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Coastal Challenges

A Guide to Coastal and Marine Issues

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Environmental Health Center
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Coastal Challenges: A Guide to Coastal and Marine Issues is a publication of the National Safety Council's Environmental Health Center. This guide updates and revises *Covering the Coasts: A Reporter's Guide to Coastal and Marine Resources*, published in the fall of 1993. Both documents were prepared in conjunction with Coastal America, a multiagency collaborative partnership dedicated to protecting, preserving, and restoring the coastal environment. The contents of this document do not necessarily reflect the views and policies of Coastal America.

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National Safety Council

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Preface

America's coastal environments present the nation with a bounty of tangible and intangible benefits. Home to a growing percentage of the country's population, the coasts provide a wealth of resources, serve as habitat to many marine species, and attract vacationers.

Coastal Challenges: A Guide to Coastal and Marine Issues is the result of an innovative effort of Coastal America, a consortium of federal agencies, and the not-for-profit, nongovernmental National Safety Council's Environmental Health Center (EHC).

This guide is intended to be a "one-stop read" on the background of coastal issues. It is not the final word, but rather a constructive first word in helping to better inform the public. Better-informed communities can more effectively shape and implement programs needed to manage the coasts.

No single entity working on its own—not the federal government or state and local governments, not regulated industries or academia, not even the combined efforts of U.S. citizens—can succeed in accomplishing all that must be done to achieve a wide range of goals. This guide represents an unusual cooperation of diverse professional interests, including journalists, government officials, citizens' representatives, academics and researchers, and regulated industries, to achieve a common goal.

Produced with the help of both coastal resource experts and journalists, the guide is a working tool of authoritative, timely, and comprehensive information. The technical review committee members were Virginia Tippie, Director, Coastal America; Donald F. Boesch, President, University of Maryland Center for Environmental Science; Roger McManus, President, Center for Marine Conservation; Jerry Schubel, President, New England Aquarium; Robert B. Stewart, President, National Ocean Industries Association; and Sarah Taylor-Rogers, Assistant Secretary, Maryland Department of Natural Resources. The Press Review

Committee members were Michael Dunne of Baton Rouge, Louisiana; Tom Horton of Hebron, Maryland; and Paul MacClennan of Buffalo, New York.

The technical review committee provided invaluable assistance in helping EHC cull through volumes of complex data and statistics and regulatory details, always with an eye to honing in on the most current and the most accurate descriptions and nuances.

The press review committee provided many insights and recommendations on successive drafts leading up to the final guide. Their advice and recommendations were invaluable in ensuring the timeliness and usefulness of the guide.

Coastal America—consisting of representatives of the federal agencies making up the unique consortium—was particularly diligent and unsparing in their efforts to help ensure access to the most authoritative and most timely information sources. EHC appreciates the cooperative spirit of Coastal America staff throughout the development of multiple drafts.

Chapter 1
Introduction

Coastal Challenges: A Guide to Coastal and Marine Issues is an update and revision of an earlier guide, *Covering the Coasts: A Reporter's Guide to Coastal and Marine Resources*, initially produced by the National Safety Council's Environmental Health Center (EHC) as a resource for print and broadcast journalists. The earlier version was written to help news media report knowledgeably and responsibly on America's great wealth of coastal and marine resources and thereby help their print and broadcast audiences—the citizens at large—better understand coastal resource issues.

While the mass media continue to be the primary source by which the public comes to know and understand environmental issues—including those specifically dealing with coastal resources—citizens themselves increasingly are arming themselves with independent and additional information tools. For this reason, the second edition has been revised to appeal not solely to news media professionals, but also to citizens at large.

Coastal and marine resources are among the world's most treasured but least understood wealths. When it comes to the coast, the attraction is obvious. The nation's citizens, both those living along the nation's coastlines and those living far inland, long to be at the coast.

The mere scale of the coasts and of their abundant resources humbles the mind. Along the Atlantic, the Pacific, the Great Lakes, the Gulf of Alaska, the Bering Sea, the Arctic Ocean, and the Gulf of Mexico coasts, the United States has more than 95,000 miles of coastline. For recreation, livelihoods, and social and economic sustenance and well-being, coastal and nearshore marine resources help shape the nation's character and its distinctive personality. The nation's coasts are both rich in their promise for tomorrow and bountiful in their delivery of today's ecological,

recreational, aesthetic, and commercial rewards. The vastness of the coasts and their resources is matched only by the dimensions of the challenges society faces in preserving and nurturing those resources.

The saltwater ocean and freshwater coastal areas are constantly changing as a result of both natural and human forces. The coasts are at once resilient and fragile. Under siege from all directions, coastal lands and waters, and the resources they house, face assault from land, sea, and air. The pressures come in the form of constantly increasing coastal populations; inadequately planned land-use decisions; and pollutants carried downstream from cities, farms, and factories. The offshore pressures include the risk of oil spills, inadequate marine sanitation device programs, development of marine mineral and energy resources, and marine and beach debris.

The atmosphere also can pose a threat. Wind currents and refreshing breezes can carry with them toxins and other pollutants from inland sources, without regard for national boundaries. Acid deposition and the long-range transport of toxic air pollutants over time can harm even the seemingly most serene coastal reserve.

Citizens routinely worry about such pressures. But to meaningfully contribute to the management of coastal and marine resources, citizens need to understand the issues and legal processes involved. They will need to understand and address a variety of issues ranging from transportation systems to the elements of aquatic biology and atmospheric chemistry. The public sector often will face inadequate resources in its efforts to manage competing demands.

The scope and complexity of the programs in place to manage and protect the country's ocean and coastal resources are as extensive as the resources themselves are expansive.

Policy makers dealing with coastal resource management activities face the same day-in/day-out complexities as do those dealing with so many other environmental and natural resource

programs. Data alone are never fully adequate to make informed decisions. The desire for more and better scientific information and "certainty" will remain. However, "hard data" can go only so far in pointing the direction toward sound policies and practices.

The limitations on scientific certainty, and the inevitable limitations on data per se, are important. So too is monitoring in providing long-term trends data. Monitoring may be particularly helpful in estuaries, where saltwater and freshwater conditions can vary widely year to year. In terms of helping policy makers identify the scope of the challenges facing them, reliable monitoring data are invaluable. The absence of long-term data drawn from monitoring can greatly complicate priority setting and decisionmaking. In the end—with a thorough understanding of the best available information gathered and presented in the most conscientious fashion—professional judgment inevitably comes into play.

As scientific certainty is pursued, so are the financial resources for researching, managing, and protecting coastal and marine areas. And, simply put, society cannot afford all that could, should, or might be done to fully protect coastal and marine resources from potential damage. This problem is not unique to coastal management programs. Continuing efforts to refine and revise program priorities, timetables, and overall goals will be needed to ensure the most cost-effective strategies and implementation. This flexibility will be particularly important as population and development pressures on coastal resources exert increasing pressures in coming years and decades.

Coastal Challenges is designed to help readers steer through the broad spectrum of issues. It provides an overview of the complexity of the issues and of the regulatory framework—the numerous agencies responsible for various coastal and marine resource management programs. Finally, it provides a wealth of sources for more detailed information.

Chapter 2
Defining Coastal and Marine Waters

Highlights

- In March 1983, the United States declared its 200-mile exclusive economic zone by presidential proclamation, thereby asserting sovereign rights over the resources in the 200 miles extending beyond its coastline, including fishing and mineral resources, and jurisdiction to protect the marine environment.
- On 29 July 1994, the United States provisionally accepted UNCLOS.
- The United Nations Convention on the Law of the Sea (UNCLOS) entered into force on 16 November 1994.
- The convention provides for five basic maritime zones: the territorial sea, the contiguous zone, the exclusive economic zone, the continental shelf, and the high seas.
- Thirty-six U.S. states and territories have a total of more than 95,000 miles of coastline bordering the Pacific and Atlantic Oceans, the Gulf of Mexico, the Gulf of Alaska, the Bering Sea, the Arctic Ocean, and the Great Lakes (which have 5,000 miles of coastline).

Scientific findings, economic values, and political considerations all influence how the definitions and terminology of the coastal environment are developed. The language used to describe the coastal environment can be a mix of words that conjure up romantic images of nature or words that sound like the stuff only geologists or lawyers could love. Sandy beaches and saltwater marshes sit side by side with continental shelves and exclusive economic zones.

Internationally Declared Zones

The language that defines the marine environment from "the coast" to the "open ocean" reflects centuries of international conflict and compromise over jurisdiction. Typically, coastal countries have attempted to set limits on other nations' access. These coastal countries wanted to protect what they perceived as their own economic and military interests. This approach usually meant that coastal countries declared waters within a certain distance from their coasts as territorial waters. Other nations would be allowed to pass through these waters, but would be prohibited from fishing or engaging in other economic or military activities.

By the early 1900s, the world was a crazy quilt of irregular territorial zones. Some countries claimed their zones extended three miles from their shoreline out to sea; others claimed six miles or more. In 1945, President Truman proclaimed the United States had exclusive control over its continental shelf, the underwater extension of the North American continent that stretches more than 200 miles beyond the U.S. shoreline. This proclamation followed the discovery of rich stores of oil and mineral resources on the continental shelf.

Luc Cuyers, in *Ocean Uses and Their Regulation,* wrote that with Truman's proclamation, "the United States called the world's attention to the notion that there was something of great value besides fish in the sea, and nothing in international law prevented a coastal state from claiming it."

Other countries followed the U.S. lead and declared control over broader ocean territories. The crazy quilt of zones became even more irregular. The United Nations responded by recommending that its member nations confer. In 1958, the first United Nations Convention on the Law of the Sea (UNCLOS), held in Geneva, Switzerland, attracted representatives of 86 countries. At the convention, delegates hammered out four agreements, or conventions, that began to define sea rights and responsibilities. A second meeting in 1960 expanded on the earlier agreements.

Finally, a third conference was convened in 1973. This conference (UNCLOS III) proved to be the most difficult, complicated, and comprehensive. It began with more than 400 draft articles. Conference delegates spent nearly 10 years whittling these articles down to about 320 articles and 9 annexes, forming a manageable convention that defines ocean boundaries and the rights and responsibilities of the world community in using the oceans.

This convention, more than any of its predecessors, specifically addressed ocean pollution, making it each country's duty to protect the ocean environment and conserve living resources. It mandated cooperation among neighboring coastal states to control ocean pollution from all sources.

During the previous two decades, the ocean's great mineral wealth beyond oil had come to light. Capturing that sea-bottom wealth, which included fields of manganese nodules, would be technologically challenging and expensive. But industrialized countries, such as the United States, anticipated that as technology improved, those fields could be mined economically in the near future. The UNCLOS convention placed deepwater seabeds outside the jurisdiction of any individual country and within the jurisdiction of a new institution, the International Seabed Authority.

In 1982, the United States voted against the convention, primarily because of concerns that provisions regarding deep seabed mining would restrict U.S. access to valuable seabed minerals. Despite U.S. opposition, in 1982 the majority of the conference delegates voted to adopt UNCLOS. The Deep Seabed Mining Implementing Agreement of July 1994 addressed U.S. concerns about potential mining restrictions. As a result, on 29 July 1994 the United States signed UNCLOS. Although the United States upholds all the provisions of the convention, the United States remains a provisional member. U.S. ratification will be possible once the U.S. Senate has provided its advice and consent.

For more information on the United Nations Convention on the Law of the Sea, see the U.N. Web site at http://www.un.org/depts/los

At the time the United States signed the convention, it was still not in force. Sixty eligible nations had to ratify UNCLOS before the convention could enter into force. That goal was not achieved until 16 November 1994. By January 1998, the convention had been adopted by 123 parties.

UNCLOS establishes five ocean zones: territorial sea, contiguous zone, exclusive economic zone, continental shelf, and high seas.

Territorial Sea

This zone may extend out to 12 nautical miles (1 nautical mile equals 1,852 meters, or 6,076 feet), measured from a baseline on a country's coast. The territorial sea is considered part of a country's sovereign territory, although ships may pass through as long as passage is innocent (i.e., not done to harass, attack, or exploit the host country or its resources).

Contiguous Zone

This zone extends an additional 12 nautical miles from the territorial sea. A host country has rights to control immigration, customs, sanitary, and pollution regulations in its contiguous zone.

Exclusive Economic Zone

A country may declare an exclusive economic zone (EEZ) extending from the outer boundary of the territorial sea to 200 nautical miles from the coast baseline (i.e., the maximum EEZ width would be 188 nautical miles from the coast where the territorial sea is 12 nautical miles). Within this zone, the coastal country does not have complete sovereignty. Other countries may fly over it, navigate through it, or lay pipes or cables. However, the coastal host country has all rights to control the resources in these waters, including fisheries and mineral resources. It also may assert jurisdiction (which the United States has not) over scientific research conducted in these waters. In March 1983, the United States declared its own 200-mile EEZ through presidential proclamation.

Continental Shelf

UNCLOS provides a complex definition of the continental shelf. This zone extends a minimum of 200 nautical miles from the coastal baseline and may extend up to 350 nautical miles in special circumstances. The coastal country has exclusive jurisdiction over the mineral resources of its shelf, including oil. Up to 7 percent of the profits from mineral development beyond the 200-mile line from shore must be shared with the international community. The coastal country is obligated to protect the continental shelf's marine environment from negative consequences of oil development.

High Seas

This maritime zone extends beyond areas of national jurisdiction and is generally open and freely available for use by all. No country may interfere with the justified and equal rights of other countries on the high seas. The seabed under the high seas, home to certain mineral beds, is the common heritage of humankind, according to part of the convention. Mineral resources of the seabed are under the jurisdiction of the United Nations International Seabed Authority.

Nationally Recognized Definitions

In addition to accepting many of the provisions of UNCLOS, the United States also recognizes state jurisdiction over coastal waters (approximately three miles for most states, nine nautical miles for Texas and the west coast of Florida). States have significant coastal resources management authority in these waters.

Thirty-six U.S. states and territories have a total of 95,429 miles of coastline bordering the Pacific and Atlantic Oceans, the Gulf of Mexico, the Gulf of Alaska, the Bering Sea, the Arctic Ocean, and the Great Lakes (which have 5,000 miles of coastline). The area where water meets land—the beaches, bays, and wetlands—is the coastal zone. In addition to these areas, estuaries

(where saltwater and freshwater mix) and watersheds (drainage basins) are integral parts of the coastal zone.

The coastal zone is formally defined in section 304 of the Coastal Zone Management Act as follows:

> the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each other and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches.

Among the many commercially valuable fish and shellfish that depend on coastal waters, particularly the bays and estuaries, are striped bass, shad, salmon, sturgeon, shrimp, clams, crabs, oysters, lobsters, mussels, abalone, and bay scallops. The National Marine Fisheries Service estimated that U.S. consumers spent $41.2 billion for fishery products in 1996. These waters also serve as habitat and breeding areas for hundreds of varieties of birds and other animals, including marine mammals, such as seals, manatees, sea lions, and otters. Coastal waters also provide important recreational, aesthetic, and cultural value.

Rocky Shores, Sandy Beaches, Wetlands

The natural shoreline geography and geology of coastal waters are diverse. The three basic types of shoreline are rocky shores, sandy beaches, and wetlands. Within these types are various subtypes.

Rocky shores and sandy beaches are defined in the U.S. Geological Survey's 1991 report, *Coasts in Crisis*:

> ***Rocky shores*** form on high-energy coasts where mountains meet the sea at the base of sea cliffs. Active tectonic environments, such as in California,

produce rocky coasts as a result of mountain-building processes, faulting, and earthquakes. Rocky coasts also form where ice and strong waves have effectively removed fine-grained sediment. In Maine and parts of Alaska, glaciers have scoured most of the sediment cover from the shore. In the Arctic, ice gouging and rafting have removed sand-sized particles from some beaches, leaving cobbles and boulders.

The U.S. Geological Survey categorizes ***sandy beaches*** into three subtypes: mainland, pocket, and barrier beaches.

Mainland beaches stretch unbroken for many miles along the edges of major land masses. Some are low standing and prone to flooding; others are backed by steep headlands. They receive sediment from nearby rivers and eroding bluffs. Examples of mainland beaches include the coasts of ... northern New Jersey and southern California.

Pocket beaches form in small bays surrounded by rocky cliffs or headlands. The headlands protect the sandy alcoves from erosion by winter storms and strong currents. Pocket beaches are common in Maine and the Pacific Northwest.

Barrier beaches are found along the Gulf of Mexico, Cape Cod, the Hatteras National Sea Shore, and much of Alaska. They are part of complex integrated systems of beaches, dunes, marshes, bays, tidal flats, and inlets. The barrier islands and beaches are constantly migrating, eroding and building in response to natural processes and human activities.

Wetlands are semiaquatic lands that are either inundated or saturated by water for varying periods during the growing season. In all wetlands, the presence of water creates conditions that favor the growth of specially adapted plants (hydrophytes) and promotes the development of characteristic hydric (wet or moist) soil properties. The two subtypes of wetlands are inland and coastal.

Inland wetlands include marshes and wet meadows dominated by grasses and herbs, shrub swamps, and wooded swamps dominated by trees and woody vegetation.

Coastal wetlands, as their name suggests, are found along the Atlantic, Pacific, Alaska, Great Lakes, and Gulf of Mexico coasts and are closely linked to the nation's estuaries. For instance, saltwater and fluctuating water levels (due to tidal action) combine to create a rather difficult environment for most plants. Consequently, many shallow coastal areas are mud flats or sand flats lacking vegetation. Certain grasses and grass-like, salt-tolerant (halophytic) plants form extensive colonies called coastal marshes. These marshes are particularly abundant along the South Atlantic and Gulf of Mexico coasts. Mangrove swamps, dominated by halophytic shrubs or trees, are common in Hawaii and in southern Florida. (See chapter 3 for a discussion of wetland functions and chapter 4 for a discussion of wetland delineation.)

Estuaries

Coastal wetlands are integral parts of estuaries, water bodies where freshwater empties into and mixes with saltwater. Estuaries are different from oceans and rivers—chemically, biologically, and hydraulically—and are highly productive. Recognition of the distinctive nature and importance of estuaries has increasingly led to the development of separate regulations and strategies to address them. About 75 percent of commercially important fish and shellfish in the United States are estuarine-dependent (i.e., they rely on estuaries and upper reaches of tidal rivers for early life stages, food, migration, or spawning).

Under the Clean Water Act (CWA), the estuary has its own legal definition and protection. An estuary, according to the act, is "all or part of the mouth of a river or stream or other body of water having unimpaired natural connection with the open sea and within which seawater is measurably diluted with freshwater derived from land drainage." Examples of estuaries are the San Francisco Bay, Chesapeake Bay, Long Island Sound, and Mobile Bay (Alabama).

The definition of estuary under the CWA also takes upstream waters into account: "associated aquatic ecosystems and those portions of tributaries draining into the estuary up to the historic height of migration of anadromous fish or the historic head of tidal influence, whichever is higher." Anadromous fish are fish that live in the sea but spawn in freshwater, such as salmon and herring. The reference to the "historic height of migration" is often cited as justification for maintaining that an estuarine zone extends beyond just a narrow tidal region. By this approach, for instance, part of New York State is included in the Delaware Bay Estuary Program (see National Estuary Program, chapter 5), and some argue the same logic should lead to considering New York as part of the Chesapeake Bay Program.

Watersheds

A watershed, also known as a drainage basin, is defined by the U.S. Environmental Protection Agency (EPA) as a geographic area in which water, sediments, and dissolved materials drain to a common outlet—a point on a larger stream, a lake, an underlying aquifer, an estuary, or an ocean.

The effect of streams and rivers on the ocean environment can begin well upstream, miles from the coast and well above the spawning grounds of anadromous fish. Here, the rivers and streams begin to gather the silt and sand that is carried downstream to build beaches. Any change in the course of the river, through dams, diversions, or draining, can cause fluctuations in sand and

water delivery to the ocean. Here, also, the quality of water that later feeds coastal wetlands can begin to deteriorate from pollutants.

A large river's watershed may cover thousands of square miles. Watersheds are increasingly the basis for public/private water quality protection efforts. The Chesapeake Bay watershed extends from Central New York State to Central Virginia, and the Gulf of Mexico drainage area covers more than 40 percent of the land area of the continental United States—from the Appalachians to the Rockies and parts of Canada.

The Great Lakes

For millions of Americans, the term "coast" conjures up images of the five Great Lakes—Superior, Huron, Michigan, Erie, and Ontario. Shared with Canada, the complex Great Lakes ecosystem supports a wide variety of freshwater flora and fauna.

The Great Lakes: An Environmental Atlas and Resource Book published in 1995 by Environment Canada and EPA, points out that "the magnitude of the Great Lakes water system is difficult to appreciate, even for those who live within the basin." The *Atlas* offers these facts about the significance of the Great Lakes:

- ❑ One-tenth of the U.S. population and one-fourth of Canada's population live in the Great Lakes basin.
- ❑ The Great Lakes span more than 750 miles (1,200 kilometers) from east to west. The five lakes contain the largest system of fresh surface water in the world and about 18 percent of the world's freshwater (only the polar ice caps contain more).
- ❑ Nearly one-fourth of Canadian agricultural production and 7 percent of U.S. agricultural production are located in the Great Lakes basin.
- ❑ The eight Great Lakes states have more than 5,000 miles of shoreline.

Outflows from the Great Lakes are small—less than 1 percent—relative to the total volume of water (23,000 cubic kilometers, or 5,500 cubic miles). As a result, pollutants entering the lakes stay in the system and become more concentrated with time.

The economic contributions from the Great Lakes region are also noteworthy. According to a 1995 background paper by the Great Lakes Commission and the Federal Reserve Bank of Chicago, the eight Great Lakes states contain 30 percent of U.S. manufacturing, and the province of Ontario contains 50 percent of Canada's manufacturing. The Great Lakes states account for 40 percent of U.S. industrial water use and 70 percent of U.S. steel production.

The Great Lakes: An Environmental Atlas and Resource Book is available online at http://www.cciw.ca/glimr/great-lakes-atlas/intro.html.

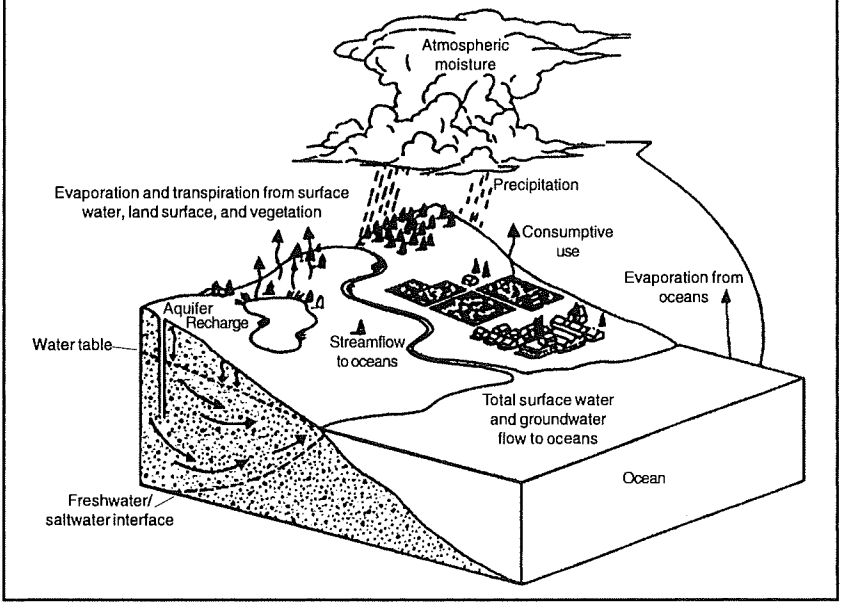
Chapter 3
Importance of the Resource: Facts at Your Fingertips

Highlights

- Oceans contain more than 97 percent of the Earth's water.
- The U.S. exclusive economic zone (EEZ), which reaches 200 miles from the coast into the oceans, is estimated to contain about one-fifth of the world's harvestable seafood.
- Approximately 15,000 to 40,000 species of fish live in the oceans and 180 species of fish live in the Great Lakes. More than 2,000 plant and animal species have been identified in the Chesapeake Bay estuarine region alone.
- Offshore energy sources account for 11.8 percent of world-wide and 18.6 percent of U.S. oil production. Offshore sources provide about 25 percent of worldwide and 26 percent of U.S. gas production.
- Gulf of Mexico coastal wetlands serve as essential habitat for 75 percent of U.S. migrating waterfowl.
- Commercial landings by fishers at U.S. ports in 1996 were 9.6 billion pounds, a decrease of approximately 223 million pounds (2 percent) from 1995.
- In 1996, an estimated 77.7 million recreational boaters spent approximately $17.75 billion on products and services related to recreational boating.

Oceans cover more than two-thirds of the Earth's surface and contain more than 97 percent of all the water on Earth. They play a critical role in the planet's energy and nutrient cycles (see figure 1). People rely on the oceans for many things, including

Figure 1
Water's Natural Cycle



Source: Council on Environmental Quality 1992

energy and mineral resources, and oceans are a habitat for sustaining living resources, an important food source. People also rely on the oceans as "a medium for recreation, learning, and enlightenment ... for reinvigorating our own energy, our imagination, and our creativity as human beings," said James Broadus of the Woods Hole Oceanographic Institution.

The U.S. coastline consists of many types of land forms and ecological systems, including rocky shores, mangrove marshes, sandy beaches, barrier islands, barrier reefs, tidal flats, sea grass shallows, cypress swamps, and river delta systems. Coastal waters teem with rich and varied marine life. Salt marshes, the Atlantic coastal shelf, and reef systems along the U.S. coastline are among the most productive ecosystems in the world.

The U.S. exclusive economic zone (EEZ)—waters to 200 miles offshore—contains fisheries, oil and gas, and hard minerals and provides many recreational opportunities. It is the largest, and

> "The greatest resource of the ocean is not material but the boundless spring of inspiration and well-being we gain from her."
>
> *Jacques Cousteau*

perhaps the richest, EEZ in the world. The zone reaches into the Atlantic and Pacific Oceans, the Gulf of Mexico, the Gulf of Alaska, and the Bering Sea, encompassing about 2.2 million square miles. The U.S. EEZ, which includes vast fisheries off the Gulf of Mexico and the prosperous Alaskan fishing ports fed by colder North Pacific waters, is estimated to contain about one-fifth of the world's harvestable seafood. U.S. coastal waters are also home to enormous populations of marine birds and mammals.

Many so-called "ecosystem services"—benefits derived from the world's natural ecosystems, including raw materials, food, and recreation—are traded in economic markets and therefore have readily identifiable economic values. Some ecosystem services, however, are not traded, including regulating the atmosphere, treating natural waste, buffering storms and floods, cycling nutrients, and providing habit for wildlife. In a May 1997 *Nature* article, a group of ecologists attempted to place a value on ecosystem services, especially in the coastal zone. They estimated that the worth of these services for marine ecosystems is approximately $21 trillion each year. Coastal environments (e.g., continental shelves, estuaries, reefs, tidal marshes, and mangroves) cover only about 6 percent of the Earth's surface, yet provide 32 percent of the value of all ecosystem services.

The United States has always been a maritime nation and has always derived a significant amount of its wealth and power from the sea. According to *Sea Technology* magazine, the value of goods and services sold by the ocean/marine industry (including manufacturing plants, research laboratories, test facilities, shipyards, and all types of support facilities) was estimated in 1995 at $60 billion annually.

The future of the United States will in no small measure depend on its ability to intelligently harness the great wealth of the

sea on a sustainable basis without harming the marine resource itself. David M. Graham, editor of *Sea Technology* magazine, noted in the October 1991 issue,

> As a current and potentially increasing source of food, energy, and minerals; as a conveyor of ships, communications, and wastes; and as a place of recreation, the oceans will come under increasing pressure in the next decade. This pressure will result from economic necessities and the relentless demographic push toward our coastlines as populations there will jump some 20–25 percent in the next two decades or so.

In June 1997, *Sea Technology* reported that about two-thirds of the world's cities with populations exceeding 1.6 million are located on or near coasts.

In addition to the economic and recreational benefits that they provide, the oceans also regulate the world's climate. They help to maintain the global equilibrium between hot and cold by constantly pushing toward a more even distribution of temperatures. In a relatively stable pattern, oceans transfer heat from the equator to the poles in huge currents near the surface, such as the Gulf Stream. Deep ocean currents transfer cooler temperatures from the poles toward the equator. As the warm ocean water from the tropics moves northward, some of it evaporates. In the Atlantic Ocean, when warm ocean water hits the cold polar winds between Greenland and Iceland, the evaporation accelerates, leaving behind saltier seawater that becomes denser and heavier. This rapidly cooling water sinks to the bottom at the rate of 5 billion gallons per second, forming a deep current as powerful as the Gulf Stream that flows south underneath the Gulf Stream near the ocean floor. In the process, the current transfers cold from the poles back toward the equator, along with a large volume of nutrients essential to numerous temperate and tropical species.

Plant and Animal Species

Jacques Cousteau wrote,

> The oceans are superior to land as an environment for life support. They provide directly the water fundamental to all forms of growth, laden with vital salts, dissolved gases and minerals. The water temperature is more constant than air, reliably warmer in shallow and surface areas, reliably cooler in the deeps—freeing many species from the need to adapt, as most land animals must, to wide variations in temperature.

This lack of adaptability, however, also increases the risk to species from environmental disturbances.

Aquatic systems are highly diverse. Estimates of the number of species of ocean fish range from 15,000 to 40,000. A cubic foot of ocean surface water may have as many as 20,000 microscopic plants, together with hundreds of planktonic animals. An estimated 180 species of fish are native to the Great Lakes.

More than 2,000 plant and animal species have been identified in the Chesapeake Bay estuarine region, according to *Life in the Chesapeake Bay*, by Alice Jane and Robert L. Lippson. According to the Sierra Club's *Adventuring in Florida*, 350 species of birds, 1,000 varieties of plants, 250 species of trees, 40 species of mammals, and 50 species of reptiles dwell in the vast Florida Everglades. More than 50 species of mollusks live in Long Island Sound, and the Puget Sound is home to more than

Background Reading

Overviews of the diversity of life in and around the coasts can be found in the following books: Rachel Carson's *The Sea Around Us* and *The Edge of the Sea*; Jacques Cousteau's *The Ocean World*; and *The Living Ocean* by Boyce Thorne-Miller and John Catena.

200 varieties of fish and 14 marine mammal species. Countless species of microscopic algae and plankton form the base of the food web.

