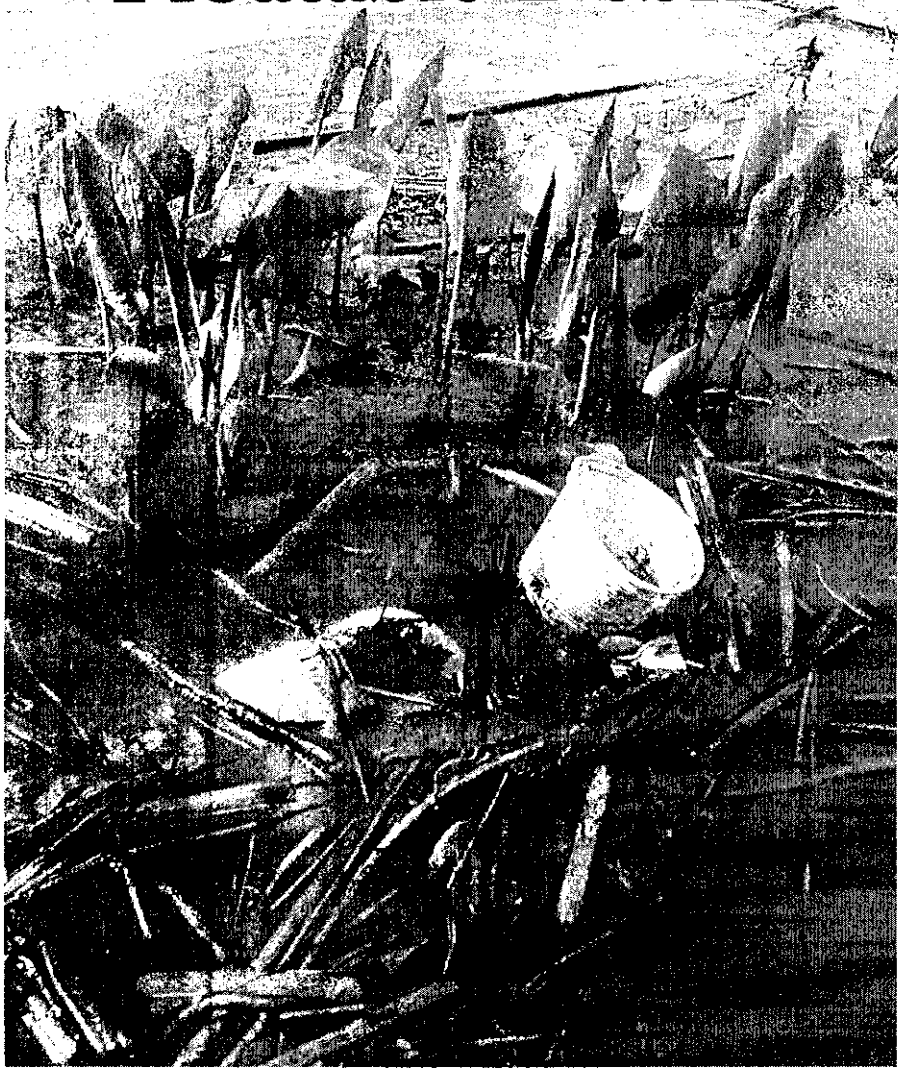
#245

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Assessing and Monitoring Floatable Debris



24582

Acknowledgements

James Woodley, U.S. Environmental Protection Agency, Office of Water, Oceans and Coastal Protection Division, Marine Pollution Control Branch, Washington, DC, was the primary author and project leader for this document.

Susan Hitch, U.S. Environmental Protection Agency, Oceans and Coastal Protection Division, provided photos.

Dacia Mosso, Tetra Tech, Inc., Fairfax, Virginia, assisted in the effort.

Seba Sheavly, The Ocean Conservancy, Virginia Beach, Virginia provided valuable contributions.

MESSAGE FROM THE ADMINISTRATOR

I am pleased to provide you with a guidance document, *Assessing and Monitoring Floatable Debris*, which will help states, tribes, and local governments address their problems with floatable debris in our waterways and on our beaches.

In coastal communities across the nation and around the world, there is a growing concern regarding the impacts of floatable debris on public health and the marine environment. Because of recurring incidents such as entanglement of endangered species, loss of tourism, injured beach-goers, eyesore views of coastal areas and damaged property, we are looking for solutions to address this growing issue.

In October 2000, Congress passed the Beaches Environmental Assessment and Coastal Health (BEACH) Act. The BEACH Act, among other things, asked EPA to provide technical assistance to states and local governments in assessing and monitoring their floatable materials.

The purpose of this document is to help states, tribes, and local governments develop programs to assess and monitor their coastal recreation waters for floatable debris. These programs would be used to help identify sources of floatable debris, protect human and animal health and safety in those waters, and restore and preserve the overall coastal watershed and aquatic environment.

We are also concerned about the health of our beachgoers and have initiated a program to ensure frequent monitoring of our beach waters, and that the information on water quality is made available to the public. EPA has developed the *National Beach Guidance and Required Performance Criteria for Grants* to address these issues.

EPA hopes that this document, *Assessing and Monitoring Floatables Debris*, along with the efforts from the volunteers and the community, will help strengthen the future of our coastal recreation waters by helping our citizens develop an environmental awareness that will last a lifetime.

Christine Todd Whitman
Administrator

Assessing and Monitoring Floatable Debris

August 2002

Oceans and Coastal Protection Division
Office of Wetlands, Oceans, and Watersheds
Office of Water
U.S. Environmental Protection Agency
Washington, DC 20460

Contents

Executive Summary

Assessing and Monitoring Floatable Debris is designed to assist states, tribes, and local governments in developing their own assessment and monitoring programs for floatable debris in coastal recreation waters. The Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000 defines coastal recreation waters as the Great Lakes and marine coastal waters (including coastal estuaries) that are designated under section 303(c) of the Clean Water Act by states. Coastal watersheds, which include coastal recreation waters as well as upstream areas, beaches, nearshore waters, estuaries, oceans, and offshore habitats, are important resources. They are a source of aesthetic beauty, recreation, and food, and they have local and national economic value. These waters provide habitat for thousands of aquatic species and represent a scientific resource. Despite their value, coastal recreation waters sometimes appear to be a repository for trash and other types of wastes. The floatable materials in these wastes, referred to as floatable debris, can have an adverse impact on both wildlife and humans. Turtles, marine mammals, birds, fish, crustaceans, and other wildlife are affected primarily by entanglement and ingestion. Floatable debris can also endanger human health and safety. For example, some types of debris can pose a health risk through disease transmission, sharp objects can cause injury, and floatable debris can disable vessels when propellers become entangled. Floatable debris also is visually unappealing, which can cause economic losses from decreased tourism, and potentially damaging to boats, which can financially harm a region's fishing industry.

In response to growing concern regarding the impact of floatable debris, important legislation has been passed and programs implementing the legislation have been established. In 1987, Congress approved ratification of Annex V of the MARPOL treaty and enacted domestic legislation known as the Marine Plastic Pollution Research and Control Act, which prohibits any ship in U.S. waters from dumping plastics. Other floatable debris-related legislation includes the Shore Protection Act of 1988; the Marine Protection, Research, and Sanctuaries Act; and the Clean Water Act, as amended by the Water Quality Act of 1987. In October 2000, Congress passed the BEACH Act. The BEACH Act authorizes the U.S. Environmental Protection Agency (EPA) to award program development and implementation grants to eligible states, territories, tribes, and local governments to support microbiological testing and monitoring of coastal recreation waters that are adjacent to beaches or similar points of access used by the public. It also tasks EPA to provide technical assistance to states and local governments in establishing assessment and monitoring programs for floatable materials. The BEACH Act defines floatable materials as any foreign matter that may float or remain suspended in the water column. The term includes plastic, aluminum cans, wood products, bottles, and paper products.

This document provides examples of monitoring and assessment programs that have been established in the United States to address the impact of floatable debris, as well as examples of mitigation activities to address floatable debris, and contact information. Section 1 of the document discusses some of the impacts of floatable debris on the aquatic environment, and describes the current legislation available to address those impacts.

Section 2 of the document discusses the types and origins of floatable debris. The many types of floatable debris and their origins include street litter, medical items, debris from industrial activities, sewage-related items, galley waste from ships, fishing equipment, and items from offshore mineral and oil and gas exploration activities. Floatable debris can be transported into coastal recreation waters from land by improper disposal of trash by beachgoers, by rain washing the debris into storm drains or directly into rivers and streams, or the debris being blown into the waters from landfills, garbage bins, or litterbugs. It also can be deposited into coastal recreation waters from ocean sources such as ships, recreational boaters, fishermen, and offshore oil and gas exploration and production facilities. Floatable debris can travel long distances over the ocean and be deposited far from its source.

Section 3 discusses a variety of plans and programs that have been developed and implemented to assess and monitor floatable debris. Although each plan or program seeks to reduce floatable debris, the specific objectives or strategies vary:

- The Floatables Action Plan, for example, was developed by an interagency work group to reduce the number of ocean beach closings in New York and New Jersey due to floatable debris.
- EPA initiated the Combined Sewer Overflow (CSOs) Studies Program to supplement existing information on CSOs and storm water discharges (SWDs) as sources of floatable debris. The program was implemented through monitoring of CSOs and SWDs, and it provides a characterization of debris from those discharges.
- The International Coastal Cleanup Campaign (ICCC) was established to conduct annual cleanups and to characterize debris found on shorelines, underwater sites, waterways, and beaches. The ICCC also is designed to increase public awareness about the impact of marine debris.
- The National Marine Debris Monitoring Program, established to characterize types of debris washing onto beaches and the sources of that debris, is a statistically valid, 5-year scientific study.
- Finally, the Storm Drain Sentries Program was developed to address the impact of floatable debris on coastal watersheds from storm drain systems.

Section 4 presents recommendations for developing assessment and monitoring programs that were presented in the *Marine Debris Survey Manual*, developed by the National Oceanic and Atmospheric Administration, and Chapter 16 of EPA's *Volunteer Estuary Monitoring: A Methods Manual* (USEPA, 1993). The *Marine Debris Survey Manual* provides useful information for designing marine debris surveys and assessment and/or monitoring programs, considering important variables such as wind and the type of debris, and conducting shipboard sighting surveys for large debris items. Chapter 16 of the *Volunteer Estuary Monitoring: A Methods Manual,* includes recommendations for organizing a floatable debris monitoring and cleanup program.

Section 5 provides a number of examples of prevention and mitigation activities associated with floatable debris that are under way around the country. The following are examples:

- The Society of the Plastics Industry partnered with EPA to characterize process operations in the plastics industry and to identify potential sources of plastic pellet losses to the environment. EPA reported its recommendations to the plastics industry.
- A CSO and storm water permit system is being developed in New York and New Jersey. The system will address the control of solids and floatable debris.
- The Navesink River Nonpoint Source Program was established to reduce nonpoint source bacterial pollution in the Navesink estuary.
- Some states, such as California, New York, and Alaska, have listed debris as a pollutant that is causing impairment of their waters. A number of states, including California, have developed or are in the process of developing Total Maximum Daily Loads (TMDLs) to address the impact of debris.
- Several National Estuary Programs have floatable debris management goals in their Comprehensive Conservation and Management Plans. Some examples include: (1) the New York-New Jersey Harbor Estuary Program; (2) the Long Island Sound Study; (3) the San Juan Bay Estuary; and (4) the Santa Monica Bay Restoration Project. These programs address floatable debris by involving local communities in the assessment and monitoring process.

