Liz Sullivan, Ocracoke Island, NC

Coastal Resources—Tidal Estuaries, Shoreline Waters, and Coral Reefs

The United States' coastal resources include nearly 90,000 square miles of estuarine waters, more than 5,500 miles of Great Lakes shoreline, nearly 60,000 miles of ocean shoreline, and extensive coral reef areas. This chapter discusses the states' water quality findings for these diverse resources.

The findings in this chapter largely agree with the water quality and ecological assessment of the nation's estuaries provided in the *National Coastal Condition Report*, EPA-620/R-01/005, published in March 2002. The *National Coastal Condition Report* was based on data from a variety of federal, state, and local sources, including EPA's National Coastal Assessment Program, with samples taken from over 1,000 randomly selected sites in the estuaries of the United States. For a copy of this report, visit *http://www.epa.gov/owow/oceans/nccr/index.html*.

ESTUARIES

Estuaries are the waters where rivers meet the oceans and include bays and tidal rivers. These waters serve as nursery areas for many commercial and recreational fish species and most shellfish populations, including shrimp, oysters, clams, crabs, and scallops.

Twenty-three of the 27 coastal states, the District of Columbia, the Commonwealth of the Northern Mariana Islands, and the Delaware River Basin Commission (collectively referred to as states in the rest of this chapter) rated general water quality conditions in some of their estuarine waters (Appendix C, Table C-2, contains individual state data). Puerto Rico's information on its estuarine waters was based on linear miles rather than square miles, and consequently could not be aggregated with information reported by the other states.

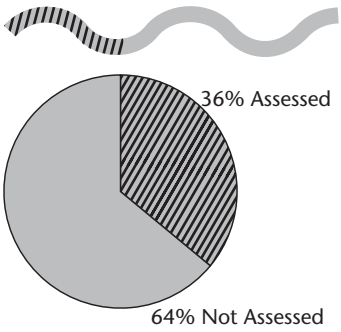
Altogether, these states assessed 31,072 square miles of estuarine waters, which equals 36% of the 87,369 square miles of estuarine waters in the nation. The states based 51% of their assessments on monitored data and evaluated 32% of the assessed estuarine waters with qualitative information (see Appendix C, Table C-2, for individual state information). The states did not specify whether 17% of the assessed estuarine waters were monitored or evaluated.

The number of assessed estuarine square miles increased slightly between 1998 and 2000, as did the percentage of total estuarine area assessed. This is primarily due to increases in the area assessed in a few states. California, Florida, Mississippi, and Washington all assessed significantly more estuarine area in 2000 than in 1998.

The states constantly revise their assessment methods in an effort to improve their accuracy and precision.

Estuaries Assessed by States

2000 31,072 square miles = 36% assessed
Total square miles = 87,369[a]



1998 28,687 square miles = 32% assessed
Total square miles: 90,465[b]

1996 28,819 square miles = 72% assessed
Total square miles: 39,839[c]

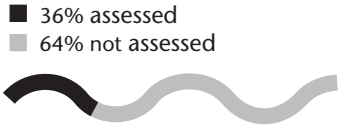
1994 26,847 square miles = 78% assessed
Total square miles: 34,388[d]

1992 27,227 square miles = 74% assessed
Total square miles: 36,890[e]

[a]Source: 2000 state Section 305(b) reports.
[b]Source: 1998 state Section 305(b) reports.
[c]Source: 1996 state Section 305(b) reports.
[d]Source: 1994 state Section 305(b) reports.
[e]Source: 1992 state Section 305(b) reports.

Assessed Waters

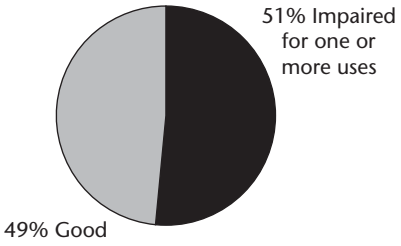
Total estuaries = 87,369 square miles[a]
Total assessed = 31,072 square miles



Of the assessed estuarine waters:

- 51% were monitored
- 32% were evaluated
- 17% were not specified

Assessed Water Quality



[a]Source: 2000 state Section 305(b) reports.

49% of ASSESSED estuaries have good water quality.

These changes, however, limit the comparability of data from year to year. Similarly, differences in state assessment methods limit meaningful comparisons of estuarine information submitted by individual states. States devote varying resources to monitoring biological integrity, water chemistry, and toxic pollutants in fish tissues. The wide range in water quality ratings reported by the states reflects both differences in water quality and differences in monitoring and assessment methods.

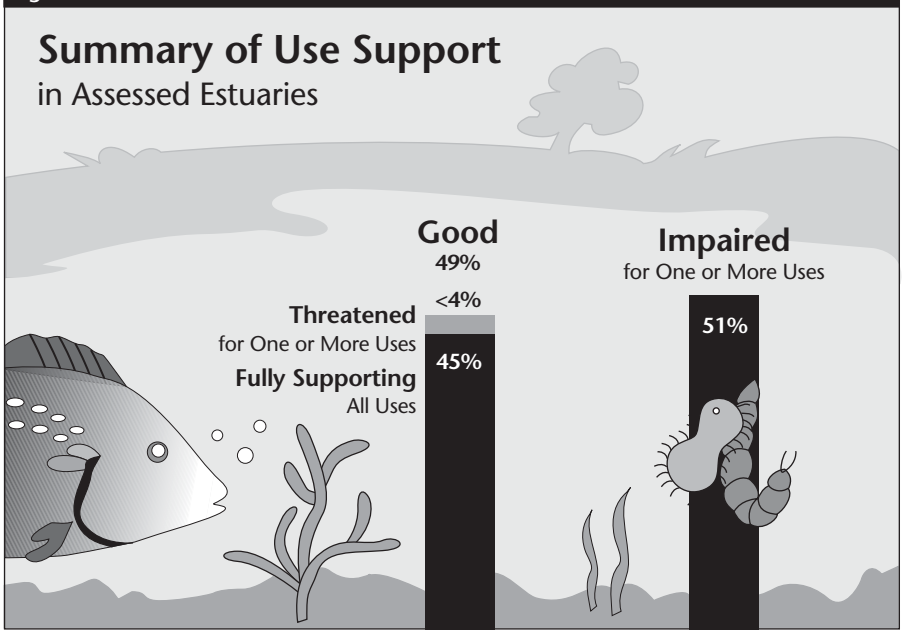
Summary of Use Support

The states reported that 49% of their assessed estuarine waters have good water quality that fully supports designated uses (Figure 4-1). Of the assessed waters, 45% fully support uses and nearly 4% are threatened for one or more uses. Some form of pollution or habitat degradation impairs the remaining 51% of assessed estuarine waters.

Individual Use Support

Individual use support assessment provides important details about the nature of water quality problems in our nation's surface waters. The states establish specific designated uses for waterbodies through their water quality standards. For reporting purposes, the states consolidate their more detailed uses into five general use categories. The standard uses for estuaries are aquatic life support, fish consumption, shellfish harvesting, primary contact recreation (such as swimming and diving), and secondary contact recreation (such as boating). Few states designate saline estuarine

Figure 4-1



This figure presents the status of the assessed square miles of estuaries. Of 31,072 square miles assessed, 49% fully support their designated uses and 51% are impaired for one or more uses. Less than 4% of assessed waters are fully supporting uses but threatened.

Based on data contained in Appendix C, Table C-2.

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

waters for drinking water supply use and agricultural use because of high treatment costs.