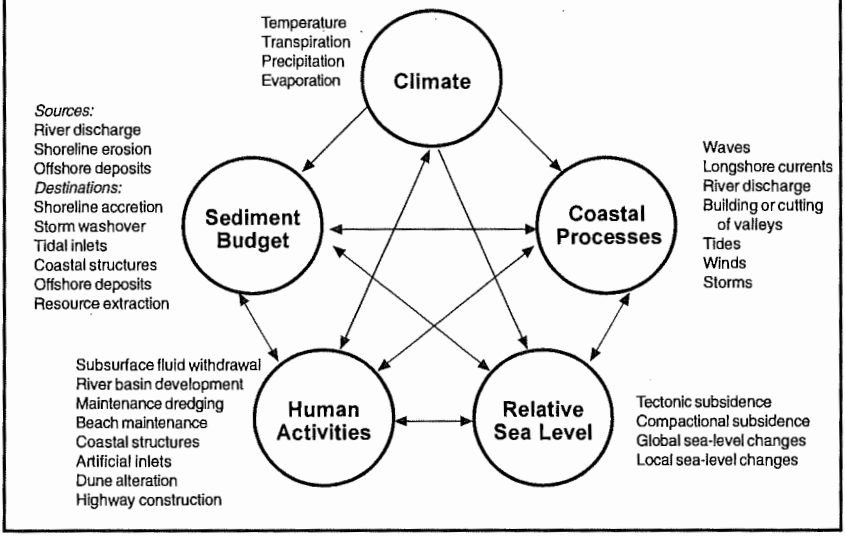
Ecosystems and habitats in coastal and nearshore waters teem with life because of interactions between inland and oceanic systems. Coastal wetlands, estuaries, and salt marshes are critical habitat for a wide range of fish, shellfish, birds, and other aquatic and terrestrial life. Reef systems provide food and shelter for fish, plants, mollusks, and crustaceans. In coastal areas, nutrients from land runoff combine with organic matter from nearshore waters. Food washes in and wastes wash out regularly with the tides. In some coastal areas, particularly along the Pacific coastline, colder, nutrient-rich waters are brought to the coastal surface waters in a process called "upwelling," yielding highly productive systems.

Estuaries and coastal areas serve as feeding, spawning, and nursery grounds for many species that spend most of their adult lives in the ocean. Salmon, for instance, spawn upriver in freshwater, while shrimp spawn and grow to be adults in coastal waters. Coastal waters and estuaries provide habitats for more than 75 percent of the total commercial fish catch and 80 to 90 percent of the recreational catch of fish and shellfish in the continental United States. These coastal waters also support a great share of the clam, oyster, lobster, and mussel fisheries, and 100 percent of the blue crab, abalone, and bay scallop fisheries. The continued viability of these fisheries depends on the continued good health of these habitats.

Many marine mammals, such as seals, sea lions, manatees, and sea otters, live in or near coastal water habitats. Many species of birds depend on wetlands and other coastal habitats for food, breeding, migration, and resting areas.

The marine environment remains relatively unexplored. The high biological diversity of deep sea ecosystems is only beginning to be understood. For example, hydrothermal vents—areas located along deep seabeds, particularly along the central rift valleys of the East Pacific where hot, sulfur-rich water is released from geothermally heated rock—were discovered less than 20 years ago. The

Figure 2
Factors Affecting Coastal Environments



Source: Modified from Williams, Dodd, and Gohn 1990

ecological and habitat values of deep sea thermal vents are being appreciated more and more by conservationists, scientists, developers, and the general public. These ecosystems and their enormous variety of marine life are part of complex food web interactions. Disruption of any part can harm many other parts of the ecosystem (see figure 2).

Energy and Mineral Resources

Some coastal and marine areas hold vast oil and gas reserves. Gold, cobalt, phosphorites, and other valuable minerals, as well as sand and gravel, abound in some areas. Offshore energy sources account for 11.8 percent of worldwide and 18.6 percent of U.S. oil production, and about 25 percent of worldwide and 26 percent of U.S. natural gas production. The United States accounts for about 8 percent of worldwide ocean oil production and 38 percent of ocean natural gas production. The value of U.S. production from federal offshore sources has ranged from $12 billion to $22.4 billion

annually from 1985 through 1996, according to the Department of the Interior Minerals Management Service's (MMS's) *Mineral Revenues: Report on Receipts from Federal and Indian Leases.*

Offshore oil and gas production has become very important to domestic energy production. Since 1954, the annual market value of crude oil produced from federal offshore leases has been more than $3.4 billion, reaching a peak of $10.8 billion in 1984. The 1996 value was more than $8 billion, and annual offshore production in U.S. waters is increasing.

MMS manages oil and gas leasing on the 1.4 billion acres of the U.S. outer continental shelf (OCS). States manage and lease the areas within three miles of shore, except on the Texas coast and the west coast of Florida, where three marine leagues, or nine nautical miles, are retained as state waters.

In 1996, 32.8 million of the 1.4 billion acres of the U.S. OCS were under lease to oil and gas exploration, development, and production companies. According to MMS, 3,860 oil and gas production facilities and more than 80,000 petroleum workers are located on the U.S. OCS. In 1996, nearly 1,800 OCS leases were in production in the Gulf of Mexico, yielding about 95 percent of U.S. offshore production. In 1996, the OCS oil and gas lease program generated more than $4.2 billion in production royalties and lease-related revenues for the federal government. Table 1 lists the five largest oil and gas operators producing on the OCS (ranked by production quantity) in 1996.

Additional Resources

The Minerals Management Service (MMS), a Department of the Interior bureau that manages offshore production, publishes several reports: *MMS Offshore Stats*, a quarterly newsletter; *Federal Offshore Statistics*, published annually; *Mineral Revenues: Report on Receipts from Federal and Indian Lands*, published annually; the *Annual Report to Congress: OCS Oil and Natural Gas Leasing and Production Program.* For copies, contact MMS's Document Distribution Center at (703) 787-1080. The MMS World Wide Web site is http://www.mms.gov.

Table 1
Largest Oil and Gas Operators on the Outer Continental Shelf in 1996 (Ranked by production quantity)

Oil (in barrels)		Gas (in millions of cubic feet)	
1. Shell Offshore Inc.	68,850,388	1. Shell Offshore Inc.	516,799,845
2. Chevron U.S.A. Inc.	44,410,288	2. Chevron U.S.A. Inc.	465,135,278
3. Marathon Oil Company	22,883,810	3. Union Oil Company of California	281,107,091
4. Exxon Corporation	22,026,588	4. Texaco Exploration & Production	264,613,378
5. BP Exploration & Oil Inc.	20,310,139	5. Exxon Corporation	244,217,360

Source: Minerals Management Service 1997

Condensates, or liquid hydrocarbons such as pentanes and heavier hydrocarbons that are blended with crude oil for refining, are also produced on the OCS. In 1990, their market value exceeded $1 billion.

Most offshore mineral, oil, and gas production takes place offshore of Louisiana. Following Louisiana, the leaders in U.S. offshore production of minerals, oil, and gas are Texas, California, Alaska, Florida, and Alabama (the exact order of the states depends on which resource is being computed). Discoveries of oil and gas have recently expanded production into the deeper waters of the Gulf of Mexico.

According to December 1995 estimates, about 13 percent of U.S. oil reserves and about 18 percent of U.S. natural gas reserves (or potential for production) lie within the federal OCS. MMS estimates of OCS resources and U.S. Geological Survey estimates of onshore and state water resources indicate that about 55 percent of the nation's conventionally recoverable oil resources and 51 percent of the nation's conventionally recoverable gas resources are located in the OCS.

Federal OCS oil and gas lease revenues go to the U.S. Treasury General Fund, the Land and Water Conservation Fund, and the National Historic Preservation Fund through a complex process. Bonus payments (one-time payments for the exclusive

rights to the leases), rental payments, and royalty payments contributed more than $75 billion to the U.S. Treasury from 1971 through 1990.

The United States is just now beginning to tap the vast saltwater and freshwater bodies for new "alternative" energy sources. For instance, the prospects for ocean thermal energy conversion, which derives energy by tapping the temperature gradients in seawater, remain bright, yet will not likely be developed on a large scale for many years. Harnessing tidal power one day may be another way to produce energy from the oceans, but this, some say, also may have environmental side effects. For example, a contemplated tidal energy project in Canada's Bay of Fundy has raised fears that it would harm the summering shad.

The waters of the Great Lakes are also a source of energy. About 20 billion kilowatt hours of electricity are produced each year from the water flowing into or out of the Great Lakes.

Wetlands

While wetlands sometimes have been referred to as mere "swamps," they are now recognized for a variety of important ecological functions. Each wetland works in combination with other wetlands, adjacent uplands, and aquatic systems as part of a

Table 2
Coastal Wetland Acreage in the Continental United States[1]

	Salt Marsh	Fresh Marsh	Forested Wetlands[2]	Total Wetlands
Atlantic Coast	1,651,900	1,490,600	8,410,900	11,553,400
Gulf of Mexico	2,496,600	2,751,100	8,211,800	13,459,500
Pacific Coast	121,900	291,200	757,100	1,170,200
Total	4,270,400	4,532,900	17,379,800	26,183,100

[1]Excludes Alaska, the Great Lakes, and Hawaii
[2]Includes mangroves

Source: Watzin and Gosselink 1992

complex, integrated system that can deliver a range of benefits to society. Wetlands form an important transition zone between upland and aquatic ecosystems and are typically very productive because they contain elements common to both systems.

Wetlands vary from region to region, but they share three characteristics, as described in *The Fragile Fringe*:

- ❑ They are periodically flooded, or at least saturated to or near the surface.
- ❑ They have unique hydric soils characterized by periodic wetness and differing from those of adjacent upland areas.
- ❑ They support plant species that have adapted to or are dependent on periodically wet conditions.

Table 2 shows the estimated total acreage of coastal wetlands on the Atlantic, Pacific, and Gulf of Mexico coasts.

The U.S. Army Corps of Engineers (USACE) defines wetlands as areas that are inundated by surface water or groundwater "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." The guidelines for determining which areas meet this definition, called "delineation criteria," have been under debate.

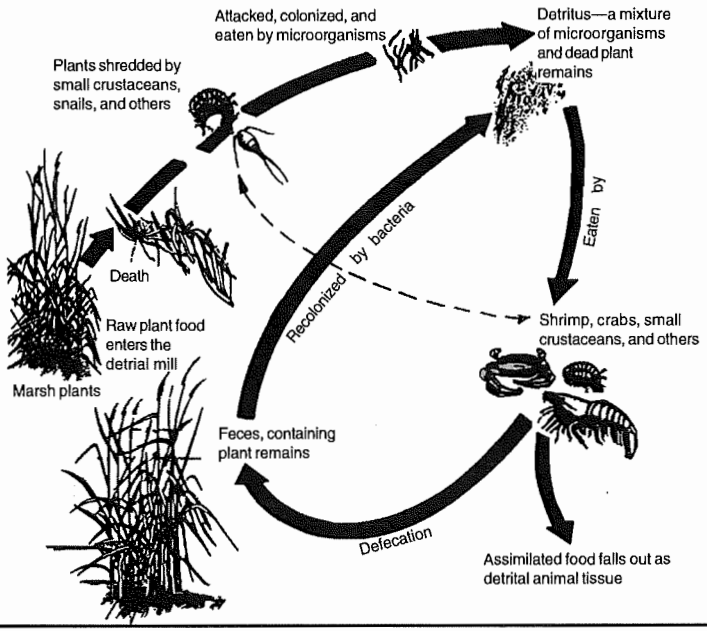
In 1987, the USACE issued a manual for identifying and delineating wetlands to provide regulators, landowners, and others with guidelines and methods to determine whether an area is a wetland for the purposes of carrying out the Clean Water Act (CWA) section 404 permit program (see chapter 5). The USACE is responsible for regulating the discharge of dredge and fill materials into U.S. waters, including wetlands. The USACE manual presents technical guidelines for identifying wetlands and distinguishing them from aquatic habitats and other nonwetlands. It also provides methods and supporting documentation for applying technical guidelines.

In 1989 and again in 1991, USACE, the U.S. Environmental Protection Agency (EPA), the Fish and Wildlife Service, and the Natural Resources Conservation Service attempted to revise the 1987 manual used to identify wetlands. The two revised manuals use the same three parameters as the original manual—soils, vegetation, and hydrology—to delineate wetlands, but differ in how they assess those parameters. For example, the 1989 manual required an inundation, or elevated water table, within 6 to 18 inches of the surface for seven consecutive days during the growing season, while the 1987 manual required inundation within major portions of the root zone during the growing season. For now, all the federal agencies have agreed to use the 1987 manual to provide greater federal consistency to delineate wetlands.

Wetlands provide habitat for a wide variety of fish and wildlife. Coastal wetlands are especially important habitats for estuarine and marine fish and shellfish, various waterfowl, shore birds, wading birds, and mammals. Approximately 35 percent of all federally listed rare and endangered animal species either live in or depend on wetlands. The EPA has estimated that Gulf of Mexico coastal wetlands serve as essential habitat for 75 percent of U.S. migrating waterfowl. Wetlands are among the world's most productive ecosystems (often more productive than artificial agricultural systems), producing great volumes of organic matter that forms the base of the aquatic food chain (see figure 3). Although many commercial and game fish rely on nearshore and coastal waters, many others, including two-thirds of commercial fish and shellfish on the Atlantic seaboard, use coastal marshes and estuaries as nursery or spawning grounds. Because they form the transition zone between terrestrial and aquatic systems, wetlands are highly diverse in animal and vegetative composition, a highly desirable trait ecologically.

Wetlands also provide a number of useful services, depending on their type, location, and geographical factors. According to the National Wetlands Policy Forum, wetlands also serve the following functions:

Figure 3
Marsh Grasses Support the Food Web



Source: Watzin and Gosselink 1992

- ***Flood Conveyance.*** Wetlands help mitigate the severity of floods, storing water during floods and releasing it gradually to downstream areas, thereby helping to reduce flood peaks. By reducing the velocity of flood waters, wetlands help reduce erosion.
- ***Barriers to Waves and Erosion.*** Coastal wetlands help reduce the effects of storm tides and waves, helping to protect adjacent upland areas. Wetlands vegetation also helps protect shorelines from erosion. In addition, because they often are located between rivers and high ground, estuarine wetlands buffer shorelands against erosion.
- ***Water Quality, Quantity, Supply.*** Wetlands are a source of groundwater and surface water recharge. They help to purify streams, lakes, and coastal waters by filtering urban and agricultural runoff and trapping sediments that otherwise could harm aquatic life.

- ***Recreational, Educational, Commercial Services.*** Wetlands are popular sites for fishing, hunting, hiking, boating, and wildlife observation. They provide unique educational opportunities for nature and scientific observation and study. They also provide an important source of commercial timber, of marsh grasses, and of food plants such as cranberries.

The National Wetlands Policy Forum has recommended an interim national wetlands goal of "no overall net loss of the nation's remaining wetlands base," with a long-term goal of increasing "the quantity and quality of the nation's wetlands resource base."

The group emphasized that its recommendation

> does not imply that individual wetlands will in every instance be untouchable or that the no net loss standard should be applied on an individual permit basis—only that the nation's overall wetlands base reach equilibrium between losses and gains in the short run and increase in the long run.

The "no net loss" goal is unrealistic "without initiating active programs of wetlands restoration and creation," the group said in its final report. In October 1997, Vice President Gore asked the federal agencies to form a "net gain" strategy that would create as many as 100,000 acres of wetlands by 2005. The Department of Agriculture's Buffer Initiative will be the basis for achieving 2 million miles of riparian buffer strips to protect waters from agricultural runoff by 2002.

Two approaches to the "no net loss" policy involve sequencing and mitigation banking. Once a wetland is identified as warranting regulatory protection, regulators use a series of sequential steps, or "gates," through which a wetlands development proposal must pass: (1) avoid development in the wetland to the extent practicable,

(2) minimize the areas or extent of degradation of the wetland, and finally, (3) require compensation for wetlands impacts that cannot be avoided or minimized. This concept of sequencing is designed to ensure that, where appropriate, alternatives to wetlands development are considered and losses are fully offset.

Mitigation banking involves restoring, enhancing, or creating wetlands to specifically compensate for future, unavoidable losses. Compensation for multiple projects is consolidated into a single site, where units of restored or created wetlands become "credits." The accumulated credits subsequently can be "withdrawn" to offset debits at the project site.

In practice, the concept is somewhat akin to the kinds of "offsets" or "banking" strategies used in emissions control programs—allowing emissions from this source as long as they are more than offset by emission reductions elsewhere. In November 1995, federal agencies issued guidance promoting the establishment and appropriate use of mitigation banks within federal wetlands programs. To date, approximately 200 wetlands mitigation banks, in virtually every state, are either in use or under development. However, the long-term viability of mitigation banking has not yet been demonstrated as an effective program to stem wetland losses.

Commercial Uses

More than 110 million metric tons of fish and shellfish are harvested worldwide annually. Sixty percent of the world's population receive more than 40 percent of their animal protein from fish. The sea provides the entire annual protein supply for 1 billion people, according to the United Nations Food and Agriculture Organization.

World fish landings, or the quantities of fish, shellfish, and other aquatic plants and animals brought ashore and sold, were 113 million metric tons in 1995, an increase of 2.4 million metric tons from 1994. China was the leading nation in fish landings,

with 21.6 percent of the total catch, and the United States was fifth, with 5 percent.

Though Americans have typically consumed less seafood per capita than inhabitants of most other industrialized countries, they are eating more seafood than in the past. The U.S. annual per capita consumption of commercially caught fish and shellfish has risen slowly from 11.8 pounds in 1970 to approximately 15 pounds each year since 1990. Of the 14.8 pounds per capita consumed in 1996, about 60 percent was fresh and frozen fish, 30 percent canned fish, and about 2 percent cured fish.

National fishery statistics are compiled annually by the Fisheries Statistics Division of the National Marine Fisheries Service and published annually in *Fisheries of the United States*. The report is available on the World Wide Web at http://kingfish.ssp.nmfs.gov. This document includes information on commercial and recreational fisheries of the United States and foreign catches in its EEZ. Information is broken down by species, geographic location, fishing effort, employment, and other criteria.

Table 3 lists the top commercial fish according to quantity and value. According to the 1996 edition of *Fisheries of the United States*, commercial landings by U.S. fishers at U.S. ports were 9.6 billion pounds (4.3 million metric tons) in 1996 (7.5 billion pounds of edible fish and 2.1 billion pounds of industrial fish). This total represents a decrease of 222.7 million pounds (2 percent) from the 1995 total. Landings that decreased from 1995 to 1996 were Pacific hake, menhaden, pollock, and pink and red salmon.

Aquaculture, or fish farming, is a potentially enormous industry. Growing oysters, mussels, shrimp, and other seafood for human consumption is already a large industry in some coastal nations, with a practical potential to match the present world fisheries harvest. Among the major species raised are salmon, catfish, clams, oysters, crawfish, prawns, shrimp, and abalone. According to the National Oceanic and Atmospheric Administration (NOAA), 77 million pounds (meat weight) of shellfish were harvested from U.S. waters in 1995, with a dockside value of $200 million.

Table 3 Rankings for U.S. Commercial Fish Landings, 1996	
According to Quantity	**According to Value**
1. Alaska pollock (single species)	1. Shrimp
2. Menhaden	2. Crab
3. Salmon	3. Salmon
4. Cod	4. Lobster
5. Hake	5. Alaska pollock
6. Flounder	6. Flounder
7. Crab	7. Cod

Source: National Oceanic and Atmospheric Administration 1997

Aquaculture, however, has the potential to harm the marine environment by introducing polluting wastes into marine waters, according to a 1997 Environmental Defense Fund report. Additional concerns about aquaculture include nutrient overenrichment and other habitat degradation and risks to wild stocks. The major fears for wild stocks are the introduction of exotic diseases and parasites, an inability to distinguish between cultured and wild forms of the same species, and potential interbreeding and replacement of wild stocks by escaped cultured species.

Small-scale, but encouraging, projects combine various land/water systems for sewage treatment, algae production, and mariculture (the cultivation of marine and brackish-water organisms in their natural environment). Woods Hole Oceanographic Institution scientist John Ryther has calculated that a 50-acre algae farm and a 1-acre production facility could produce 1 million pounds of shellfish per year by using effluents from a town of 11,000 people. Some argue that there are problems with these combination programs, such as discharge that may be contaminated with pathogens and heavy metals.

Fisheries continue to grow in importance, both economically and as a food source. Many historically rich fisheries, however, have been virtually depleted, among them the once plentiful New England groundfish. Overfishing, combined with other factors such as pollution, habitat degradation, and bycatch (fish and other marine life incidentally caught) waste, has left many fisheries on

Additional Resources

Statistics on fisheries are available from these organizations.

National

NOAA, National Marine Fisheries Service, Fisheries Statistics and Economics Division (F/ST1)
1315 East West Highway, Room 12339
Silver Spring, MD 20910
(301) 713-2328,
http://remora.ssp.nmfs.gov

International

United Nations Food and Agriculture Organization (FAO)
2175 K Street, NW, Suite 300
Washington, DC 20037
(202) 653-2400
http://www.fao.org

General

Center for Marine Conservation
1725 DeSales Street, NW
Washington, DC 20036
(202) 429-5609
http://www.cmc-ocean.org

the verge of collapse. In the Chesapeake Bay, the once thriving oyster fishery may disappear, striped bass fishing has been highly regulated and in some instances banned, and the once abundant shad are scarce. Programs to bring back striped bass and shad are meeting with some success. In the Great Lakes, many species such as lake trout and sturgeon have virtually disappeared or are under state fishing bans because they contain high levels of toxic contaminants. Elsewhere in the United States, salmon cannot swim past dams to spawn upstream in many rivers. Several species have been officially listed as endangered as a result of habitat degradation or destruction and hydroelectric dams. Chapter 4 includes statistics on overfishing.

Shipping, Ports, and Harbors

The U.S. Maritime Administration (MARAD), a branch of the Department of Transportation, compiles statistics and economic information about shipping. The USACE generates waterborne commerce statistics. According to MARAD, 364 privately owned, deep-draft vessels made up the U.S. Merchant Marine fleet as of 1 April 1997. Of these ships, 296 were ocean-going ships and 68 were Great Lakes vessels. The privately owned American-flag merchant fleet ranked eleventh in the world on a dead weight tonnage basis and fifteenth in total number of ships in 1997. The largest fleets by far are Panamanian- and Liberian-flagged ships, followed by ships registered in Greece, Cyprus, and the Bahamas. The flag does not necessarily determine the owner or operator of the ship. While all U.S.-flagged ships are U.S.-owned, many foreign-flagged ships may also be owned or controlled by U.S. companies or individuals.

MARAD estimates that as of 1 January 1997, 34,591 people were employed in commercial shipyards in the United States. Clerks, checkers, and allied craftspeople, collectively listed as "longshoremen," accounted for another 22,894 jobs.

Petroleum products and coal accounted for more than 50 percent of the tonnage of U.S. waterborne commerce. Table 4 lists the top 10 U.S. ports by total waterborne commerce. General cargo (countable items as opposed to bulk cargo) accounts for only 10 percent of U.S. foreign waterborne tonnage. However, general cargo commodities are higher in value, produce more revenue, and have a greater economic effect per ton than bulk

Additional Resources

For statistical and economic information on shipping, contact the U.S. Maritime Administration, Department of Transportation, 400 Seventh Street, SW, Room 7219, Washington, DC 20590 (202) 366-5812.

The administration's World Wide Web site is http://marad.dot.gov.

Table 4 Top 10 U.S. Ports, 1994 (ranked by tonnage of freight handled)	
Port	**Total (metric tons)**
Port of South Louisiana	167,697,405
Houston, Texas	130,327,860
New York/New Jersey	114,395,955
Baton Rouge, Louisiana	78,240,516
Valdez, Alaska	77,197,549
Corpus Christi, Texas	70,885,650
New Orleans, Louisiana	66,526,176
Port of Plaquemine, Louisiana	58,747,729
Long Beach, California	51,275,779
Tampa, Florida	47,084,629

Source: Maritime Administration 1996

goods such as coal and oil. Table 4 shows the 1994 top 10 U.S. ports ranked by tonnage of freight handled.

The Great Lakes and connecting waterways have also played a major role in U.S. and Canadian transportation. Beginning about 1825, the Erie Canal primarily carried settlers westward and freight eastward. When the Welland Canal joined Lake Erie and Lake Ontario and other canals joined the Ohio and Mississippi Rivers, the Great Lakes became the hub of transportation in eastern North America. With the completion of the St. Lawrence Seaway in 1959, ocean-going vessels were able to navigate the Great Lakes. Competition from trains and trucks, however, has prevented the expansion of Great Lakes shipping as much as had been expected, and the fleet is continuously being reduced.

Recreational Uses

Americans increasingly visit beaches and coastal resorts to enjoy recreational activities such as fishing, boating, sunbathing, snorkeling, scuba diving, surfing, and swimming. According to Gallup Organization polls, fishing has consistently been among the public's three leading sports since Gallup began collecting

such data 30 years ago. Recreational fishery statistics, however, are not collected in as much detail as commercial statistics. The real economic values in sport or recreational fishing can be found in money spent on fishing-related products and services (e.g., transportation, fuel, tackle, lodging, charter boat fees, food, gear, magazines) rather than in dollars generated by selling fish. The nonmonetary values are the pleasures derived from the sport and from the consumption of the fish.

The National Marine Manufacturers Association (NMMA) is an industry trade group that researches and publishes boating data. The NMMA reported that in 1996, 320,850 new boats came into use throughout the United States, bringing the country's recreational boat population to more than 15.8 million. In addition, approximately 77.7 million recreational boaters in 1996 spent a total of $17.7 billion on related products and services.

Because public policy decisions about the coasts and oceans must take recreation and tourism into account, the U.S. Department of Agriculture's Forest Service and NOAA undertook the National Coastal Recreation Inventory Project (NCRIP) to learn more about coastal recreation. In a 1989 report, NCRIP stated that

Additional Resources

- U.S. Department of Commerce, *NOAA Strategic Plan: A Vision for 2005*, May 1996, http://www.noaa.gov
- NOAA, National Ocean Service, *50 Years of Population Change Along the Nation's Coasts: 1960-2010*, 1990, http://www-orca.nos.noaa.gov/info_access/orca_infoaccess.html
- NOAA, National Ocean Service, *Estuaries of the United States: Vital Statistics of a Natural Resource Base*, http://www-orca.nos.noaa.gov/info_access/orca_infoaccess.html

Many other NOAA publications are available online and may be accessed through the NOAA Central Library home page at http://www.lib. noaa.gov. The home page provides a link to NOAA's "Wind and Sea" Internet finder. The reference desk may also be contacted at (301) 713-2600, extension 124.

"coastal outdoor recreation opportunities will become a major factor in land-use and resource allocation decisions into the 21st century."

The NCRIP report pointed to the need to develop an increased understanding of issues surrounding coastal recreation: "How great are the recreational values of the nation's coastal areas, what are their characteristics, and how should public policy consider them? Existing information is inadequate to resolve these issues."

Current NOAA estimates concerning the recreational uses of U.S. coastal areas include the following:

- Approximately 94 million people boat and fish annually.
- The average American spends 10 recreational days on the coast each year.
- The coasts (excluding the Great Lakes coastline) support 25,500 recreational facilities.
- More than 180 million Americans visited ocean and bay beaches in 1993.
- Recreational fishing contributes $13.5 billion annually to the U.S. economy.
- Coastal recreation and tourism generate $8 to $12 billion annually.

Coastal tourism, like the coastal population, has grown tremendously and will continue to grow. The second-largest, fastest-growing industry in Hawaii is marine tourism. On a typical summer weekend, the beach population of California's Ventura, Los Angeles, and Orange counties is comparable to that of the seventh-largest city in the United States.

An April 1987 Office of Technology Assessment publication, *Wastes in Marine Environments*, discussed a National Park Service study showing that Park Service "lands that include marine waters recorded more than 60 million recreational visits in 1985; over 25 million of these were recorded at National Seashores."

Recreational use of the coasts, however, comes at a price. The USACE reported in 1996 that from 1950 to 1996 the federal government spent $440 million to maintain and replenish beaches. Because of these expenses, the future of the USACE shoreline protection program is currently being debated.

Waste Disposal

In addition to supplying living and nonliving resources and meeting transportation and recreation needs, coastal waters long have been used for disposing of sewage treatment effluent (liquid) and sludge (semiliquid), dredged materials, and industrial wastes. Marine bodies have a great capacity to assimilate certain wastes, but this capacity is neither uniform nor unlimited. Improper disposal practices can harm coastal and marine resources.

In 1989, about 10 percent of all sewage sludge produced in the United States was disposed of into the ocean from vessels or through pipelines, according to David Bulloch in *The Wasted Ocean*. Today, ocean dumping of sewage sludge and industrial waste from vessels is prohibited by U.S. law, as is the discharge of sewage sludge from pipes into the ocean. The discharge of sewage effluent and industrial waste from pipes is regulated under the CWA.

According to *Ebb Tide for Pollution*, a 1989 Natural Resources Defense Council report, U.S. factories dispose of more than 5 trillion gallons of wastewater and 2.3 trillion gallons of sewage annually into coastal waters.

Nonpoint source pollution, such as urban and agricultural runoff, also can affect coastal environments. Another Natural Resources Defense Council report, *Testing the Waters*, estimates more than 2,600 beach closings or advisories were issued for swimming in 1996 (see chapter 4, table 5). High levels of bacteria, primarily from sewage effluent, caused the majority of closures and advisories.

Dredged materials from harbors and channels—clean sand and gravel or muck that may be contaminated with heavy metals and oil—are often disposed of in diked disposal areas or in a limited number of ocean disposal sites. The USACE disposes of about 300 to 350 million cubic yards of dredged material per year; 90 to 95 percent is categorized as clean (i.e., free from contamination) and can be used beneficially for projects such as creating wetlands, replenishing beaches, and enhancing habitat. The remaining amount is disposed of by using special management techniques intended to minimize or eliminate potential adverse effects. Dredged material disposal is subject to permitting and regulation under the Marine Protection, Research and Sanctuaries Act (for ocean waters) or the CWA (for internal waters, such as the Great Lakes and estuaries).

The variety of resources in coastal areas can create much pressure for conflicting uses of those resources. Chapter 4 offers additional statistical information and discusses some of the coastal and ocean issues resulting from these pressures.

Chapter 4
Major Coastal and Marine Resource Issues

Highlights

- Half of the nearly 269 million people living in the United States live in coastal counties, which represent some 10 percent of the continental United States.
- The primary sources of direct discharges into marine waters are dredged material, municipal sewage sludge, and industrial wastes.
- Nationally, the primary nonpoint sources of water pollution involve urban runoff and agricultural activities.
- The 48 contiguous states lost 52 percent of their original inland and coastal wetlands between the 1780s and the 1980s. In 1995, 46 percent of original wetlands remained.
- Increasing population, development, and conflicting natural resource policies have left coastal areas vulnerable to natural and human-made hazards—coastal storms, chronic erosion, and potential sea-level rise among them.

Major issues that often face coastal management programs include population, pollution, habitat loss, coastal hazards, marine/beach debris, oil spills, global climate change, overfishing, loss of biological diversity, and nonindigenous or "nuisance" species. Each of these topics is covered in this chapter.

Population

The number of people living in coastal areas, and their associated use of resources, has a tremendous effect on coastal areas. In 1997, 5.9 billion people inhabited the Earth, and that number is expected to rise to 9.3 billion by 2050. Nearly 269 million people live in the United States, and almost 50 percent live in coastal counties, which represent some 10 percent of the contiguous United States. At 341 persons per square mile, the average population density is more than four times greater in coastal counties than in noncoastal counties. According to the National Oceanic and Atmospheric Administration (NOAA), the coastal population is expected to climb significantly in the next decade.

