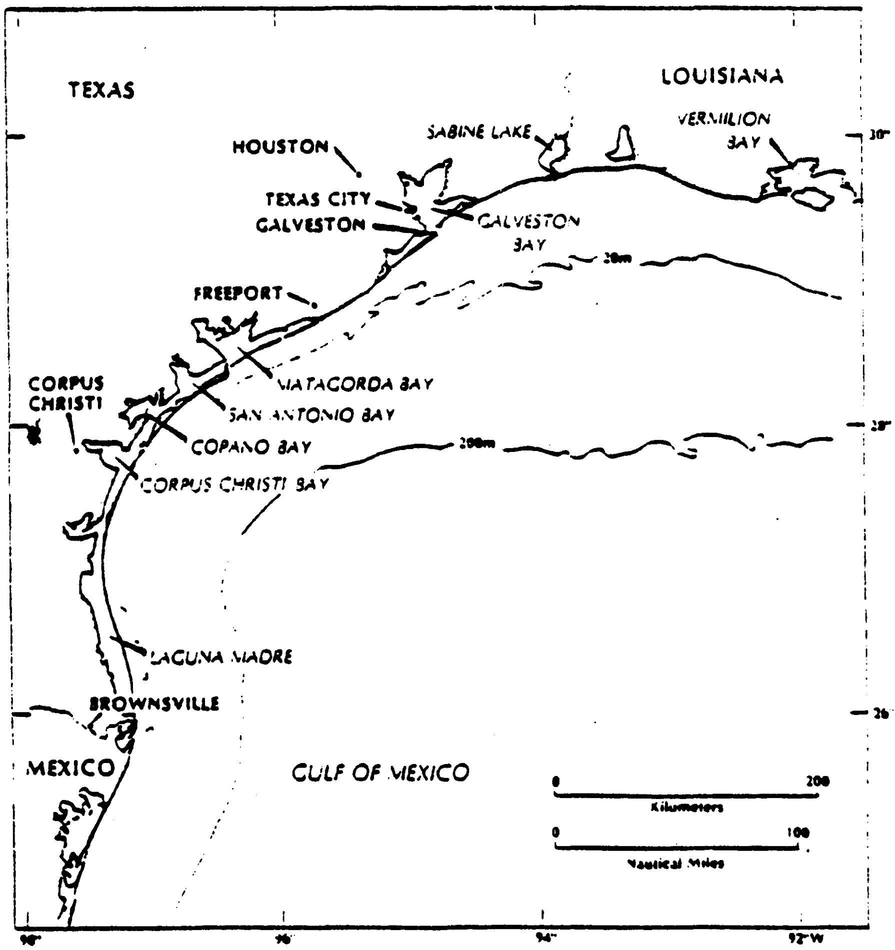
United States
Environmental Protection
Agency

Office of Water
Criteria and Standards Division
Washington, DC 20460

EPA

FINAL

Environmental Impact Statement (EIS) for the Sabine - Neches, Texas Dredged Material Disposal Site Designation



ENVIRONMENTAL PROTECTION AGENCY

ENVIRONMENTAL IMPACT STATEMENT (EIS)
FOR
SABINE-NECHES, TEXAS,
OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION

Prepared by: **U.S. Environmental Protection Agency**
Criteria and Standards Division
Washington, D.C. 20460

Summary Sheet

ENVIRONMENTAL IMPACT STATEMENT (EIS)
FOR
SABINE-NECHES, TEXAS
OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION

( ) Draft

(x) Final

( ) Supplement to Draft

ENVIRONMENTAL PROTECTION AGENCY
CRITERIA AND STANDARDS DIVISION

1. Type of action.

   (x) Administrative/Regulatory action

   ( ) Legislative action

2. Description of the proposed action.

   The proposed action is the designation of four Sabine-Neches, Texas, Disposal Sites, for the disposal of dredged material. The interim disposal sites (numbered 1 through 4) are centered at 29°26'51"N, 93°42'18"W; 29°29'33"N, 93°44'08"W; 29°32'58"N, 93°47'57"W; 29°36'31"N, 93°49'35"W; and cover 2.4, 4.2, 4.7 and 4.2 nmi^2 respectively. The closest site is 2.7 nmi south of Texas Point, Texas, and the furthest is 16 nmi south of Texas Point. It is proposed that the interim sites receive final designation for the disposal of dredged material from the Sabine-Neches Area. The purpose of the action is to provide an environmentally acceptable ocean location for the disposal of dredged material which complies with the environmental impact criteria of the Ocean Dumping Regulations.

3. Environmental effects of the proposed action.

The only long-term adverse environmental effect of the proposed action appears to be smothering of the benthos and a temporary reduction in benthic infauna. Adverse impacts within the site are unavoidable, but the disposal operations will be regulated to prevent unacceptable environmental degradation outside site boundaries.

4. Alternatives to the proposed action.

The alternatives to the proposed action are: (1) no action, which would allow the interim designation of the four Sabine-Neches ODMDS's sites to expire, after which site use would be discontinued as an EPA approved site, or (2) designation of an alternative ocean disposal site.

5. Federal, State, public, and private organizations from whom comments have been requested.

Federal Agencies and Offices

Council on Environmental Quality
Department of Commerce
Maritime Administration
National Oceanic and Atmospheric Administration (NOAA)
Department of Defense
Army Corps of Engineers (CE)
Department of the Navy
Department of Health and Human Services
Department of Interior
Bureau of Land Management
Bureau of Outdoor Recreation
Fish and Wildlife Service
Geological Survey

Department of State

Department of Transportation

Coast Guard

National Science Foundation

States and Municipalities

State of Texas

Sabine, Texas

Port Arthur, Texas

Orange, Texas

Port Neches, Texas

State of Louisiana

Cameron, Louisiana

State Agencies

Texas Parks and Wildlife Department

Texas Historical Commission

Louisiana Department of Art, Historical and Cultural Preservation

Louisiana Department of Culture, Recreation, and Tourism

Texas Air Control Board

Texas State Soil and Water Conservation Board

State of Louisiana Wildlife and Fisheries Commission

Private Organizations

American Littoral Society

Audubon Society

Center for Law and Social Policy

Environmental Defense Fund, Inc.

National Academy of Sciences

National Wildlife Federation

Resources for the Future

Sierra Club

Texas Industrial Commission

Water Pollution Control Federation

Academic/Research Institutions

Texas A & M University
University of Texas
Lamar University, Texas

6. The final statement was officially filed with the Director, Office of Environmental Review, EPA.

7. Comments on the final EIS are due 30 days from the date of EPA's publication of Notice of Availability in the Federal Register which is expected to be ______________.

Federal Register

Comments should be addressed to:

Mr. William C. Shilling
Criteria and Standards Division (WH-585)
Environmental Protection Agency
Washington, D.C. 20460

Copies of the Final EIS may be obtained from:

Environmental Protection Agency
Criteria and Standards Division (WH-585)
Washington, D.C. 20460
202/245-3036

The Final EIS may be reviewed at the following locations:

Environmental Protection Agency
Public Information Reference Unit, Room 2404 (Rear)
401 M Streeet, SW
Washington, D.C. 20024

Environmental Protection Agency
Region VI
1201 Elm Street
Dallas, Texas 75270

SUMMARY

PURPOSE OF AND NEED FOR ACTION

This Environmental Impact Statement (EIS) provides information required for the decisionmaking process, with respect to final designation of four Sabine-Neches Ocean Dredged Material Disposal Sites (ODMDS's). The purpose of the proposed action is to provide the most feasible and environmentally acceptable ocean locations for the disposal of material dredged from the Sabine-Neches Entrance Channels (Sabine Bank Channel, Sabine Pass Outer Bar Channel, Sabine Pass Jetty Channel, and Sabine Pass Channel).

Disposal sites in the ocean are needed to receive material dredged from the Sabine-Neches Entrance Channels and adjacent areas. Without dredging, operating depths through the Channel System would decrease, thus limiting economically important ship traffic to and from Beaumont, Port Arthur, Orange and Port Neches, Texas. In evaluating alternative methods for the disposal of dredged material, the U.S. Army Corps of Engineers (CE), which performs the dredging operations, has demonstrated that disposal in the ocean is the most reasonable method at present (CE, 1975a).

The Environmental Protection Agency (EPA), the agency responsible for designating ocean disposal sites, approved the four Sabine-Neches ODMDS's (Existing Sites) for interim use in 1977 (40 CFR 228), based on historical use of the sites. Existing Site No. 4 had been used since at least 1931, and Sites 1, 2, and 3 since 1962 for the disposal of material dredged from the Sabine-Neches Entrance Channels. In order for any interim designated ODMDS to maintain its status as an EPA approved site, final designation must precede the expiration date of the interim designation.

ALTERNATIVES INCLUDING THE PROPOSED ACTION

Alternatives to the Proposed Action include No Action or designation of one or more alternative ocean disposal sites (other than Existing Sites). Non-ocean disposal methods were considered by the CE (while evaluating the need for ocean disposal) to be less desirable than disposal in the ocean because of the quantity of sediments to be dredged, the limited receiving capacity of land disposal sites, and economic and environmental concerns. Thus, this EIS does not consider ocean non-alternatives for disposal of dredged material.

Taking no action towards final designation of the sites for continued use, or terminating their further use, would require the CE to either: (1) justify an acceptable alternate disposal method (e.g., land based), (2) develop information sufficient to select an acceptable ocean site for disposal, or (3) modify or cancel dredging projects that depend on ocean disposal as the only feasible method for disposal of the dredged material.

Three general ocean environments off Sabine, Texas, were considered as potentially suitable areas in which to locate one or more ocean disposal sites. These are: shallow-water (depths less than 20m, from shore to approximately 20 nmi offshore), mid-Shelf (depths from 20m to 200m, from approximately 20 to 80 nmi offshore) and deepwater Continental Slope (depths greater than 200m, approximately 90 nmi offshore).

Two of these areas (mid-Shelf and Deepwater) were eliminated from further consideration based on the information and evaluation presented in the Sabine-Neches Site Evaluation Study.

Ocean dredged material disposal sites located in alternative shallow-water areas would be in high-energy environments similar to that of the Existing Sites. They would be further removed from the location of the dredging operation. The Existing Sites are located adjacent to the channel and are thus in areas that are already influenced by sediments reaching the dredging area. Relocation of the sites to a more distance alternative shallow-water area would result in depositing the dredged material in an area that has been or is less influenced by sediments discharging through the Channel. Because of this factor and the greater cost of disposal, sites in alternative shallow-water areas were eliminated.

The Existing Sites (Figure S-1) are located in the shallow-water area. It was determined these sites (1to 4) are environmentally acceptable and the most economical location to receive the material dredged from the Sabine-Neches Entrance Channels. The Existing Sites (interim designated sites) are discussed in detail and evaluated based on the 11 specific site selection criteria listed at 40 CFR 228.6. A summary of this evaluation based on three key criteria is as follows.

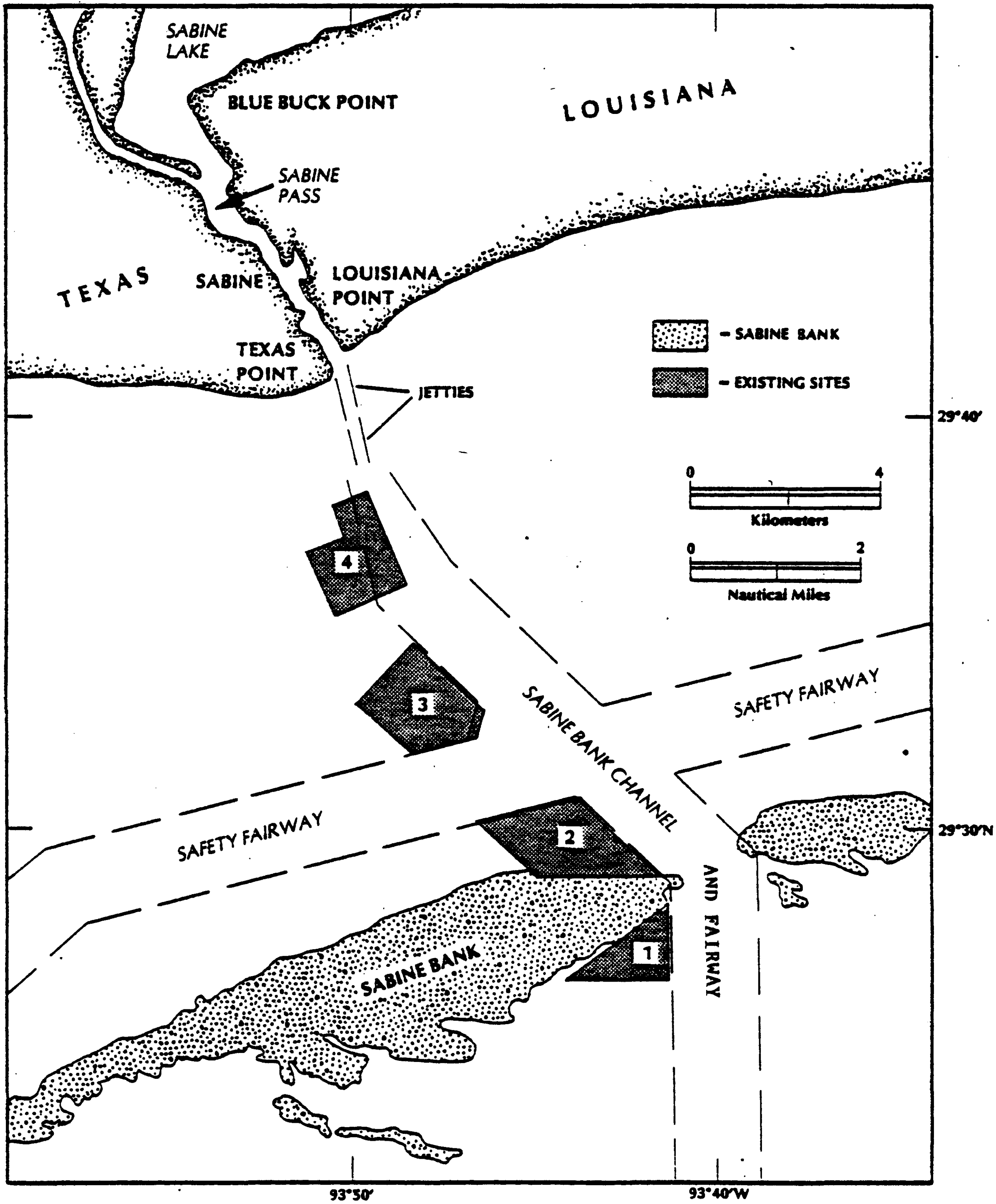


Figure S-1. Existing Sabine-Neches ODMDS's

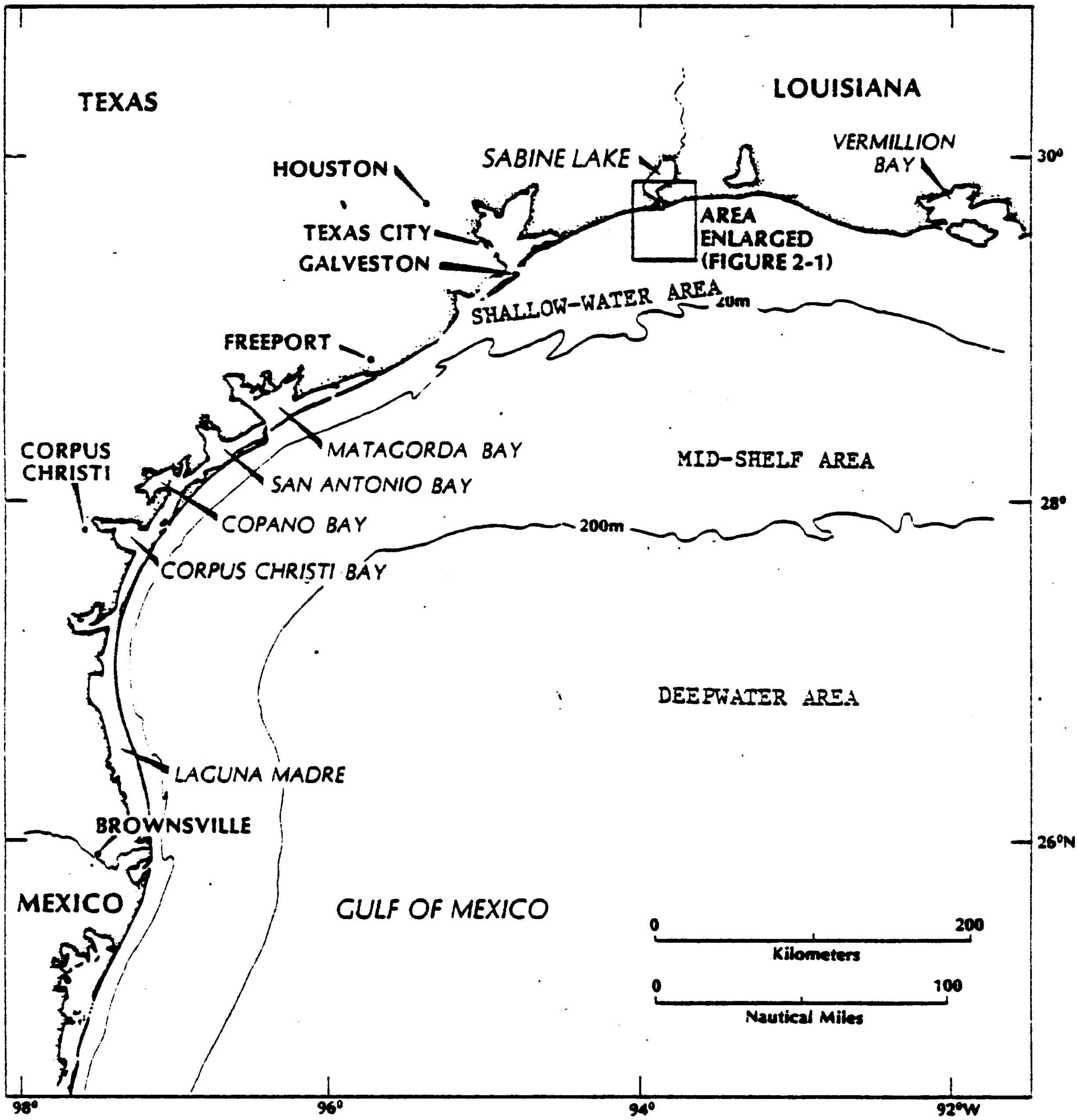


Figure S-2. Area Overview

GORGRAPHICAL POSITION, DEPTH OF WATER,
BOTTOM TOPOGRAPHY AND DISTANCE FROM SHORE

The Existing Sites (numbered 1 through 4) are on the Continental Shelf in a shallow water, nearshore environment. Distance from shore varies: the closest, Site 4, is 2.7 nmi from shore; the farthest, Site 1, is 16 nmi from shore. Bottom topography at all sites is essentially flat.

LOCATION IN RELATION TO BREEDING, SPAWNING, FEEDING OR
PASSAGE AREAS OF LIVING RESOURCES IN ADULT OR JUVENILE PHASES

The Existing Sites are in an area of breeding, spawning, and nursery grounds for fish and shellfish. Many fishes and shrimp spawn in Sabine Lake and Sabine Pass, and juveniles later migrate into the nearshore waters off Texas Point, probably passing through the Existing Sites as they proceed seaward; some species continue seaward past the sites, others (mainly shrimp) sometimes remain in nearshore waters in the vicinity of or within the Existing Sites.

DISPERSAL, HORIZONTAL TRANSPORT AND VERTICAL MIXING CHARACTERISTICS OF
THE AREA, INCLUDING PREVAILING CURRENT DIRECTION AND VELOCITY IF ANY

The Existing Sites are in a high-energy environment, thus, strong currents, waves, storms, and tidal curents constantly mix the water and bottom sediments, dispersing sediments over a wide area. Surface currents (1.0 kn) and bottom currents (0.25 kn) result in a net transport of sediments in a south-southwesterly direction. Hurricanes and tropical storms occasionally move into the nearshore zone causing bottom current velocities to increase to 4 kn and result in massive sediment transport in various directions.

AFFECTED ENVIRONMENT

The Texas-Louisiana coast is part of the Chenier Plain ecosystem of the Gulf of Mexico. The Chenier Plain is a highly productive and complex mixture of wetlands, uplands, and open water created by sediment deposition from the Mississippi River. The coast is marked by many inlets that allow connection with numerous shallow estuaries.

The climate of Sabine, Texas, is a mixture of tropical and temperate conditions with moderate temperatures and abundant rainfall. Summer conditions extend from May through September; winter conditions extend from December through February. Air temperatures average 27.5°C in summer, 20.7°C in autumn, 12.6°C in winter, and 20.1°C in spring (DOC, 1972).

Severe storms have profound effects on the environment of the Existing Sites. Tropical storms or hurricanes strike the area on a triennial average. Storms rework sediments and can bury the benthos under shifting sediments. As a result, bottom-dwelling animals in shallow-water environments are adapted to periodic burial.

Prevailing surface currents off Texas Point are relatively constant throughout the year, flowing to the west at speeds of 0.9 to 1.1 kn. Strong onshore winds during the summer hurricane season can cause a brief change to onshore or easterly flow.

Bottom currents off Texas Point average 0.23 kn and generally flow in a south-southwesterly direction. Current velocities fluctuate greatly over the year, but are generally lower in the summer than in winter. Bottom currents can become quite strong during storms when rip currents redistribute coarse sediments along the entire coast.

Plankton communities at the Existing Sites are typical of the nearshore Continental Shelf waters in the Gulf of Mexico. Diatoms are the dominant phytoplankton group nearshore, decreasing in number seaward, and gradually are replaced by coccolithophorids. Zooplankton are dominated by copepods, chaetognaths, cladocerans, and urochordates. Plankton abundance is greatest inshore, reflecting the high availability of nutrients from land runoff and estuaries.

Numerous commercial and recreational species of fish and shellfish inhabit the nearshore Shelf. The most important fish species are menhaden, snappers, croakers and groupers. Important shellfish are browm and white shrimp. Major fishing areas occur over the Sabine Bank; most shrimping occurs along a half-mile stretch adjacent to the Bank. In 1979, commercial fish and shellfish catches for the Texas-Louisiana coast totaled about 1.6 billion pounds, with a total cash value of $358 million.

Additional commercial activities in the Gulf of Mexico include oil and gas exploration and development, and commercial shipping. In the past 25 years, oil and gas development in the Gulf has contributed over $40 billion to the economies of Texas and Louisiana. Much of this oil and gas was refined within Sabine-Neches Waterway and shipped to other areas via large deep-draft tankers. In 1978, commercial oil and gas commodities entering and leaving Sabine-Neches Waterway totaled over 30 million short tons.

ENVIRONMENTAL CONSEQUENCES

Continued disposal at the Existing Sites would have no significant adverse impacts on human health, economics, safety, or aesthetics. Approximately 4.5 million yd^3 of material are dredged annually from the Sabine-Neches Entrance Channel and dumped at the Existing Sites. The only adverse effects on the environment from dumping have been localized reductions in populations of some benthic organisms and temporary formation of mounds. Reduced abundances of bottom-dwelling animals occur as a result of smothering (through burial) by dredged material. Mounds resulting from disposal of dredged material are temporary. Tidal and other currents, and storms are sufficient to erode mounds within the Existing Sites, resulting in essentially flat bottom topography.

Disposal operations do not interfere with any long-term beneficial uses of resources. Commercial and sport fishing are not impaired and important finfish and shellfish are not endangered by disposal activities. Oil and gas exploration and development will not be affected by disposal activities; although oil production platforms are located within the Existing Sites, they are few in number and will not interfere or pose a safety hazard. The only resources lost by disposal activities are sand for fill, energy expended, and money spent on disposal. These losses are insignificant in comparison with the advantages of disposal at the Existing Sites.

Disposal of dredged material is expected to have minimal impact on threatened or endangered species occurring in the region. Turtle species inhabiting the area are wide-ranging oceanic species, and the Existing Sites cover only a small fraction of their feeding and migrating range. Other species which may feed in the area are the West Indian Manatee and brown pelicans. The Existing Sites and vicinities do not contain unique feeding or breeding grounds for any of these species. Site use is not anticipated to affect their survival.

The possibility of long-term adverse biological effects from contaminants in dredged material is low at the Existing Sites. Dredged materials must meet certain bioassay and bioaccumulation criteria (outlined at 40 CFR 227.27) to ensure that sediments are suitable for disposal in the ocean.

CONCLUSION

Existing Sites 1 to 4 are environmentally acceptable and the most economical locations to receive material dredged from the Sabine Entrance Channel System, and are therefore the preferred site.

ORGANIZATION OF THE ENVIRONMENTAL IMPACT STATEMENT

The above information, which summarizes the content of this EIS, is organized into six chapters and six appendicies. Four chapters comprise the main body of the EIS:

- Chapter 1 specifies the purpose and need for the proposed action, i.e., the final designation of the Sabine-Neches ODMDS's. Background information on the ocean disposal of dredged material is presented. Also discussed is the legal framework that guides EPA's selection and designation of disposal sites and the CE's responsibilities in ocean disposal of dredged material.

- Chapter 2 describes alternatives to the proposed action.

- Chapter 3 describes the affected environment of the Existing sites and the history of dredged material disposal in the northern Gulf of Mexico.

- Chapter 4 analyzes the environmental consequencs of dredged material disposal at the Existing Sites.

- Chapter 5 identifies the preparers and receivers of the EIS.

- Chapter 6 glossary, abbreviations and references.

Four appendices are included to support the text:

- Appendix A presents the results and discusses surveys performed for the EIS.

- Appendix B discusses the effects that hurricanes and storms have on sediment transport along the northern coast of the Gulf of Mexico.

- Appendix C presents the calculations of initial mixing of dredged material after disposal.

- Appendix D describes the disposal costs and economic feasibility associated with the use of alternative sites.

- Appendix E is the CE-Galveston District Public Notice of Maintenance Dredging for the Sabine-Neches Waterway.

- Appendix F Site Designation Study for Sabine-Neches Texas.

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CONTENTS (continued)

CONTENTS (continued)

ILLUSTRATIONS

CONTENTS (continued)

TABLES

Chapter 1

PURPOSE OF AND NEED FOR ACTION

The Ports of Beaumont, Orange, Port Neches, and Port Arthur are the center of commerce and industry for southeastern Texas. Access of ships to the harbor depends on dredging of the channels to maintain the authorized depths. The action proposed in this EIS is the final designation of environmentally acceptable Sabine-Neches Ocean Dredged Material Sites.

The action proposed in this Environmental Impact Statement (EIS) is the final designation for continuing use of four Ocean Dredged Material Disposal Sites (ODMDS's) in the Sabine, Texas, area. The purpose of the proposed action is to provide the most environmentally acceptable location for the disposal of materials dredged from the Sabine-Neches Entrance Channels. The Sabine-Neches Entrance Channels are comprised of the Sabine Bank Channel, Sabine Pass Outer Bar Channel, Sabine Pass Jetty Channel and Sabine Pass Channel of the Sabine-Neches Waterway. The EIS presents the information needed to evaluate the suitability of ocean disposal areas for final designation for continuing use, and is based on one of a series of disposal site environmental studies. The environmental studies and final designation process are being conducted in accordance with the requirements of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA), as amended (86 Stat. 1052, 33 USCA Part 1401 et seq.); the Environmental Protection Agency's (EPA's) implementation of the Ocean Dumping Regulations and Criteria (40 CFR 220-229); and other applicable Federal environmental legislation.

Based on an evaluation of all reasonable alternatives, the proposed action in this EIS is to permanently designate the four existing interim-designated Sabine-Neches ODMDS's. The boundary coordinates, distances from shore, average depths, and areas of the sites (Figure 1-1) are presented in Table 1-1.

The Sabine-Neches, Texas ODMDS, as delineated above, would be designated for the disposal of dredged material. The sites may be used for the disposal of the dredged material only after evaluation of each Federal project or permit application has established that the disposal is within site capacity and in compliance with the criteria and requirements of EPA and the U.S. Army Corps of Engineers (CE) regulation.

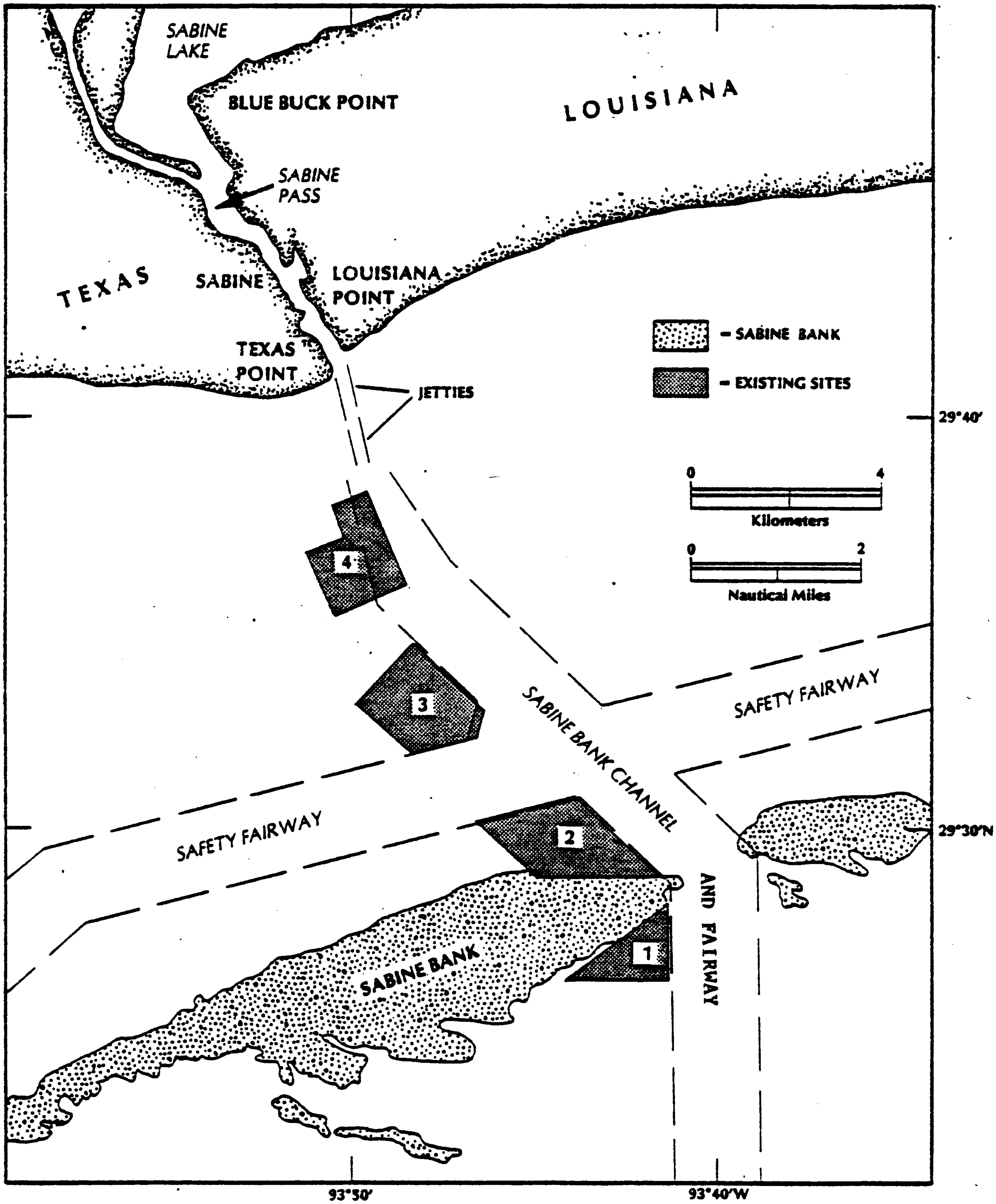

Figure 1-1. Existing Sabine-Neches ODMDS's

TABLE 1-1
GEOGRAPHIC CHARACTERISTICS OF THE EXISTING SITES

Site	Corner Coordinates	Distance from Shore (nmi)	Area (nmi^2)	Depth (m)
Existing Sites				
Site 1	29°28'03"N, 93°41'14"W 29°26'11"N, 93°41'14"W 29°26'11"N, 93°44'11"W	16	2.4	11-13
Site 2	29°30'41"N, 93°43'49"W 29°28'42"N, 93°41'33"W 29°28'42"N, 93°44'49"W 29°30'08"N, 93°46'27"W	11.8	4.2	9-13
Site 3	29°34'24"N, 93°48'13"W 29°32'47"N, 93°46'16"W 29°32'06"N, 93°46'29"W 29°31'42"N, 93°48'16"W 29°32'59"N, 93°49'48"W	6.8	4.7	10
Site 4	29°38'09"N, 93°49'23"W 29°35'53"N, 93°48'18"W 29°35'06"N, 93°50'24"W 29°36'37"N, 93°51'09"W 29°37'00"N, 93°50'06"W 29°37'46"N, 93°50'26"W	2.7	4.2	5-9

PURPOSE AND NEED

MARINE PROTECTION, RESEARCH, AND SANCTUARIES ACT

The MPRSA was enacted in October 1972. Congressional intent for this legislation as expressed in the act is:

> Sec. 2(b). The Congress declares that it is the policy of the United States to regulate the dumping of all types of

> materials into ocean waters and to prevent or strictly limit the dumping into ocean waters of any material which would adversely affect human health, welfare, amenities, or the marine environment, ecological systems, or economic potentialities.
>
> (c). It is the purpose of this Act to regulate (1) the transportation by any person of material from the United States and, in the case of United States vessels, aircraft, or agencies, the transportation of material from a location outside the United States, when in either case the transportation is for the purpose of dumping the material into ocean waters, and (2) the dumping of material transported by any person from a location outside the United States if the dumping occurs in the territorial sea or the contiguous zone of the United States.