Section 1
Introduction

Importance of Coastal Watersheds
Impacts of Floatable Debris
Impacts on Wildlife
Impacts on Humans
Beaches Environmental Assessment and Coastal Health Act of 2000
Other Floatable Debris-Related Legislation

Section 1: Introduction

This document is designed to be a tool to help states, tribes, and local governments develop programs to assess and monitor their coastal recreation waters for floatable material. Coastal recreation waters are part of the coastal watershed. They are defined by the Clean Water Act (CWA), as amended by the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, as "the Great Lakes and marine coastal waters (including coastal estuaries) that are designated under section 303(c) of CWA by states" and are used for swimming, bathing, surfing, or similar water contact activities. The programs developed would be used to help identify sources of floatable debris, protect human and animal health and safety in those waters, and restore and preserve the overall coastal watershed and aquatic environment. *Assessing and Monitoring Floatable Debris* also will help to preserve and strengthen local and state economies by maintaining or increasing tourism in coastal communities.

Much of the information presented here comes from data collected by marine debris monitoring studies and assessment programs already being implemented in the United States.

1.1 Importance of Coastal Watersheds

Oceans cover more than two-thirds of our planet and are extraordinary resources that contribute to the health and well-being of people and other living things. Likewise, freshwater rivers, streams, lakes, and other water bodies provide significant value to our coastal watersheds. A watershed is a geographic area in which all sources of water, including lakes, rivers, estuaries, wetlands, and streams, as well as ground water, drain to a common surface water body. Coastal watersheds begin with the streams and rivers that ultimately flow to the coastal areas, and they include upstream areas, beaches, nearshore waters, estuaries, oceans, and offshore habitats such as coral reefs and shellfish beds that receive flow from the terrestrial watershed. These surface waters provide a home for thousands of species of aquatic plants and animals and are important to people because they yield an abundance of natural resources, such as nutritious foods and pharmaceutical and petroleum products. In addition, these waters are appreciated for their great beauty, recreational opportunities, and economic and scientific resources.

At the same time, however, coastal recreation waters have been used as a repository for trash and other wastes. Although the aquatic environment can safely receive pollutants and wastes to some degree, this ability is limited. This limitation is particularly significant now that part of our solid waste stream is made up of synthetic materials, which can remain in the environment for many years without decomposing. Some of the wastes consist of materials that are extremely buoyant and thus can float many miles from the point where they originate.

More and more people are moving near the Nation's coasts, and the production of trash and floatable debris continues to increase. Unless we better control the disposal of trash and other wastes, it is likely that the amount of such debris entering our waterways will increase. In the past, floatable debris on beaches and in waterways was considered an eyesore. It has now become evident, however, that such materials can also have serious impacts on human health, wildlife, the aquatic environment, and the economy, and therefore the problem of floatable debris should be addressed.

For the purpose of this document, the terms *floatable materials, floatable debris, trash,* and *marine debris* are used interchangeably. Floatable materials is defined by the BEACH Act to mean any foreign matter that may float or remain suspended in the water column and includes plastic, aluminum cans, wood products, bottles, and paper products.

1.2 Impacts of Floatable Debris

Floatable debris causes problems in coastal watersheds because it can easily come into contact with aquatic animals, people, boats, fishing nets, and other objects. Thousands of aquatic animals are caught in and strangled by floatable debris each year. Coastal communities also lose money when littered beaches must be closed or cleaned up, and the fishing industry and recreational and commercial boaters must spend thousands of dollars every year to repair vessels damaged by floatable debris.

1.2.1 Impacts on Wildlife

The two primary problems that floatable debris poses to wildlife are entanglement and ingestion. Entanglement results when an animal becomes encircled or ensnared by debris. It can occur accidentally or when the animal is attracted to the debris as part of its normal behavior or out of curiosity. For example, an animal might try to use a piece of floatable debris for shelter, as a plaything, or as a source of food (if other plants and animals are already trapped in the debris or if the debris resembles prey that is part of the animal's normal diet). Entanglement is harmful to wildlife for several reasons. Not only can it cause wounds that can lead to infections or loss of limbs, but it can also cause strangulation or suffocation. In addition, entanglement can impair an animal's ability to swim, which can result in drowning or difficulty in moving about, finding food, and escaping from predators.

Ingestion occurs when an animal swallows floatable debris. It sometimes occurs accidentally, but usually animals feed on debris because it looks like food. Ingestion of debris can lead to starvation or malnutrition if the ingested items block the intestinal tract, preventing digestion, or accumulate in the digestive tract, making the animal feel "full" and lessening its desire to feed. Ingestion of sharp objects can damage the mouth, digestive tract, or stomach lining and cause

infection or pain. Ingested items also can block air passages and prevent breathing, thereby causing death.

Marine mammals, turtles, birds, fish, and crustaceans all have been affected by entanglement in or ingestion of floatable debris. Many of the species most vulnerable to the problems of floatable debris are endangered or threatened. *Endangered species* are plants and animals that are in immediate danger of becoming extinct because their population levels are extremely low. *Threatened species* are plants and animals that might become endangered in the near future if nothing is done to protect them.

It is estimated that some 100,000 marine mammals die every year from entanglement or ingestion of floatables. Of the different types of marine mammals, seals and sea lions are the most affected (particularly by entanglement) because of their natural curiosity and tendency to investigate unusual objects in the environment. Packing straps and net fragments are a major problem for these animals. Some studies have linked the decline of the northern fur seal of Alaska and the endangered Hawaiian monk seal to entanglement in debris. Whales, including the endangered humpback whale, right whale, and gray whale, have been found entangled in fishing nets and line. Manatees, another endangered species, have become entangled in crab-pot lines, and dolphins and porpoises have been caught in fishing nets. Ingestion of debris by marine mammals appears to occur less frequently, but it has been reported for elephant seals, sea lions, certain types of whales, and manatees. These cases are significant because they have usually contributed to or resulted in the death of the animals due to suffocation or starvation (USEPA, 1992b).

Right whales are at risk from entanglement in fishing gear and collisions with ships (ENN, 1999). They are especially vulnerable because they move slowly and spend extended periods of time at or near the surface (Ferdinand, 2002). In the summer of 2001, the attempted rescue of a right whale entangled in fishing gear off the coast of Massachusetts became a top news story. The right whale, fondly referred to as Churchill, was suffering from a severe infection caused by a synthetic line embedded in his upper jaw. The rescue effort entailed tracking Churchill for 100 days by beacon satellite, injecting him with drugs, and strapping a harness to his tail to keep him from thrashing, while attempting to remove the entangled fishing gear. The mission eventually failed and Churchill became the sixth right whale death in 2001 and the second that year as a result of entanglement (Dooley, 2001).

Sea turtles also have become entangled in floatable debris. All of the five sea turtle species found in the United States are endangered species, and all have been found entangled in different types of floatables debris, such as fishing line, rope, and fishing nets. Ingestion of floatable debris is an even greater problem for these species. Sea turtles have been found to swallow plastic bags because the bags look like jellyfish, one of their favorite foods. A plastic bag can block a turtle's digestive tract, leading to starvation. Cases of turtles swallowing balloons, tar balls, and debris that has become covered with algae also have been reported (USEPA, 1992b).

Nearly a million seabirds are thought to die from entanglement or ingestion of floatable material each year. Because most seabirds feed on fish, they are often attracted to fish that have been caught or entangled in nets and fishing line. Entanglement in fishing line has been a particular problem for the brown pelican, which is an endangered species. Seabirds are some of the most frequent victims of abandoned nets. As many as 100 birds have been found in a single abandoned net. Many birds, including ducks, geese, cormorants, and gulls, have been found entangled in six-pack rings and other encircling debris. The ingestion of plastic resin pellets (the small, round pellets that are melted and used to form plastic products) is a major concern. Many types of birds have been found to feed on these pellets, most likely because they mistake them for fish eggs or other types of food (USEPA, 1992b).

Fish and crustaceans such as lobsters and crabs are frequently caught in lost or discarded fishing gear in a phenomenon known as ghost fishing. For example, a ½-mile section of nylon net was found in Lake Superior. It had been abandoned for an estimated 15 years and contained 100 pounds of fish, much of which was decomposing. Lost traps also continue to attract fish and crustaceans, which enter them in search of food or shelter. In New England alone, nearly 500,000 lobster pots are lost every year (USEPA, 1992b).

Wildlife are affected when floatable debris disturbs their environment. Lost or discarded fishing gear and nets can drag along the ocean floor or through coral reefs, disrupting the animals and plants that live there. In addition, debris can bioaccumulate in the food chain. Bioaccumulation occurs when organisms low on the food chain consume a substance that builds up in their bodies. When animals higher on the food chain eat those organisms, they also ingest that substance and it accumulates in their bodies. The higher an animal is on the food chain, the greater the quantity of the substance consumed and accumulated. For example, eagles and other predators high on the food chain have been found with large concentrations of plastic pellets in their stomachs after feeding on smaller birds, which had previously ingested fish that had eaten the material. Also, floatable debris can smother corals and other sessile benthic organisms. It can prevent the sunlight from reaching plants, inhibiting their ability to produce energy through photosynthesis.

> Bioaccumulation refers to the degree to which an organism takes up and retains a contaminant from all applicable exposure routes. Bioaccumulation takes into account that organisms may accumulate contaminants through multiple exposure routes and that the total accumulation will depend upon the rate of intake versus the rate at which the organism is capable of eliminating (through urine or feces) or breaking down the chemical through metabolic processes (Ecorisk, 2002).

1.2.2 Impacts on Humans

Floatable debris also can have serious consequences for people. First, floatables can endanger human health and safety. Sharp objects, such as broken glass and rusty metal, can cause injuries

when people step on them on the beach or ocean floor. Abandoned fishing nets and lines can entangle scuba divers, and some divers have barely escaped serious injury or death. Floatables that wrap around boat propellers or puncture holes in the bottom of boats can disable vessels, thereby endangering human lives. This problem is especially serious if power is lost in a storm and the boat cannot return to shore or steering is hampered and the boat cannot avoid a collision. Submarines can be obstructed by abandoned fishing nets, making navigation and surfacing difficult. Contaminated debris, including medical waste and sewage, can pose a public health hazard through disease transmission. There is a strong correlation between swimmers in contaminated waters and higher rates of gastrointestinal illness compared to nonswimmers. During the summers of 1987 and 1988, beaches in New York and New Jersey were closed when medical waste, including syringes and bandages from hospitals, washed up on their shores. These beach closings caused many vacationers to go elsewhere, adversely affecting the economies of the areas with closings.

Second, floating debris is an eyesore, and debris stranded on beaches and shorelines degrades coastal aesthetics. Coastal communities lose millions of tourism dollars when large amounts of floatables make their beaches unattractive to visitors. Not only does floatable debris cost coastal communities lost revenues from tourism, but cleaning up beaches littered with floatables also can be very expensive, and it can be disruptive to the aquatic organisms that may live there.

