



## Project Summary

# Proximity of Sanitary Landfills to Wetlands and Deepwater Habitats: An Evaluation and Comparison of 1,153 Sanitary Landfills in 11 States

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Sanitary landfills can cause considerable harm to sensitive ecosystems if they are not properly located, designed, and managed. The purpose of this report is to evaluate and compare the proximity of 1,153 sanitary landfills in 11 states (Connecticut, Delaware, Florida, Georgia, Louisiana, New Jersey, New York, North Carolina, Pennsylvania, Texas, and Washington) to wetlands and deepwater habitats (i.e., rivers, lakes, streams, bays, etc.). The facilities were identified on U.S. Fish and Wildlife Service's National Wetlands Inventory maps. The nearness or proximity of the sanitary landfills to wetlands and deepwater habitats was determined by drawing three concentric regions around the point representing the location of each landfill. The radii of the concentric regions were: 1/4 mile, 1/2 mile, and 1 mile. Almost all of the sanitary landfills are located in or are close to either wetlands or deepwater habitats. Almost all are close to wetlands while approximately half are close to deepwater habitats. The hydrology of wet environments and possible movement of contaminants from waste-disposal sites located in these environments are discussed. Sanitary landfills have the potential to adversely affect sensitive ecosystems, such as wetlands and

deepwater habitats, either through habitat alterations or through the migration of contaminants. Because of this, facilities located in or close to wetlands and/or deepwater habitats need to be properly designed and monitored.

*This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Las Vegas, NV, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).*

### Introduction

Sanitary landfills, as typically defined, are waste-management facilities regulated under Subtitle D of the Resource Conservation and Recovery Act (RCRA). These facilities are commonly referred to as municipal waste landfills and they are primarily used to receive household refuse and nonhazardous commercial waste. However, sanitary landfills also receive other types of Subtitle D waste, such as sewage sludge and industrial wastes. Sanitary landfills typically receive some hazardous waste in the form of household hazardous waste, and hazardous waste from small-quantity generators as defined in 40 CFR Part 261.10 (Definitions). Depending upon the definition of a sanitary landfill used by the individual states, there are between

6,500 and 9,300 of these facilities permitted in the United States.

Sanitary landfills can cause considerable harm to sensitive ecosystems if they are not properly located, designed, and managed. These facilities have the potential to adversely affect sensitive ecosystems, such as wetlands and deepwater habitats, either through habitat alterations or through the migration of contaminants. In order to evaluate the seriousness of this problem, information is needed on the nearness of sanitary landfills to wetlands and surface water bodies. The purpose of this study is to evaluate and compare the proximity of sanitary landfills in 11 states (Connecticut, Delaware, Florida, Georgia, Louisiana, New Jersey, New York, North Carolina, Pennsylvania, Texas, and Washington) to wetlands and deepwater habitats (i.e., rivers, lakes, streams, bays, etc.).

## Materials and Methods

The source of data used to determine the locations of the sanitary landfills was the computer data file developed by Development Planning and Research Associates, Inc. (DPRA) for use by the U.S. Environmental Protection Agency's Office of Solid Waste in its RCRA Subtitle D program. The DPRA data file includes information on 7,683 sanitary landfills, and 6,849 of these facilities have latitude and longitude coordinates in degrees, minutes, and seconds specified in the data file.

Wetlands typically form part of a continuous transition zone between uplands and open water. Therefore, the delineation of the upper and lower boundaries in any wetland definition is somewhat arbitrary. There are a number of definitions of wetlands that have been developed for use in classifying natural environments or for regulatory purposes. While these definitions are not identical, they are very similar. The selection of a specific definition for use in this study was determined by the availability of national wetlands and deepwater habitats geographic data.

The most extensive, consistent source of wetlands and deepwater habitats geographic data is the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI). The NWI has developed detailed, large-scale maps for a significant portion of the United States. Wetlands and deepwater habitats are delineated on the NWI maps. The delineation of wetlands and deepwater habitats was developed using remote

sensing techniques and field investigations. The NWI maps are developed in accordance with the National Map Accuracy Standard (NMAS). The NWI 1:24,000 scale maps used in this study are accurate, according to the NMAS, to within 40 feet of ground measurements. These maps are particularly useful for plotting the location of sanitary landfills and for determining the proximity of these facilities to wetlands and deepwater habitats.

The NWI maps use the definitions and the classification system for wetlands and deepwater habitats developed by the U.S. Fish and Wildlife Service. Wetlands are defined as lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is covered by shallow water. Deepwater habitats are defined as permanently flooded lands lying below the deepwater boundary of wetlands.