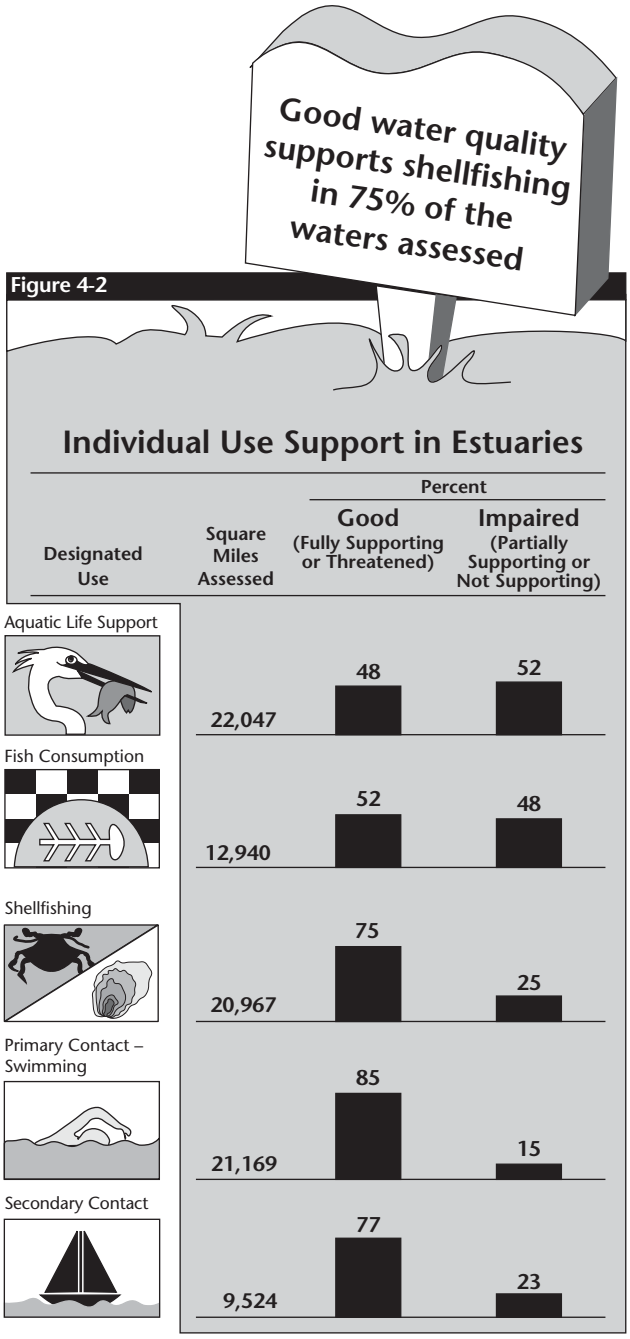
Twenty-two states reported the individual use support status of their estuarine waters (see Appendix C, Table C-3, for individual state information). Most often, these states examined aquatic life conditions and swimming use in their estuarine waters (Figure 4-2). The states reported that pollutants:

- Impact aquatic life in 11,391 square miles of estuarine waters (about 52% of the 22,047 square miles assessed for aquatic life support).
- Restrict fish consumption in 6,255 square miles of estuarine waters (about 48% of the 12,940 square miles assessed for fish consumption).
- Restrict shellfish harvesting in 5,288 square miles of estuarine waters (25% of the 20,967 square miles assessed for shellfishing use support).
- Violate swimming criteria in 3,245 square miles of estuarine waters (15% of the 21,169 square miles assessed for swimming use support).

Water Quality Problems Identified in Estuaries

When states and tribes rate waters as impaired, they also try to identify the causes and sources of impairment. Figures 4-3 and 4-4 identify the pollutants and sources of pollutants that impair the most square miles of assessed estuarine waters.

It is important to note that information about pollutants and sources is incomplete. The states do not



This figure presents a tally of the square miles of estuaries assessed by states for each category of designated use. For each category, the figure summarizes the proportion of the assessed waters rated according to quality.

Based on data contained in Appendix C, Table C-3.

always report the pollutant or source of pollutants affecting every impaired estuarine waterbody. In some cases, they may recognize that water quality does not fully support a designated use but may not have adequate data to document the specific pollutant or stressor responsible for the impairment. Sources of impairment are even more difficult to identify than pollutants and stressors.

Pollutants and Processes Impacting Estuaries

Twenty-five states reported pollutants and processes related to human activities that impact some of their estuarine waters (see Appendix C, Table C-4, for individual state information). Often, more than one pollutant or stressor impacts a single estuarine waterbody. In such cases, the states and other jurisdictions count a single square mile of estuary under each pollutant or stressor category that affects the estuary. Therefore, the percentages of estuarine waters impaired by all the pollutant and stressor categories do not add up to 100% in Figure 4-3.

The states identified more square miles of estuarine waters polluted by metals than any other pollutant or stressor (Figure 4-3). States reported that metals, primarily mercury, pollute 8,077 square miles of estuarine waters (26% of the assessed estuarine waters and 52% of the impaired estuarine waters). Similar to lakes, this is mainly due to the widespread detection of mercury in fish tissue samples. Mercury bioaccumulates in fish tissue, and the consumption of fish with high concentrations of mercury can be harmful to human health. The health risk is higher for sensitive populations such as pregnant women, nursing women, and children. Nine states have statewide fish consumption advisories for mercury in coastal and/or estuarine waters that recommend restricting the consumption of fish from those waters.

The states determined that pesticides pollute 5,985 square miles (19% of the assessed estuarine waters and 38% of the impaired estuarine waters). Pesticides such as DDT and chlordane pose risks to human health and aquatic life because they bioaccumulate in fish tissues.

Oxygen depletion from organic wastes impacts 5,324 square miles of estuarine waters (17% of the assessed estuarine waters and 34% of the impaired estuarine waters). Oxygen depletion may trigger fish kills and foul odors, and can adversely affect aquatic life.

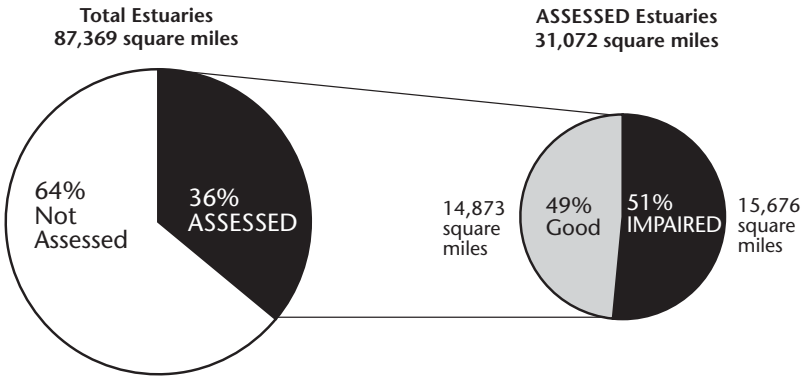
The states reported that pathogens impair 4,764 square miles of estuarine waters (15% of the assessed estuarine waters and 30% of the impaired estuarine waters). Most states monitor indicator bacteria, such as *E. coli*, that inhabit the digestive tracts of humans and other warm-blooded animals and populate sewage in high densities. The presence of such bacteria in water samples is an indicator that an estuary is contaminated with sewage that may contain numerous viruses and bacteria that cause illness in people.