Finally, lost or discarded fishing gear can financially harm a region's fishing industry. In addition to the costs associated with replacing the missing gear, floatable debris can cause costly or irreparable damage to boats. Fishing nets can wrap around propellers, plastic sheeting can clog cooling water intakes, and lost nets or lines can entangle vessels. In a 1987 survey in the Seattle area, almost two-thirds of the people who responded to the survey indicated that their boats had been damaged by floatables in the previous 2 years. When lobster or crab traps are lost, they trap thousands of animals that consequently are never caught and sold. Ghost fishing also kills thousands of fish that might otherwise have found their way to market.

1.3 Beaches Environmental Assessment and Coastal Health Act of 2000

Congress enacted the BEACH Act on October 10, 2000. It is designed to reduce the risk of disease to users of the Nation's coastal recreation waters. The act authorizes the Environmental Protection Agency (EPA) to award program development and implementation grants to eligible states, territories, tribes, and local governments to support microbiological testing and monitoring of coastal recreation waters, including the Great Lakes, that are adjacent to beaches or similar points of access used by the public. BEACH Act grants also provide support for developing and implementing programs to notify the public of the potential for exposure to disease-causing microorganisms in coastal recreation waters.

The BEACH Act amended the Clean Water Act and required EPA to accomplish the following:

- Publish new or revised microbiological water quality criteria within 5 years of enactment and review the criteria every 5 years.
- Ensure state or tribal adoption of existing microbiological water quality criteria within 42 months of enactment and within 36 months of revisions.
- Provide technical assistance to states, tribes, and local governments for assessment and monitoring of floatable material.
- Maintain a public right-to-know database.
- Implement a state and tribal grant program for beach monitoring and notification consistent with performance criteria.

The act also authorizes EPA to provide technical assistance to states and local governments for the assessment and monitoring of floatable materials. In partially fulfilling that obligation, through this document, EPA has compiled and presented the most current information available addressing the assessment and monitoring of floatable debris.

1.4 Other Floatable Debris-Related Legislation

In response to growing concern over floatable debris, governments have taken actions nationally as well as internationally, to reduce discharges at their source. For example, intentional at-sea dumping of garbage generated on land became subject to international control in 1972 through the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (commonly called the London Convention (LC)). Similarly, at-sea disposal of garbage generated during the routine operation of ships (e.g., garbage not deliberately carried to sea for the purpose of disposal) was addressed through a 1978 Protocol to the 1973 International Convention for the Prevention of Pollution by Ships (commonly called the MARPOL Convention). Specifically, the **1978 Protocol to the MARPOL Convention** added five annexes, each dealing with a different form of pollution from ships. Of these, **Annex V** established regulations on discharging ship-generated garbage, including a prohibition on discharging any plastics at sea.

In 1987, two important actions were taken in the United States to address this marine pollution problem. First, Congress approved the ratification of Annex V to the MARPOL Convention and enacted domestic legislation known as the **Marine Plastic Pollution Research** and **Control Act (MPPRCA)**, which prohibited any ship in U.S. waters from dumping plastics. Second, MPPRCA required EPA, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Coast Guard to work together to assess the feasibility of using volunteer groups in monitoring floatable debris on the Nation's coastlines.

The Shore Protection Act of 1988 (33 U.S.C. 2601 *et seq.*) (SPA) was enacted to minimize trash, medical debris and other unsightly and potentially harmful materials from being deposited into the coastal waters of the United States as a result of inadequate waste handling procedures by vessels transporting wastes on U.S. coastal waters and at associated loading and offloading facilities. EPA and the Department of Transportation (DOT) are assigned the responsibility for implementing SPA. EPA is responsible for developing regulations implementing Sec. 4103 of the Act which requires owners and operators of waste sources, vessels transporting waste, and waste receiving facilities to take all reasonable steps to minimize the amount of municipal and commercial waste deposited into coastal waters during various vessel and facility operations. EPA proposed its implementing regulations on August 30, 1994 (Waste Handling Practices for Vessels and Waste Transfer Stations, 40 CFR Part 237). The Department of Transportation developed an interim permit and enforcement program such that all vessels transporting solid wastes require a permit from the U.S. Coast Guard and concurrence from EPA that the vessel owner or operator has not violated applicable environmental regulations. DOT's interim rule was finalized in the spring of 2002.

Regulations under the Marine Protection, Research, and Sanctuaries Act (33 U.S.C. 1401 *et seq.*) (MPRSA), promulgated in 1977, implement the London Convention nationally. The regulations prohibit the transport for the purpose of dumping into the ocean of any "persistent inert synthetic or natural materials which may float or remain in suspension in the ocean in such a manner that they may interfere materially with fishing, navigation, or other legitimate uses of the ocean." Activities involving transport of material for the purpose of disposal at sea are regulated under this act, and permits granted by the Agency prohibit the transport of floatable plastics or debris out to sea for the purpose of dumping.

As amended by the **Water Quality Act of 1987, the Clean Water Act (33 U.S.C. 1251 et seq.)** requires EPA to establish regulations that treat storm water as point source discharges that must be regulated. Under Phase I and Phase II of the National Pollutant Discharge Elimination System (NPDES) Storm Water Program, EPA has issued regulations for storm water that require more than 5,000 municipalities (including many in coastal areas), as well as many industrial facilities, to obtain NPDES permits to discharge storm water. Specifically, Phase I requires NPDES permit coverage for storm water discharges from storm water associated with industrial activity (including construction sites greater than 5 acres in size) and from municipal separate storm sewer systems (MS4s) located in incorporated places or counties that serve populations of

100,000 or more. The Phase II rule requires NPDES permit coverage for storm water discharges from construction sites between 1 and 5 acres and from MS4s that serve areas with populations less than 100,000 down to a lower limit based on the U.S. Census Bureau's definition of an urbanized area. The permit prohibit non-storm water discharges to storm sewers and are leading to improved source control techniques and best management practices. The best way for municipalities and industries to meet the storm water regulation and protect the quality of our waters is to prevent floatables and other pollutants from washing into storm sewers.

Pursuant to the same Water Quality Act, EPA issued the **National CSO Control Strategy**, which also treats CSO discharge points as individual point sources, subject to NPDES permit requirements. The strategy sets forth three objectives:

1. Ensure that all CSO discharges occur only as a result of wet weather.

2. Bring all wet weather CSO discharge points into compliance with the technology-based requirements of the Clean Water Act and applicable state water quality standards.

3. Minimize water quality, aquatic biota, and human health impacts from wet weather overflows that do occur.

EPA's *National CSO Control Strategy* confirms that CSOs are point sources independent of the publicly owned treatment works (POTWs) and reaffirms that both technology-based and water quality-based requirements apply to CSOs. The strategy also emphasizes that CSO point sources that discharge without a permit are unlawful and must be issued permits or be eliminated.

Section 2
Types and Origins of Floatable Debris

Storm Water Discharges
Combined Sewer Overflows
Beachgoers and Other Nonpoint Sources
Ships and Other Vessels
Solid Waste Disposal and Landfills
Offshore Mineral and Oil and Gas Exploration/Production
Industrial Activities
Illegal Dumping or Littering

Section 2: Types and Origins of Floatable Debris

Floatable debris comes from many sources, including the ocean, land, and atmosphere. Floatables can be washed into the ocean by heavy rainfall, carried out to sea by rivers and streams, picked up off a beach by waves and tidal action, or deposited in streams or oceans from the atmosphere (i.e., balloons). Floating debris also can travel long distances over the ocean, and when these items get into the ocean they can cause problems over a large area. The most buoyant types of floatable debris are plastics and some types of rubber. Paper, wood, and cloth items initially float but tend to sink once they become saturated with water. Glass, metal, and some types of rubber sink unless air is trapped in pockets of the material.

Activities on land can also generate floatable debris. Such debris can be blown directly into the ocean or can be transported to the ocean if blown into a river or stream that empties into the sea. Objects that can be easily blown around are a particular problem because they can become floatable debris even when originally disposed of in an appropriate manner. During storms and other periods of high winds or high waves, almost any kind of trash (including glass, metal, wood, and medical waste) can be deposited into the ocean. Careful collection, handling, and disposal of trash, as well as attempts to reduce the amount of trash that must be disposed of, can help to reduce the floatable debris problem. Sections 2.1 through 2.8 provide some examples of the most common types and sources of floatables. Specific examples of types of debris released from different sources are provided in Table 1.

Table 1. Types and Sources of Floatable Debris

Source	Examples of Debris Released
Storm Water Discharges	Street litter (e.g., cigarette butts, filters, and filter elements), medical items (i.e., syringes), resin pellets, food packaging, beverage containers, and other material from storm drains, ditches, or runoff
Combined Sewer Overflows	Street litter, sewage-related items (condoms, tampons, applicators), medical items (i.e., syringes), resin pellets, and other material from storm drains, ditches, or runoff
Beachgoers and Other Nonpoint Sources	Food packaging, beverage containers, cigarette butts, toys, sewage, pieces of wood and siding from construction projects, and trash (e.g., beverage containers, food packaging) left behind by workers in forestry, agriculture, construction, and mining
Ships and Other Vessels	Fishing equipment (e.g., nets, lures, lines, bait boxes, ropes, and rods), strapping bands, light sticks (used by fishermen to light up fishing lines and recreational divers), plastic salt bags, galley wastes, household trash, plastic bags and sheeting, and beverage yokes (six pack rings for beverage containers)
Solid Waste Disposal and Landfills	Materials such as garbage and medical waste
Offshore Mineral and Oil and Gas Exploration	Data-recording tape, plastic drill pipe thread protectors, hard hats, gloves, and 55-gallon drums
Industrial Activities	Plastic pellets and other materials
Illegal Dumping or Littering	Food packaging, beverage containers, cigarette butts, appliances, electronics, and ocean and street litter

2.1 Storm Water Discharges

Storm water runoff (the water that flows along streets or along the ground as a result of a storm-derived runoff) can carry street litter into storm drains, which convey this water and debris to a nearby river or stream or even directly to the ocean. Typical floatables from storm water include

street litter (e.g., cigarette butts, filters, and filter elements), medical items (i.e., syringes), resin pellets, food packaging, beverage containers, and other material that might have washed down a storm drain or ditch or run off from land (e.g., styrofoam coffee and drink cups).

2.2 Combined Sewer Overflows

Pipes that carry a combination of sewage and storm water are known as combined sewers. In many areas of the country with older sewer systems, sewage is carried in the same pipe system as storm water runoff. Unlike separate storm drains, combined sewer pipes run to a sewage treatment plant rather than directly into a nearby body of water. At the sewage treatment plant, sewage is separated into sludge (solid waste materials) and wastewater. The sludge is dried and either disposed of in a landfill or treated and sold as a fertilizer. The treated wastewater is discharged into a river or other nearby waterway, free of solid waste. During heavy rains, combined sewer overflows (CSOs) can occur, which is a result of too much volume. The combined raw sewage and storm water are diverted directly into the nearest receiving waters. The typical floatable debris from CSOs include street litter, sewage-related items (e.g., condoms, tampons, applicators), medical items (i.e., syringes), resin pellets, and other material that might have washed into the storm drains or run off land, as well as industrial wastes from non-residential users of the sewer system.