Title I of the MPRSA, which is the act's primary regulatory section, authorizes the Administrator of EPA (Section 102) and the Secretary of the Army acting through the CE (Section 103) to establish ocean disposal permit programs for nondredged and dredged materials, respectively. Title I also requires EPA to establish criteria, based on those factors listed in Section 102(a), for the review and evaluation of permits under the EPA and CE permit program. In addition, Section 102(c) of Title I authorizes EPA, considering criteria established pursuant to Section 102(a), to designate recommended ocean disposal sites or times for dumping of nondredged and dredged material.

CORPS OF ENGINEERS NATIONAL PURPOSE AND NEED

Section 103 of Title I requires the CE to consider in its evaluation of Federal projects and Section 103 permit applications the effects of ocean disposal of dredged material on human health, amenities, the marine environment, ecological systems, and economic potentialities. As part of this evaluation, consideration must be given to utilizing, to the extent feasible, ocean disposal sites designated by the EPA pursuant to Section 102(c). Since 1977, the CE has used those ocean disposal sites designated by EPA on an interim basis. Use of these interim-designated sites for ocean disposal has been an essential element of the CE's compliance with the requirements of the MPRSA and its ability to carry out its statutory responsibility for maintaining the Nation's navigation waterways. To continue to maintain the Nation's waterways, the CE considers it essential that environmentally acceptable ocean disposal sites be identified, evaluated, and permanently designated for continued use pursuant to Section 102(c). These sites will be used after review of each project has established that the proposed ocean disposal of dredged material is in compliance with the criteria and requirements of EPA and CE regulations.

CORPS OF ENGINEERS LOCAL NEED

The Sabine-Neches Waterway System (SNWS) extends over 18 miles into the Gulf of Mexico from the ends of the jetties at Texas Point and Louisiana Point. The entire SNWS including 76 miles of inland waterways total 94 miles. To maintain the authorized depths of the SNWS seaward of the jetties, the Galveston District removes on an annual basis approximately 5,000,000 cu yd of material. Historically, most of the dredged material from this portion of the SNWS has been disposed of at the ODMDS bordering the waterway. Presently, four sites are in use and have received interim designation status from EPA. The need to permanently designate the interim designated sites or silimar areas for disposal of dredged material is considered an essential element in the District's Operations and Maintenance (O&M) Program for the SNWS. In the past the use of the four interim designated sites has provided for an effective utilization of dredging resources by minimizing dredging and disposal costs while reducing the annual dredging period (5 months) required to maintain the SNWS to its authorized depths. An indirect benefit from the use of multiple sites for dredged material disposal is to reduce the time when the hopper dredge is a potential navigational hazard for other users of the SNWS. In addition to the site being used in the O&M of the SNWS, it is also expected that these ODMDS's will be used in the assessment of alternative disposal plans for new work Federal projects and Section 103 permit applications.

By locating and permanently designating specific ODMDS's it is anticipated the District's ability to identify and measure environmental as well as social and economic impacts expected to result from ocean disposal of dredged material will be enhanced. As a result, the project assessments and/or evaluations presented to the public and decision makers for review will be based on the best available scientific data which hopefully will result in improved decision making.

EPA'S PURPOSE AND NEED

As previously stated, the CE has indicated a need for locating and designating environmentally acceptable ODMDS's to carry out its responsibilities under the MPRSA and other Federal statutes. Therefore, in response to the CE's stated need, EPA, in cooperation with the CE, has initiated the necessary studies pursuant to the requirements of 40 CFR 228.4(e) to select, evaluate, and possibly designate the most suitable sites for the ocean disposal of dredged material. This document has been prepared to provide the public and decisionmakers with relevant information to assess the impacts associated with the final designation of four sites proposed for final designation, the Sabine-Neches ODMDS's. It is not anticipated that the CE will conduct any further environmental studies with respect to the selection of these sites.

INTERIM DUMPING SITES

On 11 January 1977, EPA promulgated final Ocean Dumping Regulations and Criteria to implement MPRSA. The Regulations set forth criteria and procedures for the selection and designation of ocean disposal sites. In addition, the regulations designated 129 ocean sites for the disposal of dredged material to allow the CE to fully comply with the purpose and procedural provisions of the MPRSA. These sites could be used for an interim period by the CE, pending completion of site designation studies as required by the Regulations. Use of the interim-designated sites by the CE would be dependent on compliance with the requirements and criteria contained in EPA's Ocean Dumping Regulations and Criteria.

Those sites given interim designation were selected by EPA in consultation with the CE, with the size and location of each site based on historic use. The interim designation would remain in force for a period not to exceed 3 years from the date of the final promulgation of the Regulations. However, due to the length of time required to complete the necessary environmental studies and operating restraints of both a technical and budgetary nature, environmental studies were not completed within the approved 3-year period. As a result, the Regulations were amended in January 1980 to extend the interim designation for those sites currently under study for a period not to exceed 3 years, while the remaining sites' interim status was extended indefinitely pending completion of studies and determination of the need for continuing use.

SITE STUDIES

In mid-1977, EPA, by contract, initiated environmental studies on selected nondredged material disposal sites. The studies were designed to characterize the sites' chemical, physical, and biological features and to provide the data needed to evaluate the suitability of each site for continuing use. All studies are being conducted in accordance with the appropriate requirements of Part 228 of the EPA Ocean Dumping Regulations and Criteria. Results of these studies are being used in the preparation of an EIS for each site where such a statement is required by EPA policy. The CE, to assist EPA in its national program for locating and designating suitable sites for the ocean disposal of dredged materials, agreed in 1979 to join the contract effort by providing funds for field surveys to collect and analyze baseline data. Data from each field survey and other relevant information are being used by EPA in its disposal-site evaluation study and in its EIS's to ascertain the acceptability of an interim site and/or another site(s) for final designation. In addition to providing funds, the CE agreed to further assist EPA by providing technical review and consultation.

The EPA, in consultation with the CE, selected 25 areas containing 59 interim-designated ODMDS's for study under the EPA contract. Regional priorities and possible application of the data to similar areas were considered in this selection process. For some selected areas, an adequate data base was found to exist; consequently, field studies for these areas were considered unnecessary for disposal-site evaluation studies. For the remaining selected areas, it was determined that surveys would be required for an adequate data base to characterize the areas' physical, chemical, and biological features and to determine the suitability of a site(s) in these areas for permanent designation. Field surveys were initiated in early 1979 and were completed in mid-1981.

The studies are directed to the evaluation of alternative ocean disposal sites for the disposal of dredged material in an area. Based on the data from the disposal-site evaluation study and other relevant information, an EIS will be prepared for each of the 25 selected areas. These EIS's only address those issues germane to the selection, evaluation, and final designation of environmentally acceptable ODMDS's. As a result, the data and conclusions contained in Chapters 2, 3, and 4 are limited to those significant issues relevant to site designation (i.e., analyses of impacts on site and adjacent area from the disposal of dredged material). Non-ocean disposal alternatives (e.g., upland, beach nourishment) are not addressed in the EIS's. However, in the event that non-ocean disposal alternatives have been previously addressed by Federal projects or Section 103 permit-application EIS's, a summary of the results and conclusion is included in Chapter 2.

SITE DESIGNATION

In accordance with the EPA's Ocean Dumping Regulations and Criteria, site designation will be by promulgation through formal rulemaking. The decision by EPA to designate a site(s) for continuing use will be based on appropriate Federal statutes, disposal-site evaluation study, EIS, supporting documentation and public comments on the Draft EIS, Final EIS, and the public notice issued as part of the proposed rulemaking.

In the event that the selected area(s) is deemed suitable for final designation, it is EPA's position that the site-designation process, including the disposal-site(s) evaluation study and the development of the EIS, fulfill all statutory requirements for the selection, evaluation, and designation of an ODMDS.

The EIS and supporting documents provide the necessary information to determine whether the proposed site(s) is suitable for final designation. In the event that an interim-designated site is deemed unacceptable for continuing use, the site's interim designation will be terminated and either the no-action alternative will be selected (no site being designated) or an alternative site(s) will be selected/designated. Furthermore, final site designation infers only EPA's determinations that the proposed site is suitable for the disposal of dredged material. Approval for use of the site will be determined only after review of each project to ensure that the proposed ocean disposal of dredged material is in compliance with the criteria and requirements of EPA and CE regulations.

LEGISLATION AND REGULATION BACKGROUND

FEDERAL LEGISLATION

Despite legislation dating back almost 100 years for the control of disposal into rivers, harbors, and coastal waters, ocean disposal of dredged material was not specifically regulated in the United States until passage of the MPRSA in October 1972. The first limited regulation was provided by the Supervisor of New York Harbor Act of 1888, which empowered the Supervisor (a U.S. Navy line officer) to prevent the illegal deposit of obstructive and injurious materials in New York Harbor, its adjacent and tributary waters, and Long Island Sound. In 1952, an amendment provided that the Secretary of the Army appoint a Corps of Engineers officer as Supervisor and, since that date, each New York District Engineer has automatically become the Supervisor of the Harbor. In 1958, an amendment extended the act to apply to the harbors of Hampton Roads, Virginia, and Baltimore, Maryland. Under the 1888 act, the Supervisor of the Harbor established sites in the Hudson River, Long Island Sound, and Atlantic Ocean for dumping certain types of materials. Further limited regulation was provided by the River and Harbor Act of 1899, which prohibited the unauthorized disposal of refuse into navigable waters (Section 13) and prohibited the unauthorized obstruction or alteration of any navigable water (Section 10).

The Fish and Wildlife Coordination Act was passed in 1958. Its purpose was "...to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs...." The law directed that water-resource projects, including channel deepening, be performed "with a view to the conservation of wildlife resources by preventing loss of and damage to such resources...." This was a first step towards concern for ocean areas. After the passage of this law, the CE (backed by judicial decisions) could refuse permits if the dredging or filling of a bay or estuary would result in significant unavoidable damage to the marine ecosystem.

Passage of the National Environmental Policy Act (NEPA) of 1969 (PL 91-190, 42 USC Parts 4321-4347, 1 January 1970) reflected public concern over the environmental effects of man's activities. Subsequently, particular attention was drawn to the effects of dredged materials by the River and Harbor Act of 1970 (PL 91-611). This act initiated a comprehensive nationwide study of dredged material disposal problems. Consequently, the CE established the Dredged Material Research Program (DMRP) in 1973, a 5-year, $30-million research effort. Objectives were (1) to understand why and under what conditions dredged material disposal might result in adverse environmental impacts, and (2) to develop procedures and disposal options to minimize adverse impacts (CE, 1977).

Two important acts were passed in 1972 that specifically addressed the control of waste disposal in aquatic and marine environments: (1) the Federal Water Pollution Control Act Amendments (FWPCA), later amended by the Clean Water Act of 1977, and (2) the MPRSA. Section 404 of the FWPCA established a permit program, administered by the Secretary of the Army acting through the Chief of Engineers, to regulate the discharge of dredged material into the waters of the United States (as defined at 33 CFR 323.2[a]). Permit applications are evaluated using guidelines jointly developed by EPA and the CE. Section 404(c) gives the EPA Administrator authority to restrict or prohibit dredged material disposal if the operation will have unacceptable adverse effects on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding grounds), wildlife, or recreational areas. Procedures to be used by EPA in making such a determination are found at 40 CFR 231.

MPRSA regulates the transportation and ultimate dumping of barged materials in ocean waters. The act is divided into three parts: Title I--Ocean Dumping, Title II—Comprehensive Research on Ocean Dumping, and Title III—Marine Sanctuaries. This EIS is concerned only with Title I of the act.

Title I, the primary regulatory section of MPRSA, establishes the permit program for the disposal of dredged and nondredged materials, mandates determination of impacts and alternative disposal methods, and provides for enforcement of permit conditions. The purpose of Title I is to prevent or strictly limit the dumping of materials that would unreasonably affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities. Title I of the act provides procedures for regulating the transportation and disposal of materials into ocean waters under the jurisdiction or control of the United States. Any person of any nationality wishing to transport waste material from a U.S. port, or under a U.S. flag, to be dumped anywhere in the oceans of the world, is required to obtain a permit.

Title I prohibits the dumping into ocean waters of certain wastes, including radiological, biological, or chemical warfare agents, and all high-level radioactive wastes. In March 1974, Title I was amended (PL 93-253) to bring the act into full compliance with the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, discussed below under "International Considerations." The provisions of Title I include a maximum criminal fine of $50,000 and jail sentence of up to 1 year for every unauthorized dump or violation of permit requirements, or a maximum civil fine of $50,000. Any individual may seek an injunction against an unauthorized dumper with possible recovery of all costs of litigation.

FEDERAL CONTROL PROGRAMS

Several Federal departments and agencies participate in the implementation of MPRSA requirements, with the lead responsibility given to EPA (Table 1-2). In October 1973, EPA implemented its responsibility for regulating ocean dumping under MPRSA by issuing the Final Ocean Dumping Regulations and Criteria (hereinafter "the Regulations" or "Ocean Dumping Regulations") which were revised in January 1977 (40 CFR 220-229). The Ocean Dumping Regulations established the procedures and criteria to apply for dredged material permits (Part 225), enforce permit conditions (Part 226), evaluate permit applications for environmental impact (Part 227), and designate and manage ocean disposal sites (Part 228).

TABLE 1-2
RESPONSIBILITIES OF FEDERAL DEPARTMENTS AND AGENCIES
FOR REGULATING OCEAN DISPOSAL UNDER MPRSA

Department/Agency	Responsibility
U.S. Environmental Protection Agency	Issuance of waste disposal permits, other than for dredged material.
	Establishment of criteria for regulating waste disposal.
	Enforcement actions.
	Site designation and management.
	Overall ocean disposal program management.
	Research on alternative ocean disposal techniques.
U.S. Department of the Army Corps of Engineers	Issuance of permits for transportation of dredged material for disposal.
	Recommendation of disposal site locations.
U.S. Department of Transportation Coast Guard	Surveillance.
	Enforcement support.
	Issuance of regulations for disposal vessels.
	Review of permit applications.
U.S. Department of Commerce National Oceanic and Atmospheric Administration	Long-term monitoring and research.
	Comprehensive ocean dumping impact and short-term effect studies.
	Marine sanctuary designation.
U.S. Department of Justice	Court actions.
U.S. Department of State	International agreements.

OCEAN DUMPING EVALUATION PROCEDURES

The Ocean Dumping Regulations specify the procedures for evaluating the effects of dredged material disposal. The EPA and CE evaluate Federal projects and permit applications for non-Federal projects to determine (1) whether there is a demonstrated need for ocean disposal and that other environmentally sound and economically reasonable alternatives do not exist (40 CFR 227 Subpart C), and (2) compliance with the environmental impact criteria (40 CFR 227 Subparts B, D, and E). Figure 1-2 outlines the cycle used to evaluate the acceptability of dredged material for ocean disposal.

Under Section 103 of MPRSA, the Secretary of the Army is given the authority, with certain restrictions, to issue permits for the transportation of material dredged from non-CE projects for ocean disposal. For Federal projects involving dredged material disposal, Section 103(e) of MPRSA provides that "the Secretary [of the Army] may, in lieu of the permit procedure, issue regulations which will require the application to such projects of the same criteria, other factors to be evaluated, the same procedures, and the same requirements which apply to the issuance of permits..." for non-Federal dredging projects involving disposal of dredged material. Consequently, both Federal and non-Federal dumping requests undergo identical regulatory reviews. The only difference is that, after the review and approval of the dumping request, non-Federal projects are issued an actual permit. The CE is responsible for evaluating disposal applications and granting permits to dumpers of dredged materials; however, dredged material disposal sites are designated and managed by the EPA Administrator or his designee. Consequently, dredged material generated by Federal and non-Federal projects must satisfy the requirements of the MPRSA (as detailed in the Ocean Dumping Regulations) to be acceptable for ocean disposal.

ENVIRONMENTAL IMPACT CRITERIA

Section 103(a) of the MPRSA states that dredged material may be dumped into ocean waters after determination that "the dumping will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, or economic potentialities." This applies to the ocean disposal

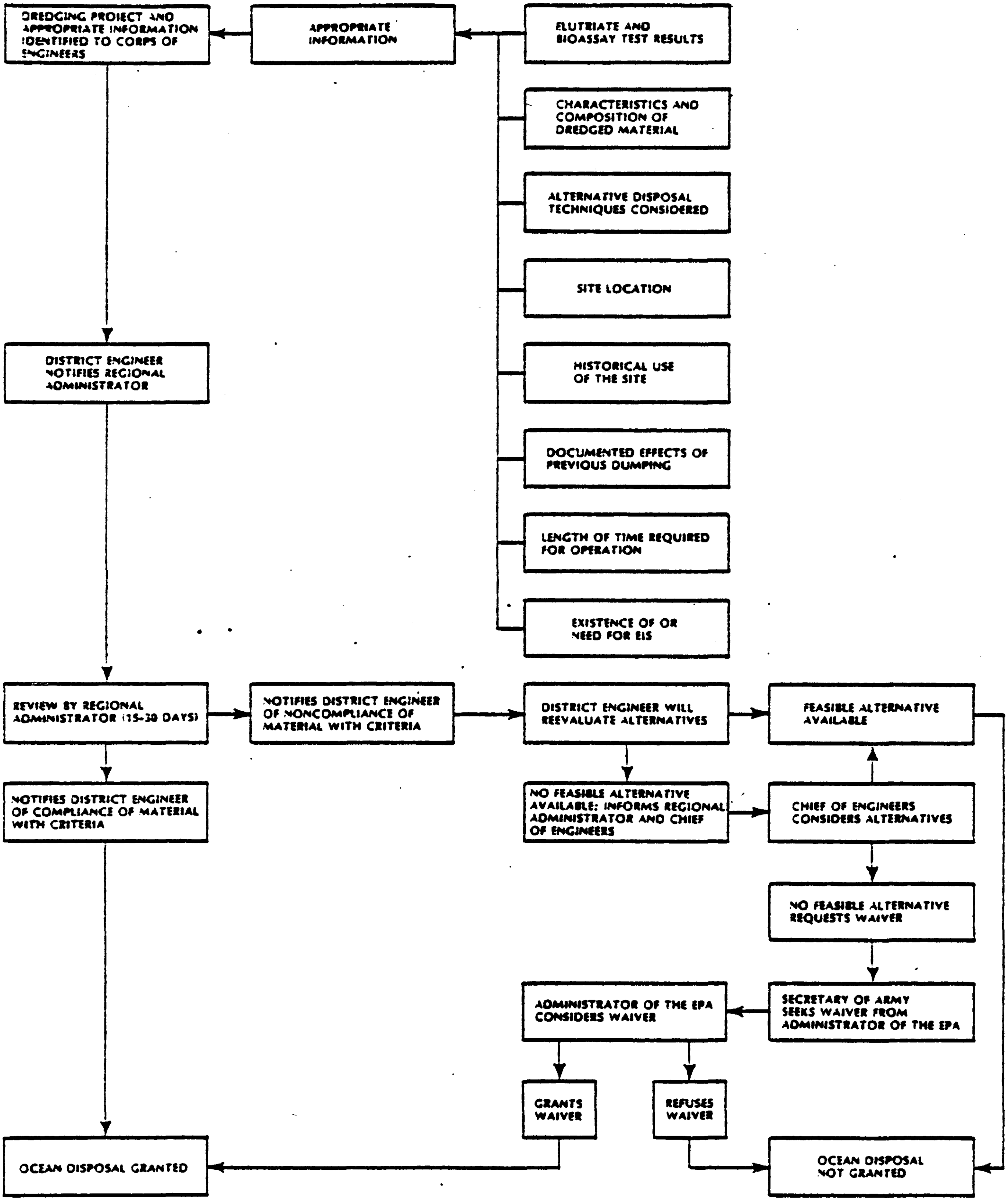

Figure 1-2. Dredged Material Evaluation Cycle

of dredged materials from both Federal and non-Federal projects. To ensure that dumping in the ocean will not unreasonably degrade or endanger public health and the marine environment, the Ocean Dumping Regulations restrict the transportation of all materials for dumping, specifically:

- Prohibited materials: High-level radioactive wastes; materials produced or used for radiological, chemical, or biological warfare; materials insufficiently described to apply the Criteria (40 CFR 227); and persistent inert synthetic or natural materials which float or remain suspended and interfere with fishing, navigation, or other uses of the ocean.

- Constituents prohibited as other than trace contaminants: Organohalogens; mercury and mercury compounds; cadmium and cadmium compounds; oil; and known or suspected carcinogens, mutagens, or teratogens.

- Strictly regulated materials: Liquid waste constituents immiscible with or slightly soluble in seawater (e.g., benzene), radioactive materials, wastes containing living organisms, highly acidic or alkaline wastes, and wastes exerting an oxygen demand.

Dredged material is environmentally acceptable for ocean disposal without further testing if it satisfies any one of the following criteria:

- Dredged material is composed predominantly of sand, gravel, rock, or any other naturally occurring bottom material with particle sizes larger than silt, and the material is found in areas of high current or wave energy...

- Dredged material is for beach nourishment or restoration and is composed predominantly of sand, gravel, or shell...

- When: (i) the material proposed for dumping is substantially the same as the substrate at the proposed disposal site; and (ii) the [proposed dredging] site...is far removed from known existing and historical sources of pollution so as to provide reasonable assurance that such material has not been contaminated by such pollution. (40 CFR 227.13[b])

If dredged material does not meet the above criteria, then further testing of the liquid, suspended particulate, and solid phases is required. The Ocean Dumping Regulations require that the liquid phase "not contain... constituents in concentrations which will exceed applicable marine water quality criteria after allowance for initial mixing" (40 CFR 227.6), and that "bioassays on the liquid phase of the dredged material show that it can be discharged so as not to exceed the limiting permissible concentration..." (40 CFR 227.13).

The suspended particulate and solid phases must be tested using bioassays which can demonstrate that dredged materials will not cause the "occurrence of significant mortality or significant adverse sublethal effects including bioaccumulation due to the dumping..." and that the dredged material "can be discharged so as not to exceed the limiting permissible concentration...." The bioassays ensure that "no significant undesirable effects will occur due either to chronic toxicity or to bioaccumulation." The required testing ensures that dredged material contains only constituents which are:

> (1) present in the material only as chemical compounds or forms (e.g., inert insoluble solid materials) non-toxic to marine life and non-bioaccumulative in the marine environment upon disposal and thereafter, or (2) present in the material only as chemical compounds or forms which, at the time of dumping and thereafter, will be rapidly rendered non-toxic to marine life and non-bioaccumulative in the marine environment by chemical and biological degradation in the sea; provided they will not make edible marine organisms unpalatable; or will not endanger human health or that of domestic animals, fish, shellfish, or wildlife. (40 CFR 227.6)

PERMIT ENFORCEMENT

Under MPRSA, the Commandant of the U.S. Coast Guard (USCG) is assigned responsibility by the Secretary of Transportation for conducting surveillance of disposal operations to ensure compliance with the permit conditions and to discourage unauthorized disposal. Alleged violations are referred to EPA for appropriate enforcement. Civil penalties include a maximum fine of $50,000; criminal penalties involve a maximum fine of $50,000 and/or a 1-year jail term. Where administrative enforcement action is not appropriate, EPA may request the Department of Justice to initiate relief actions in court for violations of the terms of MPRSA. Surveillance is accomplished by means of spot checks of dump vessels for valid permits, interception or escorting of dump vessels, use of shipriders, and aircraft overflights during dumping.

The Commandant of the Coast Guard has published guidelines for ocean dumping surveillance and enforcement in Commandant Instruction 16470.2B, dated 29 September 1976. An enclosure to the instruction is an Interagency Agreement between the CE and the USCG regarding surveillance and enforcement responsibilities over federally contracted ocean dumping activities associated with Federal Navigation Projects. Under the agreement, the CE "recognizes that it has the primary surveillance and enforcement responsibility over these activities." The CE directs and conducts the surveillance effort over CE contract dumpers engaged in ocean disposal activities, except in New York and San Francisco; the USCG retains primary responsibility for surveillance in these two areas. In all other areas, the USCG will respond to specific requests from the CE for surveillance missions. The USCG retains responsibility for surveillance of all dredged material ocean dumping activities which are not associated with Federal Navigation Projects.

OCEAN DISPOSAL SITE DESIGNATION

EPA is conducting intensive studies of various disposal sites in order to determine their acceptability. The agency has designated a number of existing disposal sites for use on an interim basis until studies are completed and formal designation or termination of each site is decided (40 CFR 228.12, as amended 16 January 1980, 45 FR 3053).

Under Section 102(c) of MPRSA, EPA is authorized to designate sites and times for ocean disposal of acceptable materials. Therefore, EPA established criteria for site designation in the Regulations. These include general and specific criteria for site selection and procedures for designating the sites for disposal. If it appears that a proposed site can satisfy the general criteria, then the specific criteria for site selection will be considered. Once designated, the site may be monitored for adverse disposal impacts. The criteria for site selection and monitoring are detailed in Chapter 2.

INTERNATIONAL CONSIDERATIONS

The principal international agreement governing ocean dumping is the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention), which became effective in August 1975, upon ratification by 15 contracting countries including the United States (26 UST 2403: TIAS 8165). There are now 47 contracting parties. Designed to control dumping of wastes in the ocean, the Convention specifies that contracting nations will regulate disposal in the marine environment within their jurisdiction and prohibit disposal without permits. Certain hazardous materials are prohibited (e.g., radiological, biological, and chemical warfare agents, and high-level radioactive matter). Certain other materials (e.g., cadmium, mercury, organohalogens and their compounds; oil; and persistent, synthetic, or natural materials that float or remain in suspension) are also prohibited as other than trace contaminants. Other materials (e.g., arsenic, lead, copper, zinc, cyanides, fluorides, organosilicon, and pesticides) are not prohibited from ocean disposal, but require special care. Permits are required for ocean disposal of materials not specifically prohibited. The nature and quantities of all ocean-dumped material, and the circumstances of disposal, must be periodically reported to the Inter-Governmental Maritime Consultative Organization (IMCO), which is responsible for administration of the Convention.

U.S. ocean dumping criteria are based on the provisions of the London Dumping Convention (LDC) and include all the considerations listed in Annexes I, II, and III of the LDC. Agreements reached under the LDC also allow exclusions from biological testing for dredged material from certain locations. These agreements are also reflected in the U.S. ocean dumping criteria. Thus, when a material is found to be acceptable for ocean dumping under the U.S. ocean dumping criteria, it is also acceptable under the LDC.

Chapter 2

ALTERNATIVES INCLUDING THE PROPOSED ACTION

Chapter 2 discusses existing ocean sites for the disposal of dredged material from the Sabine-Neches Entrance Channels, as well as the No-Action alternative. Environmental impacts from 20 years of dumping at the Existing Sites are documented and found to be limited to smothering of the benthic infaunal community, and temporary shoaling. The No-Action alternative is rejected because a decision of either final designation or termination of the Existing Sites is required. Based on this study EPA proposes that the Existing Sites received final designation.

NO-ACTION ALTERNATIVE

The No-Action alternative to the proposed action would be to refrain from designating an ocean site for the disposal of dredged material from Sabine-Neches Entrance Channels. Four Existing Sites are currently designated on an interim basis. These interim designations are scheduled to expire in July 1984, unless formal rulemaking is completed earlier that either (1) designates the interim sites for continuing use, or (2) extends their interim designation.

By taking no action, the present ocean sites would not receive final designation, nor would an alternative ocean disposal site(s) be designated. Consequently, the CE would not have EPA-recommended ocean disposal sites(s) available in the area, thus precluding ocean dumping as a disposal method for dredged material. Therefore, the CE would be required to either: (1) justify an acceptable alternative disposal method (e.g., land based), or (2) develop information sufficient to select an acceptable ocean site for disposal, or (3) modify or cancel proposed dredging projects that depend upon disposal in the ocean as the only feasible method for the disposal of dredged material. The no-action alternative was determined to be unaccepable.

UPLAND DISPOSAL

Alternative disposal methods considered by the CE (1975a) while evaluating the need for an ocean disposal site include disposal on land and disposal into leveed areas. Upland disposal alternatives were considered by the CE to be less desirable than disposal in the ocean because of the quantity of sediments dredged, the limited receiving capacity of terrestrial disposal sites, and economic and environmental concerns (CE, 1975a)

Disposal of sediments dredged from the Entrance Channel is leveed areas (in Sabine Lake and Pass) were rejected by the CE primarily because of cost, lack of docking facilities to handle the hopper dredge, and the increases safety hazard that would result from hopper dredge traffic.

SELECTION OF ALTERNATIVE SITES

The general criteria (40 CFR 228.5) used to select a dredged material disposal site are:

- **The dumping of materials into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of heavy commercial or recreational navigation.**
- **Locations and boundaries disposal sites will be so chosen that temporary perturbations in water quality...can be reduced to normal ambient sea-water levels or to undetectable contaminant concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.**

- **The sizes of ocean disposal sites will be limited in order to localize...any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long range impacts.**

- **...wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.**

Utilizing the foregoing criteria, three general areas were selected for consideration during the Site Evaluation Study. These areas, Shallow-Water Area, Mid-Shelf Area and Deepwater Area, were evaluated using the 11 specific site selection criteria of the ODR.

It was determined during the Site Evaluation Study that location of an ODMDS in the Mid-Shelf Area or the Deepwater Area offered no material advantage over a location in the Shallow-Water Area. In addition, hauling dredged material to these more distant area presented both safety and economic disavantages. Based on these results, the Mid-Shelf area and the Deepwater Area were eliminated from further consideration.

The Existing Sites are located in the Shallow-Water Area and have been historically used for disposal of dredged material. They are adjacent to the dredging areas which minimizes the hauling distance for disposal. Movement of the sites to an alternative location in the Shallow-Water Area would place them in a quite similar ocean environment while increasing the safety risks and costs of disposal operations. It was determined during the Site Evaluation Study that the Existing Sites were environmentally acceptable; therefore, it was determined that relocation of the sites to an alternative Shallow-Water area was not warranted.

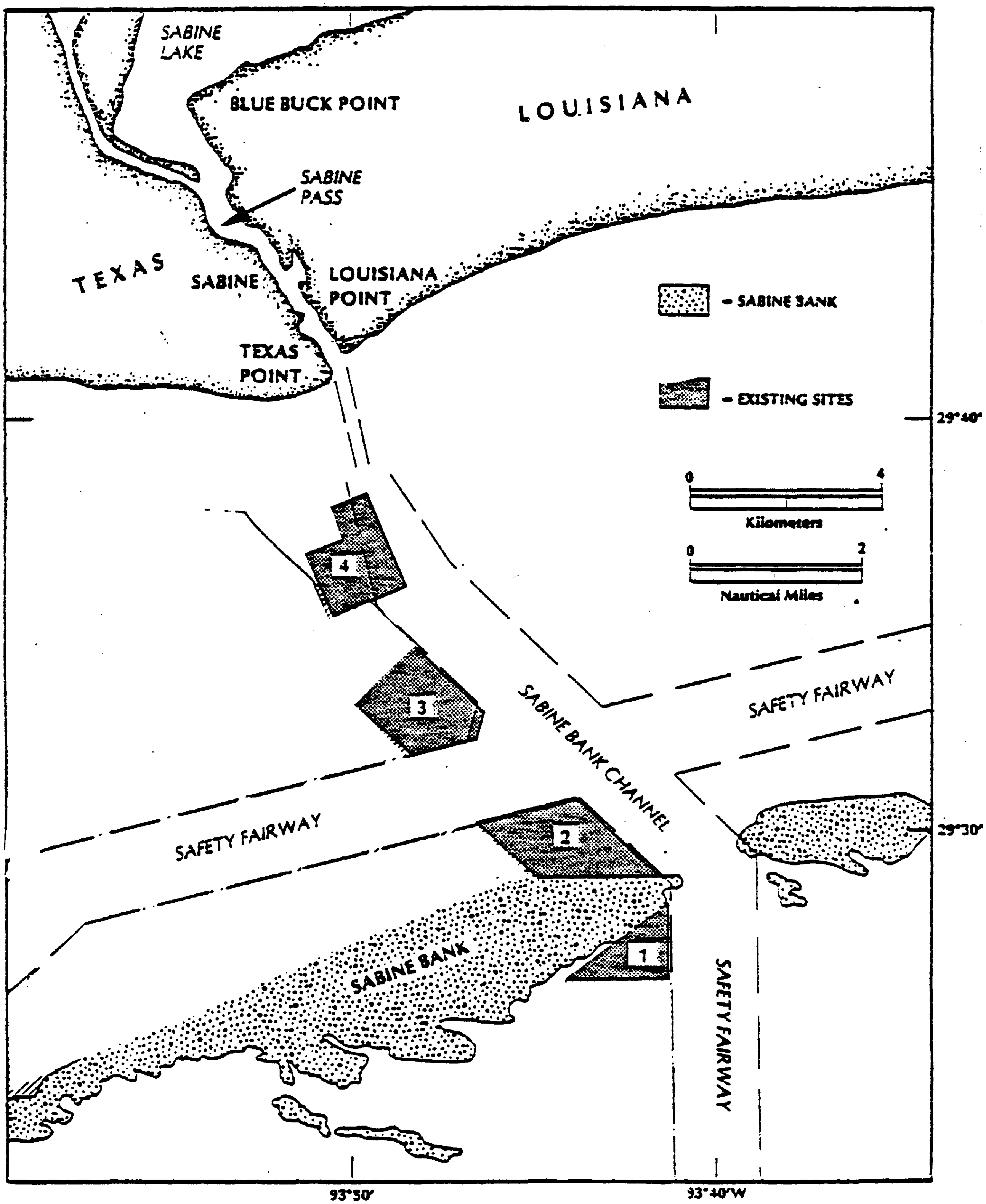

Figure 2-1. Existing Sites

Previous dredged material disposal has occurred at the Existing Sites and no significant adverse environmental effects have been detected (CE, 1975a). On the basis of previous use, cost effectiveness, and the absence of significant adverse impacts, final designation of the four Existing Sites was recommended in the Site Evaluation Study.