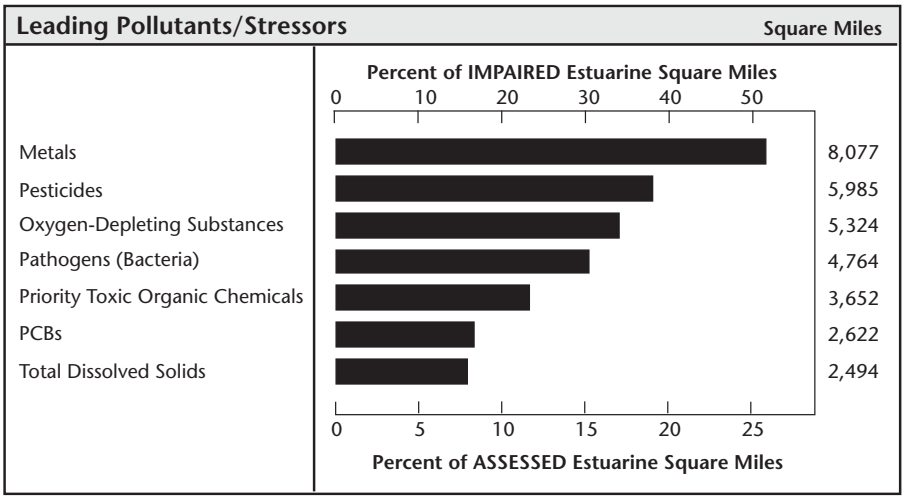
Sources of Pollutants Impacting Estuaries

Twenty-five states reported sources of pollution related to human activities that affect some of their estuarine waters (see Appendix C, Table C-5, for individual state information). These states reported that unknown sources impaired the greatest number of estuarine square miles (7,592 square miles). Of the known sources, states report that municipal point sources (sewage treatment

Figure 4-3

Leading POLLUTANTS in Impaired Estuaries





States assessed 36% of the total square miles of estuaries for the 2000 report. The larger pie chart on the left illustrates this proportion. The smaller pie chart on the right shows that, for the subset of assessed waters, 49% are rated as good and 51% as impaired. When states identify waters that are impaired, they describe the pollutants or processes causing or contributing to the impairment. This bar chart presents the leading causes and the number of estuarine square miles impacted. The percent scales on the upper and lower x-axes of the bar chart provide different perspectives on the magnitude of the impact of these pollutants. The lower axis compares the square miles impacted by the pollutant to the total ASSESSED square miles. The upper axis compares the square miles impacted by the pollutant to the total IMPAIRED square miles.

Based on data contained in Appendix C, Table C-4.

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

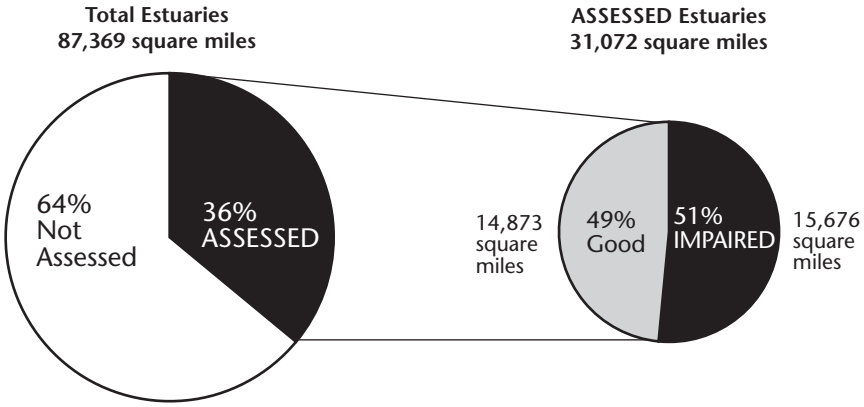
The pollutants/processes and sources shown here may not correspond directly to one another (i.e., the leading pollutant may not originate from the leading source). This may occur because a major pollutant may be released from many minor sources. It also happens when states do not have the information to determine all the sources of a particular pollutant/stressor.

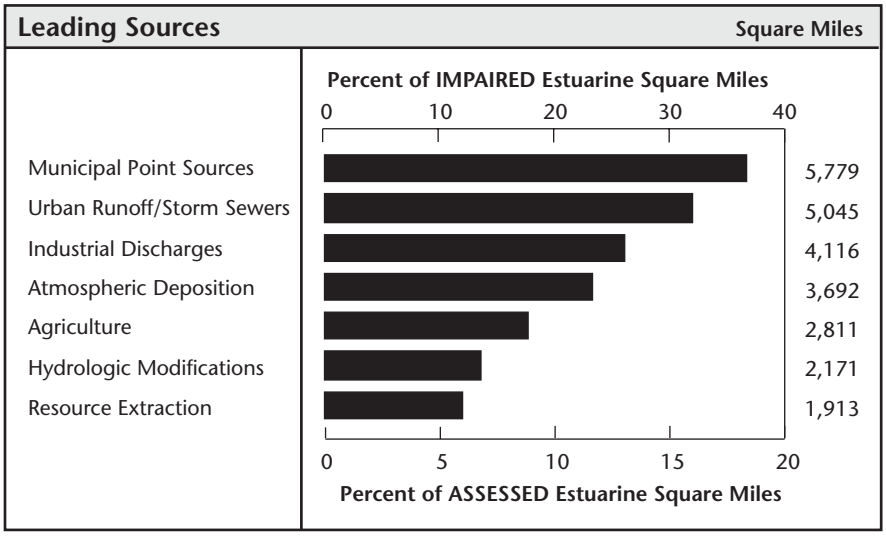
According to the states, **MUNICIPAL POINT SOURCES** are the leading source of pollution in assessed estuaries. This source

- Affects 19% of the assessed portions of estuaries
- Contributes to 37% of reported water quality problems in the impaired portions of estuaries (see Figure 4-4).

Figure 4-4

Leading SOURCES of Estuary Impairment*





States assessed 36% of the total square miles of estuaries for the 2000 report. The larger pie chart on the left illustrates this proportion. The smaller pie chart on the right shows that, for the subset of assessed waters, 49% are rated as good and 51% as impaired. When states identify waters that are impaired, they also describe the sources of pollutants associated with the impairment. The bar chart presents the leading sources and the number of estuarine square miles they impact. The percent scales on the upper and lower x-axes of the bar chart provide different perspectives on the magnitude of the impact of these sources. The lower axis compares the square miles impacted by the source to the total ASSESSED square miles. The upper axis compares the square miles impacted by the source to the total IMPAIRED square miles.

*Excludes unknown, natural, and "other" sources.

Based on data contained in Appendix C, Table C-5.

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

plants) are the most widespread source of pollution in their assessed estuarine waters. Pollutants in municipal discharges degrade aquatic life or interfere with public use of 5,779 square miles of estuarine waters (19% of the assessed estuarine waters and 37% of the impaired estuarine waters) (Figure 4-4). The states also reported that pollution from urban runoff and storm sewers impact 5,045 square miles of estuarine waters (16% of the assessed estuarine waters and 32% of the impaired estuarine waters); industrial discharges pollute 4,116 square miles of estuarine waters (13% of the assessed estuarine waters and 26% of the impaired estuarine waters); and atmospheric deposition of pollutants impacts 3,692 square miles of estuarine waters (12% of the assessed estuarine waters and 24% of the impaired estuarine waters).

GREAT LAKES SHORELINE

The Great Lakes—Superior, Michigan, Huron, Erie, and Ontario—are an important part of the physical and cultural heritage of North America. These vast inland freshwater seas provide water for consumption, transportation, power, recreation, fisheries, and a host of other uses. The Great Lakes basin is home to more than 10% of the U.S. population and some of the world's largest concentrations of industrial capacity. Many consider the Great Lakes the United States' fourth seacoast.

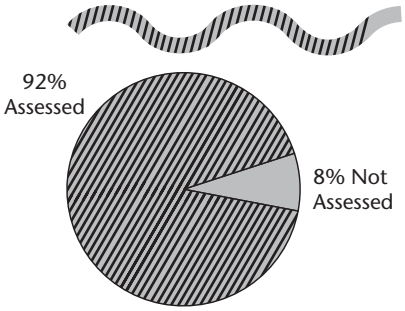
Six of the eight Great Lakes states rated general water quality conditions in 5,066 miles of Great Lakes shoreline in their 2000 Section 305(b) reports (see Appendix F, Tables F-1 and F-2, for individual state information). These states based less than 1% of their assessments on monitored data and evaluated 75% of the assessed shoreline miles with qualitative information. The states did not specify whether the remaining 25% of the assessed shoreline miles were monitored or evaluated.