2.3 Beachgoers and Other Nonpoint Sources

Every year thousands of people visit U.S. beaches. Many of these beachgoers leave behind materials that become floatable debris—food packaging and beverage containers, cigarette butts, and toys like plastic shovels, pails, and frisbees. This trash can be blown into the ocean, picked up by waves, or washed into the water when it rains. Trash or materials that have blown directly into the tributaries, streams, and rivers from yards, recreational areas, and other nonpoint sources are also sources of floatable debris.

Nonpoint sources of marine pollution include agriculture, forestry, construction, urban runoff, atmospheric fallout, ground water seepage, oil and other chemical spills and disposal, solid waste disposal and its leachates, subsurface disposal of sewage and other wastes, and mining operations (Caribbean Islands Directorate, 1989).

2.4 Ships and Other Vessels

Boats of all types are also sources of floatable debris. Fishing vessels are sources of fishing nets, lines, lures, rope, bait boxes, strapping bands, light sticks, salt bags, galley wastes, household trash, plastic bags and sheeting, beverage yokes, and other types of materials accidentally lost at sea. Other types of vessels that are sources of floatable debris include recreational boats; military and other government vessels; merchant marine vessels (e.g., ocean-going and domestic cargo vessels, ocean and domestic tugs and barges, ocean liners, ferries, and small charter boats); and

educational, private research, and industrial vessels (USEPA, 1990). Trash can accidentally fall, blow, or wash off vessels into the water. In some cases, trash is deliberately thrown overboard. One major reason for the overboard disposal of trash is that there is limited storage space aboard these vessels. Most of the time, however, trash is disposed of in the ocean by people who are unaware of the problems this practice can cause.

2.5 Solid Waste Disposal and Landfills

Waste disposal activities can cause problems when trash is lost during collection or transportation or when trash blows or is washed away from disposal facilities. This floatable material can be of any type, but it is most commonly garbage. Medical waste is of particular concern; but it seems to be adequately controlled in recent years, compared to the late 1980s. EPA defines medical waste as cultures and stocks of infectious agents; human blood and blood products; human pathological wastes, including those from surgery and autopsy; contaminated animal carcasses from medical research; wastes from patients isolated with highly communicable diseases; and all used sharps (e.g., needles, scalpels, etc.) and certain unused sharps. Solid waste that is generated from hospitals includes administrative papers and records, wrappers from bandages and catheters, intravenous (IV) bags and used vials, syringes and needles, and disposable items such as tongue depressors and thermometer covers (USEPA, 1989).

2.6 Offshore Mineral and Oil and Gas Exploration/Production

Offshore oil and gas platforms are structures that are constructed in the ocean and form a base from which oil and gas drilling is conducted. Because offshore oil and gas platforms are surrounded by water, any items lost from these structures become floatable debris. As with ocean vessels, trash has sometimes been intentionally discarded directly into the ocean from these structures. Typical floatable debris generated from these platforms includes data-recording tape, items like plastic drill pipe thread protectors, hard hats, gloves, and 55-gallon storage drums. Oil and gas companies, however, are making an effort to prevent the disposal of trash into the ocean from their platforms.

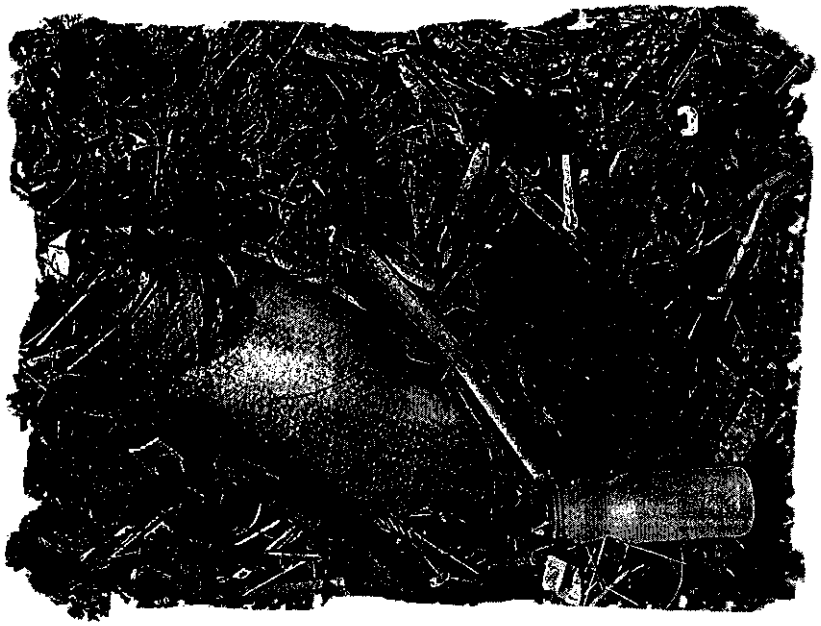
2.7 Industrial Activities

Industrial facilities contribute to the floatable debris problem when waste items generated by industrial processes (production scraps, flawed products, and packaging material) are improperly disposed of on land. Finished products also can become floatable debris if they are lost during loading and unloading at port facilities or they are lost when they are transported through waterways or over land. An example is plastic resin pellets, the small spheres produced as the raw form of plastic. Manufacturing facilities use the pellets to make plastic products. During plastic resin pellet production, transportation, and processing, some resin pellets can be released into the environment. As with other types of trash, wind and storm water can carry these pellets to nearby water bodies.

2.8 *Illegal Dumping or Littering*

Littering and illegal dumping of waste are both sources of floatable debris. The land-based debris can blow or wash into water bodies. People who litter are a significant source of floatable debris. Litter sometimes directly becomes floatables when it is discarded in the ocean or on the beach. In addition to the obvious problem of debris in coastal recreation waters, litter discarded hundreds of miles inland also can become floatable debris when it gets into streams, rivers, estuaries, and the ocean. Littering and illegal dumping can also occur from vessels and oil and gas exploration and production platforms.

Section 3
Current Floatable Debris Assessment and Monitoring Methodologies



Floatables Action Plan
Combined Sewer Overflows Studies Program
International Coastal Cleanup Campaign
National Marine Debris Monitoring Program
Storm Drain Sentries Program
Clean Marinas Program

Section 3: Current Floatable Debris Assessment and Monitoring Methodologies

This section provides examples of current plans and programs for assessing and monitoring floatable debris. Although each plan or program seeks to reduce floatable debris in the long term, the specific objectives or strategies of the plans vary. Examples of different objectives include beach cleanup, education, direct floatable debris reduction in specific waterways, classification and tallying of floatable debris for further analysis, and source determination. Most assessment and monitoring programs use volunteers to help with conducting cleanups and collecting and characterizing floatable debris. Determining the type, amount, and sources of floatable debris is an important first step in reducing the amount of floatables reaching aquatic environments.

3.1 Floatables Action Plan for New York and New Jersey Waters

3.1.1 Background

The Floatables Action Plan was developed in 1989 by an interagency work group addressing ocean beach closings in New York and New Jersey waters due to debris washing onto the beaches. This plan is designed to reduce the number of such ocean beach closings. Implementation of the plan was facilitated by the use of helicopter and vessel surveillance, cleanup vessels, volunteers, and prison inmates.

3.1.2 Goals

The Floatables Action Plan is designed to accomplish the following objectives:

- Minimize the amount of floatable debris escaping the Harbor Complex.
- Maintain an effective communication network to coordinate floatable debris removal activities and to respond to the spotting of slicks.
- Ensure timely notification of beach operators of potential wash-ups of floatable debris.
- Minimize beach closings due to floatable debris.

The plan defines floatable debris as waterborne waste material that is buoyant. Examples include wood, beach litter, aquatic vegetation, street litter, sewage-related wastes, fishing gear, and medical wastes. A number of agencies are implementing the plan.

3.1.3 Methodology

The plan calls for the use of skimmer vessels to contain and remove floatable debris before it escapes from the harbor; helicopter flyovers, which provide aerial surveillance to potentially reduce the impact of debris slicks spotted off the coasts; and the use of prison inmates to remove shoreline debris.

3.1.4 Unique Characteristics

The success of the Floatables Action Plan is the result of a partnership involving New York, New Jersey, and local municipalities. The plan uses multimedia approaches, such as aerial surveillance, coastal cleanup of the beaches by volunteers, and containing and removing debris from areas around storm water and CSO dischargers, to reduce the impact of debris on the coasts.

3.1.5 Contact Information

For more information regarding the Floatables Action Plan, contact Larry Gaugler (gaugler.larry@epa.gov), EPA Region 2, Floatables Coordinator, Division of Enforcement and Compliance Assistance, EPA Region 2, 290 Broadway, New York, NY 10007.

3.2 Combined Sewer Overflows Studies Program

3.2.1 Background

In November 1988, to supplement existing information on CSOs and storm water discharges (SWDs) as sources of floatable debris to the aquatic environment, EPA initiated the CSO Studies Program.

3.2.2 Goals

The following are the goals of the CSO Studies Program:

- Characterize CSOs and SWDs as land-based sources of plastic debris in the aquatic environment.
- Determine the types and relative amounts of floating debris contributed by these two sources.
- Characterize the types and composition of debris in Philadelphia and Boston sewage treatment plants (referred to as water pollution control plants [WPCPs] and publicly owned treatment works [POTWs]) to determine the potential waste releases from these facilities during system failures.

3.2.3 Methodology

To implement the CSO Studies Program, a two-component study design was developed. The first component, monitoring of CSOs and SWDs, consisted of the following activities (Battelle Ocean Sciences, 1993):

- *Outfall reconnaissance.* Before making final selections, several CSOs and SWDs were visited to determine the suitability and representativeness of each outfall as a candidate for study.
- *Outfall selection.* Representative CSOs and SWDs were selected based on information acquired through site visits and examination of land use maps and plans.
- *Outfall sampling.* Custom-made nets for containment of debris discharged from selected CSOs and SWDs were designed, manufactured, and installed..
- *Discharge event response.* Floatable debris samples were collected from the containment net at each outfall during or after at least three major storm or discharge events.
- *Sample analysis.* Samples were analyzed to characterize and quantify the types of debris collected.

The second component, which focused on characterizing debris from POTWs and WPCPs, included the following activities:

- *POTW and WPCP selection.* Identification and selection of sewage treatment facilities for sampling man-made debris.
- *POTW and WPCP sampling.* Sampling of measured volume of debris (relative to the daily volume of debris) collected by the screening units for the settling and clarifying tanks. Also, sample a measured volume (relative to the daily volume) of scum from the skimmer tanks.
- *Preprocessing.* Separation of all natural materials (including large pieces of cut lumber) and polystyrene foam from man-made debris. Count numbers of dead animals, food items (oranges, apples, etc.), and large pieces of man-made debris, and estimate the amount of fecal matter. Record types and numbers of items removed from the man-made material.
- *Sample processing and analysis.* Sorting of man-made debris from scum and screening samples and enumerate items.

Candidate CSO and SWD outfalls were selected according to the following criteria:

- *Accessibility.* Outfalls had to be accessible by land or small boat.
- *Outfall water depth.* Water depth at the site had to be shallow (less than 20 feet at high tide).
- *Representativeness.* Drainage areas had to be residential or commercial.
- *Outfall dimensions.* The dimensions of each outfall had to be such that the deployed nets would capture all material discharged during a sampling event.