Intense fishing activity for white and brown shrimp, shellfish, and several species of demersal finfish occurs throughout the Shallow-Water Area (Figure 2-1) off Texas Point. Previous dumping of dredged material at the Existing Sites has not noticeably interfered with Shallow-Water fisheries.

Previous dumping at the Existing Sites has resulted in temporary reductions in abundances of benthic infauna (CE, 1975a). Presumably, this reduction is caused by burial of some immobile organisms during disposal operations and their inability to burrow through the deposited material. Although abundances have been reduced, diversity within the sites has remained the same as the surrounding area. Thus, the lower number of organisms can probably be attributed to periodic disposal operations and is considered to be a minor effect (CE, 1975a).

Accumulation of material due to dumping occurs within the Existing Sites. However, strong bottom currents associated with storms and waves tend to disperse the sediments (see Appendix B).

DETAILED CONSIDERATION OF THE SITES

The proposed action is the final designation of four Sabine-Neches ODMDS's. Final site selection was based on the Sabine-Neches Site Designation Study and evaluation of the Existing Sabine-Neches ODMDS's using the 11 specific criteria listed at 40 CFR 228.6 of the Ocean Dumping Regulations. EPA established the criteria to constitute "an environmental assessment of the impact of the use of the site for disposal" (40 CFR 228.6[b]). Applications of the criteria to the Existing Sites for disposal of dredged material at Sabine-Neches follows.

In the following sections, the 11 specific criteria are applied to the Existing Sites.

(1) GEOGRAPHICAL POSITION, DEPTH OF WATER, BOTTOM TOPOGRAPHY AND DISTANCE FROM COAST [40 CFR 228.6(a)(1)]

TABLE 2-1
GEOGRAPHIC CHARACTERISTICS OF THE EXISTING SITES

Site	Corner Coordinates	Distance from Shore (nmi)	Area (nmi^2)	Depth (m)
Existing Sites				
Site 1	29°28'03"N, 93°41'14"W 29°26'11"N, 93°41'14"W 29°26'11"N, 93°44'11"W	16	2.4	11-13
Site 2	29°30'41"N, 93°43'49"W 29°28'42"N, 93°41'33"W 29°28'42"N, 93°44'49"W 29°30'08"N, 93°46'27"W	11.8	4.2	9-13
Site 3	29°34'24"N, 93°48'13"W 29°32'47"N, 93°46'16"W 29°32'06"N, 93°46'29"W 29°31'42"N, 93°48'16"W 29°32'59"N, 93°49'48"W	6.8	4.7	10
Site 4	29°38'09"N, 93°49'23"W 29°35'53"N, 93°48'18"W 29°35'06"N, 93°50'24"W 29°36'37"N, 93°51'09"W 29°37'00"N, 93°50'06"W 29°37'46"N, 93°50'26"W	2.7	4.2	5-9

EXISTING SITES

Bottom topography within each of the Existing Sites is flat with no unique features or relief. Each varies only in distance from shore and depth.

(2) LOCATION IN RELATION TO BREEDING, SPAWNING, NURSERY, FEEDING, OR PASSAGE AREAS OF LIVING RESOURCES IN ADULT OR JUVENILE PHASES [40 CFR 228.6(a)(2)]

EXISTING SITES

The Existing Sites are between the shrimp spawning grounds of the Mid-Shelf and the important nursery area of Sabine Lake, therefore they could be passageways of commercially valuable species (EHA, 1979). However, the sites represent only a minor portion of the entire range of shrimp along the Gulf coast and thus would only affect a small percentage of the existing population. Many commercially and recreationally important species of fish also occur in this region; however, most recognized breeding and spawning grounds occur in the productive marshes and estuaries of the coastal region or in the midwater areas of the Gulf (Chittenden and McEachran, 1976).

Henningson (1977), in a study off Galveston, Texas, found that disposal of dredged material is apparently not detrimental to free-swimming animals (nekton). Some nekton, including fish, may actually be attracted to the turbid waters which result from disposal activities to seek food or protection from predators (EHA, 1979).

(3) LOCATION IN RELATION TO BEACHES AND OTHER AMENITY AREAS [40 CFR 228.6(a)(3)]

EXISTING SITES

Amenities in the vicinity of the Existing Sites include fishing and boating activities. Disposal of dredged material has not affected these activities adversely because effects were limited to a turbidity plume at the site that disperses within a few hours after disposal.

Existing Site 4 (located closest to shore) is 2.7 nmi south of the nearest land (Texas Point). The beach has not been adversely affected by disposal activities because a prevailing southwesterly current has caried material away from shore.

(4) TYPES AND QUANTITIES OF WASTES PROPOSED TO BE DISPOSED OF, AND PROPOSED METHODS OF RELEASE, INCLUDING METHODS OF PACKING THE WASTE, IF ANY [40 CFR 228.6(a)(4)]

Sediments to be dumped at the Existing Sites result from the dredging of the Sabine-Neches Entrance Channels. Materials dredged from the Entrance Channel are dumped at the Existing Sites closest to the area of dredging. The average annual amount dumped at the Existing Sites from 1960 to 1979 was 4.5 million yd^3. Dredged sediments are predominantly clay or clayey silt (see Appendix A; CE, 1975a). All dredged material dumped in the ocean must conform to the EPA dredged material criteria listed at Section 227.13(b) of the Ocean Dumping Regulations.

A hopper dredge has been used for the dredging of the Sabine-Neches Entrance Channels. The unpacked dredged material is released when the bottom doors on the hoppers are opened.

(5) FEASBILITY OF SURVEILLANCE AND MONITORING [40 CFR 228.6(a)(5)]

Surveillance and monitoring are feasible easy at the Existing Sites for the following reasons: (1) shallow-depths reduces costs associated with acquiring samples, (2) day-use boaters and shore based observers could be used for surveillance and (3) transportation costs to and from the sites for surveillance and monitoring purposes would be low.

(6) DISPOSAL, HORIZONTAL TRANSPORT AND VERTICAL MIXING CHARACTERISTICS OF THE AREA, INCLUDING PREVAILING CURRENT DIRECTION AND VELOCITY, IF ANY [40 CFR 228.6(a)(b)]

EXISTING SITES

In shallow-water areas, most dredged material falls to the bottom immediately after dumping and only a small portion of the finer fraction is lost from the main settling surge (Pequegnat et al., 1978). This small portion disperses as individual particles. Bottom currents measured 6.5 nmi off Texas Point average 0.23 kn and flow in a south-southwesterly direction. These currents are capable of transporting the dispersed dredged material over a wide area.

Bottom currents become quite strong during storms, when powerful rip currents redistribute coarse sediments along the Texas-Louisiana coast (DOE, 1978). Periodically, hurricanes also produce currents strong enough to prevent any significant shoaling due to the accumulation of dredged material (see Appendix B). Evidence of this is the lack of shoaling at any of the Existing Sites despite the approximately 88 million yd^3 of material that has been dumped in the past 50 years.

(7) EXISTENCE AND EFFECTS OF CURRENT AND PREVIOUS DISCHARGES AND DUMPING IN THE AREA (INCLUDING CUMULATIVE EFFECTS) [40 CFR 228.6(a)(7)]

EXISTING SITES

No significant changes in diversity have occurred in the benthos of the disposal sites off Texas Point, based on a comparison of 1974 samples with samples taken from 1951 to 1954; however, minor reductions in abundances of benthic infauna are apparent (CE, 1975a). This loss in abundance is apparently a result of repeated dumping of materials onto immobile benthic organisms. Studies have shown that the populations being reduced are capable of recolonization within a few months (CE, 1975a). In addition, trawl data indicated that free-swimming animals in the disposal area did not differ from animals occurring in undisturbed areas (CE, 1975a). Surveys conducted for EPA by Interstate Electronics Corporation (IEC) in 1979 and 1980 (see Appendix A) also indicated no significant differences in the benthic community inside and outside the sites; however, low abundances of some dominant species were recorded at Site 3 (see Appendix A). No areas of special scientific importance, aquaculture, or desalination activities occur or are known to be planned in the vicinity of the Existing Sites.

(8) INTERFERENCE WITH SHIPPING, FISHING, RECREATION, MINERAL EXTRACTION, DESALINATION, FISH AND SHELLFISH CULTURE, AREAS OF SPECIAL SCIENTIFIC IMPORTANCE AND OTHER LEGITIMATE USES OF THE OCEAN [40 CFR 228.6(a)(8)]

EXISTING SITES

Existing Sites 2, 3, and 4 partially extend into the navigational safety fairway; however, they do not represent hazards to shipping. Sediments dredged from the channel are dumped within site boundaries but outside the safety fairway. Fairways were only "established to control the erection of structures therein to provide safe approaches through oil fields in the Gulf of Mexico to entrances to the major ports along the Gulf Coast" (33 CFR 209.135).

Existing Sites 1, 2, and 3 are in an area of important commercial shrimping (Grid Zone 17), which extends 60 nmi along the Texas-Louisiana Coast, and from the shoreline to about 90 nmi offshore. The sites are small (total 15.7 nmi^2). Previous disposals of dredged material in the small area do not appear to have affected the overall Shrimp catch of the Zone and are not exptected to affect it in the future.

Existing Sites 1 and 2 are near Sabine Bank. At times, upper layer water currents may move the disposal plume toward and onto the Bank. These fines will be widely dispersed initially and continually dispersed by bottom currents; and thus, should not materially affect commercial and recreation fishing at th Bank. A rise at edge of the Bank tends to direct bottom sediments along rather than onto the Bank. While bottom currents may carry material dumped at Site 2 toward the Bank, it is expected most of these materials will move along the edge of the Bank rather than onto it.

Oil and gas exploration and production could potentially be affected by disposal activities. Existing Sites 2 and 3 are presently being leased for oil and gas exploration and already contain oil production platforms and gas pipelines. As long as the density of these platforms and pipelines in these areas remains low, no significant conflict between the two uses of the disposal area should occur. However, if additional structures are placed within the disposal sites, particularly Existing Site 3, it may be necessary to restrict dumping due to navigational hazards.

No present-day or impending mineral extraction or desalination projects exist in the area of the Existing Sites (CE, 1979a).

(9) THE EXISTING WATER QUALITY AND ECOLOGY OF THE SITE AS DETERMINED BY AVAILABLE DATA OR BY TREND ASSESSMENT OR BASELINE SURVEYS [40 CFR 228.6(a)(9)]

EXISTING SITES

The Shallow-Water Area is a dynamic, high-energy environment. Water quality and ecology are influenced by nearshore mixing processes, runoff, and seasonal storms. Nearshore waters of the Gulf coast are naturally turbid (Lee et al., 1977).

Phytoplankton and zooplankton studies conducted southwest of the Existing Sites revealed seasonal differences in species composition; however, diatoms dominate the phytoplankton community and copepods dominate the zooplankton community (SEADOCK, 1976).

Fish and Shrimp dominate the nekton community of the Existing Sites, and species are typical of those reported from western gulf coastal waters (see Appendix A; CE, 1975a). Several of these species are commercially and recreationally important, including Atlantic croaker, Atlantic bumper, seatrout, menhaden, catfish, and brown and white shrimp.

The benthic community of the Existing Sites is characteristic of sand and mud habitats, and is dominated by worms, the most abundant of which are the acorn work, *Balanoglossus* cf. *aurantiacus*, and the nemertean, *Cerebratulus lacteus* (see Appendix A).

Chemical constituents of the water at the Existing Sites do not exceed the EPA (1976) water-quality criteria (see Appendix A; CE, 1978a,b). According to Horne and Swirsky (1979), concentrations of all measured constituents in the water (except dissolved ammonia, nitrate, and organic nitrogen) were below analytical detection limits. The three exceptions occurred in relatively low concentrations; however, no appropriate water-quality criteria regulating concentrations of these constituents apply.

(10) POTENTIALITY FOR THE DEVELOPMENT OR RECRUITMENT OF NUISANCE SPECIES IN THE DISPOSAL SITE [40 CFR 228.6(a)(10)]

EXISTING SITES

No changes in species composition at the Existing Sites have resulted from disposal operations (CE, 1975a). Trawl and benthic data also indicated that "the disposal area at the time of sampling did not differ from other nearby undisturbed areas...disposal of dredged material has contributed little to changing the character of the faunal communities in the vicinity of Sabine Pass" (CE, 1975a).

(11) EXISTENCE AT OR IN CLOSE PROXIMITY OF THE SITE OF ANY SIGNIFICANT NATURAL OR CULTURAL FEATURES OF HISTORICAL IMPORTANCE [40 CFR 228.6(a)(11)]

EXISTING SITES

Neither the Texas Antiquities Committee nor the Louisiana Division of Archaeology and Historic Preservation Office has found evidence of natural or cultural features of historic important in the area, but they noted that unknown sunken prehistoric sites may exist.

According to the CE (1975a), sunken vessels which exist in the offshore disposal area should not be permanently affected by disposal operations.

CONCLUSIONS

The Existing Sites are the preferred sites for the disposal of dredged material. Benthic sampling data indicate that despite 20 years of disposal, "no significant changes have occurred in the faunal communities as a result of dredging and disposal operations," with the exception of some reduction of infaunal abundances (CE, 1975a). In addition, "because the areas have been used for many years future changes in the benthic community cannot reasonably be expected from continued disposal" (CE, 1975a).

Dredging and disposal activities are not expected to inferfere with commercial and recreational fisheries. Most recreational fishing occurs over Sabine Bank. Sediments dumped at Existing Sites 1 and 2 may be transported toward but not onto the Bank due to the existing topography. A rise at the edge of the Bank tends to divert bottom sediments around the Bank. Commercial fishing will not be adversely affected by disposal of sediments. The Existing Sites are between the breeding and spawning grounds of the mid-Shelf and nearshore areas, but do not pose a significant problem because their locations and areas represent only a small fraction of the entire Gulf breeding and spawning areas. A monitoring program conducted by the CE concluded that "the place, time and conditions of disposal are such as not to produce an unacceptable adverse impact on...wildlife fisheries (including spawning and breeding areas...)" (CE, 1975a).

Selection of a disposal site anywhere within the Shallow-Water Alternative Area would be environmentally acceptable. However, designating a site other than the Existing Sites offers no clear economic advantage or environmental benefit. In addition, the Existing Sites have been historically used without apparent significant adverse environmental effects.

RECOMMENDED USE OF THE SITES

Future use of the Sabine-Neches ODMDS's for disposal of dredged material in the ocean must comply with the Ocean Dumping Regulations and Criteria, which bring prospective disposal activities into compliance with MPRSA (PL 92-532, as amended) and the London Ocean Dumping Convention.

The most recent (and still applicable) public notice of CE dredging within the Sabine-Neches Waterway, presented in Appendix E, describes the types and quantities of materials to be dredged and the disposal methods used.

TYPES OF MATERIAL

Sediments from the dredging of the Sabine-Neches Entrance Channels may be dumped at the Existing Sites. Other dredged material will be unaccepted unless the sediments comply with EPA criteria see forth at 40 CFR 227.13 of the Ocean Dumping Regulations.

PERMISSIBLE MATERIAL LOADINGS

Annual dredged material loadings at the Existing Sites have averaged 4.5 million cubic yards, and disposal of sediments from Sabine-Neches Entrance Channel has not resulted in the long-term formation of shoals, or changes in the biota. Thus, an upper limit cannot be determined for the amount of dredged material that can be dumped at the Existing Sites without causing significant adverse effects. Nevertheless, if accelerated disposal rates occur, and are observed in later monitoring studies to produce significant adverse effects, disposal operations would be altered in accordance with the Ocean Dumping Regulations and Criteria (40 CFR 228.11) to reduce the impact.

DISPOSAL METHODS

Current disposal techniques being used by the CE at the Existing Sites are acceptable for continued use. After material is dredged and transported by hopper dredge, it is discharged from underwater ports while the hopper dredge is underway within the boundaries of the Existing Sites.

MONITORING THE DISPOSAL SITE

The Ocean Dumping Regulations require that effects of disposal on a disposal site and surrounding marine environment be evaluated periodically. Information used in making the disposal impact evaluation may include data from monitoring surveys. Thus, "if deemed necessary," the CE District Engineer (DE) or EPA Regional Administrator (RA) may establish a monitoring program to supplement historical site data. The monitoring plan is developed by determining appropriate monitoring parameters, frequency of sampling, and areal extent of the survey. Factors considered in making this determination include frequency and volumes of disposal, physical and chemical nature of the dredged material, dynamics of the site physical processes, and life histories of the species monitored.

The primary purpose of the monitoring program is to determine whether disposal at the sites is significantly affecting areas outside the sites, and to detect any long-term adverse effects occurring in or around the sites. Consequently, the monitoring study must survey the sites as well as surrounding areas, including control sites and areas which are likely to be affected (as indicated by environmental factors, such as prevailing sediment transport). Results of an adequate survey will provide early indication of potential adverse effects outside the sites.

GUIDELINES FOR THE MONITORING PLAN

Periodic monitoring should test various water-quality, sediment, and biotic parameters. Because Sabine Bank is productive fishing area, tests shoul dalso be conducted at the Bank. Existing Site 3 is in an active area for oil and gas exploration; therefore, construction activity of platforms, pipelines routes, and other potential hazards to the hopper dredge or the oil industry should be periodically reviewed. If construction activity intensifies so that the hopper dredge operations are affected, a new disposal site may have to be designated.

Monitoring requirements for the Existing Sites are minimized because the dredged material is environmentally acceptable for disposal in the ocean and is generally similar to sediments of the surrounding waters. Many physical parameters will be unaffected significantly by dredged material disposal. Physical parameters that show large variations after disposal and return quickly to ambient levels do not require monitoring. Selected parameters which occasionally vary widely (e.g., sediment characteristics) may be monitored to separate natural environmental fluctuations from those caused by disposal of dredged material.

Requirements for the monitoring plan of the Existing Sites can be determined by application of the following considerations.

MOVEMENT OF MATERIAL INTO ESTUARIES OR MARINE SANCTURIES, OR ONTO OCEANFRONT BEACHES, OR SHORELINES

Prevailing southwesterly bottom currents at the Existing Sites carry dredged material away from the nearest beaches, shorelines, and Sabine Pass. There are no marine sancturaries near the Exising Sites; therefore, monitoring of dredged sediment movement toward shore is not recommended.

MOVEMENT OF MATERIALS TOWARD PRODUCTIVE
FISHERY OR SHELLFISHERY AREAS

Existing Sites 1 and 2 border Sabine Bank, a productive fishery. Prevailing bottom currents may carry some dredged material toward the Bank. Although there are no data to suggest that the existing fishery has been affected adversely as a result of previous dumping operations at Sites 1 and 2, grain-size analyses could be considered as part of an overall monitoring scheme to insure that the material is not being transported onto the Bank.

ABSENCE FROM THE DISPOSAL SITES OF
POLLUTION-SENSITIVE BIOTA
CHARACTERISTIC OF THE GENERAL AREA

Disposal at the Existing Sites has not resulted in changes in species composition of the benthos. However, bioaccumulation tests conducted on sediments from the Entrance Channel showed a positive result for aliphatic petroleum hydrocarbons in polychaetes placed in sediments adjacent to Site 1. Consequently, monitoring of these pollution-sensitive biota (polychaetes) which are present at the sites should be considered to determine any effects resulting from accumulation of hydrocarbons by these organisms.

PROGRESSIVE, NON-SEASONAL, CHANGES IN WATER
QUALITY OR SEDIMENT COMPOSITION AT THE
DISPOSAL SITES ATTRIBUTABLE TO DREDGED MATERIAL

Studies indicate that although disposal of dredged material from the Sabine Entrance Channel may contain detectable amounts of cadmium and mercury, the material will be sufficiently diluted and will not significantly affect the water quality of the Existing Sites (EHA, 1979; Horne & Swirsky, 1979). Therefore, monitoring of water quality is unnecessary.

Sediment composition at the Existing Sites has not been altered by dredged material disposal; however, because of differences between sediments of the Entrance Channel and other areas of the Channel System, it is recommended that sediment grain-size composition of the sites be monitored. Sediment composition should be determined using the same sampling design and frequency of collection as the benthic community analysis.

PROGRESSIVE, NON-SEASONAL, CHANGES IN COMPOSITION OR NUMBERS OF PELAGIC, DEMERSAL, OR BENTHIC BIOTA AT OR NEAR THE DISPOSAL SITES ATTRIBUTABLE TO DREDGED MATERIAL

Pelagic and demersal organisms at the Existing Sites and vicinity are not significantly affected by disposal; however, there is a reduction in abundances of benthic infauna. Thus, monitoring such animals could be considered to ensure that reductions in species are a direct result of burial during dumping operations. Appropriate benthic species to monitor at the Existing Sites would be species that are associated with the natural community of the sites (e.g., Balanoglossus aurantiacus, Cerebratulus lacteus, Magelona pacifica, Paraprionospio pinnata, Sigambra tentaculata, Cossura delta, Mediomastus californiensis, and Parmphinome pulchella). Survey transects should be established to sample the Existing Sites and areas upcurrent and downcurrent of the sites to detect any biotic changes which extend past the boundaries of the Existing Sites.

ACCUMULATION OF MATERIAL CONSTITUENTS (INCLUDING HUMAN PATHOGENS) IN MARINE BIOTA AT OR NEAR THE SITES

Bioaccumulation studies of dredged material from the Entrance Channel adjacent to the Existing Sites were conducted using grass shrimp, clams, and polychaete worms. Test sediments from the Entrance Channel near Site 1 produced a significant accumulation of aliphatic petroleum hydrocarbons in polychaetes; as a result, concentrations of these hydrocarbons should be monitored periodically. Concentrations of pesticides, polychlorinated biphenyls, and trace metals in test organisms were found to be less than or statistically no greater than concentrations in organisms of the surrounding sediments.

Biological samples could be collected and organisms of limited motility (to ensure that the impact is from dredged material) could be tested for heavy metal concentrations in their tissues. However, there are no commercial species at the sites that are of limited motility. Other organisms that could be considered for analysis include benthic invertebrates, which may represent a food resource for the more transient commercial species.

Chapter 3

AFFECTED ENVIRONMENTS

This chapter describes the environments of the Existing Sites evaluated in Chapter 2. Physical mixing processes at the Existing Sites are influenced by tidal and Gulf currents. Severe storms and hurricanes occur approximately once every 3 years and significantly redistribute Shelf sediments. Sediments at the Existing Sites support a diverse biological community, including several commercially and recreationally important species.

Chapter 3 describes the regional environment of the western Gulf of Mexico and the specific environments of the Existing Sites. The physical, geological, chemical, and biological characteristics that will effect or be affected by dredged material disposal are described. The chapter provides the environmental information necessary to evaluate the proposed action involving the designation of four Sabine-Neches ODMDS's. Ocean uses (fishing, recreation, resource development, ocean dumping) in the vicinity of the alternative sites are discussed at the end of the chapter.

REGIONAL CHARACTERIZATION

The southwestern Louisiana and southeastern Texas coasts are part of the Chenier Plain which extends 170 nmi from Vermillion Bay, Louisiana, to East Bay, Texas (Figure 3-1). The Chenier Plain is a highly productive and complex mixture of wetlands, uplands, barrier islands, and open water created by sediment deposition from the Mississippi River. The coast is marked by many inlets that connect with numerous shallow-water lakes and estuaries.

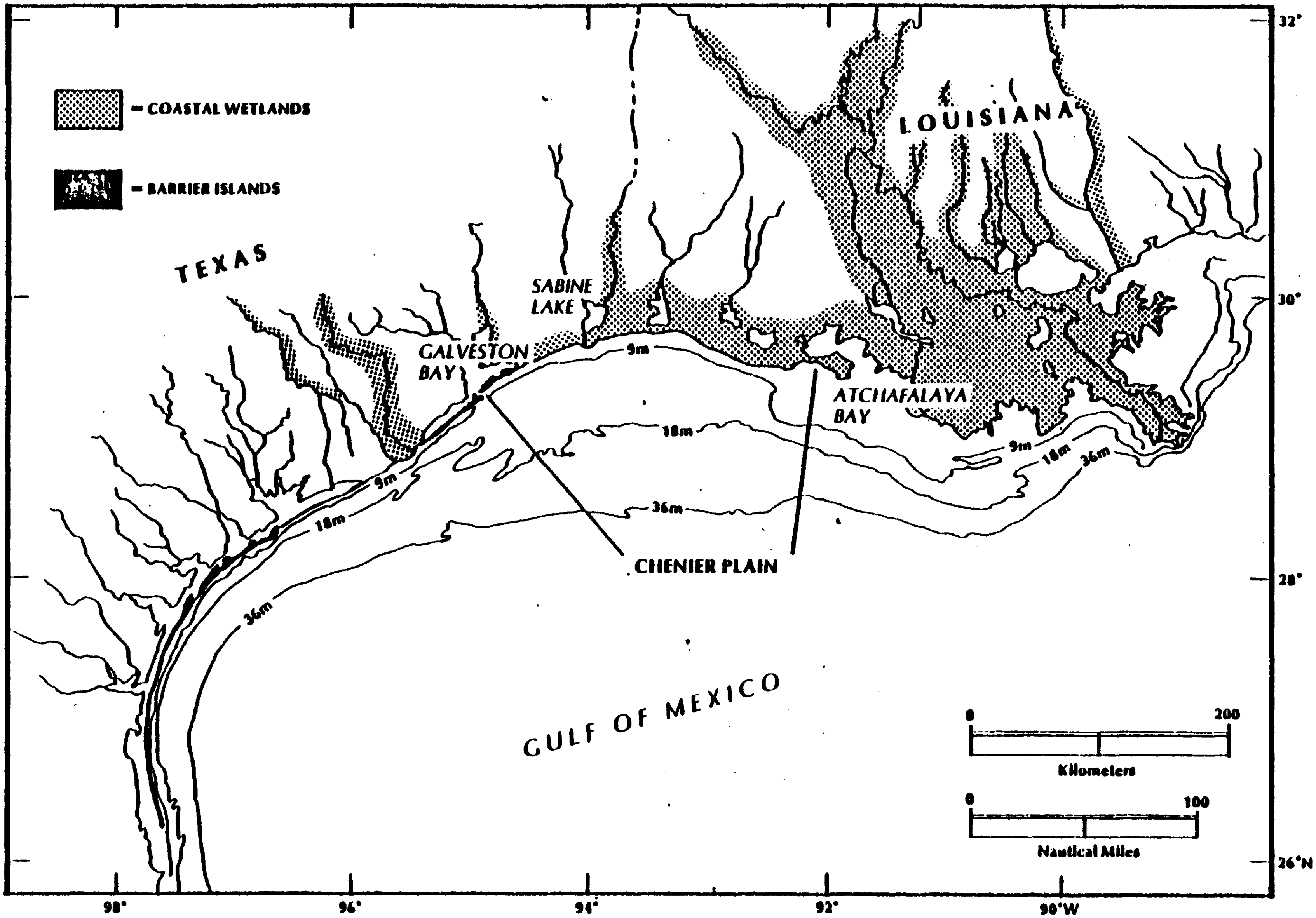

Figure 3-1. The Chenier Plain Coastal Ecosystem of Louisiana and Texas
Source: Gosselink et al., 1979

The shallow-water Gulf and estuarine bays can be considered a single ecological unit, defined by Hedgpeth (1953) as a neritic-estuarine ecosystem. Many species spawn in the Gulf and juveniles migrate to nursery areas in bays before returning to the Gulf. In addition to providing nursery grounds for nearshore marine species, estuaries also supply nutrients and organic matter to nearshore waters (Brogden and James, 1979; Gosselink et al., 1979). The greater availability of nutrients is a factor in producing higher diversity and abundance of organisms in nearshore waters than in oceanic waters.

PREVIOUS SURVEYS

Previous environmental surveys of the Existing Sites are listed in Table 3-1. Studies of lesser scope or of more peripheral interest are referenced in the surveys and herein.

SITE CHARACTERIZATION

CLIMATE

Climatic parameters of interest at an ODMDS are air temperature, rainfall, wind statistics, storm occurrences, and fog. Air temperature interacts with surface waters and, particularly during warm periods, influences the vertical stability of the water. Rainfall increases coastal freshwater runoff, thereby decreasing surface salinity and intensifying the vertical stratification of the water. Coastal runoff also might contribute suspended sediments and various chemical pollutants. Winds and storms can generate waves and currents which stir up and transport dredged material. A high incidence of fog during particular seasons might affect navigational safety and limit disposal operations.

The climate of Sabine, Texas, is a mixture of tropical and temperate zone conditions with moderate temperatures and abundant rainfall. Summer conditions extend from May through September, and winter conditions from December through February. Air temperatures average 27.5°C in summer, 20.7°C in autumn, 12.6°C in winter, and 20.1°C in spring (DOC, 1972).

TABLE 3-1
PRINCIPAL ENVIRONMENTAL SURVEYS OF THE
EXISTING SITES

Source	Subject
Shallow-water Sites	
Interstate Electronics Corporation (Appendix A)	Surveys at Existing Sites
U.S. Army Corps of Engineers (CE, 1973)	Report on Gulf Coast Deep Water Port Facilities; Texas, Louisiana, Mississippi, Alabama and Florida
U.S. Army Corps of Engineers (CE, 1975a)	Final Environmental Impact Statement, Maintenance Dredging Sabine-Neches Waterway, Texas
U.S. Army Corps of Engineers (CE, 1975b)	Environmental Inventory and Impact Evaluation of Dredging of Sabine-Neches Waterway
U.S. Army Corps of Engineers (Horne et al., 1978a)	Bioassay chemical analyses, and statistical analyses of samples from Freeport Harbor and Sabine Entrance Channel (winter series)
U.S. Army Corps of Engineers (Horne et al., 1978b)	Bioassay chemical analyses and statistical analyses of samples from Freeport Harbor and Sabine Entrance Channel (summer series)
J.D. Horne and M.A. Swirsky (1979)	Sabine-Neches bioassay studies
U.S. Department of Energy (DOE, 1978)	Strategic Petroleum Reserve, Texoma Group Salt Domes

Average annual precipitation is 134.8 cm (CE, 1975a). On the average, more precipitation occurs during mid to late summer and in winter.

During autumn and winter, weather fronts are preceded by strong southeasterly winds, followed by northerly winds. Winds occurring from late winter until early summer are generally from the southeast. Average wind speeds range from 8.5 kn in August to 13.2 kn in December (DOC, 1972).

Storms are of major importance to the Gulf coast environment. Intense wave and current action from hurricanes is an important factor in redistribution of sediments (see Appendix B). Storm surges caused by hurricane-force winds may cause water to pile up as high as 0.9m to 2.25m above sea level. Sabine Pass experiences a significant wave height of 2.7m once every 5 years (DOC, 1972).

In addition to hurricanes, tropical cyclones may result in the redistribution of sediments within Sabine Lake and along the adjacent coastal zone. The Sabine area experiences an average of one tropical storm or hurricane every 2.3 years (Figure 3-2).

Fog may occur during any part of the year but it is most prevalent during fall and winter months. Fog signal operation at Sabine Pass east jetty varies from a mean of 120 hours in December and January, to 5 hours in June (DOC, 1972). Fog can cause temporary halts in dredging operations and navigation. Several vessel collisions occur each year as a result of dense fog (CE, 1975a).

PHYSICAL OCEANOGRAPHY

Physical oceanographic parameters determine the nature and extent of the mixing zone, thereby influencing sediment transport and the chemical environment at an ODMDS. Strong temperature or salinity gradients inhibit mixing of surface and bottom waters, whereas waves aid mixing, resuspend bottom sediments, and affect water turbidity. Currents, especially bottom currents, determine the direction and influence the extent of sediment transport into and out of the ODMDS. Tidal currents might contribute to the transport of dumped material, but usually do not add net directional effects.