Heavy population densities are by no means limited to the Atlantic and Pacific seaboards. The Great Lakes basin is home to more than one-tenth of the U.S. population and one-fourth of Canada's population. Nearly 25 percent of Canadian agricultural production and 7 percent of U.S. agricultural production are located in the Great Lakes basin.

Increasing populations in coastal areas naturally demand more housing, transportation, commercial services, freshwater, and energy. These populations inevitably generate larger quantities of solid waste and place growing demands on community services, such as waste disposal and sewage treatment. These demands, alone and combined, challenge those who manage coastal resources.

Coastal population growth leads to increased land development, which also adds to pressures on wetlands, coastal forests, and other coastal resources. Land development, such as the construction of roads, parking lots, and buildings, reduces the amount of surface area that allows water to penetrate the ground and increases the amount of runoff from an area. Urban runoff can contain contaminants such as oils, greases, metals, and bacteria.

Reducing permeable surface areas also reduces groundwater recharge capacities. This situation leads to an increased potential

for flooding and increases the seriousness of flooding when it occurs. Construction also can lead to increased erosion. The larger volumes of topsoil deposited in riverbeds, delta lands, and behind dams can increase flooding potential; impede power generation; reduce reservoir storage capacities; and lead to unexpected, and possibly undesirable, alterations in stream or river flows.

Pollution

Point Sources

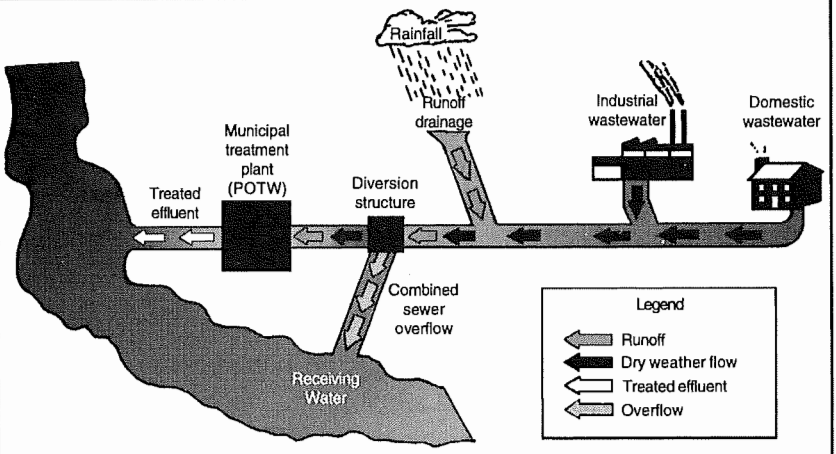
In the United States, approximately 2,000 sewage treatment plants and industrial facilities discharge effluent, treated to various extents, directly to estuaries and other coastal waters. Most sewage in the United States is treated to meet secondary treatment standards prior to disposal. The Clean Water Act (CWA) regulates discharges to marine waters under section 301(h) and requires that permits be issued for pipeline discharges from coastal municipalities and industrial facilities. Industrial and municipal discharges are regulated through a permitting system under the CWA's National Pollutant Discharge Elimination System (see chapter 5). Permits establish pollution limits and specify monitoring and reporting requirements.

More than four out of every ten gallons of water used in the United States are used for industrial purposes. Typically, about 20 percent of water used by the industry is used in the finished product; the remainder is treated and discharged back to coastal and inland waters.

Municipal discharges come from publicly owned treatment works that discharge into surface waters. About 2.3 trillion gallons of effluent are discharged from sewage treatment facilities into surface waters annually.

In some areas during heavy rains, the contents of storm sewers and sanitary sewers combine, bypassing the sewage treatment facilities and going directly into coastal and inland waters (see figure 4). Combined sewers are no longer constructed but are still

Figure 4
Typical Combined Sewer Collection Network during a Storm



Note: During a storm event, flow beyond the capacity of the treatment facility is diverted.

Source: Office of Technology Assessment 1987

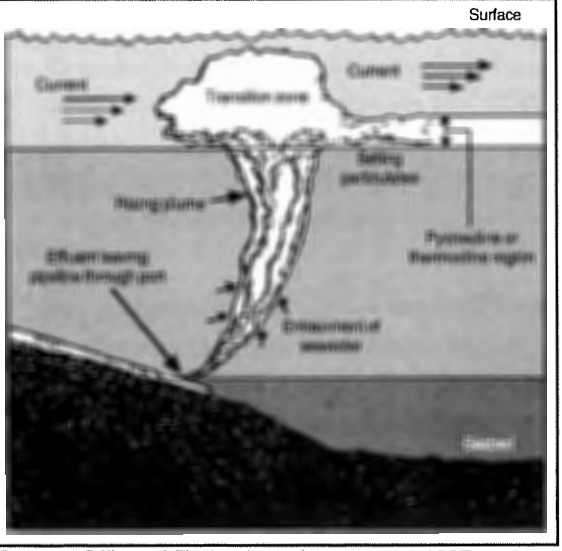
in operation in many older urban areas. In April 1994, the Environmental Protection Agency (EPA) issued a policy to control combined sewer overflows. The policy calls for communities to take immediate and long-term actions to address overflow problems. Measures specified in the policy include proper operation and regular maintenance of sewer systems and combined sewer overflows, as well as public notice in the event of overflows.

Regulation of ocean dumping began with passage of the Marine Protection, Research, and Sanctuaries Act (MPRSA) in 1972. Ocean dumping of municipal sewage sludges was phased out and ended in June 1992 under the Ocean Dumping Ban Act of 1988 (see chapter 5). MPRSA requires permits for disposal of dredged material into oceans. Figure 5 shows the general fate of effluent discharged into marine waters.

Nonpoint Sources

One- to two-thirds of the pollution in coastal waters originates from nonpoint sources, according to EPA. Nonpoint source pollution comes from many different sources and enters coastal

Figure 5
General Fate of Effluent Discharged into Marine Waters



Source: Office of Technology Assessment 1987

waters in several ways. For example, contaminants such as pesticides are picked up by rainwater as it washes over the land and drains into water bodies. Nonpoint source pollutants can enter water bodies through direct runoff, runoff through storm sewers and drains, wet or dry air deposition, and underground aquifers. Nonpoint sources of pollution include the following:

- Runoff from urban and suburban areas (oil, grease, lead, chromium, bacteria, lawn chemicals and fertilizers, and sediments)
- Runoff from farms (sediments, fertilizers, nutrients, and pesticides)
- Sedimentation and increased temperatures resulting from logging operations
- Sediment and toxic metals from construction sites and mining operations
- Atmospheric deposition of chemicals, heavy metals, nutrients, acid, and byproducts from fossil fuel combustion
- Other releases of pollutants (e.g., phenols from plastics, tributyltin leaching from ship hulls, and landfill leachates into groundwater and surface water)

Urban Runoff and Agricultural Activities. The primary sources of nonpoint source water pollution in the United States are urban runoff and agricultural activities. Pollutants include sediments from eroded or overgrazed lands, fertilizers, pesticides, and animal waste, which contains nutrients and bacteria. Excessive nutrients (forms of nitrogen and phosphorus) can be harmful to aquatic life because they stimulate the growth of algae and other plants and animals that may in turn deplete the supply of oxygen and trigger harmful algal blooms, red tides, and *Pfiesteria* outbreaks.

Various methods are being used to help reduce erosion, limit pesticide and fertilizer use, and reduce water contamination without decreasing agricultural productivity. The Natural Resources Conservation Service (NRCS), the EPA, and many state agencies are working to promote these methods and technologies, known as "best management practices," mostly on a voluntary basis.

Development can also contribute to nonpoint source pollution. Land cleared of trees and plants for development has a reduced capacity to absorb water, therefore producing more and faster-flowing runoff. Runoff from land development projects can carry sediment and toxic materials. Runoff also increases in urban areas where rain water channels off rooftops and pavement rather than soaking into the ground.

Atmospheric Deposition. Pollution can enter the water from the atmosphere either as precipitation or in dry form. This type of nonpoint source pollution is particularly problematic in lakes throughout the northern and northeastern United States and Canada, as well as estuaries along the Atlantic and Gulf Coasts.

In many cases, atmospherically deposited pollutants have travelled substantial distances by wind currents. For instance, dichlorodiphenyl trichloroethane (DDT), polychlorinated biphenyls (PCBs), and heavy metals were found in Great Lakes precipitation in 1971 and on a remote island in Lake Superior, according to studies done for and by EPA and the International Joint

Commission. In some cases, DDT-tainted deposition traveled south-to-north across the entire United States from Mexico and Central and South America. Numerous studies indicate that 80 percent of the toxic chemicals entering Lake Superior result from atmospheric deposition rather than from water discharges. Along the Gulf Coast in Tampa Bay, 28 percent of total nitrogen loading enters bay waters directly through dryfall or precipitation.

"Acid precipitation" is the term used to refer specifically to wet atmospheric deposition—rain or snow containing significant amounts of sulfuric and nitric acid or other pollutants. Major sources include emissions from the combustion of fossil fuels used for transportation and the generation of electrical power.

Other atmospheric pollutants that may be deposited on surface water include organic substances, nutrients, pesticides, heavy metals, and radioactive residue, according to *Population and Water Resources* (see "Excessive Nutrients and Eutrophication" in this chapter). The 1987 United States-Canada Great Lakes Water Quality Agreement contains specific provisions on airborne toxic pollutants in an effort to better understand and allow for improved management of this problem.

Reducing Nonpoint Source Pollution. Progress in reducing nonpoint source pollution can be slow because nonpoint sources are more numerous and more difficult to identify than point sources. Traditional regulatory approaches used for direct discharges are not easily applied to nonpoint sources of pollution. Nonpoint source pollution, for the most part, results from how the land is used, and land-use management traditionally has been a function of local governments, with agriculture in many cases exempt from local control.

In 1987, Congress amended the CWA in an attempt to address the dichotomy between point and nonpoint source controls. Under the amendments, all 50 states have conducted assessments and prepared management programs to address nonpoint source pollution under their jurisdictions. However, these management programs are not required to implement or enforce measures to

reduce nonpoint source pollution. In addition, Congress enacted the Coastal Zone Act Reauthorization Amendments of 1990, requiring states to develop coastal nonpoint source programs with regulatory mechanisms designed to reduce nonpoint source pollution of coastal waters.

Two general methods are used to reduce nonpoint source pollution: (1) reducing runoff by maintaining or increasing the ability of the land to retain water (e.g., decreasing disturbance of the land; increasing vegetation; protecting or restoring wetlands, soil, and nutrients; using natural channels and sedimentation ponds) and (2) minimizing the use of contaminating pollutants through product substitution or encouraging increased recycling and reuse of products (e.g., recycling used motor oil, better managing and controlling the application of pesticides and fertilizers).

Chemicals and Other Substances

Chemicals, pathogens, nutrients, and thermal pollution can affect marine ecosystems in different ways. Some examples of chemical and other toxic pollution in marine environments follow:

- Methyl mercury, a highly toxic form of mercury, has been found in large predatory fish, such as swordfish and tuna.
- Human carcinogens such as polycyclic aromatic hydrocarbons, petroleum hydrocarbons, dioxins, and PCBs have been found in seafood, leading to fishing bans in a number of cases.
- Forty-seven states, the District of Columbia, and the U.S. territory of American Samoa have issued consumption advisories for fish, bringing the United States advisory total to 2,193 in 1996. This is an increase of 26 percent from 1995 figures. The 1996 advisory listing applies to 100 percent of the Great Lakes waters and their connecting waters.
- In some areas, fish and shellfish have developed physiological and genetic defects, such as tumors in fish and chemical burns on lobster and crab shells.

- Areas on all of the U.S. coasts have been designated as Superfund sites because of high levels of water and sediment contamination.
- While PCB levels in the Hudson River have declined in recent years, striped bass from the Hudson are still considered unfit for human consumption because of PCB contamination.

Fish Advisories Online

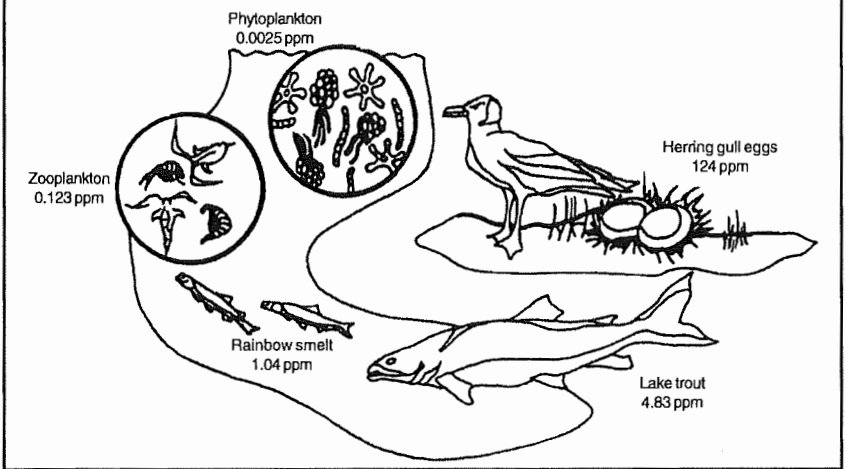
EPA's national listing of fish consumption advisories is available online at http://www.epa.gov/ost/fishadvice.

Chemicals. Chemical pollutants can threaten human and ecological health either directly or through bioaccumulation in and up the food chain. Certain chemicals can be particularly harmful—many pose risks even at very low concentrations and can remain potentially dangerous for long periods of time while they bioaccumulate in animal or human tissue.

According to data from the 1995 Toxics Release Inventory (TRI), more than 136 million pounds of toxic chemicals were released into U.S. surface waters in 1995. These chemicals include heavy metals and organic chemicals, some of which can be acutely poisonous to humans at low levels of exposure. The pollutants can settle to the bottom of water bodies, creating "hot spots" of contamination. Concentrations of contaminants gather in bottom-dwelling animals that work their way through the food chain, ultimately leading to human exposures (see figure 6). Although the TRI list includes high production volume chemicals, the list is limited to some 600 commercial chemicals. In addition, small firms and many nonmanufacturers are exempt from TRI reporting requirements.

The most severe problems are found in nonmigratory, bottom-feeding fish located around discharge points near urban and industrial areas. Shellfish, including oysters, mussels, and clams, remain in the same location throughout much of their lives and are

Figure 6
Bioaccumulation



Persistent organic chemicals, such as PCBs, can bioaccumulate. This diagram shows the degree of concentration in each level of the Great Lakes aquatic foodchain for PCBs in parts per million (ppm). The highest levels are reached in the eggs of fish-eating birds, such as herring gulls.

Source: Environment Canada and the U.S. Environmental Protection Agency 1987

especially vulnerable to contamination from toxic metals such as lead, mercury, cadmium, and chromium. Also of concern are long-lived, top-of-the-chain species, such as bluefish.

More than 350 different chemicals find their way into the Great Lakes alone, including PCBs, DDT, chlordane, and dieldrin, according to *Great Lakes, Great Legacy* published by the Conservation Foundation's Institute for Research on Public Policy. In 1990, EPA and Congress's General Accounting Office calculated that permitted industries alone were discharging 7.3 million gallons of oil and grease, 89,000 pounds of lead, 933 pounds of mercury, and 1,935 pounds of PCBs into the Great Lakes each year. The International Joint Commission (IJC) has identified 43 toxic hot spots in the Great Lakes. While paper mills built along the shores and tributaries of the Great Lakes have greatly reduced their discharges, they remain primary sources of mercury pollution.

Pathogens. Pathogens—substances that cause disease—can also contaminate fish and shellfish. The number of cases of illness linked to eating contaminated fish and shellfish remains a concern. The Centers for Disease Control and Prevention (CDC) documented 679 cases of shellfish-associated disease from 1988 through 1992. Many cases were caused by bacteria, resulting in intestinal irritation and illness. (Note that CDC surveillance data is typically underreported.)

Human exposures can occur not only from eating contaminated shellfish, but also from swimming or engaging in water contact sports in contaminated water bodies. High levels of bacteria in waters at various times have led to beach closures, particularly along the North Atlantic coast and the Great Lakes. Beach closures can be a community's worst economic nightmare when they occur during a prime tourist season. Table 5 shows the number of ocean and bay beach closures and advisories from 1992 through 1996, according to the Natural Resources Defense Council.

Pathogens can come from agriculture and urban runoff, malfunctioning septic tanks or sewage plants, or combined storm/sanitary sewer overflows that bypass treatment during storms. Overboard discharges from small or recreational boat toilets can also introduce pathogens into the waterways.

Sewage treatment plants built and upgraded with grants under the CWA have significantly improved the situation in many areas, including the Great Lakes and Chesapeake Bay. Journalist Tom Horton, author of *Turning the Tide*, reports that far fewer areas are closed to swimming than would have been the case without these improvements.

Excessive Nutrients and Eutrophication. Excessive nutrients also can threaten the coastal environment. These nutrients, primarily nitrogen and phosphorus, come mostly from agricultural and urban runoff, as well as sewage treatment plants. Soil erosion contributes to nutrient enrichment because some nutrients, such as phosphorus, attach to soil particles washed into the water. Nitrogen is water soluble, so it can reach groundwater that discharges to coastal

Table 5
Ocean, Bay, and Great Lakes Beach Closings and Advisories 1992–1996

State	1992	1993	1994	1995	1996	Notes
AL	—	—	—	—	—	No regular monitoring of ocean or bay beaches for swimmer safety
CA	609 +1 (p) +1 (e)	1,397[a] +2 (p) +2 (e)	at least 910 +6 (p) +2 (e)	at least 1,305 +11 (p) +3 (e)	at least 1054 +9 (p) +7 (e)	Limited monitoring of ocean/bay beaches for swimmer safety
CT	at least 223	at least 174	at least 156 +1 (e)	at least 251 +1 (e)	at least 196 +2 (e)	
DE	5	0	0	0	16	
FL	773[b] +1 (e)	101[c] + 1 (e)	at least 215	at least 830[d]	at least 174 +1 (p) +2 (e)	Limited monitoring of ocean/bay beaches for swimmer safety
GA	—	—	—	—	—	No regular monitoring of ocean/bay beaches for swimmer safety
HI	29	6	22	16	70	Limited monitoring of ocean/bay beaches for swimmer safety
IL	*	73	36	55	66	
IN	*	at least 30	36	14	34	
LA	1 (p)	1 (p)	1 (p)	1 (p)	1 (p)	No regular monitoring of ocean/bay beaches for swimmer safety (since 1988)
ME	at least 3 (p)	35 +3 (p)	at least 15 +3 (p)	at least 10 +3 (p)	at least 20 +3 (p)	Limited monitoring of ocean/bay beaches for swimmer safety
MD	at least 6 +3 (p) +2 (e)	at least 106 +3 (p) +1 (e)	82 +3 (p)	200 +3 (e)	at least 241 +3 (p)	Limited monitoring of ocean/bay beaches for swimmer safety
MA	at least 60	at least 61	at least 58 +1 (e)	at least 132 +1 (p)	at least 152 +2 (p)	Limited monitoring of ocean/bay beaches for swimmer safety
MI	*	*	26 +2 (p) +3 (e)	96 +3 (e)	at least 18 +2 (e)	Limited monitoring of Great Lakes beaches for swimmer safety
MN	*	0	0	0	0	Limited monitoring of Great Lakes beaches for swimmer safety
MS	—	—	—	—	—	No regular monitoring of ocean/bay beaches for swimmer safety (since 1989)
NH	0	0	0	0	0	

Table 5
Ocean, Bay, and Great Lakes Beach Closings and Advisories 1992–1996

State	1992	1993	1994	1995	1996	Notes
NJ	112	88	238	86	87	
NY	799[e] +1 (e)	at least 212[f] +1 (e)	227 +1 (e) +24 days restricted use	283 +3 (e)	219 +4 (e)	Limited monitoring of Great Lakes beaches for swimmer safety
NC	—	—	—	—	—	No regular monitoring of ocean/bay beaches for swimmer safety
OH	*	0	96	262 +3 (e)	119	
OR	—	—	—	—	—	No regular monitoring of ocean/bay beaches for swimmer safety
PA	*	19	14	10	6	Limited monitoring of Great Lakes beaches for swimmer safety
RI	0	0	0	0	0	Limited monitoring of ocean/bay beaches for swimmer safety
SC	—	—	—	—	—	No regular monitoring of ocean/bay beaches for swimmer safety
TX	1 medical advisory	42	0	0	0	Limited monitoring of ocean/bay beaches for swimmer safety (one local program)
VA	0	0	0	0	0	Limited monitoring of ocean/bay beaches for swimmer safety
WA	—	—	—	—	—	No regular monitoring of ocean/bay beaches for swimmer safety
WI	*	94	148	114 +1(e)	at least 120	Limited monitoring of Great Lakes beaches for swimmer safety

* No data were gathered by NRDC for this year.
(p) Permanent beach closure (12 or more weeks)
(e) Extended beach closure (6 to 12 weeks)
[a] This increase appears to result from 700 San Diego County closings/advisories because of heavy winter storms.
[b] Does not include closings due to Hurricane Andrew.
[c] The decrease in the number of Florida closings/advisories appears to result from significantly less rainfall in 1993 compared with 1992, particularly in Pasco and Dade Counties.
[d] Includes 465 closings due to Hurricane Opal.
[e] Included in this total are 706 rainfall advisories issued in New York City.
[f] The decrease in New York closings/advisories appears to result from less rainfall in 1993 compared with 1992 and a change in New York City's standing rainfall advisory, which covered fewer beaches for a shorter period of time.

Note: NRDC counts every day of an advisory/closure as one "beach closing." Because of inconsistencies in monitoring and closing practices, comparisons between states and trends over time based on this data are difficult to compile.

Source: Natural Resources Defense Council (NRDC) 1997

environments. When this occurs, control measures are costly and time consuming.

Eutrophication is caused by an overabundance of nutrients, particularly nitrogen and phosphorus. The excessive amounts of nutrients lead to the growth of microscopic algae that decrease water clarity and, upon decay, deplete the oxygen dissolved in the water. Decreased water clarity can lead to the loss of seagrasses. Oxygen depletion may kill or restrict the growth of fish, shellfish, and other marine organisms (see "hypoxia" in this chapter). Eutrophication may also cause blooms of algae, known as "red tides" or "brown tides" (see "*Pfiesteria*" in the next section), which discolor the water or produce toxins that are harmful to marine organisms or humans.

In the Great Lakes basin, primary sewage treatment plants, phosphate detergents, industrial discharges of nitrogen and phosphorus, and fertilizers in runoff from farmlands have contributed to eutrophication in Lake Erie and Lake Ontario, as well as in the bays of Lake Huron and Lake Michigan. The overgrowth of algae, and resulting depletion of oxygen in the lakes, has killed numerous native fish species. At the same time, it has brought about an increase in more pollution-tolerant types of fish, shifting the balance of the lakes' ecosystems.

In 1972, Lake Erie was thought to be "dying" as a result of eutrophic conditions. The solution was to reduce incoming phosphate load. Phosphorus was found not only in agricultural runoff, but also in sewage treatment plant effluents, in discharges from factories located along the shores and tributaries, and household laundry detergents. Regulations, funding, and a concerted international effort since that time have significantly reduced Lake Erie's phosphate levels, and the area of eutrophication has stabilized. Construction of secondary treatment plants has slowed algae growth and reduced sewage and seaweed on the beaches, but the dead zone remains.

Excessive nutrients are particularly harmful to coral reef ecosystems found in southern waters such as those off the Florida

Keys and the Gulf of Mexico. Algae can smother the corals and reduce the strength of their calcium carbonate skeletons, which can be fatal to the coral.

Pfiesteria. In the early 1990s, North Carolina State University research botanist JoAnn Burkholder identified *Pfiesteria* as a potential cause of fish kills in North Carolina that began in 1991. In 1997, *Pfiesteria piscidida* began attracting national attention as a result of several outbreaks of fish lesions and fish kills in a number of tributaries to the Chesapeake Bay.

Pfiesteria is a toxic, single-celled marine organism classified as a dinoflagellate. Although neither plant nor animal, dinoflagellates are typically referred to as "algae" or "algae-like." The organisms that cause red tides are also dinoflagellates. Proliferations of these and similar organisms are sometimes called "harmful algal blooms."

Current research indicates that warm, shallow, calm, brackish water; the presence of large schools of fish; and high nutrient levels work together to trigger *Pfiesteria* to bloom in a form that produces toxins. These toxins in turn may cause ulcer-like lesions on fish and result in fish kills. Toxic *Pfiesteria* blooms tend to occur between late spring and early fall and last for only very short periods of time—often only a few hours.

NOAA and EPA are leading a national effort, coordinated with state and academic scientists, to develop short- and long-term research strategies on *Pfiesteria* and other harmful algal blooms. Although there is widespread belief that *Pfiesteria,* or a *Pfiesteria*-like organism, is responsible for fish kills and lesions in several Chesapeake Bay tributaries and in North Carolina, research is still underway to establish a clear, causal relationship and to determine what is responsible for *Pfiesteria* blooms. High nitrogen and phosphorus levels have been implicated in toxic outbreaks of

Additional Resources

Information on *Pfiesteria* is available from EPA online:
http://www.epa.gov/owow/estuaries/pfiesteria/index.html

Pfiesteria (evidence suggests that high levels of these nutrients are associated with other harmful algal blooms). According to EPA, the three most significant sources of nutrient pollution are human waste from septic systems or sewage treatment plants, agricultural runoff from fertilizer or animal waste, and air deposition from such sources as utility plants and motor vehicles. Human health effects (such as skin lesions, memory loss, headaches, and dizziness) have also been reported as a result of exposure to *Pfiesteria*-contaminated water, and research in this area is in progress. Thus far, there have been no reports of human illness resulting from consumption of fish exposed to *Pfiesteria*.

Hypoxic Waters and the "Dead Zone"

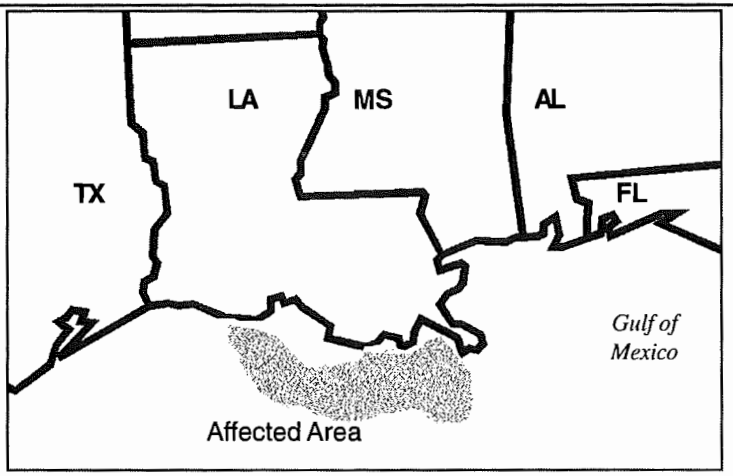
The terms "hypoxia" and "hypoxic waters" refer to waters with concentrations of less than two parts per million of dissolved oxygen, which is generally accepted as the minimum level required to support most animal life and reproduction. Oxygen depletion typically occurs in bottom waters, but can extend above them. Hypoxia is found in several large U.S. estuaries, including the Chesapeake Bay and Long Island Sound.

Hypoxic waters occur near the mouths of a number of large rivers around the world. An area in the northern Gulf of Mexico, on the inner continental shelf off the coast of Louisiana, constitutes one of the largest zones of oxygen-deficient bottom waters in the western Atlantic Ocean. According to EPA, this zone of hypoxic waters covers an area of up to 7,000 square miles during part of the year, mainly in the summer (see figure 7). This area of oxygen depletion is often called the "dead zone." From as early as February through as late as October, this zone may lack sufficient oxygen to support normal populations of fish and shellfish.

Additional Resources

Information from EPA's Office of Water and the Gulf of Mexico Program Office is available online: EPA at http://www.epa.gov/owow, and the Gulf of Mexico Program at http://pelican.gmpo.gov.

Figure 7
Hypoxic Waters in the Gulf of Mexico



Source: U.S. Department of Agriculture 1997

The causes of oxygen depletion in the northern Gulf of Mexico are complex, but current research identifies excess nutrients in the Mississippi River system as a contributing factor. A number of states along the Mississippi River add to its nutrient level through nitrogen and phosphorus runoff from fertilizers, animal manure, decaying plants, and other wastes. Other runoff sources include industrial and municipal point sources and air deposition. Appropriate levels of nutrients help water systems grow, but excess levels bolster the production of algae, creating algal blooms. As these blooms decompose, they consume nearly all the oxygen in the water.

Along the Gulf Coast the primary focus for addressing the hypoxia issue is on the importance of the nutrient contributions of the Mississippi and Atchafalya River systems. These rivers contribute 90 percent of the freshwater inflow to the Gulf of Mexico and drain the country's industrial and agricultural heartland. According to studies by the U.S. Geological Survey, concentrations of nitrates in water discharged to the Gulf have increased threefold since the 1960s. This increase in nutrient load appears to be related to the increase in the size of the hypoxia area.

Concern about the "dead zone" is both environmental and economic. Approximately 40 percent of U.S. fisheries landings, including a substantial part of the nation's most valuable fishery (shrimp), comes from this area. In 1995, the Sierra Club Legal Defense Fund (now Earthjustice), representing environmental and fishing organizations, petitioned EPA and Louisiana to address nonpoint source pollution in the Mississippi River.

According to New Orleans *Times-Picayune* reporter Mark Schleifstein in the 1997 Pulitzer Prize-winning series "Oceans of Trouble: The Dead Sea," solutions to the dead zone may be "simple ... but ... politically impossible." Among the potential solutions cited, some would likely require dramatic land-use changes in the Midwest:

- Creating a buffer of grass between fields and streams that will filter much of the nutrients before they reach the water
- Using farming methods that rely less on chemical fertilizers and pesticides, either through no-till farming or with new, satellite-based, computerized crop systems that measure the need for fertilizer more accurately
- Building wetlands at strategic points along the paths of agricultural runoff ditches to capture and treat fertilizer runoff

EPA's Office of Water is developing partnerships with the agricultural community and others to alleviate hypoxia. National efforts are headed up by EPA and the Gulf of Mexico Program Office, a consortium of five Gulf Coast states, the U.S. Department of Agriculture, numerous public and private organizations, and 18 federal agencies, whose purpose is to develop voluntary, incentive-based strategies for protecting the Gulf of Mexico ecosystem. The group is expanding to include representation from states and tribes in the Mississippi River watershed. The national strategy focuses on (1) improving the understanding and characterization of the problem, (2) reducing the inputs of nitrogen and

phosphorus to the surface water of the Mississippi River basin, and (3) developing efforts to prevent and reduce significant air and wastewater pollution sources.