In addition to the four criteria discussed previously, sewage treatment facilities were selected on the basis of the accessibility of screens and the sedimentation tank clarifiers.

3.2.4 Unique Characteristics

The CSO Studies Program provided EPA with preliminary information on the types and amounts of floating debris discharged from commercial and residential wastewater and storm water outfalls in Philadelphia and Boston. The program also provided information on the types and amounts of floatable debris removed by sewage treatment facilities in each city.

3.2.5 Contact Information

For more information, contact Doug Pabst (pabst.doug@epa.gov), USEPA Region 2, 24th Floor, 290 Broadway, New York, NY 10007-1866 or U.S. EPA's Oceans and Coastal Protection Division at (202)-566-1200.

3.3 International Coastal Cleanup Campaign

3.3.1 Background

The Ocean Conservancy, formerly known as the Center for Marine Conservation, established and maintains the annual International Coastal Cleanup Campaign (ICCC) with support from EPA and other stakeholders. The first cleanup was in 1986 in Texas, and the campaign currently involves all of the states and territories of the United States and more than 100 countries around the world. The ICCC is the largest volunteer environmental data-gathering effort and associated cleanup of coastal and underwater areas in the world. It takes place every year on the third Saturday in September.

3.3.2 Goals

The mission of the ICCC is as follows:

- Remove debris from the shorelines, waterways, and beaches of the world's lakes, rivers, and bordering oceans.
- Collect and catalog information on the amounts and types of debris.
- Educate people on the issue of floatable debris.
- Use the information collected from the cleanup to effect positive change—on all levels, from the individual to the international—to reduce floatable debris and enhance marine conservation.

The ICCC provides inspiration to hundreds of thousands of people who mobilize along waterways and beaches worldwide for the annual cleanup.

3.3.3 Methodology

The ICCC is a nonscientific survey designed to provide an annual "snapshot" of floatable debris pollution affecting the shorelines of the U. S. and around the world. Each U.S. state/territory and foreign country participating in the ICCC has a designated Cleanup Coordinator who, by the early spring of each year, begins preparations for the September event. Within each state/territory and country, a local network of site captains are organized and supplied with the materials and information necessary to conduct the local events. Supplies, provided by The Ocean Conservancy, include data cards, trash bags, gloves, posters, and associated educational materials. During the 3-hour ICCC event, volunteers collect, catalogue, and weigh the debris found on their beaches and shorelines. Information is recorded and catalogued on the ICCC data cards by the volunteers, and the information is returned to The Ocean Conservancy to be processed and tabulated. The Ocean Conservancy compiles the data and produces annual debris summary reports. Refer to Appendix A to review the data forms used by local coordinators and 2001 U.S. data summaries.

3.3.4 Unique Characteristics

The success of this event is the result of volunteerism and sponsorship. In 2001, over 140,000, people across the U.S. participated in the cleanup. They removed about 3.6 million pounds of debris from more than 7,700 miles of coasts, shorelines, and underwater sites. The 3.6 million pounds of debris constitutes more than 3.7 million debris items. Most of the states and local organizations involved have multiple sponsors to support their efforts.

3.3.5 Contact Information

For more information, visit The Ocean Conservancy web site at *www.oceanconservancy.org* or contact The Ocean Conservancy headquarters, 1725 DeSales Street, NW, Suite 600, Washington, DC 20036. Additional information about the cleanup is available from *www.epa.gov/OWOW/oceans/debris* or by contacting EPA's Oceans and Coastal Protection Division at (202)-566-1200.

3.4 National Marine Debris Monitoring Program

3.4.1 Background

EPA along with other federal agencies helped to design the National Marine Debris Monitoring Program (NMDMP), and EPA is supporting The Ocean Conservancy's implementation of the study. NMDMP is designed to gather scientifically valid marine debris data following a rigorous

statistical protocol. The NMDMP is designed to identify trends in the amounts of marine debris affecting the U.S. coastline and to determine the main sources of the debris. This scientific study is conducted every 28 days by teams of volunteers at randomly selected study sites along the U.S. coastline. The program began in 1996 with the establishment of 40 monitoring sites ranging from the Texas/Mexico border to Port Everglades, Florida, and includes Puerto Rico and the U.S. Virgin Islands. The NMDMP calls for the establishment of 180 monitoring sites located along the coast of the contiguous U.S., Alaska, Hawaii, Puerto Rico, and the U.S. Virgin Islands. To date 163 study sites have been designated and 128 sites are collecting data. The program will run for a 5-year period once all of the study sites have been established.

3.4.2 Goals

The NMDMP is designed to answer two specific questions:

- Is the amount of debris on our coastlines increasing or decreasing?
- What are the major sources of this debris?

3.4.3 Methodology

As a result of power analysis, fiscal constraints, and logistics, the NMDMP has developed the following guidelines:

- Approximately 88,000 miles of U.S. coastline (including Puerto Rico and the U.S. Virgin Islands) have been divided into nine regions based on available information on the types of marine debris found, the prevailing currents, and logistics.
- Twenty 500-meter sites per region will be surveyed monthly. The potential sites are selected based on specific criteria (e.g., substratum, slope) advocated by other marine debris monitoring studies and then finally selected by a geographically stratified random selection process.
- Approximately 30 indicator items will be surveyed every 28 to 30 days, on the same day at all 20 sites within a region. This approach will facilitate regional as well as national comparisons.
- The monitoring will be conducted by trained and certified volunteer surveyors, who will be guided and checked by a survey director, who in turn is supervised by the program team.
- The program will adhere to all scientific protocol, and quality assurance procedures will be conducted to ensure quality at all levels of the program.

Statistical power analysis is the evaluation of the ability to detect significant statistical results when real differences exist in a particular monitoring variable. Application of this tool enables the investigation of the statistical implications of alternative sampling strategies (e.g., numbers of sample replicates or sampling stations). This application is especially useful in designing new monitoring programs or in evaluating the effectiveness (or cost efficiency) of existing programs (USEPA, 1987).

- The study will detect a 30 percent change in the frequency of indicator items over 5 years (if it occurs), with a power of 0.84 and a Type I error of 0.10.

Refer to Appendix B for examples of the data forms used in the NMDMP.

3.4.4 Unique Characteristics

The program considers the physical characteristics of the beach (e.g., slope, substratum, composition, uniformity), prevailing weather patterns (e.g., onshore winds, frequency of storms), beach accessibility (e.g., private or public roads and parking nearby), and beach debris composition (e.g., land-based and ocean-based categories). Any of these variables has the ability to influence the number of potential beaches that can be used for sampling.

3.4.5 Contact Information

For more information, visit *www.oceanconservancy.org* or contact The Ocean Conservancy headquarters, 1725 DeSales Street, NW, Suite 600, Washington, DC 20036. Additional information about NMDMP is available from *www.epa.gov/OWOW/oceans/debris* or by contacting U.S. EPA's Oceans and Coastal Protection Division at (202)-566-1200.

3.5 Storm Drain Sentries Program

3.5.1 Background

The Ocean Conservancy (formerly the Center for Marine Conservation) in partnership with EPA, has established a program to raise awareness and prevent floatable debris (among other pollutants) from being washed down storm drains and ultimately reaching coastal recreation waters. The Storm Drain Sentries program aims to increase public awareness regarding the impact of trash and other pollutants being dumped or poured into storm drains by painting warning messages on one million storm water drains across the United States. Volunteers stencil storm drains with clean water messages such as "Don't Dump! Protect Your Water."

3.5.2 Goals

The goals of the program include: (1) educating people about the connection between people, land, and waterways and the detrimental effects of nonpoint source pollution; and (2) dramatically demonstrating the problem's pervasiveness by identifying the locations of the stenciled drains as potential portals for the introduction of floatable debris into coastal recreation waters.

3.5.3 Methodology

The Ocean Conservancy sends interested groups a storm drain stenciling kit that contains a fact sheet about nonpoint source pollution, its impacts, and what citizens can do to prevent it. The kit also contains instructions for managing a stenciling project and a data card for recording the number of storm drains stenciled and the types of pollutants found around each (CMC, 2000). Refer to Appendix C for examples of storm drain stenciling data cards.

3.5.4 Unique Characteristics

This program, which continues to grow rapidly, involves more than 90 organizations in 34 states and Canada. Volunteers have painted more than 330,000 storm drains. State and local governments, as well as private groups and citizens, have also joined the program (CMC, 1998).

3.5.5 Contact Information

For more information, visit *www.oceanconservancy.org* or contact The Ocean Conservancy headquarters, 1725 DeSales Street, NW, Suite 600, Washington, DC 20036. Additional information about the Storm Drain Sentries Program can be obtained from *www.epa.gov/OWOW/oceans/debris* or by contacting U.S. EPA's Ocean and Coastal Protection Division at (202) 566-1200. Stencils on loan and project guidelines can be obtained from Ron Ohrel of The Ocean Conservancy at (757)-496-0920.

3.6 Clean Marinas Program

3.6.1 Background

The EPA document, National Management Measures Guidance to Control Nonpoint Source Pollution from Marinas and Recreational Boating (USEPA, 2001b), promotes clean marinas through management measures and practices to achieve clean water. Each management measure addresses approaches to prevent nonpoint source pollution, including trash that could become floatable debris, from adversely affecting receiving waters. The measures identified relate to the siting and design of new and expanding marinas and to the good housekeeping activities practiced at marinas.

3.6.2 Goals

The program's goals are to increase awareness of clean water at and within marinas, to protect coastal and inland waterways, and to prevent the degradation of coastal habitats from nonpoint source pollution.

3.6.3 Methodology

Good marina water quality depends on water circulation within the boat basin. In a poorly flushed boat basin, floatables and other pollutants tend to concentrate and collect in corners, poorly flushed coves, and secluded or protected areas to cause offensive odors, stagnant water, and reduced dissolved oxygen. Good flushing of marina basins in tidal waters is primarily driven by the ebb and flow of the tide. Inland basin flushing in lakes and rivers depends on wind-driven circulation and current speed. Marina flushing is enhanced by design considerations such as limiting the number of enclosed areas in the marina, and vice versa, providing an open design with more than one entrance, ensuring that the entrance channel is not deeper than adjacent channels and the depth of the basin, and using mechanical aerators.

3.6.4 Unique Characteristics

Clean Marinas is a voluntary program that encourages marina managers to adopt best management practices to address the impacts of nonpoint source pollution. It also includes management practices that promote the proper and safe handling of solid and liquid waste, fish waste, petroleum control, boat cleaning, sanitation, and pumpout systems for boat holding tanks.

3.6.5 Contact Information

For more information, visit EPA's web site at *www.epa.gov/owow/nps* or call EPA's Assessment and Watershed Protection Division at (202) 566-1146.

Section 4

Developing a Floatables Assessment and Monitoring Program

Marine Debris Survey Manual
Marine Debris Monitoring and Cleanup

Section 4: Developing a Floatables Assessment and Monitoring Program

This section provides recommendations for developing programs to assess and monitor floatable debris, including specific information about designing floatable debris surveys. The section also provides information from volunteer organizations regarding floatable debris monitoring and cleanup strategies.