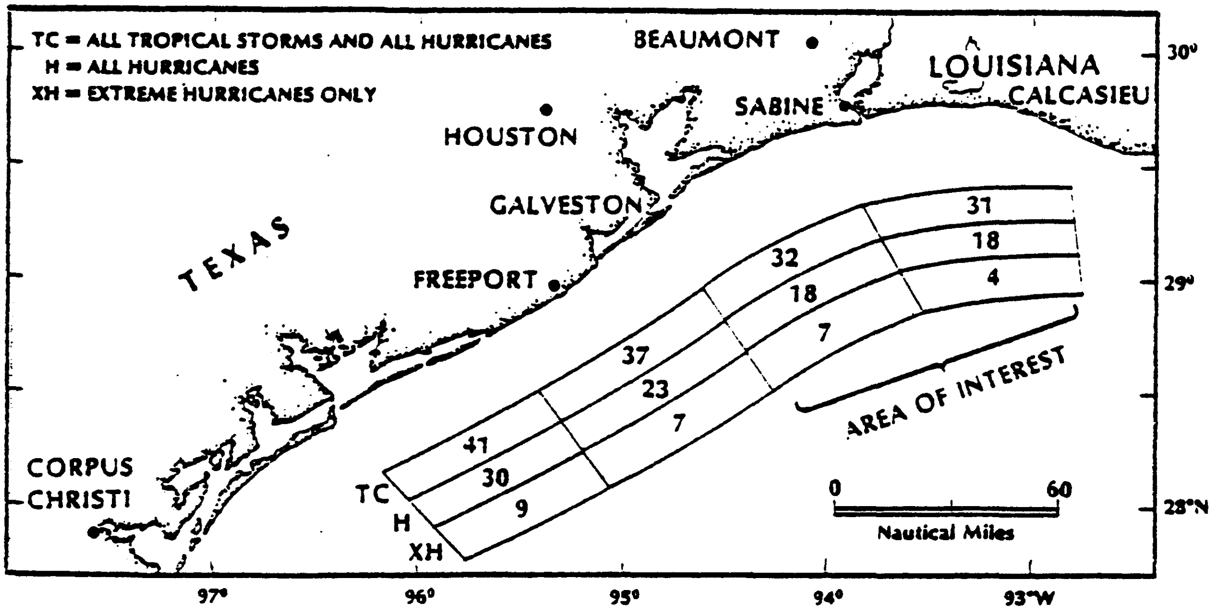

Figure 3-2. Percent Probability of Tropical Storms and Hurricanes Affecting Specified 50-Mile Sections of the Texas-Louisiana Coast During Any One Year
Source: Henry and McCormack, 1975

CURRENTS

Circulation in the Gulf of Mexico is dominated by the permanent Gulf Loop Current with detached clockwise eddies (Figure 3-3). The Gulf Loop Current is a continuation of the Yucatan Current, which originates in the western Atlantic Ocean. Currents flow north through the Yucatan Channel and penetrate into the northeastern Gulf of Mexico in a clockwise loop before exiting eastward through the Straits of Florida. The amount of penetration varies seasonally and fluctuates from year to year. During summer months, the main body of the current penetrates deeply into the Gulf; its northernmost limit is about 27°30'N. Here, counterclockwise eddies may spin off from the main loop. During the winter, the Loop is confined to the southeastern Gulf, flowing through the Straits of Florida with little intrusion into the Gulf proper (Hubertz, 1967; Leipper, 1970).

The counterclockwise circulation pattern of the northwestern Gulf and the clockwise circulation pattern of the southwestern Gulf converge southwest of Galveston, Texas (Figure 3-3). During summer, the zone of convergence

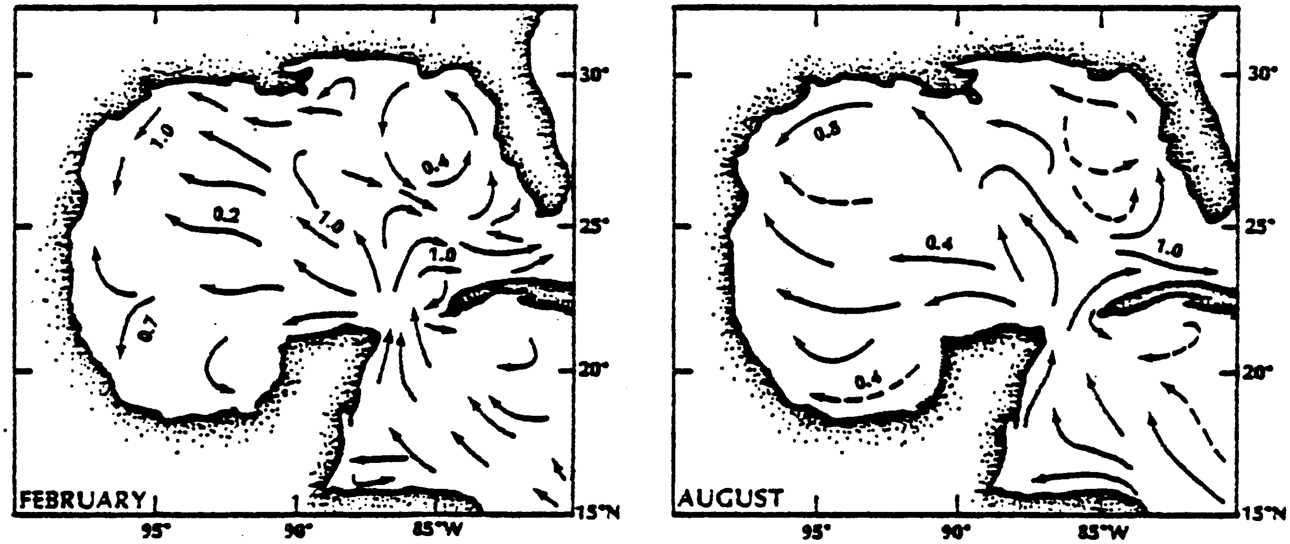

Figure 3-3. Surface Currents in the Gulf of Mexico (Speed in Knots)
Source: Nowlin, 1971

migrates northward under the influence of strong south-to-southeasterly winds. In September, a shift to more easterly winds and frequent northerlies move the zone of convergence southward (EHA, 1979).

The circulation pattern of the Texas-Louisiana coastal region has been evaluated from ship-drift and Geomagnetic Electrokinetographic (GEK) measurements compiled by the U.S. Naval Oceanographic Office (NAVOCEANO, 1980). Prevailing surface currents off Texas Point are relatively constant throughout the year, flowing to the west at speeds of 0.9 to 1.1 kn. Strong onshore winds during the summer hurricane season can cause a brief change to onshore or easterly flow. Aerial photographs of the coastal features confirm that the predominant surface currents near Texas Point are toward the west (CE, 1973).

Bottom currents measured 4.5 nmi off the coast averaged 0.25 kn and flowed in a south-southwesterly direction. Current velocities fluctuate greatly over the year, but are generally lower in summer than in winter. Bottom currents can become quite strong during storms when powerful rip currents redistribute coarse sediments along the entire coast (see Appendix B).

TEMPERATURE

Water temperatures in the shallow-water Gulf are usually constant with depth during spring, winter, and late autumn, a result of continuous vertical mixing; occasional changes in temperature with depth are accompanied by an increase in salinity, indicating intrusions of Gulf water.

Surface and bottom water temperatures at the Existing Sites range from a low of 10°C in January-February to a high of 27°C in August-September (see Appendix A; DOC, 1980a; Leipper, 1968; Ichiye and Sudo, 1971).

In deeper waters of the Gulf, average winter surface temperatures range from 18°C in the north to 27°C in the south; the average summer surface temperature is a nearly uniform 29°C (DOE, 1978). Although bottom temperature data were based on few observations (11), annual variations in bottom water temperatures are believed to be less in deeper than in shallower water (Pequegnat et al., 1978; Grassle, 1967; Chittenden and McEachran, 1976).

SALINITY

Regional salinity values are greatly influenced by freshwater runoff from Sabine Lake, resulting in generally lower salinities in the nearshore area, and a lens of lower salinity surface water 2 to 3 parts per thousand (°/oo) less saline than bottom water. Salinities reach values similar to those of central Gulf water (34°/oo to 36°/oo), about 30 nmi offshore (Leipper, 1968; Ichiye and Sudo, 1971). Surface salinities at the Existing Sites range from about 20°/oo in late August to about 29°/oo in January. Bottom salinities range from 23°/oo in late August to 30°/oo in January (see Appendix A; Leipper, 1968; Ichiye and Sudo, 1971).

Salinity is generally less variable in the deep ocean than in nearshore regions (Pequegnat et al., 1978; Grassle, 1967). In the general vicinity of the Deepwater Area, Churgin and Halminski (1974) reported that salinity values averaged between 34.2°/oo and 35.7°/oo, with extreme values of 29.4°/oo and 36.7°/oo.

GEOLOGICAL CONDITIONS

Geological information relevant to an ODMDS includes bathymetry, seafloor character, and sediment characteristics. Bathymetric data provide information on bottom stability, persistence of sediment mounds, and shoaling. The type of bottom sediments strongly influences the composition of the resident benthic biota. Differences in sediment types between natural ODMDS sediments and dredged material may be used as tracers to determine areas of bottom influenced by dumped dredged material. Changes in ODMDS sediment types caused by dumping can produce significant changes in chemical characteristics and thus change the composition of benthic biota.

BATHYMETRY

All of the Existing Sites are essentially flat with no significant relief. The only area in which any significant relief can be found is Sabine Bank (located between Existing Sites 1 and 2), which has a relief of 3m.

SEAFLOOR AND SEDIMENT CHARACTERISTICS

The Texas-Louisiana Continental Shelf is a 105-nmi wide, gently sloping submarine plain extending to a depth of 150m (DOI, 1978). At the edge of the Shelf, there is a row of low hills created largely of salt domes and mud diapirs. The Continental Slope has a steeper gradient and includes the Sigsbee Scarp, reaching to depths of 1,800m to 2,300m. The Sigsbee Scarp has a unique hill-and-basin topography, formed by the seaward extension of salt domes and diapirs of the Shelf edge (Shepard, 1973).

Sediments on the Texas-Louisiana Shelf are primarily a mixture of silty clays and silty sands, tending toward finer sediments further offshore. However, at the mouths of major estuaries, there is usually a broad layer of finer sediments superimposed over coarser sediments. Gravity cores obtained in the shallow nearshore Shelf reveal many discrete sediment layers which appear to have been deposited during the transgression of coastal waters in the wake of storm surges. This suggests that sedimentation on the nearshore Texas Shelf is significantly affected by storms (DOI, 1978), and is verified by effects of present day storms (see Appendix B). The storm-established sediment distribution creates some spatial and seasonal variation in bottom-sediment grain-size distributions which generally mask sediment variations at the Existing Sites caused by dredged material disposal.

Large localized variations in sediment sizes at the Existing Sites indicate that there may be significant movements of dumped dredged material. For example, sediments from a station in Site 3 increased from 29% to 46% sand between September 1979 and January 1980 (see Appendix A). It is not likely that this change resulted from dumping, because the dredged channel material adjacent to the site is composed of less than 30% sand. It is more likely that the finer sizes were removed (winnowed) by sediment transport between sampling periods; however, the variation between surveys could be solely spatial, a false variation produced by taking the January samples from a slightly different location.

Sites 1 and 2 are similar in sediment composition, and display little seasonal variation in grain-size distribution (see Appendix A). Channel sediments adjacent to the Existing Sites are finer than sediments at the sites; the dredged material is about 10% sand, and Existing Site sediments 65% to 80% sand. At Site 4 there is little variation between dredged and existing sediment compositions (see Appendix A).

WATER-COLUMN CHEMISTRY

The chemical parameters pertinent to evaluation of an ODMDS include suspended solids, nutrients important to phytoplankton growth (e.g., nitrates and phosphates), dissolved and particulate trace metals (e.g., cadmium, mercury, and lead), and hydrocarbons (e.g., PCB's, DDT, and phenol).

Potential impacts depend on the concentrations of constituents released from dredged material, and physical factors such as mixing and dilution rates; however, because of the transient nature of water masses, adverse effects are expected to be minor in most cases.

High levels of suspended solids may reduce light penetration through the water column, and thereby inhibit phytoplankton productivity or clog respiratory structures of fishes and other organisms.

Nutrients are essential for growth and reproduction of phytoplankton; however, under certain conditions, and at elevated levels, nutrients may promote eutrophication with subsequent depletion of dissolved oxygen, or in the case of ammonia, may be toxic to organisms in the water column.

Several trace metals are necessary micronutrients in the life processes of organisms; however, many can be toxic, such as mercury and cadmium, if present in relatively high levels in water, or in food sources such as suspended particulates. Many chlorinated or petroleum hydrocarbons are toxic, and may be bioaccumulated by marine organisms if ingested in sufficient quantities.

TURBIDITY

Continental Shelf waters of the Gulf of Mexico are naturally turbid; Secchi depths are generally 1m or less (Lee et al., 1977). At the Existing Sites, suspended sediment levels ranged from 1.0 to 2.96 mg/liter (see Appendix A). Nearshore, suspended sediments are mainly inorganic matter (quartz and clay minerals or iron-oxide aggregates), and generally result from the resuspension of bottom sediments by wind and tidal currents, commercial ship traffic, or shrimp trawling (Wright, 1978). Sabine River also contributes to local elevated levels of suspended sediments during periods of high runoff.

Turbidity generally decreases with increasing distance from shore. As little as 0.125 mg/liter suspended sediments have been recorded in surface waters over the deep-sea floor in the Gulf of Mexico (Emery and Uchupi, 1972).

DISSOLVED OXYGEN

Shallow waters at the Existing Sites are well-mixed most of the year and dissolved-oxygen concentrations are near saturation. A seasonal thermocline may develop in spring and summer which retards mixing, and, as a result of microbial oxidation of organic matter, allows bottom waters to become relatively depleted in oxygen (sometimes below the established EPA minimum of 5 mg/liter). This condition can develop and persist until summer storms generate sufficient waves which again mix the water column. Dissolved-oxygen levels below 0.1 mg/liter have been recorded in bottom waters off Galveston (EHA, 1979). Similarly, levels as low as 1.3 mg/liter have been measured near Sabine Pass during a period of summer stratification (TDWR, 1980).

At the Existing Sites, dissolved-oxygen levels throughout the water column, measured after intense storm activity in September 1979, were all near or above saturation (see Appendix A). Similar dissolved-oxygen levels were observed from September to December 1977 (DOE, 1978).

NUTRIENTS

Nutrients concentrations in nearshore waters are relatively high but decrease with increasing distance from shore. The distribution indicates that estuaries supply nutrients to the nearshore gulf which, in turn, supplies nutrients to offshore waters (Brogden and James, 1979).

Nutrient (e.g., orthophosphate, nitrate, ammonia) concentrations in nearshore waters of Texas are highly variable and influenced by general circulation patterns, river runoff, and utilization by plants (including phytoplankton). A recent survey at the Existing Sites revealed nitrate levels ranging from 0.02 to 0.18 mg-N/liter, similar to levels measured in coastal waters off Galveston Island (Horne and Swirsky, 1979). Highest nitrate levels at Sabine occurred nearshore (Site 4) and decreased with increasing distance from shore (Horne and Swirsky, 1979). Ammonia (during the same survey) showed variable levels ranging from less than 0.1 to 0.3 mg-N/liter. Under the conditions present at the Existing Sites (pH 8, water temperature 15°C to 25°C), approximately 2.7% to 5.4% of the total ammonia (or about 0.003 to 0.016 mg-N/liter) would be present as un-ionized ammonia. Phosphate concentrations have not been measured at the sites, but levels are expected to be low (less than 0.4 mg-P/liter), and similar to those occurring in waters off Galveston Island.

TRACE METALS AND HYDROCARBONS

River-borne suspended particulates dominate the flux of metals into nearshore waters and marine systems (Stoker and Seager, 1976). The equilibrium between dissolved and particulate phases is heavily dependent upon salinity, particulate organic carbon (POC), dissolved organic carbon (DOC), total suspended sediments, and dissolved silicon. The constant fluctuation of these parameters and coastal runoff results in highly variable metal concentrations in the water column at the Existing Sites (Horne et al., 1978a,b).

Water-column trace-metal concentrations at the Existing Sites were variable, displaying no seasonal or spatial trends (see Appendix A). Concentrations of mercury, cadmium, and lead were low throughout the sampling area and were within the range reported for the general gulf coastal region near Sabine (DOE, 1978). All levels were well below EPA water quality criteria for marine waters (EPA, 1976).

Pesticide concentrations were all below detection limits, except for measurements of 0.01 ng/g of polychlorinated biphenyls (PCB's) at Stations 6 and 10 (see Appendix A for station locations).

PETROLEUM HYDROCARBONS

Petroleum production and the petrochemical industry is the backbone of the Sabine, Port Arthur, and Orange, Texas, economies (CE, 1975a). Sources of petroleum hydrocarbons (PHC's) to the marine environment are numerous, including river runoff, offshore oil and gas production, transportation, and brine disposal (DOE, 1978). Biogenic hydrocarbons (BHC's) are derived from marine (plankton, infauna) and terrestrial (marsh plant) sources. Studies of dissolved hydrocarbons in the waters off Texas Point indicate levels similar to those found in other areas of the Gulf of Mexico. Concentrations of total dissolved hydrocarbons range from 0.2 to 3 mg/liter (DOE, 1978). Existing levels of PHC's and BHC's present in coastal waters suggest that both are relatively insoluble in water and are probably being removed from solution by particulate matter, and eventually deposited on the sea floor.

SEDIMENT CHEMISTRY

A variety of trace contaminants (e.g., trace metals, petroleum, and chlorinated hydrocarbons, and other organic materials commonly expressed as total organic carbon [TOC]), can accumulate in sediments. Elevated levels of marine sediment contaminants are generally the result of anthropogenic inputs (e.g., municipal and industrial wastes, urban and agricultural runoff, atmospheric fallout from urban centers, and accidental spillage).

Silty and clayey sediments have a greater absorptive capacity for trace contaminants and typically have higher TOC levels than coarser material because of their large surface-area-to-volume ratio and charge density. Accumulation of trace elements, CHC's, and PHC's in sediments can have short- or long-term adverse effects on marine organisms. Many benthic organisms are nonselective deposit feeders which ingest substantial quantities of suspended and bottom sediments. The potential for bioaccumulation of trace contaminants (e.g., mercury, cadmium, and lead) and some chlorinated hydrocarbons by these organisms is of particular environmental concern.

High concentrations of organic materials in sediments can lead to anoxic conditions resulting in the production of hydrogen sulfide and reduction metal sulfides. Oxidation of these sulfides is responsible for much of the initial consumption of oxygen immediately following dredged material disposal. Significantly lowered oxygen levels in sediments or near-bottom waters can adversely affect marine organisms.

Trace amounts of pollutants from urban, industrial, and agricultural activities enter the Sabine-Neches Waterway and are adsorbed onto suspended material (silt, clay, particulate organic carbon). Some of these sediments are transported out of the waterway during storms, periods of heavy rainfall, or ebb tides, and are distributed in coastal areas adjacent to the mouth of the channel, including the Existing Sites.

Concentrations of trace elements (mercury, lead, cadmium, and arsenic), hydrocarbons, and pesticides at the Existing Sites are similar to levels measured for the entire region (see Appendix A; DOE, 1978; Horne and Swirsky, 1979; CE, 1975a). This suggests that previous disposal activity has not noticeably altered the background levels of anthropogenic pollutants.

Of the trace contaminants measured at the sites, oil and grease and TOC showed a consistent decrease in concentrations with increasing distance offshore (see Appendix A). High inshore concentrations of oil and grease and TOC appear to be a result of runoff from Sabine Lake, because inshore levels are similar to levels found within the lake. Oil and grease materials have been shown to be 75% weathered petroleum (DOE, 1978), hence there is little doubt that most of the oil and grease materials are derived from onshore industrial waste discharges.

BIOLOGICAL CONDITIONS

Biota in the water and benthic environments of the ODMDS are described in this section. Water column biota include phytoplankton, zooplankton, and nekton; benthic biota are composed of infaunal and epifaunal organisms. Benthic biota, especially the infauna, are generally sedentary and cannot readily emigrate from an area of disturbance. The infauna, therefore, can be important indicators of environmental conditions. Dredged material disposal will have only short-term effects on planktonic communities because of their natural patchiness and the transient nature of the water masses they inhabit. Nekton generally are not adversely affected by dredged material disposal because of their high mobility.

PHYTOPLANKTON

Sampling 90 nmi southwest of Texas Point and near Freeport, Texas, indicated the diatoms *Nitschia*, *Thalassiothrix*, *Thalassionema*, *Skeletonema*, *Chaetoceros* and *Asterionella* to be dominant genera in the gulf (SEADOCK, 1976). Simmons and Thomas (1962) in a study along the Louisiana coast, from Main Pass to Blind Bay, and near Breton Island, observed similar genera of diatoms. Baalen (1976) reported a change from diatom-dominated flora in nearshore waters of the Continental Shelf to coccolithophorid-dominated flora in deeper waters of the Shelf.

In the Shelf between Galveston Bay and Texas Point, Drummond and Stein (1955) reported that particulate organic matter (primarily phytoplankton cells) was highest in nearshore locations and in areas of low salinity. The increased phytoplankton biomass in these areas was attributed to nutrients supplied from freshwater inputs.

ZOOPLANKTON

Among the permanent members of the zooplankton (holoplankton), copepods, chaetognaths, cladocerans, and urochordates are most common. Mollusc larvae (primarily snails and clams), crustacean larvae (mainly crabs and shrimp), and polychaete larvae are the major components of the temporary zooplankton (meroplankton). Secondary sources of meroplankton are fish eggs and larvae.

Harper (1977) reported that holoplankton included copepods, which comprised 82% to 90%, and chaetognaths, which comprised 3% to 5%, of the total holoplankton population. Meroplankton accounted for 3% to 5% of the total zooplankton population.

NEKTON

Chittenden and McEachran (1976) described Continental Shelf nekton communities as those inhabiting the white shrimp grounds (3.5m to 22m deep), and those within the brown shrimp grounds (22m to 200m deep). Animals in the white shrimp grounds are generally lower in relative biomass, species diversity, and abundance than populations occurring in the brown shrimp grounds further from shore. Differences are related to the more stable environment (less variability in temperature and salinity) and greater topographic relief in the deeper waters of the brown shrimp grounds (Chittenden and McEachran, 1976).

The most abundant species of demersal fish present in the white shrimp grounds are members of the drum family (Scienidae; Chittenden and McEachran, 1976; Moore, 1964). Sampling of shrimp trawls show the fish catch (by percent) is composed primarily of Atlantic croaker (Micropogon undulatus, 30%), Atlantic cutlassfish (Trichiurus lepturus, 14%), silver seatrout (Cynoscian nothus, 13%), star drum (Stellifer lancelotus, 10%) spotted seatrout (*Cynoscion arenarius*, 8%), Atlantic threadfin (*Polydactylus octonemus*, 5%), and sea catfish (*Arius felis*, 5%; Chittenden and McEachran, 1976).

Interstate Electronics Corporation (IEC) collected trawl samples at the Site Number 3 and at a control station in September 1979 and January 1980. Twenty-five species of finfish were identified (see Appendix A). The numerically abundant fishes caught in September were striped anchovy, Altantic croaker, sea catfish and red drum. During the January survey, Gulf butterfish, banded drum, fringed flounder, silver seatrout, and sand seatrout were most abundant. Survey results generally agreed with Chittenden and McEachran (1976).

In addition to the fish species present, one species of squid (*Lolliguncula brevis*) was common (see Appendix A).

MARINE MAMMALS

Most marine mammals in the Gulf of Mexico usually occur in offshore, central waters of the Gulf away from the Existing Sites (Table 3-2). However, some species occur in nearshore areas off Texas Point, occasionally passing through the Existing Sites. These include the spotted long-nose dolphin (*Stenella plagiodon*) and the Atlantic bottlenose dolphin (*Tursiops truncatus*). Marine mammals occurring in the Gulf of Mexico are listed in Table 3-2.

TABLE 3-2
SPECIES OF MARINE MAMMALS KNOWN TO OCCUR IN THE GULF OF MEXICO

Common Name	Scientific Name
Whales	
Antillean-beaked	Mesoplodon europaeus
Black right	Balaena glacialis*
Blue	Balaenoptera musculus*
Bryde's	B. brydei
Dwarf sperm	Kogia simus
False killer	Pseudorca cassidens
Fin	Balaenoptera physalus*
Goose-beaked	Ziphius cavirostris
Humpback	Megaptera novaeangliae
Killer	Orcinus orca
Minke	Balaenoptera acutorostrata
Pygmy killer	Feresa antenuata
Pygmy sperm	Kogia breviceps
Sei	Balaenoptera borealis*
Short-finned pilot	Globicephala macrorhynchus
Sperm	Physeter catodon*
Dolphins	
Atlantic bottle-nosed	Tursiops truncatus
Bridled	Stenella frontalis
Gray's	S. coeruleoalba
Risso's	Grampus griseus
Rough-toothed	Steno bredanensis
Saddleback	Delphinus delphis
Spinner	Stenella longirostris
Spotted	S. plagiodon
Pinnipeds	
California sea lion	Zalophus californianus
Manatee	
West Indian	Trichechus manatus*

* Endangered species (Federal Register, 1975)

Source: DOI 1977

BENTHOS

Keith and Hulings (1965) sampled macrofauna between Sabine Pass and Bolivar Pass, and concluded that the infaunal assemblages were typical of sand, mud, and mixed substrates. In similar benthic studies off Galveston, Texas, Henry (1976) collected 170 species in monthly samples of macrofauna; polychaetes were the dominant taxa, but the most abundant species were the hemichordate Balanoglossus sp., the nemertean Cerebratulus lacteus, and the gastropod Nassarius acutus.

Benthic organisms in the Sabine Entrance Channel sampled by EPA/IEC in September 1979 and January 1980 were similar to those colleced by Keith and Hulings (1965), with macrofaunal species being characteristic of mud and sand habitats. Dominant species at each of the 12 stations are listed in Appendix A. Five species displayed greater abundances in September 1979 than in January 1980.

Epifauna of the Shallow-Water Area (depths of 3m to 22m) off Texas Point are dominated by white shrimp; however, brown shrimp, blue crab, mantis shrimp, seabob shrimp, and broken-neck shrimp are often abundant (Brogden and James, 1979). Brown and white shrimp and blue crab are important commercial species along the Texas-Louisiana coast.

Brown and white shrimp occur in the vicinity of the Existing Sites, and the area is among the prime shrimping grounds for white shrimp. Shrimp use estuaries and adjacent nearshore waters as a spawning and nursery area. A shrimp life cycle is schematically illustrated in Figure 3-4.

Populations of brown and white shrimp in the Gulf are highly variable depending on the season and life stages present (Figure 3-4; Ringo, 1965). Spawning grounds for the brown shrimp are generally at a depth of about 27m from March through April and November through December. However, spawning brown shrimp are caught year-round at depths of 45m to 110m with peak occurrence in autumn. White shrimp spawn from spring to early autumn, in depths of 28m to 37m; within a few weeks spawning shrimp move into waters about 14m deep.

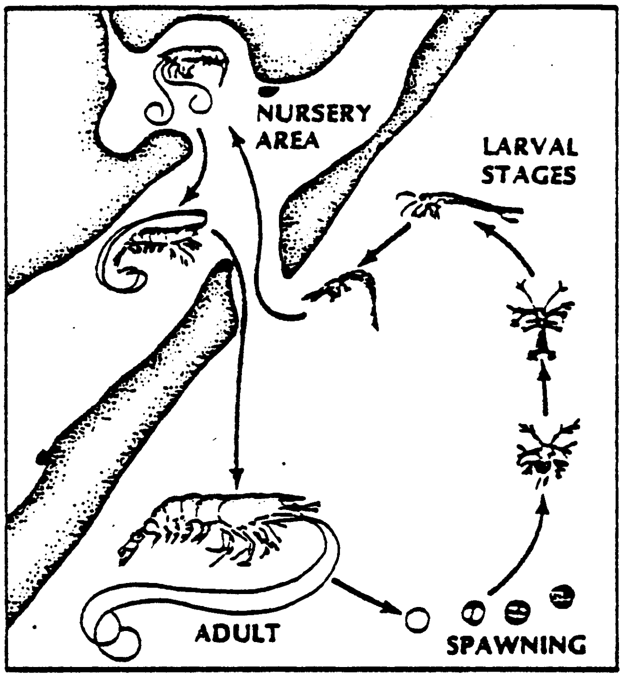

Figure 3-4 . Annual Life Cycle of Commercial Shrimp off Texas

Blue crabs are common in bays, estuaries, freshwater, and in the Gulf of Mexico. Males tend to stay in lower salinity waters, whereas females generally migrate to higher salinity areas of bays or out to sea. Fertilized females move to the open gulf from March through August. During winter, crabs of both sexes seek higher salinity water, and may winter in burrows (Lindall, et al., 1972).

THREATENED AND ENDANGERED SPECIES

Threatened and endangered species occurring in the Gulf of Mexico are presented in Table 3-3.

Probably less than 50 endangered brown pelicans occur along the Texas coast (Smith, 1975), hence a few might reside near the Existing Sites (EHA, 1979).

Little information is available on the frequency of occurrence of sea turtles and manatees along the Texas-Louisiana coast, but in the Sabine area they are considered rare (EHA, 1979).

TABLE 3-3
THREATENED AND ENDANGERED SPECIES
OF THE TEXAS-LOUISIANA COAST

Common Name	Scientific Name
Brown pelican	*Pelecanus occidentalis*
Leatherback sea turtle	*Dermochelys coriacea*
Atlantic sea turtle	*Lepidochelys kempi*
Green sea turtle	*Chelonia mydas*
Loggerhead sea turtle	*Caretta caretta*
Sperm whale	*Physeter catodon*
Fin whale	*Balaenoptera physalus*
Blue whale	*Balaenoptera musculus*
Black right whale	*Balaena glacialis*
Carribean manatee	*Trichechus manatus*

There are only a few records of sperm whale, fin whale, blue whale, and black right whale (all endangered species) occurring along the Texas-Louisana coast, and sitings of these animals are quite rare (EHA, 1979).

DREDGED MATERIAL DISPOSAL AT THE EXISTING AND OTHER SITES

RECENT DREDGED MATERIAL DISPOSAL ACTIVITIES

Dredging in the Sabine-Neches Waterway was authorized by the River and Harbor Act of 25 July 1912, and modified by subsequent acts, the latest of which occurred 23 October 1962 (CE, 1975a). Existing Site 4 has been in use since 1931 for disposal of material dredged from Sabine Entrance Channel. Prior to the 1960's, dredging did not occur in the Entrance Channel, seaward from Existing Site 1. When the Entrance Channel is dredged, sediments are dumped in one of the four Existing Sites closest to the area of dredging. Appendix E (Public Notice No. SN-M-1) describes the dredging project and the present dimensions of the dredging activity in the Sabine-Neches Waterway. Dredging volumes are presented in Table 3-4.

TABLE 3-4
DREDGED ANNUAL AMOUNTS OF MATERIAL DISPOSED OF IN
OCEAN SITES FROM SABINE-NECHES WATERWAY, TEXAS

Fiscal Year	Volume (yd^3)
1960	3,438,000
1961	3,095,000
1962	3,882,000
1963	4,252,000
1964	1,566,000
1965	2,117,000
1966	1,988,000
1967	1,076,000
1968	4,026,000
1969	7,630,000
1970	10,394,000
1971	8,907,000
1972	7,604,000
1973	3,479,000
1974	7,602,000
1975	7,188,000
1976	4,677,000
1977	- - - -
1978	2,914,000
1979	3,377,000
Average	4,460,600

Source: Medina, personal communication*

**Dredging was not performed in 1977

Aside from the four Existing Sites, the only other site that has received material dredged from the Sabine-Neches Waterway is across the Entrance Channel from Existing Site 4. This area received dredged material from side-cast dredging operation in 1964.

DREDGED MATERIAL CHARACTERISTICS

PHYSICAL CHARACTERISTICS

Sediments dredged from the Sabine Entrance Channel are primarily silts and clays. The CE conducted grain-size analyses of dredged materials over a

* R. Medina, Operations and Maintenance Branch, CE, Galveston District. 1980.

5-year period, from 1973 to 1978 (CE, 1978a). These data indicate that from the shoreline to a distance about 10 nmi offshore, clay is the predominant component of channel sediments, ranging from 63% to 70%. Further offshore, silt becomes the major size fraction, ranging between 43% and 59% (Table 3-5).

CHEMICAL CHARACTERISTICS

Concentrations of chemical constituents in sediments dredged from Stations S-1, S-2, S-3, and S-4, located within the Entrance Channel adjacent to Sites 1 through 4, respectively, are listed in Table 3-6. Arsenic, chromium, copper, lead, mercury, zinc, ammonia (as nitrogen), nitrate (as nitrogen), total organic nitrogen, oil and grease, lindane, heptachlor, and chlordane concentrations all decreased with increasing distance from shore. Remaining constituents showed no obvious spatial distribution pattern (Horne and Swirsky, 1979).

PRESENT AND FUTURE STUDIES

No surveys are presently being conducted at the Existing Sites. Future surveys may be necessary to provide data to make a disposal-impact evaluation (see Chapter 2). The CE conducts studies at the Existing Sites for "a continuing evaluation of the potential environmental effects of proposed ocean disposal of dredged materials..." (Horne and Swirsky, 1979). Studies have

TABLE 3-5
PHYSICAL CHARACTERISTICS OF DREDGED MATERIAL
IN SABINE ENTRANCE CHANNEL

Distance from Texas Point (nmi)	% Sand	% Silt	% Clay
2	4	26	70
4	3	30	67
9.5	4	33	63
11	12	43	45
13	7	59	34
14	11	56	33

Source: Horne and Swirsky, 1979

TABLE 3-6
MEAN CONCENTRATIONS OF CONSTITUENTS MEASURED IN SEDIMENT SAMPLES COLLECTED IN SABINE-NECHES WATERWAY

Parameter* (Unit)	S-1	S-2	S-3	S-4
Solids (%)	58.09	54.38	61.71	52.78
Arsenic	15.67	15	15	15
Cadmium	<1	<1	<1	<1
Chromium	9	10	8	8
Copper	7.7	14	11	11
Lead	15	17	16	25
Mercury	0.24	0.25	0.23	0.27
Nickel	25	20	17	26
Zinc	42	52	46	50
Ammonia-N	29	32	26	43
Nitrate-N	2	3	3	<3
Nitrate-N	<1	<1	<1	<1
Total Kjeldahl-N	433	690	360	673
Oil and Grease	355	337	136	98
Arochlor-1242	<0.01	<0.01	<0.01	<0.01
Arochlor-1254	<0.01	<0.01	<0.01	<0.01
Lindane	<0.001	<0.001	<0.001	<0.001
Heptachlor	<0.001	<0.001	<0.001	<0.002
p,p'-DDD	<0.001	<0.001	<0.001	<0.001
p,p'-DDE	<0.001	<0.001	<0.001	<0.001
p,p'-DDT	<0.001	<0.001	<0.001	<0.001
Chlordane	<0.001	<0.001	<0.001	<0.001
Dieldrin	<0.001	<0.001	<0.001	<0.001
Endrin	<0.001	<0.001	<0.001	<0.001
Toxaphene	<0.01	<0.01	<0.01	<0.01
Mirex	<0.01	<0.01	<0.01	<0.01
Methoxychlor	<0.01	<0.01	<0.01	<0.01

* Concentrations in mg/kg unless otherwise specified.

