection programs, and implement Underground Injection Control (UIC) programs.

■ **The Resource Conservation and Recovery Act**, which establishes State and EPA programs for ground water and surface water protection and cleanup and emphasizes prevention of releases through management standards in addition to other waste management activities.

■ **The Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Program)**, which provides EPA with the authority to clean up contaminated waters during remediation at contaminated sites.

■ **The Pollution Prevention Act of 1990**, which requires EPA to promote pollutant source reduction rather than focus on controlling pollutants after they enter the environment.

Protecting and Restoring Lakes

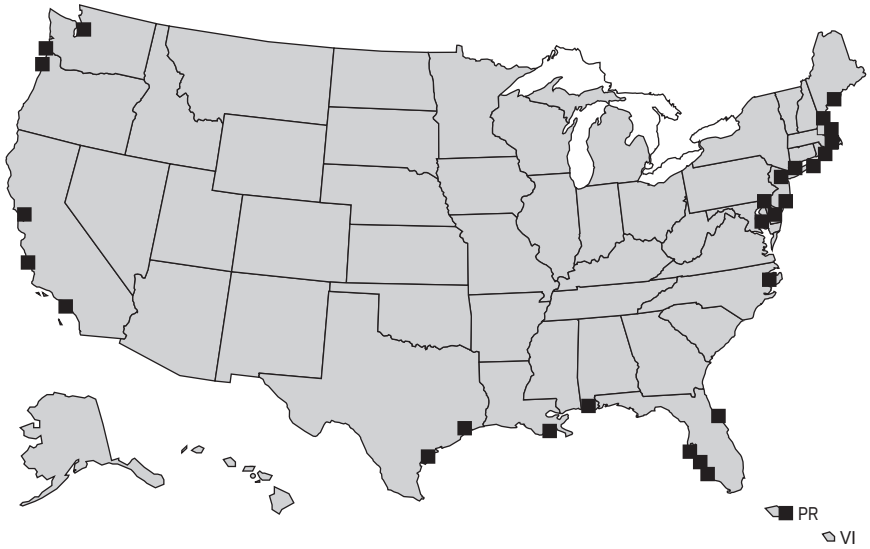
Since the 1980s, EPA has encouraged States to develop lake projects with a watershed perspective. This ensures that protection and restoration activities are long term and comprehensive. EPA offers sources of funding assistance for lake projects and also encourages States to develop their own independent mechanisms to provide resources for their lake management programs.

A good example of a State-based lakes initiative is the Illinois Conservation 2000 Clean Lakes program. Illinois' system adopted major features of the Federal Clean Lakes program. The process leading to the Conservation 2000 program can be traced back to legislative actions in the late 1980s that set up the basic framework and identified agency roles and responsibilities. The program now has assured ongoing funding to support lake restoration projects and to underwrite a variety of technical support and educational activities.

At the Federal level, EPA offers support for watershed-oriented lake projects through Nonpoint Source 319(h) grants included under State Nonpoint Source Management Programs. Other EPA resources may be available under provisions of the reauthorized Safe Drinking Water Act, with its emphasis on source water protection.

Jerome Pitt, U.S. EPA, Region 9

Figure 18. Locations of National Estuary Program Sites



Successful lake programs require local stakeholder support and an awareness on the part of stakeholders of how to identify pollution concerns as well as knowledge of appropriate lake protection and restoration management measures. EPA provides support for a variety of local stakeholder outreach and education initiatives. A good example is the Great American Secchi Dip-In, an event held for the past 4 years, in which volunteer lake and reservoir monitoring programs from across the country take a Secchi disk measurement on one day in a period surrounding July 4th. Secchi disks are typically flat, black and white disks that are used to measure the transparency of water. Transparency is one indicator of the impact of human activity on lake water quality.

The National Estuary Program

Section 320 of the Clean Water Act (as amended by the Water Quality Act of 1987) established the National Estuary Program (NEP) to protect and restore water quality and living resources in estuaries. The NEP adopts a geographic or watershed approach by planning and implementing pollution abatement activities for the estuary and its surrounding land area as a whole.

The NEP embodies the ecosystem approach by building coalitions, addressing multiple sources of contamination, pursuing habitat protection as a pollution control mechanism, and investigating cross-media transfer of pollutants from air and soil into specific estuarine waters. Under the NEP, a State governor nominates an estuary in his or her State for participation in the program. The State must demonstrate a likelihood of success in protecting candidate estuaries and provide evidence of institutional, financial, and political commitment to solving estuarine problems.

If an estuary meets the NEP guidelines, the EPA Administrator convenes a management conference of representatives from interested Federal, Regional, State, and local governments; affected industries; scientific and academic institutions; and citizen organizations. The management conference defines program goals and objectives, identifies problems, and designs strategies to control pollution and manage natural resources in the estuarine basin. Each management conference develops and initiates implementation of a Comprehensive Conservation and Management Plan (CCMP) to restore and protect the estuary.

The NEP currently supports 28 estuary projects.

The NEP integrates science and policy by bringing water quality managers, elected officials, and stakeholders together with scientists from government agencies, academic institutions, and the private sector. Because the NEP is not a research program, it relies heavily on past and ongoing research of other agencies and institutions to support development of CCMPs.