4.1 *Marine Debris Survey Manual*

The *Marine Debris Survey Manual* (Ribic et al., 1992) provides information useful to managers, researchers, government officials, and others interested in designing marine debris surveys. The manual could be used to develop a floatable debris assessment and/or monitoring program at the state or local government level. Listed in sections 4.1.1 and 4.1.2 are some of the variables the manual discusses as important, which should be considered when developing such a program (Ribic et al., 1992).

4.1.1 Design Protocols for Monitoring and Assessment of Marine Debris

These protocols should be followed when designing a monitoring and assessment program for marine debris:

- State the objectives clearly.
- Define the population of interest.
- Collect information (e.g., physical features, weather patterns, historical information) on the geographic areas of interest to develop a sampling plan.
- Define the field measurements to be made.
- Examine data from previous studies or conduct pilot studies to approximate the likely variability in the field measurements.
- Develop a quality assurance program plan to ensure that the data collected will be of high quality, verifiable, and defensible.
- Develop field sampling designs and measurement procedures that will yield representative data from the defined population, along with a specified variance or confidence limit. If necessary, make decisions on identifying the source of debris (vessel-source versus land-based).
- Determine the statistical analyses to be used.
- Conduct the study according to the written protocol.
- Analyze the data.
- Evaluate the study. (Were the objectives met? Were the collected data adequate to meet the stated objectives? Should the design be modified?)

4.1.2 Variables to Be Considered Overall

When designing an assessment and monitoring program, the following variables should be considered:

- Wind direction and speed.
- Current direction and speed.
- Location of outfalls in the path of the wind and current.
- Size and type of debris.
- Discharge-specific debris.
- Tidal range.

4.1.3 Shipboard Sighting Surveys for Large Debris Items

Open-water sighting surveys are used to identify and count floating debris from an elevated platform on a moving ship. The transect width may vary from 100 meters to the visual horizon, depending on the type of debris being studied. Surveys are typically conducted from the glare-free side of the ship, and objects are sighted visually, unaided or with binoculars. The following are typical objectives for open-water sighting surveys (Ribic et al., 1992):

- Identify types of floatable debris.
- Estimate densities of floatable debris.
- Identify areas of low or high concentrations of floatable debris relative to other oceanographic features (e.g., currents, convergence zones) or man-made structures (e.g., offshore oil platforms).
- Relate floating debris to entanglement or other effects on animals.
- Detect temporal and spatial changes in the occurrence of floatable debris.

In planned studies, debris in specific oceanic areas is considered to be the population of interest, which must be defined by the researcher.

Copies of marine debris survey forms included in the *Marine Debris Survey Manual* are provided in Appendix D.

4.1.4 Contact Information

The information provided in this section was taken from the *Marine Debris Survey Manual*, NOAA Technical Report NMFS 108, April 1992, by Christine A. Ribic, Trevor R. Dixon, and Ivan Vining. Copies of the report can be obtained from the U.S. Department of Commerce, National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

4.2 Marine Debris Monitoring and Cleanup

Marine debris monitoring information from volunteer organizations can be used to assess debris sources, identify areas where public education and outreach are necessary, and evaluate the success of legislation enacted against littering and ocean dumping. The information that follows was taken from Chapter 16 of *Volunteer Estuary Monitoring: A Methods Manual*. This information can be used to organize a volunteer floatable debris monitoring and cleanup program, with specific emphasis on data collection and data uses (USEPA, 1993a).

4.2.1 Sampling Considerations and Options

Marine debris cleanup programs generally fall into two categories: (1) programs that collect and remove debris and (2) programs that collect and remove debris and also record information on the amounts and types of debris found. Marine debris cleanup and monitoring programs should address the following questions before proceeding with any activity:

- Why do you want to conduct a cleanup?
- What do you want to accomplish?
- Do you want to conduct a cleanup to just remove debris, or do you want to collect some kind of data? If so, what kind of data should be collected (the type of data should be determined by the goal(s) of the program)?
- What will the data be used for (e.g., monitoring debris type or accumulation trends, identifying the debris sources, or influencing legislation)?
- Will this be a 1-day event, or will it need to be repeated periodically?
- What are the limits of the data?

4.2.2 Conducting a Marine Debris Cleanup

Depending on the scope and data needs of the program, organizing such an event can take either a few days or a few months. The following actions are required for a successful cleanup program:

- Identifying debris collection sites that are safe and accessible to volunteers.
- Identifying site coordinators who can manage cleanup activities at each site.
- Locating a waste hauler who will donate services to the project.
- Planning recycling options.
- Arranging for weight scales and other necessary equipment to be at the site.
- Soliciting volunteers to participate in the activity and providing training prior to the event.
- Working with the media (as appropriate) to obtain coverage of the event or have it photographed or videotaped.

- Maintaining a list of people who might participate to get some indication of the number of participants expected at the cleanup site.
- Preparing for health emergencies.
- Ensuring that volunteers know what to do with dead, entangled, or injured animals.
- Contacting potential sponsors to obtain donations of supplies, food, drinks, prizes, and whatever else might be needed.
- Inspecting equipment.
- Establishing and setting up check-in points.
- Coordinating volunteers at cleanup sites.
- Collecting data cards.
- Distributing prizes and other items to the volunteers.
- Disposing of the debris.
- Compiling cleanup information.
- Following up with site coordinators and key volunteers with results and future action.
- Providing data to state, local, or federal government agencies as appropriate.

4.2.3 Contact Information

The information provided in this section was taken from Chapter 16 of *Volunteer Estuary Monitoring: A Methods Manual*. For more information, visit the EPA web page at *www.epa.gov/owow/estuaries/monitor/chptr16.html* or contact U.S. EPA's Ocean and Coastal Protection Division at (202) 566-1200.

Section 5
Prevention and Mitigation Activities Associated with Floatable Debris

Plastic Pellet Containment
Combined Sewer Overflow Permit Conditions for Floatable Debris
Navesink River Nonpoint Source Program
Debris-Impaired Waters and Total Maximum Daily Loads
National Estuary Programs

Section 5: Prevention and Mitigation Activities Associated with Floatable Debris

This section provides examples of prevention and mitigation activities associated with floatable debris, including recommendations to industry regarding plastic pellets, permit conditions, TMDLs, and selected National Estuary Program (NEP) mitigation activities.

5.1 Plastic Pellet Containment

The Society of the Plastics Industry, Inc. (SPI) worked with EPA to characterize process operations in the plastics industry and to identify potential sources of pellet losses to the environment. SPI is the major national trade association representing the plastics industry. The release of pellets from pellet producers, transporters/contract packagers, and processors can be controlled through actions identified in an EPA study on plastic pellets in the aquatic environment (USEPA, 1992a). Recommendations to the plastics industry included the following (USEPA, 1993b):

- Adopt the SPI 1991 Pellet Retention Environmental Code and the 1992 Processor's Pledge. The code is a commitment to total containment of plastic pellets. It encourages source reduction activities to prevent releases and suggests ways to recapture spilled pellets.
- Educate employees and train them to minimize pellet spillage and loss.
- Install pellet containment systems or use portable containment apparatuses.
- Institute pellet containment activities during routine plant operations.
- Recycle spilled pellets.
- Improve the quality and frequency of pellet spill cleanup procedures.
- Use puncture-resistant packaging and minimize the use of valved bags.
- Inspect shipping vehicles (e.g., rail hopper cars, bulk trucks, freight trucks) before and after loading and offloading of pellets.
- Inspect shipping containers before and after loading and offloading of pellets.

To obtain a copy of the complete report, *Plastic Pellets in the Aquatic Environment: Sources and Recommendations* (EPA 842-B-92-010), contact the National Service Center for Environmental Publications at P.O. Box 42419, Cincinnati, OH 45242-0419, (800) 490-9198, ncepimal@one.net, *www.epa.gov/ncepihom/.*

5.2 Combined Sewer Overflow Permit Conditions for Floatable Debris

New York and New Jersey are coordinating a CSO and storm water permit system. It will address the permit programs applying to CSO discharges, efforts to reduce CSOs, control of solids and floatable debris, and issues relevant to interstate water planning coordination (USEPA, 1998b). Additional information about the permit system is available from the New Jersey

Department of Environmental Protection (NJDEP) at *www.state.nj.us/dep/index.html* or from the New York State Department of Environmental Conservation (NYSDEC) at *www.dec.state.ny.us*.

5.3 Navesink River Nonpoint Source Program

The Navesink Watershed Management Project, established in New Jersey, began in 1981 as a major interagency initiative involving environmental groups, civic organizations, and federal, state, county, and municipal agencies. The purpose of the project is to reduce nonpoint source bacterial pollution in the Navesink estuary, specifically from boats, agricultural runoff, and urban and suburban runoff (Scro and Eisele, 1993). To control pollution from boats and marinas, several organizations have taken the lead in determining the extent of recreational boating, the infrastructure needed to reduce related sewage, and the need for education to change the behavior of boaters and marina operators. Other organizations have successfully advocated statutory changes, planning, and other measures to deal with boating-related pollution (Chess and Gibson, 2000).

The Navesink Project has shown that nonpoint source programs need to be flexible and innovative, and developed on a site-specific basis. Programs must be created by the parties that will play an integral role in resource management in order to gain support (USEPA, 1995). The Harbor Estuary Program has funded a study to examine the effectiveness of certain identified best management practices (e.g., regular catch basin maintenance, street vacuuming, and storm water filtration screens). Water quality is monitored before and after implementation (USEPA, 1998b).

More information about the Navesink Project is available in the *Navesink Watershed Management Effort* (Chess and Gibson, 2000), *Navesink River Water Monitoring Project* (Scro and Eisele, 1993), or EPA's *Nonpoint Source News Notes* (USEPA, 1995).

5.4 Debris-Impaired Waters and Total Maximum Daily Loads

A Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and meet water quality standards, along with an allocation of that amount to the pollutant's sources. Section 303 of the CWA establishes the TMDL program. Water quality standards are set by states, territories, and tribes. They identify the uses for each water body, for example, drinking water supply, contact recreation (i.e., swimming), and aquatic life support (i.e., fishing), and the scientific criteria to support each use. Calculation of a TMDL includes summing the allowable loads of a single pollutant from all contributing point and nonpoint sources. TMDLs apply the standard by setting the maximum amount of pollutants and then allocating that load between point and nonpoint sources. In addition, a TMDL must include a margin of safety based on the uncertainty in the calculations and must consider the seasonality of the particular pollutant.

On their 1998 303(d) lists, California, New York, Alaska, Washington, and Connecticut identified a total of 62 waterbodies as water quality impaired because of debris, trash, floatables and/or large woody debris. California has developed 3 TMDLs for trash. For more information about the TMDL program, visit the website at www.epa.gov/owow/tmdl.

5.5 National Estuary Programs

The National Estuary Program (NEP) was established in 1987 by amendments to the Clean Water Act. The purpose of the NEP is to identify, restore, and protect nationally significant estuaries of the United States. Unlike traditional regulatory approaches to environmental protection, the NEP targets a broad range of issues and involves local communities in the process. It focuses on improving water quality in estuaries and on maintaining the integrity of the whole system—its chemical, physical, and biological properties and its economic, recreational, and aesthetic values (USEPA, 2001a).