The U.S. Fish and Wildlife Service's classification of wetlands and deepwater habitats is hierarchical in nature proceeding from general to specific. There are 5 systems, 10 subsystems, and 55 classes. In this study only the "system", i.e., the complex of wetlands and deepwater habitats that share the influence of similar hydrologic, geomorphologic, chemical, or biological factors, was used for classification purposes. The first four systems, i.e., Marine, Estuarine, Riverine, and Lacustrine, include both wetlands and deepwater habitats whereas the Palustrine System includes only wetlands.

In order to link the location of sanitary landfills in the DPRA data file to the appropriate NWI maps, we used the information on the T-70 computer tape obtained from the U.S. Geological Survey. The NWI large-scale maps were developed using U.S. Geological Survey's quadrangle maps as base maps. The T-70 computer tape contains 67 fields of information including latitude and longitude that can be used for identifying the 1:24,000 scale maps, the map names, and the state codes assigned to the maps. Sanitary landfill location data on the DPRA computer file tape were matched by a computer program against location data on the U.S. Geological Survey T-70 computer tape in order to identify the specific maps that contain sanitary landfills and/or that would be needed to evaluate the wetlands and deepwater habitats that are within 1 mile of each sanitary landfill. The map names obtained from the computer matching

were sorted by state and compared with inventories of available NWI maps.

Each sanitary landfill included in this study was located on NWI large-scale maps using standard cartographic techniques. Nearness or proximity of sanitary landfills to wetlands and deepwater habitats was determined by drawing three concentric regions around the point representing the location of each landfill. The radii of the concentric regions were: 1/4 mile, 1/2 mile, and 1 mile. The occurrence or nonoccurrence of the wetland and deepwater habitat systems in each concentric region was then recorded.

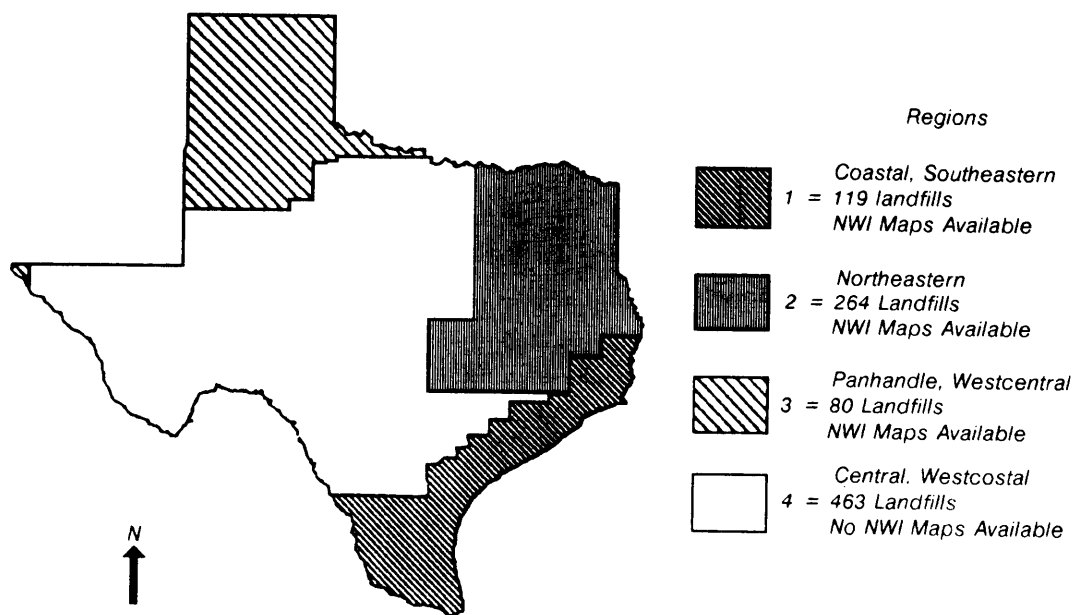
Due to the size and significant variation in environmental settings across Texas, as well as the availability of NWI maps, the state was divided into four regions: Region 1 - Coastal, Region 2 - Northeastern, Region 3 - Panhandle, and Region 4 - Central. Figure 1 identifies the four regions of Texas as delineated for this report.