Source: Horne and Swirsky, 1979

included bioassay and bioaccumulation tests, sediment chemical analyses, and seawater and elutriate tests (Horne et al., 1978a,b; Horne and Swirsky 1979).

PRESENT AND POTENTIAL ACTIVITIES IN THE VICINITY OF THE SITES

FISHERIES

The Gulf of Mexico supports extensive commercial and recreational fisheries. In 1979, commercial fishery landings in the Gulf of Mexico were 2 billion pounds, with a cash value of about $530 million. The principal species caught in the Gulf are shrimp and menhaden. In 1979, Cameron, Louisiana, located 27 nmi east of Sabine, Texas, was the leading port in the United States for quantity of commercial fish landings, with a total catch in excess of 593 million pounds, worth over $34 million. Total Louisiana fishery landings for the same period were 1.5 billion pounds, worth about $200 million (DOC, 1980). Commercial and recreational species caught in the Gulf are listed in Table 3-7.

The shrimp fishery is the most valuable commercial fishery off of the Texas-Louisiana coasts. In 1979, the commercial shrimp fishery in the Gulf of Mexico landed 206 million pounds of shrimp, worth $378 million (DOC, 1980). Brown shrimp are caught in nursery areas and in the nearshore region (24m to 56m) as they migrate to their centers of abundance seaward of the Existing Sites. White shrimp are harvested from the estuaries and the nearshore gulf (3m to 22m). The annual cash value associated with shrimp, crab, and oyster catches is four times that of finfish, with shrimp catches comprising the greatest dollar amount.

Menhaden contributes the greatest volume of commercial finfish landings in the Gulf. During 1979, 1.7 billion pounds (worth a cash value of $377 million) were landed. Menhaden are processed to obtain oil and fishmeal. Purse-seining within 3 nmi of the coast accounts for most of the harvest (DOC, 1980). Most of the menhaden are caught east of the Existing Sites, but up to 25% of the catch landed at Cameron, Louisiana, is taken from coastal waters

TABLE 3-7
DISTRIBUTION OF COMMON COMMERCIAL AND RECREATIONAL FISH SPECIES ALONG THE TEXAS COAST WITH SEASONAL OCCURRENCES AND ABUNDANCES

Species Common Name	Habitat-Remarks	Winter	Spring	Summer	Autumn
Pomatomus saltatrix Bluefish	Offshore; in schools	O	X	X	O
Sarda sarda Atlantic bonito	Offshore; blue water	O	O	O	O
Bagre marinus Gafftopsail catfish	Bays, passes, and along beaches, active in currents, all Texas Gulf coast	X	X	X	X
Rachycentron canadum Cobia	Around floating objects, harbors, and docks	O	O	X	O
Coryphaena hippurus Dolphin	Open water near floating seaweed and driftwood, warm seas	O	O	O	O
Pogonias cromis Black drum	Shallow bays, all Texas coast	X	O	X	O
Sciaenops ocellata Red drum	Bays, passes, channels	X	X	X	X
Paralichthys lethostigma Southern flounder	Sandy, silty bottoms along shores of bays	X	X	X	X
Epinephelus nigritus Warsaw grouper	Large specimens on snapper banks, small ones in bays near channels	O	O	O	O
Caranx hippos Crevalle jack	Offshore, young in bays, around bridges, pilings	O	O	X	O
Epinephelus itajara Spotted jewfish	Jetties, pilings, old wrecks, inshore coral reefs, entrances to creeks and sloughs	O	O	X	X

O = Present
X = Abundant

TABLE 3-7 (continued)

Species Common Name	Habitat-Remarks	Winter	Spring	Summer	Autumn
Menticirrus littoralis Gulf kingfish	Gulf; feed in sandy bottom bays	X	X	X	X
M. americanus Southern kingfish	Gulf; feed in sandy bottom bays	X	X	X	X
Scomberomorus cavalla King mackerel	Reefs, deep clear water	O	O	X	O
S. maculatus Spanish mackerel	Mouths of harbors and passes, young in surf	O	O	X	O
Brevoortia patronus Gulf menhaden	Gulf, bays, open water	O	O	X	X
B. gunteri Finescale menhaden	Gulf, bays, open water	O	O	X	X
Mugil cephalus Striped mullet	Harbors, beaches, mouths of rivers and bays; school	X	X	X	X
Trachinotus carolinus Florida pompano	Passes, surf	O	O	X	X
Istiophorus platypterus Sailfish	Far offshore, deep water	O	O	X	O
Cynoscion nebulosus Spotted seatrout	Bays, Gulf beaches, grassy areas	X	X	X	X
Archosargus probatocephalus Sheepshead	Pilings, jetties, oyster reefs	X	X	X	X
Lutjannus campechanus Red snapper	Generally on offshore reefs	X	X	X	X

O = Present
X = Abundant

TABLE 3-7 (continued)

Species Common Name	Habitat-Remarks	Winter	Spring	Summer	Autumn
Centropomus undecimalis Snook	Mouths of rivers and streams, frequent passes, inlets, cuts; spawn during summer	O	O	X	O
Thunnus atlanticus Blackfin tuna	Offshore waters; feed on menhaden; school in offshore waters	O	O	O	O
T. thynnus Yellowfin tuna	Offshore waters; feed on menhaden; school in offshore waters	O	O	O	O
Acanthocybium solanderi Wahoo	Open ocean, deep reefs (Freeport-Port Isabel)	O	O	O	O
Leiostomus xanthurus Spot	Bays, nearshore	O	O	O	O
Micropogon undulatus Atlantic croaker	Bayous, channels, offshore	O	X	X	X
Cynoscion arenarius Sand seatrout	Bays, channels, offshore	X	X	X	X
Cynoscion nothus Silver seatrout	Bays, channels, offshore	O	O	O	O
Chaetodipterus faber Atlantic spadefish	Bays, channels, offshore	O	O	O	O
Ancylopsetta quadrocellata Ocellated flounder	Bays, nearshore Shelf	O	O	O	O

O = Present
X = Abundant

Source: CE, 1975b

between Galveston and Sabine, Texas (Swindell, personal communication*). The Existing Sites are all seaward of the prime menhaden fishing grounds, which are within 3 nmi of shore.

GENERAL MARINE RECREATION

Waters off Sabine are used for various recreational activities including fishing, boating, swimming and other marine-related activities.

SHIPPING

According to testimony given in U.S. Congressional Hearings and reported by the CE (1975a), the Sabine-Neches port system "is among the top 10 ranked of all America's vital arteries of ocean commerce on which the economic security of the nation is increasingly dependent." Major import and export commodities include petroleum products (gasoline, oils, and jet fuels), chemicals necessary for petroleum production, corn, wheat, marine shells, and iron products. Five refineries on the Sabine-Neches Waterway process about 12% of U.S. petroleum annually, and these refineries rely on large, deep-draft tankers. In 1978, foreign and domestic ships using the Sabine-Neches Waterway carried an excess of 50 million short tons of commodities (DOC, 1978d).

OTHER OCEAN DISPOSAL SITES IN THE VICINITY OF THE EXISTING SITES

The Existing Sites are the only currently used ocean disposal sites in the Sabine area, although there are other existing dredged material disposal sites along the Texas-Louisiana coast. A discontinued disposal site for industrial wastes lies 110 nmi south of Galveston centered at 27°30'N, 94°30'W. In addition, a discontinued dredged material disposal site exists on the other side, of the Entrance Channel from Existing Site 4, which was used for a experimental side cast dumping operation in 1964.

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* E.W. Swindell, Jr., Wallace Menhaden Products, Inc., New Orleans, LA (voting member of Gulf of Mexico Fishery Management Council). 1980.

OIL AND GAS EXPLORATION AND DEVELOPMENT

Oil and gas production in the Gulf of Mexico is a major source of income and employment to the states bordering the gulf. Between 1954 and 1978, oil and gas production in the coastal waters off Texas and Louisiana had a total production value of over $39.8 billion (DOI, 1981).

All existing Gulf leases are part of the Bureau of Land Management (BLM) Outer Continental Shelf (OCS) Oil and Gas Lease Sale, and are in waters less than 200m deep. The greatest concentration of these leases occurs approximately 80 to 90 nmi from shore, in regions known as the High Island and Cameron areas; few active leases occur in waters less than 40m deep.

At present there are active oil and gas leases and production structures within Existing Site 3 (DOI, 1977; Tennessee Gas and Transmission Co., 1980; Turner, unpublished). However, these are few in number and the chance of any problems arising from interference between drilling and production operations and dredged material disposal operations is not significant.

Chapter 4

ENVIRONMENTAL CONSEQUENCES

Adverse impacts from dredged material disposal at the Existing Sites include decreased abundances of some benthic species, temporary formation of mounds, and short-term increase in turbidity levels.

This chapter examines available scientific and analytical data to determine the environmental consequences of disposal of dredged material at the Existing Sites evaluated in Chapter 2. Of primary concern in the study of disposal of dredged material in the ocean are the potential adverse impacts on man.

Environmental effects of dredged material disposal at the four Existing Sites discussed in this chapter.

- o Effects of environmental changes directly affecting public health (specifically, commercial or recreational fisheries) and safety (navigational hazards);
- o Effects of disposal operations on aesthetics;
- o Environmental consequences of dredged material disposal, including the assessment of the effects on biota, water chemistry, and sediments of the sites;
- o A description of unavoidable adverse environmental effects and mitigating measures;
- o Relationships between short-term use and long-term productivity; and
- o Irreversible or irretrievable commitments or resources which would occur if the proposed action is implemented.

EFFECTS ON PUBLIC HEALTH AND SAFETY

Ensuring the protection of public health and safety from potential adverse effects of dredged material disposal in the ocean is a primary concern. There exists a potential hazard to health and safety by the nature of the disposal operation, by the material to be dumped, or both. Hazards to navigational safety may arise from shoaling of the material or movement of disposal vessels to and from disposal sites. Health hazards may arise if there is toxic bioaccumulation of certain chemicals in organisms consumed by the public.

Potential effects on human health can be inferred from bioassay and bioaccumulation tests performed on marine organisms. Bioaccumuation tests show that aliphatic petroleum hydrocarbons are accumulated by polychaetes placed in dredged material from the Entrance Channel adjacent to Site 1 (Horne et al., 1978a,b). Thus, sediments from the disposal sites should be monitored to ensure that bioaccumulation does not result in any long-term adverse effects to the biota or the public (see Chapter 2, "Monitoring the Disposal Site" section).

Navigational hazards resulting from transit to and from disposal sites are expected to be minimal. Disposal operations take only a few minutes, and hopper-dredge operation is governed by USCG regulations.

Potential navigational problems may arise if more oil and gas structures are placed within Existing Site 3, because additional structures within the site may limit availability of navigable waters, and thereby create traffic problems between various oil platform service vessels and the hopper dredge. In the event of navigational problems, designation of an alternative site (possibly within the Shallow-Water Area) may be necessary.

EFFECTS ON AESTHETICS

Aesthetics of nearshore waters and beaches are unaffected by dredged material disposal because the nearest disposal activities will be more than

2.5 nmi from shore. Nearshore waters are naturally turbid, and the disposal of dredged material will not leave a permanently detectable surface plume.

EFFECTS ON THE ECOSYSTEM

Effects of dredged material disposal in the ocean on the ecoystem is of public concern. Some effects are large scale and immediate, however, others are subtle and often difficult to assess. For example, it is difficult to differentiate between the natural fluxes in diversity and composition of biological communities. Consequences of many effects may be difficult to interpret in light of incomplete knowledge of biological pathways, ecology of organisms, and community dynamics.

Effects of dredged material on the ecosystem depend upon several factors: sedimentary characteristics of the dredged material, degree of similarity between dredged sediments and those of the site, amount of material to be dumped, frequency of disposal, chemical characteristics of the dredged material, nutrients associated with dredged material, and turbidity associated with disposal operations. Physical and biological characteristics of the receiving environment are equally important. Effects of dredged material disposal may be lessened by locating disposal sites in a high-energy environment where mixing and dilution are maximized and sediments are occasionally disturbed (i.e., nearshore), or by siting them in an area where productivity and mixing are relatively low (i.e., deep ocean).

PHYSICAL CONDITIONS

The most significant potential physical effect of disposal at the Existing Sites would be shoaling resulting from the accumulation of sediments at the disposal sites. All Existing Sites are near shore, and although temporary mounds are formed, sediments are soon eroded by the intense physical conditions (e.g., currents, waves, and storms). There is no evidence of mounding despite 20 years of disposal, therefore shoaling will not be a long-term environmental problem.

CHEMICAL AND WATER-QUALITY CONDITIONS

Certain constituents present in trace amounts in dredged material will be released into the water upon disposal in the ocean. Elutriate tests indicate that the components that may be released from Sabine Entrance Channel dredged material are dissolved ammonia, nitrate, organic nitrogen, cadmium, and mercury. Constituents released with dredged materials may temporarily exceed existing water quality criteria (EPA, 1976) but levels would be quickly reduced to ambient levels by turbulent mixing and dispersion. The Ocean Dumping Regulations acknowledge the aforementioned dynamics of ocean disposal and allow water quality criteria to be exceeded during a 4-hour period of initial mixing (40 CFR 227.29). However, levels of all released components must meet the criteria after this period.

WATER COLUMN

Turbidity

Turbidity changes caused by disposal of dredged material may be both adverse and beneficial to the environment.

Adverse effects of turbidity might include temporary decreases in light penetration (possibly reducing photosynthesis), mechanical abrasion of the filter-feeding and respiratory structures of animals, and adsorption of essential nutrients from the water (Sterne and Stickle, 1978).

Beneficial effects of turbidity might include the release of nutrients and the adsorption and subsequent removal of undesirable chemical contaminants, (Sterne and Stickle, 1978).

Large quantities of suspended material may be released during dumping. Calculations (based on percent silt and clay and bulk density of the dredged material of Sabine Entrance Channel) indicate that approximately 40% of the material will be released as suspended particulate matter (SPM) (see Appendix C). A 1,100-m^3 hopper dredge will, therefore, release approximately 450 m^3 of SPM each time dredged material is dumped.

Because the density of the SPM is considerably greater than water, most of the material will fall directly to the bottom in the form of a jet of dense fluid (Bokuniewicz et al., 1978). Upon reaching the bottom, dredged materials, ambient water, and bottom sediments will spread out radially from the point of impact. Silt and clay lost from the jet will settle more slowly, as individual particles, creating a residual turbid plume. According to Stokes Law, 90% of these particles will settle slower than 0.07 cm/s, and 50% will settle slower than 0.005 cm/s (Sverdrup et al., 1942).

Concentrations of suspended particulate matter in the descent jet have been reported in excess of 100,000 mg/liter (CE, 1975a). Initial mixing calculations indicate that the minimum dilution factor of 1:5,000, which would be necessary to reduce SPM levels in surface waters to ambient levels, will not occur because most of the descent jet material will sink to the ocean floor; however, continuous mixing and dispersion should rapidly bring levels down to ambient concentrations of 1 to 10 mg/liter (see Appendix C).

Adverse effects of turbidity might include temporary decreases in light penetration (possibly reducing photosynthesis), mechanical abrasion of the filter-feeding and respiratory structures of animals, and adsorption of essential nutrients from the water (Sterne and Stickle, 1978).

Dissolved Oxygen

Disposal of dredged material at any Existing Site would cause temporary decreases in dissolved-oxygen concentrations near the affected area. The anticipated reduction of dissolved oxygen in the descent jet and bottom surge would be higher, but both are short-lived phenomena, and dilution in all cases will act to minimize any adverse impacts.

Nutrients

Releases of nutrients from dredged material can stimulate excessive growth of phytoplankton, but in greater concentrations can prove to be toxic (Pequegnat et al., 1978). The potential occurrence of either effect is dependent on the concentrations of constituents released and environmental factors (particularly, dissolved-oxygen levels and mixing and dilution rates).

Un-ionized ammonia is known to be toxic to aquatic organisms. In seawater, un-ionized ammonia may range from 5% to 8% of total ammonia, depending on water temperature. The highest concentration of ammonia found in an elutriate test of representative sediment samples was 3.6 mg/liter (Horne, 1979), which would only require approximately 40-fold dilution to achieve background concentrations. A minimum dilution factor of 1:5,000 for the Existing Sites (zone of initial mixing), would reduce ammonia levels immediately to background levels.

TRACE ELEMENTS AND CHLORINATED HYDROCARBONS

Elutriate tests on Sabine Entrance Channel sediments indicated that mercury and cadmium may be released in small quantities; however, the initial mixing-zone volumes for the sites are more than adequate to dilute the materials to ambient levels (Horne and Swirsky 1979).

Unlike trace metals and nutrients, chlorinated hydrocarbon pesticides and PCB's do not naturally occur in sediments, and presence of these substances are due entirely to anthropogenic (man's) activities (Brannon, 1978). Contaminants are usually tightly bound to sediments, and only limited quantities are released to interstitial waters (Burks and Engler, 1978).

Elutriate analyses and bioassays of dredged material from the Sabine Entrance Channel System confirmed that pesticides and PCB's would not adversely affect water quality at the Existing Sites (Horne and Swirsky, 1979).

SEDIMENTS

Contaminants in dredged material are not generally released into the water following disposal, but remain associated with the solid fraction of the sediments (Brannon, 1978). Therefore, disposal of dredged material is most likely to adversely affect the benthos (Brannon, 1978). Solid-phase bioassays on appropriate sensitive marine organisms demonstrated that the dredged material from Sabine Entrance Channel does not pose an unacceptable hazard to the marine environment (Horne and Swirsky, 1979; EHA, 1978). However, bioaccumulation studies did show a significant accumulation of aliphatic petroleum hydrocarbons in polychaetes placed in dredged sediments from the Entrance Channel adjacent to Site 1.

BIOLOGICAL CONDITIONS

BENTHOS

The most significant adverse impacts of dredged material disposal have been observed in the benthos (Wright, 1978). The benthos are affected by burial and smothering, which temporarily reduce abundances of benthic species. The intensity of this effect varies with type of dredged material, thickness of the overburden resulting from dumping, frequency of dumping, benthic organisms involved, and physical processes of the receiving environment.

Infaunal studies indicates that species composition is similar inside and outside of the sites. Fine sediments dumped on the sandy bottom at Sites 1 and 2 may be winnowed by turbulence and currents in the area, perhaps mitigating the effect of dumping silts and clays on the sandy substrate. In addition, any banks formed from dumping are almost totally obliterated during tropical storm or hurricane passages.

In general, it appears that disposal of dredged material at the Existing Sites has resulted in localized decreases in population densities of benthic infauna. This reduction in population density is probably a product of continual disruption of the environment by regular and repeated dumping in the area (CE, 1975a). Although abundances of some benthic populations are reduced at the sites, the effect is localized; control stations near the sites contained macrobenthic abundances similar to those of the surrounding area.

NEKTON

Nekton are generally not affected by dredged material disposal (Wright, 1978; Brannon, 1978). Effects are limited to a temporary avoidance of the plume which is present during dumping activities.

The CE (1975a) stated that for swimming organisms, "...there was no significant differences between populations in the disposal area and populations in nearby undisturbed Gulf bottom areas."

Henningsen (1977), in a study near Galveston, stated: "Dredging and dredged material disposal did not appear detrimental to nekton," inclusive of shrimp species; Henningsen's data indicated that abundances of nekton are only temporarily reduced after disposal operations, and abundances appeared to return to normal within 1 month of disposal. Temporary reductions in site abundances may be the result of two responses: (1) residual turbidity causing avoidance of the area by sensitive species, and (2) temporary reductions in food sources (e.g., burial of less motile benthic organisms). Conversely, some nekton may have been attracted to the turbid water caused by disposal, because food and protection from some predators may be available in the turbid plume (Henningsen, 1977).

THREATENED AND ENDANGERED SPECIES

Threatened and endangered species found in the vicinity of the alternative sites are listed in Table 3-3. All are free swimming, highly mobile, spending very little time within the sites, and can easily avoid active dumping. Therefore, it is unlikely that any threatened and endangered species would be affected adversely by the disposal of dredged material.

UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS AND MITIGATING MEASURES

Potential unavoidable adverse effects which may occur at the sites under consideration include:

- Generation of increased turbidity in areas of dumping, which will temporarily lower water quality;
- Temporary avoidance of dump sites by fish during and immediately following disposal operations; and
- Smothering of some benthic biota by burial under dredged material.

The above effects could occur at any oceanic site. Some of these effects are of short duration and limited impact, due to the rapid dilution of dredged material after release.

Dredged material disposal at the Existing Site has caused only localized and short-term impacts on the organisms of the site. It has been suggested by Hirsch et al. (1978) that impacts are reduced by the disposal of dredged sediments in an area (e.g., the Existing Site), with a high degree of natural environmental variability.

Therefore, mitigating measures to protect the environments of the alternative sites may not be necessary. However, a monitoring program of the designated site(s) and vicinity would ensure decisionmaking ability with respect to mitigating measures, if the need arose.

RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Disposal operations do not interfere with the long-term use of any resources at the Existing Sites. Commercial fishing and sportfishing at and near the sites are not significantly affected by present disposal operations; important species of finfish and shellfish are not endangered. The Existing Sites constitute only a small area of the much larger region of the gulf inhabited by commercially important species, and actual disposal operations occur only sporadically throughout the year. Disposal operations do not conflict with present oil and gas operations. Existing platforms within Site 3 for the past 5 years has not caused any significant interference between dumping and production activities and existing oil and gas structures.

The following table lists the OCS lease blocks that the disposal sites are located in and provides the status of those lease blocks:*

Site	Block	Lease	Lessee
#1	SA 014	G4378	Shell
	SA 015	G4746	Conoco
	WC 155	Unleased	
	WC 156	Unleased	
#2	SA 010	G3958	Shell
	SA 011	G4191	Daves
	SA 012	G4377	Shell
#3	SA 006	G4145	Superior
	SA 009	G4146	Superior

The principal adverse effect on biota is a temporary reduction in the abundance of benthic organisms after disposal. A study indicated that the organisms affected are capable of recolonization within a few months (CE, 1975a). The short-term loss is outweighed by the benefits to commerce and industry resulting from the dredging of the Sabine Entrance Channel and subsequent disposal of dredged material at a suitable site.

*Letter; U.S. Department of the Interior; September 30, 1982

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible or irretrievable resources committed to the disposal operation are:

- Loss of dredged material for possible use as land fill;
- Loss of energy as fuel required to power the hopper dredges;
- Loss of economic resources due to costs of disposal operations.

SUMMARY

Public health and safety are not likely to be significantly and adversely affected by the disposal of material dredged from the Sabine Entrance Channel. Disposal operations do not constitute any navigational hazards because mounds formed by accumulation of dumped material do not persist at the Existing Sites.

Aesthetics should not be adversely affected. The surface plume resulting from disposal is only temporary; the predominantly southwesterly bottom currents at the Existing Sites carry the dredged material away from nearby beaches.

Water quality should not be significantly affected by disposal of material dredged from the Sabine Entrance Channnel; dilution rates are sufficient to reduce all constituents to ambient levels. Bioassays of dredged material did not produce significant mortality among organisms. Bioaccumulation tests indicated that sediments in the Entrance Channel adjacent to Site 1 result in bioaccumulation of aliphatic petroleum hydrocarbons among polychaetes; therefore, monitoring of these sediments should be considered.

The biota, including threatened and endangered species, are not expected to suffer long-term effects from disposal at the Existing Sites. Fishery resources have not been shown to be adversely affected to date. Catch statistics indicate that the area around the sites contributes a significant amount to the fishery.

Chapter 5
COORDINATION

The Draft EIS was prepared by the Environmental Protection Agency's Ocean Dumping EIS Task Force. This document was based on a Preliminary EIS prepared by the Interstate Electronics Corporation.

PREPARERS OF THE DRAFT EIS

The Principal author of the Draft EIS was Christopher S. Zarba. Reviews and support were provided by the members of the Task Force:

William C. Shilling, Project Officer
Frank G. Csulak
Michael S. Moyer

PREPARES OF THE FINAL EIS

The Draft EIS was issued August 20, 1982. Eleven letters containing review comments on the DEIS were received. Christopher S. Zarba and William C. Shilling reviewed the comments and prepared responses. Revisions were made in the DEIS and this Final EIS was prepared by William C. Shilling. Additional reviews and support were provided by members of the Ocean Dumping EIS Task Force.

Frank G. Csulak
Michael S. Moyer
Edith R. Young

The comments received on the DEIS and EPA responses follow. The written comments are keyed to the responses by number; i.e., 1-1, 2-1, 3-1, 3-2, etc. The EPA sincerely thanks all those who commented on the DEIS.

COMMENTERS ON THE DRAFT EIS

The following persons submitted written comments on the Draft EIS issued August 20, 1982.

Frank S. Lisella, Ph.D.
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Center for Environmental Health
Center for Disease Control
Public Health Service
Department of Health & Human Services
Atlantic, GA 30333

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DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta GA 30333
(404) 262-6649

September 27, 1982

Mr. Christopher S. Zarba
Criteria and Standards Division (WH-585)
Environmental Protection Agency
Washington, D.C. 20460

Dear Mr. Zarba:

1-1 We have reviewed the Draft Environmental Impact Statement (EIS) for Sabine-Neches, Texas, Dredged Material Disposal Site Designation. We are responding on behalf of the U.S. Public Health Service.

We have reviewed this document for possible health effects and have no comments to offer since the proposed alternatives have been properly addressed.

Thank you for the opportunity to review this EIS. We would appreciate receiving a copy of the final document when it becomes available.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Center for Environmental Health

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Project Review
Post Office Box 2088
ALBUQUERQUE, NEW MEXICO 87103

SEP 30 1982

ER-82/1370

Mr. Christopher S. Zarba
Criteria and Standards Division (WH-585)
Environmental Protection Agency
401 M Street, S. W.
Washington, D. C. 20460

Dear Mr. Zarba:

2-1 We have reviewed the draft environmental impact statement for the Sabine Neches, Texas Dredged Material Disposal Site Designation and offer the following comments.

2-2 Page 1-2, Figure 1-1 - Dredged material disposal sites 1, 2, and 3 lie in part or entirely within active Outer Continental Shelf (OCS) oil and gas lease blocks. A map showing the relationship of these disposal sites to active OCS oil and gas leases and any oil and gas related platforms in the area should be included. The following table lists the OCS lease blocks that the disposal sites are located in and provides the status of those lease blocks:

Site	Block	Lease	Lessee
#1	SA 014	G4378	Shell
	SA 015	G4746	Conoco
	WC 155	Unleased	
	WC 156	Unleased	
#2	SA 010	G3958	Shell
	SA 011	G4191	Daves
	SA 012	G4377	Shell
#3	SA 006	G4145	Superior
	SA 009	G4146	Superior

2-3 Page 2-11, paragraph 3, - This discussion does not adequately address potential conflicts that may arise from the use of these sites for disposal of dredged material and oil and gas operations on active leases within the disposal areas.

The following items should be included in this section:

1. OCS oil and gas lease status on disposal site 1 as well as sites 2 and 3.

2. Restrictive conditions that may be attached to any U.S. Army Corps of Engineers Section 10 permit for oil and gas related structures located in or adjacent to disposal sites.

3. Protective conditions that may be attached to dredging contracts when dredged material will be disposed of in areas of active oil and gas operations.

4. Criteria for determining how many oil and gas platforms located in a disposal area would constitute a navigational hazard.

Our Minerals Management Service is responsible for managing OCS oil and gas leases and regulating OCS oil and gas operations. That office wishes to be kept advised of any monitoring activities or surveys conducted by the U.S. Environmental Protection Agency or the U.S. Army Corps of Engineers at the disposal sites. Please contact Manager, Minerals Management Service, Gulf of Mexico OCS Regional Office, P. O. Box 7944, Metairie, Louisiana 70010.

Thank you for this opportunity to provide comments on this draft statement.

Sincerely,

Raymond P. Churan
Regional Environmental Officer

DEPARTMENT OF THE ARMY
WATER RESOURCES SUPPORT CENTER, CORPS OF ENGINEERS
KINGMAN BUILDING
FORT BELVOIR, VIRGINIA 22060

REPLY TO
ATTENTION OF:

WRSC-D

1 OCT 1982

Mr. Christopher S. Zarba
Ocean Dumping EIS Task Force
Criteria and Standards Division (WH-585)
U. S. Environmental Protection Agency
401 M Street, S. W.
Washington, D. C. 20460

Dear Mr. Zarba:

3-1 Inclosed are the Corps general and specific comments on the Draft EIS for the Sabine-Neches, Texas, Ocean Dredged Material Disposal Site Designation, Incl 1. If you have any questions on the inclosed material, please contact Mr. David Mathis (325-0537) of my staff.

Sincerely,

W. R. MURDEN, P. E.
Chief, Dredging Division

1 Incl
As stated

COMMENTS TO

SABINE-NECHES OCEAN DREDGED MATERIAL DISPOSAL
SITE DESIGNATION PRELIMINARY DRAFT EIS
DATED JUN 1982

General Comments

3-2 Use of the term "Sabine Entrance Channel" - There is no reach of the project designated as such. Historically, material from The Sabine Bank Channel, Sabine Pass Outer Bar Channel, Sabine Pass Jetty Channel and Sabine Pass Channel of the Sabine-Neches Waterway has been deposited in the ODMDS's. There is no all inclusive term to describe these channels. For the purpose of this EIS, an acceptable term is the "Sabine-Neches Entrance Channels". However, the term must be defined in terms of the individual project channels. All other references to Entrance Channel, Sabine Entrance Channel and Sabine Entrance Channel System should be revised.

Specific Comments

P = page
Para = paragraph
S = sentence

Paragraphs are numbered from top of page, whether it is a complete paragraph or not.

3-3 1. P xi, para 2, S2 - The city of Beaumont should be included in this listing.

3-4 2. P xii, para 1, S2 - "Site" should be plural. Under option (3) delete "operation and maintenance".

3-5 3. P xii, para 4, S1 - Add "sites" after "existing".

3-6 4. P xii, para 5 - This paragraph repeats paragraph 4.

3-7 5. P xiii, Fig S-1 - This figure and similar ones throughout the text, indicate Sabine Bank Channel as the only channel. See General Comment.

3-8 6. P xiv, Fig S-2 - Beaumont is severely mislocated on this and subsequent maps.

3-9 7. P 1-1, Synopsis - Add Beaumont to list of ports.

3-10 8. P 1-1, para 1 - See General Comment. Revise S2 and add new sentence as follows: "... from the Sabine-Neches Entrance Channels. The Sabine-Neches Entrance Channels are comprised of the Sabine Bank Channel, Sabine Pass Outer Bar Channel, Sabine Pass Jetty Channel and Sabine Pass Channel of the Sabine-Neches Waterway project."

3-11 9. P 1-S, para 3 - Revise this paragraph as follows: "Annually, 4.5 million yd^3 of material ~~is~~ are dredged from the Sabine-Neches Entrance Channels and deposited in the ocean. The CE is responsible for planning and conducting the necessary dredging and disposal operations. For the CE's Galveston District to maintain the Sabine-Neches Entrance Channels to the authorized depths, this material must be removed on an annual basis."

3-12 10. P 1-10, para 3, S1 - MPRSA regulates dumping of material, barged or non-barged is not relevant.

3-13 11. P 2-2, para 3, S1 - This implies that disposal on land and disposal into leveed areas are different. In fact, any disposal on land requires levees, thus making them the same.

3-14 12. P 2-3, para 3, S2 - Reference to midwater and deepwater site appears inappropriate at this point. Delete sentence.

3-15 13. P 2-6, para 1, S1 - Substitute "existing" for "alternative". Last sentence on P 2-5 states criteria are applied to existing sites. In addition no other "alternative" sites are subsequently discussed.

3-16 14. P 2-7, para 1 - Since it is stated that the criteria are applied to the existing sites, the "EXISTING SITES" subheading under each criteria is unnecessary.

3-17 15. P 2-8, para 3, S1 - See General Comments. Project channels are misnamed.

3-18 16. P 2-18, para 1 - The rationale for the grain-size analyses is not clear. Further, it is unclear how such analyses will "ensure that the material is not being transported onto the Bank."

3-19 17. P 2-18, para 4 - Again, the rationale for grain-size analysis seems tenuous since it is based on only one sampling station at Site 1.

3-20 18. P 2-19, para 2 - The basis for this monitoring is questionable. S2 implies that species reduction could be attributable to something other than burial, presumably chemical. Reference should be made to bioassay studies by EHA, 1978; Horne and Swirsky, 1979; Horne, et. al., 1978a and 1979b, which showed benthic organisms unaffected by disposal operations. In addition, since the IEC study was performed during dredging operations, I suggest that it is the conclusions of the IEC study that are questionable, not the dredging operation.