With the addition of seven estuary sites in July of 1995, the NEP currently supports 28 estuary projects (see Figure 18). These 28 estuaries are nationally significant in their economic value as well as in their ability to support living

The 1993 Wetlands Plan

Shortly after coming into office, the Clinton Administration convened an interagency working group to address concerns with Federal wetlands policy. After hearing from States, developers, farmers, environmental interests, members of Congress, and scientists, the working group developed a comprehensive 40-point plan for wetlands protection to make wetlands programs more fair, flexible, and effective. This plan was issued on August 24, 1993.

The Administration's Wetlands Plan emphasizes improving Federal wetlands policy by

- Streamlining wetlands permitting programs
- Increasing cooperation with private landowners to protect and restore wetlands
- Basing wetlands protection on good science and sound judgment
- Increasing participation by States, Tribes, local governments, and the public in wetlands protection.

resources. The project sites also represent a broad range of environmental conditions in estuaries throughout the United States and its Territories so that the lessons learned through the NEP can be applied to other estuaries.

Each of the 28 estuaries in the NEP is unique. Yet the estuaries share common threats and stressors. Each estuary faces expanding human activity near its shores that may degrade water quality and habitat. Eutrophication, toxic substances (including metals), pathogens, and changes to living resources and habitats top the list of problems being addressed by NEP Management Conferences.

Protecting Wetlands

A variety of public and private programs protect wetlands. Section 404 of the CWA continues to provide the primary Federal vehicle for regulating certain activities in wetlands. Section 404 establishes a permit program for discharges of dredged or fill material into waters of the United States, including wetlands.

The U.S. Army Corps of Engineers (COE) and EPA jointly implement the Section 404 program. The COE is responsible for reviewing permit applications and making permit decisions. EPA establishes the environmental criteria for making permit decisions and has the authority to review and veto Section 404 permits proposed for issuance by the COE. EPA is also responsible for determining geographic jurisdiction of the Section 404 permit program, interpreting statutory exemptions, and overseeing Section 404 permit programs assumed by individual States. To date, only two States (Michigan and New Jersey) have assumed the Section 404 permit program from the COE. The COE and EPA share responsibility for enforcing Section 404 requirements.

The COE issues individual Section 404 permits for specific projects or general permits (Table 5). Applications for individual permits go through a review process that includes opportunities for EPA, other Federal agencies (such as the U.S. Fish and Wildlife Service and the National Marine Fisheries

Table 5. Federal Section 404 Permits

General Permits (streamlined permit review procedures)				Individual Permits
Nationwide Permits	Regional Permits	Programmatic Permits		• Required for major projects that have the potential to cause significant adverse impacts • Project must undergo interagency review • Opportunity for public comment • Opportunity for 401 certification review
		State Programmatic Permits	Others	
• Cover 39 types of activities that the COE determines to have minimal adverse impacts on the environment	• Developed by COE District Offices to cover activities in a specified region	• COE defers permit decisions to State agency while reserving authority to require an individual permit	• Special Management Agencies • Watershed Planning Commissions	

Service), State agencies, and the public to comment. However, the vast majority of activities proposed in wetlands are covered by Section 404 general permits. For example, in FY96, over 64,000 people applied to the COE for a Section 404 permit. Eighty-five percent of these applications were covered by general permits and were processed in an average of 14 days. It is estimated that another 90,000 activities are covered by general permits that do not require notification of the COE at all.

General permits allow the COE to permit certain activities without performing a separate individual permit review. Some general permits require notification of the COE before an activity begins. There are three types of general permits:

- Nationwide permits (NWPs) authorize specific activities across the entire Nation that the COE determines will have only minimal individual and cumulative impacts on the environment, including construction of minor road crossings and farm buildings, bank stabilization activities, and the filling of up to 10 acres of isolated or headwater wetlands.

- Regional permits authorize types of activities within a geographic area defined by a COE District Office.

- Programmatic general permits are issued to an entity that the COE determines may regulate activities within its jurisdictional wetlands. Under a programmatic general permit, the COE defers its permit decision to the regulating entity but reserves its authority to require an individual permit.

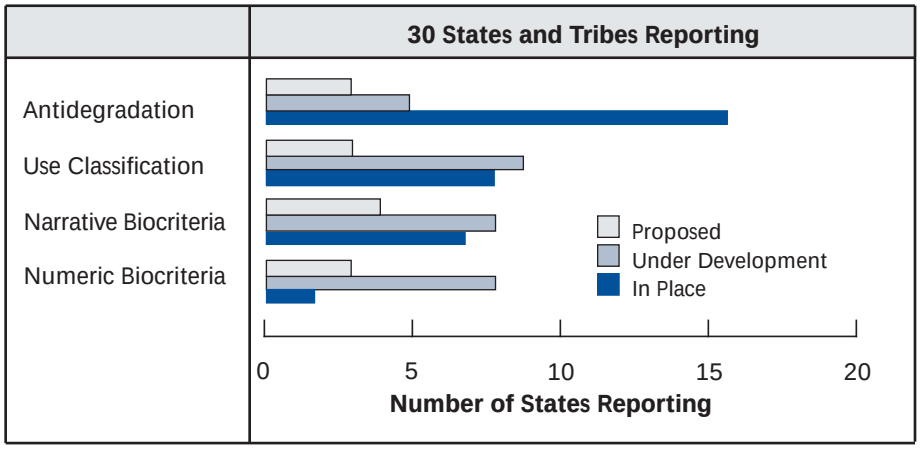
Currently, the COE and EPA are promoting the development of State programmatic general permits (SPGPs) to increase State involvement in wetlands protection and minimize duplicative State and Federal review of activities proposed in wetlands. Each SPGP is a unique arrangement developed by a State and the COE to take advantage of the strengths of the individual State wetlands program. Several States have adopted comprehensive SPGPs that replace many or all COE-issued nationwide general permits. SPGPs simplify the regulatory process and increase State control over their wetlands resources. Carefully developed SPGPs can improve wetlands protection while reducing regulatory demands on landowners.