There are 2,191 sanitary landfills in the DPRA data base for the 11 states (Connecticut, Delaware, Florida, Georgia, Louisiana, New Jersey, New York, North Carolina, Pennsylvania, Texas, and Washington) and we were able to classify 1,153 (or 53 percent) of these facilities as to their proximity to wetlands and deepwater habitats. However, if the 463 sanitary landfills in Region 4 (Central) of Texas (where we were not able to classify any of the facilities) and the 124 in the state of North Carolina (where we were able to classify only 5 percent of the facilities) are subtracted from the totals, 72 percent of the facilities were classified as to their proximity to wetlands and deepwater habitats.

In order to make comparisons relative to regional differences in the proximity of sanitary landfills to wetlands and deepwater habitats, the data were subdivided into 13 groups, i.e., 10 states (Connecticut, Delaware, Florida, Georgia, Louisiana, New Jersey, New York, North Carolina, Pennsylvania, and Washington) and the 3 regions of Texas (Regions 1, 2, and 3).

## Results and Discussion

Approximately 72 percent of the 1,153 sanitary landfills surveyed in the 11 states are located in or within 1/4 mile of wetlands, while 91 and 98 percent are located in or within 1/2 and 1 mile of wetlands, respectively (Figure 2). Most of the facilities are located either in or are close to Palustrine wetlands (i.e., approximately 69, 89, and 97 percent are located in or within 1/4, 1/2, and 1 mile,



**Figure 1.** Four regions of Texas delineated for this report.

respectively of a Palustrine wetland). Next comes riverine wetlands with approximately 4, 9, and 15 percent of the facilities located in or within 1/4, 1/2, and 1 mile of them, respectively. Estuarine and Lacustrine wetlands have very few sanitary landfills located in or close to them. Almost no facilities are located in or close to Marine wetlands. Only 2 percent of the landfills are located further than a mile from any type of wetland (Figure 3). Approximately 18 percent of the sanitary landfills are 1/4 to 1/2 mile from the closest wetland while approximately 7 percent are within 1/2 to 1 mile.

Approximately 17 percent of the sanitary landfills are located in or within 1/4 mile of deepwater habitats, while 30 and 48 percent are located in or within 1/2 and 1 mile of deepwater habitats, respectively (Figure 4). Most of the facilities are in the vicinity of Riverine or Lacustrine deepwater habitats. Approximately 11, 21, and 33 percent are located in or within 1/4, 1/2, and 1 mile, respectively, of Riverine deepwater habitats while approximately 5, 10, and 20 percent are located in or within 1/4, 1/2, and 1 mile, respectively, of Lacustrine deepwater habitats. Very few facilities are located in or close to

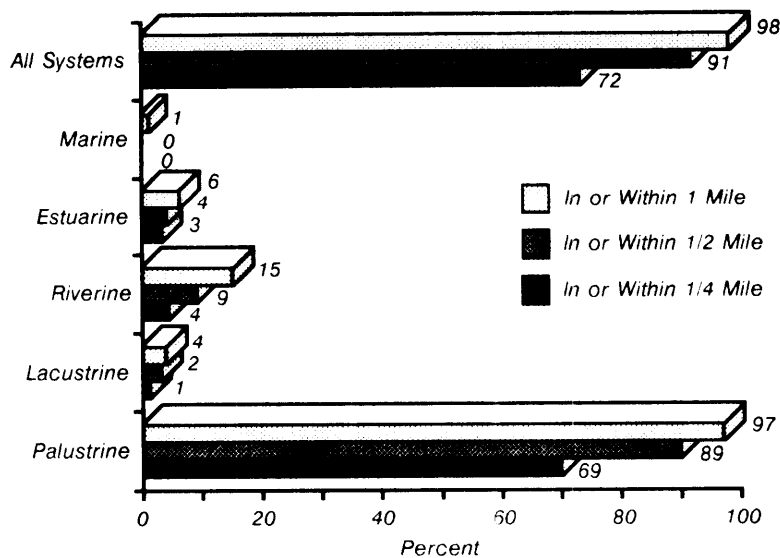
Estuarine deepwater habitats and almost none are located close to Marine deepwater habitats. Approximately 52 percent of the landfills are located further than a mile from any type of deepwater habitat (Figure 5).