The NEP is designed to encourage local communities to be responsible for managing their estuaries. Each program consists of representatives from Federal, state, and local government agencies responsible for managing the estuary's resources, as well as community members such as citizens, educators, researchers, and business leaders. Stakeholders work together to identify the estuary's problems, develop specific actions to address those problems, and create and implement a formal management plan to restore and protect the estuary. There are currently 28 NEP programs. More information about the NEP is available at *www.epa.gov/owow/estuaries*.

5.5.1 New York-New Jersey Harbor Estuary Program

EPA authorized the New York-New Jersey Harbor Estuary Program (HEP) in 1987. The program is a multiyear effort to develop and implement a plan to protect, conserve, and restore the estuary. Program participants include scientists, citizens, business interests, environmentalists, representatives from local, state, and Federal environmental agencies, and others (HEP, 1996).

One component of HEP's Comprehensive Conservation and Management Plan (CCMP) is the management of floatable debris. The goals of the floatable debris management plan are:

- To eliminate floatables-related beach closures.
- To prevent adverse impacts on commercial and recreational boating from floatable debris.
- To prevent adverse impacts on coastal species resulting from floatable debris.

To achieve these goals, HEP decided to address the floatable debris problem with two tracks. The fast track, which was developed and implemented in 1989, included the following specific actions to clean up existing debris after it had entered the system:

- *Surveillance.* The New Jersey Department of Environmental Protection (NJDEP), EPA, and the U.S. Coast Guard (USCG) conduct helicopter and aircraft patrols of the harbor to look for slicks of floating debris. There are also daily vessel patrols of the harbor by EPA and USCG, weekly patrols of the New York Bight by USCG, and daily overflights of the Bight by NJDEP.
- *Regular Cleanups.* The U.S. Army Corps of Engineers (USACE) has an ongoing program to capture loose timbers and other navigation hazards in the harbor. USACE cleans up floatable slicks, using specially designed nets to collect small debris. Cleanups are regularly scheduled at the Verrazano Narrows and Arthur Kill (locations where garbage slicks tend to form) during and following new moon and full moon high tides and after storms that cause CSOs. During the summer bathing season (mid-May to mid-September), cleanups occur daily.
- *Nonroutine Cleanups.* USACE attempts to capture additional slicks in the harbor when conditions are brought to its attention. State coordinators notify local authorities and beach operators of potential wash-ups.
- *Communications Network.* EPA coordinates a reporting network and cleanup activities. EPA, New York State Department of Environmental Conservation, NJDEP, New York City Department of Sanitation, USACE, and USCG are all on-call 24 hours a day. Hotline numbers are available for citizens' telephone calls.

The longer-term strategy, which supplements the short-term action plan and reduces the amount of debris entering the system, consists of the following:

- Continue and improve the successful short-term floatables action plan.
- Develop and implement a long-term, source-oriented strategy to reduce the amount of floatables entering the ecosystem.
- Take action as soon as there are commitments and mechanisms in place for implementation.
- Take additional actions, over time, as mechanisms and commitments are developed.
- Expand public education and outreach efforts to foster lifestyle changes that will reduce the public's contribution to the floatable debris problem.

The following are the objectives and recommendations of the HEP Floatables Plan:

- Continue and enhance implementation of the short-term floatables action plan.
- Expand the USACE Harbor Drift Removal Program without compromising key habitat.
- Implement beach and shoreline cleanups.
- Assess and control landfill and solid waste practices to minimize aerial sources of floatables.
- Communicate impacts of marine debris and appropriate disposal practices.
- Reduce floatable loadings from CSOs, storm water discharges, and other nonpoint sources.

Also, pilot projects have been established at marinas in New York and New Jersey to encourage proper handling and recycling of marine debris. This campaign, a model to be replicated at marinas throughout the New York-New Jersey Harbor Estuary, discourages tossing trash

overboard, encourages recycling and waste minimization, educates boaters about the problems of marine pollution, fosters appreciation of local marine areas, and creates an awareness of the Harbor and Long Island Sound Estuary Programs (USEPA, 1998b).

For more information about the New York-New Jersey HEP, refer to *www.harborestuary.org*. The CCMP is available at *www.harborestuary.org/mgmt.htm*. Information about the successes and future challenges of the program is available from *Successes and Challenges: Highlights of Program Accomplishments and Challenges for the Future*, which is available at *www.hudsonriver.org/hep/pdf/sc.pdf*. A list of HEP contacts is available from *www.harborestuary.org/contacts.htm*.

5.5.2 Long Island Sound Study

The Long Island Sound Study (LISS) is a cooperative effort involving researchers, regulators, user groups, and other concerned organizations and individuals. This partnership is designed to protect and improve the health of the sound by implementing the 1994 CCMP for the sound (LISS, 2001). The floatable debris part of the plan seeks to reduce the flow of litter from its major sources, and to collect and pick up litter once it is in the sound. Source control is the most effective strategy to combat littering and improper disposal. To reduce the flow of floatable debris into the sound, management actions center on the following (LISS, 1994):

- *Combined sewer overflow abatement and storm water management.* New York City has begun to implement a CSO abatement program for controlling the discharge of pathogens. Connecticut will implement its long-term CSO abatement program to manage sewer areas affecting Long Island Sound. New York and Connecticut are implementing statewide storm water permit programs to manage storm water from industrial and construction activities. Both states are also using their nonpoint source programs to control pathogen discharges to the sound. Each of these programs will also substantially reduce the amount of floatable debris entering the sound.
- *Education.* The New York Sea Grant Extension Program, Connecticut Sea Grant Marine Advisory Program, and LISS have organized volunteers from civic associations, schools, and environmental and youth groups to paint messages on storm drains, such as "Don't Dump–Drains to Long Island Sound." Another program, "Clean Streets/Clean Beaches" is an anti-litter program launched in April 1992 by a coalition of public and private groups in New Jersey and New York. The goal of this program is to make people aware that street debris can ultimately be found on beaches and that they should not litter.

According to the 1998 CCMP Tracking Survey, 2,685 New York volunteers collected more than 35,846 pounds of trash from the shoreline along the sound during 1998. In Connecticut, approximately 750 volunteers removed more than 7,000 pounds of trash from 20 miles of shore. Additionally, between 1991 and 1998 more than 18,650 storm drains have been stenciled with the "Don't Dump—Drains to Long Island Sound" message and more than 3,330 drains in New York have been stenciled with a bilingual (Spanish/English) "Clean Streets = Clean Beaches" slogan (LISS, 1998).

More information about LISS is available at *www.epa.gov/region01/eco/lis*. The CCMP is available at *www.epa.gov/region01/eco/lis/plan.html*. For more general information, contact the U.S. EPA Long Island Sound Office, Stamford, Government Center, 888 Washington Avenue, Stamford, CT 06904-2152, (203) 977-1541 or the Marine Sciences Research Center, SUNY Stony Brook, Stony Brook, NY 11794-5000, (516) 632-7666. A more detailed list of contacts is available at *www.epa.gov/region01/eco/lis/contacts.html*.

5.5.3 San Juan Bay Estuary

The San Juan Bay Estuary (SJBE) system was nominated for the National Estuary Program on April 16, 1992. It is the only NEP located in a tropical geographic region and outside the mainland United States. The goals of the SJBE Program are to (SJBE Program, 2000):

- Establish a comprehensive water quality policy. This policy will ensure the integrity of marine resources and terrestrial ecosystems while supporting human activities in the system.
- Develop an effective administrative and regulatory framework for the SJBE system that will serve as a model for other estuary systems, especially for tropical systems.
- Optimize the social, economic, and recreational benefits associated with the SJBE system.
- Prevent further degradation and improve the system's water quality to help ensure healthy terrestrial and aquatic communities and social well-being.
- Minimize the health risks associated with direct human contact with the surface waters and the consumption of fish and shellfish.

The objectives of the SJBE Program are to:

- Identify the major stressors impacting the system and establish their relative importance.
- Develop action plans to remediate problems identified in the system.
- Conserve and enhance the integrity of the known, highly valuable natural resources in the system, and restore, to the extent possible, areas that have been adversely affected.
- Address the major concerns of citizens and user groups regarding the quality of the system.
- Promote the public's awareness regarding estuarine resources and involvement in the development of an effective management plan for the system.

- Develop a hydrological model of the system to determine effective alternatives to improve circulation and predict the hydrological impacts of future development.

To prioritize issues of concern and to develop proposed solutions to improve the health of the estuary, the SJBE Program developed four Action Plans. The goal of the Aquatic Debris Action Plan is to improve habitat quality and enhance the aesthetic, recreational, and economic values of the SJBE by ensuring that the watershed is free of aquatic debris. The first objective of the plan is to significantly reduce the amount of aquatic debris that reaches all estuarine waters. This is to be accomplished by the following actions:

- Develop and implement community-based solid waste management and recycling programs in coordination with municipalities.
- Continue to implement the Action Plan Demonstration Project developed in Piñones, Loíza.
- Continue the annual aquatic debris cleanup event held in Islote de la Guachinanga.
- Conduct periodic aquatic debris cleanup activities at suggested SJBE locations.

The second objective of the plan is to develop, promote, and implement voluntary compliance and pollution prevention initiatives. This can be accomplished by establishing Solid Waste Pollution Prevention Pilot Programs at different SJBE locations. The third objective of the plan is to strengthen the enforcement of littering laws and regulations by:

- Implementing measures to detect, correct, and control illegal dumping activities and enforcing Puerto Rico's Anti-Littering Law (Law No. 11 of 1995).
- Enforcing the Law for the Management of Used Tires (Law No. 171) and other regulatory measures related to the illegal dumping of used tires within the estuary system and its drainage basin.

More information is available from the San Juan Bay Estuary Program Office, U.S. Army Corps of Engineers Building, 400 Fernandez Juncos Avenue, Second Floor, San Juan, Puerto Rico, 00901-3299, (787) 725-8162. Edna Villanueva, the Technical Director, may be contacted at edna.villanueva@usace.army.mil.

5.5.4 Santa Monica Bay Restoration Project

The Santa Monica Bay Restoration Project (SMBRP) is a group of environmentalists, scientists, government representatives, business people, and members of the public. It was formed in 1988 to develop a restoration plan for the bay. The mission of SMBRP, one of the first NEPs, is to create a comprehensive plan to ensure the long-term health of Santa Monica Bay, which is adjacent to the heavily urbanized, second-most-populous region in the United States. Among a variety of projects and programs addressing various issues related to the bay, SMBRP has educated beachgoers about marine debris and provided stations for depositing and recycling trash. SMBRP also has acted as the Los Angeles County coordinator for Coastal Cleanup Day,

tripling the number of cleanup volunteers. The Project encourages using management practices such as handling, storing, and disposing of materials and wastes properly to prevent them from entering storm drains (SMBRP, no date). More information is available at *www.smbay.org* or from the Santa Monica Bay Restoration Project, 320 West Fourth Street, 2nd Floor, Los Angeles, CA 90013, (213) 576-6615.

References and Additional Resources

References

Battelle Ocean Sciences. 1993. *Pilot Study to Characterize Floatable Debris Discharged from Combined Sewer Overflows and Stormwater Discharges September 1989 Through May 1990.* Final data report submitted to U.S. Environmental Protection Agency by Battelle Ocean Sciences, Duxbury, MA.

Caribbean Islands Directorate. 1989. *Land-Based Sources of Marine Pollution in the Wider Caribbean Region.* U.S. Man and the Biosphere Program, Puerto Rico Workshop, San Juan, Puerto Rico, August 7-9, 1989.