3-21 19. P 3-23, para 1 - Delete this paragraph. This was an experimental operation involving a side cast dredge. The dredging occurred only once for a two-month period. To call the site a discontinued DMDS implies a more extensive usage than existed.

3-22 20. P 3-30, para 4, S3 - Delete this sentence. See Comment 19.

3-23 21. P 4-3, para 2 - Delete this paragraph, not appropriate to the Chapter.

3-24 22. Appendix C - The use of the initial mixing data in this manner is completely erroneous. Indicates a lack of knowledge concerning the initial mixing process and the meaning of the derivations. Delete this appendix.

3-25 23. P D-3, Table D-1 - For Site 4, correct "Travel Time" to "1.5", "Price" to "1,500", and "Production" to "1,200,000".

3-26 24. P D-2, para 1 and 2 - Revise time, dollars and production to reflect above changes in Table D-1.

3-27 25. P F-7, para 4, S1 - Change "Galveston Bay Channel System" to "Sabine-Neches Entrance Channels".

3-28 26. P F-8, para 3 - Listing the sites as 1, 2, 3 and 4 and then indicating their distance as 2.7 to 16 nmi from shore, implies that 1 is 2.7 nmi and 4 is 16 nmi. This is obviously not the case.

3-29 27. P F-25, Table F-2 - The data in this table conflicts with Table D-1.

Corps of Engineers Local Need

3-30 The Sabine-Neches Waterway System (SNWS) extends over 18 miles into the Gulf of Mexico from the ends of the jetties at Texas Point and Louisiana Point. The entire SNWS including 76 miles of inland waterways totals 94 miles. To maintain the authorized depths of the SNWS seaward of the jetties, the Galveston District removes on an annual basis approximately 5,000,000 cu yd of material. Historically, most of the dredged material from this portion of the SNWS has been disposed of at the ODMDS bordering the waterway. Presently, four sites are in use and have received interim designation status from EPA. The need to permanently designate the interim designated sites or similar areas for disposal of dredged material is considered an essential element in the District's Operation and Maintenance (O&M) Program for the SNWS. In the past the use of the four interim designated sites has provided for an effective utilization of dredging resources by minimizing dredging and disposal costs while reducing the annual dredging period (5 months) required to maintain the SNWS to its authorized depths. An indirect benefit from the use of multiple sites for dredged material disposal is to reduce the time when the hopper dredge is a potential navigational hazard for other users of the SNWS. In addition to the site being used in the O&M of the SNWS it is also expected that these ODMDS's will be used in the assessment of alternative disposal plans for new work Federal projects and Section 103 permit applications.

By locating and permanently designating specific ODMDS's it is anticipated the District's ability to identify and measure environmental as well as social and economic impacts expected to result from ocean disposal of dredged material will be enhanced. As a result, the project assessments and/or evaluations presented to the public and decision makers for review will be based on the best available scientific data which hopefully will result in improved decision making.

Incl 1

NATIONAL WILDLIFE FEDERATION

1412 Sixteenth Street, N.W. Washington, D.C. 20036 202—797-6800

October 4, 1982

Mr. Christopher S. Zarba
Criteria and Standards Division (WH-585)
Environmental Protection Agency
Washington, D.C. 20460

Re: Comments on Draft Environmental Impact Statement for the Sabine-Neches, Texas, Dredged Material Disposal Site Designation

Dear Mr. Zarba:

4-0 Following are the comments of the National Wildlife Federation on the referenced DEIS:

1. Inadequate consideration of non-ocean alternatives

4-1 We incorporate our comments on this issue by reference to earlier comments, especially those of 15 January 1980 on the Hawaii ODMDS, those of 8 January 1981 on the San Francisco Channel Bar ODMDS, and those of 5 April 1982 on the New York ODMDS.

2. Inadequate consideration of ocean disposal alternatives

4-2 a. Lack of Environmental Information on Alternative Sites

We are deeply concerned with EPA's statement that "designating a site other than the Existing Sites offers no clear economic advantage or environmental benefit." DEIS at 2-14. It is clearly apparent from reading the Sabine-Neches Site Evaluation Study that "there is no specific water quality or ecological data available" for the Mid-Shelf Area alternative, and "specific data are sparse for the Deepwater Area" alternative (DEIS at F-20). How does EPA compare environmental values to determine the benefits of individual disposal site alternatives on the basis of little or no data?

4-3 b. Failure to Compare Alternative Sites

Chapter 2 of the draft EIS does not even attempt to discuss ocean alternatives other than the Existing Sites in the context of the eleven specific criteria. The draft EIS (chapter 2) first gives a cursory review of the no action and upland disposal alternatives (although the latte. .s supposedly not even an "alternative"). DEIS at 2-1, 2-2. Then the draft EIS correctly cites the general criteria for dredged material disposal that EPA ". . . whenever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used." DEIS at 2-5, emphasis added. Notwithstanding this statement, the Deepwater Site alternative is not discussed in chapter 2; only the Existing Sites are evaluated for consistency with the more specific criteria. The draft EIS proceeds to conclude that there are no economic advantages or environmental benefits to alternative sites (i.e., the Mid-Shelf Area or the Deepwater Area), but the data that the decisionmaker has been given are obviously insufficient to reach this conclusion. DEIS at 2-14.

The Site Evaluation Study does compare alternative sites in the context of the specific criteria, but, as explained earlier, the absence of environmental data on the Mid-Shelf and Deepwater alternatives makes the comparison suspect.

c. Inadequate Economic Comparison

4-4 We are concerned that only economic criteria have been applied to justify the continued use of the Existing Sites. The draft EIS appears to rely heavily on the analysis compiled in the Site Evaluation Study, which states that: "the primary reason against recommendating [sic] designation of the Deepwater Site as a ODMDS is transportation costs." DEIS at F-25.

We agree that the costs of transportation to the Deepwater Site appear superficially to greatly exceed the costs of transportation to the Existing Sites. The Site Evaluation Study, however, relies upon 1979 estimates of New York area disposal costs and concedes unintelligibly that: "based on evaluation of specific cost estimates for the transportation portion of the dredging process are not available." DEIS at F-23. The draft EIS compares operating costs in a totally different format (making intelligent comparison with the earlier Study estimates virtually impossible), one which makes no attempt to estimate operating costs of using the Mid-Shelf Site Alternative. DEIS at D-3.

Furthermore, we suggest that operating costs may be affected by consideration of the fate of dredged material dispersal, as mentioned in our comment number 4 below.

3. Inadequate Consideration of Environmental Effects at the Existing Sites

4-5 We are concerned that the environmental effects of the disposal of dredged materials, both real and potential, have been brushed-off irresponsibly. We note that the Sabine-Neches Waterway is one of the "top-ten" marine transportation routes in the country. The

Waterway is used by ships that carry petroleum products and chemicals and the area is the center for fi... refineries that process approximately 12-percent of the n..ion's petroleum each year. Moreover, outer continental shel: ..il and gas exploration, development, and production is increasing in the region.

4-6 Consistent with this petroleum-related transportation and development, the draft EIS points out that bioaccumulation tests on polychaetes adjacent to Existing Site 1 show positive for aliphatic petroleum hydrocarbons. The draft EIS suggests that "concentrations of these hydrocarbons should be monitored periodically. DEIS at 2-19. We agree wholeheartedly with EPA's suggestion, but we question EPA's desire to continue monitoring these sites. "No surveys are presently being conducted at the Existing Sites." DEIS at 3-24. "It is not anticipated that the CE will conduct any further environmental studies with respect to the selection of these sites." DEIS at 1-6. And, according to the Site Evaluation Study: "numerous studies have been done on the [Existing] sites and a wide variety of data is available there by [sic] eliminating the need for expensive data collection and analysis." DEIS at F-24.

4-7 We note that the draft EIS states that "Existing Sites 1 and 2 border Sabine Bank, a productive fishery," and that "prevailing bottom currents may carry some dredged material toward the Bank." DEIS at 2-18. Although the draft EIS claims that "there are no data to suggest that the existing fishery has been affected adversely" (DEIS at 2-18), it is disturbing to know that bioaccumulation tests using sediments adjacent to Existing Site 1 on polychaetes, which are important organisms in the marine food chain, indicate a positive accumulation of hydrocarbons.

4-8 What is even more disturbing is the undocumented assertion that "test sediments from the Entrance Channel near Site 1 produced a significant accumulation of aliphatic petroleum hydrocarbons in polychaetes." DEIS at 2-19, emphasis added. There is no explanation as to what aliphatics were found, in what concentrations they were found, and how EPA knows that there were only aliphatic hydrocarbons and not the more toxic aromatic hydrocarbons. Moreover, Appendix A, "Survey Methods, Results, and Interpretations" sets out test results on "oil and grease," but there has been no attempt to relate these results to conclusions drawn in the main body of the draft EIS. What are the constituents of "oil and grease" and are they present in statistically significant amounts? Finally, how can EPA be certain that no significant undesirable effects will occur due either to chronic toxicity or to bioaccumulation from what it has determined to be "a significant accumulation of aliphatic petroleum hydrocarbons?" DEIS at 2-19.

4-9 We agree with EPA that the Mid-Shelf Site Alternative may not be the best alternative due to its proximity to the rare coral reefs of the East and West Flower Garden Banks. Since these banks are being withdrawn from the list of Active Candidates for consideration as a marine sanctuary, extra discretion is warranted. The draft EIS, however, does not indicate a precise spot for the Mid-Shelf (or Deepwater) alternative. This lack of precision gives the draft EIS the flavor of inadequacy--that alternatives have been suggested purely for the sake of meeting NEPA standards, but without the due consideration that alternatives warrant. We recommend that EPA reexamine the possibility of disp[...]ing dredged material with statistically significant concentrations of hydrocarbons at a Mid-Shelf Site and remove Existing Sites 1 and 2 from consideration for designation. The Mid-Shelf Site could be situated down-current from the Flower Garden Banks and in water deep enough to withstand the effects of major storms. Existing sites 3 and 4 can be designated for the disposal of relatively benign dredged material. This alternative should protect the productivity of both the Sabine Bank and the Flower Garden Banks, while minimizing transportation costs.

4. Inadequate Description of Dredged Material Dispersal

The draft EIS is incomplete in that it does not consider the ultimate fate of the dredged material. We have several questions concerning this issue.

4-10 What are the dynamics of dredged material transport compared to sediments derived from coastal or riverine erosion? We note that the draft EIS briefly mentions that "coastal runoff also might contribute suspended sediments . . . " DEIS at 3-3, emphasis added.

4-11 Where does the dredged material go after it has been dumped? We understand from the draft EIS that mounds form initially and then disperse due to ocean currents or storms. The draft EIS states that currents transport the dredged material "over a wide area" and that the currents "flow in a south-south westerly direction." DEIS at 2-9. Since there is no shoaling at "the Existing Sites despite the approximately 88 million yd^3 of material that has been dumped in the past 50 years," (DEIS at 2-9), does the material disperse into the safety fairway southwest of Sites 3 and 4? If so, do these fairways ever have to be dredged?

4-12 The draft EIS explains that "sediments dumped at Existing Sites 1 and 2 may be transported toward but not onto the [Sabine] Bank due to the existing topography." DEIS at 2-14. Are the sediments transported toward the Bank as a result of topography, or are they prevented from depositing onto the Bank as a result of topography, or both? If only the latter, how can sediments travel northwest from Existing Site 1 in south-south western currents?

4-13 The draft EIS states that hurricane currents are strong enough to prevent shoaling (DEIS at 2-9) and that tropical storm Delia reoriented an 18,000-pound steel anchor toward the east in 1973 (DEIS at B-2). Could this imply that storms like Delia can also dump dredged materials which lie on Existing Sites to the west of Sabine Channel back into the channel to the east?

4-14 Finally, how does the "zone of convergence" of cyclonic and anticyclonic currents described in the draft EIS (DEIS at 3-6) affect sediment transport around the Sabine-Neches sites as it migrates over the year?

4-15 These questions are directed toward the issue of redeposition in the dredged channel. What are the costs of redredging the same material for four months out of every year versus the benefits of dredging less often and disposing the material over the shelf break at the Deepwater Site?

5. Miscellaneous Comment

4-16 Since sediments dredged from the Sabine Channel are dumped outside the safety fairway at Existing Sites 2, 3, and 4, the site boundaries do not have to extend into the safety fairway.

We appreciate the opportunity to communicate these comments and concerns and trust that the Final EIS will adequately address the need for precision in describing viable alternatives such as a Mid-Shelf Site for dredged material with statistically significant concentrations of hydrocarbons.

If you have any questions, or desire clarification, regarding any of the points raised in this letter, please feel free to contact us.

Sincerely,

Porter Hoagland
Conservation Intern
Pollution and Toxic Substances Division

Kenneth S. Kamlet
Director
Pollution and Toxic Substances Division

cc: Col. Alan Laubscher
Galveston District, COE

OFFICE OF THE GOVERNOR

WILLIAM P. CLEMENTS, JR.
GOVERNOR

October 8, 1982

Mr. Christopher S. Zarba
Criteria and Standards Division (WH-585)
U.S. Environmental Protection Agency
Washington, D. C. 20460

Dear Mr. Zarba:

5-1 The Draft Environmental Impact Statement pertaining to the Sabine-Neches, Texas Dredged Material Disposal Site prepared by the U.S. Environmental Protection Agency, has been reviewed by the Budget and Planning Office and interested state agencies. Copies of the review comments are enclosed for your information and use. The State Environmental Impact Statement Identifier Number assigned to the project is 2-08-50-050.

The Budget and Planning Office appreciates the opportunity to review this project. If we can be of any further assistance during the environmental review process, please do not hesitate to call.

Sincerely,

William C. Hamilton

William C. Hamilton, Manager
General Government Section
Budget and Planning Office

msw

Enclosures: Comments by Texas Air Control Board
General Land Office
State Department of Highways
and Public Transportation
Texas Parks and Wildlife Department
Texas State Soil and Water Conservation Board
Texas Department of Water Resources

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TEXAS AIR CONTROL BOARD

6330 H... ..90 EAST
AUSTIN ...AS 78723
512 ...5711

September 29, 1982

Dr. Jarvis Miller, Director
Governor's Budget and Planning Office
Attention: General Government Section
P. O. Box 12428
Austin, Texas 78711

Subject: Dredged Material Disposal Site Designation
Sabine-Neches
EIS Number 2-08-50-050

Dear Dr. Miller:

6-1 We have reviewed the above cited document and found it to be consistent with the State Implementation Plan.

Thank you for providing us the opportunity to review the document. If we can assist further, please contact me.

Sincerely,

Roger R. Wallis, Deputy Director
Standards and Regulations Program

cc: Mr. Michael Peters, Regional Supervisor, Beaumont

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General Land Office
AUSTIN, TEXAS 78701
BOB ARMSTRONG, COMMISSIONER

1700 North Congress
Austin, Texas 78701

Telephone (512) 475-1166

October 5, 1982

Dr. Jarvis Miller, Director
Governor's Budget and Planning Office
Attention: General Government Section
P.O. Box 12428
Texas 78711

Re: Dredged Material Disposal Site Designation Sabine-Neches

Dear Dr. Miller:

7-1 The General Land Office appreciates the opportunity to comment on the referenced document. As noted in the report, the existing disposal sites 1 through 4 have been used for dredged material disposal for over 20 years with apparently localized, minor, and reversible impacts. However, the precise boundaries, or aereal extent, of the existing sites is not given in this report, although boundaries are mentioned on page F-17, Appendix A. Before final designation of these disposal sites, this information should be included.

Sincerely,

Mike Hightower

Mike Hightower, Program Manager
Land Resources Program

MH/SD/iw

COMMISSION

ROBERT H. DEDMAN, CHAIRMAN
A. SAM WALDROP
JOHN R. BUTLER, JR.

STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION
DEWITT C. GREER STATE HIGHWAY BLDG.
AUSTIN, TEXAS 78701

ENGINEER DIRECTOR
MARK G. GOODE

September 24, 1982

IN REPLY REFER TO
FILE NO
D8-E 854

Draft Environmental Impact Statement
Sabine-Neches, Texas

Dredged Material Disposal Site

Dr. Jarvis Miller, Director
Governor's Budget & Planning Office
Sam Houston Building
Austin, Texas

Dear Dr. Miller:

8-1 Thank you for the opportunity to review the draft environmental statement for Sabine-Neches Ocean Dredged Material Disposal Sites Designation.

The Department has no comment.

Sincerely yours,

M. G. Goode
Engineer-Director

By: Marcus L. Yancey Jr.
Marcus L. Yancey, Jr.
Deputy Engineer-Director

TEXAS
PARKS AND WILDLIFE DEPARTMENT

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Houston

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Budget/Planning

September 27, 1982

Dr. Jarvis Miller, Director
Governor's Budget and Planning Office
Attention: General Government Section
Post Office Box 12428
Austin, Texas 78711

Re: Dredged Material Disposal Site Designation Galveston and Sabine - Neches; EIS Nos. 2-07-50-106 and 2-08-50-050

Dear Dr. Miller:

9-1 This agency can foresee no apparent significant adverse impacts that should result upon fish and wildlife resources from designation of the dredge sites proposed in the above-referenced documents.

The opportunity to review these documents is appreciated.

Sincerely,

Charles D. Travis
Executive Director

CDT:RS:mg

Celebrating One Hundred and Fifty Years — 1836 - 1986

TEXAS STATE SOIL AND WATER CONSERVATION BOARD
1002 First National Building
P. O. Box 658
Temple, Texas 76503
Area Code 817, 773-2250

September 9, 1982

Dr. Jarvis Miller, Director
Governor's Budget and Planning Office
Attention: General Government Section
P.O. Box 12428
Austin, TX 78711

Dear Dr. Miller:

10-1 We have reviewed the draft environmental impact statement for the Sabine-Neches, Texas Dredged Material Disposal Site Designation, prepared by the U.S. Environmental Protection Agency. We offer no comment on the statement at this time.

Sincerely yours,

James M. Moore
Engineer

JMM/vd

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

September 1, 1982

RECEIVED
SEP 3 1982
Budget/Planning

Dr. Jarvis Miller, Director
Governor's Budget & Planning Office
Sam Houston Building, 7th Floor
Austin, Texas 78711

Dear Dr. Miller:

Re: Review of Environmental Protection Agency (EPA) Draft Report: ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR THE SABINE-NECHES, TEXAS DREDGED MATERIAL DISPOSAL SITES (FOUR) DESIGNATION. June 9, 1982. (State File Reference: EIS No. 2-08-50-050)

11-1 In response to your August 23 memorandum, the Texas Department of Water Resources (TDWR) offers the following staff review comments on EPA's subject report which analyses the potential environmental impacts of certain alternative plans being considered by EPA, pursuant to Section 228.12(a) of the Federal Ocean Dumping Regulations, 40 CFR, Chapter I, Subchapter H which requires that a final existing Interim Dredge Material Disposal Sites for the placement of dredged materials under U.S. Army Corps of Engineer permits authorized in Section 103 of the Marine Protection, Research and Sanctuaries Act, from future operation and maintenance dredging of the Sabine-Neches Waterway System:

11-2 1. From the standpoint of TDWR's statutory responsibilities under the Texas Water Code, relative to water quality management and pollution control, we concur in principle with the EPA's finding that the most feasible alternative plan is for EPA to designate the four existing interim sites (see Figure 1-1 and Table 1-1, pages 1-2 and 1-3 of report) for permanent continued use as the Sabine-Neches Waterway System's Ocean Dredged Material Disposal Sites, to accommodate an average annual disposal operation of approximately 4.5 million cubic yards. We note the findings presented in Chapter 4 and Appendix F, indicating that disposal operations at the four interim sites since 1977, have not resulted in any significant, detectable, long-term, permanent, adverse environmental impacts, insofar as coastal water quality is concerned. (Particular reference is made to the Summary, pagaes 4-12 and 4-13).

P. O. Box 13087 Capitol Station • Austin, Texas 78711 • Area Code 512/475-3187

Dr. Jarvis Miller, Director
Page 2
September 1, 1982

11-3 2. We note the inferred assurances given in the report that potential adverse effects of the disposal operations have been and will continue to be minimized by controlling the quality, volume, and placement rate of dredged spoil materials, and by virtue of having located the disposal sites in areas where physical dispersion and dilution are maximized due to natural forces, and where sediments are naturally disburbed (i.e., in nearshore, high-energy (wave, tide, current, environment), and/or by locating the sites in areas where natural biological activity is low (i.e., in deepwater, low-energy environment). Also, we note that the report (see pages 2-16 to 2-20) recognizes the provisions of Section 228.10 of 40 CFR Part 228, which requires the periodic evaluation of the impacts of disposal operations at each site designated by EPA under Section 102 of the Marine Protection, Research, and Sanctuaries Act, and the submission of a report to Congress. We believe that the Summary to Chapter 4 of the report (pages 4-12 and 4-13) should state specifically what method and actions will be adopted to implement the requirements of Section 228.10 of 40 CFR Park 228 of the Ocean Dumping Regulations. this implementation requires careful development of a monitoring plan.

Sincerely yours,

Harvey Davis
Executive Director

EPA RESPONSES TO THE PUBLIC REVIEW COMMENTS ON THE SABINE-NECHES DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

1-1 EPA thanks the Department of Health and Human Services for its review of the DEIS.

2-1 EPA thanks the Department of Interior for reviewing the Draft EIS.

2-2 It is stated in the DEIS on pages 2-11, 4-11 and Appendix F, Page F-18, the sites are located all or in part on oil and gas exploration lease areas. It is also stated that there have been platforms located within Existing Site 3 for the past 5 years and there have been no significant interferences between dumping and existing oil and gas structures. It is further stated that should the erection of additional structures in a disposal site prove to be a navigational hazard, it may be necessary to restrict dumping.

The information on the relations of oil and gas leases to the sites has been added to the Final EIS (page 4-11).

2-3 See comment response 2-2. The specific items in the comment are being referred to the EPA Regional VI Office and the Corps of Engineers District Office for their use in managing the sites and the disposal activities.

3-1 EPA thanks the Corps of Engineers for reviewing the Draft EIS.

3-2 The suggested terminology has been incorporated.

3-3 Beaumont has been inserted as one of the Ports.

EPA RESPONSES TO THE PUBLIC REVIEW COMMENTS ON THE SABINE-NECHES DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) (Con't)

3-4	Page xii has been revised.
3-5	See repsonse 3-4.
3-6	See response 3-4.
3-7	The map is intended to show the Existing Sites, not all the Waterways Channels.
3-8	The map has been corrected.
3-9	Beaumont has been added to synopsis.
3-10	The suggested language has been incorporated into paragraph 1, page 1-1.
3-11	The Corps of Engineers Local Needs attached to the comments has been incorporated in the Final EIS.
3-12	Barged material is used here in a general sense.
3-13	The statement refers to leveed areas in Sabine Lake of Pass, not on land.

EPA RESPONSES TO THE PUBLIC REVIEW COMMENTS ON THE SABINE-NECHES DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) (Con't)

3-14 Rather than being inapproriate at this point, it is believed discussions of the mid-water and deepwater sites were too limited. Consequently, pages 2-2 and 2-3 have been revised to briefly reflect their elimination during the Site Designation Study (Appendix F).

3-15 The suggested substitution has been made in the Final EIS.

3-16 It is agreed the subheading Existing Sites may be unnecessary. However, it does not detract from the discussion and does specifically delineate area being discussed.

3-17 The paragraph has been rewritten to include the names suggest by the CE.

3-18 Grain-Size analysis may detect a change in the Bank sediment that could possibly be related to the dredged material.

3-19 See response 3-18. This paragraph relates to future monitoring. A number of samples over time might detect a change.

3-20 The monitoring program will be designed by the CE District Engineer and/or the EPA Regional Administrator. Monitoring of the biota covered is suggested for consideration in the design of that program.

EPA RESPONSES TO THE PUBLIC REVIEW COMMENTS ON THE SABINE-NECHES DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) (Con't)

3-21 The statement is correct. It does not call the site a discontinued site. However, this site is not in use and could be referred to as a discontinued site.

3-22 See response 3-21.

3-23 It is agreed the statement is inappropiate. It has been deleted in the Final EIS.

3-24 It is not agreed the approach is completely erroneous. It is agreed it may not be the approach preferred by the Corps of Engineers.

3-25 The chart is for comparative purposes. It is believed the original estimates were correct.

3-26 See response 3-25.

3-27 Change has been made.

3-28 Agreed. Order has been changed.

3-29 See response 3-25.

3-30 The local needs statement has been used in the Final EIS.

EPA RESPONSES TO THE PUBLIC REVIEW COMMENTS ON THE SABINE-NECHES DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) (Con't)

4-0 EPA appreciates the review of the Draft Environmental Impact Statement (EIS) for the Sabine-Neches, Texas Dredged Material Disposal Site Designation (DEIS), by the National Wildlife Federation (NWF). The comments reflect a number of continuing NWF long-range concerns. EPA also shares some of these long-range concerns and is addressing them as resources permit. However, it appears from the comments that NWF has not fully considered two important aspects of the DEIS.

The four interim designated Ocean Dredged Material Disposal Sites (ODMDS) have been used for many years. Studies over several years were directed to determination of whether these historically used sites should be designated for continued use; and if not, what alternative ocean area would be suitable for the designation of an ODMDS(s). Historical data and information was gathered and a survey (EPA/IEC) of the existing sites implemented. Evaluation of the resulting information did not indicate the use of the existing interim designated sites for many years had resulted in environmental damages outside the site boundaries. In addition, the evaluations did not indicate any alternative ocean area with environmental or economic advantages over the existing interim sites. Based on these evaluations, it was determined the interim designated sites should be designated for continued use.

The DEIS was not intended to be a research document or to cover all aspects of the Gulf of Mexico off the Texas-Louisiana Coast. It was intended to present completely and concisely the information providing the basis for the proposed action. It is believed this was accomplished.

4-1 See EPA's responses to those comment in the corresponding Final EIS's.

4-2 The purpose of the Site Evaluation Study was to evaluate and compare the environmental (using the 11 specific criteria 40 CFR §228.6 ODR) and economic characteristics of areas and sites that could be used for the disposal of dredged material from the Sabine-Neches Area. Based on the available information, it was determined in this study that location of an ODMDS in the Mid- Shelf or Deepwater areas offered no environmental or economic advantage over the existing sites. Further, it was concluded that the existing sites were preferable for disposal of dredged material (page F-23). Detailed consideration of the Mid-Shelf and Deepwater areas under the 11 specific criteria was not repeated in the DEIS which focused on the proposed action. However, in order to make this information available to all reviewers of the DEIS, the Site Designation Study was attached as Appendix F.

The conclusions in the Site Designation Study and the DEIS were based on the available historical data and information and the EPA/IEC survey results. With unlimited funds, certainly numerous potential disposal areas could be selected and surveyed. Unlimited funds were not available at the time of the survey planning nor are they available now. However, when the data and information is viewed in the context of its purpose, it provides the necessary information for the judgements presented in both the Site Designation Study and the DEIS.

4-3 See comment response 4-2.

4-4 See comment response 4-2.

The evaluations in the Site Evaluation Study (Appendix F) indicated a Deepwater ODMDS may be environmentally acceptable. However, these evaluations did not indicate that such a site would offer environmental advantages over the existing historically used sites. As correctly pointed out in the comment, the primary reason against recommending designation of the Deepwater ODMDS was transportation costs. It is not believed the environmental advantages, if any, of such a site justifies an increase in costs of over 400 percent.

The spelling of "recommending" has been corrected.

Appendix D and Appendix F are attachments to the DEIS and were provided for he reviewers information. The cost information in these two attachments represents two different approaches and are not directly comparable. Increased costs for Mid-Shelf ODMDS are shown in Table F-2 of Appendix F.

4-5 It is believed the environmental effects of the disposal of dredged material have been adequately addressed in the DEIS. The remainder of the comment is an accurate resume of the information in the DEIS.

4-6 The Ocean Dumping Regulations require that effects of dredged material disposal on a disposal site and surrounding marine environment be evaluated periodically. Information used in making the disposal impact evaluation may include data from monitoring surveys. Thus, "if deemed necessary," the CE District Engineer (DE) or EPA Regional Administrator (RA) may establish a monitoring program to supplement historical site data. The monitoring plan is developed by determining appropriate monitoring parameters, frequency of sampling, and areal extent of the survey. Factors considered in making this determination include frequency and volumes of disposal, physical and chemical nature of the dredged material, dynamics of the sites physical processes, and life histories of the species monitored.

The primary purpose of the monitoring program is to determine whether disposal at the sites is significantly affecting areas outside the sites, and to detect any long-term adverse effects occurring in or around the sites. Consequently, the monitoring study may include a survey of sites as well as surrounding areas, including control sites and areas which are likely to be affected (as indicated by environmental factors, such as prevailing sediment transport). Results of the monitoring will provide early indication of potential adverse effects outside the sites.

The statements on page 1-6, DEIS and page F-23, Appendix F both refer to the site designation. They do not infer the elimination of future monitoring.

EPA RESPONSES TO THE PUBLIC REVIEW COMMENTS ON THE
SABINE-NECHES DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) (Con't)

4-7 As noted in the comment, existing Site 1 and 2 border Sabine Bank and prevailing bottom currents may carry some dredged material toward the Bank. The channel from which the sediments are dredged also is adjacent to the Bank. These sediments, on which the bioaccumulation tests were made, are available for transport regardless of where an ODMDS is designated. Evaluation of the historical data and information and the survey results did not indicate that the existing fishery had been adversely affected. It is believed this is because of the configuration of the Bank as noted on page F-17, Appendix F. However, because of the factors mentioned above, periodic monitoring is recommended. (page 2-18 and 2-19, DEIS)

4-8 The basis for the statement regarding aliphatic hydrocarbons is referenced on page 4-8, DEIS. "Significant accumulation" is open to interpretation. However, as a minimum, it indicates some were found. The "oil and grease" test is a very general one. The results of this test on samples collected during the survey are reported in Appendix A. Because of the possible presence of a number of compounds, it was recommended they be included in the monitoring program (page 2-19, DEIS).

4-9 It is believed the evaluation of the Mid-Shelf and Deepwater areas was the proper approach.

Situating an ODMDS down-current from the Flower Garden Bank area could solve one of the major problems associated with designating and using an ODMDS in the Mid-Shelf area. However, as stated on pages F-24 and F-25 of the Site Designation Study there are a variety of other potential problems associated with the use of an ODMDS in the Mid-shelf area.

4-10 It is not agreed the DEIS is incomplete. The evaluations of existing historical information and survey data that led to the decision on the proposed action are presented (see response 4-0). It is agreed that a number of questions regarding sediment sources to and transport in coastal waters, particularly in specific areas, need to be addressed in continuing investigations. The sediments reaching the channels that must be dredged for navigational purposes come from many sources. The dynamics of dredged material transport are dependent on the dredged material characteristics and the physical/climatic characteristics of the area.

4-11 As stated on page 2-9 and in Appendix B, bottom currents during storms redistribute sediments along the Texas-Louisiana coast. It would be reasonable to assume that some portion of the dredged material dumped at the existing sites could end up in the safety fairway as a result of storm activity. The wide redistribution of the sediments has not resulted in the need to dredge the safety fairways.

4-12 See comment response 4-7.

4-13 Yes, it is possible that storms could redistribute dumped sediments back into the channel.

4-14 The portion of the DEIS that discusses cyclonic and anticyclonic currents was included to provide background information. The currents affect the Sabine-Neches Sites in a general way.

EPA RESPONSES TO THE PUBLIC REVIEW COMMENTS ON THE
SABINE-NECHES DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) (Con't)

4-15 If significant quantities of dredged material were being redeposited in the dredged channel these cost figures would be of great value in accessing the acceptability of the sites. However, none of the data indicates that the redeposition of dredged material in the dredged channel is a problem.

4-16 Since sediments dredged from the Sabine Channel are dumped outside the safety fairway at Existing Sites 2, 3, and 4, there is no need to alter site boundaries.

5-1 EPA thanks the Texas Office of the Governor for reviewing the Draft EIS.

6-1 EPA thanks the Texas Air Control Board for reviewing the Draft EIS.

7-1 EPA thanks the Texas General Land Office for reviewing the Draft EIS. For boundaries of the sites, see page 1-3 of the DEIS.

8-1 EPA thanks the Texas Department of Highways and Public Transportation for reviewing the Draft EIS.

9-1 EPA thanks the Texas Parks and Wildlife Department for reviewing the Draft EIS.

10-1 EPA thanks the Texas State of Soil and Water Conservation Board for reviewing the Draft EIS.

11-1 EPA thanks the Texas Department of Water Resources for reviewing the Draft EIS.

EPA RESPONSES TO THE PUBLIC REVIEW COMMENTS ON THE
SABINE-NECHES DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) (Con't)

11-2 EPA appreciates the comments.

11-3 The monitoring program, if deemed necessary, will be established by the CE District Engineer or the EPA Regional Administrator. The Guidelines for the Monitoring Plan include recommendations for the monitoring program.

Chapter 6

GLOSSARY, ABBREVIATIONS, AND REFERENCES

GLOSSARY

ABUNDANCE — The number of individuals of a species inhabiting a given area. Normally, a community of several component species will inhabit an area. Measuring the abundance of each species is one way of estimating the comparative importance of each component species.

ADSORB — To adhere in an extremely thin layer of molecules to the surface of a solid or liquid.

AMBIENT — Pertaining to the undisturbed or unaffected conditions of an environment.