Approximately 76 percent of the sanitary landfills are located in or within 1/4 mile of either wetlands or deepwater habitats, while 93 and 98 percent are located in or within 1/2 and 1 mile of either wetlands or deepwater habitats, respectively (Figure 6). Most of the facilities are near Palustrine habitats (i.e., Palustrine wetlands since the Palustrine system only includes wetlands). Approximately 69, 89, and 97 percent are located in or within 1/4, 1/2, and 1 mile, respectively, of Palustrine habitats. Riverine habitats have the next highest number of sanitary landfills located in or close to them (approximately 14, 28, and 44 percent in or within 1/4, 1/2, and 1 mile, respectively). Fewer facilities are located in or close to Lacustrine habitats (6, 11, and 22 percent are located in or within 1/4, 1/2, and 1 mile, respectively). Not many facilities are located in or close to Estuarine habitats and almost none are located in or close to Marine habitats. Approximately 2 percent of the landfills are located further than a mile from

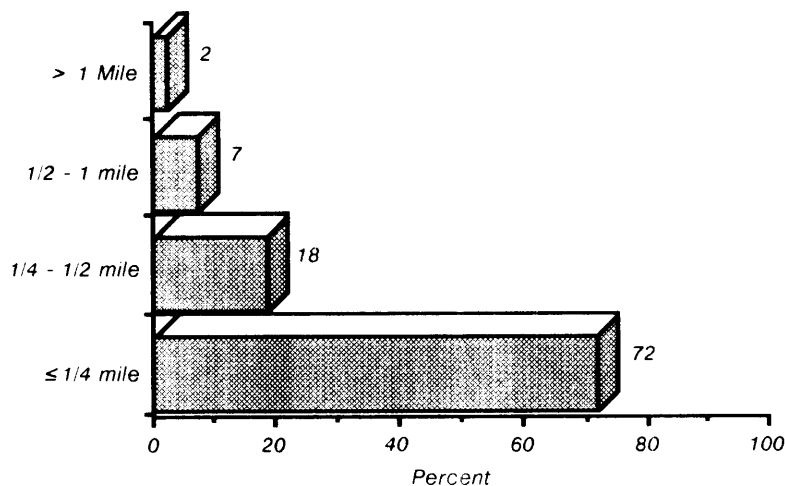
either a wetland or deepwater habitat (Figure 7).

There are some differences among the 10 states and 3 regions in the relative proximity of sanitary landfills to wetlands (Figure 8). The percent of the facilities located in or within 1/4 mile of wetlands ranges from 45 percent for Washington to 96 percent for Connecticut. More than 75 percent of the sanitary landfills in Connecticut, Florida, Georgia, Louisiana, New Jersey, New York, North Carolina, and Texas Region 2 (Northeastern) are located in or within 1/4 mile.

A comparison of the proximity of sanitary landfills to wetlands among the three regions of Texas surveyed is especially interesting. It surprised us to find that 83 percent of the sanitary landfills in Texas Region 2 (Northeastern) are located in or within 1/4 mile of wetlands as compared to 64 percent in Texas Region 1 (Coastal) with its large expanse of coastal wetlands. We also found it intriguing that 51 percent of the facilities are located in or within 1/4 mile of wetlands in Texas Region 3 (Panhandle) which is in the more inland and arid portion of Texas (Figure 1). If the results presented here for 11 states relative to proximity of sanitary landfills to wetlands and deepwater habitats are



**Figure 2.** Proximity of 1,153 sanitary landfills in 11 states to wetlands.



**Figure 3.** Distance of 1,153 sanitary landfills in 11 states to closest wetland.

somewhat typical of the rest of the country, then, there is a propensity for sanitary landfills to be located either in or close to wetlands. This study did not acquire data that would elucidate why facilities are located close to wetlands. However, we speculate that wetlands or areas close to wetlands are not deliberately sought out as sites for sanitary landfills; but, are often used for this purpose because they have low market values, are undeveloped, and are relatively close to sources of solid waste.

Most sanitary landfills in all states and regions are located within 1/4 mile of a wetland and very few are further than 1 mile from a wetland. The percent of the facilities further than 1 mile from a wetland ranges from 0 percent for Connecticut, Delaware, Georgia, New Jersey, North Carolina, Texas Region 1 (Coastal), and Texas Region 2 (Northeastern) to 8 percent for Washington.