Water quality standards for wetlands ensure that the provisions of CWA Section 303 that apply to other surface waters are also applied to wetlands. In July 1990, EPA issued guidance to States for the development of wetlands water quality standards. Water quality standards consist of designated beneficial uses, numeric criteria, narrative criteria, and antidegradation statements. Figure 19 indicates the State's progress in developing these standards.

Standards provide the foundation for a broad range of water quality management activities under the CWA including, but not limited to, monitoring for the Section 305(b) report, permitting under Sections 402 and 404, water quality certification under Section 401, and the control of nonpoint source pollution under Section 319.

States, Territories, and Tribes are well positioned between Federal and local government to take the lead in integrating and expanding wetlands protection and management programs. They are experienced in managing federally mandated environmental programs, and they are uniquely equipped to help resolve local and regional conflicts

Figure 19. Development of State Water Quality Standards for Wetlands



and identify the local economic and geographic factors that may influence wetlands protection.

Section 401 of the CWA gives States and eligible American Indian Tribes the authority to grant, condition, or deny certification of federally permitted or licensed activities that may result in a discharge to U.S. waters, including wetlands. Such activities include discharge of dredged or fill material permitted under CWA Section 404, point source discharges permitted under CWA Section 402, and Federal Energy Regulatory Commission's hydropower licenses. States review these permits to ensure that they meet State water quality standards.

Section 401 certification can be a powerful tool for protecting wetlands from unacceptable degradation or destruction especially when implemented in conjunction with wetlands-specific water quality standards. If a State or an eligible Tribe denies Section 401 certification, the Federal permitting or licensing agency cannot issue the permit or license.

Until recently, many States waived their right to review and certify Section 404 permits because these States had not defined water quality standards for wetlands or codified regulations for implementing their 401 certification program into State law. Now, most States report that they use the Section 401 certification process to review Section 404 projects and to require mitigation if there is no alternative to degradation of wetlands. Ideally, 401 certification should be used to augment State programs because activities that do not require Federal permits or licenses, such as some ground water withdrawals, are not covered.

State/Tribal Wetlands Conservation Plans (SWCPs) are strategies that integrate regulatory and cooperative approaches to achieve State wetlands management goals, such as no overall net loss of wetlands. SWCPs are not meant to create a new level of bureaucracy. Instead, SWCPs improve government and private-sector effectiveness and efficiency by identifying gaps in wetlands protection programs and identifying opportunities to improve wetlands programs.

States, Tribes, and other jurisdictions protect their wetlands with a variety of other approaches, including permitting programs, coastal management programs, wetlands acquisition programs, natural heritage programs, and integration with other programs. The following trends emerged from individual State and Tribal reporting:

- Most States have defined wetlands as waters of the State, which offers general protection through antidegradation clauses and designated uses that apply to all waters of a State. However, most States have not developed specific wetlands water quality standards and designated uses that protect wetlands' unique functions, such as flood attenuation and filtration.

- Without specific wetlands uses and standards, the Section 401 certification process relies heavily on antidegradation clauses to prevent significant degradation of wetlands.

- In many cases, the States use the Section 401 certification process to add conditions to Section 404 permits that minimize the size of wetlands destroyed or degraded by proposed activities to the extent practicable. States often add conditions that require compensatory mitigation for destroyed wetlands, but the States do not have the resources to perform enforcement inspections or followup monitoring to ensure that the wetlands are constructed and functioning properly.

- More States are monitoring selected, largely unimpacted wetlands to establish baseline conditions in healthy wetlands. The States will use this information to monitor the relative performance of constructed wetlands and to help establish biocriteria and water quality standards for wetlands.

Although the States, Tribes, and other jurisdictions report that they are making progress in protecting wetlands, they also report that the pressure to develop or destroy wetlands remains high. EPA and the States, Tribes, and other jurisdictions will continue to pursue new mechanisms for protecting wetlands that rely less on regulatory tools.

