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A History of Ocean Dumping

R. L. Swanson
Waste Reduction and Management
Institute
Marine Sciences Research Center

Although in 1992 the Federal government halted ocean dumping of everything but dredge spoil, many people who see refuse washing up on beaches and shores believe ocean dumping continues. This bulletin, therefore, looks at the reality of ocean dumping in the United States — its history; the kinds of materials dumped at sea; the effects of ocean dumping; and regulations.

From the late-19th-century until 1992, the United States (U.S.) used ocean dumping as a waste management practice for a number of wastes. Dumping is the intentional release, for the sole purpose of disposal, of waste materials into the sea from a vessel — ship, tug and tow. Because the vast volume of the ocean was thought capable of assimilating, dispersing and isolating the dumped wastes, ocean dumping has been used to:

- remove noxious materials from populated areas;
- protect the public health;
- save land for purposes other than waste disposal; and
- keep ports and harbors clear for unimpaired navigation.

Many waste materials, including military and chemical warfare agents, industrial materials, refuse, derelict vessels and harbor

debris, low-level radioactive wastes, sewage sludge and dredge spoils, were dumped over the past century by many coastal nations.

Although now mostly banned, the impacts of a century of ocean dumping on public health and marine ecosystems are still debated in the scientific community. Contaminants include particulates, pathogenic micro-organisms, organic material and nutrients, trace elements such as metals, synthetic organic compounds, petroleum-related compounds and radionuclides.

Because of the interconnectedness of the oceans, researchers fear dumped wastes will be transported globally. This is particularly worrying because synthetic organic chemicals, especially pesticides and polychlorinated biphenyls (PCBs), do not readily degrade.

Dumping's impacts on the oceans depend not only on what was dumped but also on the characteristics of the dump site and the ecosystem at risk. Some sites for example may cause wastes to disperse while others allow them to accumulate. Furthermore, some chemical constituents may dissolve, while others may have an affinity for particles and settle with those particles to the ocean floor. Most of the impacts, however, are seen in coastal waters.

Contaminants can harm organisms in several possible ways, including smothering them, poisoning them, and causing tumors. Contaminants may also affect how an organism's physiological systems

function, causing, for example, reproductive failure. Some of the contaminants, such as synthetic organics, can be bio-concentrated and passed up the food web. Finally, excess nutrients can lead to eutrophication in coastal waters, which deprives marine life of oxygen causing fish kills and other organism fatalities.

These contaminants and pathways can also impact humans. Pathogens, toxic and potentially carcinogenic materials can be consumed in seafood. In addition, direct contact when swimming in contaminated waters can lead to gastroenteritis and other illnesses.



An acid waste plume spreads from a ship making a legal drop in the New York Bight. (R.L. Swanson)

Dumping

is not the only source of waste material in the ocean, and in many cases is not the major source. It is, however, easy to regulate and has therefore been a target for reduction and elimination.

Since 1975, the International Maritime

Organization (IMO) has administered ocean dumping practices in international waters under the Convention on Prevention of Marine Pollution by Dumping Wastes and Other Matter. Over the past two decades, the convention has been amended and modified to become more restrictive. Over 90 nations, including the U.S., have ratified the convention.

For the U.S., three laws and their amendments control ocean dumping:

- The Marine Protection Research and Sanctuaries Act of 1972 (known as the Ocean Dumping Act, Public Law 92-532);
- The Federal Water Pollution Control Act of 1972 (also called the Clean Water Act, Public Law 92-500); and
- The Ocean Dumping Ban Act of 1988 (Public Law 100-688), which is consistent with

the London Dumping Act and the Clean Water Act. The Ocean Dumping Ban Act ended all waste dumping at sea except dredge spoil.

Disposal of dredge spoil seaward of the territorial sea is regulated by the Ocean Dumping Act; disposal landward of the territorial sea falls under the Clean Water Act. Under the regulatory process, the Federal government must approve the dumpsite for a specific waste, and the dumper must obtain permits to dispose of the waste at the site.