Heated (Thermal) Water

Temperature is one of the most important environmental variables affecting aquatic life. Thermal pollution is the discharge of water sufficiently warm to harm aquatic life. If water temperatures rise too high, dissolved oxygen levels drop, directly threatening aquatic life and contributing to eutrophication. This process makes the water unusable for drinking and recreation, according to the National Audubon Society's *Population and Water Resources.*

Electric generating plants, which use large quantities of water for cooling, draw water from lakes, rivers, or the ocean and pump it through condensers at the plants before returning the water to its source. When the water is discharged, it is sometimes as much as 10 degrees Celsius (18 degrees Fahrenheit) warmer than the source waters. To minimize thermal pollution, most plants are now regulated to control the temperatures of discharged effluent. Cooling towers are used extensively to cool the heated water prior to returning it to the original waterbody.

Heated water from electric generating plants is not the sole source of thermal pollution. Urban runoff can be heated as it passes over highways, pavements, and buildings. This runoff can significantly increase the temperature of the bodies of water into which it flows.

Habitat Loss

Diversity of species is often greatest where two ecosystems meet. Changes in the balance of freshwater and saltwater in coastal ecosystems can lead to the loss of species sensitive to this

balance. For example, if a barrier island becomes eroded, the tidal action can increase, raising the salinity levels in wetlands behind the island. The increased salinity can kill plants and destroy wetlands.

Wetlands

According to the Department of the Interior's Fish and Wildlife Service (FWS), the contiguous 48 states lost 52 percent of their wetlands between the 1780s and 1980s (see figure 8). In the 1700s an estimated 221 million acres of wetlands existed in the lower 48 states. In 1995, approximately 100.9 million acres of wetlands existed in the contiguous 48 states. Of that amount, 95 percent were inland, freshwater wetlands, and 5 percent were coastal or estuarine wetlands.

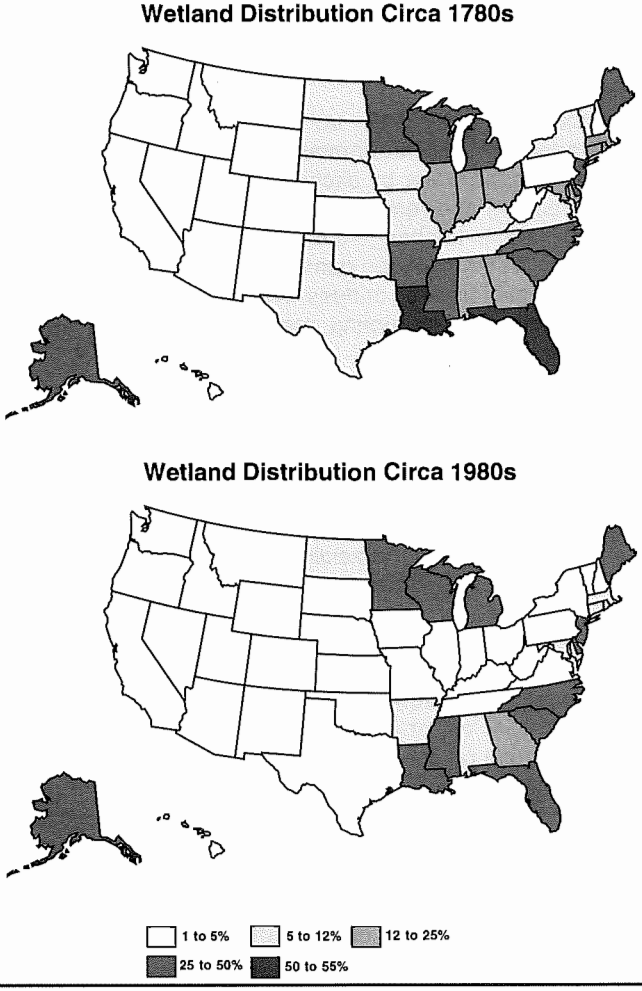
In a preliminary study released in 1997, the FWS examined wetlands trends from 1985 to 1995. The findings showed that while wetland acreage continues to drop, it is dropping at a slower rate than previously. The average annual net loss of wetlands between 1985 and 1995 was 117,000 acres. This rate of loss is 60 percent lower than the rate of loss reported between the mid-1970s and the mid-1980s.

Both natural events and human activities contribute to coastal habitat loss and degradation (see table 6). Natural threats to wetlands include the following:

- ❑ Erosion
- ❑ Subsidence
- ❑ Sea level rise
- ❑ Droughts
- ❑ Hurricanes and other storms
- ❑ Overgrazing by wildlife

Human activities exacerbate or accelerate nearly of all these natural processes. Coastal wetland loss has resulted from human activities such as oil and gas exploration and river channelization that accelerate natural processes. Forested wetlands, inland

Figure 8
Percentage of U.S. Wetlands Present in the United States (1780s and the 1980s)



Source: U.S. Government Accounting Office 1991

marshes, and wet meadows that have been drained for agricultural uses cannot effectively respond to the natural processes and are damaged further.

Much of the coastal wetland loss has resulted from development. In addition, many coastal marshes in Louisiana have been

Table 6
Types of Wetlands Alteration

Physical

Clearing—removing vegetation by burning, cutting, and so forth
Diverting sediment—trapping sediment and inhibiting regeneration of wetlands
Diverting water—preventing water from entering the wetland (e.g., diking, damming), or adding more than normal amounts of water to a wetland
Draining—removing the water by ditching, tilling, pumping, and so forth.
Excavating—dredging and removing soil from wetlands
Filling—adding material to change the bottom level or replace with dry land
Flooding—raising water levels by damming or channeling water
Shading—placing platforms or bridges over wetlands, killing vegetation
Adjacent area activities—disrupting interaction between a wetland and an adjacent area

Chemical

Metals—increasing or decreasing metal levels in the local water or soil system
Nutrient levels—increasing or decreasing nutrient levels in the local water or soil system
pH—increasing or decreasing the acidity of water (e.g., acid mine drainage)
Toxics—adding toxic compounds to a wetland (intentional, such as herbicide treatment, or unintentional, such as oil from cars or spills)

Biological

Disrupting natural populations—reducing populations of existing species, introducing exotic species, or otherwise disturbing resident organisms
Grazing—consumption of, compaction of, and damage to vegetation by domestic or wild animals

submerged by rising Gulf of Mexico waters, land subsidence, and shoreline erosion. Over the past 25 years, Louisiana, which has more than 40 percent of the wetlands in the continental United States, lost valuable coastal wetlands at rates between 30 and 50 square miles per year. The Southeast region as a whole sustained a loss of 60,500 acres per year from 1985 to 1995.

While the wetlands losses are most severe in the Southeast (55 percent of the total loss from 1985 to 1995), the FWS's 1997 report showed that the Northeast lost 22,800 acres per year (20 percent). West of the Mississippi, the losses are 34,100 acres per

year (29 percent). In the last 200 years, California has lost 91 percent of its wetlands, and Connecticut has lost more than half of its coastal wetlands.

Other Coastal Habitats

Other coastal habitats have also been damaged. For example, the Chesapeake Bay watershed has only 10 percent of the submerged aquatic vegetation (SAV) or sea grasses that existed several decades ago. Tampa Bay had lost 80 percent of its original SAV by 1982. Activities that increase water turbidity—such as dredging, runoff, and increased nutrient loading—can have devastating effects on the seagrasses. About 150,000 acres (23 percent) of Florida's mangrove forests have been lost, and the coral reefs and barrier beaches have sustained serious damage.

Tidal flats, a major resource of the middle and lower Texas coastal zone, serve as a foraging area for wading birds and export nutrients to other estuarine habitats. However, tidal flats continue to be developed and destroyed.

Oyster reefs in the Gulf of Mexico, which provide a number of ecological and environmental benefits, are being threatened by point and nonpoint source pollution, as well as a lack of nutrients resulting from the construction of dams and reservoirs. Previously, oyster dredging depleted stocks severely.

Many barrier islands, unique habitats for a variety of plants and animals and protection for coastal mainland, are being overdeveloped.

Dredging and disposing of dredged material can also affect ocean life, altering the habitat of bottom-dwelling and marine plants. Dredging for navigation in harbors and inlets also removes sediment and can interfere with longshore movement of beach materials. Dredging in adjacent freshwater or brackish wetlands to create canals for navigation, pipeline installation, and drainage opens the way for saltwater intrusion and other hydrologic effects during storms and high tides.

In coastal Louisiana, the increased salinity associated with dredging for navigation and pipeline installation (as well as other effects from these activities) has damaged wetlands and accelerated land loss. In some areas where dramatic wetlands loss has occurred, clean dredged material has been used as a beneficial source of sediment to restore wetlands and other habitats. When the sediment is contaminated, however, toxins can bioaccumulate in fish and shellfish and pass up the food chain.

Dams, stream channels, and other hydromodification projects can also alter habitats by changing water flow or increasing sediment deposits. *Population and Water Resources* states that in coastal areas, where freshwater and saltwater meet and mix, any alteration of the coastal water system can damage the freshwater system by decreasing the amount of freshwater, transferring pollution, or increasing salinity.

Coastal Hazards

Increasing population and development have left coastal areas more vulnerable to a variety of hazards, including coastal storms, chronic erosion, and potential sea-level rise. Twenty-five percent of the 95,000 miles of United States coastline is experiencing significant chronic erosion. Storms are a primary cause of erosion along many coasts. Storms often bring strong winds and large waves, raising water levels as much as seven meters above normal, according to *Coasts in Crisis*.

The development of coastal areas can not only increase the risk to human life, but can also create a substantial financial risk. The federal government's flood insurance program poses inestimable tax liabilities in the future to compensate for land and property damages brought about by coastal hurricanes, storms, erosion, flooding, or other hazards.

In many coastal areas, much of the sediment that maintains the coast is supplied by upstream rivers. Dams built for flood control

and water catchment along these rivers inhibit the flow of sediment to the coastal area. Lacking the sediment, the coastal areas erode more quickly. Some areas of the Gulf of Mexico coast are eroding at a rate of 100 feet per year, according to EPA.

For example, the amount of sediment carried by the Mississippi River has declined by one-half, exacerbating the deterioration of Louisiana's wetlands. The U.S. Army Corps of Engineers is working to counteract wetlands loss by building structures to divert sediment-laden freshwater from the Mississippi to adjacent wetlands, reports the U.S. Geological Survey in *Coasts in Crisis*.

Increased sediment from erosion of stream banks also can cause problems—smothering aquatic plant life, clogging fish gills, and cutting off essential light to underwater plants. Stream bank erosion is typical in developed areas where pavement, compacted soil, and other nonpermeable surfaces prevent water infiltration and result in increased water and sediment runoff.

Sediment from soil erosion in tropical areas can be particularly harmful to reefs. The increased sedimentation "adversely affects the structure and function of reefs by smothering coral colonies and reducing the light available for photosynthesis by corals and algae," according to Caroline Rogers of the National Park Service.

In sandy beach areas, destruction of dune grasses and compaction and alteration of dunes can increase wind velocities, tidal erosion, and the movement of beach materials. The result leaves the coastal area more vulnerable to storm damages. Increased sediment movement can also destroy breeding grounds for fish and require additional dredging of existing navigation channels.

Some areas—such as Cape May, New Jersey—have attempted to halt the natural drift of sand with jetties built out into the water. The beach expands on the updrift side of the jetty, while the downdrift side loses sand. However, jetties have become controversial because of concerns that they may actually increase coastal erosion.

Other areas have attempted to reduce coastal erosion by directly replenishing beach materials with sand brought in from

Coastal Property Rights

Issues surrounding individual property owners' rights on coastal properties are controversial, emotional, and frequently highly politicized. On the last day of its term in June 1992, the U.S. Supreme Court handed down a much anticipated decision in a case expected to influence public and private land-use issues well into the next century. While the *Lucas v. South Carolina Coastal Council* decision stands, its effect has been more limited than predicted in the early 1990s.

The case involves a Fifth Amendment takings challenge to the South Carolina Beachfront Management Act. Landowner David H. Lucas argued that in being forbidden to build permanent, habitable structures on his coastal lots, he had been deprived of the full economic value of his property. The state maintained that such buildings would lead to increased beach erosion. While a trial court awarded Lucas compensation for the taking, the South Carolina Supreme Court sided with the state's Coastal Council and ruled that the action under the state law did not constitute a compensable taking of Lucas's property.

But by a 6-2-1 majority, the U.S. Supreme Court reversed the South Carolina Supreme Court ruling. The majority decision, written by Justice Antonin Scalia, was "narrowly confined ..., involving an alleged total deprivation of economic value," Rutherford H. Platt, University of Massachusetts geography professor and lawyer, wrote in the September–October 1992 issue of *The Environmental Forum*.

Platt, the author of *Land Use Control: Geography, Law, and Public Policy* (1991), wrote that the *Lucas* decision established a new standard "whereby the loss of all economic value due to public regulation will only be permitted if 'background principles of nuisance and property law' would have led to the same result." That approach "certainly invites landowner challenges to public land-use regulations of many types." Platt predicted that the holding would lead to more litigation over the terms "total economic value" and "background nuisance principles."

"If read carefully, *Lucas* need not be considered devastating either to coastal erosion management laws or to broader environmental regulatory programs such as wetlands, historic preservation, and growth management," Platt wrote in 1992. "However, its impact will not be limited to its fairly narrow area of application—'total takings.'"

In the nearly six years since the Supreme Court case, few decisions have expanded the Lucas decision. While the property rights issue likely will remain part of the political landscape in the future, in his 1996 book, *Land Use and Society: Geography, Law, and Public Policy*, Platt said that efforts to use the ruling "as a club to intimidate public officials seem to be losing credibility in the absence of many later decisions that follow or expand upon the *Lucas* decision."

elsewhere. The success of beach replenishment has been mixed. In the late 1970s, $64 million was spent to replenish Miami Beach. While not intended as a long-term solution, the Miami Beach restoration lasted more than a decade. Many replenished beaches endure only a briefer time—one-half of the replenished beaches on the East Coast lasted less than two years, according to *Coasts in Crisis*.

As with other threats to U.S. coastal and marine resources, the potential for harm is by no means restricted to the Atlantic and Pacific seaboards. The level of the Great Lakes varies significantly over short-term, seasonal, and long-term periods as a result of natural forces. The causes of the variations include annual changes in precipitation and runoff, long-term changes in precipitation and temperature, and short-term changes in winds. While wave and tidal action is generally limited in lakes, storm surges can quickly raise the lake water level and inflict considerable damage. Chicago's Lake Michigan shoreline contains many badly deteriorated structures built to protect the city from flooding after severe flood damages had occurred.

Concerns about flooding and erosion have led to many long-term IJC studies on managing levels and flows, diversion, and consumptive use. In the Great Lakes, the IJC is responsible for the levels and flows of the lakes, separate from its responsibility for water quality. The only regulation of water flow and lake level, designed to facilitate shipping, occurs on the St. Mary and St. Lawrence Rivers under the auspices of the IJC. Water is diverted at Niagara Falls for hydropower and then returned to the river, affecting the flow over Niagara Falls. Many experts say the effect of these controls is minimal compared to natural fluctuations.

Diversions—transfers of water from one watershed to another—were found to have little long-term effect on lake levels. Consumptive use—water that is withdrawn for use and not returned—was thought to have a negligible effect on the Great Lakes system because of its large size. According to the IJC study cited in *The Great Lakes: An Environmental Atlas and Resource*

Book, climate and weather changes affect the lake levels more than any human-made diversions or consumptive uses, especially if current trends are sustained.

The *Atlas* cites a 1993 IJC study that concluded that "the cost of major engineering works to further regulate the levels and flows of the Great Lakes and St. Lawrence River would exceed the benefits provided and would have negative environmental impacts." The alternative suggested by the IJC was coordinated land use and shoreline management programs that would apply to the entire Great Lakes basin. The programs would be designed to mitigate any further damages from floods and erosion.

Marine and Beach Debris

In addition to aesthetic harm to coastal areas, debris in marine environments directly affects fish and wildlife, commercial and recreational fishers, recreational boaters, marine merchants, and recreational users of coastal beaches. Wildlife can ingest debris or become entangled in it, either of which can be fatal. Of particular concern are plastics, such as monofilament fishing line, fishing nets, pellets, plastic bags, and balloons.

The increasing use of plastics for consumer and industrial products and processes has led to an increase in plastic debris in the ocean. According to the Center for Marine Conservation's (CMC's) *Citizen's Guide to Plastics in the Ocean*, "no one knows just how much plastic is out there." Plastic items are now the most common human-made objects sighted at sea, according to CMC.

The same characteristics that make plastic so useful—lightness, durability, and strength—also make it particularly harmful when disposed of improperly in the coastal or marine environment. Common types of marine debris include the following:

- ❑ Fishing gear (nets, lines, traps)
- ❑ Plastic strapping used in shipping

- ❑ Petroleum industry plastics, including hard hats and "write-enable" rings (plastic rings used to protect tapes used during seismic recording and other computer-related activities)
- ❑ Plastic pellets (the raw form of plastic before it is melted down for consumer goods)
- ❑ Sewage-associated plastic, including tampons, condoms, and disposable diapers
- ❑ Plastic bags
- ❑ Six-pack holder rings
- ❑ Domestic plastics (e.g., plastic utensils and polystyrene cups)

The image of a shore bird or sea turtle entangled in a six-pack holder has become a well-recognized symbol of the problem. Plastic nets, lines, and strapping can also trap and entangle wildlife (such as marine and terrestrial birds, mammals, and marine and freshwater fish), exhausting or suffocating them.

Sea turtles sometimes eat plastic bags, mistaking them for their favorite food, jellyfish. When ingested, plastics can damage an animal's stomach lining or inhibit the animal's hunger sensation and thus its hunger drive. Ingested plastic can also block the intestinal passages.

Plastic debris also affects commercial and recreational activities. In the Gulf of Mexico, concerns have been raised about plastic sheeting caught in fishing nets, disrupting fishing activity. Nets, lines, ropes, and plastic sheeting can ensnare vessels and entangle scuba divers. Plastic bags can also clog cooling-water intakes on boats, causing engine failures.

Water-based sources of marine debris include the following:

- ❑ Recreational fishing and boating wastes, such as fishing lines, floats, and lures
- ❑ Commercial fishing wastes, such as plastic rope, plastic light sticks, fishing nets, wood and metal fish and crab traps

- ❑ Barges carrying garbage to coastal landfills (lightweight litter can be blown off the barge decks and into the water)
- ❑ Operational wastes from merchant shipping vessels, such as plastic strapping bands and plastic sheeting
- ❑ Offshore petroleum activities, specifically garbage from oil drilling rigs and production platforms
- ❑ Galley-type wastes, such as egg cartons and bleach bottles, assumed to originate in ships' galleys
- ❑ Passenger cruise lines, which disposed of an estimated 62 million pounds of garbage into the sea each year prior to 1987 (new restrictions for plastic garbage have been in place since then; see chapter 5 for a description of the International Convention for the Prevention of Pollution from Ships)
- ❑ Military ships and vessels, which prior to 1987 could legally dispose of wastes overboard (see chapter 5 for a description of the International Convention for the Prevention of Pollution from Ships)

Land-based sources of marine debris include the following:

- ❑ Sewage-associated wastes, both from sewage treatment and from combined sewer overflow during heavy rainfall
- ❑ Plastics manufacturing and processing, including plastic pellets
- ❑ Litter from streets or sidewalks that is washed into storm sewers during rains and released into waterways
- ❑ Litter left on beaches by the general population (in Los Angeles County alone, for instance, beachgoers typically leave behind approximately 75 tons of trash a week)
- ❑ Trash carried by stormwater into rivers, lakes, and coastal waters

In 1988, CMC organized an annual nationwide beach cleanup project. The project is now an international event and takes place the

third Saturday in September. In 1996, 277,710 volunteers representing 93 countries, including 55 U.S. territories and states, participated in the effort. CMC reported that 4,890,914 pounds of debris were removed from 9,128 miles of beach and coastline during the 1996 event. The beach cleanup has both practical and symbolic value, because it actively involves thousands of individuals in an environmental project that can have a lasting effect on those participants.

In the 1996 event, plastic was the most abundant material, accounting for almost 61 percent of all trash. While the single most numerous item collected was cigarette filters, they did not account for a large percentage of debris volume. Glass and paper each accounted for 10 percent of the debris volume; metal accounted for 11 percent; and rubber, wood, and cloth accounted for 3 percent. Because many types of items are in general use, identifying the debris source is difficult, although in some cases types of sources or even specific sources were identified.

Oil Spills

Although oil spills from ships account for only 5 percent of the oil in the oceans, spills can cause major short-term damage to marine and coastal environments. Petroleum hydrocarbons at sufficient concentrations are toxic to a wide variety of marine organisms. In addition to fouling shorelines and killing wildlife, petroleum hydrocarbons can reduce growth, alter feeding behavior, and lower reproductive success of marine life, according to the Natural Resources Defense Council's *Ebb Tide for Pollution.*

From 1973 to 1993, most oil spill incidents occurred in rivers and canals, according to the U.S. Coast Guard pollution incident report. Pipelines were the most frequent spill source; however, tankships spilled the largest volume of oil into the environment. Crude oil was the most frequently spilled oil cargo and accounted for the largest oil spill volume. In general, 95 percent of reported spills are smaller than 1,000 gallons and constitute only 5 percent of the spill volume. The remaining 5 percent of reported spills

account for 95 percent of the spill volume. By nearly every measure, the volume of oil spilled in U.S. coastal waters has steadily declined from 1973 to 1993. In 1993, 8,972 reported oil spills dispersed 2,067,388 gallons of oil into the waters of the United States. The volume of oil spilled into the environment has declined in large part because of regulatory changes resulting from periodic spill disasters, such as the *Exxon Valdez*.

The March 1989 *Exxon Valdez* grounding in Alaska's Prince William Sound was the largest spill (10.8 million gallons, or 257,000 barrels) in U.S. history and unquestionably one of the most widely reported environmental disasters ever, both domestically and internationally. According to the Alaska Department of Environmental Conservation, the spill covered more than 1,240 miles of shoreline. More than 980 sea otters, 135 bald eagles, and 33,000 seabirds were found dead as a result of the spill. Some estimates put the number of birds that died because of the spill at more than 500,000.

Such spills have occurred worldwide at the rate of three to five per year since 1967, according to the U.S. Congress's Office of Technology Assessment. Iraqi President Saddam Hussein's 1991 intentional oil spills during the Persian Gulf War were the largest in history, an estimated 6 million barrels of oil, 23 times the amount from the *Exxon Valdez*. The Persian Gulf spill, covering about 600 square miles of water and blackening about 300 miles of shoreline, is seen as the first extensive and deliberate use of environmental terrorism as part of a war strategy.

Varied methods are used to combat oil spills, but a common lesson learned from most spills is that the best strategy is to avoid the spill in the first place. Once sizable amounts of oil are spilled into the marine environment, cleanups are inevitably difficult.

Mechanical spill cleanups, involving containment booms and oil recovery skimmers, are the primary U.S. oil spill response methods. Dispersants also are used, although concerns have been raised about their potential toxicity and their overall effectiveness.

An Office of Technology Assessment report, *Coping with an Oiled Sea*, found that cleanup efforts recovered less than 10 percent of the oil discharged in large ocean tanker spills. The report states that contingency plans have often been found to be ineffective in big spills. In fact, recent experiences with major spills in coastal areas is showing that cleanup activities sometimes can prove more harmful than not cleaning up, according to David Kennedy of the NOAA's Hazardous Materials Division. The image of Exxon company employees and contractors washing rocks after the Valdez spill may be convincing on the national evening news, but serious doubts arise over whether such high-publicity steps actually help or hurt the environment in the long run. (About 12 percent of the oil from the *Exxon Valdez* spill eventually was recovered, about 30 percent eventually evaporated, and more than half remains in the environment, according to the Alaska Department of Environmental Conservation.)

To help prevent oil spills, the 1990 Oil Pollution Act, enacted in response to the *Exxon Valdez* spill, requires double hulls on oil tankers, but calls for a 25-year phase-in period. Although the benefits of double hulls are widely recognized, some naval engineers fear double-hulled ships are more vulnerable to capsizing. As with other environmental issues, trade-offs may arise, and double-hulled ships are by no means "invincible." For instance, on 5 December 1992, a double-hulled Greek tanker, the *Aegean Sea*, ran aground off the coast of La Coruma, Spain, damaging more than 60 miles of rocky coastline with a crude oil slick reportedly covering some 19 square miles.

Not all oil spills into the marine environment inflict permanent or serious environmental damage. The 1990 *Mega Borg* spill of some 5 million gallons of light crude oil in the Gulf of Mexico, for instance, is believed to have avoided causing major damage because of a variety of factors: temperature and ocean current conditions, the nature of the crude oil itself, and the ability of spill response teams to limit the amount of oil that actually reached the shoreline and the most vulnerable areas and species.

The effects of an oil spill and the success of cleanup efforts depend on the characteristics of the water and land nearby, as well as weather conditions. In some cases, luck—good or bad—plays the prominent role in determining the severity of a spill. The shallower the water, the greater the likelihood of damage to life on the bottom. High winds and ocean currents can spread oil faster and impede cleanup efforts. Tidal mud flats and shallow grass beds are especially difficult to clean up. The time of day a spill occurs also can be important, because adequate sunlight and good visibility increase the effectiveness of response efforts.

Smaller, routine, and nonaccidental disposals, on land and in the water, can be as damaging as large spills. Though newspapers carry few headlines or stories about the 180 million gallons per year of used motor oil dumped in sewer drains or landfills by do-it-yourself mechanics, Americans dispose of more oil from their crankcases each year than was spilled by the *Exxon Valdez*.

None of this discussion is intended to minimize or downplay the potential environmental harm that can result from oil spills into the marine environment. Instead, its purpose is to illustrate the need to examine each incident and its effects individually, mindful of the wide array of factors that can either mitigate or exacerbate the environmental effects.

Offshore drilling operations can also cause coastal pollution through the disposal of wastes, which are mostly made up of drilling muds. The drilling muds, which lubricate the drill bit and maintain downhole pressure, sometimes contain toxic chemicals. The Natural Resources Defense Council has estimated that each offshore drilling can lead to the discharge of some 1,500 to 2,000 tons of drilling muds and cuttings into surrounding waters. These discharges are subject to regulation under the CWA.

Global Climate Change

Global climate change refers to climatic changes resulting from the buildup of greenhouse gases and stratospheric ozone depletors

such as carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (CFCs). While the environmental effects of global climate change are uncertain, climate changes inevitably will influence the global water cycle.

The buildup of greenhouse gases results primarily from a 25 percent increase in the total amount of atmospheric carbon dioxide since the beginning of the Industrial Revolution. Carbon dioxide comes from burning fossil fuels (coals, oil, and gas) and destroying forests. Deforestation releases carbon dioxide whether the trees are burned or left to rot. Deforestation also destroys a primary source of carbon dioxide absorption and oxygen production—the trees' leaves. Increases in methane concentrations have resulted in part from increased wetland cultivation of rice and from increased livestock rearing. CFCs—manufactured chemicals used in refrigeration, air conditioners, foam, and insulation, as well as solvents and cleaners in electronics manufacturing—make up about one-quarter of the pollutants responsible for the Earth's greenhouse effect, according to the NOAA. Internationally, the use of CFCs in electronics has now been phased out.

Potential consequences of a warming Earth include a rise in sea level resulting from melting polar ice caps and thermal expansion of ocean waters. A sea-level rise could cause coastal flooding, which would erode shorelines; destroy some coastal urban areas and much of the remaining wetlands; increase salinity of rivers, bays, and groundwater; and substantially lower the Great Lakes because of increased evaporation. An increase in severe storms, which some speculate to be an effect of global warming, would exacerbate coastal flooding. Precipitation patterns would change as a result of changes in the water cycle. Some areas with limited freshwater supplies (e.g., California) may receive less precipitation, further decreasing the crucial supply of freshwater to estuaries. Other areas may receive more precipitation, resulting in increased runoff, decreased estuarine salinity, and increased delivery of nutrients from nonpoint sources.

Along much of the U.S. coast, a one-foot rise in sea level could cause the erosion of up to 2,000 feet of beach. The cost of protecting beaches and coastal structures along the Atlantic coast alone has been estimated at $10 billion to $100 billion.

Overfishing

The Magnuson-Stevens Fishery Conservation and Management Act, as amended in 1996, defines overfishing as "a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis." Overfishing has biological and environmental, as well as economic and social, implications. A summary report from a 1991 Smithsonian Institution conference on oceans noted that "because of their integral roles in marine food webs, drastic fluctuations in fish populations will have reverberations throughout marine ecosystems." Overfishing of oysters, for example, can harm water quality because oysters play an important role in filtering and cleaning water.

According to a September 1997 report to Congress by the National Marine Fisheries Service (NMFS), 86 of the 279 fish species that have been assessed are classified as overfished. Magnuson-Stevens provides for conservation and management of fishery resources within the U.S. exclusive economic zone (EEZ), as well as fishery management authority over continental shelf resources and some migratory species beyond the EEZ. This authority does not apply within a foreign nation's territorial sea or recognized fishery conservation zone.

Overfishing is most severe along the New England and Pacific coasts (the Pacific jurisdiction includes Hawaii and Guam). Among the 86 overfished species are cod, some flounder, Atlantic swordfish, Atlantic sea scallops, American lobster, and many southeastern U.S. snappers and groupers. Of the remaining assessed stocks, 183 species are not considered overfished, and 10 species are approaching overfished status. The status of 448 species is unknown, and those species may not be surveyed because of their low commercial

value. Under the 1996 Magnuson-Stevens amendments, NMFS must report annually to Congress on the status of U.S. fisheries. In addition to continually evaluating fisheries, the amendments call for efforts to rebuild fisheries, including creating regional "essential fish habitats," which are the waters and environment needed to ensure that fish spawn, breed, feed, and grow to maturity.

Depleted fisheries stocks result in significant losses of productivity, jobs, and recreational fishing opportunities. NMFS estimates that rebuilding the nation's overfished fisheries and efficiently managing the nation's living marine resources could substantially benefit commercial fishing, as well as provide many new jobs. Similar economic benefits, and countless hours of fishing pleasure, would also be generated in the recreational fishing sector.

Another issue that contributes to overexploitation and economic loss is incidental capture, or bycatch, of species in the course of commercial fishing. Bycatch affects almost all U.S. fisheries to some extent, but it is especially severe in trawl fisheries. Bycatch in other fisheries can undermine the management of many stocks, including the recovery of protected species of marine mammals and sea turtles. The recovery of depleted reef fishes in the Gulf of Mexico, for example, may be slowed or prevented by bycatch of young reef fish by shrimpers. Finding a management scheme that allows full use of productive species while protecting other species from incidental capture is a significant challenge.

Technological advances have also contributed to overfishing. Throughout the 1980s and 1990s, commercial and recreational fishers have benefited from a tremendous increase in the availability of improved technology, including sonar, radar, computerized navigational devices, better boats and engines, and electronic fish finders. As a result of these improvements, pressures on fishery resources have increased at a faster rate than the numerical increase in boats and fishers might suggest.