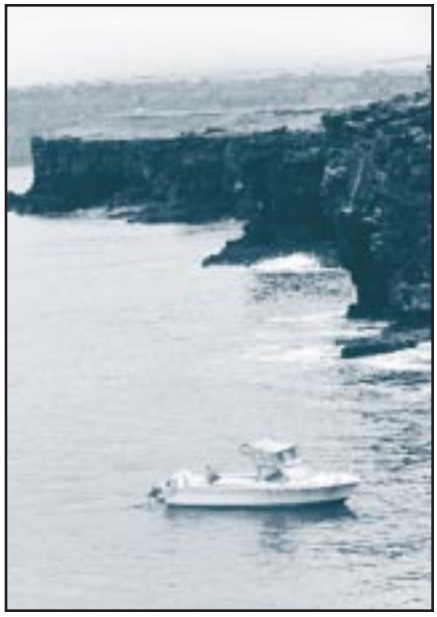
Protecting the Great Lakes

Restoring and protecting the Great Lakes requires cooperation from numerous organizations because the pollutants that enter the Great Lakes originate in both the United States and Canada, as

well as in other countries, and pollutants enter the lakes via multiple media (i.e., air, ground water, and surface water). The International Joint Commission (IJC), established by the 1909 Boundary Waters Treaty, provides a framework for the cooperative management of the Great Lakes. Representatives from the United States and Canada, the Province of Ontario, and the eight States bordering the Lakes sit on the IJC's Water Quality Board. The Water Quality Board recommends actions for protecting and restoring the Great Lakes and evaluates the environmental policies and actions implemented by the United States and Canada.

The EPA Great Lakes National Program Office (GLNPO) coordinates activities within the United States at all government levels and works with academia, industry, and nongovernment organizations to protect and restore the lakes. The GLNPO provides leadership through its annual Great Lakes Program Priorities and Funding Guidance. The GLNPO also serves as a liaison to the Canadian members of the IJC and the Canadian environmental agencies.

The 1978 Great Lakes Water Quality Agreement (as amended in 1987) lay the foundation for ongoing efforts to restore and protect the Great Lakes. The Agreement committed the United States and Canada to developing Remedial Action Plans (RAPs) for Areas of Concern and Lakewide Management Plans (LaMPs) for each lake. Areas of Concern are specially designated waterbodies around the Great Lakes that show symptoms of



Paul Goetz, Cary, NC

serious water quality degradation. Most of the 42 Areas of Concern are located in harbors, bays, or river mouths entering the Great Lakes. RAPs identify impaired uses and examine management options for addressing degradation in an Area of Concern. LaMPs use an ecosystem approach to examine water quality issues that have more widespread impacts within each Great Lake. Public involvement is a critical component of both LaMP development and RAP development.

EPA advocates pollution prevention as the most effective approach for achieving the virtual elimination of persistent toxic discharges into the Great Lakes. The GLNPO has funded numerous pollution prevention grants throughout the Great Lakes Basin since FY93. The GLNPO is targeting its grant dollars to support projects that further the goal of virtual elimination of persistent toxic substances. As part of the efforts to protect Lake Superior, EPA, the States, and Canada are implementing a virtual elimination initiative for Lake Superior that seeks to eliminate new contributions of critical pollutants, especially mercury.

The Great Lakes Water Quality Initiative is a key element of the environmental protection efforts undertaken by the United States in the Great Lakes Basin. The purpose of the Initiative is to provide a consistent level of protection in the Basin from the effects of toxic pollutants. In 1989, the Initiative was organized by EPA at the request of the Great Lakes States to promote consistency in their environmental programs in the Great Lakes Basin with minimum requirements.

Initiative efforts were well under way when Congress enacted the Great Lakes Critical Programs Act of 1990. The Act requires EPA to publish proposed and final water quality guidance that specifies minimum water quality criteria for the Great Lakes System. The Act also requires the Great Lakes States to adopt provisions that are consistent with the EPA final guidance within 2 years of EPA's publication. In addition, Indian Tribes authorized to administer an NPDES program in the Great Lakes Basin must also adopt provisions consistent with EPA's final guidance.

To carry out the Act, EPA proposed regulations for implementing the guidance on April 16, 1993, and invited the public to comment. The States and EPA conducted public meetings in all of the Great Lakes States during the comment period. As a result, EPA received over 26,500 pages of comments from

over 6,000 commenters. EPA reviewed all of the comments and published the final guidance in March of 1995.

The final guidance prioritizes control of long-lasting pollutants that accumulate in the food web—bioaccumulative chemicals of concern (BCCs). The final guidance includes provisions to phase out mixing zones for BCCs (except in limited circumstances), more extensive data requirements to ensure that BCCs are not underregulated due to a lack of data, and water quality criteria to protect wildlife that feed on aquatic prey. Publication of the final guidance was a milestone in EPA's move toward increasing stakeholder participation in the development of innovative and comprehensive programs for protecting and restoring our natural resources.

The Chesapeake Bay Program

The Chesapeake Bay is an enormously complex and dynamic system of fish, waterfowl, and vegetation in an estuary where salt water from the Atlantic Ocean and fresh water from its many tributaries in the 64,000-square-mile watershed come together. The extremely shallow and productive Bay presents formidable challenges to the understanding and management of this great estuary. In many areas of the Bay, water quality is not sufficient to support living resources year round. In the warmer months, large portions of the Bay contain little or no dissolved oxygen, which may cause fish eggs and larvae to die. The growth and reproduction of oysters, clams, and other bottom-dwelling animals are impaired. Adult fish find their habitat reduced and their feeding inhibited.

Many areas of the Bay also have cloudy water from excess sediment in the water or an overgrowth of algae (stimulated by excessive nutrients in the water). Turbid waters block the sunlight needed to support the growth and survival of Bay grasses, also known as submerged aquatic vegetation (SAV). Without SAV, critical habitat for fish and crabs is lost. Although there has been a recent resurgence of SAV in some areas of the Bay, most areas still do not support abundant populations as they once did.