Here is an overview of ocean dumping practices:

1. Military and Chemical Warfare Agents

Before and after World War II, obsolete munitions were often transported to sea and dumped in coastal waters and beyond the continental shelf break of the Atlantic and Pacific Oceans, and into the Gulf of Mexico. In the 1960s, some ships loaded with a chemical waste such as mustard gas were towed to sea and then scuttled. Many of the wastes, such as nerve gas, would have been neutralized when they reacted with the sea water, with a pH of 8.

- Current Status — Logistical problems and public opposition halted the practice in the early 1970s.

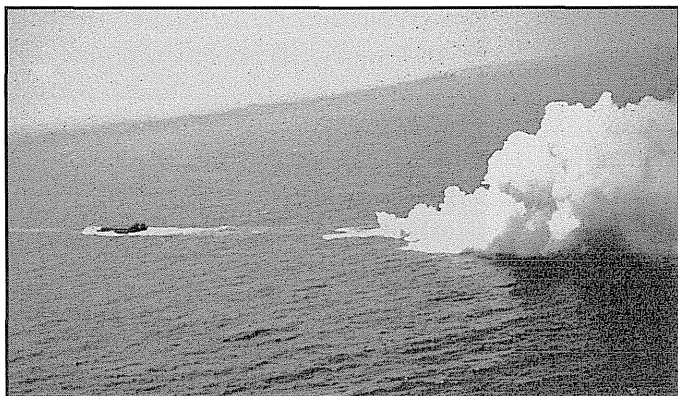
2. Industrial Wastes

Wastes from manufacturing and processing operations have been dumped off all the marine coasts of the United States. They included acid and alkali solutions, wastes from pharmaceutical manufacture, and drilling fluids from offshore oil and gas production.

The buffering capacity of the ocean rapidly — in minutes to hours — neutralized dumped acid and alkali wastes generated in the production of paint pigments, fertilizers, and polymers.

Off the coast of New Jersey, acid-iron waste dumped into and neutralized by sea water formed a highly iridescent ferric hydroxide floc near the water surface. Easily visible from the air, this sheen was often used to dramatize the impacts of ocean dumping. However, other than the initial shock, the effects of acid and

alkali dumping on marine organisms appear to be minimal. In fact, fishes were apparently attracted to the acid dumping area off the New Jersey coast. The dump site, known by fishermen as the "acid grounds," was a popular fishing area.



Metallic sodium explodes in the waters off the Gulf Coast as the marksman on board the dumping ship hits a bullseye on the drum just dropped overboard. (NOAA)

In another interesting case, an inorganic sludge, consisting of metallic sodium and compounds of calcium and sodium, was often thrown overboard from a

vessel in sealed 55-gallon drums in deep water about 50 nautical miles from the mouth of the Mississippi River. Upon reaching a safe distance from the vessel, the drum was shot with a rifle, causing an explosion as the metallic sodium reacted with sea water.

During the 1970s and through the early 1980s, industrial wastes were dumped at two sites beyond the continental shelf break. The 106-Mile Chemical Waste Disposal Site, located about 106 nautical miles southeast of the entrance to New York Harbor in 950-1,475 fathoms of water, was used to dispose of acid and alkali solutions and some fly ash from coal-powered electric generating plants. Its use as a chemical dump was phased out in 1987.

Another site was in the waters off Puerto Rico. Pharmaceutical companies dumped wastes — mostly water, solvents and food for bacteria — in 3,300-4,400 fathoms of water in the Puerto Rico Trench, about 40 nautical miles north of Arecibo. Because the waste was dumped into the wake of the discharging vessel, it probably never reached depths of greater than about 100 fathoms.

Although some drilling fluids or muds

used in oil and gas exploration may have been ocean dumped, many of those wastes are piped ashore for treatment and disposal. These materials include barite, clays, lignosulfates and lignites. However, other waste products may have been dumped from drilling platforms. Controls now exist to regulate and limit this form of dumping. Most U.S. platforms are in the Gulf of Mexico, with others off the coast of Alaska and a few off the coast of California.

- **Current Status** — The U.S. Environmental Protection Agency (EPA) aggressively pursued reducing ocean dumping of industrial wastes in conjunction with passage of the Ocean Dumping Act of 1972. From 1973-1985, the quantity of dumped industrial wastes decreased from 5.1×10^6 tons to only about 0.2×10^6 tons, and the number of dumpers decreased from more than 300 to three.