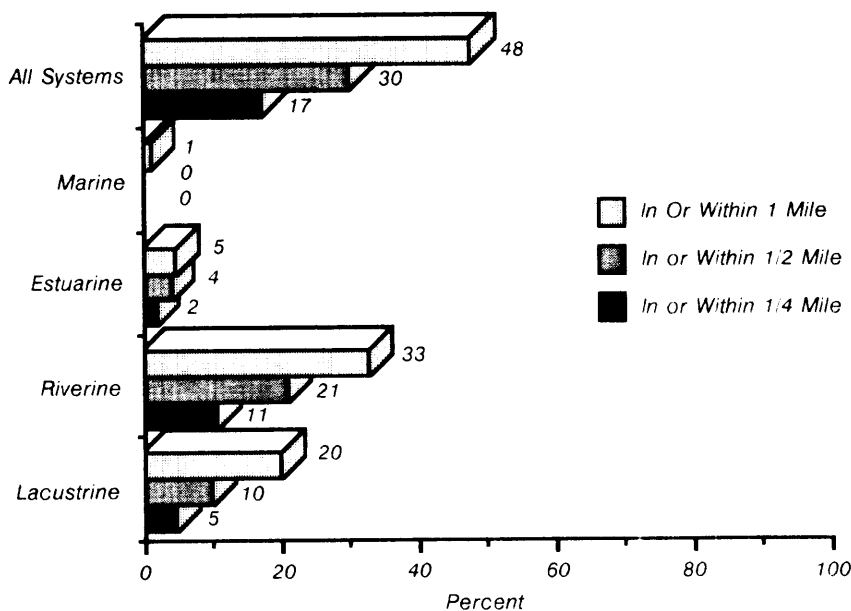
There are differences among the 10 states and 3 regions in the

relative proximity of sanitary landfills to deepwater habitats (Figure 9). The percent of the facilities located in or within 1/4 mile of deepwater habitats ranges from 0 percent for Georgia to 33 percent for Delaware. In five states (Connecticut, Delaware, Louisiana, New Jersey, and New York) more than 20 percent of the facilities are located in or within 1/4 mile of deepwater habitats. In seven of the 10 states and 3 regions, more than half of the sanitary landfills are located further than 1 mile from a deepwater habitat. These are Texas Region 3 (Panhandle) (96 percent), Georgia (67 percent), North Carolina (67 percent), Pennsylvania (57 percent), Texas Region 2 (Northeastern) (56 percent), Texas Region 1 (Coastal) (54 percent), and Florida (51 percent). Connecticut, with 23 percent, has relatively the fewest facilities further than 1 mile from a deepwater habitat.

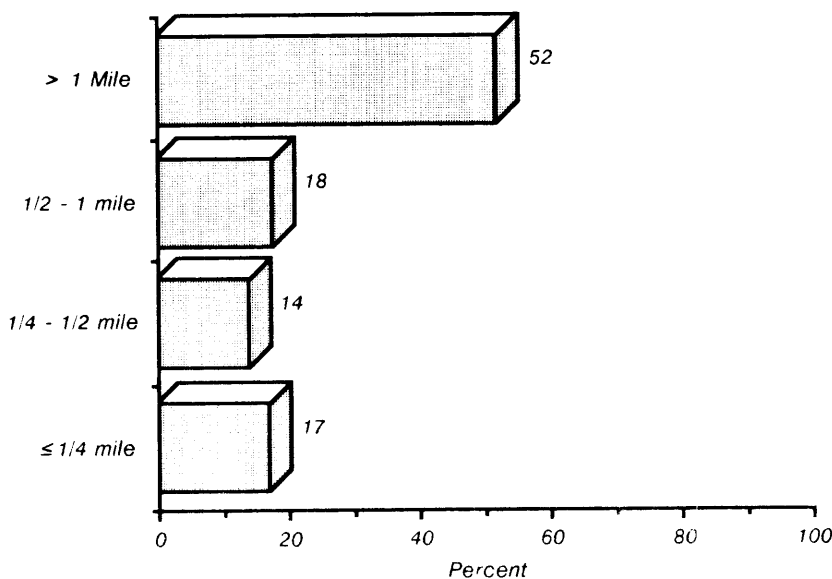
Relative distances of the sanitary landfills to either wetlands or deepwater habitats in the 10 states and three regions are given in Figure 10. Since most facilities are much closer to wetlands than to deepwater habitats, the distribution of their relative proximity to either wetlands or deepwater habitats reflects more closely the distribution of their proximity to wetlands. The percent of the facilities located in or within 1/4 mile of either wetlands or deepwater habitats ranges from 49 percent for Washington to 99 percent for Connecticut. More than 75 percent of the sanitary landfills in Connecticut, Florida, Georgia, Louisiana, New Jersey, New York, North Carolina, and Texas Region 2 (Northeastern) are located in or within 1/4 mile of either wetlands or deepwater habitats.