The main causes of the Bay's poor water quality and aquatic habitat loss are elevated levels of the nutrients nitrogen and phosphorus. Both are natural fertilizers found in animal wastes, soil, and even the atmosphere. These nutrients have always existed in the Bay, but not at the present elevated concentrations. When the Bay was surrounded primarily by forests and wetlands, very little nitrogen and phosphorus ran off the land into the water. Most of it was absorbed or held in place by the natural vegetation. As the use of the land has changed and the watershed's population has grown, the amount of nutrients entering the Bay has increased tremendously.

The Chesapeake Bay Program is a unique regional partnership leading and directing the restoration of Chesapeake Bay since 1983. The Chesapeake Bay Program partners include the States of Maryland, Pennsylvania, and Virginia; the District of Columbia; the Chesapeake Bay Commission; and EPA. The Chesapeake Executive Council, made up of the governors of Maryland, Pennsylvania, and Virginia; the mayor of the District of Columbia; the EPA administrator; and the chair of the Chesapeake Bay Commission, provides leadership for the Bay Program and establishes program policies to restore and protect the Bay and its living resources.

The Bay Program has set itself apart by adopting strong numerical goals and commitments with deadlines, and tracking progress with an extensive array of environmental indicators. In the 1987 Chesapeake Bay Agreement, Chesapeake Bay Program partners set a goal to reduce the nutrients nitrogen and phosphorus entering the Bay by 40% by the year 2000. In the 1992 amendments to the Agreement, partners agreed to maintain the 40% goal beyond the year 2000 and to attack nutrients at their source—upstream in the tributaries. Recent agreements have outlined a regional focus to address toxic problem areas, set specific goals and commitments for federally owned lands throughout the watershed, involved the 1,650 local governments in the Bay restoration effort, and addressed land use management in the watershed, including a riparian buffer initiative.

Since its inception, the Chesapeake Bay Program's highest priority has been the restoration of the Bay's living resources—its finfish, shellfish, Bay grasses, and other aquatic life and wildlife. Now, the Chesapeake is clearly on the upswing. Bay grasses have increased by 70% since 1984, with recent population changes suggesting that many of these

populations may rebound if water quality conditions are improved and maintained. Striped bass populations have reached historically high levels and wild shad are increasing in numbers as hatchery-reared shad successfully reproduce and their offspring make their runs back up into tributaries. Bald eagles are also returning to the Chesapeake Bay, with over 500 young produced in 1996, up from only 63 young in 1977.

Other improvements have also been observed in the Bay. The Bay Program, through 1996, has reopened 272 miles of fish spawning habitat through its fish passage initiative. According to the Toxics Release Inventory, chemical releases in the Bay watershed have shown a 55% drop between 1988 and 1994, and Toxics of Concern have declined by 62% during the same period.

In spite of near record-high flows in 3 of the past 4 years, most of the Bay's major rivers are running cleaner than they were 10 years ago. Phosphorus concentrations have shown significant reductions throughout most of the Bay, and nitrogen levels have remained steady in spite of the high flows and population increases. Overall, these nutrient trends indicate that water quality conditions in this important tributary are improving basinwide.

Despite these promising trends in nutrients, dissolved oxygen levels are still low enough to cause severe impacts and stressful conditions in the mainstem of the Bay and several of the larger tributaries. A long-term decline in the abundance of the native waterfowl is also of great concern. The necessary corrective action to reverse this trend is habitat improvement and resurgence of SAV.

Sam Mohar, 4th Grade, Burton GeoWorld, Durham, NC

The blue crab is currently the most important commercial and recreational fishery in the Bay. With increasing fishing pressures and relatively low harvests in recent years, there is growing concern for the health of the stocks. While scientists agree that neither the crab population nor the fishery are on the verge of collapse, they concur that the stock is fully exploited. The 1997 Blue Crab Fisheries Management Plan contains recommendations to maintain regulations, limit access to the fishery, prevent exploitation and improve research and monitoring and incorporates an enhanced habitat section recommending protection and restoration of Bay grasses and water quality.

Overall, the Chesapeake Bay still shows symptoms related to stress from an expanding population and the changes such growth brings about in land use. However, the concentrated restoration and management effort begun 12 years ago has produced tangible results. When taken as a whole, results from cooperative monitoring of input from the Bay's rivers generally show very encouraging signs.

The Gulf of Mexico Program

The Gulf of Mexico Program (GMP) was established in August 1988 as a partnership to provide a broad geographic focus on the major environmental issues in the Gulf before they become irreversible or too costly to correct. Its main purpose is to develop and implement strategies for protecting, restoring, and maintaining the health and productivity of the Gulf of Mexico in ways consistent with the economic well being of the

Region. This partnership also includes representatives from State and local government, Federal agencies, and the citizenry in each of the five Gulf States, the private sector (business, industry, and agriculture), and the academic community. The partnership provides:

- A mechanism for addressing complex problems that cross Federal, State, and international jurisdictional lines
- Better coordination among Federal, State, and local programs, increasing the effectiveness and efficiency of the long-term commitment to manage and protect Gulf resources
- A regional perspective to access and provide the information and address research needs required for effective management decisions
- A forum for affected groups using the Gulf, for public and private educational institutions, and for the general public to participate in the solution process.