By the time the Ocean Dumping Ban Act (Public Law 100-688) prohibiting industrial waste dumping was passed in 1988, there was no industrial waste dumping in U.S. waters. The London Dumping Convention (LDC), administered by the IMO, banned industrial waste dumping in international waters in 1993.

3. Refuse

Refuse is the wet and dry discards of commercial and municipal waste streams — garbage and trash. Because they see refuse washing up on beaches, many people believe municipalities still dump refuse in the ocean. No U.S. municipalities dump refuse at sea. Although New York City, Oakland and San Francisco all used ocean dumping of refuse, the practice ended shortly after World War II. New York City stopped dumping at sea in 1934, following a U.S. Supreme Court decision prohibiting the activity. New York City does, however, transport refuse by barge to the world's largest landfill on Staten Island.

As late as 1968, the U.S. military still

dumped small quantities of refuse from several installations at Long Beach and San Diego, California. Charlotte Amalie, capital of the U.S. Virgin Islands, also dumped some refuse at sea in the early 1960s. The activities have long since ceased.

While refuse is no longer dumped at sea, it still washes ashore and also damages a variety of marine organisms. Much of the "marine debris" seen washing up on beaches enters coastal waters from storm sewers and from combined sewers, which mix storm water with domestic waste water that bypasses sewage treatment plants during storms and system breakdowns. Considerable refuse continues to

4. Derelict Vessels and Harbor Debris

For many years, debris that is a hazard to navigation — including derelict vessels — in New York Harbor was hauled to sea and burned on barges. From 1987 to 1990, an average of 26,000 tons per year were burned at the designated burn site.

- **Current Status** — This practice was phased out in 1991, following severe but unrelated marine debris washups in the late 1980s and injuries to several swimmers by debris that may have drifted into the surf zone from the burn barge.

5. Radioactive Waste

Low-level radioactive waste are typically paper, glass, plastics, cloth, equipment, sludges, and organic liquids contaminated with small quantities of radioactive nuclides. High-level radioactive wastes are those containing in each metric ton (2,205 pounds) of material more than 37,000 TBq (1 terabecquerel = 10^{12} becquerels) of tritium, 37 TBq of beta- and gamma-emitters, or 3.7 TBq of alpha-emitters with half-lives over 50 years.

The U.S. has never dumped high-level nuclear waste in the ocean and has not dumped low-level wastes since 1970. The low-level wastes dumped off the U.S. coast were usually encased in concrete in 55-gallon drums. Approximately 15 sites for low-level wastes were located around the U.S. coast, usually in deep water. The Farallon Island, California site, in 1,400 fathoms of water, was perhaps the most well-known and controversial of the low-level waste sites.

Beginning in 1967, many European countries dumped containerized low-level wastes at an internationally approved site off the northwest Spanish coast in a depth of about 2,700 fathoms. Use of this site was considerably reduced during the 1980s as dumping became more controversial. Japan and the Republic of Korea also dumped



Marine debris washed up on a beach. (R.L. Swanson)

be thrown overboard from ocean-going vessels.

- **Current Status** — These marine debris problems are now being addressed with some success. The EPA is implementing storm water control regulations, and major coastal cities are trying to improve or implement combined sewer overflow control

technologies.

The IMO encourages member nations to implement programs to control disposal of refuse at sea by commercial and recreational vessels. It is now illegal to dispose of garbage and trash at sea within 25 nautical miles of shore, and plastic may no longer be disposed of anywhere in the ocean. The U.S. Navy, the U.S. Coast Guard, and the National Oceanic and Atmospheric Administration (NOAA) are all aggressively reducing the amounts of garbage and trash their vessels dispose of at sea.



M/V NORTH RIVER dumping sewage at a site in the New York Bight (R.L. Swanson)

small quantities in the ocean in the 1960s and early 1970s. While many countries have dumped low-level wastes, none has admitted dumping high level wastes; however the Soviet Union may have dumped high-level wastes as well. The international scientific

community is studying these activities.

The Soviet Union covertly dumped contained- and liquid-low-level wastes in the Kara Sea, an arm of the Arctic Ocean, and also in the Sea of Japan near the Kamchatka Peninsula over a period of decades. It is believed that the Soviet Union dumped many times the amount dumped by all other nations combined.