Although overfishing clearly remains a problem, some efforts are under way to address it. The NMFS Office of Science and Technology is, for example, evaluating the distressed red snapper

fishery in the Gulf of Mexico. A special review panel has been formed to examine the red snapper stock to protect it from commercial and recreational overfishing, reduce bycatch of red snapper by Gulf shrimpers, and investigate the biological traits that make red snapper vulnerable to overfishing.

Loss of Biological Diversity

Ecologists examine the differences in the composition of species in ecosystems, the physical structure of ecosystems, and the way they function. The three levels of biological diversity, as described by CMC, are as follows:

- Species diversity, which varies enormously over the surface of the Earth and over time
- Genetic diversity, a lower level consisting of the genetic variation among different individuals within each species, providing the raw material for evolution and selective breeding
- Ecosystem diversity, the highest level of biological diversity or the diversity of communities of organisms in their physical settings

CMC also identifies five major classes of threats to biological diversity:

- Human overexploitation of living things, both intentional and unintentional
- Physical destruction of ecosystems, from sea grass beds and mangrove forests to the soft seabed
- Pollution of all sorts
- Global atmospheric change, including stratospheric ozone depletion and global climate change
- The introduction of nonindigenous species (such as the blue crab species once native to the United States that is now well established in the Mediterranean)

Many issues addressed in this chapter can cause a loss of biological diversity. Twenty-nine marine mammals and birds in American coastal waters are listed as threatened or endangered marine species. Table 7 lists threatened and endangered marine and marine edge species (i.e., those species that depend on coasts, near-coastal areas, or intertidal areas for food, shelter, or breeding).

Nonindigenous or "Nuisance" Species

According to James Carlton, director of the Maritime Studies of Williams College/Mystic Seaport program in Connecticut, the introduction of nonindigenous species can "cause fundamental irreversible alterations in the structure of aquatic communities. No introduced marine organism, once established, has ever been successfully removed or contained."

Public awareness of the potential risks of introducing nonindigenous, or "nuisance," species has been raised by experiences associated with introduction of zebra mussels from the Black Sea to the Great Lakes. The mussels can block pipes and cause extensive ecological damage. The zebra mussels were unintentionally brought to North America from the Mediterranean Sea via ballast water (water pumped into a ship's hull).

In the Great Lakes, accidental and deliberate introduction of nuisance species such as the sea lamprey, zebra mussels, and round goby played a part in the decline of fisheries. Today, the sea lamprey is controlled with a chemical lampreycide. According to the Georgian Bay Association, however, alternatives to chemical treatments are being explored, coupled with efforts to reduce chemical lampreycide use by 50 percent by 2000. Efforts to control nuisance species are costly; Great Lakes municipalities and industries have spent a total of $120 million to combat nuisance species from 1989 to 1994.

The U.S. Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 was reauthorized by the National Invasive

Table 7
Marine and Marine-Edge Species Protected by the U.S. Endangered Species Act[1]

Marine Species	Endangered	Threatened
Mammals	Blue Whale Bowhead Whale Finback Whale Gray Whale+ Humpback Whale Right Whale Sei Whale Sperm Whale Vaquita (Cochito) Dugong West Indian Manatee Marine Otter Caribbean Monk Seal Hawaiian Monk Seal Mediterranean Monk Seal Saimaa Seal	Southern Sea Otter Steller Sea Lion Guadalupe Fur Seal
Reptiles	Hawksbill Sea Turtle Kemp's Ridley Sea Turtle Leatherback Sea Turtle American Crocodile Saltwater Crocodile+	Green Sea Turtle* Olive Ridley Sea Turtle* Loggerhead Sea Turtle
Fishes	Sockeye Salmon+ Shortnose Sturgeon Coho Salmon+ Totaba (Seatrout) Umpqua River Culthroat Trout	Chinook Salmon* Central California Coast Gulf Sturgeon
Birds	Short-tailed Albatross** Amsterdam Albatross Abbott's Booby Cahow (Bermuda Petrel) Madeira Petrel Mascarene Black Petrel Hawaiian Dark-Rumped Petrel Andrew's Frigatebird Audouin's Gull Brown Pelican+ Galapagos Penguin California Least Tern Canarian Black Oystercatcher Madagascar Sea Eagle	Marbled Murrelet Newell-Townsend Shearwater+ Roseate Tern*

Table 7
Marine and Marine-Edge Species Protected by the U.S. Endangered Species Act[1]

Marine-Edge Species	Endangered	Threatened
Mammals	Alabama Beach Mouse Anastasia Island Beach Mouse Choctawhatchee Beach Mouse Perdido Key Beach Mouse Pacific Pocket Mouse Saltmarsh Harvest Mouse Shark Bay Mouse Morro Bay Kangaroo Rat False Water Rat Florida Salt Marsh Vole	Southeastern Beach Mouse
Birds	Laysan Duck Chinese Egret Nordmann's Greenshank New England Shore Plover California Clapper Rail Lightfooted Clapper Rail+ Cape Sable Seaside Sparrow	Piping Plover*
Fishes	Tidewater Goby	
Reptiles	None	Atlantic Marsh Snake
Invertebrates	Morro Shoulderband Snail (Banded Dune)	Northeastern Beach Tiger Beetle
Plants	None	Seabeach Amaranth

[1] Includes species that require marine habitats (or their edges) to survive.
* Denotes threatened species that are endangered throughout certain portions of their range or species with endangered breeding populations.
\+ Denotes species that are endangered or threatened only in certain portions of their range.
** Denotes species that are endangered/threatened in their entire range, except for a certain limited portion of their range.

Source: Crouse 1997

Species Act of 1996. The act, created in response to the Great Lakes zebra mussel population increase, called for programs to prevent, research, and monitor aquatic nuisance species. The act focuses on ballast water, including the development of new technologies to prevent transport of aquatic nuisance species through ballast water.

Chapter 5
Key Laws and Associated Programs

Scores of federal and state laws and regulations can and do affect coastal and marine resources management issues. From programs aimed at protecting plants and wildlife, water quality, and ecosystems to those regulating dredge and fill activities, waste disposal, and fishing, these programs address the full range of commercial and recreational uses, preservation and development, and state and federal responsibilities.

This chapter provides a broad overview of key federal laws and programs that affect coastal and marine resources. Appendix A provides additional concise information on other relevant laws and programs.

National Environmental Policy Act

Discussion of U.S. environmental programs at the federal level inevitably focuses on the National Environmental Policy Act (NEPA), the "environmental impact statement" (EIS) statute signed into law on 1 January 1970. Through decades of judicial interpretation and review, NEPA has evolved as one of the United States' single most important environmental protection laws, and it is a model copied widely throughout the world.

At its heart, NEPA requires preparation of an EIS for major federal actions that significantly affect the environment. This general principle has been broadly interpreted by the judiciary, and it has led to widespread acceptance of the overall impact statement process. The law also authorized the establishment of the Council on Environmental Quality (CEQ) in the Executive Office of the President. The CEQ has primary responsibility for managing the EIS process and for counseling the executive branch on environmental matters.

Sometimes considered the environmental "mouse that roared" because its influence belies its brevity, NEPA is widely regarded by environmental historians and professionals as one of the most critical components of the so-called environmental revolution that was ushered in with its signing by President Richard Nixon at the start of the 1970s.

Clean Water Act

Environmental historians emphasize that a thorough understanding of U.S. water pollution control law should start with the 1899 Rivers and Harbors Act (see appendix A) and the 1924 Oil Pollution Act (OPA). The first Water Pollution Control Act (P.L. 80-845) was enacted in 1948 in light of concerns over typhoid, diarrhea, and dysentery and their effects on beaches and shellfish beds.

In the mid-1950s, and again in the mid-1960s, Congress passed amendments to the Water Pollution Control Act. In 1972, Congress, overriding a presidential veto, passed the Federal Water Pollution Control Act (P.L. 92-500), substantially rewriting and strengthening federal water pollution control authorities.

The 1972 amendments to the Federal Water Pollution Control Act authorized $18 billion over five years for grants to local communities to build sewage treatment plants. (It was concern over that spending commitment that had prompted President Nixon's veto, overwhelmingly overridden by the House and Senate.) Importantly, the 1972 amendments also created a national permitting program requiring that dischargers to navigable waters of the United States have a federal- or state-approved permit specifying allowable discharges.

The 1972 amendments stated some laudable—if, in hindsight, somewhat impractical—objectives that all navigable waters of the United States be "fishable and swimmable" by 1983. The amendments also specified a "zero discharge" goal—a goal, not a requirement—by 1985.

Through substantive amendments in 1977 and again in 1987, the Clean Water Act (CWA) and now the Water Quality Act have focused attention on protecting and restoring coastal resources through three programs in particular:

- ❒ The National Estuary Program
- ❒ The Great Lakes Program
- ❒ The Chesapeake Bay Program

Part of the significance of these specific programs is that they illustrate Congress's formal recognition of issues such as population and development pressures—and not just pollution—as critical to coastal resources management.

A discussion of key sections of the law follows.

Section 301(h)

Some municipalities that discharge to marine waters argued that secondary treatment was unnecessary because the larger tides and more substantial currents of the marine environment dilute and disperse effluent more efficiently than freshwater environments. In response, section 301(h) allows for a case-by-case review of treatment requirements for marine dischargers meeting certain requirements.

A 301(h) applicant must demonstrate, among other things, that its discharges will not exceed water quality standards for the pollutant at issue. Discharges to marine waters must not interfere, alone or in combination with pollutants from other sources, with protection of public water supplies or with maintenance of balanced indigenous populations of shellfish, fish, and wildlife. The discharge also must not interfere with allowable recreational activities on the water.

The 1987 Water Quality Act (P.L. 100-4) modified section 301(h), specifying a minimum of primary treatment and adding additional pretreatment requirements for discharges from urban

areas with a population of more than 50,000 people. The 1987 provisions also disallowed waivers of secondary treatment requirements for discharges into stressed saline estuarine waters.

Section 303

Section 303 requires the U.S. Environmental Protection Agency (EPA) to establish water quality criteria guidelines for states to use in preserving designated uses of streams, lakes, and rivers within their borders (for instance, recreation and fishing).

EPA's water quality criteria and effluent guidelines outline levels that could cause a health risk or a significant degradation of the water quality for the specific use designation. EPA and delegated states use the standards to determine effluent limitations and to issue discharge permits under the National Pollutant Discharge Elimination System (NPDES).

The 1972 amendments specified that publicly owned treatment works (POTWs) must upgrade to "secondary treatment," that is, provide biological and chemical treatment processes that go beyond the fine-mesh screens and gravity techniques that characterize primary treatment.

Section 307

Section 307's National Pretreatment Program regulates discharges from industrial facilities to public sewage treatment facilities, as well as from treatment facilities into navigable waters of the United States. The program has two main parts: general pretreatment regulations and national categorical standards.

The general pretreatment regulations apply to discharges to POTWs that might cause a fire or explosion or otherwise impede operation of the POTW. In addition, EPA has the authority to issue technology-based categorical standards for pollutants on an industry-by-industry basis.

Section 312

Section 312 requires EPA to set standards for marine sanitation devices, or on-board boat toilets. The U.S. Coast Guard is charged with enforcing the standards and certifying that the devices meet EPA standards.

Section 319

One of the longest-running public policy issues in the water pollution control field is over controls on "point sources" (such as industrial discharge pipes) versus controls on "nonpoint sources" (such as urban runoff and agricultural fields). The section 319 nonpoint source management program requires states to assess and develop control programs for nonpoint sources. It authorizes EPA to approve state management programs and to provide program implementation grants. EPA and the National Oceanic and Atmospheric Administration (NOAA) jointly implement a parallel program in coastal areas under section 6217 of the Coastal Zone Management Reauthorization Act. Unlike section 319 of CWA, the Coastal Zone Management Reauthorization Act requires states to implement and enforce management measures to reduce nonpoint source pollution.

Section 320

The section 320 National Estuary Program, part of the 1987 amendments, promotes comprehensive planning efforts to help protect nationally significant estuaries deemed to be threatened by pollution, development, or overuse. As of November 1997, 28 estuaries had been officially designated as national estuaries under this program (see table 8).

Section 402

The section 402 NPDES permitting program generally is considered to be among the most significant provisions of the 1972 amendments. The program makes it illegal for municipal and industrial facilities to discharge pollutants into navigable waters

Table 8
Participants in the National Estuary Program
(as of November 1997)

National Estuary	Year of Entry
Albemarle-Pamlico Sounds, North Carolina	1987
Barataria-Terrebone Estuarine Complex, Louisiana	1990
Barnegat Bay, New Jersey	1995
Buzzards Bay, Massachusetts	1987
Casco Bay, Maine	1990
Charlotte Harbor, Florida	1995
Corpus Christi Bay, Texas	1993
Delaware Estuary in New Jersey, Pennsylvania, and Delaware	1988
Delaware Inland Bays, Delaware	1988
Galveston Bay, Texas	1988
Indian River Lagoon, Florida	1990
Long Island Sound, Connecticut and New York	1987
Lower Columbia River, Oregon and Washington	1995
Maryland Coastal Bays, Maryland (does not include Chesapeake Bay)	1995
Massachusetts Bay, Massachusetts (including Cape Cod Bay and Boston Harbor)	1990
Mobile Bay, Alabama	1995
Morro Bay, California	1995
Narragansett Bay, Rhode Island	1987
New Hampshire Estuaries, New Hampshire	1995
New York-New Jersey Harbor, New York and New Jersey	1988
Peconic Bay, New York	1993
Puget Sound, Washington	1987
San Francisco Bay, California	1987
San Juan Bay, Puerto Rico	1993
Santa Monica Bay, California	1988
Sarasota Bay, Florida	1988
Tampa Bay, Florida	1990
Tillamook Bay, Oregon	1993

Source: EPA 1997

unless they have an authorized permit (issued either by EPA or, more commonly, by a designated state). Dischargers' effluent reports are made public to allow EPA and citizens to review compliance.

Section 403(c)

For discharges to territorial seas, contiguous zones, or oceans, section 403 specifies that EPA consider pollutant effects on human health, marine life, marine ecosystem diversity and productivity, and aesthetic and recreational values.

Section 403(c) ocean discharge criteria require that point source discharges to territorial seas, the contiguous zone, and oceans that are NPDES permitted not "unreasonably degrade the marine environment." This provision authorizes EPA to assess point source discharge effects on the marine environment and surrounding biological communities. EPA has authority to specify additional effluent limitations or to prohibit the discharge by not issuing a permit.

NPDES permits are not to be issued for discharges into the territorial sea, waters of the contiguous zone, or oceans if they do not comply with EPA ocean discharge guidelines addressing factors such as bioaccumulation, coastal zone management, special aquatic sites, human health effects, and marine water quality criteria.

Section 404

Section 404 of the 1972 amendments established the program to regulate permits for disposal of dredge and fill materials into wetlands and other waters of the United States. The program is jointly administered by EPA and the U.S. Army Corps of Engineers (USACE).

USACE district offices are responsible for reviewing permit applications and issuing or denying permits, subject to guidelines jointly developed with review and approval by EPA. Under section 404(c), EPA has the authority to override a USACE decision to issue a permit or to prohibit or restrict the discharge of dredged or fill material to wetlands. Generally, EPA uses this authority only for the more significant and controversial permit applications.

Areas are classified as wetlands based on three criteria: wetlands vegetation, hydric soils, and hydrology (in the form of flooding or soil saturation). Once an area is identified as a wetland and qualifies under the law as a "water of the United States," the section 404 permitting program takes effect. The courts generally have interpreted the law to include all waters whose degradation or destruction *could* affect navigable waters and interstate commerce. Thus, "waters of the United States" include wetlands adjacent to interstate rivers and streams and coastal waters.

Courts by and large have interpreted the term "discharge" to include both additions and redeposits into the wetlands or other waters of the United States. Section 404(f)(1) exempts certain discharges from the permit requirement, such as "normal" farming, ranching, and silviculture (forestry) practices, but these exemptions are subject to important caveats and conditions as a result of executive branch and judicial interpretations.

General permits can be issued under section 404(e) on a nationwide, regional, or state level for categories of activities deemed similar in nature and likely to have only minimal environmental impacts. As of 1997, 39 nationwide permits had been issued (not all nationwide permits apply in every state).

The potential for controversy involved with section 404 permitting and its possible effects on development activities is considerable. Regional EPA offices and USACE district offices, along with applicable state agencies, can be valuable resources of information on this program.

Marine Protection, Research, and Sanctuaries Act

Ocean Dumping Act of 1972

Title I of the Marine Protection, Research, and Sanctuaries Act (MPRSA), commonly known as the Ocean Dumping Act, regulates transportation of material for the purpose of dumping it into ocean waters. The act requires U.S.-registered vessels, or any

vessel sailing from a U.S. port, to have a permit before it can lawfully dispose of materials in U.S. coastal waters. In addition, the act serves to implement an international treaty regulating ocean dumping known as the London Convention (see appendix A).

The following are ineligible for ocean dumping permits:

- ❑ Radiological, chemical, and biological warfare agents
- ❑ High-level radioactive waste
- ❑ Medical wastes (added by 1988 amendment to MPRSA)
- ❑ Materials that violate applicable water quality standards

Four federal agencies oversee the Ocean Dumping Act: EPA, USACE, NOAA, and the Coast Guard. EPA also designates sites for ocean dumping and performs related research. EPA regulates ocean disposal of substances other than dredged spoils, which are regulated by the USACE. NOAA oversees long-range research on marine environment effects. The Coast Guard is in charge of maintaining surveillance of ocean dumping.

For dredged material, USACE, uses EPA's environmental criteria to make dumping permit decisions, which are subject to EPA review. EPA designates sites for ocean dumping, most of which involves dredged materials removed from the waterway bottoms to maintain navigation channels. Approximately 60 million cubic yards are disposed of in the oceans annually.

Congress amended the MPRSA in 1988 with the Ocean Dumping Ban Act (P.L. 100-688), making ocean dumping of industrial waste and sewage sludge unlawful by 31 December 1991. When the Ocean Dumping Ban Act was first signed in 1988, nine Atlantic seaboard municipalities were actively engaged in ocean dumping—three in New York and six in New Jersey. Collectively, they dumped some 8.7 million wet tons of sludge each year. Each has since met the phaseout dates, and ocean disposal of sewage sludges and of industrial wastes has now officially halted.

Discharges through pipelines or from stationary drilling platforms into estuaries, navigable waters, and territorial seas are regulated under the CWA.

Title III—National Marine Sanctuaries Act

NOAA administers the National Marine Sanctuary Program, established in 1972 by Title III of the Marine Protection, Research, and Sanctuaries Act. NOAA is responsible for preparing EISs and overseeing management plans and public comment. NOAA is also responsible for preserving and protecting marine areas that have special significance based on their "conservation, recreational, ecological, historic, research, educational, or aesthetic qualities."

NOAA administers a detailed review process of these areas before they can be formally designated as national marine sanctuaries. Areas passing that review are nominated for designation by the secretary of commerce, but Congress can disapprove designations. States with proposed marine sanctuaries in their borders also can disapprove the inclusion of waters within their borders, and because competing interests are involved, the designation process often engenders controversy. As of November 1997, 12 sanctuaries covering nearly 18,000 square miles had been designated (see table 9 and figure 9).

Title V—Beach National Coastal Water Quality Monitoring Program

Title V establishes a national coastal water quality monitoring program, which EPA and NOAA administer. The agencies collect and analyze coastal ecosystem environmental data on water quality, living resources, environmental degradation, and long-range trends.

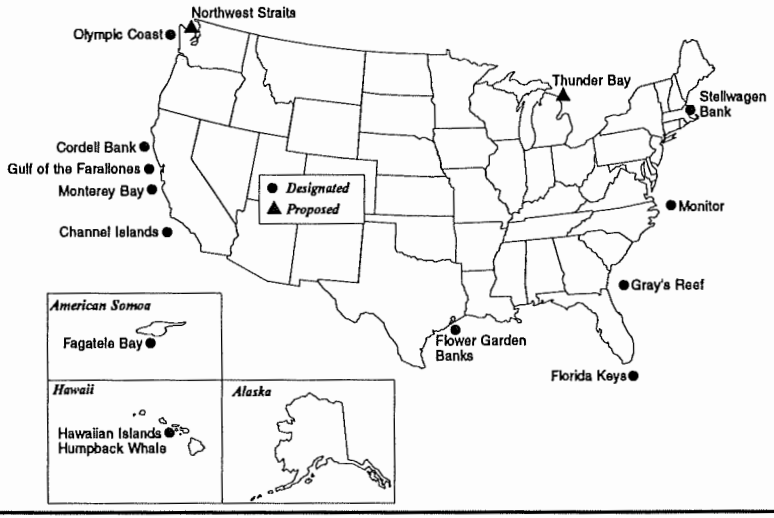
Water Resources Development Act of 1996

The passage of the Water Resources Development Act of 1986 (WRDA 86) marked a milestone in the authorization of future water resources projects, as well as the evolution of overall water

Table 9 National Marine Sanctuaries	
Name of Sanctuary and State	**Designation Date**
Channel Islands National Marine Sanctuary, California	September 1980
Cordell Bank National Marine Sanctuary, California	May 1989
Fagatele Bay National Marine Sanctuary, American Samoa	April 1986
Florida Keys National Marine Sanctuary, Florida	September 1990
Flower Garden Banks National Marine Sanctuary, Louisiana and Texas	January 1992
Gray's Reef National Marine Sanctuary, Georgia	January 1981
Gulf of the Farallones National Marine Sanctuary, California	January 1981
Hawaiian Islands Humpback Whale National Marine Sanctuary, Hawaii	November 1992
Monitor National Marine Sanctuary, North Carolina	January 1975
Monterey Bay National Marine Sanctuary, California	September 1992
Olympic Coast National Marine Sanctuary, WA	July 1994
The Gary E. Studds Stellwagen Bank National Marine Sanctuary, Massachusetts	November 1992

Source: National Marine Sanctuaries Program (no date)

Figure 9
National Marine Sanctuaries



Source: National Marine Sanctuaries Program (no date)

resources policy and direction in the Civil Works Program administered by USACE. Based upon the agreements established in 1986, the administration and Congress agreed to a standardized method of setting and modifying water resources policy and authorizing water resources projects for study or construction. Since WRDA 86, Water Resources Development Acts have been developed every two years (with the exception of 1994), streamlining the congressional and administrative approval process. These WRDAs provide overall water resources policy and direction such as cost-sharing reforms; environmental and engineering initiatives; planning, construction and operational definitions and criteria; and authorizations for new water resources projects.

An example of the evolution of water resources policy is section 1135 of WRDA 86, which authorized the secretary of the Army to modify existing water resources project structures or their operations for the purpose of environmental improvements in the public interest. This provision was passed in response to Congress's desire to have water resources projects become more environmentally compatible, particularly those constructed years ago. In WRDA 96, section 204 expanded the original authorization to include environmental activities either on or off the project site when it is found the USACE project contributed to the degradation of the environment. This modification was developed because simply modifying structures or operations did not adequately address many of the environmental problems identified.

The most current WRDA was passed in 1996 (P.L. 104-303) and is typical of previous WRDAs in that it provides important cost-sharing reforms, environmental initiatives, and new project authorizations to be undertaken by USACE. The act is summarized in the following paragraphs:

- ***Title I, Water Resources Projects***, authorizes the secretary of the Army to carry out nearly 50 specific water resources development and conservation projects for flood control; storm and hurricane damage prevention and reduction;

environmental restoration and protection; erosion protection; hydropower; water supply; and safety improvements.

- ***Title II, General Provisions***, provides 37 specific provisions including cost-sharing reforms for flood control, environmental restoration and environmental protection projects, and dredged material disposal facilities. The new nonfederal cost-sharing requirements for flood control and most environmental restoration projects authorized after this act have been increased to 35 percent. This title also makes cost sharing for the construction of dredged material disposal facilities consistent with the cost sharing for commercial navigation operation and maintenance dredging activities. Some of the more significant environmental provisions in this title include (1) section 204, which expands section 1135 of WRDA 86 to include environmental activities either on or off the project site when it is found the USACE project contributed to the degradation of the environment; (2) section 206, which establishes a small-project authority for aquatic ecosystem restoration projects to improve the quality of the environment in the public interest; and (3) section 207, which directs the secretary to select a beneficial use disposal method that is not the least-cost option if the incremental costs are reasonable in relation to the environmental benefits to be achieved.
- ***Title III, Project Related Provisions***, provides 66 specific project modifications and activities to be conducted by the secretary of the Army via USACE, including additional project purposes, cost-sharing clarifications, and operation and maintenance responsibilities.
- ***Title IV, Studies***, authorizes the secretary of the Army to conduct 46 water resources studies examining the feasibility of providing water resource projects for flood control, navigation, environmental restoration and protection, and erosion control.

- ***Title V, Miscellaneous Provisions***, contains 86 provisions dealing with subjects ranging from naming projects to authorizing the secretary of the Army to continue to participate in the Everglades and South Florida Ecosystem Restoration project.
- ***Title VI, Extension of Expenditure Authority Under the Harbor Maintenance Trust Fund***, amends the Internal Revenue Service code of 1986 to allow the use of the Harbor Maintenance Trust Fund for the operation and maintenance construction of confined disposal facilities.

WRDAs can make a significant contribution to the continued restoration and protection of the nation's coastal resources.

Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) provides for management of the nation's coastal resources, including the Great Lakes, by balancing economic development with environmental preservation. Its goals are "to preserve, protect, develop, enhance, and restore, where possible, the coastal resources."

The National Estuarine Research Reserves system was created in 1972 with the passage of CZMA. The National Estuarine Research Reserves system protects representative estuarine areas through a partnership between NOAA and state governments. Each estuarine reserve has research, education, and monitoring functions that include researching reserve environments, developing student curricula, and tracking the status and trends in coastal ecosystem health. As of January 1998, 22 estuarine reserves had been designated, encompassing more than 425,000 acres of estuarine waters, wetlands, and uplands.

Coastal Zone Management Program

The federal government encourages states to exercise full authority over their coastal lands and waters. CZMA encourages

states to produce and enforce their own coastal zone management programs consistent with the federal law and its goals. The act was intended primarily to change how federal, state, and local agencies and officials manage coastal resources and allocate them among competing users. Under the law, the federal government provides financial assistance to states that develop coastal zone management programs approved by the secretary of commerce.

Once the state program is accepted, the federal government is responsible for ensuring that federal activities on the coast conform to the state program. States with approved plans may object to federal permits for activities that are inconsistent with the state's coastal zone management plan. This section of the law is called the federal "consistency" requirement. It mandates that federal programs or actions be consistent with state federally approved coastal zone management programs. In some cases, federal activities have clashed with state interests, resulting in appeals to the secretary of commerce. Some issues have gone to court for resolution.

The secretary of commerce, through NOAA, periodically evaluates state program performance, and Department of Commerce can withhold federal funds for states not meeting federal standards. Each state program must provide, at a minimum, for standards that (1) protect natural resources and fish and wildlife, (2) manage coastal development, (3) provide public access to the coast for recreational purposes, and (4) include public and local government participation in coastal management decisionmaking. States must submit coastal zone management programs to NOAA for approval to receive federal funds to implement the programs. The programs designate the boundaries of the coastal zone, prioritize land and water uses, and identify critical areas of concern and legislation concerning the coast. Environmental, economic, social, and cultural aspects of the zone are considered, and the programs and their annual implementation plans must identify problems and propose solutions.

The state coastal zone management programs have included efforts to improve governmental decisionmaking, including

expediting and simplifying permit reviews and improving information resources and public participation. CZMA funds have also helped to establish setback lines and erosion protection efforts, revitalize waterfronts, rebuild fishing piers, protect marshes, improve public access to beaches, clean up beaches, and increase tourism benefits to local communities.

Thirty-five states and territories are eligible to participate in the coastal zone management program, which includes the shoreline of the Great Lakes. By January 1998, 32 states had created approved programs covering more than 98 percent of the country's coastline. Minnesota and Indiana are developing coastal zone management programs. Illinois is not pursuing development of a program.

Coastal Nonpoint Pollution Control Program

In 1990, Congress passed the Coastal Zone Act Reauthorization Amendments, adding a section designed to reduce nonpoint source pollution of coastal waters. Section 6217 requires states that have coastal zone management program to develop and implement coastal nonpoint pollution control programs.

Each state's nonpoint source program must be designed with two tiers. The first tier is to develop technology-based management measures that reflect the best available technology for nonpoint sources. These state measures must be "in conformity with" guidance established by EPA for nonpoint pollution sources.

These first-tier management measures should address certain nonpoint pollution sources, such as agricultural runoff, urban runoff, shoreline erosion, and marinas. Management measures in this first tier should address protection of wetlands, riparian habitats, and treatment systems (e.g., filter strips and constructed wetlands).

If, after applying the management measures in the first tier, a state is unable to meet coastal water quality standards and properly protect certain coastal areas, it next must implement a second tier

of more stringent management measures. State nonpoint source programs must be submitted to NOAA and EPA for review and approval. If a state does not submit a program, a portion of the coastal zone management program funding and funding under section 319 of the CWA is reduced.

Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act (MMPA) of 1972 was reauthorized in 1994 (P.L. 103-238). The act provides for conservation and management of marine mammals under U.S. jurisdiction. It establishes a moratorium on the "taking"—meaning "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill"—of marine mammals. The act also authorizes the collection of animals from the wild for scientific research or public display or to enhance the survival of a species or stock. The 1994 amendments allow the incidental taking of marine mammals "in the course of commercial fishing operations." However, the amendments now have specific habitat protection provisions that restrict taking activity if it adversely affects species, stock, or habitat (rookeries, mating grounds, or similar areas).

Alaska Native organizations are now eligible for grants to (1) collect and analyze data on marine mammal populations; (2) monitor the harvest of marine mammals for subsistence use; (3) participate in marine mammal research conducted by the federal government, states, academic institutions, and private organizations; and (4) develop marine mammal comanagement structures with federal and state agencies.

The Department of Commerce's National Marine Fisheries Service (NMFS) and the Department of the Interior's Fish and Wildlife Service (FWS) oversee the law. NMFS is responsible for seals, sea lions, porpoises, and whales, and FWS is responsible for sea otters, polar bears, walruses, dugongs, and manatees.

A Marine Mammal Commission (MMC) established under the law makes recommendations to the commerce and interior secretaries and other federal officials on protecting and conserving marine mammals. The MMC consists of three commissioners, full-time staff, an advisory committee, and a Committee of Scientific Advisors on Marine Mammals (which consists of nine scientists).

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 extends federal fishery jurisdiction to 200 miles offshore. The law provides for fishery management authority in affected waters and limits bycatch or "fish which are harvested in a fishery, but which are not sold or kept for personal use ...." In 1996, the amendments to the act (P.L. 104-297) included preventing overfishing, rebuilding depleted stocks, reducing bycatch, and designating and conserving "essential fish habitat."

Under the "Magnuson-Stevens Act," as it is frequently called, the U.S. Department of State, in cooperation with NOAA, negotiates Governing International Fishery Agreements (GIFA) with foreign nations wanting to fish within the 200-mile exclusive economic zone. Those agreements are subject to presidential and congressional review.