Through its partnerships, the GMP is working with the scientific community, policy makers at the Federal, State and local levels, and the public to help preserve and protect America's abundant sea. It has made significant progress identifying the environmental issues in the Gulf Ecosystem and organizing a program to address those issues. Eight issue areas were initially identified as Program concerns:

- Habitat degradation in such areas as coastal wetlands, seagrass beds, and sand dunes
- Freshwater inflow changes in the volume and timing of flow resulting from reservoir construction; diversions for municipal, industrial, and agricultural purposes; and modifications to watersheds with concomitant alteration of runoff patterns
- Nutrient enrichment resulting from such sources as municipal wastewater treatment plants, storm water, industries, and agriculture
- Toxic substances and pesticides contamination originating from industrial, urban, and agricultural sources
- Coastal and shoreline erosion caused by natural and human-related activities
- Public health threats from swimming in, and eating seafood products coming from, contaminated water
- Marine debris from land-based and marine recreational and commercial sources
- Sustainability of the living aquatic resources of the Gulf of Mexico ecosystem.

The current focus of the GMP is on nutrient enrichment, shellfish restoration, critical habitat, and introduction of exotic species.

The GMP is now focusing its limited resources on implementation of actions to address specific problems that emerged as the Program concerns were characterized. The current focus is on nutrient enrichment, shellfish restoration, critical habitat, and introduction of exotic species. Other operational efforts provide public education and outreach and data and information transfer.

Since its formation in 1988, the GMP has been committed to sponsoring projects that will benefit the environmental health of the region. These projects, numbering over 200, vary immensely, from "shovel-in-the-ground" demonstration projects to scientific research to public education. Examples include a wetlands restoration project in Texas' Galveston Bay System, a Bay Rambo Artificial Oyster Reef project in Louisiana, a Shellfish Growing Water Restoration project in Mississippi, a demonstration project in sewage management in Alabama, and a health professional education program in Florida.

Ground Water Protection Programs

The sage adage that "An ounce of prevention is worth a pound of cure" is being borne out in the field of ground water protection. Studies evaluating the cost of prevention versus the cost of cleaning up contaminated ground water have found that there are real cost advantages to promoting protection of our Nation's ground water resources.

Numerous laws, regulations, and programs play a vital role in protecting ground water. The following Federal laws and programs enable, or provide incentives for,

Jeff Reynolds, Raleigh, NC

EPA and/or States to regulate or voluntarily manage and monitor sources of ground water pollution:

■ The Safe Drinking Water Act (SDWA) authorizes EPA to ensure that water is safe for human consumption. One of the most fundamental ways to ensure consistently safe drinking water is to protect the source of that water (i.e., ground water). Source water protection is achieved through three SDWA programs: the Wellhead Protection Program, the Sole Source Aquifer Program, and the Underground Injection Control Program. The 1996 Amendments to the SDWA also created the Source Water Assessment Program to ensure that States conduct assessments to determine the vulnerability of drinking water to contamination.

■ The Resource Conservation and Recovery Act (RCRA) addresses the problem of safe disposal of the huge volumes of solid and hazardous waste generated nationwide each year. RCRA is part of EPA's comprehensive program to protect ground water resources through the development of regulations and methods for handling, storing, and disposing of hazardous material and through the regulation of underground storage tanks—the most frequently cited source of ground water contamination.

■ The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 created several programs operated by EPA, States, Territories, and Tribes that act to protect and restore contaminated ground water. Restoration of contaminated ground water is one of the primary goals of the Superfund program. As stated in the National Contingency Plan, EPA expects to return usable ground waters to their beneficial uses, wherever possible, within a time frame that is reasonable given the particular circumstances of the site.

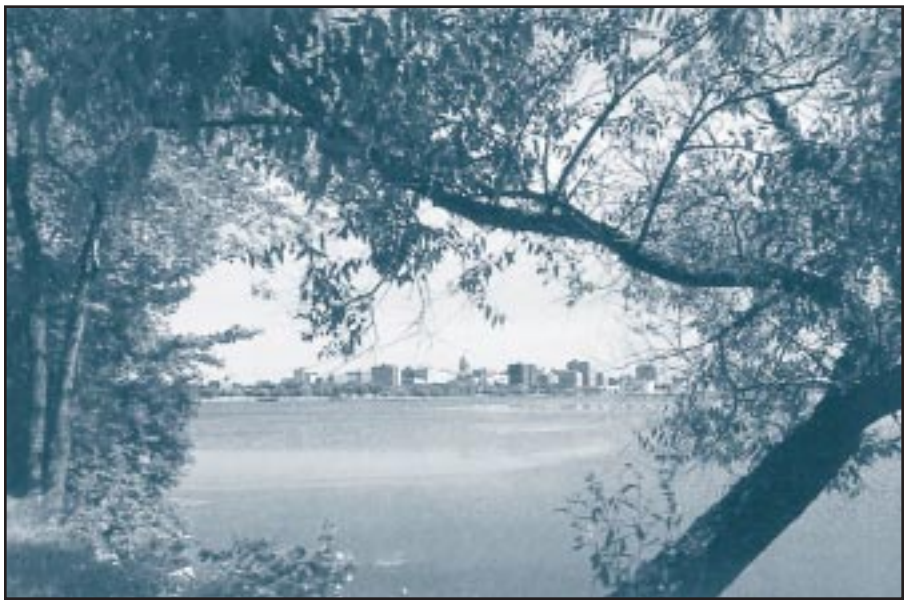
■ Clean Water Act Sections 319(h) and (i) and 518 provide funds to State agencies and Indian Tribes to implement EPA-approved nonpoint source management programs and ground water protection activities. Such activities include assessing and characterizing ground water resources; delineating wellhead protection areas; and addressing ground water protection priorities.