- Current Status — The Ocean Dumping Act of 1972 and the LDC both prohibit dumping of low-level wastes. The LDC also prohibits the dumping of high-level wastes.

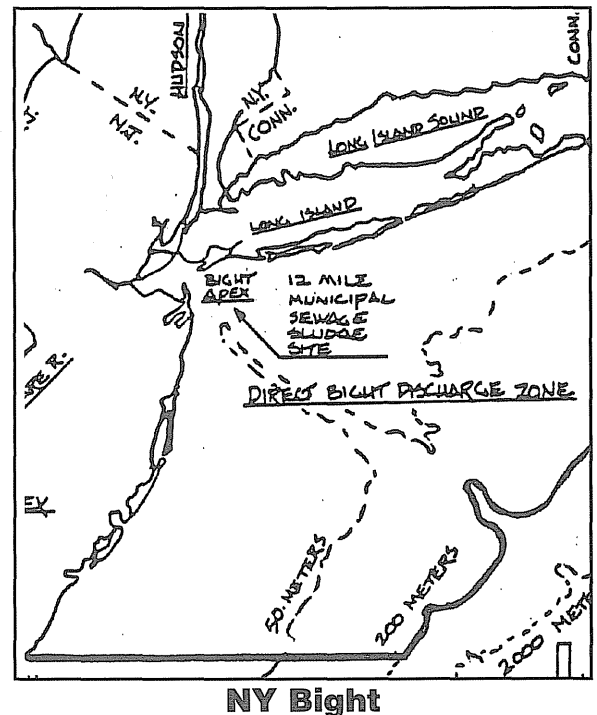
There are proposals to use quiescent, deep-ocean basins as locations for sub-seabed burial of radioactive wastes in secure containers, perhaps constructed of stainless steel. Some oceanographers believe this strategy would permanently isolate these materials and minimize human and ecosystem exposure. Existing rules and regulations discourage this consideration. In the meantime, there are no acceptable land-based permanent disposal alternatives in the

U.S. for high-level wastes. They are stored in temporary facilities at various sites around the U.S. while Federal and other government officials argue about their long-term disposition.

6. Sewage Sludge

Sewage sludge — or biosolids — is defined as “any solid, semisolid, or liquid waste generated by a wastewater treatment plant.” It is a by-product of treating sewage. Typically, sewage sludge is 95-per cent to 97-per cent water, depending on the degree of treatment. The small fraction of solids comprises dissolved and suspended solids, plus a heavier grit.

Sewage sludge is typically contaminated with toxic metals, petroleum hydrocarbons, synthetic organic hydrocarbons, and pathogenic organisms. Chemicals found in sludge generally reflect the character of the



community producing the sewage: residential communities produce relatively uncontaminated sludge compared to communities serving industries. Pretreatment of industrial wastes since the 1980s has improved

considerably the quality of sewage effluent and sludge from treatment.

shelf off the Delaware coast. Philadelphia last used a site 35 nautical miles off the coast, in about 26 fathoms of water. Camden stopped dumping in 1976, and Philadelphia in 1980.

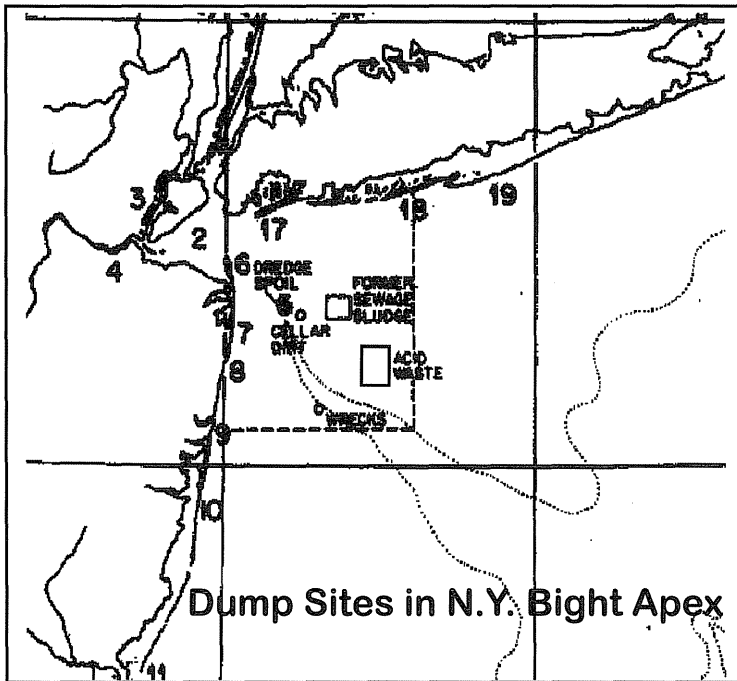
Because it is 95 per cent to 97 per cent water, sewage sludge is readily diluted, transported and dispersed in the marine environment. It is known to raise the levels of metals, and of chlorinated organic compounds in sediments at shallow continental shelf dumping sites. The biological community near shallow sites is abnormal relative to life in pristine sites of similar nature. Deeper water sites could also be contaminated over long periods of time.