In all states and regions, most sanitary landfills are located within 1/4 mile of either a wetland or deepwater habitat and relatively very few are located further than 1 mile. The percent of the facilities located further than 1 mile from either a wetland or deepwater habitat ranges from 0 percent for Connecticut, Delaware, Georgia, New Jersey, North Carolina, Texas Region 1 (Coastal), and Texas Region 2 (Northeastern) to 7 percent for Washington.

The data available to us specifies only the point location of the sanitary landfills and, therefore, does not define either their size or boundaries.



**Figure 4.** Proximity of 1,153 sanitary landfills in 11 states to deepwater habitats.



**Figure 5.** Distance of 1,153 sanitary landfills in 11 states to closest deepwater habitat.

However, we know from other studies that many sanitary landfills are typically on the order of 100 acres in size. For example, in the state of Florida, approximately 35 percent of the active sanitary landfills are between 50 and 150 acres in size, with an average size of 110 acres. A landfill that is a 100 acres in size and uniformly distributed around a point

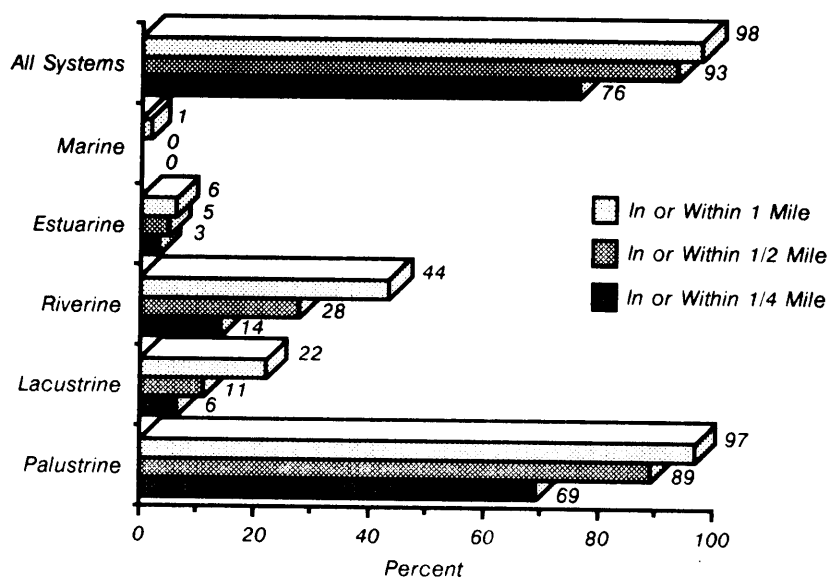
will have a radius of approximately 1/4 mile and, therefore, will approximate the boundary of the first concentric 1/4-mile radius region. Undoubtedly, most of the landfills located in a 1/4-mile radius region containing either wetlands or deepwater habitats are located in, adjacent, adjoining, contiguous, abutting, or in very close

proximity to wetlands or deepwater habitats. Since landfills vary considerably in size and shape, some of the landfills located in the 1/2-mile radius and 1-mile radius regions containing wetlands or deepwater habitats will probably also be located in wetlands or deepwater habitats.

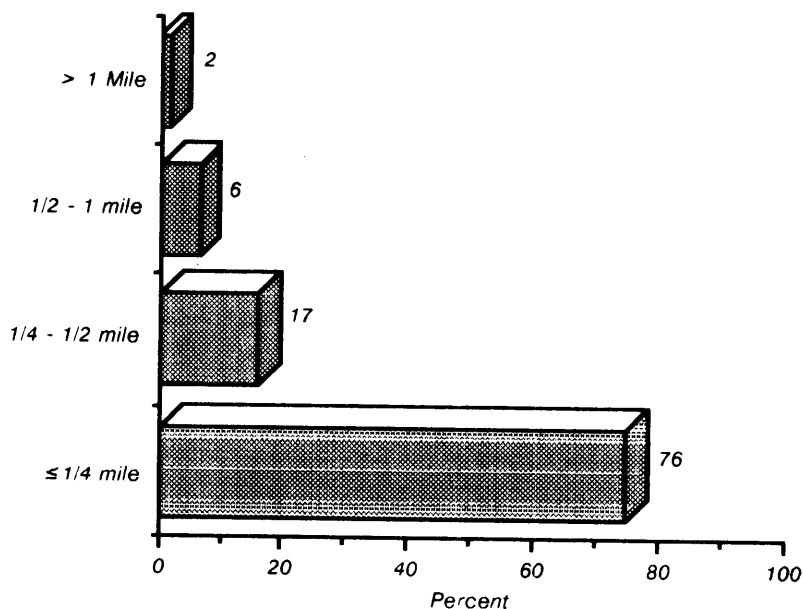
We believe that, for the most part, the wetlands and deepwater habitats identified in this study as being close to sanitary landfills are not small, isolated, or unimportant habitats. Small wetlands or deepwater habitats typically do not appear on NWI maps, because of the limitations associated with the remote sensing techniques and interpretation procedures used by the NWI. Habitats less than 5 acres in size are typically not included in NWI map products due to these limitations. However, some habitats between 1 and 5 acres in size may occasionally appear on NWI maps. The minimum size of a habitat that will appear on NWI maps depends upon the habitat type (i.e., some types are easier to photo interpret than others), isolation from similar types, areal extent and shape, as well as other attributes.