Comprehensive State Ground Water Protection Programs

A Comprehensive State Ground Water Protection Program (CSGWPP) is composed of six "strategic activities." They are:

- Establishing a prevention-oriented goal
- Establishing priorities, based on the characterization of the resource and identification of sources of contamination
- Defining roles, responsibilities, resources, and coordinating mechanisms
- Implementing all necessary efforts to accomplish the State's ground water protection goal
- Coordinating information collection and management to measure progress and reevaluate priorities
- Improving public education and participation.

■ Section 102 of the Clean Water Act grants States the authority to develop Comprehensive State Ground Water Protection Programs (CSGWPPs) tailored to their goals and priorities for the protection of ground water resources. CSGWPPs attempt to combine all of the above efforts and emphasize contamination prevention. The programs provide a framework for EPA to give greater flexibility to a State for management and protection of its ground water resources. CSGWPPs guide the future implementation of all State and Federal ground water programs and provide a framework for States to coordinate and set priorities for all ground-water-related activities.



Meg Turville-Heitz, Madison, WI

Another means of protecting our Nation's ground water resources is through the implementation of Wellhead Protection Plans (WHPs). EPA's Office of Ground Water and Drinking Water is supporting the development and implementation of WHP Programs at the local level through many efforts. For example, EPA-funded support is provided through the National Rural Water Association (NRWA) Ground Water/ Wellhead Protection programs. As of December 31, 1996, over 2,600 communities had become involved in developing local WHP plans.

Comprehensive State ground water protection programs support State-directed priorities in resource protection.

These 2,600 communities represent over 6 million people. Over 1,600 of these communities have completed their plans and are managing their wellhead protection areas to ensure the community that their water supplies are protected.

As a result of the 1996 Amendments to the SDWA, source water protection has become a national priority. Accordingly, EPA included a source water protection goal in a draft of *Environmental Goals for America With Milestones for 2005*, which was released in January 1996. The draft goal states that "by the year 2005, 60% of the population served by community water systems will receive their water from systems with source water protection programs in place." This goal will be achieved using a three-phased approach, which builds upon key accomplishments and foundations, such as the WHP Program, and maximizes the use of new tools and resources provided for under the 1996 Amendments. The new emphasis on public involvement and new State Source Water Assessment Programs should lead to State Source Water Protection Programs. Also, the Amendments provide States an unprecedented opportunity for source water assessment and protection programs to use new funds from the Drinking Water State Revolving Fund (DW-SRF) program for eligible set-aside activities.

What You Can Do

Federal and State programs have helped clean up many waters and slow the degradation of others. But government alone cannot solve the entire problem, and water quality concerns persist. Nonpoint source pollution, in particular, is everybody's problem, and everybody needs to solve it.

Examine your everyday activities and think about how you are contributing to the pollution problem. Here are some suggestions on how you can make a difference.

Paul Kazyak, Maryland Department of Natural Resources

Be Informed

You should learn about water quality issues that affect the communities in which you live and work. Become familiar with your local water resources. Where does your drinking water come from? What activities in your area might affect the water you drink or the rivers, lakes, beaches, or wetlands you use for recreation?

Learn about procedures for disposing of harmful household wastes so they do not end up in sewage treatment plants that cannot handle them or in landfills not designed to receive hazardous materials.

Be Responsible

In your yard, determine whether additional nutrients are needed before you apply fertilizers, and look for alternatives where fertilizers might run off into surface waters. Consider selecting plants and grasses that have low maintenance requirements. Water your lawn conservatively. Preserve existing trees and plant new trees and shrubs to help prevent erosion and promote infiltration of water into the soil. Restore bare patches in your lawn to prevent erosion. If you own or manage land through which a stream flows, you may wish to consult your local county extension office about methods of restoring stream banks in your area by planting buffer strips of native vegetation.

Around your house, keep litter, pet waste, leaves, and grass clippings out of gutters and storm drains. Use the minimum amount of water needed when you wash your car. Never dispose of any household, automotive, or gardening wastes in a storm drain. Keep your septic tank in good working order.

Within your home, fix any dripping faucets or leaky pipes and install water-saving devices in shower heads and toilets. Always follow directions on labels for use and disposal of household chemicals. Take used motor oil, paints, and other hazardous household materials to proper disposal sites such as approved service stations or designated landfills.

Be Involved

As a citizen and a voter there is much you can do at the community level to help preserve and protect our Nation's water resources. Look around. Is soil erosion being controlled at construction sites? Is the community sewage plant being operated efficiently and correctly? Is the community trash dump in or along a stream? Is road deicing salt being stored properly?

Become involved in your community election processes. Listen and respond to candidates' views on water quality and environmental issues. Many communities have recycling programs; find out about them, learn how to recycle, and volunteer to help out if you can. One of the most important things you can do is find out how your

community protects water quality, and speak out if you see problems.