ANTHROPOGENIC — Relating to the effects or impacts of man on nature. Construction wastes, garbage, and sewage sludge are examples of anthropogenic materials.

ASSEMBLAGE — A group of organisms sharing a common habitat.

BASELINE CONDITIONS — The characteristics of an environment before the onset of an action which can alter that environment; any data serving as a basis for measurement of other data.

BENTHOS — All marine organisms (plant or animal) living on or in the bottom of the sea.

BIOACCUMULATION — The uptake and assimilation of materials (e.g., heavy metals) leading to elevated concentrations of the substances within organic tissue, blood, or body fluid.

BIOASSAY — A method for determining the toxicity of a substance by the effect of varying concentrations on growth or survival of suitable plants, animals or micro-organisms; the concentration which is lethal to 50% of the test organisms or causes a defined effect in 50% of the test organisms, often expressed in terms of lethal concentration (LC_{50}) or effective concentration (EC_{50}), respectively.

BIOTA — Animals and plants inhabiting a given region.

BOD — Biochemical Oxygen Demand or Biological Oxygen Demand; the amount of dissolved oxygen required by aerobic micro-organisms to degrade organic matter in a sample of water usually held in the dark at 20°C for 5 days; used to assess the potential rate of substrate degradation and oxygen utilization in aquatic ecosystems.

CONTINENTAL SHELF	That part of the Continental Margin adjacent to a continent extending from the low water line to a depth, generally 200m, where the Continental Shelf and the Continental Slope join.
CONTINENTAL SLOPE	That part of the Continental Margin consisting of the declivity from the edge of the Continental Shelf down to the Continental Rise.
COST/BENEFIT RATIO	A comparison of the price, disadvantages and liabilities of any project versus profit and advantages.
CURRENT METER	An instrument for measuring the speed of a current, and often the direction of flow.
DEMERSAL	Living at or near the bottom of the sea.
DENSITY	The mass per unit volume of a substance, usually expressed in grams per cubic centimeter (1 g water in reference to a volume of 1 cc @ 4°C).
DIATOMS	Microscopic phytoplankton characterized by a cell wall of overlapping silica plates. Sediment and water column populations vary widely in response to changes in environmental conditions.
DISPERSION	The dissemination of discharged matter over large areas by natural processes, e.g., currents.
DISSOLVED OXYGEN	The quantity of oxygen (expressed in mg/liter, ml/liter or parts per million) dissolved in a unit volume of water. Dissolved oxygen (DO) is a key parameter in the assessment of water quality.
DIVERSITY (Species)	A statistical concept which generally combines the measure of the total number of species in a given environment and the number of individuals of each species. Species diversity is high when it is difficult to predict the species or the importance of a randomly chosen individual organism, and low when an accurate prediction can be made.
DOMINANT SPECIES	A species or group of species which, because of their abundance, size, or control of the energy flow, strongly affect a community.
EBB CURRENT, EBB TIDE	Tidal current moving away from land or down a tidal stream.
ECOSYSTEM	The organisms in a community together with their physical and chemical environments.
EPIFAUNA	Animals which live on or near the bottom of the sea.

ESTUARY	A semienclosed coastal body of water which has a free connection to the sea, commonly the lower end of a river, and within which the mixing of saline and fresh water occurs.
FAUNA	The animal life of any location, region, or period.
FINFISH	Term used to distinguish "normal" fish (e.g., with fins and capable of swimming) from shellfish, usually in reference to the commercially important species.
FLOOD TIDE, FLOOD CURRENT	Tidal current moving toward land, or up a tidal stream.
HOPPER DREDGE	A self-propelled vessel with capabilities to dredge, store, transport, and dispose of dredged materials.
INDICATOR SPECIES	An organism so strictly associated with particular environmental conditions that its presence is indicative of the existence of such conditions.
INFAUNA	Aquatic animals which live in the bottom sediment.
INITIAL MIXING	Dispersion or diffusion of liquid, suspended particulate, and solid phases of a waste material which occurs within 4 hours after dumping.
INTERIM DISPOSAL SITES	Ocean disposal sites tentatively approved for use by the EPA.
INVERTEBRATES	Animals lacking a backbone or internal skeleton.
LONGSHORE CURRENT	A current which flows in a direction parallel to a coastline.
MAIN SHIP CHANNEL	The designated shipping corridor leading into a harbor.
MAINTENANCE DREDGING	Periodic dredging of a waterway, necessary for continued use of the waterway.
MIXED LAYER	The upper layer of the ocean which is well mixed by wind and wave activity.
MONITORING	As used herein, observation of environmental effects of disposal operations through biological and chemical data collection and analyses.
NEKTON	Free swimming aquatic animals which move independently of water currents.
NUISANCE SPECIES	Organisms of no commercial value, which, because of predation or competition, may be harmful to commercially important organisms.

PARAMETER	Values or physical properties which describe the characteristics or behavior of a set of variables.
PELAGIC	Pertaining to water of the open ocean beyond the Continental Shelf and above the abyssal zone.
PERTURBATION	A disturbance of a natural or regular system; any departures from an assumed steady state of a system.
PHYTOPLANKTON	Minute passively floating plant life in a body of water; the base of the food chain in the sea.
PLANKTON	The passively floating or weakly swimming, usually minute animal and plant life in a body of water.
POLYCHAETA	The largest class of the phylum Annelida (segmented worms); benthic marine worms distinguished by paired, lateral, fleshy appendages provided with bristles (setae) on most segments.
PYCNOCLINE	A vertical density gradient in a body of water, positive with respect to depth, and much greater than the gradients above and below it.
RECRUITMENT	Addition to a population of organisms by reproduction or immigration of new individuals.
RUNOFF	That portion of precipitation upon land which ultimately reaches streams, rivers, lakes and oceans.
SALINITY	The amount of salts dissolved in water; expressed in parts per thousand ($^{o}/oo$, or ppt).
SECCHI DISK	A white, black or varicolored disc, 30 centimeters in diameter, used to measure water transparency (clarity).
SHELF WATER	Water which originates in, or can be traced to the Continental Shelf, differentiated by characteristic temperature and salinity.
SHELLFISH	Any invertebrate, usually of commercial importance, having a rigid outer covering, such as a shell or exoskeleton; includes some molluscs and arthropods; term is the counterpart of finfish.
SHIPRIDER	A shipboard observer, assigned by the U.S. Coast Guard to ensure that a waste-laden vessel is dumping in accordance with permit specifications.
SLOPE WATER	Water which orginates from, occurs at, or can be traced to the Continental Slope, differentiated by characteristic temperature and salinity.

SPECIES	A group of morphologically similar organisms capable of interbreeding and producing fertile offspring.
STANDARD ELUTRIATE ANALYSIS	A test used to determine the types and amounts of constituents which can be extracted from a known volume of sediment by mixing with a known volume of water.
SUBSTRATE	The solid material upon which an organism lives, or to which it is attached (e.g., rocks, sand).
SURVEILLANCE	Systematic observation of an area by visual, electronic, photographic, or other means for the purpose of ensuring compliance with applicable laws, regulations, permits, and safety.
SUSPENDED SOLIDS	Finely divided particles of a solid temporarily suspended in a liquid (e.g., soil particles in water).
THERMOCLINE	A vertical temperature gradient in some layer of a body of water, which is appreciably greater than the gradients above or below it; a layer in which such a gradient occurs.
TRACE METAL OR ELEMENT	An element found in the environment in extremely small quantities; usually includes metals constituting 0.1% (1,000 ppm) or less, by weight, in the earth's crust.
TURBIDITY	Cloudy or hazy appearance in a naturally clear liquid caused by a suspension of colloidal liquid droplets, fine solids, or small organisms.
ZOOPLANKTON	Weakly swimming animals whose distribution in the ocean is ultimately determined by current movements.

ABBREVIATIONS

C	Centigrade
CE	U.S. Army Corps of Engineers
CFR	Code of Federal Regulations
cm	centimeter(s)
DMRP	Dredged Material Research Program
DOC	U.S. Department of Commerce
DOE	Department of Energy
DOI	U.S. Department of the Interior
EHA	Espey, Huston and Associates, Inc.
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
g	gram(s)
hr	hour(s)
IMCO	Inter-Governmental Maritime Consultative Organization
kg	kilogram(s)
km	kilometer(s)
kn	knot(s)
m	meter(s)
mg	milligram(s)
mm	millimeter(s)
μ	micron(s)
μg	microgram(s)
MPRSA	Marine Protection, Research, and Sanctuaries Act
N	north
ng	nanogram(s)
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
nmi	nautical mile(s)
NOAA	National Oceanic & Atmospheric Administration
NOO	Naval Oceanographic Office
NTU	nephelometric turbidity units
ODMDS	Ocean Dredged Material Disposal Site
pg	picogram(s)
PL	Public Law

ppb	parts per billion
ppm	parts per million
ppt	parts per thousand ($^{o}/oo$)
s	second(s)
SPM	suspended particulate matter
TDWR	Texas Department of Water Resources
TOC	total organic carbon
TSS	total suspended solids
USCG	United States Coast Guard
W	west
yd^3	cubic yard(s)
yr	year(s)

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Appendix A

SURVEY METHODS, RESULTS, AND INTERPRETATIONS

CONTENTS

ILLUSTRATIONS

TABLES

Appendix A

SURVEY METHODS, RESULTS, AND INTERPRETATIONS

Field surveys at the Sabine-Neches ODMDS's were conducted in September 1979 and January 1980 by Interstate Electronics Corporation (IEC) under contract to the EPA (Contract Number 68-01-4610). The purpose of the surveys was to collect biological, chemical, geological, and physical oceanographic data to assess the effects of dredged material disposal on the marine environment, and to augment historical information from the area. A major consideration of survey design was to determine whether any adverse effects identified within the ODMDS's were detectable outside of the sites' boundaries.

Methods of data collection, results, and interpretations of the survey data are presented in the following sections. The data are briefly compared with historical information; however, more comprehensive treatment is given in Chapter 3 of this EIS.

METHODS

All survey operations were conducted using the Ocean Survey Vessel ANTELOPE. Loran-C and radar range and bearing positioning were used for navigation, providing accuracy within 0.25 nmi.

Stations 1, 3, 4, 5, 10, 11, and 12 were located inside the ODMDS's, and control stations 2, 6, 7, 8, and 9 were positioned in predominant upcurrent-downcurrent directions outside the site (Figure A-1). Station locations were designed to determine whether transport of dredged material was occurring outside of the site boundaries. Samples collected, coordinates, and water depths for all stations are presented in Table A-1.

Microbiological analyses of sediments and tissues, and physical oceanographic measurements were performed aboard the ANTELOPE; all other detailed chemical, geological, and biological analyses were performed at shore-based laboratories listed in Table A-2.

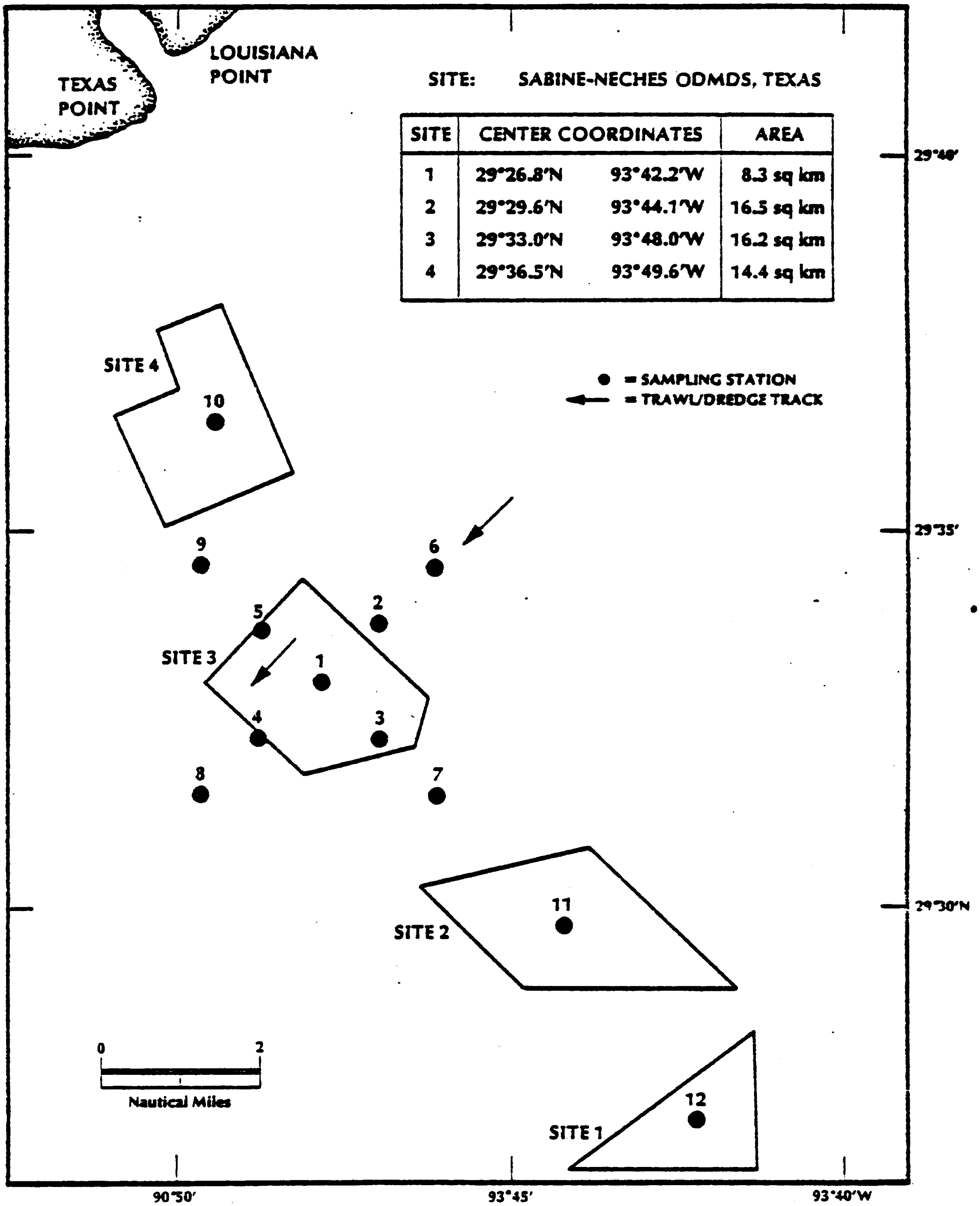

Figure A-1. Station Locations, EPA/IEC Survey
of the Sabine-Neches ODMDS's, September 1979 and January 1980

TABLE A-1
SAMPLING REQUIREMENTS—SABINE-NECHES ODMDS'S

	WATER COLUMN								SEDIMENT									BIOTA
			WATER SAMPLING ROSETTE						BOX CORER, 8 DROPS									DREDGE/TRAWL
	INSTRUMENT ARRAY 1 PROFILE/ STATION		GO FLOW 2 SAMPLES: SURFACE AND BOTTOM/STATION				GO-FLOW TEFLON LINED 1 SAMPLE/ STATION MIDWATER		GEOLOGICAL - CHEMICAL 2 CORES/STATION					ONE CORE PER STA	BIO-LOGICAL 5 CORES/ STATION		EPIFAUNA & MACROINFAUNA TISSUES 2 TRAWLS/ SITE	
STATION NUMBER	PROFILES OF SALINITY, PH, TEMPERATURE & TURBIDITY	CALIBRATION SAMPLES: SALINITY, TURBIDITY PH, & TEMPERATURE	SUSPENDED SOLIDS	DISSOLVED OXYGEN	DISSOLVED TRACE METALS	PARTICULATE TRACE METALS	CHLORINATED HYDROCARBON SCAN	GRAINSIZE, ARTIFACTS	TOTAL ORGANIC CARBON	TRACE METALS	CHLORINATED HYDROCARBON SCAN (a)	OIL & GREASE	ELUTRIATE TEST	GRAIN SIZE & ARTIFACTS	MACROINFAUNA, TAXONOMY	TRACE METALS (b)	CHLORINATED HYDROCARBON SCAN (b)	TOTAL & FECAL COLIFORMS (b)
001	●	●	●	●	QC	QC	QC	●	●	QC	QC	●	●	●	●	QC	QC	●
002								●	●	●		●		●	●			
003								●	●	●		●		●	●			
004								●	●	●		●		●	●			
005								●	●	●		●		●	●			
006	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
007	●	●	●	●				●	●	●		●		●	●			
008	●	●	●	●				●	●	●		●		●	●			
009	●	●	●	●				●	●	●		●		●	●			
010	●	●	●	●	●	●	●	●	●	QC	●	●		●	●			
011	●	●	●	●	●	●	●	●	●	●	●	●		●	●			
012	●	●	●	●	●	●	●	●	●	●	●	●		●	●			

STATIONS

NUMBER	001	002	003	004	005	006	007	008	009	010
LATITUDE	29°33.0'N	29°33.8'N	29°32.2'N	29°32.4'N	29°33.8'N	29°34.6'N	29°31.5'N	29°31.5'N	29°34.6'N	29°36.5'N
LONGITUDE	93°48.0'W	93°47.1'W	93°47.1'W	93°48.9'W	93°48.9'W	93°46.2'W	93°46.2'W	93°50.1'W	93°50.1'W	93°49.6'W
DEPTH	12m	11m	12m	12m	12m	12m	12m	12m	11m	6m
NUMBER	011	012								
LATITUDE	29°29.5'N	29°26.8'N								
LONGITUDE	93°44.1'W	93°42.2'W								
DEPTH	12m	12m								

NOTES:

QC = one quality control sample will be taken in addition to any other samples required
(a) Composite sample from two cores
(b) Composite species samples from tows and/or box cores

Biological tows will also be samples for taxonomic voucher specimens after other samples have been removed.

Station is located at mid-point of trawls

TABLE A-2
LABORATORIES PERFORMING ANALYSES OF SAMPLES FROM SABINE-NECHES ODMDS'S

Biology	Chemistry/Geology
Barry A. Vittor and Associates Mobile, Alabama	Science Applications, Incorporated (SAI) La Jolla, California
La Mer* San Pedro, California	LFE Environmental* Richmond, California

* Denotes Quality Control Laboratory

Sampling equipment, procedures, and preservation methods were in accordance with the "Oceanographic Sampling and Analytical Procedures Manual" (IEC, 1980). A summary of these methods is presented in the following sections.

WATER COLUMN MEASUREMENTS

Shipboard Procedures

Conductivity and temperature were measured with a Plessey CTD, and data were stored on 9-track disks. A rosette sampler equipped with 30-liter Go-Flo bottles was used to collect surface and near-bottom samples for suspended solids and dissolved oxygen, and for salinity and temperature calibration samples; mid-depth samples were collected for analysis of dissolved and particulate trace metals and dissolved chlorinated hydrocarbons (CHC's). Salinity samples were analyzed with a Beckman salinometer. Surface and bottom water temperatures were measured using reversing or bucket thermometers. Turbidity was measured with a Hach laboratory turbidimeter; dissolved oxygen was determined using a modified Winkler method (Strickland and Parsons, 1972); and pH was measured with a Beckman pH meter. Water samples for total suspended solids and trace metals (particulate and dissolved) analyses were transferred from Go-Flo bottles to 2-liter pressure filtration bottles, then filtered through Nucleopore filters. The filtrate was collected for dissolved trace metals analysis in precleaned bottles acidified with Ultrex nitric acid. Measured water volumes were pressure-fed directly from Go-Flo bottles through an Amberlite XAD resin column for extraction of CHC's (Osterroht, 1977). Filters for particulate trace metals and suspended solids, and resin columns for CHC's, were processed in a positive pressure clean hood and frozen until analyzed.

Laboratory Methods

Total suspended solids were determined gravimetrically on an electrobalance (Meade et al., 1975). Filters containing particulate trace metal samples were leached for 2 hours with 1N Ultrex nitric acid. Leachates were analyzed for cadmium and lead by graphite furnace atomic absorption spectrophotometry (AAS), and for mercury by cold-vapor AAS (EPA, 1979).

Dissolved mercury was analyzed by cold vapor AAS following an acid-permanganate digestion and reduction with hydroxylamine and stannous sulfates (EPA, 1979). Dissolved cadmium and lead were concentrated using a chelation-solvent extraction method (Sturgeon et al., 1980), and analyzed by graphite furnace AAS.

CHC's were eluted from resin columns with acetonitrile. The eluate was extracted three times with hexane, evaporated to near dryness, fractionated on florisil columns, and analyzed by electron capture gas chromatography (Osterroht, 1977). The chromatogram was scanned for presence of polychlorinated biphenyls (PCB's); Arochlors 1016, 1221, 1232, 1242, 1248, 1254, 1260, and 1262; and various pesticides and derivatives (aldrin, dieldrin, endrin, heptachlor, β-BHC, DDT, DDD, DDE, and heptachlor epoxide).

GEOCHEMISTRY AND GRAIN SIZE-ANALYSIS

Shipboard Procedures

Fifty grams of sediment were removed from each of seven 0.065-m^2 box cores per station, and frozen for grain-size analysis. Sediment samples for geochemical analyses (trace metals, oil and grease, total organic carbon [TOC], and CHC's) were collected from the surface 2 cm of two cores per station, stored in acid-cleaned Teflon jars, and frozen.

Laboratory Methods

Sediment grain size was determined by washing sediment samples through 2,000- and 62-µm mesh sieves to separate gravel, sand, and silt/clay fractions (Folk, 1978). Sand/gravel fractions were separated with 1 phi (Ø) interval sieves, dried, and weighed. The silt/clay fractions were analyzed using a pipette method (Rittenhouse, 1933).

Trace metals (cadmium, lead, and arsenic) were leached from 5g to 10g of sediments for 2 hours with 25 ml of 1N nitric acid, and analyzed by graphite furnace AAS. Mercury was leached from 5g to 10g of sediment at 95°C with aqua regia and potassium permanganate, reduced using hydroxylamine sulfate and stannous sulfate, and analyzed by cold-vapor AAS (EPA, 1979).

Oil and grease were extracted from 100g sediment samples with an acetone-hexane mixture, dried and quantified gravimetrically according to the method of APHA (1975). TOC in sediments was measured with a Perkin-Elmer Model 240 Elemental Analyzer (Gibbs, 1977).

CHC's were soxhlet extracted from sediment samples (Stations 1, 6, 10, 11, and 12 only) using a 1:1 acetone-hexane solvent. The extract was evaporated, cleaned using a florisil column, fractionated on a silicic acid column, and analyzed by electron capture gas chromatography (EPA, 1974). An additional acid cleanup step was required for analysis of PCB's (see above for CHC's examined).

Elutriate analyses were performed in accordance with the specifications of EPA/CE (1977). Sediments and unfiltered disposal site water were mixed at a 1:4 ratio, and mechanically and air-agitated for 30 minutes. After a 1-hour settling period, test water was filtered, acidified with Ultrex hydrochloric acid, and analyzed for trace metals using techniques described above.

BIOLOGICAL MEASUREMENTS (Including Tissue Chemistry and Coliform)

Shipboard Procedures

Five macrofaunal samples were collected at each station using a 0.065-m^2 box core and washed through a 0.5-mm screen; organisms were preserved in 10% formalin in seawater and stored until analysis. Two 3.5-cm diameter subcores were taken from one box core at each station for the first survey at the site, and preserved for enumeration of meiofauna.

Two trawls, one inside and one outside of the site, were conducted using a 7.6m Otter trawl to collect epifauna for analysis of tissue concentrations of CHC's, trace metals, and total and fecal coliforms. In additon, information from the catch was used to further characterize the benthic and nektonic communities.

Epifauna from the trawls were sorted in stainless steel trays and enumerated. Tissue was combined from at least three individuals of each of the commercially important species captured, aseptically homogenized in a blender, and cultured within 6 hours for total and fecal coliforms using a modified APHA (1975) technique described in IEC (1980). Other specimens were transferred from the trays to acid-rinsed plastic buckets, and then into clean plastic bags and frozen for trace metal analyses. Additional specimens were transferred to stainless steel buckets with stainless steel forceps, wrapped in aluminum foil, placed in polyethylene bags, and frozen for CHC analysis.

Laboratory Methods

Eight dominant macrofaunal species were selected by Interstate biologists for enumeration in all samples. Selection of species was based on the inspection of initial laboratory data (species abundance throughout the site), feeding type, and known association with environmental conditions, particularly substrates. Each of the six dominant species were enumerated in all five station replicates, and mean species abundances were calculated for each station. All samples were transferred to 70% alcohol for storage.

Analysis of cadmium and lead concentrations in tissues followed techniques described by EPA (1977). Approximately 5g to 10g of homogenized tissue were digested with nitric acid and hydrogen peroxide while heated. The digests were then evaporated, diluted to volume with deionized water, and analyzed with flame or flameless AAS. Analyses of mercury concentrations in tissue required digestion of an 8g to 10g sample with concentrated nitric and sulfuric acids and potassium permanganate, reduction of the ionized mercury with hydroxylamine and stannous sulfates, and analysis with cold-vapor AAS (EPA, 1979).

Tissue analyses for CHC's (see above for CHC's examined) required homogenization of 50g of tissue with sodium sulfate, extraction with hexane, cleanup, fractionation, and analysis with electron capture gas chromatography (EPA, 1974).

COMPUTER DATA AND ANALYSIS

All data were entered into the Interstate computerized Oceanic Data and Environmental Evaluation Program data base (ODEEP). Statistical analysis included calculation of means, variances, correlations, and analysis of variance. Correlations were run between parameter values measured within individual sediment samples (casts).

RESULTS AND DISCUSSION

PHYSICAL AND CHEMICAL CHARACTERISTICS

Water Column

Watercolumn measurements for temperature, salinity, dissolved oxygen, pH, turbidity, total suspended solids, and dissolved and particulate trace metals are summarized in Tables A-3 and A-4.

TABLE A-3
PHYSICAL AND CHEMICAL WATER-COLUMN CHARACTERISTICS IN THE EXISTING SITES AND VICINITY

Station	Depth (m)	Temperature (°C)		Salinity (°/oo)		Dissolved Oxygen* Concentration (ml/liter) (percent saturation in parentheses)		pH		Turbidity (NTU)		Total Suspended Solids (mg/liter)	
		Sept	Jan	Sept	Jan	Sept	Jan	Sept	Jan	Sept	Jan	Sept	Jan
1	2	26.10	14.2	23.948	27.037	6.22 (130)	5.12 (85)	8.23	7.81	2.21	3.60	3.56	4.77
	5			24.340	29.862			8.24	8.08	2.18	1.80	3.10	1.38
	9		14.2		29.161		4.72† (80)		8.02		4.40		
	10			24.602		5.38 (110)		8.26		3.03		2.37	6.40
6	2	25.50	14.1	22.939	26.379	6.65 (135)		8.31	8.48	2.00	3.00	3.25	6.55
	5			23.020	26.726			8.30	8.45	2.20	3.00	3.54	5.74
	8		13.4		26.840		5.38 (85)		8.43		3.00		6.51
	12	25.90		23.064		6.36 (130)		8.29		2.05		2.86	
7	2	26.00	14.2	24.455	27.501		5.97 (100)	8.22	8.08	1.49	2.20	2.51	2.94
	6				28.532				8.02		1.70		2.62
	7			24.507				8.32		2.61		2.38	
	11			24.569		5.75 (120)		8.34		1.81		4.27	
	12		14.0		28.680		5.20 (85)		7.99		1.90		2.62
8	2	25.60	13.9	24.165	26.640	6.00 (115)	5.87 (100)	8.28	8.09	1.80	2.20	2.52	3.82
	5			24.649				8.27		2.00		2.28	
	6				28.138				8.02		2.40		4.35
	11	26.00		25.079		5.16 (105)		8.25		2.80		4.77	
	12		14.0		28.267		4.94 (80)		8.03		2.30		4.43
9	2	26.00	14.3	22.080	25.792	6.94† (135)	5.95 (100)	8.33	8.07	2.10	4.20	3.87	5.29
	5			23.847	26.421			8.30	8.04	3.20	7.90	4.55	11.10
	10	26.00	13.8	24.082	26.525	5.39 (110)	4.92 (80)	8.27	7.99	6.30	8.80	9.90	9.96
10	2	25.00	13.9	20.914	24.141	5.37 (105)	6.14 (100)	7.88	8.49	75.00	5.50	11.70	9.02
	4			22.281	25.594			8.09	8.40	95.00	8.50	14.80	8.16
	7	25.50	13.4	23.215	25.533	6.00 (120)	5.31 (85)	8.09	8.42	120.00	9.90	17.50	12.40
11	2	26.80	14.6	24.497	29.195	5.20 (115)	5.45† (90)	8.31	8.24	1.90	1.30	3.09	1.68
	5			25.958	29.334			8.24	8.34	6.45	1.60	7.21	2.87
	9		14.3				4.91 (80)		8.34		1.90		2.65
	10			25.405	29.459	6.04 (125)		8.26		3.55		5.78	
12	2	25.00	14.6	25.371	28.941	5.21 (105)	5.13 (90)	8.23	8.33	6.26	1.40	4.96	1.56
	5			25.412	29.018			8.24	8.34	5.99	1.70	4.74	0.73
	10		14.2	25.382	29.282	5.91 (120)	4.91 (80)	8.25	8.33	5.92	1.20	5.00	1.31

† Only one sample at this depth
* Value is mean of two samples except where noted. An average temperature of 25.9°C was assumed in percent saturation calculation when no bottom temperature was available for September.

TABLE A-4
WATER-COLUMN DISSOLVED AND PARTICULATE METAL CONCENTRATIONS IN THE EXISTING SITES AND VICINITY (ONE MIDWATER SAMPLE COLLECTED AT EACH STATION.)

Phase	Station	Mercury		Cadmium		Lead	
		Sept	Jan	Sept	Jan	Sept	Jan
Dissolved (µg/liter)	1	<0.003	<0.003	0.062	0.023	0.219	0.322
	6	<0.003	0.010	0.273	-	0.242	0.109
	10	0.004	0.007	0.084	0.176	0.126	0.170
	11	<0.003	0.005	0.205	0.017	0.278	<0.2
	12	0.012	0.006	0.034	0.123	0.584	0.261
Particulate (µg/liter)	1	<0.0002	<0.0002	0.055	0.005	0.073	0.022
	6	0.001	<0.0004	0.037	0.006	0.041	0.087
	10	0.002	0.002	0.034	0.006	0.159	0.072
	11	0.001	0.003	0.005	0.012	0.074	0.042
	12	0.001	0.003	0.034	0.023	0.022	0.014

- = Sample contaminated

Temperatures exhibited little variation with depth during both surveys and were lower in January than September. Temperatures ranged from 25.0°C to 26.8°C in September, and from 13.4°C to 14.6°C in January (Table A-3). As expected for a coastal area with freshwater input, salinity generally increased with depth and with increasing distance from shore. Salinity was lower in September than January, probably a result of greater runoff present during late summer. Salinities measured during September and January ranged from approximately 20.9°/oo to 26.0°/oo and 24.1°/oo to 29.9°/oo, respectively. Both salinity and temperature values were similar to those recorded by DOE (1978) during the same seasons.

Waters in the survey area were well oxygenated at all depths, but were slightly lower in January than in September. Surface dissolved-oxygen concentrations ranged from 5.20 to 6.94 ml/liter (105% to 135% saturation) in September, and from 5.12 to 6.14 ml/liter (85% to 100% saturation) in January. Near-bottom (7m to 12m) dissolved-oxygen concentrations ranged from 5.16 to 6.36 ml/liter (105% to 130% saturation) in September, and from 4.72 to 5.32 ml/liter (80% to 85% saturation) in January. Comparable values have been reported by DOE (1978).

The pH of the waters within the Existing Sites was quite uniform with depth and showed no consistent seasonal or areal trends. Values ranged from 7.8 to 8.5, within the range for the general area as measured by CE (1975).

Turbidity and total suspended solids (TSS) concentrations decreased with increasing distance from shore (Table A-3). No consistent seasonal or vertical trends were observed. Turbidity and TSS concentrations were highest at shallow, nearshore Station 10; possible sources of suspended matter include runoff from the Sabine estuary and/or resuspension of bottom sediments. Turbidity ranged from 1.20 to 120 Nephelometric Turbidity Units (NTU); TSS concentrations ranged from 0.73 to 17.50 mg/liter.

Concentrations of dissolved and particulate mercury, cadmium, and lead were low throughout the survey area (Table A-4), and within ranges reported for the Gulf coastal region by DOE (1978). No consistent temporal or spatial trends in dissolved trace metal concentrations were observed; levels ranged from <0.003 to 0.012 µg/liter mercury, 0.017 to 0.273 µg/liter cadmium, and <0.2 to 0.584 µg/liter lead. As expected, concentrations of trace metals in the particulate phase (µg/l) varied more or less proportionally with the quantity of suspended matter (TSS) in the water. Particulate metal levels ranged from <0.0002 to 0.003 µg/liter mercury, 0.005 to 0.055 µg/liter cadmium, and 0.014 to 0.159 µg/liter lead. Concentrations of total (particulate plus dissolved) mercury and cadmium were all well below EPA minimum marine water quality criteria (45 FR 79318); no such levels have been established for lead.

Concentrations of all dissolved PCB's, pesticides, and pesticide derivatives at middepth in the water column at Stations 1, 6, 10, 11, and 12 were below detectable levels in September and extremely low, less than 0.1 ng/liter, in January. Low organohalogen levels (less than 1 µg/liter) were also measured during a study conducted in the Sabine-Neches Waterway (Horne and Swirsky, 1979).