Vessels of nations that have a GIFA with the United States may fish in the Magnuson-Stevens 200-mile zone for species managed under the act after they have been issued an allocation of that species and a valid fishing permit. After a GIFA is in force, a foreign nation must submit a permit application to the State Department for each vessel to fish or conduct other operations related to fishing.

The act also establishes eight regional councils charged with preparing fishery management plans for fisheries they determine require active federal management. These plans seek to prevent

overfishing, while allowing for maximum harvesting of fish based upon the best scientific information available. The plans are submitted to the secretary of commerce for approval and implementation.

Amendments to the act require NMFS to describe, identify, conserve, and enhance "essential fish habitat," defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Fishery management plans are now required to include essential fish habitat provisions.

Endangered Species Act

The 1973 Endangered Species Act (ESA) was enacted to protect endangered or threatened species. The act is administered by the Department of Commerce through NMFS and the Department of the Interior through FWS. These departments also designate critical habitat for listed species.

The law prohibits taking, importing, exporting, selling, transporting, or possessing any illegally acquired species listed as endangered. The exceptions are for scientific research or species enhancement, which requires a permit.

The FWS and NMFS are required to make a public list of all threatened species and review it every five years to determine if any species can be removed or changed in status. The agencies must prepare recovery plans for listed species. The law authorizes civil and criminal penalties and gives federal and state agencies enforcement authority. (See chapter 4, table 7, for a list of marine endangered species.)

National Invasive Species Act of 1996

The National Invasive Species Act calls for more widespread efforts to prevent the introduction and spread of nonindigenous or "nuisance" species into U.S. waters via the ballast waters of

commercial vessels. The act reauthorizes and amends the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. Its key provisions are to examine attributes and patterns of nonindigenous species invasions and the effectiveness of ballast management. It also stipulates that the Department of Transportation issue guidelines to control zebra mussels and other aquatic nuisance species introduced by recreational activities. EPA is authorized to fund research grants to identify methods for controlling the spread of invading species.

Oil Pollution Act of 1990

The *Exxon Valdez* oil spill in Alaska's Prince William Sound in March 1989 has had a profound effect on environmental management and policy issues. In response to the extensive media coverage and public interest attending the spill, Congress in 1990 enacted the Oil Pollution Act of 1990 (OPA).

The law combines various oil spill response mechanisms from the CWA, the Deepwater Port Act of 1974, the Trans-Alaska Pipeline Act, and the Outer Continental Shelf Lands Act, among others. It seeks to harmonize these federal laws with state laws, international conventions, and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA, or Superfund).

The act addresses oil discharges to navigable waters and shorelines. It requires that emergency response plans be prepared that detail steps to be taken in the event of a spill. OPA raises liability limits in cases involving gross negligence or willful misconduct and expands cleanup and economic damage collections. The act creates an Oil Spill Liability Trust Fund to pay for removal costs and damages if the government is unable to collect cleanup costs from the liable party. In 1996, OPA amendments (P.L. 104-324) revised the financial responsibility requirements for offshore facilities and provided for the payment of interim, short-term damages.

The law authorizes the federal government to order or conduct removal actions, strengthens prevention control requirements for vessels and facilities, and provides for tougher criminal penalties and higher civil penalties for spills. The law also imposes tighter standards and reviews for licensing of tank vessel personnel, making it easier to suspend, revoke, or terminate such licenses. The 1996 amendments expand research and training on oil discharge removal.

The law requires the phasing out of single-hulled tank vessels. By the year 2015, all tankers in U.S. waters must have double hulls. All new (and some existing) oil tankers and barges operating in U.S. waters are required to have double hulls. New vessels of less than 5,000 gross tons, such as inland barges, must have some form of double containment, though not necessarily double hulls.

OPA also provides for emergency response planning. It mandates the Coast Guard to establish a National Response Unit and smaller response units for each of the 10 Coast Guard districts to coordinate equipment used in spill cleanup. The law requires EPA and the Coast Guard to oversee creation of contingency plans for specific areas to deal with worst-case-scenario oil spills.

The National Contingency Plan (NCP), a series of regulations under the act, provides a method of ranking waste sites for inventory and cleanup. In addition, the NCP suggests techniques for cleanup and coordinates intergovernmental cleanup activities. States play an active role in developing contingency plans, including natural resource recovery plans.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (P.L. 96-510) established the Superfund program and trust fund. This program provides for cleanup and emergency response for hazardous substances released into the

environment, as well as the cleanup of inactive hazardous waste disposal sites. EPA administers the Superfund program and is responsible for adding hazardous wastes sites to the National Priorities List. A site must be on this list to receive money from the trust fund for long-term (nonemergency) cleanup.

The basic purpose of this statute is to respond to past releases of hazardous substances into the air, water, or land. However, the OPA handles petroleum and oil spills. EPA can order responsible parties to take appropriate removal and remedial actions. If responsible parties do not respond, EPA can use federal funds to perform the necessary work and then recover expenses through litigation. If no "potentially responsible party" (PRP) exists or can be located, the cleanup funds come from the Superfund trust fund.

EPA investigates spill and contamination reports and determines PRPs, penalties, and liability assessments. The Coast Guard is the lead agency for coastal spills and monitors or supervises these cleanups. The Coast Guard is usually the first agency contacted about a marine spill, and it is responsible for notifying other federal, state, and local agencies. The Coast Guard also supports regional and national emergency response teams and develops and maintains chemical assessment databases.

Table 10
Key Federal Authorities and Programs

U.S. Department of Agriculture (USDA)

Scope	Legislative Authority	Major Programs/Activities
Surface water pollution due to agriculture runoff (mitigation of adverse effects of land management activities)	Department of Agriculture Organic Act 16 U.S.C. 500 *et seq.*	• Promotes nonpoint source contaminants research • Establishes Habitat Modification Program
	Water Quality Initiative Food, Agriculture, Conservation, and Trade Act of 1990	• Establishes Point Source Contamination Program to investigate chemicals in bottom sediment • Promotes watershed projects to enhance water quality • Establishes Watershed Protection and Flood Prevention Program • Establishes Rural Abandoned Mine Program
	Federal Agriculture Improvement and Reform Act of 1996	• Establishes Environmental Quality Incentives • Establishes Conservation Farm Option
Wetlands protection	Water Bank Act (P.L. 91-559) 16 U.S.C. 1301-11, 150 & 03	• Preserves, restores, and improves wetlands • Avoids conservation assessments
	Food Security Act of 1985 (P.L. 99-196) 16 U.S.C. 3801 *et seq.*	• Establishes Wetlands Conservation Program • Establishes Conservation Compliance Program • Establishes Conservation Reserve Program • Establishes Sodbuster Program • Establishes Swampbuster Program
	Food, Agriculture, Conservation, and Trade Act of 1990	Establishes Wetlands Reserve Program
	Federal Agriculture Improvement and Reform Act of 1996	Establishes Wildlife Habitat Incentives Program

Department of the Army, U.S. Army Corps of Engineers

Scope	Legislative Authority	Major Programs/Activities
Wetlands	Clean Water Act (P.L. 92-500) Coastal Wetlands Planning, Protection, and Restoration Act	Regulates section 404 dredged and fill materials permits (jointly implemented with EPA) Exercises authority to create wetlands across the United States and specifically in Louisiana
Environmental restoration	Water Resources Development Act	• Modifies existing projects on or off project site or operations for environmental improvement (section 1135 (1986)) • Authorizes development projects for environmental purposes (section 704 (1986)) • Authorizes the use of dredged material for beneficial uses (section 204 (1992)) • Authorizes environmental dredging as part of the operations and maintenance of federal navigation projects and in nonproject-specific waters of the United States (section 205 (1996)) • Authorizes small aquatic ecosystem restoration projects to improve the quality of the environment if they are cost-effective and in the public interest (section 206 (1996))
Environmental protection	Water Resources Development Act of 1990	Authorizes protection of the environment as a major mission of the USACE (section 306)
Wetlands conservation	Water Resources Development Act of 1976 (P.L. 94-587) 42 U.S.C. 1962d-5f	Authorizes the use of dredged material for wetlands creation (section 150)
Avoiding obstructions to navigation	River and Harbors Appropriation Act of 1899, 33 U.S.C. 401	Regulates construction activities in and adjoining navigable waters that alter the course, condition, location, or capacity of such waters

Department of the Army, U.S. Army Corps of Engineers

Scope	Legislative Authority	Major Programs/Activities
Regulation of ocean dumping of dredged materials	Marine Protection, Research, and Sanctuaries Act (P.L. 92-532) 33 U.S.C 1401 *et seq.*	Authorizes the USACE to issue ocean dumping permits subject to environmental criteria (section 103)
Fish and wildlife mitigation	Water Resources Development Act of 1986 (P.L. 99-622), 33 U.S.C. 2201-2283 Fish and Wildlife Coordination Act of 1958 (P.L. 85-624), 16 U.S.C. 661-666c.	Mitigates fish and wildlife losses associated with authorized water resources projects, including the acquisition of lands or interests in lands (section 906) Provides for consultation with FWS and mitigates and enhances fish and wildlife resources
Navigable waters	Rivers and Harbors Act of 1899 Section 10 and 13	Authorizes USACE to issue navigable water structure permits
Nonindigenous aquatic species	National Invasive Species Act (P.L. 104-332)	• Establishes a broad, federal program to prevent the introduction of and to control introduced aquatic nuisance species • Authorizes EPA to award research grants for controlling the spread of invading species (jointly administered with EPA, NOAA, FWS, USACE, and U.S. Coast Guard)

U.S. Department of Commerce, National Oceanic and Atmospheric Administration

Scope	Legislative Authority	Major Programs/Activities
Marine mammals	Marine Mammal Protection Act of 1972 (P.L. 92-522) 16 U.S.C. 1361 *et seq.*	Prohibits or strictly regulates the direct or indirect taking or importation of marine mammals
	Fur Seal Act of 1966 (P.L. 89-702) 16 U.S.C. 1151 *et seq.*	Prohibits the taking of fur seals on lands or waters under U.S. jurisdiction
	Whale Conservation and Protection Study Act (P.L. 94-532)	Authorized a study of whales in coastal areas in the late 1970s
Anadromous fish	Anadromous Fish Conservation Act of 1965 (P.L. 89-304) 16 U.S.C. 757a-757g	Conserves, develops, and enhances anadromous fishery resources
	Salmon and Steelhead Conservation and Enhancement Act (P.L. 96-561) 16 U.S.C. 3301-3371	Manages and enhances salmon and steelhead stocks jointly with the Department of the Interior
	Atlantic Striped Bass Conservation Act (P.L. 89-304) 16 U.S.C. 757g	Evaluates population status and determines need for a moratorium on takes
	Federal Paver Act (P.L. 95-617) 16 U.S.C. 791a *et seq.*	• Protects, mitigates damages to, and enhances fish (including habitat and spawning grounds) • Prescribes fishways for nonfederal hydropower projects
Great Lakes Research	Clean Water Act (P.L. 92-500) 33 U.S.C. 1268	Establishes a Great Lakes National Program Office

U.S. Department of Commerce, National Oceanic and Atmospheric Administration

Threatened and endangered species and their critical habitats	Endangered Species Act of 1973 (P.L. 93-205) 16 U.S.C. 1531 *et seq.*	Ensures that any action authorized, funded, or carried out by any federal agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in habitat destruction or modification critical to such species
Marine fisheries	Magnuson-Stevens Fishery Conservation and Management Act (P.L. 104-297) 16 U.S.C. 1801 *et seq.* Interjurisdictional Fisheries Act (P.L. 99-659) 16 U.S.C. 4101-4107 North Pacific Fisheries Act of 1954 (P.L. 85-114) 16 U.S.C. 1021 *et seq.* North Pacific Halibut Act of 1982 16 U.S.C. 773 *et seq.*	Conserves and manages fish stocks throughout a 200-mile U.S. Fishery Conservation Zone by developing fishery management plans and designating essential fish habitat Promotes and encourages the management of interjurisdictional fishery resources Enforces International Convention for the High Seas Fisheries of the North Pacific Ocean Enforces the convention between the United States and Canada for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea
Marine sanctuaries	Marine Protection, Research, and Sanctuaries Act (Title III) (P.L. 104-283) 16 U.S.C. 1431 *et seq.*	Manages designated marine areas that are special due to their natural or human-use values through the National Marine Sanctuary Program
Deep seabed minerals	Deep Seabed Hard Minerals Resources Act (P.L. 96-283)	Licenses consortia to mine hard minerals beyond the continental shelf
Ocean thermal energy	Ocean Thermal Energy Conversion Act (P.L. 96-326)	Licenses the construction and operation of ocean thermal energy conversion plants
Nonindigenous aquatic species	National Invasive Species Act (P.L. 104-332)	• Establishes a broad, federal program to prevent the introduction of and to control introduced aquatic nuisance species • Authorizes EPA to award research grants for controlling the spread of invading species (jointly administered with EPA, NOAA, FWS, USACE, and U.S. Coast Guard)

U.S. Department of Commerce, National Oceanic and Atmospheric Administration

Scope	Legislative Authority	Major Programs/Activities
Coastal zone management	Coastal Zone Management Act of 1972 (P.L. 104-150) 16 U.S.C. 1451 *et seq.*	• Manages coastal zone management grants • Reviews and approves state coastal zone management plans • Provides federal consistency determination • Reviews state performance • Manages National Estuarine Research Reserve System • Oversees coastal nonpoint source pollution control program (6217 provisions—1990 Reauthorization Amendments) • Encourages state/federal partnership programs to provide for sustainable development of coastal areas, conservation of coastal resources through coastal zone management programs, and establishment of biogeographically representative estuarine areas as national estuarine research reserves for long-term research and education
Nonpoint source pollution	Coastal Zone Act Reauthorization Amendments of 1990 (P.L. 101-508) 16 U.S.C. 1455b	Establishes Coast Nonpoint Pollution Control Program (jointly implemented with EPA)

U.S. Department of Health and Human Services, U.S. Food and Drug Administration

Scope	Legislative Authority	Major Programs/Activities
Fish and shellfish market safety	Federal Food, Drug, and Cosmetic Act 21 U.S.C. 301-392	• Sets standards of quality for foods, including seafood • Sets "action levels" and "tolerances" for unavoidable contaminants in foods, including seafood
Interstate safety	Pubic Health Service Act 42 U.S.C. 201 *et seq.*	• Provides federal assistance to states to prevent the interstate transmission of disease • Establishes Interstate Shellfish Sanitation Program
Anadromous fish conservation	Anadromous Fish Conservation Act (P.L. 89-304) 16 U.S.C. 7571	Provides enforcement actions to eliminate or reduce polluting substances detrimental to fish and wildlife in interstate or navigable waters

U.S. Department of the Interior, U.S. Fish and Wildlife Service

Scope	Legislative Authority	Major Programs/Activities
Water quality	Clean Water Act (P.L. 92-500) 33 U.S.C. 1285	Promotes development of best management practices as part of its water control programs
Oil spill response	Oil Pollution Act of 1990 as amended (P.L. 104-324)	Assesses natural resource damages and enhances capabilities for oil spill response
Land and water conservation	Land and Water Conservation Fund Act (P.L. 88-578) 16 U.S.C. 4601-4 -11	Establishes a fund to acquire land or waters, or interests in land or waters, to promote outdoor recreation opportunities
Coastal barrier islands	Coastal Barrier Improvement Act of 1990 (P.L. 101-591) 16 U.S.C. 3501-3510	• Establishes coastal barrier resources system • Regulates growth of undeveloped coastal barriers and associated aquatic habitats • Restricts federally subsidized development of underdeveloped coastal barriers
Threatened and endangered species and their critical habitat	Endangered Species Act of 1973 (P.L. 93-205) 16 U.S.C. 1531-1543	Ensures that any action authorized, funded, or carried out by any federal agency should not be likely to jeopardize continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat critical to such species
Estuarine areas	Estuary Protection Act (P.L. 90-454) 16. U.S.C. 1221 *et seq.*	Conserves estuarine areas
Wetlands conservation	North American Wetlands Conservation Act (P.L. 101-233) Coastal Wetlands Planning, Protection, and Restoration Act of 1990, Title III (P.L. 101-646) 16 U.S.C. 3951 *et seq.*	• Funds the purchase of critical wetlands in the United States, Canada, and Mexico • Matches funds for wetlands conservation projects in North America • Encourages wetlands conservation and planning in U.S. coastal areas • Provides state grants for wetlands conservation
Marine mammals	Marine Mammal Protection Act of 1972 (P.L. 92-522)	Prohibits or strictly regulates direct or indirect taking or importation of marine mammals

U.S. Department of the Interior, U.S. Fish and Wildlife Service

Scope	Legislative Authority	Major Programs/Activities
Migratory birds	Migratory Bird Hunting and Conservation Stamp Act (P.L. 85-585)	Uses hunting stamp funds to acquire bird refuges and waterfowl production areas
	Migratory Bird Conservation Act (P.L. 87-812) 16 U.S.C. 715-715s	Acquires areas to manage and protect migratory birds
	Migratory Bird Treaty Act (P.L. 86-732) 16 U.S.C. 701-711	Prohibits the taking of migratory birds protected under treaties with Great Britain, Mexico, and Japan
Fish and wildlife conservation	Fish and Wildlife Coordination Act of 1958 (P.L. 85-624) 16 U.S.C. 661- 666c	Provides consultation when a federal agency or federal permittee proposes to modify a body of water
	Fish and Wildlife Conservation Act 2901 *et seq.*	Promotes conservation and promotion of nongame fish and wildlife and their habitats, including providing grants to states
	Fish Restoration and Management Projects Act (P.L. 91-503) 16 U.S.C. 777-7771	Funds state programs to restore and manage fishery resources
	National Wildlife Refuge System Improvement Act of 1997	Formally establishes conservation programs and allows restoration of habitats for fish, wildlife, and plants
	Federal Water Project Recreation Act (P.L. 94-576) 16 U.S.C. 460	Provides federal funds to enhance fish and wildlife and acquire land for these same purposes in conjunction with federal water development projects
	Fish and Wildlife Act of 1956, as amended 16 U.S.C 742a-j	Establishes a comprehensive national fish, shellfish, and wildlife resources policy emphasizing commercial fishing industry (transfers responsibilities from FWS to NOAA for commercial and marine sportfish, except for the Great Lakes)
	Great Lakes Fish and Wildlife Restoration Act of 1990 (P.L. 101-537) 16 U.S.C. 941	• Develops restoration strategies for Great Lakes fish and wildlife • Provides for planning, development, and maintenance of fish and wildlife on military lands

U.S. Department of the Interior, U.S. Fish and Wildlife Service

Scope	Legislative Authority	Major Programs/Activities
Fish and wildlife conservation, continued	Sikes Act (P.L. 86-797) 16 U.S.C. 670a-o	Provides cooperation with the Department of Defense in planning, developing, and maintaining fish and wildlife resources on military reservations throughout the United States
Nonindigenous aquatic species	National Invasive Species Act (P.L. 104-332)	• Establishes a broad, federal program to prevent the introduction of and to control introduced aquatic nuisance species • Authorizes EPA to award research grants for controlling the spread of invading species (jointly administered with EPA, NOAA, FWS, USACE, and U.S. Coast Guard)
Anadromous fish	Anadromous Fish Conservation Act of 1965 (P.L. 89-304)	Conserves, develops, and enhances anadromous fishery resources
	Atlantic Striped Bass Conservation Act	Evaluates the population status and determines the need for a moratorium on takes
	New England Fishery Resources Restoration Act of 1990 (P.L. 101-593)	Establishes cooperative programs to restore and maintain nationally significant and interjurisdictional fishes of New England river systems
	Klamath River Basin Fish Resources Restoration Act (P.L. 99-552)	Establishes a 20-year program to restore and maintain anadromous fish population of the Klamath River Basin
	Trinity River Basin Fish and Wildlife Restoration (P.L. 98-541)	Restores fish and wildlife populations damaged as a result of the construction of Trinity Dam
	Mitchell Act (16 U.S.C. 755-757)	Funds salmon smolt production in national fish hatcheries in the Columbia River Basin
Anadromous fish and wetlands in California	Omnibus Water Reclamation Act of 1992, Title 34	Provides an opportunity for restoring anadromous fish and wetlands in conjunction with Bureau of Reclamation projects

U.S. Department of the Interior, Minerals Management Service

Scope	Legislative Authority	Major Programs/Activities
Outer continental shelf	Outer Continental Shelf Lands Act	Manages the outer continental shelf, including leasing to private companies for oil and gas exploration and development

U.S. Department of Transportation

Scope	Legislative Authority	Major Programs/Activities
Marine life conservation and wetland protection and restoration	Reefs for Marine Life Conservation (P.L. 92-402)	Uses obsolete ships as artificial reefs to conserve marine life
	National Fishing Enhancement Act of 1964 (P.L. 98-623)	• Establishes fishery agreements with Iceland and the European Economic Community • Requires artificial reef construction to enhance fishery resources
	Intermodal Surface Transportation Efficiency Act (P.L. 102-240) Pending Reauthorization	Allows state transportation agencies to contribute highway funds to wetland conservation and mitigation efforts and wetland mitigation banks
	Oil Pollution Act of 1990, as amended (P.L. 104-324)	• Addresses oil discharges to navigable waters and shorelines • Raises liability limits in cases of gross negligence or willful misconduct • Expands cleanup and economic damage collections
	Rivers and Harbors Act of 1899	• Enhances transportation activities • Responds to marine pollution
	Act to Prevent Pollution from Ships, as amended (P.L. 104-324)	Controls discharges of operational wastes from ships
	Ports and Waterways Safety Act of 1972, as amended (P.L. 104-324)	• Finances cleanup operations from federal trust fund • Develops new preventative and contingency planning requirements for oil pollution

U.S. Department of Transportation

Scope	Legislative Authority	Major Programs/Activities
Marine life conservation and wetland protection and restoration, continued	Federal Water Pollution Control Act of 1972	• Promulgates and enforces comprehensive pollution prevention regulations for shipboard and waterfront facilities • Requires all transportation-related, onshore facilities (tank trucks, rail cars, and pipelines) to have response plans and discharge removal equipment for responding to oil spills
	Department of Transportation Act	Provides that the Department of Transportation may approve the use of a publicly owned park, recreation area, wildlife or waterfowl refuge, or any historic site only if there is no feasible alternative and if all possible planning to minimize harm is done (Section 4(f))
	Airport and Airway Improvement Act, as amended	Provides that grants for airport development may not be approved unless certain conditions and environmental standards are met
	Hazardous Materials Transportation and Uniform Safety Act and Hazardous Materials Transportation Act	• Regulates transportation of hazardous materials • Imposes standards on states for setting hazardous materials transportation routes • Trains local officials on response to hazardous materials transportation incidents
Nonindigenous aquatic species	National Invasive Species Act (P.L. 104-332)	• Establishes a broad, federal program to prevent the introduction of and to control introduced aquatic nuisance species • Authorizes EPA to award research grants for controlling the spread of invading species (jointly administered with EPA, NOAA, FWS, USACE, and U.S. Coast Guard)

U.S. Environmental Protection Agency (EPA)

Scope	Legislative Authority	Major Programs/Activities
Water quality	Clean Water Act (P.L. 92-500) 33 U.S.C. 1251 *et seq.*	• Establishes National Estuary Program • Establishes discharge permits (NPDES) program • Establishes oil and hazardous substance spill programs • Establishes toxic (priority) pollutant and pretreatment programs • Establishes ocean discharge criteria • Establishes nonpoint source control program • Establishes Chesapeake Bay Program • Regulates combined sewer overflow in estuaries • Establishes individual control strategies for toxic pollutants • Develops contaminated sediment strategy • Establishes Gulf of Mexico Program • Establishes Great Lakes Program • Authorizes dredged and fill material permits for wetlands (jointly implemented with the USACE) (section 404) • Authorizes secondary treatment waivers • Regulates vessel sewage discharge
Ocean dumping	Marine Protection, Research, and Sanctuaries Act (P.L. 92-532) 33 U.S.C. 1401 *et seq.*	• Establishes environmental criteria to evaluate permit applications • Designates ocean dumpsites for dredged material • Reviews USACE permits for dredged material ocean dumping

U.S. Environmental Protection Agency (EPA)

New hazardous chemical substances and mixtures	Toxic Substances Control Act (P.L. 94-469) 15 U.S.C. 2601	• Regulates the introduction of new hazardous chemical substances and mixtures • Maintains health and environmental data on toxic substances • Avoids unreasonable risk of injury to health and environment
Pesticides	Federal Insecticide, Fungicide, and Rodenticide Act (P.L. 92-516) 7 U.S.C. 136 *et seq.*	• Allows EPA to deny or cancel registrations of pesticides whose use would/does cause fish contamination • Collects data on pesticides that may be causing fish contamination • Sets "action levels" or "tolerances" for unavoidable pesticide contaminants in fish and shellfish
Coastal litter and pollution	Shore Protection Act of 1988 (P.L. 100-688) 33 U.S.C. 1401 *et seq.*	Regulates waste-handling practices by waste sources, vessels, and receiving facilities to minimize deposition of waste into coastal waters
Nonpoint source pollution	Coastal Zone Act Reauthorization Amendments of 1990 (P.L. 101-508) 16 U.S.C. 1455b	Establishes Coast Nonpoint Pollution Control Program (jointly implemented with NOAA)
Environmental impacts of proposed federal activities	National Environmental Policy Act	Requires submission of environmental impact statement for all major federal actions that may significantly affect the quality of the human environment
Nonindigenous aquatic species	National Invasive Species Act (P.L. 104-332)	• Establishes a broad, federal program to prevent the introduction of and to control introduced aquatic nuisance species • Authorizes EPA to award research grants for controlling the spread of invading species (jointly administered with EPA, NOAA, FWS, USACE, and U.S. Coast Guard)

Appendix A
Additional Laws and Programs

Rivers and Harbors Act of 1899

The Rivers and Harbors Act is administered by the U.S. Army Corps of Engineers (USACE). It prohibits the building of causeways, dams, or dikes in or over navigable waters without USACE approval. Section 10 of the law requires permits for structures or work in or affecting navigable U.S. waters, such as boat docks or bulkheads. When a permit under section 404 of the Clean Water Act (CWA) is required, a section 10 permit is required as well.

Section 13 of the Rivers and Harbors Act prohibits throwing, discharging, or depositing any refuse matter, other than that flowing from streets and sewers and passing into a liquid state, into navigable waters or their tributaries. This prohibition does not extend to operations designed to improve navigation or the construction of public works.

Prior to passage of the 1972 Federal Water Pollution Control Act Amendments, the 1899 Rivers and Harbors Act provided the primary federal basis for managing and regulating dredge and fill activities in wetlands. The 1972 Federal Water Pollution Control Act supersedes this law in that respect.

Submerged Lands Act

The Submerged Lands Act of 1953 recognizes state authority over submerged lands extending out to three geographical miles into the Atlantic and Pacific Oceans and three marine leagues into the Gulf of Mexico from the coastline. The lands beneath navigable waters are defined as (1) lands within state boundaries that were navigable when the state became a member of the Union, (2) lands periodically or permanently covered by tidal waters, or

(3) lands that were filled in or reclaimed lands that were formerly beneath navigable waters.

The federal government retains certain rights to use the submerged lands for commerce, navigation, defense, and international affairs, but not the rights of ownership or management that were specifically granted in the act.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act of 1934 authorizes the secretaries of commerce and agriculture "to provide assistance to and cooperate with federal and state agencies to protect, rear, stock, and increase the supply of game and fur-bearing animals, as well as to study the effects of domestic sewage, trade wastes, and other polluting substances on wildlife."

Amendments passed in 1958 provide for the Fish and Wildlife Service (FWS) to review proposed federal actions that may affect a stream, wetland, or other body of water, and recommend ways to conserve fish and wildlife. FWS reviews development and regulatory actions. It also authorizes the secretary of the interior to provide public fishing areas and accept donations of lands and funds.

The act further requires the FWS to investigate the effects of water pollution on fish and wildlife, including

- ❑ Determining standards for water quality for maintaining fish and wildlife
- ❑ Studying methods of abating and preventing pollution and recovering useful products
- ❑ Collecting and distributing data on the results of the investigations

Land and Water Conservation Fund Act

The Land and Water Conservation Fund Act of 1965 seeks to ensure that present and future generations will have adequate outdoor recreational resources. The act mandates that governments and private interests conserve, develop, and use such resources for public benefit and enjoyment.

The act authorizes the Land and Water Conservation Fund to be collected from surplus property sales, motorboat fuel taxes, certain revenues authorized from the Outer Continental Shelf Lands Act, and user fees at designated National Park System "units." It authorizes the Interior Department to acquire lands or allocate funds to states to carry out the act.

Outer Continental Shelf Lands Act

The outer continental shelf (OCS) is an undersea land lying seaward and generally beyond the three-mile seaward boundaries of the states. This area sometimes contains oil and gas reserves. The federal government, which administers control through the Department of the Interior's Minerals Management Service (MMS), has exclusive jurisdiction of this subsoil and seabed, which it leases to private companies for exploration, drilling, and production.

The OCS encompasses about 1.4 billion acres, and as of 30 September 1997, approximately 35 million acres were under lease for natural gas and oil development, exploration, and production. Rents, royalties, and other revenues from these lease activities are the source of billions of dollars to the U.S. Treasury and various funds—approximately $3.75 billion in fiscal year 1996.

The Outer Continental Shelf Lands Act requires the Interior Department to develop and maintain estimates of reserves and undiscovered resources in the OCS. The department must assess

the likely effects of gas and oil activities on marine, coastal, and human environments. It administers competitive lease sales of offshore tracts and regulates OCS activities to ensure safety and environmental protection. In the case of OCS sand, gravel, and shell resources, the department is authorized to negotiate agreements with any person to use these resources for either shore protection or beach/wetland restoration or for a construction project funded at least in part by the federal government.

Activities that threaten to harm life or the environment may be suspended by the secretary of the interior, although no such action has yet been taken on the basis of potential environmental damage. In accordance with the National Environmental Policy Act, areas being considered for mineral leases must be studied for the potential environmental effects of exploration and production activities on the human, marine, and coastal environments of the OCS. Holders of leases and permits must operate in compliance with environmental protection regulations.

The Coast Guard inspects OCS facilities and investigates major oil spills, fires, deaths, or serious injuries. The law provides for penalties and remedies for violations.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) of 1976 establishes the federal program regulating solid and hazardous waste management. Just as Superfund is designed to clean up existing and abandoned hazardous waste sites, RCRA is intended to prevent the creation of new comparable risks to human health resulting from improper hazardous waste disposal. The law establishes a "cradle-to-grave" system to track hazardous wastes from generation to final disposal.

New hazardous waste landfills must obtain a permit from the U.S. Environmental Protection Agency (EPA) or an authorized

state, and existing landfills must meet minimum technology requirements. Amendments passed in 1984 and other policies include the following provisions:

- ❑ Controls on leaking underground storage tanks
- ❑ Incentives for using alternative waste disposal methods such as waste reduction, recycling, and resource recovery
- ❑ New technology requirements for disposal methods such as incineration and resource recovery, as well as landfills
- ❑ Identification of hazardous wastes so they can be disposed of separately from nonhazardous materials
- ❑ New public participation rights for citizen involvement in RCRA permits and the right to sue EPA for adequate enforcement of RCRA requirements

Major sections of RCRA are described in the following paragraphs.