Summary of Use Support

The states reported that 22% of their assessed Great Lakes shoreline miles have good water quality that fully supports designated uses, and all of these supporting waters are threatened for one or more uses (Figure 4-5). Some form of pollution or habitat degradation impairs the remaining 78% of assessed Great Lakes shoreline. This degradation leads to fish consumption advisories. It is important to note that two Great Lakes states, Ohio and Wisconsin, did not report summary use support status for their shoreline waters. EPA used their aquatic life use support information to represent summary water quality conditions. Nearly all of the assessed Great Lakes shoreline supports recreation and drinking water uses.

Great Lakes Shoreline Miles Assessed by States

2000 5,066 miles = 92% assessed
Total shoreline miles = 5,521[a]



1998 4,950 miles = 90% assessed
Total shoreline miles: 5,521[b]

1996 5,186 miles = 94% assessed
Total shoreline miles: 5,521[c]

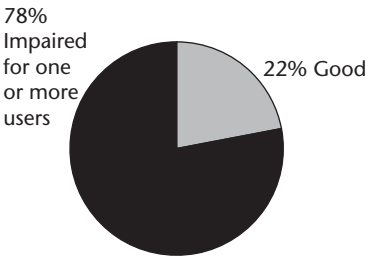
1994 5,224 miles = 94% assessed
Total shoreline miles: 5,559[d]

1992 5,319 miles = 99% assessed
Total shoreline miles: 20,121[e]

Of the assessed Great Lakes shoreline waters:

- <1% were monitored
- 75% were evaluated
- 25% were not specified

Assessed Water Quality



[a]Source: 2000 state Section 305(b) reports.
[b]Source: 1998 state Section 305(b) reports.
[c]Source: 1996 state Section 305(b) reports.
[d]Source: 1994 state Section 305(b) reports.
[e]Source: 1992 state Section 305(b) reports.

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

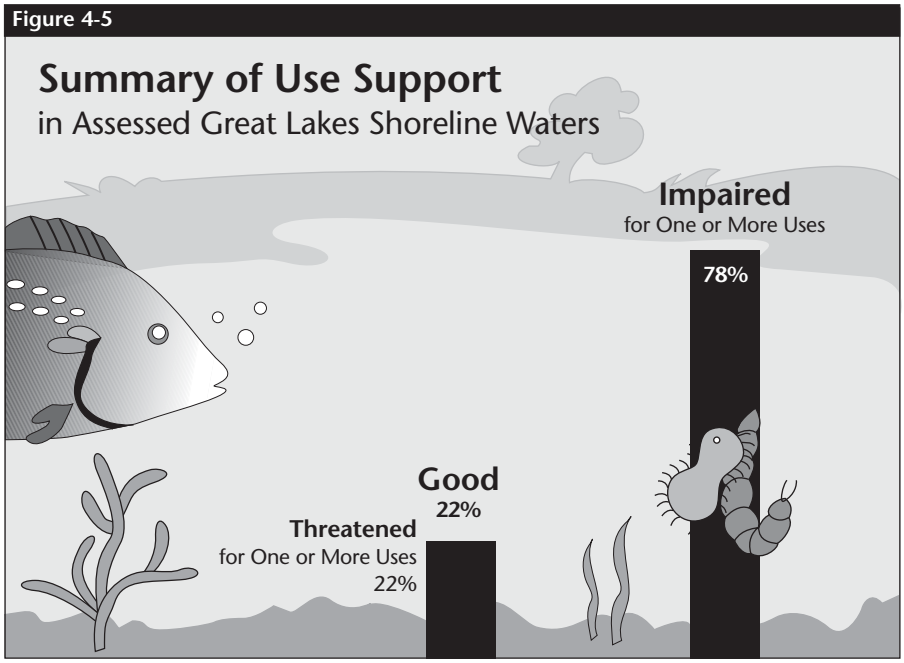
Individual Use Support

The states establish specific designated uses for waterbodies through their water quality standards. For reporting purposes, the states consolidate their more detailed uses into six general use categories. The standard uses of Great Lakes waters are aquatic life support, fish consumption, primary contact recreation (such as swimming and diving), secondary contact recreation (such as boating), drinking water supply, and agricultural use.

Six of the eight Great Lakes states reported the individual use support status of their Great Lakes shoreline (see Appendix F, Table F-3, for individual state information). These states report that swimming, secondary contact, drinking water supply, and agricultural uses are met in nearly all assessed shoreline miles (Figure 4-6). The greatest impacts to Great Lakes shoreline are on fishing activities.

The states bordering the Great Lakes have issued advisories to restrict consumption of fish caught along their entire shorelines. Depending upon location, mercury, PCBs, pesticides, or dioxins are found in fish tissues at levels that exceed standards set to protect human health. The water concentrations of most organochlorine compounds have declined dramatically since control measures began in the mid-1970s. As a result, concentrations of these contaminants in fish tissue have also declined, although 4,976 shoreline miles (100% of the assessed Great Lakes waters) still fail to fully support fish consumption uses.

Figure 4-5



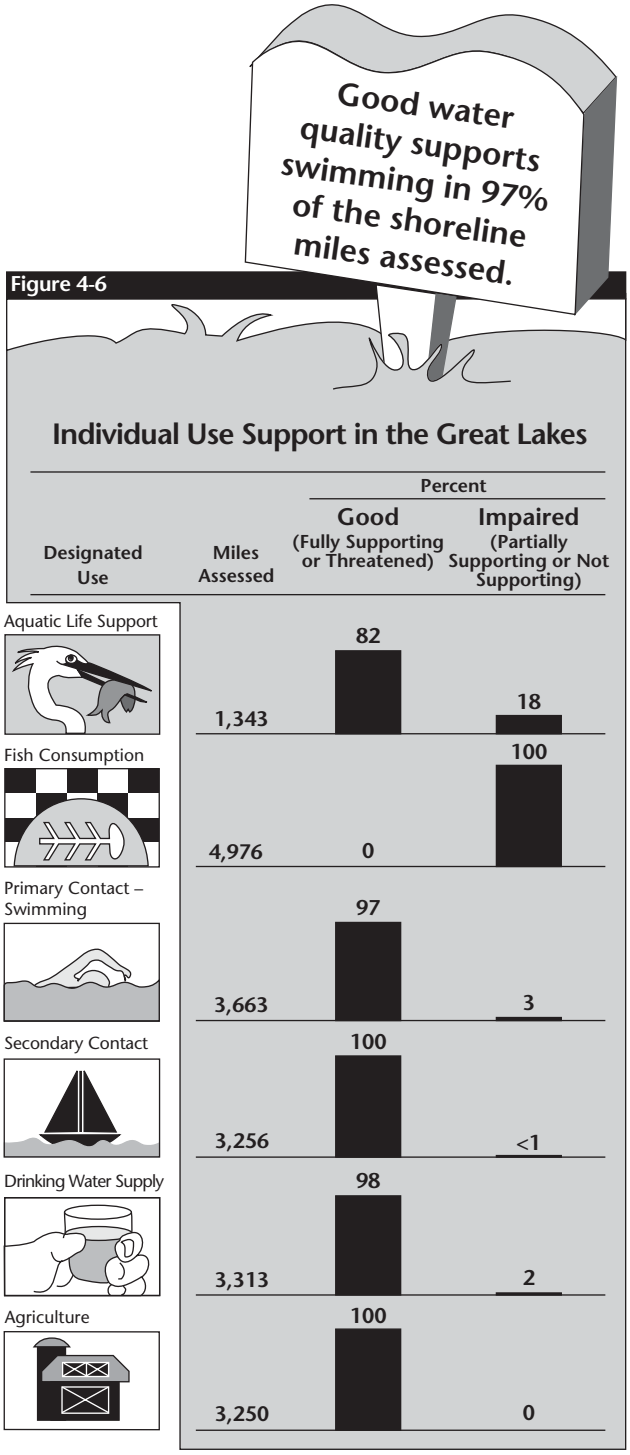
This figure presents the status of the assessed Great Lakes shoreline waters. Of the 5,066 miles of Great Lakes shoreline assessed, 22% fully support their designated uses but are threatened, and 78% are impaired for one or more uses.