- **Current Status** — The Ocean Dumping Ban Act halted ocean disposal of sewage sludge in the U.S. Sewage sludge is now disposed of or reused on land. Nevertheless, when previously contaminated sediments from previous ocean dumping are stirred up by weather conditions, they may release contaminants back into the water column.

The U.S., England, Scotland, Ireland, and the Federal Republic of Germany have dumped sewage sludge into the marine environment. In the U.S., sewage sludge dumping only occurred along the mid-Atlantic coast, starting in 1924 when New York City began dumping at a site about 12 nautical

7. DREDGE SPOILS

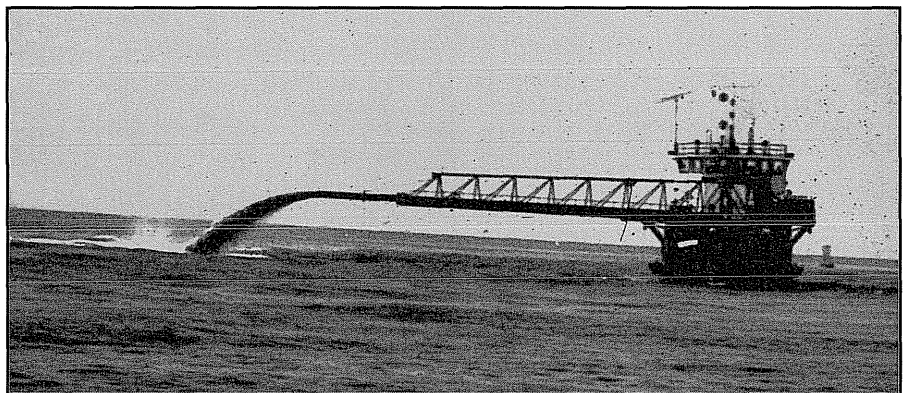
Dredge spoils or dredged materials are sediments removed from navigational channels and harbors as part of maintenance or development. These sediments often comprise clean sands and gravels that can be



miles off the coasts of New Jersey and Long Island. A number of other communities also dumped at this site until 1987, when dumping was moved to the same general location as the 106-Mile Site that was used for industrial wastes.

At the peak of sewage sludge dumping in the mid-1980s, about 9 million to 10 million wet tons of sludge were dumped annually.

The Cities of Camden, New Jersey, and Philadelphia, Pennsylvania, also dumped sewage sludge at several locations on the continental



Marine dredging maintains navigable channels. (Sea Grant)

used as a resource for projects such as beach nourishment. About three per cent of the sediments, however, are heavily polluted with toxic metals, petroleum hydrocarbons, and synthetic organic chemicals. Their

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management is a problem: historically they have been ocean dumped.

At the height of ocean dumping activities, dredge spoils constituted about 80 per cent by weight of materials dumped. The amount varies widely depending on the need for harbor and channel development and maintenance. In the late 1980s, there were some 125 disposal sites around the U.S. coasts, but nearly 95 per cent of all dredge spoil dumping was done at only about a dozen sites near major ports such as New York, New Orleans, San Francisco and Baltimore. On a world-wide basis, every coastal country needs to dredge, and about one-quarter of all dredged material is ocean dumped.