The exact geographic boundary of the landfill is not the critical consideration for determining adverse impacts associated with these facilities. A major consideration is whether or not the facility site is hydrologically interconnected, either by surface or subsurface flows, with wetlands, deepwater habitats, and/or habitats with water tables close to the surface. If hydrologically interconnected, contaminants can easily migrate off-site to the other environments. Also, the construction and operation of a landfill in or close to sensitive habitats can cause physical alterations to the landscape that may adversely affect these habitats. Beyond the adverse physical alterations to the habitat from the landfill, ingress or egress (i.e., access roads and transportation of waste) to a landfill can cause additional physical alterations to the surrounding landscape.

There are special problems associated with the siting, design, operation, and monitoring of waste-disposal sites in or close to either wetlands or deepwater habitats. These problems stem from conditions that are common and somewhat unique to wet environments. Conditions of concern that often occur in these



**Figure 6.** Proximity of 1,153 sanitary landfills in 11 states to either wetlands or deepwater habitats.

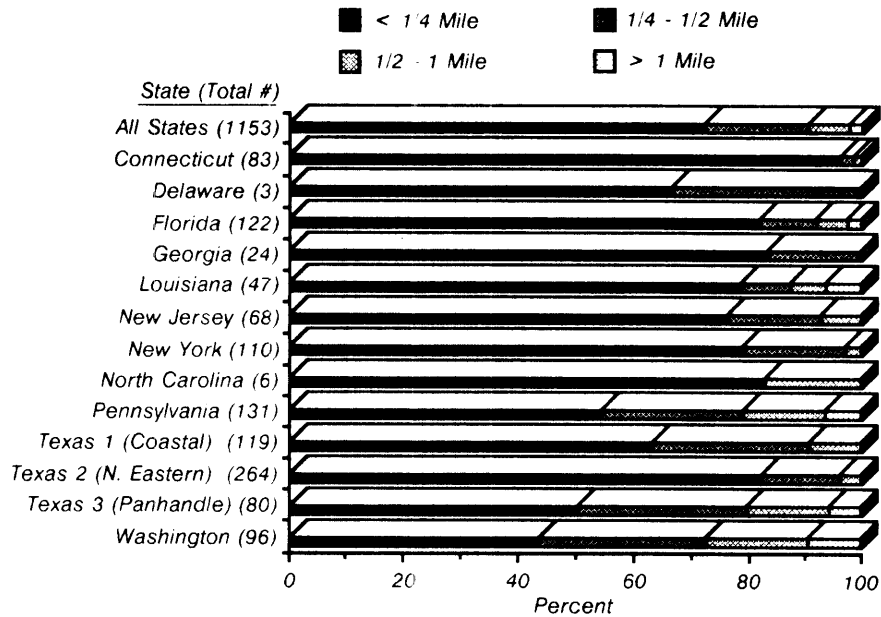


**Figure 7.** Distance of 1,153 sanitary landfills in 11 states to either the closest wetland or deepwater habitat.

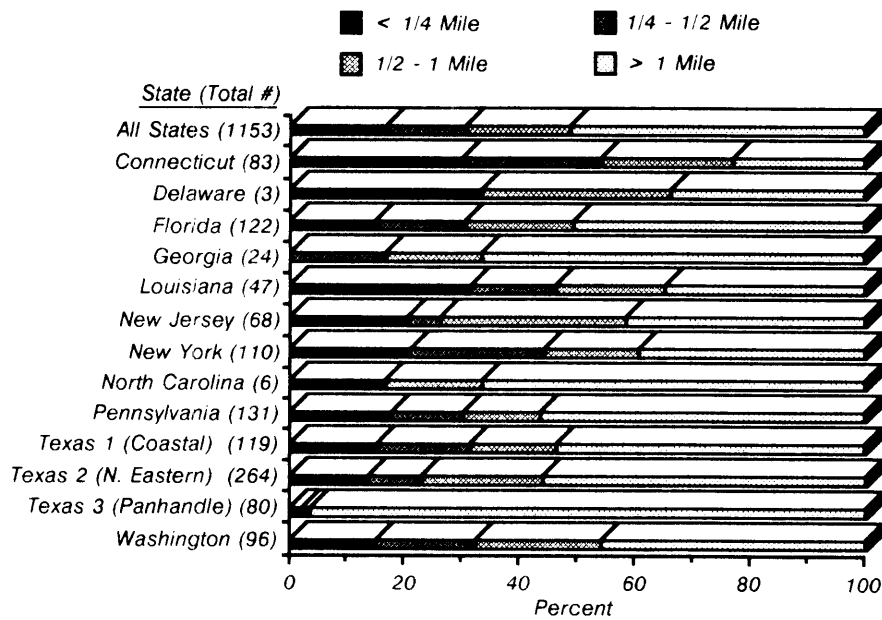