Based on data contained in Appendix F, Table F-2.

Water Quality Problems Identified in Great Lakes Shoreline Waters

Only four Great Lakes states identified pollutants and sources of pollutants degrading Great Lakes shoreline (Appendix F, Tables F-4 and F-5, contain individual state information). Limited conclusions can be drawn from this fraction of the nation's Great Lakes shoreline miles. The major causes of impairment cited by the four states were priority toxic organic chemicals, nutrients, pathogens, and sedimentation. In addition, oxygen-depleting substances, foul odor and taste, and PCBs caused water quality impairments (Figure 4-7).

The states reported that contaminated sediments, urban runoff and storm sewers, and agriculture are the primary sources of pollutants that impair their Great Lakes shoreline waters (Figure 4-8). Atmospheric deposition, habitat modification, land disposal, and septic tanks were also cited as sources of pollution.

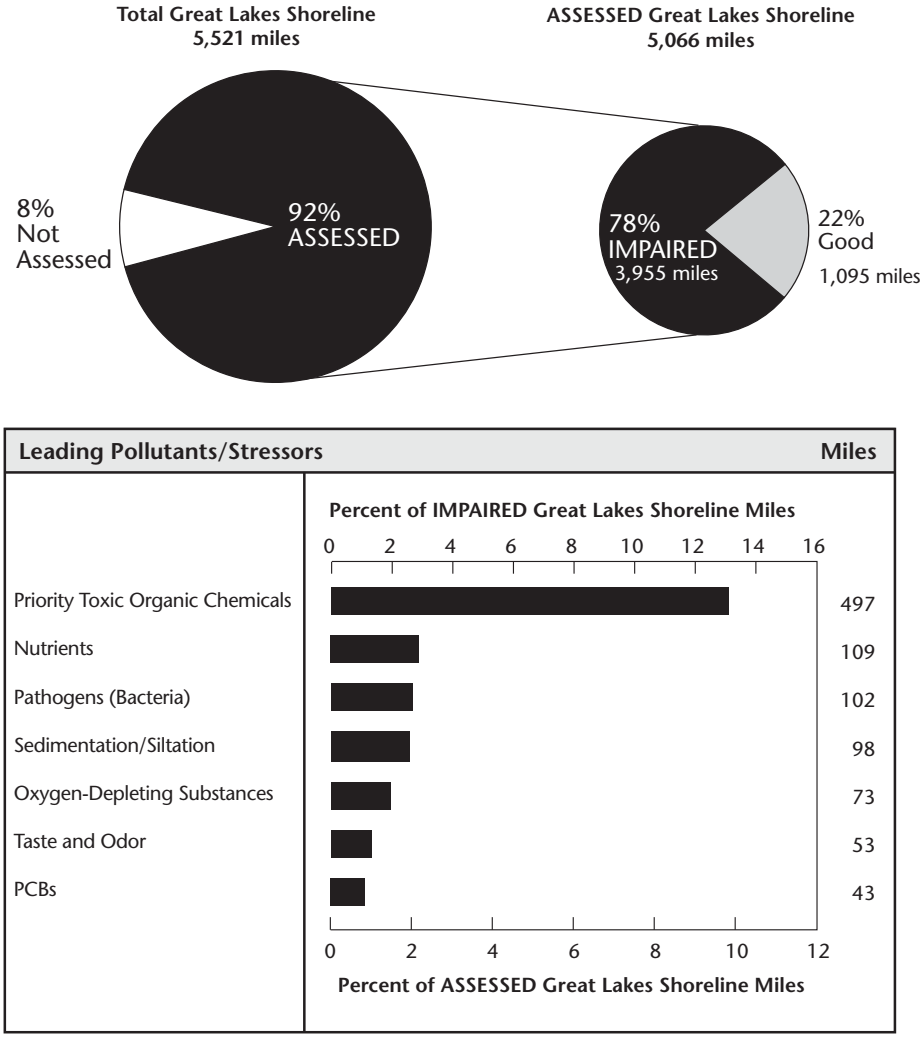


This figure presents a tally of the miles of Great Lakes shoreline assessed by states for each category of designated use. For each category, the figure summarizes the proportion of the assessed waters rated according to quality.

Based on data contained in Appendix F, Table F-3.

Figure 4-7

Leading POLLUTANTS in Impaired Great Lakes Shoreline Waters



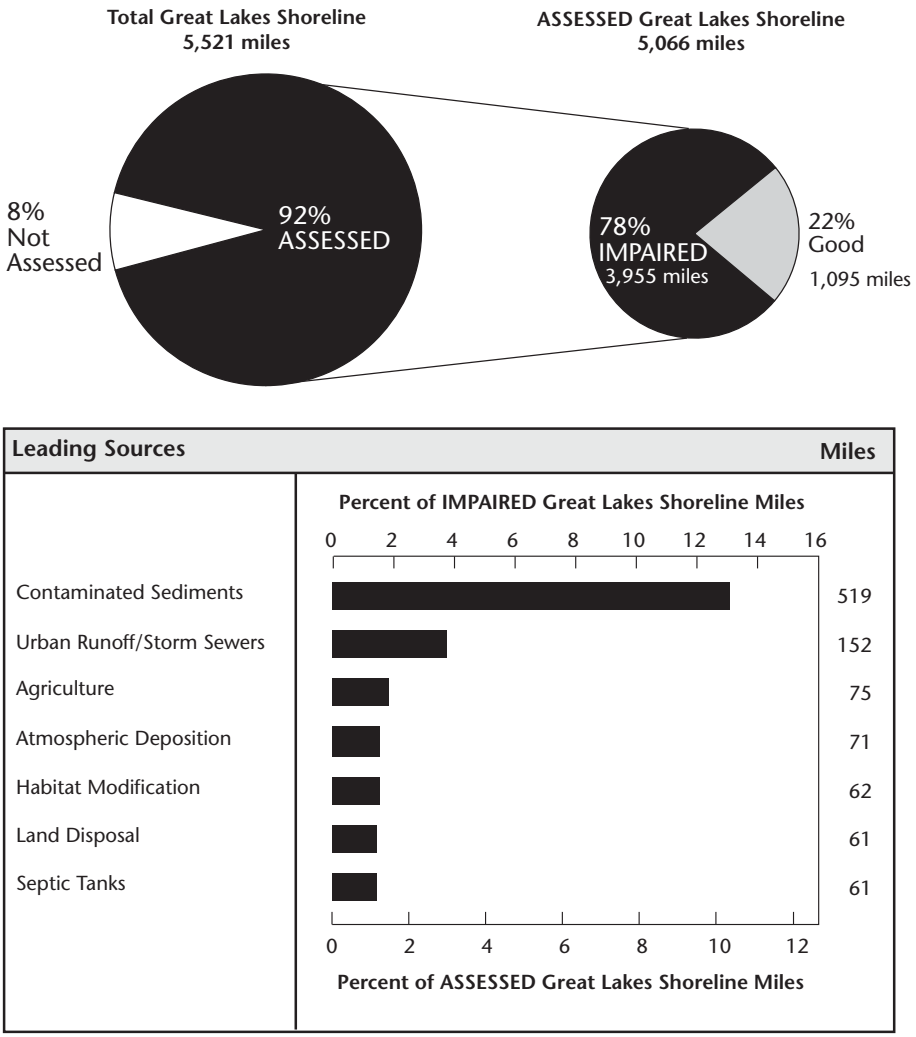
States assessed 92% of the total miles of Great Lakes shoreline for the 2000 report. The larger pie chart on the left illustrates this proportion. The smaller pie chart on the right shows that, for the subset of assessed waters, 22% are rated as good and 78% as impaired. When states identify waters that are impaired, they describe the pollutants or processes causing or contributing to the impairment. The bar chart presents the leading causes and the number of Great Lakes shoreline miles impacted. The percent scales on the upper and lower x-axes of the bar chart provide different perspectives on the magnitude of the impact of these pollutants. The lower axis compares the miles impacted by the pollutant to the total ASSESSED miles. The upper axis compares the miles impacted by the pollutant to the total IMPAIRED miles.