- **Current Status** — Removal and disposal of dredge spoils in the marine environment has become more difficult since the passage of the Ocean Dumping Act in 1972. Because they are so dense, dredge spoils tend to accumulate at the dump site -- usually in shallow water -- thereby creating hills or mounds.

In general, there is little difficulty dumping clean material. Criteria continue to be developed to protect the marine environment from contaminated dredge spoils. Grossly polluted spoils may no longer be taken to a designated dump site: upland disposal may be required. Less polluted material may still be ocean dumped but it may require covering or capping with clean material. This isolates the spoils from marine organisms that inhabit the area and reduces the likelihood that the materials will be transported elsewhere. If there are no disposal options available, a port or harbor may not be able to dredge and, therefore, may not be able to accommodate shipping. There are several waterways in the Port of New York and New Jersey, such as Newtown Creek and the Gowanus Canal, that fall into this category.

8. HAZARDOUS WASTE INCINERATION AT SEA

Incineration of liquid synthetic organic wastes may be an effective means of minimizing their adverse effects. Incineration at sea,

in specialized vessels, was practiced from 1969 to the late 1980s, primarily by European countries in the North Sea. The practice was regulated by the LDC, and some 110,000 tons of chlorinated organic compounds were incinerated annually during the 1980s. The U.S. successfully conducted several test burns before prohibition of the practice under the Ocean Dumping Ban Act. European nations stopped sea incineration by 1994.

Incineration at sea was attractive because it isolated these toxic compounds from major population centers. Nevertheless, although combustion efficiencies were high— well over 99.99 per cent — there was considerable concern that the stack emissions could have adverse impacts on the organisms in the surface layer of the ocean. In addition, there was also concern that an accident at sea or at holding or transfer stations could result in a devastating spill. Few effects, however, were ever measured in studies conducted in association with test burns.

- **Current Status** — No nation now incinerates hazardous wastes at sea.

CONCLUSION

Wastes are much cleaner now because of new technologies developed over the past decade to pretreat many waste streams. Landbased disposal is preferred because many believe potentially hazardous wastes can be encapsulated, monitored and treated. Also, as waste becomes cleaner its resource value may be of use. This may be the case, for example, with sewage sludge, although we do not yet know the long-term effects of the use. If we succeed in cleansing sewage and industrial effluents and reducing non-point sources of pollution, sediments that require dredging may be sufficiently clean for beneficial use as well. Therefore, the isolation, dispersion and neutralization that

ocean dumping provided is no longer as necessary as in the past.

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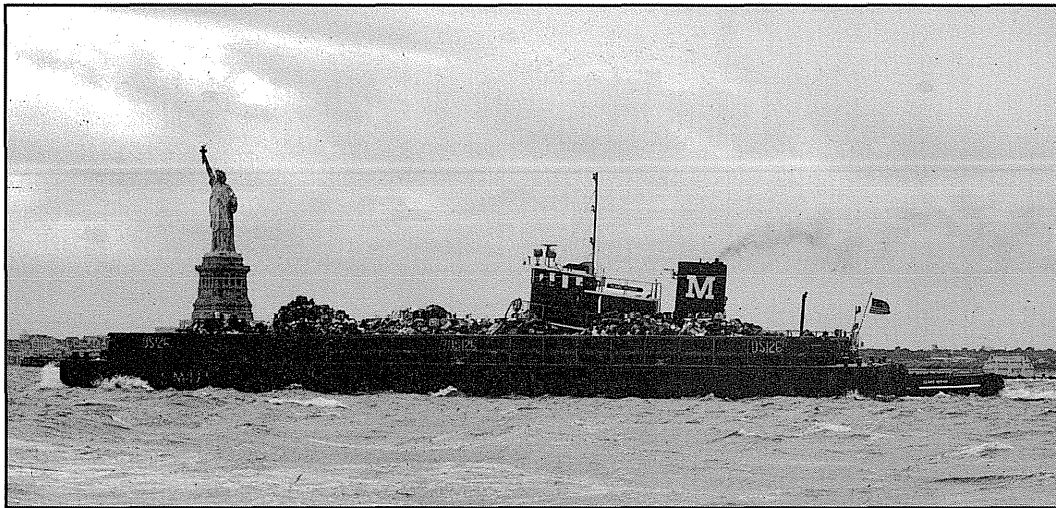
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