Underground Storage Tank Provisions

RCRA was amended in 1984 to address underground storage tanks. Subtitle I of RCRA, administered primarily by states, is intended to prevent groundwater contamination from leaking underground storage tanks. Under the law, underground storage tanks are required to have spill and overfill prevention devices, as well as leak detection devices. Owners and operators are required to clean up contamination from leaking tanks. Some states, such as California and Florida, have more stringent regulations requiring secondary containment of tanks and piping.

Medical Waste Provision

RCRA Subtitle J, the Medical Waste Tracking Act, became law in 1988. The act passed, in part, in response to media attention to medical wastes along the New Jersey shoreline and the resulting temporary beach closings along the East Coast in the summer of

1988. The act established a two-year demonstration tracking program as a first step in controlling irresponsible disposal of medical wastes. The demonstration program addressed institutional and commercial medical waste, but not household or individual medical waste.

Federal Facility Compliance Act

RCRA was amended in 1992 by the Federal Facility Compliance Act of 1992. This amendment waives the government's sovereign immunity from prosecution under RCRA. As a result, the Department of Justice can issue and enforce injunctions, administrative orders, or penalties for noncompliance with RCRA against facilities, departments, and agencies.

Land Disposal Program Flexibility Act

In 1996, RCRA was amended by the Land Disposal Program Flexibility Act (P.L. 104-119). This act exempts hazardous waste from RCRA regulation if it is treated to a point where it no longer exhibits the characteristic that made it hazardous. The waste must also be disposed of in a facility regulated under the CWA or in a Class I deep injection well regulated under the Safe Drinking Water Act.

Outer Continental Shelf Lands Act Amendments of 1978

Responding to the "energy crisis" and resulting lines for gasoline in the mid-1970s, Congress amended the Outer Continental Shelf Lands Act in 1978. The amendments expedite OCS exploration and development while increasing state participation in OCS decisionmaking.

The act seeks to minimize conflicts between oil and gas activities and fishing interests and establishes a fisherman's contingency fund to pay for damaged vessels and gear resulting from

OCS activities. The amendments, later superseded by the Oil Pollution Act of 1990 (P.L. 101-380), also established the Offshore Oil Pollution Compensation Fund. This fund receives fees collected from OCS oil production to finance cleanup of oil spills and pay for damages to natural resources and property. Offshore facility operators who cause oil pollution are liable for removal costs and damages.

Coastal Barriers Resources Act/Improvement Act

The Coastal Barriers Resources Act of 1982 addresses coastal barrier islands of the Atlantic and Gulf coasts. It seeks to minimize the loss of human life and reduce damage to fish and wildlife habitats of the coastal barrier islands by restricting federal expenditures and financial assistance that encourage development on those islands. The Coastal Barriers Improvement Act of 1990 expands the definition of a coastal barrier and adds areas in Puerto Rico, the U.S. Virgin Islands, the Great Lakes, and additional areas along the Atlantic and Gulf coasts

The law forbids the use of major types of federal funds such as loans, grants, and insurance for promoting development and economic growth within certain areas of the fragile, unstable, and vulnerable barrier islands coastal system. Flood insurance, USACE development projects, and Department of Veterans Affairs and Federal Housing Administration loans, as well as federal assistance for the construction of sewer systems, highways, water supply systems, airports, bridges, and jetties, are no longer allowed in these areas.

The act also requires federal agencies to consult with the FWS prior to obligating funding or performing any activities within units of the system.

The act establishes the Coastal Barrier Resources System, a network of undeveloped coastal barrier units, located along the coast from Maine to Texas, that are targeted for protection. Initially

the system included approximately 452,000 acres of natural barriers. As of 1998, it included nearly 1.3 million acres. Massachusetts, Florida, and Texas have large protected areas.

The act is not designed to penalize existing communities, and it applies only to a specified group of largely undeveloped barrier islands. The act continues to allow federal assistance for certain purposes including energy exploration, extraction, or transportation; military activities essential to national security; and Coast Guard facilities.

Safe Drinking Water Act of 1974

The Safe Drinking Water Act of 1974 (P.L. 93-523) requires EPA to establish national standards for drinking water. The law is administered by states that have demonstrated that their programs meet federal requirements. EPA administers the law in states that do not have programs that meet federal requirements.

Drinking water systems, like sewage treatment plants, are generally managed by local governments. The law requires that community drinking water systems (1) conduct routine monitoring for numerous pollutants and (2) demonstrate compliance with minimum standards. As of late 1997 EPA has set standards for 83 pollutants, including several toxic chemicals.

The Safe Drinking Water Act requires public notification if standards are violated or monitoring requirements are not met. It authorizes citizens' suits to force compliance.

The Safe Drinking Water Act amendments of 1996 (P.L. 104-182) establish a new emphasis on preventing contamination problems through drinking water source protection and enhanced water system management. The amendments also establish a citizens' "right-to-know" program and authorize a state revolving loan fund program to help public water systems finance projects to meet the Safe Drinking Water Act's requirements.

Federal Agriculture Improvement and Reform Act

The Federal Agriculture Improvement and Reform Act (FAIRA) of 1996 (also known as the "Farm Bill") consolidated and simplified some of the existing conservation programs established under the Food, Agriculture, Conservation, and Trade Act of 1990. Implemented primarily by the U.S. Department of Agriculture (USDA), both acts encourage reducing soil erosion, retaining wetlands, and protecting other environmentally sensitive cropland. Important sections are covered in the following paragraphs:

Sections 301 through 317

The conservation compliance provision discourages production of crops on highly erodible cropland unless the land is protected from erosion under an approved conservation system.

Sections 321 through 326

The wetlands conservation, or "Swampbuster," provision, is the principal wetlands protection program for agricultural lands. It expands the definition of agricultural lands to include pasturelands, rangelands, and tree farms, but not commercial forest operations.

Amendments under FAIRA change many Swampbuster provisions to give farmers more flexibility in complying with wetlands conservation requirements. Farm operators must agree to abide by Conservation Compliance and Swampbuster provisions to qualify for farm subsidies. If wetlands are drained, dredged, filled, leveled, or otherwise altered to produce an agricultural commodity after 28 November 1990, or if an agricultural commodity is planted on a wetland that was converted after 23 December 1985, USDA program benefits generally will not be available.

The USDA's Natural Resource Conservation Service (NRCS) certifies wetland determinations subject to the Swampbuster provision. Such determinations remain in effect as long as the land is used for agricultural purposes. NRCS maintains the criteria for soils and plants that define wetlands.

Section 332 and 341

The Conservation Reserve Program offers long-term rental payments and cost-share assistance to farm owners or operators to establish permanent vegetative cover for land that is highly erodible or contributes to a serious water quality problem. This program is financed by the Commodity Credit Corporation. Maximum enrollment at any time is 36.4 million acres.

Sections 333 and 341

These sections refer to the Wetlands Reserve Program, whose purpose is to restore and protect wetlands. Enrollment in the program is limited to 975,000 acres, and eligibility has been expanded to include land that maximizes wildlife benefits and wetland values and functions.

Section 334

The Environmental Quality Incentives Program (EQIP) provides incentives for farmers and ranchers to adopt practices that reduce environmental and natural resource problems. The program consolidates many of the conservation programs that existed prior to the 1996 Farm Bill. EQIP provides technical, financial, and educational assistance; half is targeted to livestock-related natural resource problems, and the other half is targeted to more general conservation priorities. Eligibility is limited to farmers or ranchers who produce livestock or crops on cropland, rangeland, pasture, forest land, and other farm or ranch lands in identified priority areas.

EQIP can provide technical assistance, cost-share payments, incentive payments, and education to crop farms and moderate-scale livestock farms to improve compliance with federal, state, and tribal environmental laws. EQIP contracts cover five to ten years, limited to $10,000 per farm or ranch per year or $50,000 total for multiyear contracts. Cost sharing may pay up to 75 percent of the costs of certain conservation practices, such as developing filter strips, manure management facilities, and grassed

waterways; capping abandoned wells; and initiating other practices important to improving and maintaining the health of natural resources. Incentive payments may be made to encourage a farmer or rancher to perform land management practices such as nutrient management, manure management, integrated pest management, irrigation water management, and wildlife habitat management. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the program incentive.

EQIP works in cooperation with local workgroups, state technical committees, and state and federal agencies to establish priority areas where there are serious and critical environmental needs and concerns. Priority areas are defined as watersheds, regions, or areas of special environmental sensitivity or areas that have significant soil, water, or related natural resource concerns. These concerns could include soil erosion, water quality and quantity, wildlife habitat, wetlands, and forest and grazing lands. The local workgroups generate needs assessments, recommend potential priority areas, and identify farmer interest in participation in the program. The workgroups forward this information to the state technical committee, which makes recommendations to the NRCS. For funding considerations, higher priority is given to areas where state or local governments offer financial or technical assistance. All funded EQIP activities must be carried out according to a conservation plan that addresses the primary natural resource concerns.

Funding for EQIP comes from USDA's Commodity Credit Corporation, which funds several other USDA conservation programs. EQIP's budget for fiscal years 1997 through 2002 is $200 million per year. Individual states, under the guidance of USDA's NRCS state technical committees, have considerable latitude in deciding how EQIP funds will be spent. States are required to designate priority areas, outlining both high-priority geographic areas and more general statewide natural resource concerns. Funding in each state is currently split between priority

area projects (65 percent) and statewide natural resource concerns (35 percent) for projects outside of a geographic priority area.

Intermodal Surface Transportation Efficiency Act

In 1991, Congress passed the Intermodal Surface Transportation Efficiency Act (P.L. 102-240), legislation that has historically been known simply as "the highway bill." The law—often referred to ISTEA, pronounced "ice tea"—funds highway and bridge construction and maintenance and mass transit systems for a six-year period.

The National Highway System consists of the major roads in the United States, including all the interstate routes and a large percentage of urban and rural roads. This law establishes the eligibility of highway funds for wetlands banking, mitigation of damage to wildlife habitat, historic sites, activities that contribute to meeting air quality standards, a wide range of bicycle and pedestrian projects, and highway beautification.

From an environmental perspective, an important component of the 1991 ISTEA legislation is the Congestion Mitigation/Air Quality program, aimed at reducing air quality problems and traffic congestion by diverting some traditional highway construction funds to these efforts. ISTEA is pending reauthorization and may undergo provisional changes.

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention)

The London Convention (LC), formerly known as the London Dumping Convention, grew out of proposals made by the 1972 United Nations Conference on the Human Environment in Stockholm, Sweden, a predecessor of the 1992 "Earth Summit"

held in Rio de Janeiro, Brazil. The LC regulates ocean dumping to prevent (1) pollution of the marine environment, (2) harm to living marine resources, (3) hazards to human health, and (4) damage to amenities. Dumping involves any deliberate disposal at sea from vessels, aircraft, platforms, or other structures, but excludes waste disposal from the normal operation of vessels. The United States implements the LC through title I of the Marine Protection, Research, and Sanctuaries Act. With few exceptions, the LC prohibits ocean dumping without a permit. Three annexes contain technical criteria to be used in evaluating permit applications.

Annex I lists prohibited materials such as organohalogens (e.g., PCBs), mercury, petroleum products, plastics, cadmium, crude oil, fuel oil, heavy diesel oil, lubricating oils, hydraulic fluids, and high-level radioactive wastes in other than trace amounts. Annex II identifies materials for which a special permit is required, including "wastes containing significant amounts" of arsenic, zinc, copper, lead, beryllium, chromium, nickel, vanadium, and pesticides. Annex III contains general criteria to be used in evaluating permit applications and selecting disposal sites.

The LC requires that records be kept on permitted dumping activities and that conditions of their adjacent seas be monitored and reported.

Brownfields

In 1993 EPA launched its Brownfields Initiative, which included a grants program for states, municipalities, counties, and Native American tribes to undertake brownfields pilots. Since then, EPA has awarded more than 113 of these grants of up to $200,000 over a two-year period. The grants help to test redevelopment models; remove regulatory barriers while maintaining environmental and human health integrity; and coordinate creative assessment, cleanup, and redevelopment efforts at federal, state, and local levels.

A brownfield is a site or part of a site that has a potential for redevelopment, but has actual or perceived contamination. EPA's Brownfields Initiative is designed to empower states, communities, and other stakeholders to work together in a timely manner to assess, safely clean up, and sustainably reuse brownfields sites.

Several of the pilot sites have involved coast redevelopment. By reusing selected brownfields sites and creating a "green" corridor along the Rio Grande River on the Mexican border of the United States, Laredo, Texas, expects to spur economic development on the riverfront, increase interest in environmental cleanup, and improve the river's water quality. The community of Cape Charles/Northampton County, Virginia, is using brownfields funds to plan and develop an "eco-industrial park," restore lost wetlands, build a tertiary sewage treatment plant, and establish a nature trail and environmental education facility. New Bedford, Massachusetts, is using its grant to convert brownfields into productive aquaculture sites. The pilot underway in Tacoma, Washington, is an effort by the Puyallup Tribe to redevelop the industrial waterfront area. Part of this project entails researching the potential for a marine terminal and developing a drainage and wetlands mitigation plan for some of the property. These are just a few examples of EPA's Brownfields Initiative activities in coastal areas.

Fish and Wildlife Service's Coastal Ecosystem Program

The goal of the FWS's Coastal Ecosystem Program is to conserve fish and wildlife and their habitats and to support healthy coastal ecosystems. The program's approach is to work in partnership with federal, state, international, native American, and local agencies; nongovernmental

Coastal Ecosystem Program Sites

Albemarle/Pamlico Sound
Chesapeake Bay
Delaware Bay
Everglades/South Florida
Gulf of Maine
Puget Sound
San Francisco Bay
South California Coast/
San Diego Bay
South Carolina Coast
South New England/
New York Bight
Texas Coast

organizations; and the private sector to develop and implement ecosystem-based policies and programs that protect and enhance coastal living resources.

The emphasis of the Coastal Ecosystem Program is to have natural laboratories for long-term research and monitoring projects, as well as public education, so that comparative work can be accomplished through these sites. The guiding principles of the program are as follows:

- ❑ Maintain natural coastal ecosystem diversity, function, and productivity.
- ❑ Promote natural, self-sustaining populations of native species within their historic ranges.
- ❑ Provide for ecologically sound levels of public use, economic benefit, and enjoyment of natural resources.

As of July 1997, the program had restored 22,828 acres of coastal wetlands; protected more than 7 miles of shoreline habitat; reopened 267 miles of coastal streams for anadromous fish passage; and protected 56,209 acres of habitat through conservation easements.

Great Lakes Water Quality Agreements

The Great Lakes Water Quality Agreements between the United States and Canada in 1972 and 1978 establish common water quality objectives and processes to control pollution; perform research on Great Lakes problems; and survey, monitor, and disseminate information.

Canada and the United States agreed to develop a systematic and comprehensive approach to control pollution, abate contamination, and restore beneficial uses of the waters. The IJC, originally established under the Boundary Waters Treaty of 1909, advises both governments on issues affecting the Great Lakes and

recommends action. The parties evaluate progress. Some critics contend that the IJC has no real enforcement authority and that the Great Lakes Water Quality Agreements need to be modified into a formal treaty with the force of law.

The 1978 agreement expanded the scope and approach to cover the whole ecosystem, including atmospheric deposition and reintroduced residuals from past pollution, rather than focusing only on the water. In calling for target loadings for phosphorus, the 1978 agreement acknowledged the concept of mass balance in Great Lakes management. A target loading is the level judged not to cause undesirable effects, including overproduction of algae and anoxic conditions on lake bottoms. Mass balances are used to calculate the amount of pollutant that remains active after all sources and losses are considered.

The 1978 agreement also calls for elimination of most discharges of persistent toxic chemicals.

Great Lakes Protection Fund

The Great Lakes Protection Fund was created in 1989 to promote regional ecosystem stewardship. It is the nation's first multistate environmental endowment and serves as a not-for-profit, grant-making corporation. The fund was developed after two decades of cooperative efforts to address the lakes' ecological problems.

The Great Lakes Protection Fund finances collaborative efforts to enhance the health of the Great Lakes ecosystem. The fund projects address the interdependence of natural ecosystems and human economic systems. These projects help to ensure that the natural and human systems are resilient, productive, diverse, and sustainable. By 1997, the fund has made 139 grants, which represent an investment of over $19.8 million in the health of the Great Lakes ecosystem. Additionally, the fund has provided more than $10 million to its seven member states to support local efforts that address the priorities of these individual states.

International Convention for the Prevention of Pollution from Ships

The 1973 and 1978 International Convention for the Prevention of Pollution from Ships, known as MARPOL (for marine pollution), did not go into effect until 1983, after several modifications. Its intent is to end "the deliberate, negligent, or accidental release of ... harmful substances from ships" and to "achieve the complete elimination of international pollution of the marine environment ... by harmful substances." It addresses wastes generated during the normal operations of vessels.

The convention is under the auspices of the International Maritime Organization, a specialized agency of the United Nations established in 1959 and headquartered in London. Domestically, the U.S. Coast Guard was given authority to implement MARPOL through the Act to Prevent Pollution from Ships and the Ports and Waterways Safety Act.

MARPOL is organized into five annexes:

- Annex I regulates oil discharges from ships, including restrictions on light refined oil. It disallows discharges of all oil within 50 miles of land and disallows discharges into the Mediterranean, Red, Black, and Baltic Seas and the Persian Gulf.
- Annex II aims to prevent pollution from dry noxious or liquid substances carried in bulk. Ships are required to keep a cargo record book and have an International Pollution Prevention Certificate aboard. These certificates are issued by the country of registry.
- Annex III addresses hazardous freight.
- Annex IV governs disposal of both treated and untreated shipboard sewage, setting limits on how far from shore each may be discharged.

- Annex V addresses ship-generated garbage and includes a prohibition on disposal of plastics into the sea. The Gulf of Mexico is designated as an area that prohibits ships from dumping garbage and plastics. As of May 1996, 79 countries, including the United States, had ratified Annex V.

State Wetlands Grants Program

The State Wetlands Grants Program, enacted as title III of the Coastal Wetlands Planning, Protection, and Restoration Act, was intended to help states and tribes increase their knowledge about and develop wetlands protection programs. It was initiated in 1990 with a $1 million appropriation, and the program has since expanded. In the last seven years, EPA has provided nearly $70 million to support the development of state and tribal wetlands protection programs. In 1995, $15 million was appropriated to support the grant program.

The grants fund local efforts to collect basic information on wetlands resources, identify threats to the resources, examine techniques for protecting the resources, create comprehensive wetlands protection plans, and conduct public education campaigns to promote wetlands protection.

The National Sea Grant College Program

The National Sea Grant College Program is a partnership between the nation's universities and NOAA, chartered in 1966 by the National Sea Grant College Program Act. The program encourages the wise stewardship of marine resources through research, education, outreach, and technology transfer. The NOAA Office of Sea Grant administers the program. The office provides financial support to colleges, universities, and other research institutions through a matching fund program.

The core of the Sea Grant partnership is made up of 29 Sea Grant College programs located in coastal and Great Lakes states and Puerto Rico. The network, however, stretches to some 300 participating institutions whose more than 3,000 scientists, engineers, educators, students, and outreach specialists focus on solving marine and Great Lakes resource management, development, and conservation issues.

The Sea Grant produces and makes available a wealth of information on marine topics, from public school curriculum materials to the most advanced scientific research. The National Sea Grant Depository at the University of Rhode Island's Pell Library stores nearly 55,000 scientific, technical, advisory, educational, and public information reports developed by the Sea Grant-supported network.

Legacy Resource Management Program

The Legacy Resource Management Program was established as part of the 1991 Department of Defense appropriation. Its purpose is to preserve, protect, list, and manage the sensitive and significant biological, geophysical, cultural, and historical resources on 25 million acres of Department of Defense land and to do so in a manner consistent with military requirements.

In its first year, the program undertook 90 projects in 37 states totaling $10 million. In 1992 the program expanded to $25 million, and in each year from 1993 through 1995, funding remained a steady $50 million. In 1996 and 1997, the appropriation decreased to $10 million and $12.5 million, respectively. In 1996 the focus of the program and its funding changed from installation projects to regional initiatives in support of military land-use requirements.

National Oceanic Partnership Program

The National Oceanic Partnership Program (NOPP) was created in 1997 under the National Defense Authorization Act (P.L. 104-201). The budget for the program is $13 million for applied research in oceanographic and atmospheric technologies and $7.5 million for NOPP survey ship operations. The program is designed to coordinate and leverage all U.S. oceanographic efforts in the Navy, industry, and academia and to encourage the sharing of resources, intellectual talent, and facilities in ocean science and education. The secretary of the Navy is the chair of the program.

Agricultural Outleasing Funds

Under 10 U.S.C. 2667(d), rental fees received from a lease for agricultural or grazing purposes of land under control of the secretary of a military department may be retained and spent on the installation to cover administrative expenses of leasing and natural resources programs. Total income from agricultural and grazing outleases on naval installation varies from year to year, but is typically about $3 million annually.

Proceeds are used to administer the agricultural and grazing outleasing program. Priority is given to ensuring that proper conservation measures are implemented on the leases. Funds available over and above lease conservation work are used for natural resources conservation projects such as endangered species protection, nonpoint source pollution abatement, fish and wildlife habitat management, and wetlands enhancement. Coastal America projects are implemented on military installations.

Additional Federal Activities

Databases

Public agencies rely on the power of the computer to collect and process the volumes of data they collect in the course of

creating, monitoring, and enforcing their pollution control programs. The result is a variety of databases that can generate, in various forms, information about such things as the number of regulated pipeline dischargers and exactly what, how much, and where they discharge.

The databases, like all computer technology, evolve and change and usually improve over time. Many of these databases can be accessed on the World Wide Web.

Both EPA and NOAA have World Wide Web sites with reports, legislative highlights, and other information about coastal issues. For more information, see EPA's site at http://www.epa.gov and NOAA's site at http://www.noaa.gov.

Index of Watershed Indicators (IWI). EPA developed the IWI database in 1997 to characterize and consolidate indicators of the health of national water resources. The index includes 15 indicators, such as fish and wildlife consumption advisories, ambient water quality data, and urban runoff potential. The index is based on "Indicators of Water Quality in the United States," developed by EPA in partnership with states, tribes, private organizations, and other federal agencies. The index evaluates more than 2,000 watersheds in the contiguous United States (Alaska, Hawaii, and the territories will be added in the future). For more information, see http://www.epa.gov/owow/surf/iwi.

Permit Compliance System (PCS). This management system contains data on facilities that have discharge permits under the National Pollutant Discharge Elimination System. There are more than 65,000 active permits.

Information recorded in this database includes the identity and location of permitted facilities, discharge limits for the facilities, actual amounts of pollutants measured in facilities' wastewater, and compliance schedules and violations. For more information, see http://www.epa.gov/enviro/html/pcs/pcs_overview.html.

Storage and Retrieval of U.S. Waterways Parametric Data (STORET). STORET now includes data on ambient water

quality, biological monitoring, and analytical tools for a range of EPA water quality and ecosystem health assessment activities. STORET will include the physical location at which monitoring occurs, the names of organizations that conduct monitoring activities, descriptions of projects or surveys that are being carried out, and descriptions of the water quality sampling and measurement activities that take place. It will also record the results of sample analyses and field measurement. For more information on STORET and how to access the database, see http://www.epa.gov/owow/STORET.

Emergency Response Notification System (ERNS). This database contains information on oil and hazardous substance spills or releases. Online access is available only to EPA and relevant federal officials, but diskettes, hard copy, or tapes are available through Freedom of Information Act requests. EPA's Emergency Response Division of the Office of Emergency and Remedial Response is the sponsoring office.

Fish and Wildlife Information Exchange (FWIE). This exchange is a technical assistance center and clearinghouse for fish and wildlife information systems. It is housed at Virginia Polytechnic Institute and State University as part of the Multi-State Fish and Wildlife Information Systems Project.

The FWIE works with agencies that have fish and wildlife management responsibilities to build systems, acquire data, and plan fish and wildlife information management activities to better use existing data resources. The FWIE maintains copies of important national and regional fish and wildlife datasets. The FWIE also publishes a quarterly newsletter and holds annual meetings. The FWIE is available on the Web at http://www.fw.vt.edu/fishex.

Monitoring

More than $130 million is spent annually on monitoring programs in the United States. Monitoring is mandated by various statutes, including the CWA; the Marine Protection, Research, and Sanctuaries Act; the Outer Continental Shelf Lands Act; and the

National Ocean Pollution Research, Development, and Monitoring Planning Act.

Monitoring is defined in many ways and conducted for various purposes. It is generally intended to produce information about three broad categories of problems: (1) compliance, to ensure that activities are carried out in accordance with regulations and permit requirements; (2) model verification, to check the validity of assumptions and predictions used as the basis for sampling design or permitting and evaluation of management alternatives; and (3) trend monitoring, to identify and quantify longer-term environmental changes anticipated (hypothesized) as possible consequences of human activities. Most agencies conduct or require monitoring to ensure compliance with permit conditions.

Marine environmental monitoring is conducted by federal, state, and local agencies; waste dischargers; and researchers. Five federal agencies conduct marine environmental monitoring activities in the coastal ocean: NOAA, EPA, the USACE, the Coast Guard, and the Minerals Management Service of the Department of the Interior.

The main purposes of EPA's monitoring and analysis program is to help states monitor their waters and provide technical guidance to states to monitor and plan for cleanup of those waters. The program also helps develop monitoring approaches and helps states adopt those approaches more and more on a watershed basis. Among the monitored targets are estuaries, surface waters, sediment, and fish tissue (for signs of bioaccumulation of toxics). State monitoring programs help states determine what controls are needed on point and nonpoint sources to reduce discharges.

Environmental Monitoring and Assessment Program (EMAP). EMAP is a research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. Funded by EPA, EMAP's goal is to develop the scientific understanding for translating environmental monitoring data into forecasts of future risks to natural resources.

For more information, contact Dr. Kevin Summers, One Sabine Island Drive, Gulf Breeze, FL 32561, (850) 934-9200. EMAP is also available on the Web at http://www.epa.gov/emap.

Coastal America

Coastal America is an interagency partnership of 12 federal agencies working together to protect, preserve, and restore coastal ecosystems. Established in 1992, the partnership includes not only federal agencies, but state, local, and tribal governments and nongovernmental organizations. The partnership includes the Departments of Agriculture, the Air Force, the Army, Commerce, Defense, Energy, Housing and Urban Development, the Interior, the Navy, and Transportation; EPA; and the Executive Office of the President.

The purpose of Coastal America, which provided funding to support research and writing of this publication, is to—

- ❒ Protect, preserve, and restore the nation's coastal ecosystems through existing federal capabilities and authorities
- ❒ Collaborate and cooperate in the stewardship of coastal living resources by working in partnership with other federal programs and by integrating federal actions with state, local, and tribal governmental and nongovernmental efforts
- ❒ Provide a framework for action that serves as a model for effective management of coastal living resources

The Coastal America partnership process and organizational structure enables early identification of policy issues and conflicts at the local, regional, and national level. It also encourages timely resolution of these issues by policy makers. The collaborative planning process is guided by the concepts of ecosystem management and sustainable development and seeks to incorporate

environmental objectives into major development plans. The Coastal America collaborative interagency structure enables national policy issues to be identified and resolved, regional plans and strategies to be developed, and local projects to be implemented. In addition to projects, the partnership is establishing a network of Coastal Ecosystem Learning Centers to improve public understanding of coastal issues.

Through 1997, the partnership had completed or undertaken more than 200 projects in 26 states, 2 territories, and the District of Columbia. With more than 300 nonfederal partners involved, more than $100 million has been committed to these projects.