Based on data contained in Appendix F, Table F-4.

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

Figure 4-8

Leading SOURCES of Great Lakes Shoreline Impairment



States assessed 92% of the total miles of Great Lakes shoreline for the 2000 report. The larger pie chart on the left illustrates this proportion. The smaller pie chart on the right shows that, for the subset of assessed waters, 22% are rated as good and 78% as impaired. When states identify waters that are impaired, they also describe the sources of pollutants associated with the impairment. The bar chart presents the leading sources and the number of Great Lakes shoreline miles they impact. The percent scales on the upper and lower x-axes of the bar chart provide different perspectives on the magnitude of the impact of these sources. The lower axis compares the miles impacted by the source to the total ASSESSED miles. The upper axis compares the miles impacted by the source to the total IMPAIRED miles.

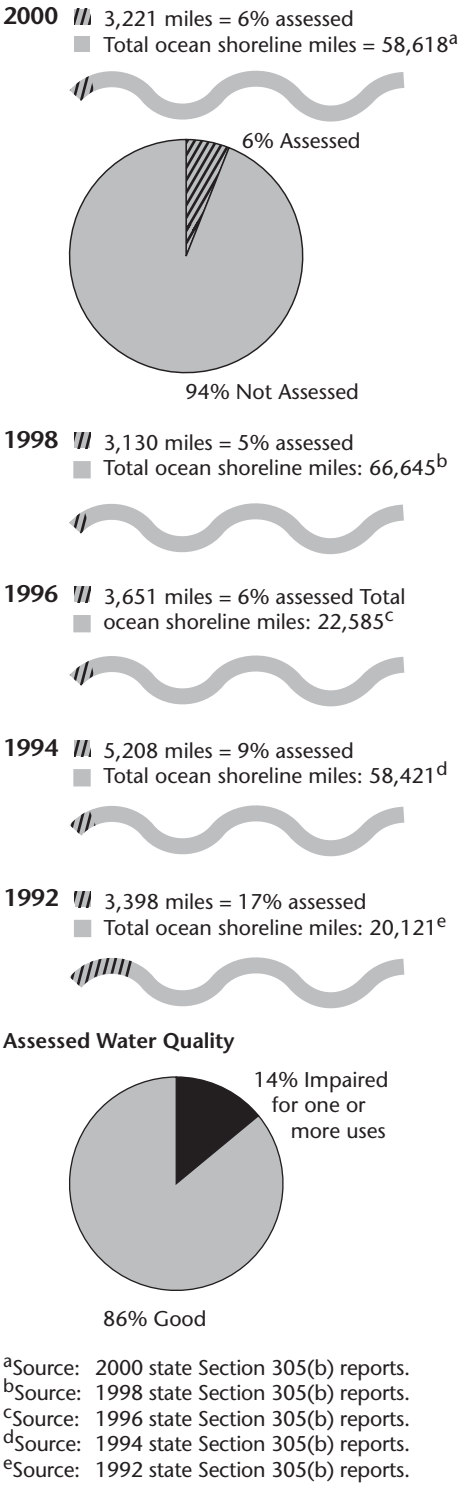
Based on data contained in Appendix F, Table F-5.

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

The pollutants/processes and sources shown here may not correspond directly to one another (i.e., the leading pollutant may not originate from the leading source). This may occur because a major pollutant may be released from many minor sources. It also happens when states do not have the information to determine all the sources of a particular pollutant/stressor.

Ocean Shoreline Waters Assessed by States

Including Alaska's Ocean Shoreline



[a]Source: 2000 state Section 305(b) reports.
[b]Source: 1998 state Section 305(b) reports.
[c]Source: 1996 state Section 305(b) reports.
[d]Source: 1994 state Section 305(b) reports.
[e]Source: 1992 state Section 305(b) reports.

OCEAN SHORELINE WATERS

The oceans are of incalculable value to our planet. The global ocean affects the health and safety of the world by providing food, recreation, local weather amelioration, and global climate stabilization. Predictions say that 75% of the U.S. population will live, work, or play along ocean coasts by the year 2015.

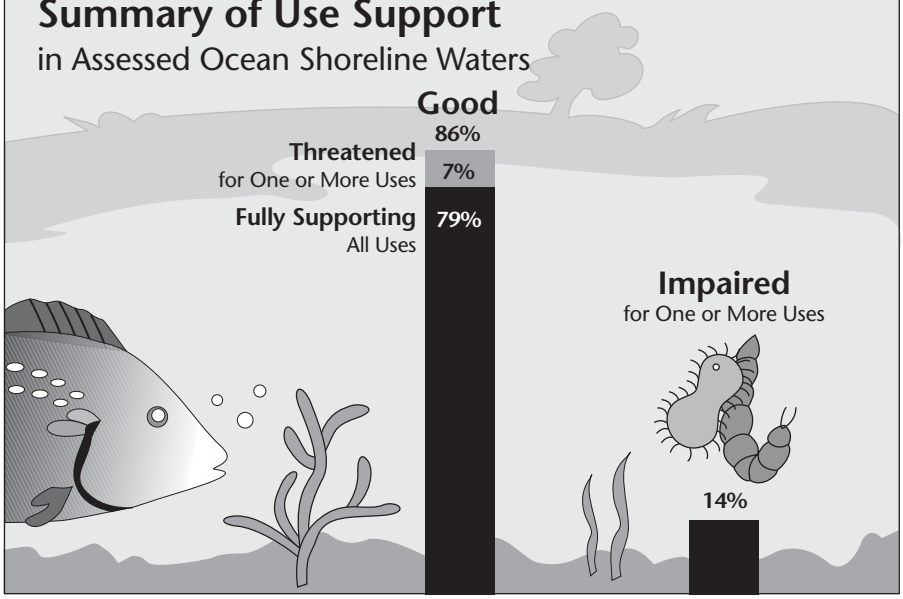
Fourteen of the 27 coastal states and territories rated general water quality conditions in some of their coastal waters (see Appendix C, Table C-6, for individual state information). Texas provided information on its ocean shoreline waters based on square miles rather than linear miles. Consequently, their data could not be aggregated with those reported by the other states.

Altogether, these states assessed 3,221 miles of ocean shoreline, which equals 5.5% of the nation's coastline (including Alaska's 36,000 miles of coastline) or 14% of the 22,618 miles of national coastline excluding Alaska. The states based 34% of their assessments on monitored data and 59% on qualitative information (see Appendix C, Table C-6, for individual state information). The states did not specify whether 7% of the assessed coastal shoreline waters were monitored or evaluated.

Summary of Use Support

The states reported that 86% (2,755 miles) of their assessed ocean shoreline miles have good quality that supports a healthy aquatic community and public activities (Figure 4-9). Of the assessed waters, 79% fully support designated uses and 7% are threatened for one or more uses. Some form of pollution or habitat degradation impairs the remaining 14% of the assessed shoreline.

Figure 4-9



This figure presents the status of the assessed miles of ocean shoreline. Of the 3,218 miles ocean shoreline assessed, 86% fully support their designated uses and 14% are impaired for one or more uses. Seven percent of the assessed waters are fully supporting uses but threatened.