environments include: (1) high-water tables; (2) hydrological inter-connections of deepwater habitats, wetlands, and adjacent areas with a high-water table; (3) ground-water discharges; (4) production of large quantities of leachates as a result of water percolating through waste-disposal piles; (5) lateral and upward components of ground-water flows; (6) disposal-site waste piles extending below the water table; (7) complex local hydrology; (8) high hydraulic conductivity of the substrate because of saturated conditions; and (9) increased likelihood of contaminants coming in contact with surface waters, soils, plants, and animals.

## Conclusions and Recommendations

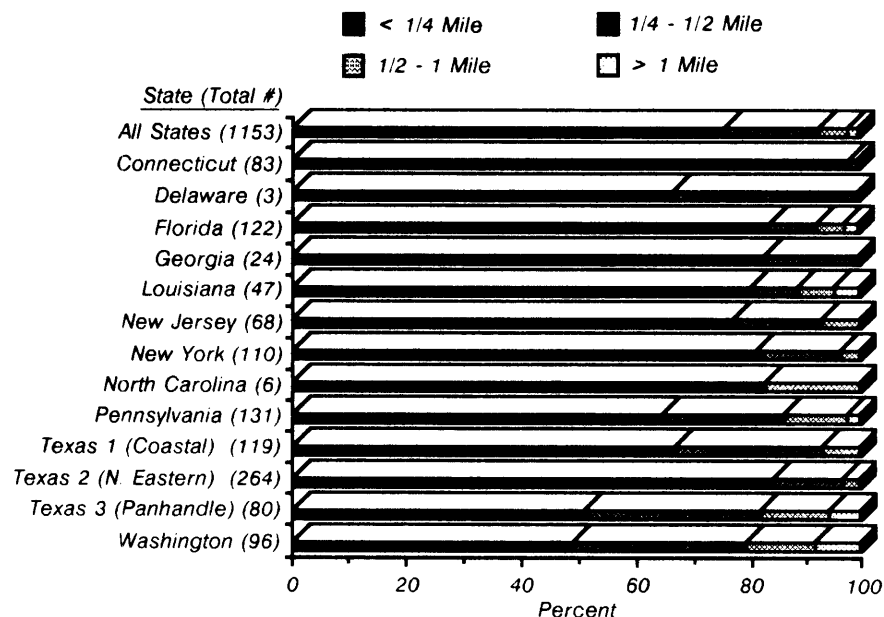
We conclude that sanitary landfills have the potential to adversely affect sensitive ecosystems, such as wetlands and deepwater habitats, either through habitat alterations or through the migration of contaminants. Landfills located in or close to these environments need to be properly designed and monitored. It is recommended that special monitoring and design requirements be developed for waste disposal sites located either in or close to wetlands and/or deepwater habitats.



**Figure 8.** Distance of 1,153 sanitary landfills in 11 states to the closest wetland by state or region.



**Figure 9.** Distance of 1,153 sanitary landfills in 11 states to the closest deepwater habitat by state or region.



**Figure 10.** Distance of 1,153 sanitary landfills in 11 states to the closest wetland or deepwater habitat by state or region.

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The complete report, entitled "Proximity of Sanitary Landfills to Wetlands and Deepwater Habitats: An Evaluation and Comparison of 1,153 Sanitary Landfills in 11 States," (Order No. PB 90-216 524/AS; Cost: \$17.00, subject to change) will be available only from:

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