Appendix B
Key National and Regional Contacts

Private Organizations

Alliance for the Chesapeake Bay
6600 York Road
Baltimore, MD 21212
Tel: (410) 377-6270
Fax: (410) 377-7144
http://www.gmu.edu/bios/bay/acb

Alliance for the Chesapeake Bay
P.O. Box 1981
Richmond, VA 23218
Tel: (804) 775-0951
Fax: (804) 775-0954
http://www.gmu.edu/bios/bay/acb

Alliance for the Chesapeake Bay
225 Pine Street
Harrisburg, PA 17101
Tel: (717) 236-8825
Fax: (717) 236-9019
http://www.gmu.edu/bios/bay/acb

American Clean Water Project
107 Spyglass Lane
Fayetteville, NY 13066
Tel: (315) 637-4718

American Littoral Society
Sandy Hook
Highlands, NJ 07732
Tel: (732) 291-0055

American Oceans Campaign
725 Arizona Avenue, Suite 102
Santa Monica, CA 90401
Tel: (310) 576-6162
Fax: (310) 576-6170
http://www.americanoceans.org

American Rivers
1025 Vermont Avenue, NW, Suite 720
Washington, DC 20005
Tel: (202) 547-6900
Fax: (202) 347-9240
http://www.amrivers.org/

Assembly of First Nations
Effects on Aboriginals from Great Lakes Environment (EAGLE) Project
One Nicholas Street, Suite 1002
Ottawa, Ontario K1N 7B7, CANADA
Tel: (613) 241-6789
Fax: (613) 241-5808
http://www.afn.ca

Association of State and Interstate Water Pollution Control Administrators
750 First Street, NW, Suite 910
Washington, DC 20002
Tel: (202) 898-0905
Fax: (202) 898-0929
http://www.asiwpca.org

Atlantic States Legal Foundation, Inc.
658 West Onondaga Street
Syracuse, NY 13204
Tel: (315) 475-1170
Fax: (315) 475-6719

The Audubon Institute
P.O. Box 4327
New Orleans, LA 70178
Tel: (504) 861-2537
Fax: (504) 865-7332
http://www.audubooninstitute.org

Canadian Environmental Law Association
517 College Street, Suite 401
Toronto, Ontario M6G 4A2, CANADA
Tel: (416) 960-2284
Fax: (416) 960-9392
http://www.web.net/cela

Center for Marine Conservation
1725 DeSales Street, NW, Suite 600
Washington, DC 20036
Tel: (202) 429-5609
Fax: (202) 872-0619
http://www.cmc-ocean.org

Center for Marine Conservation
(Pacific Coast)
580 Market Street
San Francisco, CA 94104
Tel: (415) 391-6204
Fax: (415) 956-7441
http://www.cmc-ocean.org

Center for Marine Conservation
1432 North Great Neck Road, Suite 103
Virginia Beach, VA 23454
Tel: (757) 496-0920
Fax: (757) 496-3207
http://www.cmc-ocean.org

Center for Marine Conservation
(Florida)
One Beach Drive, SE, Suite 304
St. Petersburg, FL 33701
Tel: (813) 895-2188
Fax: (813) 895-3248
http://www.cmc-ocean.org

Chesapeake Bay Foundation
162 Prince George Street
Annapolis, MD 21401
Tel: (410) 268-8816 (Annapolis)
(410) 269-0481 (Baltimore)
(301) 261-2350 (Washington, DC)
Fax: (410) 268-6687

Clean Water Action Project
4455 Connecticut Avenue, NW
Suite A300
Washington, DC 20008
Tel: (202) 547-1196
Fax: (202) 895-0438
http://www.essential.org/cwa

Clean Water Fund
2229 North Charles Street
Baltimore, MD 21218
Tel: (410) 889-4055
Fax: (410) 235-8816
http://www.essential.org/cwa

Clean Water Fund
326 Hennepin Avenue, East
Minneapolis, MN 55414
Tel: (612) 623-1855
Fax: (612) 623-3354
http://www.essential.org/cwa

Clean Water Fund
76 Summer Street, 3rd Floor
Boston, MA 02110
Tel: (617) 338-6673
Fax: (617) 423-4870
http://www.essential.org/cwa

Coastal Alliance
215 Pennsylvania Avenue, SE
Washington, DC 20003
Tel: (202) 546-9554
Fax: (202) 546-9609

Coastal Conservation Association
4801 Woodway, Suite 220W
Houston, TX 77056
Tel: (713) 626-4222
Fax: (713) 626-5852
http://www.ccatexas.org

Coastal Society
P.O. Box 25408
Alexandria, VA 22313-5408
Tel: (703) 768-1599
Fax: (703) 768-1598

Coastal States Organization
444 North Capitol Street, NW
Washington, DC 20001
Tel: (202) 508-3860
Fax: (202) 508-3843

Consortium for Ocean Research and Education
1755 Massachusetts Avenue, NW Suite 800
Washington, DC 20036
Tel: (202) 232-3900
Fax: (202) 332-9751
http://core.cast.msstate.edu

Council of Great Lakes Governors
35 East Wacker Drive, Suite 1850
Chicago, IL 60601
Tel: (312) 407-0177
Fax: (312) 407-0038
http://www.cglg.org

Cousteau Society
870 Greenbriar Circle, Suite 402
Chesapeake, VA 23320
Tel: (757) 523-9335
Fax: (757) 523-2747
http://www.cousteau.org

Earth Island Institute
300 Broadway, Suite 28
San Francisco, CA 94133-3312
Tel: (415) 788-3666
Fax: (415) 788-7324
http://www.earthisland.org/ei

Environmental Defense Fund
257 Park Avenue South
New York, NY 10010
Tel: (212) 505-2100
Fax: (212) 505-2375
http://www.edf.org

Environmental Law Institute
1616 P Street, NW, Suite 200
Washington, DC 20036
Tel: (202) 328-5150
Fax: (202) 939-3868
http://www.eli.org

Great Lakes Advisory Council
Faculty of Environmental Studies
SUNY College of Environmental Science and Forestry
1 Forestry Drive
Syracuse, NY 13210
Tel: (315) 470-6636
Fax: (315) 470-6915

Great Lakes Protection Fund
35 East Wacker Drive, Suite 1880
Chicago, IL 60601
Tel: (312) 201-0660
Fax: (312) 201-0683
http://www.great-lakes.net/glpf/

Great Lakes Research Consortium
1 Forestry Drive, 24 Bray Hall
Syracuse, NY 13210
Tel: (315) 470-6816
Fax: (315) 470-6970
http://www.esf.edu/glrc

Great Lakes United
State University at Buffalo
1300 Elmwood Avenue
Buffalo, NY 14222
Tel: (716) 886-0142
Fax: (716) 886-0303

Greenpeace USA
1436 U Street, NW
Washington, DC 20009
Tel: (202) 462-1177
Fax: (202) 462-4507
http://www.greenpeace.org

Heal the Bay
2701 Ocean Park Boulevard, Suite 150
Santa Monica, CA 90405
Tel: (310) 581-4188
Fax: (310) 581-4195
http://www.healthebay.org/healthebay

International Oceanographic Foundation
4600 Rickenbacker Causeway
Virginia Key
Miami, FL 33149-1098
Tel: (305) 361-4888
Fax: (305) 361-4711
http://www.rsmas.miami.edu/iof

Lake Michigan Federation
220 South State Street, Suite 2108
Chicago, IL 60604
Tel: (312) 939-0838
Fax: (312) 939-2708
http://www.lakemichigan.org

Michigan United Conservation Clubs
P.O. Box 30325
Lansing, MI 48909
Tel: (517) 371-1041
Fax: (517) 371-1505
http://www.mucc.org

National Audubon Society
700 Broadway
New York, NY 10003
Tel: (212) 979-3000
Fax: (212) 979-3016
http://www.audubon.org

National Audubon Society
(Governmental Affairs)
1901 Pennsylvania Avenue, NW
Suite 1100
Washington, DC 20006
Tel: (202) 547-9009
Fax: (202) 861-4290
http://www.audubon.org

National Audubon Society
Great Lakes Office
692 North High, Suite 208
Columbus, OH 43215
Tel: (614) 224-3303
Fax: (614) 224-3305
http://www.audubon.org

National Marine Manufacturers Association
1819 L Street, NW, Suite 700
Washington, DC 20036
Tel: (202) 861-1180
Fax: (202) 861-1181

National Ocean Industries Association
1120 G Street, NW, Suite 900
Washington, DC 20005
Tel: (202) 347-6900
Fax: (202) 347-8650

National Wildlife Federation
1400 16th Street, NW
Washington, DC 20036
Tel: (202) 797-6800
Fax: (202) 797-6646
http://www.nwf.org

Natural Resource Center (Great Lakes)
506 East Liberty, 2nd Floor
Ann Arbor, MI 48104
Tel: (313) 769-3351
Fax: (313) 769-1449
http://www.greatlakes.nwf.org

Natural Resources Defense Council
40 West 20th Street
New York, NY 10011
Tel: (212)727-2700
Fax: (212) 727-1773
http://www.nrdc.org

The Nature Conservancy
1815 North Lynn Street
Arlington, VA 22209
Tel: (703) 841-5300
Fax: (703) 841-1283
http://www.tnc.org

Pollution Probe
12 Madison Avenue
Toronto, Ontario, M5R 2S1, CANADA
Tel: (416) 926-1907
Fax: (416) 926-1601
http://www.pollutionprobe.org

Restore America's Estuaries
1200 New York Avenue, Suite 400
Washington, DC 20005
Tel: (202) 289-2379
Fax: (202) 842-4932
http://www.estuaries.org

Save the Bay
434 Smith Street
Providence, RI 02908-3770
Tel: (401) 272-3540
Fax: (401) 273-7153
http://www.savethebay.org

Save the River
P.O. Box 322
Clayton, NY 13624
Tel: (315) 686-2010
http://www.gisco.net/str

Sea Grant Consortium
287 Meeting Street
Charleston, SC 29401
Tel: (803) 727-2078
Fax: (803) 727-2080
http://www.csc.noaa.govSCSeaGrant

Sea Grant Program
Virginia Graduate Marine Science Consortium
University of Virginia
170 Rugby Road, Madison House
Charlottesville, VA 22903
Tel: (804) 924-5965
Fax: (804) 982-3694

SeaWeb
1731 Connecticut Avenue, NW
4th Floor
Washington, DC 20009
Tel: (202) 483-9570
Fax: (202) 483-9354
http://www.seaweb.org

Sierra Club
408 C Street, NE
Washington, DC 20002
Tel: (202) 547-1142
Fax: (202) 547-6009
http://www.sierraclub.org

Trout Unlimited
1500 Wilson Boulevard, Suite 310
Arlington, VA 22209-2404
Tel: (703) 522-0200
Fax: (703) 284-9400
http://www.tu.org

Worldwatch Institute
1776 Massachusetts Avenue, NW
Washington, DC 20036
Tel: (202) 452-1999
Fax: (202) 296-7365
http://www.worldwatch.org

World Wildlife Fund
1250 24th Street, NW
Washington, DC 20037
Tel: (202) 293-4800
Fax: (202) 293-9211
http://www.wwf.org

Government Agencies

U.S. Department of Agriculture

Natural Resources Conservation Service
P.O. Box 2890
14th and Independence Ave., SW
Washington, DC 20250
Tel: (202) 720-1845
Fax: (202) 720-4265
http://www.nrcs.usda.gov

U.S. Department of the Air Force

Air Force Regional Environmental Office
Eastern Region
60 Forsyth Street, SW, Suite 8M80
Atlanta Federal Center
Atlanta, GA 30303-3416
Tel: (404) 562-4205
Fax: (404) 562-4221
http://www.afcee.brooks.af.mil/at/atform.htm

Air Force Regional Environmental Office
Western Region
333 Market Street, Suite 625
San Francisco, CA 94105-2196
Tel: (415) 977-8888
Fax: (415) 977-8900
http://www.afcee.brooks.af.mil/sf/sfform.htm

U.S. Department of the Army

U.S. Army Corps of Engineers
Office of the Chief of Engineers
Pulaski Building
Washington, DC 20314-1000
Tel: (202) 761-0660
Fax: (202) 761-1373
http://www.usace.army.mil

U.S. Department of Commerce

National Marine Fisheries Service
1315 East West Highway
Silver Spring, MD 20910
Tel: (301) 713-2370
http://kingfish.ssp.nmfs.gov

National Oceanic and Atmospheric Administration
Public Affairs
14th Street & Constitution Avenue, NW
Washington, DC 20230
Tel: (202) 482-6090
Fax: (202) 482-3154
http://www.noaa.gov

National Ocean Service
1305 East West Highway
Silver Spring, MD 20910
Tel: (301) 713-3066
Fax: (301) 713-4263
http://www.nos.noaa.gov

Smithsonian Institution
1000 Jefferson Drive, SW
Washington, DC 20560
Tel: (202) 357-1300
http://www.si.edu

U.S. Department of Health and Human Services

Food and Drug Administration
5600 Fisher Lane
Rockville, MD 20857
Tel: (301) 443-1544
Fax: (301) 443-3819
http://www.fda.gov

U.S. Department of Housing and Urban Development

U.S. Department of Housing and Urban Development
415 7th Street, SW
Washington, DC 20410-7000
Tel: (202) 708-1422
Fax: (202) 619-8365
http://www.hud.gov

U.S. Department of the Interior

Fish and Wildlife Service
1849 C Street, NW
Washington, DC 20240
Tel: (202) 208-5634
Fax: (202) 219-2428
http://www.fws.gov

Geological Survey
12201 Sunrise Valley Dr.
Reston, VA 22091
Tel: (703) 648-4460
Fax: (703) 648-4466
http://www.usgs.gov

Minerals Management Service
Public Affairs Office
1849 C Street, NW, LMS-4230
Washington, DC 20240
Tel: (202) 208-3985
Fax: (202) 208-3968
http://www.mms.gov

National Park Service
Water Resource Division
1849 C Street, NW, Room 3223
Washington, DC 20240
Tel: (202) 208-4639
Fax: (202) 208-4620
http://www.nps.gov

U.S. Department of the Navy

U.S. Department of the Navy
Office of the Assistant Secretary Installations and Environment
1000 Navy Pentagon
Washington, DC 20350-1000
http://enviro.navy.mil

U.S. Department of Transportation

Coast Guard
2100 2nd Street, SW
Washington, DC 20593
Tel: (202) 267-2229
Fax: (202) 267-4307
http://www.dot.gov/dotinfo/ucg/welcome.html

Federal Highway Administration
Environmental Operations Division
400 7th Street, SW
Washington, DC 20590
Tel: (202) 366-0660
Fax: (202) 366-7239
http://www.fhwa.dot.gov

Federal Railroad Administration
Nassif Building
400 7th Street, SW
Washington, DC 20590
Tel: (202) 632-3393
Fax: (202) 632-3700
http://www.fra.dot.gov

Maritime Administration
400 7th Street, SW
Washington, DC 20530
Tel: (202) 366-5812
Fax: (202) 366-3889
http://marad.dot.gov

U.S. Environmental Protection Agency

U.S. Environmental Protection Agency (4101)
Assistant Administrator for Water
401 M Street, SW
Washington, DC 20460
Tel: (202) 260-5700
Fax: (202) 260-5711
http://www.epa.gov/watrhome

U.S. Environmental Protection Agency
Chesapeake Bay Program Office
401 Severn Avenue, Suite 109
Annapolis, MD 21401
Tel: (800) 968-7229
Fax: (410) 267-5777
http://www.chesapeakebay.net/bayprogram

U.S. Environmental Protection Agency
Great Lakes National Program Office
77 West Jackson Boulevard
Chicago, IL 60604
Tel: (312) 353-2117
Fax: (312) 353-2018

U.S. Environmental Protection Agency
Gulf of Mexico Program Office
Building 1103, Room 202
Stennis Space Center, MS 39529-6000
Tel: (228) 688-3726
Fax: (228) 688-2709
http://pelican.gmpo.gov

U.S. Environmental Protection Agency
Water Resource Center (RC4100)
401 M Street, SW
Washington, DC 20460
Tel: (202) 260-7786
Fax: (202) 260-0386

Executive Office of the President

Council on Environmental Quality
722 Jackson Place, NW
Washington, DC 20503
Tel: (202) 395-5750
Fax: (202) 456-6546
http://www.ceq.eh.doe.gov

Coastal America
Reporters Building
300 7th Street, SW, Suite 680
Washington, DC 20250-0599
Tel: (202) 401-9928
Fax: (202) 401-9821
http://www.csc.noaa.gov/coastalamerica

United Nations

United Nations Environment Programme
New York Liaison Office
(Headquarters)
First Avenue and East 42nd Street
New York, NY 10017
Tel: (212) 963-1234
Fax: (212) 963-4879
http://www.un.org

International Joint Commission

International Joint Commission
United States Section
1250 23rd Street, NW, Suite 100
Washington, DC 20440
Tel: (202) 736-9000
Fax: (202) 736-9015
http://www.ijc.org

International Joint Commission
Great Lakes Regional Office
100 Ouellette Avenue, 8th Floor
Windsor, Ontario, N9A 6T3 CANADA
Tel: (519) 257-6700
Fax: (519) 257-6740
http://www.ijc.org

International Joint Commission
Great Lakes Commission
The Argus II Building
400 South 4th Street
Ann Arbor, MI 48103-4816
Tel: (313) 665-9135
Fax: (313) 665-4370
http://www.glc.org

International Joint Commission
Great Lakes Fisheries Commission
2100 Commonwealth Boulevard, Suite 209
Ann Arbor, MI 48105-2945
Tel: (313) 662-3209
Fax: (313) 741-2010
http://www.glfc.org

International Joint Commission
Great Lakes Environmental Research Laboratory
2205 Commonwealth Boulevard
Ann Arbor, MI 48105-2945
Tel: (313) 741-2235
Fax: (313) 741-2055
http://www.glerl.noaa.gov

Hotlines, Clearinghouses, and Databases

(Also see appendix A)

Department of Fisheries and Wildlife
Virginia Polytechnical Institute and State University
Blacksburg, VA 24061-0321
Tel: (540) 231-5573
Fax: (540) 231-7580
http://www.fw.vt.edu/fisheries

To report sightings of fish kills and fish lesions (*Pfiesteria*)
In Maryland (888) 584-3110
In Virginia (804) 698-4000
In North Carolina (919) 733-5083

Fish and Wildlife Information Exchange
Virginia Polytechnical Institute and State University
203 West Roanoke Street
Blacksburg, VA 24061
Tel: (540) 231-7348
Fax: (540) 231-7019
http://www.fw.vt.edu/fishex/wwwmain.html

National Small Flows Clearinghouse
P.O. Box 6064
Morgantown, WV 26506
Tel: (304) 293-4191
Fax: (304) 293-3161
http://www.estd.wvu.edu

U.S. EPA, Office of Water Assessment and Watershed Protection Division
Nonpoint Source Information Exchange
401 M Street, SW (4503F)
Washington, DC 20460
Tel: (202) 260-7085
Fax: (202) 260-7024

U.S. Environmental Protection Agency, Office of Water (4203)
Permit Division
401 M Street, SW
Washington, DC 20460
Tel: (202) 260-9545
Fax: (202) 260-1460

U.S. Environmental Protection Agency (4604)
Safe Drinking Water Hotline
401 M Street, SW
Washington, DC 20460
Tel: (800) 426-4791
Fax: (703) 285-1105

U.S. Environmental Protection Agency, Office of Water (4503F)
Storage and Retrieval of U.S. Waterways Parametric Data (STORET)
401 M Street, SW
Washington, DC 20460
Tel: (800) 424-9067
Fax: (202) 260-1977
http://www.epa.gov/owow

Watershed Information Resources System
Terrene Institute
4 Herbert Street
Alexandria, VA 22305
Tel: (703) 548-5473
Fax: (703) 548-6299
http://www.terrene.org

U.S. EPA Wetlands Information Hotline
1355 Beverly Road, Suite 250
McLean, VA 22101
Tel: (800) 832-7828
Fax: (703) 748-1308
http://www.epa.gov/owow

Appendix C
Glossary

Acid deposition: A complex chemical and atmospheric phenomenon that occurs when sulfur and nitrogen compounds and other substances are transformed by chemical processes in the atmosphere. This transformation often occurs far from the original sources. The chemicals are then deposited on Earth in either a wet or dry form. The wet forms, popularly called "acid rain," can fall as rain, snow, or fog. The dry forms are acidic gases or particulates.

Acid precipitation: Rain or snow that contains significant amounts of sulfuric acid or nitric acid.

Anadromous fish: Fish, such as salmon, that live in the sea but spawn in freshwater.

Aquaculture: The cultivation of marine or freshwater food fish or shellfish under controlled conditions for commercial purposes.

Aquifer: A geologic formation, or group of formations, containing usable amounts of groundwater that can supply wells and springs.

Archipelagic waters: Waters that border the coasts of large groups of islands, such as Japan or the Aleutian Islands.

Barrier island: A sandy, elongated island situated just off the coast that protects lagoons and wetlands from marine elements. In the United States, these islands are primarily found along the Gulf of Mexico, the East Coast, and Alaska. Barrier islands form and change position and shape in response to coastal processes and human actions.

Barrier reef: A long, narrow ridge of coral or rock parallel to and relatively near a coastline, separated from the coastline by a lagoon too deep for coral growth.

Bayou: A marshy or sluggish body of water that is a tributary to another body of water.

Benthic: Occurring at the bottom of a body of water, usually in the depths of the ocean.

Bioaccumulation: The process by which some persistent contaminants concentrate and accumulate as they travel via digestive processes to higher levels of the food chain and become biologically magnified.

Biodiversity: The variety and variability of life forms, including genetic and ecosystem diversity, in a defined area at and over time.

Bog: A type of wetland that accumulates appreciable peat deposits. Bogs depend primarily on precipitation for their water source and are usually acidic and rich in plant residue with a conspicuous mat of living, green moss.

Brackish: A combination of saltwater and freshwater, common to coastal wetlands and estuaries.

Brown tide: See "red tide."

Bycatch: Fish and other marine life caught incidentally while fishing for a different type of fish or marine life.

Chlorofluorocarbons (CFCs): A family of inert, nontoxic, and easily liquefied chemicals used in refrigeration, air conditioning, packaging, and insulation or as solvents and aerosol propellants. Because CFCs are not destroyed in the lower atmosphere, they drift into the upper atmosphere, where their chlorine components destroy ozone.

Coastal zone: Land and water adjacent to the coast that exert an influence on the uses of the sea and its ecology or whose uses and ecology are affected by the sea.

Confined disposal facility: An upland or in-water structure constructed solely for the disposal of contaminated dredged material.

Contiguous zone: The area between 12 and 24 miles from the coast in which a host country has rights to control immigration, customs, sanitary, and pollution regulations.

Continental shelf: A shallow, submerged shelf of land extending from the border of a continent, usually ending in a steep slope to deep oceanic waters. According to UNCLOS, the continental shelf extends 200 nautical miles from the coastal baseline (350 nautical miles in special circumstances). The host coastal country has exclusive jurisdiction over mineral resources within this zone and is obligated to protect marine life within this zone from negative effects of resource development.

Cypress swamps: Swamplands in the Atlantic and Gulf Coast regions dominated by cypress trees.

Detritus: Loose material (such as organic matter or rock fragments) that results from disintegration.

Direct discharge: Also known as point source emissions, direct discharge refers to any intentional release of wastes through direct dumping or pipeline discharge.

Effluent: Wastewater—treated or untreated—that flows out of a treatment plant, sewer, or industrial outfall.

Erosion: The wearing away and removal of materials of the Earth's crust by natural means, including running water, waves, moving ice, wind currents, and chemical solution.

Estuary: A region of interaction between rivers and nearshore ocean waters where tidal action and river flow create a mixing of freshwater and saltwater. These areas may include bays, mouths of rivers, salt marshes, and lagoons.

Eutrophication: The enrichment of waters by nutrients either through human-induced or natural means. This enrichment decreases oxygen content and favors plant life over animal life.

Exclusive economic zone (EEZ): An area extending up to 200 nautical miles from the coast of a country. Within this zone, the host country controls resources, such as fisheries and minerals; has jurisdiction over scientific research; and is responsible for protecting environmental health.

Fish catch: The quantity of a fishery item taken at sea. The entire catch is not usually brought to land and sold.

Fish landing: Quantities of fish, shellfish, and other aquatic plants and animals brought ashore and sold. Landings of fish may be in terms of round (live) weight or dressed weight.

Food chain: A sequence of organisms, each of which uses the next, lower member of the sequence as a food source.

Food web: The totality of interacting food chains in an ecological community.

General cargo: Materials carried on ships that are countable and transported in containers. General cargo does not refer to bulk items, such as grain or rice.

Global climate change: Worldwide changes in the Earth's climate systems thought to result from the emission of greenhouse gases including carbon dioxide, methane, nitrous oxide, and CFCs.

Ground fish: A bottom fish, caught on or near the sea floor, especially one of commercial importance (e.g., cod, hake, pollack, haddock).

Groundwater: The supply of freshwater found beneath the Earth's surface, usually in aquifers, which is often used to supply wells and springs.

Habitat: The environment in which an animal or plant can normally be found or normally grows.

Halophyte: A group of salt-tolerant plants, ranging from cacti to sea grass, that can absorb salt and heavy metals such as cadmium and arsenic from waste water.

High seas: Open waters of an ocean or sea beyond the limits of national territorial jurisdiction.

Hydrate: A solid compound containing water molecules.

Hydric soil: A soil that is saturated, flooded, or ponded long enough to support the growth of wetlands vegetation.

Hydromodification: Changing the flow, and thereby habitats, of natural water systems. This process includes the construction of dams, stream channels, and canals.

Hydrophyte: A group of plants that grows in water or soil too waterlogged for most plants to survive.

Hydrothermal vents: Areas located along deep seabeds where hot water, rich in sulfur, is released from geothermally heated rock.

Hypoxia: The terms "hypoxia" and "hypoxic waters" refer to waters with concentrations of less than two parts per million of dissolved oxygen, which is generally accepted as the minimum level required to support most animal life and reproduction.

Jetty: A structure extending into a sea, lake, or river to influence the current or tide in an effort to protect harbors, shores, and banks from sediment loss.

Industrial fish: Items processed from fish, shellfish, or other aquatic plants and animals that are not consumed directly by humans. These items contain products from seaweeds, fish meal, fish oils, aquatic animal skins, as well as shells.

International seabed: The area that extends beyond the continental shelf, generally thought of as open seas, that is under the jurisdiction of the United Nations International Seabed Authority.

Lagoon: A shallow sound or body of water, usually landward of a barrier island, connected to a larger body of water.

Leachate: A solution obtained from leaching or the action of percolating liquid to separate the soluble contents. Chemicals such as fertilizer are leached from soil when rainwater travels through the soil.

Manganese nodules: An irregular, potato-shaped mass of manganese-rich material that occurs on the ocean floor. Where concentrated, these nodules have potential value because of their content of manganese, cobalt, copper, and nickel.

Mangrove: Tropical evergreen trees and shrubs of the genus *Rhizophora* that have stilt-like roots and stems and form dense thickets along tidal shores.

Mariculture: Cultivation of marine and brackish water organisms in their natural environment for use as a food resource.

Marsh: A type of wetland that does not accumulate appreciable peat deposits and is dominated by herbaceous vegetation. Marshes may be either freshwater or saltwater and tidal or nontidal.

Mass balance: A scientific method for evaluating the sources, transport, and fate of contaminants entering a water system, and the effects of those contaminants on water quality.

Nautical mile: The accepted U.S. value as of 1 July 1959 is 1,852 meters (6,076.115 feet), approximately 1.15 times as long as the U.S. statute mile of 5,280 feet.

Nonpoint source: Sources of pollution discharged over a wide land area, not from one specific location. These sources include urban/suburban runoff, agricultural runoff, erosion, construction, and mining.

Nuisance species: Nonnative populations of fish and shellfish that dramatically increase, displacing native species, reducing biodiversity, and limiting water-use activities.

Nutrients: Forms of nitrogen and phosphorus that, in excessive amounts, can be harmful to aquatic life.

Overfishing: Fishing pressure that exceeds the sustainable level for that species, reducing abundance so much that production is much lower than the potential.

Pathogen: An agent, such as a bacterium or virus, that can cause disease.

Permeability: The rate at which liquids pass through soil or other materials in a specified direction.

Phosphorus: An essential chemical food element that can contribute to the eutrophication of lakes and other water bodies. Increased phosphorus levels result from the discharge of phosphorous-containing materials into surface waters.

Phytoplankton: That portion of the plankton community consisting of tiny plants (e.g., algae, diatoms).

Pipeline discharges: A type of direct discharge from a conduit or pipe, especially one used to convey water, gas, or petroleum products.

Point source: A stationary location or fixed facility from which pollutants are discharged or emitted (e.g., pipe, ditch, ship, ore pit, smoke stack).

Primary treatment: The first major stage in wastewater treatment. Screens and a sedimentation tank are used to remove most materials that float or will settle. Primary treatment removes about 30 percent of carbonaceous biochemical oxygen demand from domestic sewage.

Red tide: A visible red, brown, green, or yellow coloration of water, caused by excessive amounts of nutrients that lead to the growth of microscopic algae. These algae decrease water clarity and, upon decay, deplete the oxygen dissolved in the water. Decreased water clarity can lead to a loss of seagrasses, and oxygen depletion may kill or restrict fish, shellfish, and other marine organisms.

Riparian habitat: Areas adjacent to rivers or streams that have a high density, diversity, and productivity of plant and animal species relative to nearby uplands.

River delta systems: Habitats located at the point a river empties into a larger body of water (a lake or ocean). These areas are usually rich in nutrients.

Sea grass shallow: A shallow coastal area, usually found on the Atlantic and Gulf of Mexico coasts, on which certain grasses that have adapted to the changing tides grow.

Secondary treatment: The second stage in most publicly owned wastewater treatment systems in which bacteria consume the organic parts of the waste. This step is accomplished by bringing together waste, bacteria, and oxygen in trickling filters or in the activated sludge process. This treatment removes floating and settleable solids and about 90 percent of the oxygen-demanding substances and suspended solids. Disinfection is the final stage of secondary treatment.

Silviculture: The management of forest land for timber. This process sometimes contributes to water pollution, as in clearcutting.

Spoil: Dirt or rock that has been removed from its original location, destroying the composition of the soil in the process, as with stripmining or harbor dredging.

Submerged aquatic vegetation (SAV): Plants that grow for the most part under water.

Superfund program: The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This statute, originally enacted in 1980 and substantially modified in 1986, provides the authority to fund and carry out the U.S. Environmental Protection Agency's (EPA) hazardous waste emergency and long-term cleanup activities. These long-term activities include establishing the National Priorities List, investigating sites for inclusion on the list, determining priority level on the list, and conducting and supervising the ultimate cleanup actions. The National Priorities List is EPA's list of the most serious uncontrolled or abandoned hazardous waste sites. The Superfund program does not address oil spills or other petroleum contamination.

Surface water: All water naturally open to the atmosphere (e.g., rivers, lakes, reservoirs, streams, impoundments, seas, estuaries) and all springs and wells that are directly influenced by surface water.

Territorial sea: A zone extending 12 nautical miles into the sea measured from a baseline on the coast of a country. This area is considered part of a country's sovereign territory.

Tertiary treatment: The advanced cleaning of wastewater that goes beyond the secondary or biological stage. This step removes nutrients such as phosphorus and nitrogen and most biological oxygen demand and suspended solids.

Thermal pollution: The discharge of water sufficiently warm to lower dissolved oxygen levels, cause eutrophication, affect the life processes of aquatic organisms, or damage the quality of water for drinking or recreational use.

Tidal flat: An extensive flat tract of land alternatively covered and uncovered by the tide and mostly consisting of unconsolidated mud and sand.

Turbidity: A haziness in air caused by the presence of particles and pollutants or a similar cloudy condition in water resulting from suspended silt or organic matter.

United Nations Conference on the Law of the Sea (UNCLOS): An international agreement that defines basic sea rights and responsibilities.

Upstream waters: Rivers, creeks, and tributaries that empty into an estuary or other body of water. Also, any water located in the opposite direction of the current of a river, creek, or other tributary.

Upwelling: Appearance of water from the nutrient-rich lower marine water to the surface, particularly near the shore. An upwelling is usually caused by the offshore drift of coastal surface water.

Watershed: A geographic area in which water, sediments, and dissolved materials drain to a common outlet—to a point on a larger stream, lake, underlying aquifer, estuary, or ocean.

Water table: The upper limit of the portion of the ground wholly saturated with water.

Wetland: An area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Appendix D
List of Acronyms

CDC	Centers for Disease Control and Prevention
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	President's Council on Environmental Quality
CFC	chlorofluorocarbon
CMC	Center for Marine Conservation
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DDT	dichlorodiphenyl trichloroethane
EEZ	exclusive economic zone
EQIP	Environmental Quality Incentives Program
EIS	environmental impact statement
EHC	Environmental Health Center
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ERNS	Environmental Response Notification System
FAIRA	Federal Agriculture Improvement Reform Act
FAO	United Nations Food and Agriculture Organization
FWIE	Fish and Wildlife Information and Exchange
FWS	Fish and Wildlife Service
GAO	General Accounting Office (Congressional)
GIFA	Governing International Fishery Agreements
IJC	International Joint Commission
ISTEA	Intermodal Surface Transportation Efficiency Act
IWI	Index of Watershed Indicators
LC	London Convention
MARAD	U.S. Maritime Administration
MARPOL	International Convention for the Prevention of Pollution from Ships

MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MPRSA	Marine Protection, Research, and Sanctuaries Act of 1972
NCP	National Contingency Plan
NCRIP	National Coastal Recreation Inventory Project
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NMMA	National Marine Manufacturers Association
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OCS	outer continental shelf
OPA	Oil Pollution Act of 1990
PCBs	polychlorinated biphenyls
PCS	Permit Compliance System
P.L.	Public Law
POTW	publicly owned treatment works
ppm	parts per million
PRP	potentially responsible party
RCRA	Resources Conservation and Recovery Act
SAV	submerged aquatic vegetation
STORET	Storage and Retrieval of U.S. Waterways Parametric Data
TRI	Toxics Release Inventory
UNCLOS	United Nations Conference on the Law of the Sea
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
U.S.C.	U.S. Code
WRDA	Water Resources Development Act

Appendix E
Source Materials

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