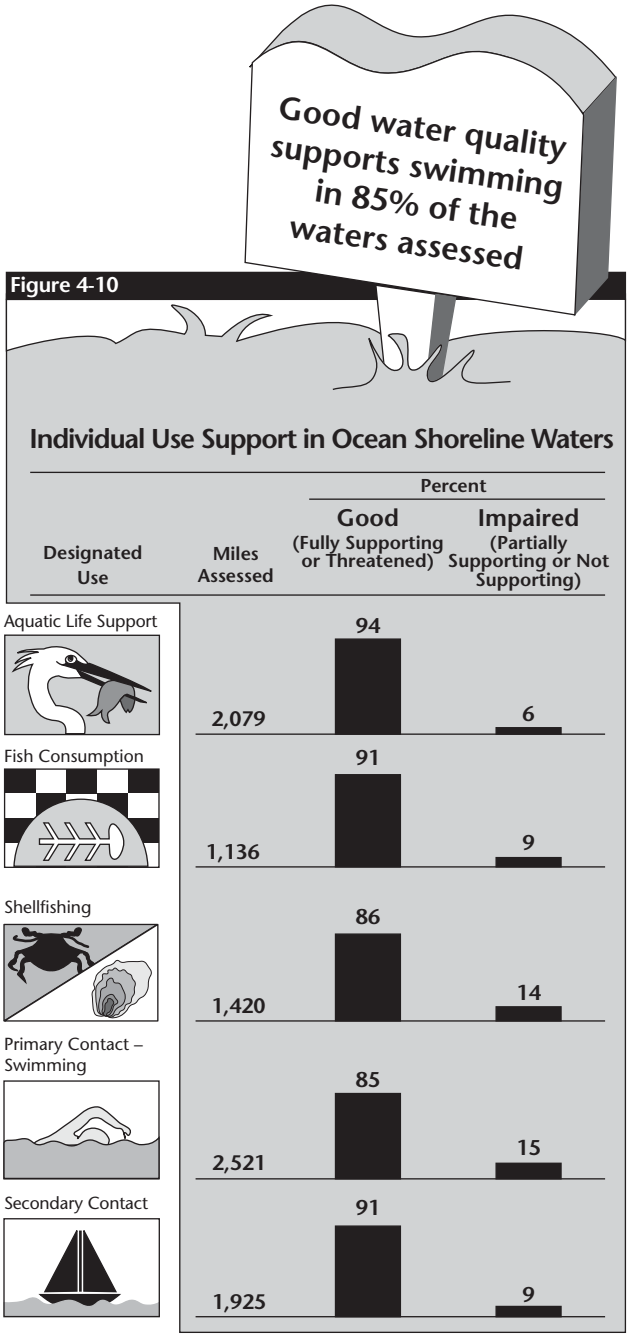
Note: Numbers may not add to 100% due to rounding.

Based on data contained in Appendix C, Table C-6.

Individual Use Support

The states establish specific designated uses for waterbodies through their water quality standards. For reporting purposes, the states consolidate their more detailed uses into five general use categories. The standard uses of ocean coastal waters consist of aquatic life support, fish consumption, shellfish harvesting, primary contact recreation (such as swimming and diving), and secondary contact recreation (such as boating). Few states designate saline ocean waters for drinking water supply and agricultural use because of high treatment costs.

The states provided limited information on individual use support in ocean shoreline waters (Appendix C, Table C-7, contains individual state information). Swimming was the most often rated use. Limited conclusions can be drawn from this fraction of the nation's ocean shoreline miles. The reporting states indicated that the greatest impacts to coastal shoreline are on swimming and shellfishing (Figure 4-10). It is important to note that 15 states have adopted statewide coastal fish consumption advisories for mercury, PCBs, and other pollutants. The effect of these advisories is not reflected in Figure 4-10.



This figure presents a tally of the miles of ocean shoreline assessed by states for each category of designated use. For each category, the figure summarizes the proportion of the assessed waters rated according to quality.

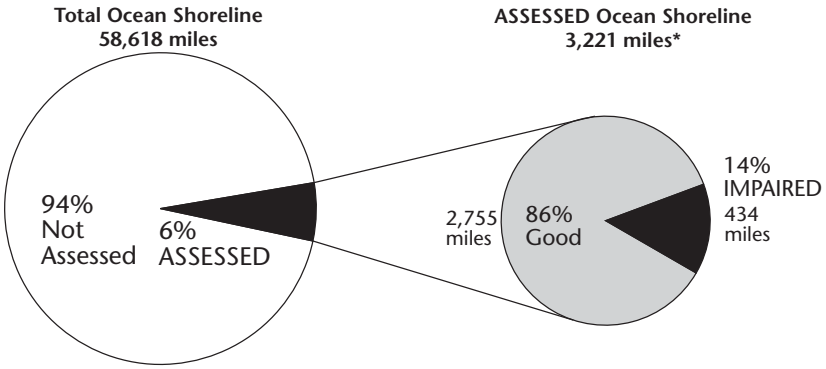
Based on data contained in Appendix C, Table C-7.

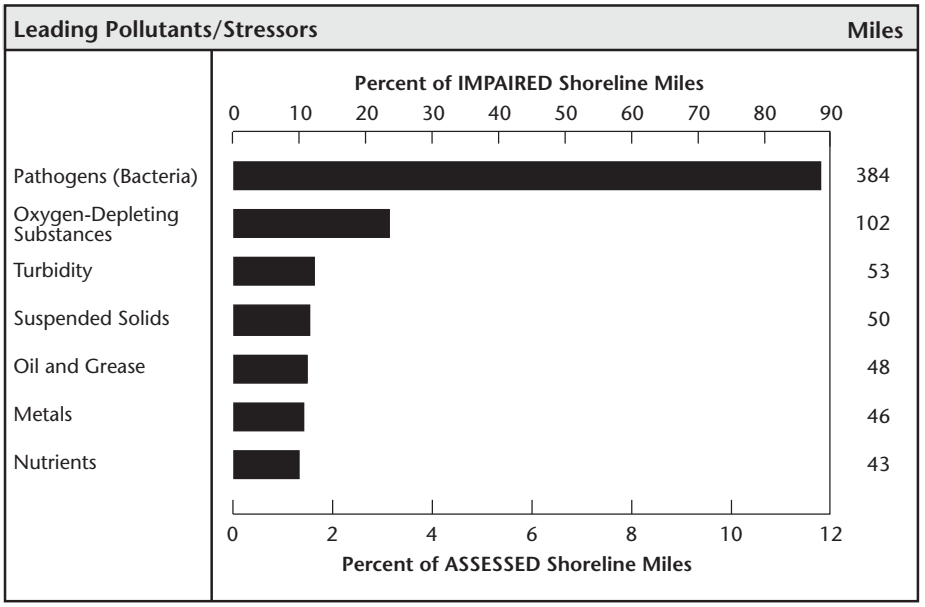
Water Quality Problems Identified in Ocean Shoreline Waters

Of the 14 states that reported on coastal waters, 10 identified pollutants and sources of pollutants degrading ocean shoreline waters (Appendix C, Tables C-8 and C-9, contain individual state information). The primary pollutants and stressors reported by the 10 states include bacteria (pathogens), oxygen-depleting substances, turbidity and suspended solids, (Figure 4-11). The primary sources reported include urban runoff and storm sewers, nonpoint sources, land disposal of wastes, septic tanks, and municipal point sources (sewage treatment plants (Figure 4-12).

Figure 4-11

Leading POLLUTANTS in Impaired Ocean Shoreline Waters





States assessed 6% of the total miles of ocean shoreline for the 2000 report. The larger pie chart on the left illustrates this proportion. The smaller pie chart on the right shows that, for the subset of assessed waters, 86% are rated as good and 14% as impaired. When states identify waters that are impaired, they describe the pollutants or processes causing or contributing to the impairment. The bar chart presents the leading causes and the number of ocean shoreline miles impacted. The percent scales on the upper and lower x-axes of the bar chart provide different perspectives on the magnitude of the impact of these pollutants. The lower axis compares the miles impacted by the pollutant to the total ASSESSED miles. The upper axis compares the miles impacted by the pollutant to the total IMPAIRED miles.