Chess, C., and G. Gibson. 2000. *The Navesink Watershed Management Effort.* Center for Environmental Communication, Rutgers University, New Brunswick, New Jersey. Accessed July 2001.

CMC. 1998. *Million Points of Blight.* Center for Marine Conservation, Washington, DC. <http://cmc-ocean.org/cleanupbro/millionpoints.php3>. Accessed July 2001.

CMC. 2000. *1999 International Coastal Cleanup.* Center for Marine Conservation, Washington, DC.

Dooley, E.C. 2001, December 11. Whale's tale a costly lesson. *Cape Cod Times.* <www.capecodonline.com/cctimes/archives/2001/dec/11/whalezxstale11.htm>. Accessed June 2002.

Ecorisk. 2002. *Ecorisk Fundamentals: 2.2. Bioconcentration, Bioaccumulation and Biomagnification.* <http://web.ead.anl.gov/ecorisk/fundamentals/html/ch2/2.2.htm>. Accessed June 2002.

ENN. 1999. *Northern Right Whale on Path to Extinction.* Environmental News Network. <www.enn.com/enn-news-archive/1999/03/031899/rightwhale_2200.asp>. Accessed June 2002.

Ferdinand, P. 2002, June 17. Near Cape Cod, Whales Get Right of Way. *The Washington Post.*

Gaugler, L. 1999. *Floatables Action Plan Assessment Report.* U.S. Environmental Protection Agency, Region 2.

HEP. 1996. *Final Comprehensive Conservation and Management Plan.* New York-New Jersey Harbor Estuary Program, including the Bight Restoration Plan. <www.harborestuary.org/mgmt.htm>. Accessed July 2001.

LISS. 1994. *Long Island Sound Study Management Plan.* Long Island Sound Study. <www.epa.gov/region01/eco/lis/plan.html>. Accessed July 2001.

LISS. 1998. *The Comprehensive Conservation and Management Plan: 1998 Tracking Report.* Long Island Sound Study. <www.epa.gov/region01/eco/lis/98track/98tracking.pdf>. Accessed July 2001.

LISS. 2001. *Long Island Sound Study Online.* Long Island Sound Study. <www.epa.gov/region01/eco/lis>. Accessed July 2001.

NAS. 1975. Marine litter. In *Assessing Potential Ocean Pollutants.* A report of the study panel on assessing potential ocean pollutants to the Ocean Affairs Board, Commission on Natural Resources, National Research Council, National Academy of Sciences, Washington, DC.

Ribic, C.A., T.R. Dixon, and I. Vining. 1992. *Marine Debris Survey Manual.* NOAA Technical Report NMFS 108. U.S. Department of Commerce, Springfield, VA.

Scro, R., and W.J. Eisele. 1993. *Navesink River Water Monitoring Project.* Accessed July 2001.

SJBE Program. 2000. *Comprehensive Conservation and Management Plan for the San Juan Bay Estuary.* San Juan Bay Estuary Program, San Juan, Puerto Rico.

SMBRP. No date. *Santa Monica Bay Home Page.* About the Santa Monica Bay Restoration Project. <www.smbay.org/10.htm>. Accessed July 2001.

USEPA. 1987. *Technical Support Document for ODES Statistical Power Analysis.* EPA 430/09-87-005. U.S. Environmental Protection Agency, Office of Marine and Estuarine Protection, Washington, DC.

USEPA. 1989. *Environmental Backgrounder: Medical Waste.* U.S. Environmental Protection Agency, Office of Public Affairs, Washington, DC.

USEPA. 1990. *Methods to Manage and Control Plastic Wastes.* EPA 530-SW-89-051. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response and Office of Water, Washington, DC.

USEPA. 1992a. *Plastic Pellets in the Aquatic Environment: Sources and Recommendations, Final Report.* EPA-842-B-92-010. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 1992b. *Turning the Tide on Trash: A Learning Guide on Marine Debris.* EPA 842-B-92-003. U.S. Environmental Protection Agency, Office of Water, Washington, DC. <www.epa.gov/owow/OCPD/Marine/contents.html>. Accessed April 2002.

USEPA. 1993a. Chapter 16 of *Volunteer Estuary Monitoring: A Methods Manual.* EPA 842-B-93-004. U.S. Environmental Protection Agency, Washington, DC. <www.epa.gov/nep/monitor/chptr16.html>. Accessed July 2001.

USEPA. 1993b. *Plastic Pellets in the Aquatic Environment: Sources and Recommendations, A Summary.* EPA 842-S-93-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 1995. Notes from the States, Tribes, and Localities, Where the Action Is. U.S. Environmental Protection Agency. *Nonpoint Source News Notes.* No. 40, March/April 1995. <www.epa.gov/OWOW/info/NewsNotes/issue40/nps40sta.html>. Accessed July 2001.

USEPA. 1998a. *Coastal Watersheds.* EPA 842-F-98-006. U.S. Environmental Protection Agency, Office of Water, Washington, DC. <www.epa.gov/owow/oceans/factsheets/fact1.html>. Accessed April 2002.

USEPA. 1998b. *National Estuary Program: 1995 Project Summaries.* U.S. Environmental Protection Agency, Washington, DC. <www.epa.gov/owow/estuaries/projects/hep.htm>. Accessed July 2001.

USEPA. 2001a. *National Estuary Program: Bringing Our Estuaries New Life.* U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 2001b. *National Management Measures Guidance to Control Nonpoint Source Pollution from Marinas and Recreational Boating.* EPA 841-B-01-005. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Additional Resources

Clean Ocean Action. 1999. *1999 Clean Ocean Action's Beach Sweeps Results.* Clean Ocean Action, Highlands, New Jersey. Information about the organization is available at *www.CleanOceanAction.ORG.*

Citizens Advisory Committee and the Science and Technical Advisory Committee. 2001. *Successes and Challenges: Highlights of Program Accomplishments and Challenges for the Future.* New York/New Jersey Harbor Estuary Program. <www.hudsonriver.org/hep/pdf/sc.pdf>. Accessed July 2001.

CMC. No date. *The International Coastal Cleanup: How a Good Idea Grew.* Center for Marine Conservation, Washington, DC.

CMC. 1993. *All About Beach Cleanups: A Helpful Planning Guide.* Center for Marine Conservation, Washington, DC.

Collier County. 2001. *Amendment Cycle 1, 2001 Draft: June 8, 2001.* Collier County, Florida. Accessed July 2001.

Faris, J., and K. Hart. No date. *Sea of Debris: A Summary of the Third International Conference on Marine Debris.* North Carolina Sea Grant College Program. Copies are available from Alaska Fisheries Science Center, NOAA/NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115-0070.

FWS. 2000. *Recovery Plan: Recovery Tasks.* U.S. Fish and Wildlife Service. <http://pipingplover.fws.gov/recplan/tasks.html>. Accessed July 2001.

Gulf of Mexico Program. 1995. *Phase I: Gulf of Mexico Program Action Projects Summary, 1988-1995.* Draft. U.S. Environmental Protection Agency, Gulf of Mexico Program, Stennis Space Center, Mississippi.

NJDEP. 1999. *Performance Report.* New Jersey Department of Environmental Protection. <www.state.nj.us/dep/fgw/pdf/99fedb~1.pdf>. Accessed July 2001.

NOAA. 2001. *Endangered Species: Leatherback Sea Turtle.* National Marine Fisheries Service, National Oceanic and Atmospheric Administration. <www.nmfs.noaa.gov/prot_res/species/turtles/leatherback.html>. Accessed July 2001.

O'Hara, K.J., S. Iudicello, and R. Bierce. 1988. *A Citizens Guide to Plastics in the Ocean: More Than a Litter Problem.* Center for Environmental Education, Washington, DC.

Olin, S. 2001. Geologist issues advisory paper on Pemaquid beach. *The Lincoln County News* 26(20). Accessed July 23, 2001.

Palm Beach County. 2000. *Guidelines for Proper Beach and Dune Management.* Palm Beach County, Department of Environmental Resources Management. <www.co.palm-beach.fl.us/erm/divisions/enhancement/shoreline/pdf/guidelin.pdf>. Accessed July 2001.

Project Pacific. 2001. *California Grunion.* <www.projectpacific.org/grunion.html>. Accessed July 2001.

Redford, D., M. Billy, and A. Tom. 1992. The United States Environmental Protection Agency's Role in Controlling Aquatic Debris. *Chemistry and Ecology* 6:189-197.

USEPA. 1989. *Managing and Tracking Medical Wastes: A Guide to the Federal Program for Treatment, Destruction, and Disposal Facilities.* EPA 530-SW-89-023. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 1994. *Status of Efforts to Control Aquatic Debris.* EPA 842-K-94-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Glossary

Coastal recreation waters	[As defined in the Clean Water Act, as amended by the BEACH Act], the Great Lakes and marine coastal waters (including coastal estuaries) that are designated under section 303(c) of the Clean Water Act by a state for use for swimming, bathing, surfing, or similar water contact activities. Coastal recreation waters do not include either inland waters or waters upstream of the mouth of a river or stream having an unimpaired natural connection with the open sea.
Coastal watershed	A geographic area that starts at the headwaters of the streams and rivers that ultimately drain to the coastal areas. Headwaters often include wetlands, which are typically adjacent to rivers or streams. Upon reaching coastal areas, rivers empty into estuaries. Nearshore waters (the areas directly offshore from the beach), offshore coral reefs (in tropical areas), and other offshore areas are also part of the coastal watershed (USEPA, 1998a).
Floatable debris	Waterborne waste material that is buoyant. Examples include wood, beach litter, street litter, sewage-related wastes, fishing gear, and medical wastes (Gaugler, 1999).
Marine debris (litter)	Solid materials of human origin that are discarded at sea or reach the sea through waterways or domestic and industrial outfalls (NAS, 1975).

Acronyms

BEACH Act	Beaches Environmental Assessment and Coastal Health Act
CCMP	Comprehensive Conservation and Management Plan
CMC	Center for Marine Conservation
CWA	Clean Water Act
CSO	combined sewer overflow
EPA	Environmental Protection Agency
HEP	Harbor Estuary Program
ICCC	International Coastal Cleanup Campaign
LISS	Long Island Sound Study
MARPOL Convention	International Convention for the Prevention of Pollution by Ships
MPPRCA	Marine Plastic Pollution Research and Control Act
MPRSA	Marine Protection, Research, and Sanctuaries Act
NEP	National Estuary Program
NJDEP	New Jersey Department of Environmental Protection
NMDMP	National Marine Debris Monitoring Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NYSDEC	New York State Department of Environmental Conservation
POTW	publicly owned treatment works
SJBE	San Juan Bay Estuary
SMBRP	Santa Monica Bay Restoration Project
SPA	Shore Protection Act
SPI	Society of the Plastics Industries, Inc.
SWD	storm water discharge
TMDL	Total Maximum Daily Load
USACE	United. States. Army Corps of Engineers
U.S.C.	United States Code
USCG	United States Coast Guard
WPCP	water pollution control plant

Office of Water
Office of Wetlands, Oceans, and Watersheds
Oceans and Coastal Protection (4504-T)
EPA-842-B-02-002
https://www.epa.gov/ow/o.wo
August 2002