Volunteer Monitoring: You Can Become Part of the Solution

In many areas of the country, citizens are becoming personally involved in monitoring the quality of our Nation's water. As a volunteer monitor, you might be involved in taking ongoing water quality measurements, tracking the progress of protection and restoration projects, or reporting special events, such as fish kills and storm damage.

Volunteer monitoring can be of great benefit to State and local governments. Some States stretch their monitoring budgets by using data collected by volunteers, particularly in remote areas that otherwise might not be monitored at all. Because you are familiar with the water resources in your own neighborhood, you are also more likely to spot unusual occurrences such as fish kills.

The benefits to you of becoming a volunteer are also great. You will learn about your local water resources and have the opportunity to become personally involved in a nationwide campaign to protect a vital, and mutually shared, resource. If you would like to find out more about organizing or joining volunteer monitoring programs in your State, contact your State department of environmental quality, or write to:

Alice Mayio
Volunteer Monitoring Coordinator
U.S. EPA (4503F)
401 M St. SW
Washington, DC 20460
(202) 260-7018

For further information on water quality in your State or other jurisdiction, contact your Section 305(b) coordinator listed at the back of this document. Additional water quality information may be obtained from the Regional offices of the U.S. Environmental Protection Agency (see inside back cover).

Nancy Malmgren, Seattle, WA

For Further Reading

EPA's Volunteer Monitoring Program. EPA-841-F-95-001. February 1995. Contains a brief description of EPA activities to promote volunteer monitoring.

Volunteer Monitoring. EPA-800-F-93-008. September 1993. A brief fact sheet about volunteer monitoring, including examples of how volunteers have improved the environment.

National Directory of Citizen Volunteer Environmental Monitoring Programs, Fourth Edition. EPA-841-B-94-001. January 1994. Contains information about 519 volunteer monitoring programs across the Nation.

Volunteer Stream Monitoring: A Methods Manual. EPA-841-D-95-001. 1995. Presents information and methods for volunteer monitoring of streams.

Volunteer Estuary Monitoring: A Methods Manual. EPA-842-B-93-004. December 1993. Presents information and methods for volunteer monitoring of estuarine waters.

Volunteer Lake Monitoring: A Methods Manual. EPA-440/4-91-002. December 1991. Discusses lake water quality issues and methods for volunteer monitoring of lakes.

Many of these publications can also be accessed on the Internet at **http://www.epa.gov/volunteer/epasvmp.html**.

Fish Consumption Advisories

States issue fish consumption advisories to protect the public from ingesting harmful quantities of toxic pollutants in contaminated fish and shellfish. Fish may accumulate dangerous quantities of pollutants in their tissues by ingesting many smaller organisms, each contaminated with a small quantity of pollutant. This process is called bioaccumulation or biomagnification. Pollutants also enter fish and shellfish tissues through the gills or skin.

Fish consumption advisories recommend that the public limit the quantity and frequency of consumption of fish caught in specific waterbodies. The States tailor individual advisories to minimize health risks based on contaminant data collected in their fish tissue sampling programs. Advisories may completely ban fish consumption in severely polluted waters, or limit fish consumption to several meals per month or year in cases of less severe contamination. Advisories may target a subpopulation at risk (such as children, pregnant women, and nursing mothers), specific fish species, or larger fish that may have accumulated high concentrations of a pollutant over a longer lifetime than a smaller, younger fish.

The EPA fish consumption advisory database tracks advisories issued by States and Tribes. For 1996, the database listed 2,196 fish consumption advisories in effect in 47 States, the District of Columbia, and American Samoa. Fish consumption advisories are unevenly

Chesapeake Bay Foundation, Richmond, VA

distributed among the States because the States use their own criteria to determine if fish tissue concentrations of toxics pose a health risk that justifies an advisory. States also vary the amount of fish tissue monitoring they conduct and the number of pollutants analyzed. States that conduct more monitoring and use strict criteria will issue more advisories than States that conduct less monitoring and use weaker criteria. For example, 70% of the advisories active in 1996 were issued by the States surrounding the Great Lakes, which support extensive fish sampling programs and follow strict criteria for issuing advisories.

Most of the fish consumption advisories (76%) are due to mercury. The other pollutants most commonly detected in elevated concentrations in fish tissue samples are polychlorinated biphenyls (PCBs), chlordane, dioxins, and DDT (with its byproducts).

Many coastal States report restrictions on shellfish harvesting in estuarine waters. Shellfish–particularly oysters, clams, and mussels–are filter-feeders that extract their food from water. Waterborne bacteria and viruses may also accumulate on their gills and mantles and in their digestive systems. Shellfish contaminated by these microorganisms are a serious human health concern, particularly if consumed raw.

States currently sample water from shellfish harvesting areas to measure indicator bacteria, such as total coliform and fecal coliform bacteria. These bacteria serve as indicators of the presence of potentially pathogenic microorganisms associated with untreated or undertreated sewage. States restrict shellfish harvesting to areas that maintain these bacteria at concentrations in sea water below established health limits.

In 1996, 10 States reported that shellfish harvesting restrictions were in effect for 4,804 square miles of estuarine and coastal waters during the 1994-1996 reporting period. Five States reported that nonpoint sources, point sources, urban runoff and storm sewers, municipal wastewater treatment facilities, marinas, septic tanks, and industrial discharges restricted shellfish harvesting.