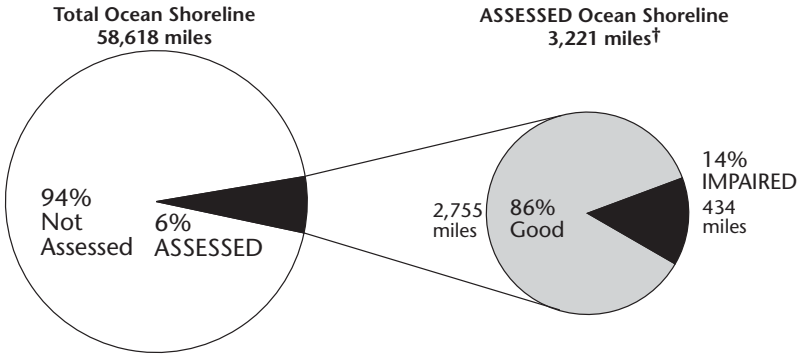
Based on data contained in Appendix C, Table C-8.

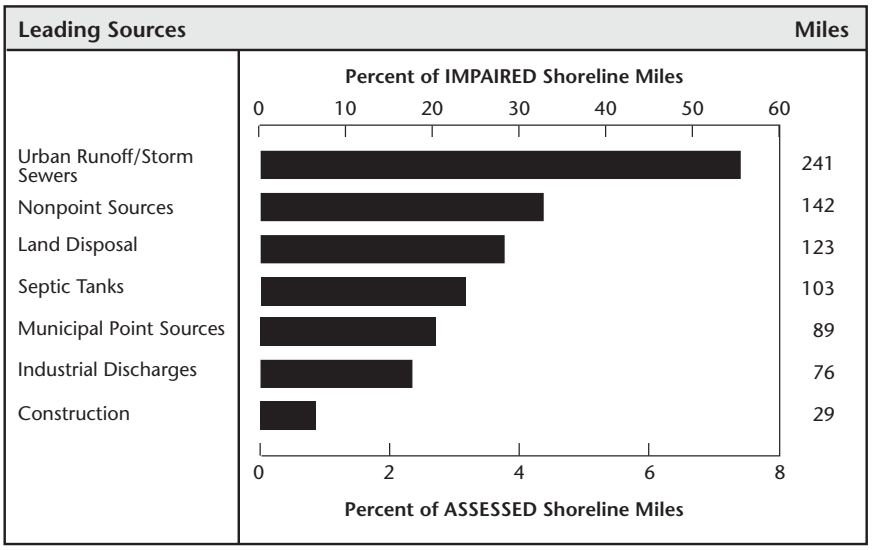
*Includes miles assessed as not attainable.

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

Figure 4-12

Leading SOURCES of Ocean Shoreline Impairment*





States assessed 6% of the total miles of ocean shoreline for the 2000 report. The larger pie chart on the left illustrates this proportion. The smaller pie chart on the right shows that, for the subset of assessed waters, 86% are rated as good and 14% as impaired. When states identify waters that are impaired, they also describe the sources of pollutants associated with the impairment. The bar chart presents the leading sources and the number of ocean shoreline miles they impact. The percent scales on the upper and lower x-axes of the bar chart provide different perspectives on the magnitude of the impact of these sources. The lower axis compares the miles impacted by the source to the total ASSESSED miles. The upper axis compares the miles impacted by the source to the total IMPAIRED miles.

Based on data contained in Appendix C, Table C-9.

*Excludes natural sources.

†Includes miles assessed as not attainable.

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

The pollutants/processes and sources shown here may not correspond directly to one another (i.e., the leading pollutant may not originate from the leading source). This may occur because a major pollutant may be released from many minor sources. It also happens when states do not have the information to determine all the sources of a particular pollutant/stressor.

CORAL REEFS

Coral reef systems are among the most diverse ecosystems on earth. Coral reefs are based on tiny individual coral animals called polyps, which secrete a hard calcium carbonate skeleton. They provide habitat for a large variety of organisms that use the coral as a source of food and shelter. Residents of coral reefs include various sponges; mollusks such as sea slugs, oysters, and clams; crustaceans such as crabs and shrimp; many kinds of sea worms; echinoderms such as starfish and sea urchins; other cnidarians such as jellyfish and sea anemones; various types of algae; sea turtles; and many species of fish.

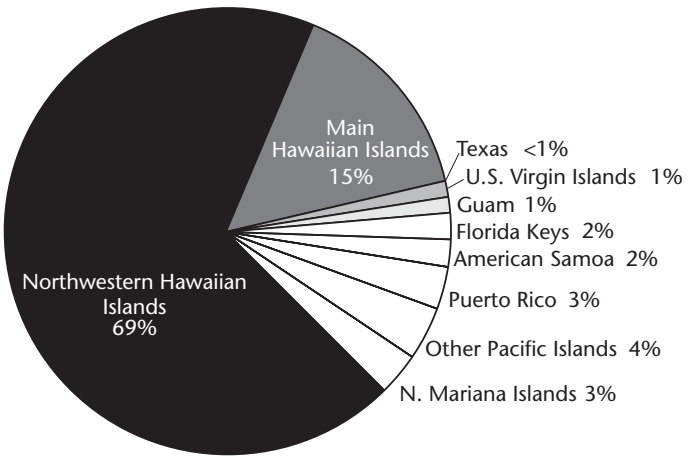
These reefs are living jewels that encircle the shoreline in many tropical areas, providing important assets to local and national economies, including fisheries for food, materials for new medicines, and income from tourism and recreation. Coral reefs also provide coastal communities with protection from storms.

Coral reef areas are found in only three states—Florida, primarily in the Florida Keys; Hawaii, throughout the Hawaiian archipelago; and Texas, in the offshore Flower Gardens (Figure 4-13). Lush reef areas are also found in five U.S. territories in both the Atlantic and Pacific regions, including American Samoa, Guam, the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands.

The proximity of coral reefs to land makes them particularly sensitive to impacts from human activities. Because they depend on light, coral reefs require clear water for growth and can be severely damaged by sediment or other factors that reduce water clarity or quality. Recent evidence indicates that coral reefs are deteriorating worldwide, and many are in crisis. Symptoms include loss of hard corals, increased abundance of algae, and a dramatic increase in bleaching episodes and disease outbreaks.

Figure 4-13

U.S. Coral Reef Areas



Coral Reef Degradation

Natural impacts to coral reefs occur as a result of hurricanes and severe storms. Outbreaks of Crown-of-Thorn starfish populations that feed voraciously on coral polyps kill large parts of Pacific Ocean reefs. Coral bleaching and other coral diseases are also stressing coral reef ecosystems in both the Atlantic and Pacific.

Human activities also can cause significant impacts to coral populations. These activities include:

- Introduction of alien species from ballast water of international cargo ships
- Removal of selected tropical fish and invertebrate species for the aquarium trade
- Commercial and recreational fishing pressures
- Marine debris, petroleum, and other toxic chemical spills
- Nutrient pollution from nonpoint source agricultural runoff or from point source discharges from sewage treatment facilities
- Sediment runoff
- Offshore dredging activities
- Marine tourism
- Urbanization of coastal areas.

In an effort to prevent further loss of coral reef ecosystems, the U.S. Coral Reef Task Force was established in 1998. The task force comprises many federal agencies including EPA, and is charged with mapping and monitoring coral reefs, researching coral reef degradation, working to implement measures to protect coral reefs, and promoting coral reef conservation worldwide. More information on the interagency efforts to study and protect coral reefs is available on the Internet at *http://coralreef.gov*.

In 2000, a major protection measure was enacted for the coral reefs of the northwest Hawaiian Islands, which represent nearly 70% of the coral reefs in U.S. waters. The area was designated as a federal Ecosystem Reserve and is the largest nature preserve ever established in the United States. It will protect more than 4,000 square miles of some of the most extensive and pristine coral reefs in U.S. waters. The reefs extend from near-shore areas just beneath the ocean surface to a depth of 600 feet, as much as 100 miles out to sea.

For more information on each of the states and territories with coral reef resources, refer to Chapter 10 (state summaries).