Sediments

Physical - Sediments in the survey area were poorly sorted and exhibited a general gradation from fine to coarse material with increasing distance from shore (Table A-5). This gradation is consistent with previous observations for the general region seaward of the Sabine estuary (Coastal Ecosystems Management, 1975; Department of Interior, 1979). Sediments at nearshore Station 10 consisted primarily of silt (19.8% to 29.3%) and clay (68% to 79%) during both surveys, and graded to predominantly sand (42.4% to 95.8%) at the most seaward station (Station 12). Overall ranges for each grain-size class were approximately 0% to 16% for gravel, 0% to 96% for sand, 2% to 51% for silt, and 0% to 82% for clay. Sediment texture exhibited seasonal changes at several stations, but was generally similar between surveys. Because the natural sediment texture is generally similar to that of dredged materials dumped at the Existing Sites (see Chapter 3), it is not possible to differentiate between the two, nor delineate any area affected by dumping with the present data.

Chemical - Concentrations of trace metals (mercury, cadmium, lead, and arsenic), TOC, and oil and grease in sediments of the Existing Sites and vicinity are listed in Table A-6. Although concentrations of these constituents did not significantly ($p>0.01$) correlate with percentages of silt or clay, some interdependence was indicated by the survey results.

Trace-metal concentrations exhibited a general decrease with increasing distance from shore, as did percentages of sediment fines. Arsenic concentrations, measured only in September, were greatest (2.4 to 2.7 mg/kg) at nearshore Station 10; concentrations were among the lowest at offshore Stations 11 and 12 (0.6 to 1.3 mg/kg). Lead concentrations varied similarly; concentrations ranged from <0.02 mg/kg at Stations 2, 3, 11, and 12, to about 2.6 mg/kg at Stations 9 and 10, and were similar between surveys. Cadmium and mercury concentrations were generally near detection limits of the analytical methods employed. This factor may have contributed to the weak relationships between levels of these metals with distance from shore and sediment grain size. Cadmium and mercury levels ranged from less than 0.01 mg/kg (undetectable) to 0.13 mg/kg and 0.05 mg/kg, respectively, with little change between surveys. Cadmium and lead concentrations were similar to or less than levels measured in the general area by DOE (1978). All the above concentrations are within or below ranges reported for the region surrounding the Existing Sites (DOE, 1978; Horne and Swirsky, 1979; Coastal Ecosystems Management, 1975).

TABLE A-5
SEDIMENT GRAIN-SIZE COMPOSITION AT THE EXISTING SITES AND VICINITY

Station	Gravel %		Sand %		Silt %		Clay %	
	Sept	Jan	Sept	Jan	Sept	Jan	Sept	Jan
1	4.6 (0.9-10.0)	1.7 (0.0-5.6)	46.7 (16.5-66.5)	27.6 (10.1-52.0)	23.5 (16.0-35.0)	27.7 (23.0-31.4)	25.2 (13.4-38.5)	43.0 (21.5-60.8)
2	3.4 (0.1-16.0)	1.5 (0.0-5.6)	26.8 (18.6-37.1)	16.9 (3.0-35.4)	31.6 (25.1-36.4)	31.3 (23.3-40.8)	38.2 (29.2-49.4)	50.3 (35.7-61.6)
3	1.9 (0.0-10.0)	2.8 (0.0-10.0)	29.0 (3.7-55.4)	46.3 (32.2-58.4)	33.1 (25.1-40.1)	27.8 (23.8-32.9)	36.0 (14.7-56.2)	23.0 (17.1-27.1)
4	0.0 (0.0-0.2)	0.0 (0.0-0.0)	23.2 (9.9-38.9)	16.8 (7.8-29.6)	38.9 (35.1-51.3)	37.3 (33.6-41.2)	37.9 (25.3-55.0)	45.9 (35.0-56.6)
5	1.0 (0.0-3.6)	0.0 (0.0-0.0)	19.1 (2.8-52.2)	4.9 (3.0-8.4)	20.6 (13.8-30.5)	25.2 (20.9-28.0)	59.4 (30.7-81.9)	69.9 (63.5-76.1)
6	0.8 (0.0-3.4)	0.0 (0.0-0.0)	27.1 (8.1-44.6)	9.7 (7.4-14.7)	20.6 (15.2-28.3)	29.6 (20.6-34.0)	51.4 (34.0-66.5)	60.7 (57.3-62.2)
7	0.3 (0.0-1.0)	0.9 (0.0-3.3)	60.2 (34.9-79.9)	61.5 (50.9-70.0)	20.8 (9.6-30.8)	20.2 (13.0-26.2)	18.6 (5.8-33.6)	17.5 (13.7-22.9)
8	0.3 (0.0-1.1)	0.1 (0.0-0.2)	37.0 (22.0-48.1)	39.4 (32.9-43.6)	35.6 (27.0-40.9)	33.7 (30.0-36.6)	27.1 (19.1-42.7)	26.8 (23.6-33.0)
9	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.5 (0.3-0.7)	2.5 (0.3-13.2)	21.1 (17.8-23.7)	20.5 (18.1-25.0)	78.4 (76.0-81.6)	77.1 (61.8-81.1)
10	0.0 (0.0-0.0)	0.0 (0.0-0.0)	1.7 (0.3-5.7)	1.3 (0.8-1.9)	27.8 (25.1-29.3)	24.9 (19.8-27.8)	70.5 (67.6-74.6)	73.7 (71.0-79.0)
11	0.7 (0.1-1.6)	1.0 (0.1-2.7)	68.6 (59.0-79.4)	76.3 (55.8-87.3)	21.1 (11.9-25.9)	16.4 (11.6-29.8)	9.7 (6.6-15.5)	6.3 (0.0-12.6)
12	4.6 (0.0-9.5)	3.3 (0.6-9.1)	79.2 (42.4-93.9)	84.9 (64.2-95.8)	12.6 (7.0-37.5)	9.3 (1.8-15.5)	3.7 (0.0-20.1)	2.5 (0.0-11.2)

Note: Data represent mean (range) for seven replicate box cores at each station

TABLE A-6
CONCENTRATIONS OF TRACE HEAVY METALS, TOTAL ORGANIC CARBON, AND OIL AND GREASE IN SEDIMENTS OF THE EXISTING SITES AND VICINITY*

Station	Mercury (mg/kg)		Cadmium (mg/kg)		Lead (mg/kg)		Arsenic† (mg/kg)	Total Organic Carbon (mg/g)		Oil and Grease (mg/g)	
	Sep	Jan	Sep	Jan	Sep	Jan	Sep	Sep	Jan	Sep	Jan
1	0.01, 0.03	0.02, 0.02	0.02, 0.04	0.03, 0.03	0.14, 0.04	0.15, 0.35	1.11, 0.85	3.26, 3.99	4.10, 8.65	2.08, 0.66	1.16, 0.56
2	0.02, 0.03	0.03, 0.04	0.01, 0.03	0.01, 0.04	0.02, 0.04	0.02, 0.57	1.13, 1.00	7.37, 6.83	4.59, 7.42	1.25, 1.05	0.47, 5.26
3	0.02, 0.03	0.03, 0.02	0.02, 0.03	0.02, 0.02	0.03, 0.01	0.74, 0.02	0.73, 0.97	5.90, 5.92	2.43, 3.74	0.79, 0.53	0.34, 1.95
4	0.03, 0.03	0.04, 0.01	0.04, 0.03	0.05, 0.03	0.05, 0.10	0.42, 0.20	1.19, 1.18	9.28, 5.77	6.61, 6.16	0.98, 5.20	2.05, 1.14
5	0.04, 0.04	0.04, 0.03	0.13, 0.07	0.03, 0.05	0.82, 0.33	0.61, 0.64	1.77, 1.92	10.80, 12.08	12.30, 10.55	3.05, 2.22	1.56, 2.30
6	0.02, 0.01	0.05, 0.02	0.03, 0.05	0.04, 0.02	0.02, 0.15	1.33, 0.42	0.91, 1.59	5.04, 9.98	9.32, 9.26	3.71, 2.96	0.28, 1.49
7	0.01, 0.01	0.02, 0.02	0.02, 0.02	0.02, 0.02	1.44, 1.68	0.38, 0.37	1.28, 1.25	1.86, 2.71	3.54. 2.03	0.65, 0.90	0.57, 1.13
8	0.02, 0.02	0.03, 0.04	0.02, 0.04	0.02, 0.02	0.07, 0.11	0.09, 0.12	1.57, 1.20	4.12, 6.71	4.99, 4.96	3.40, 1.24	0.95, 1.18
9	0.03, 0.02	0.02, 0.02	0.09, 0.08	0.02, 0.02	2.63, 1.23	0.62, 0.49	1.80, 2.27	11.22, 11.71	10.55, 11.11	5.48, 1.82	1.01, 1.20
10	0.03, 0.04	0.02, 0.05	0.10, 0.08	0.04, 0.04	2.59, 1.02	1.09, 0.83	2.67, 2.43	12.54, 12.37	12.38, 14.06	2.44, 2.99	5.11, 3.77
11	0.01, 0.01	0.01, 0.01	0.01, 0.02	0.01, 0.01	0.02, 0.02	0.06, 0.02	0.75, 1.32	2.02, 2.08	1.59, 1.59	0.46, 1.21	2.23, 0.72
12	0.01, 0.01	0.01, 0.01	0.03, 0.01	0.01, 0.01	0.02, 0.02	0.01, 0.01	1.24, 0.61	5.03, 1.44	0.55, 0.57	0.94, 0.64	0.06, 0.23

* Values represent single analysis from duplicate box cores

† Arsenic analyses not performed for January 1980 survey

TOC concentrations also appeared to decrease with increasing distance from shore (Figure A-2) and increasing sediment grain size (Table A-6). Values ranged from 0.55 to 14.06 mg/g, with the highest concentrations occurring at nearshore stations 10, 9, and 5. Minimum TOC concentrations were found at seaward stations 7, 11, and 12. TOC showed positive correlations ($p<0.01$) with percent clay, percent silt, and oil and grease. No significant differences in TOC levels were observed between surveys. TOC concentrations were similar to those measured in the general area by DOE (1978).

Spatial distributions of oil and grease concentrations showed some similarity to those for other sediment parameters. Relationships with grain size and distance from shore, however, were relatively weak. Oil and grease levels ranged from a minimum of 0.06 mg/g during January at Station 12, to maxima over both surveys in excess of 5 mg/g at Stations 2, 4, 9, and 10. The minimum concentration was similar to the low of 0.05 mg/g measured at the Existing Sites by Horne and Swirsky (1979); the maximum concentration measured during the latter study was only 0.7 mg/g, substantially lower than the EPA/IEC survey maximum (5.48 mg/g). The reason for presence of such high levels during the surveys is not known, but may be related to differences in analytical methods.

Sediment CHC (PCB's, pesticides, and derivatives) concentrations were determined only for Stations 1, 6, 10, 11 and 12 (Table A-7). During September, all CHC's at these stations were below detectable levels (<0.01 ng/g). Only op'DDE, pp'DDE, and dieldrin were measurable in January; concentrations were all below 6 ng/g, and measurable at Stations 10 and 11, only. Higher levels were determined for Station 10 relative to Station 11, probably as a result of the greater proportions of silt and clay at Station 10. A previous study at the Existing Sites yielded similar levels (<10 ng/g) of CHC's (Horne and Swirsky, 1979).

Tissue Chemistry

Concentrations of trace metals and chlorinated hydrocarbons (CHC's) in organisms collected in trawls were generally low (Table A-8). Most CHC's were

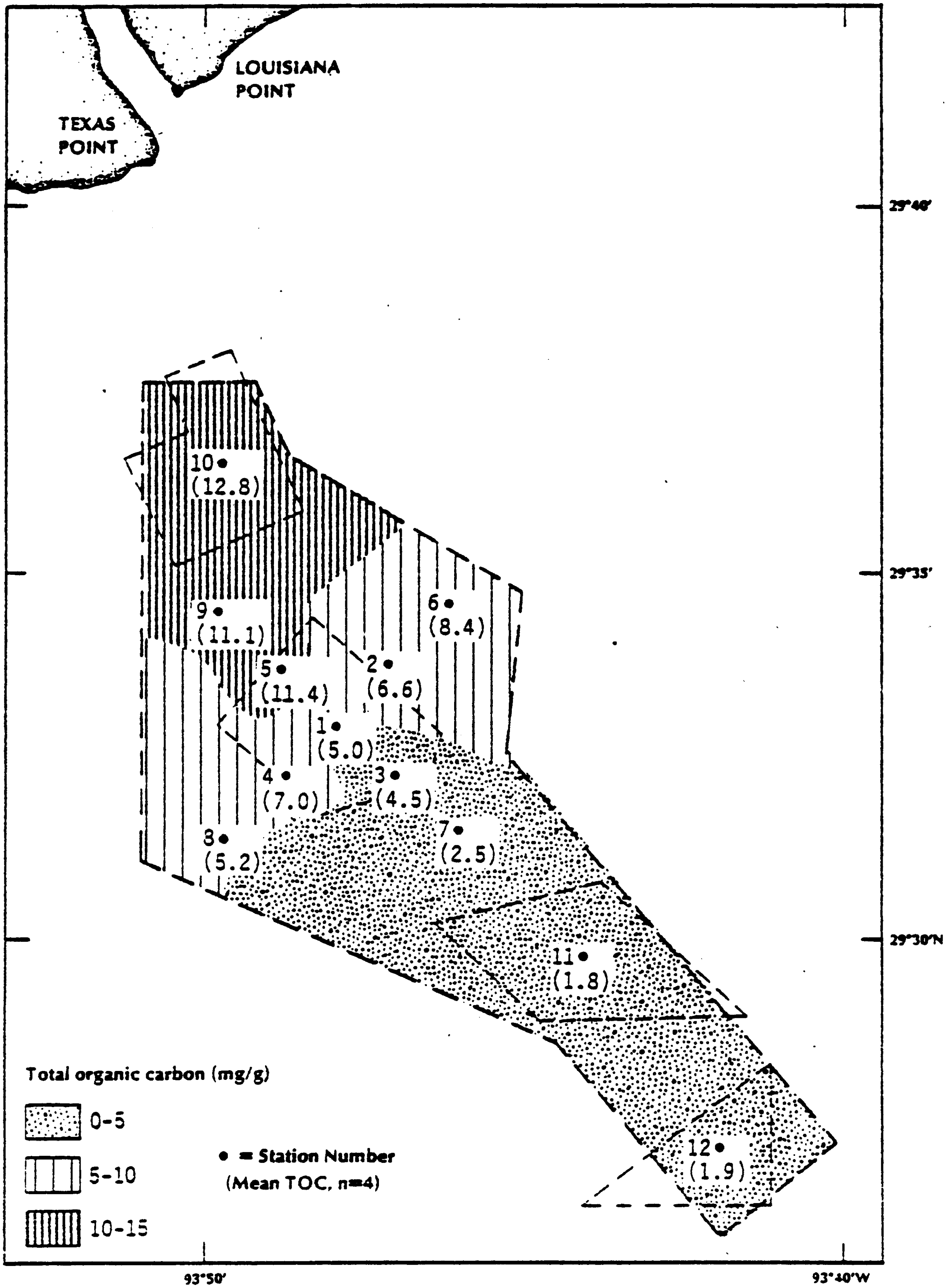

Figure A-2. Total Organic Carbon (mg/g) at the Existing Sites and Vicinity

TABLE A-7
SEDIMENT CHLORINATED HYDROCARBON CONCENTRATIONS IN THE EXISTING SITES AND VICINITY (JANUARY DATA ONLY)*

Compound	Station	
	10	11
op'DDE	ND	0.02
pp'DDE	0.32	0.03
Dieldrin	5.58	ND

* All concentrations in nanograms per gram (ng/g = 10^{-9} g/g)

ND = None detected

below detectable levels in anchovies and shrimp; only PCB (Arochlor 1242) was detected in a single shrimp sample collected during January 1981. The concentration of 0.01 ng/g PCB was substantially lower than the U.S. Food and Drug Administration tolerance level of 5,000 ng/g (21 CFR Part 109). Trace metal (mercury, cadmium, and lead) concentrations in shrimp (Trachypeneus similis) collected during January were within ranges reported by Tillery (1980) for this species in coastal waters of the Gulf of Mexico. No historical data for trace metals in the crab Portunus spinimanus were available; however, the mercury concentration in this species (1.01 µg/g) slightly exceeded the FDA action level of 1.0 µg/g (FDA, 1981). These crabs were collected outside the ODMDS. No explanation can be given for this elevated mercury level.

Elutriate Tests

Elutriate tests indicated little or no release of mercury, cadmium, or lead into seawater mixed with sediment from Stations 1 and 6 (Table A-9).

TABLE A-8
DRY WEIGHT CONCENTRATIONS OF TRACE
METALS AND CHLORINATED HYDROCARBONS (CHC's) IN
ORGANISMS COLLECTED IN TRAWLS IN VICINITY OF EXISTING SITES

Station	Species	Trace Metals (μg/g) Hg	Cd	Pb	CHC's
September 1980					
1	<u>Anchoa hepsetus</u> (anchovy)	-	-	-	ND
1	<u>Xiphosura kroyeri</u> (shrimp)	-	-	-	ND
6	<u>Anchoa hepsetus</u> (anchovy)	-	-	-	ND
6	<u>Penaeus aztecus</u> (shrimp)	-	-	-	ND
January 1981					
1	<u>Trachypeneus similis</u> (shrimp)	0.063	0.082	0.443	-
6	<u>Portunus spinimanus</u> (crab)	1.01	0.122	0.322	-
6	<u>Penaeus setiferus</u> (shrimp)	-	-	-	PCB (Arochlor 1242): 0.01 ng/g*

- = Not determined (insufficient sample)

ND = None detected

* No other CHCs detected (see methods section for CHC's examined)

BIOLOGY

Benthos

Macrofauna at the Existing Sites were best represented by polychaeteous annelids; 19 species were abundant in September 1979, whereas 27 species were abundant in January 1980 (Tables A-10 and A-11). The majority of polychaete species were small-bodied organisms typical of mud to sand habitats.

TABLE A-9
RESULTS OF ELUTRIATE TESTS* FOR SEDIMENTS INSIDE AND OUTSIDE EXISTING SITE #3

Station	Concentration in Test Water Hg	Cd	Pb	Pretest Concentration Hg	Cd	Pb
1 (inside Site 3)	0.003	<0.06	0.126	<0.003	<0.06	0.009
6 (outside Site 3)	<0.003	0.019	0.366	<0.003	0.018	0.430

* Sediment and water collected during September 1979; all concentrations are µg/liter in dissolved phase

The nemertean ribbon worm, Cerebratulus lacteus, was common throughout the area, as was the hemichordate acorn worm, Balanoglossus cf. aurantiacus. Molluscs were represented by a few bivalve species; these were especially abundant at Station 2 in January 1980. Only two arthropod species were abundant in September 1979, but by January seven species were common; these included amphipods, cumaceans, shrimp, and pea crabs.

Quantitative data for the eight most abundant species among both surveys were analyzed by one-way analyses of variance (ANOVA), followed by multiple-range tests to elucidate temporal and spatial distribution patterns (Table A-12). A summary of distributions along with biological notes for each of the eight species is presented in Table A-13. Densities of two species, Balanoglossus cf. aurantiacus and Magelona cf. phyllisae, did not significantly change between surveys, but both species displayed spatial patterns among stations. B. cf. aurantiacus was most abundant in the center of the study area, especially at Stations 4, 7, and 8 (Figure A-3), where sediments were silty-clayey sands. M. cf. phyllisae was most abundant in sandy sediments at Station 11 (Figure A-4).

TABLE A-10
TOTAL NUMBERS AND RELATIVE PERCENTAGES OF MACROFAUNA COLLECTED AT THE EXISTING SITES AND VICINITY, SEPTEMBER 1979

Species	Feeding Type	STATION 1	2	3	4	5	6	7	8	9	10	11	12
CNIDARIA:													
Anemone sp. A	S			10(1.4)									
Anemone sp. B	S			55(7.5)									
NEMATODA	TD						13(1.1)						
NEMERTINEA:													
†*Cerebratulus lacteus*	C	35(6.0)	131(20.5)	55(7.5)	73(13.7)	33(11.7)	86(7.3)	94(5.7)	89(9.6)	67(7.7)	28(2.2)	102(3.8)	16(1.4)
Nemertean sp. A	C										19(1.5)		
ANNELIDA:													
Lepidasthenia varia	C							24(1.4)					38(3.3)
†*Paramphinome pulchella*	C	40(6.8)	76(11.9)	97(13.2)	66(12.4)	36(12.8)	119(10.2)	105(6.3)	65(7.0)	175(20.2)	139(10.7)	12(0.5)	52(4.5)
Gyptis brevipalpa	C									14(1.6)			
Podarke obscura	C					13(4.6)							
Ancistrosyllis jonesi	TD			9(1.2)									54(4.7)
A. papillosa	TD							19(1.1)					
†*Sigambra tentaculata*	TD	6(1.0)	46(7.2)	20(2.7)	15(2.8)	17(6.1)	93(7.9)	36(2.2)	38(4.1)	61(7.0)	67(5.2)	27(1.0)	81(7.1)
Glycinde solitaria	C					6(2.1)				35(4.0)	119(9.1)		
Diopatra cuprea	O			8(1.1)	3(0.6)							16(0.6)	47(4.1)
Lumbrineris verrilli	TD											75(2.8)	
†*Paraprionospio pinnata*	D	48(8.2)	145(22.7)	74(10.1)	51(9.6)	62(22.1)	482(41.1)	161(9.7)	83(9.0)	392(45.2)	739(56.8)	219(8.2)	126(11.0)
Prionospio cirrifera	D												30(2.6)
†*Magelona* cf. *phyllisae*	D	37(6.3)	52(8.1)	86(11.7)	97(18.2)	14(5.0)	46(3.9)	527(31.8)	191(20.7)	18(2.1)	74(5.7)	1611(60.5)	134(11.7)
Paradonela lyra	D		16(2.5)										36(3.1)
†*Cossura delta suyeri*	D	21(3.6)	38(5.9)	33(4.5)	42(7.9)	31(11.0)	47(4.0)	39(2.4)	76(8.2)	15(1.7)	16(1.2)	13(0.5)	
†*Mediomastus californiensis*	D	0(0)	18(2.8)	1(0.1)	4(0.8)	1(0.4)	28(2.4)	37(2.2)	2(0.2)	31(3.6)	47(3.6)	110(4.1)	108(9.4)

TABLE A-10 (continued)

Species	Feeding Type	STATION 1	2	3	4	5	6	7	8	9	10	11	12
Branchiomaychis americana	D			10(1.4)			12(1.0)		5(0.5)				
Owenia fusiformis	D												24(2.1)
Ampharete americana	D							38(2.3)				18(0.7)	
MOLLUSCA:													
Cyrtopleura costata	S	164(27.9)		11(1.5)									
Pelecypoda sp. A	?	13(2.2)											
ARTHROPODA:													
Copepoda spp.	?D							15(0.9)	23(2.5)	28(3.2)			85(7.4)
Oxyurostylis smithi	D	20(3.4)		22(3.0)				24(1.4)				46(1.7)	
SIPUNCULIDA:													
Golfingia murinae bilobatae	D				3(0.6)	16(5.7)			29(3.1)				
Phascolion sp. A	D											12(0.5)	
Sipunculida sp. B	D		5(0.8)	14(1.9)					42(4.6)			34(1.3)	
HEMICHORDATA:													
‡*Balanoglossus* cf. *aurantiacus*	D	80(13.6)	13(2.0)	74(10.1)	88(16.5)	19(6.8)	26(2.2)	103(6.2)	157(17.01)	1(0.1)		19(0.7)	74(6.4)
CHAETOGNATHA:													
Sagitta spp.	C												46(4.0)
Total %		464 (79.0)	540 (84.4)	579 (78.9)	442 (83.1)	248 (88.3)	952 (81.2)	1222 (73.6)	800 (86.5)	837 (96.4)	1248 (96.0)	2314 (86.9)	951 (82.8)

‡ Species selected for additional analysis based on abundance and ecological significance.

Notes: Rare species not listed; relative percentages (in parentheses) based on total abundance of all individuals (including rare species) collected among five core samples from each station; S = suspension feeder, D = Deposit feeder, C = Carnivore, and O = Omnivore

TABLE A-11
TOTAL NUMBER AND RELATIVE PERCENTAGE OF MACROFAUNA COLLECTED AT THE EXISTING SITES AND VICINITY, JANUARY 1980

Species	Feeding Type	STATION 1	2	3	4	5	6	7	8	9	10	11	12
NEMATODA:	D	32(4.9)	17(0.9)	20(3.2)									
NEMERTINEA:													
1Cerebratulus lacteus	C	50(7.7)	12(0.6)	57(9.1)	28(5.5)	25(12.0)	23(4.8)	31(5.1)	43(9.0)	56(22.2)	25(2.5)	43(2.2)	11(1.1)
Nemertean, unidentified	C											57(2.9)	
ANNELIDA:													
Lepidasthenia varia	C					8(3.8)							
Sthenelais boa	C												6(0.6)
S. limicola	C	4(0.6)				6(2.9)							
Sthenelais sp.	C				8(1.6)								
1Paramphinome pulchella	C		108(5.9)		1(0.2)		81(16.8)			72(28.6)	147(14.9)	1(0.1)	23(2.4)
Pseudoeurythoe ambigua	C						7(1.4)				7(0.7)		
Ancistrosyllis jonesi	TO			6(1.0)						3(1.2)			
Sigambra wassi	TO					1(0.5)							
1S. tentaculata	TO	3(0.5)	9(0.5)	3(0.5)	6(1.2)	3(1.4)	21(4.3)		6(1.3)	8(3.2)	66(6.7)	21(1.1)	6(0.6)
Gyptis brevipalpa	C					8(3.8)							
G. vittata	C					8(3.8)							
Nereis micromma	O												19(2.0)
Aglaophamus verrilli	C												13(1.4)
Lumbrineris verrilli	O											36(1.8)	
1Paraprionospio pinnata	D	31(4.8)	40(2.2)	67(10.7)	21(4.1)	19(9.1)	50(10.4)	20(3.3)	19(4.1)	41(16.3)	354(36.0)	47(2.4)	22(2.3)
Prionospio cirrifera	D	41(6.3)			6(1.2)			23(3.8)				83(4.3)	88(9.2)
Scoloplos rubra	D												13(1.4)
Spiophanes bombyx	D	92(14.2)		25(4.0)				66(10.8)				175(9.0)	338(35.3)
1Magelona cf. phylliseae	D	68(10.5)	25(1.4)	77(12.2)	60(11.7)	5(2.4)	53(11.0)	172(28.1)	118(25.5)	5(2.0)	90(9.1)	945(48.4)	58(6.1)
Armandia maculata	D	2(0.3)			18(3.5)								
Aricidea sp. B	D								6(1.3)				
1Cossura soyeri	D	37(5.7)	10(0.5)	28(4.5)	32(6.3)	2(1.0)	36(7.5)	3(0.5)	30(6.5)	17(6.7)	9(0.9)	8(0.4)	

TABLE A-11 (Continued)

Species	Feeding Type	STATION 1	2	3	4	5	6	7	8	9	10	11	12
Capitella capitata													9(0.9)
†*Mediomastus californiensis*	D	84(13.0)	147(8.0)	64(10.2)	14(2.7)	8(3.8)	35(7.2)	9(1.5)	18(3.9)	11(4.4)	82(8.3)	177(9.1)	109(11.4)
Owenia fusiformis													47(4.9)
Ampharetidae, unidentified	D	23(3.5)	102(5.5)			6(2.9)	44(9.1)			7(2.8)			
Sabellides capensis	S					3(1.4)							
MOLLUSCA:													
Abra aequalis	S		213(11.6)				14(2.9)	7(1.1)				31(1.6)	
Cyrtopleura costata	S		21(1.1)										
Mulinia lateralis	S		1032(56.1)										
Pelecypoda, unidentified	?							5(0.8)			56(5.7)		
ARTHROPODA:													
Corophium tuberculatum	S		16(0.9)				15(3.1)					17(0.9)	
Ericthonius brasiliensis	S												11(1.1)
Oxyurostylis smithii	D									2(0.8)			
O. cf. *smithii*	D		14(0.8)			7(3.3)							
Pinnixa pearsei	O	43(6.6)		45(7.2)	81(15.8)	46(22.0)		51(8.3)	53(11.5)	2(0.8)	4(0.4)		
Pinnixa sp.	O			4(0.6)									
Trachypenaeus similis	O									3(1.2)			
SIPUNCULIDA:													
Golfingia murinae bilobatae	D	4(0.6)		19(3.0)	10(2.0)			19(3.1)	15(3.2)				
HEMICHORDATA:													
†*Balanoglossus* cf. *aurantiacus*	D	33(5.1)		57(9.1)	164(32.0)	18(8.6)	1(0.2)	115(18.8)	89(19.3)	6(2.4)	2(0.2)	2(0.1)	12(1.3)
Total		547	1766	472	449	173	380	521	397	233	842	1643	785
%		(84.3)	(96.0)	(75.3)	(87.8)	(82.7)	(78.7)	(85.2)	(85.6)	(92.6)	(85.4)	(84.3)	(82.0)

† Species selected for additional analyses based on abundance and ecological significance.

Notes: Rare species not listed; relative percentages based on total abundance of all individuals (including rare species) collected among five core samples from each station; S = Suspension feeder, D = Deposit feeder, C = Carnivore; O = Omnivore.

TABLE A-12
SUMMARY OF ANALYSES OF VARIANCE FOR THE EIGHT DOMINANT MACROFAUNAL SPECIES AT THE EXISTING SITES AND VICINITY

Species	Between Surveys	Between Stations		
		Sept 1979	Jan 1980	Pooled†
C. lacteus	*	NS	NS	-
P. pulchella	*	*	*	-
S. tentaculata	*	*	*	-
P. pinnata	*	*	*	-
M. cf. phyllisae	NS	-	-	*
C. soyeri	*	*	*	-
M. californiensis	*	*	*	-
B. cf. aurantiacus	NS	-	-	*

* $p \leq 0.05$ (significant
NS $p > 0.05$ (non-significant)
† When data between surveys were NS, all data for each station was pooled, then tested by one-way analysis of variance.

Cerebratulus lacteus, Sigambra tentaculata, Paraprionospio pinnata, Cossura soyeri, and Paramphinome pulchella displayed greater abundance in September than in January; this probably represents seasonal recruitment of juveniles into the populations. C. lacteus was patchily distributed throughout the area, and no spatial trends could be determined. P. pinnata (Figures A-5 and A-6) and P. pulchella (Figure A-7, A-8) were more abundant on muddier sediments (particularly at Station 10) of the northern study area; of the two, the latter species was more patchy in its abundance. S. tentaculata was distributed primarily at the northern and southern ends of the study area (Figures A-9 and A-10). C. soyeri displayed a density pattern similar to B. cf. aurantiacus in that it mainly was associated with muddy sands in the center of the study area (Figures A-11 and A-12). Mediomastus californiensis was the only species which was more abundant in the January survey. Its greatest abundance occurred in the southern portion of the study area (Figures A-13 and A-14).

The spatial distributions displayed by many of the dominant species were not related to the positions of the disposal sites, but rather associated with

TABLE A-13
DISTRIBUTION AND BIOLOGICAL NOTES ON DOMINANT MACROFAUNAL SPECIES IN THE SABINE-NECHES WATERWAY

Species	Distribution in Study Area	Biological Notes
Balanoglossus cf. aurantiacus	Similar density in September 1979 and January 1980; greatest density in center of study area with clayey-silty sands.	Enteropneusta (acorn worm), up to 16 cm long; inhabits U-shaped burrow; surface deposit feeder, uses ciliary-mucous mechanism for sediment ingestion (Hyman, 1951; Gosner, 1971).
Magelona cf. phyllisae	Similar density in September 1979 and January 1980; abundant in sandy sediments of southern part of study area.	Mageloid polychaete, up to 4 cm long; burrowing deposit feeder (Hartman, 1969; Fauchald and Jumars, 1979).
Cerebratulus lacteus	Greater density in September 1979; no spatial abundance patterns apparent.	Nemertean (ribbon worm), up to 1.2m long; inhabits burrow; carnivorous on polychaetes (Hymen, 1968; Day, 1967).
Paraprionospio pinnata	Greater density in September 1979; most abundant on clay sediment of northern part of study area.	Spionid polychaete, up to 6 cm long; inhabits burrow; surface deposit feeder; probably opportunistic with high reproductive potential (Day, 1967; Fauchald and Jumars, 1979).
Sigambra tentaculata	Greater density in September 1979; patchy distribution, low density in center of area.	Pilargid polychaete, small-bodied, up to 2 cm long; carnivore or omnivore (Hartman, 1968; Day, 1967).
Cossura soveri	Greater density in September 1979; most abundant through center of study area in clayey-silty sand.	Cossurid polychaete, small-bodied, less than 2.0 cm long; deposit feeder (Fauchald and Jumars, 1979).
Paramphinome pulchella	Greater density in September 1979; patchy distribution, but more abundant in northern part of study area.	Amphinomid polychaete (fireworm), small-bodied, up to 1.5 cm; carnivorous (Pettibone, 1963; Fauchald and Jumars, 1979).
Mediomastus californiensis	Greatest density in January 1980; most abundant in sand sediments of southern study area.	Capitellid polychaete, body thread-like, less than 2.0 cm; burrowing deposit feeder; probably opportunistic with high reproductive potential (Hartman, 1947; Fauchald and Jumars, 1979).

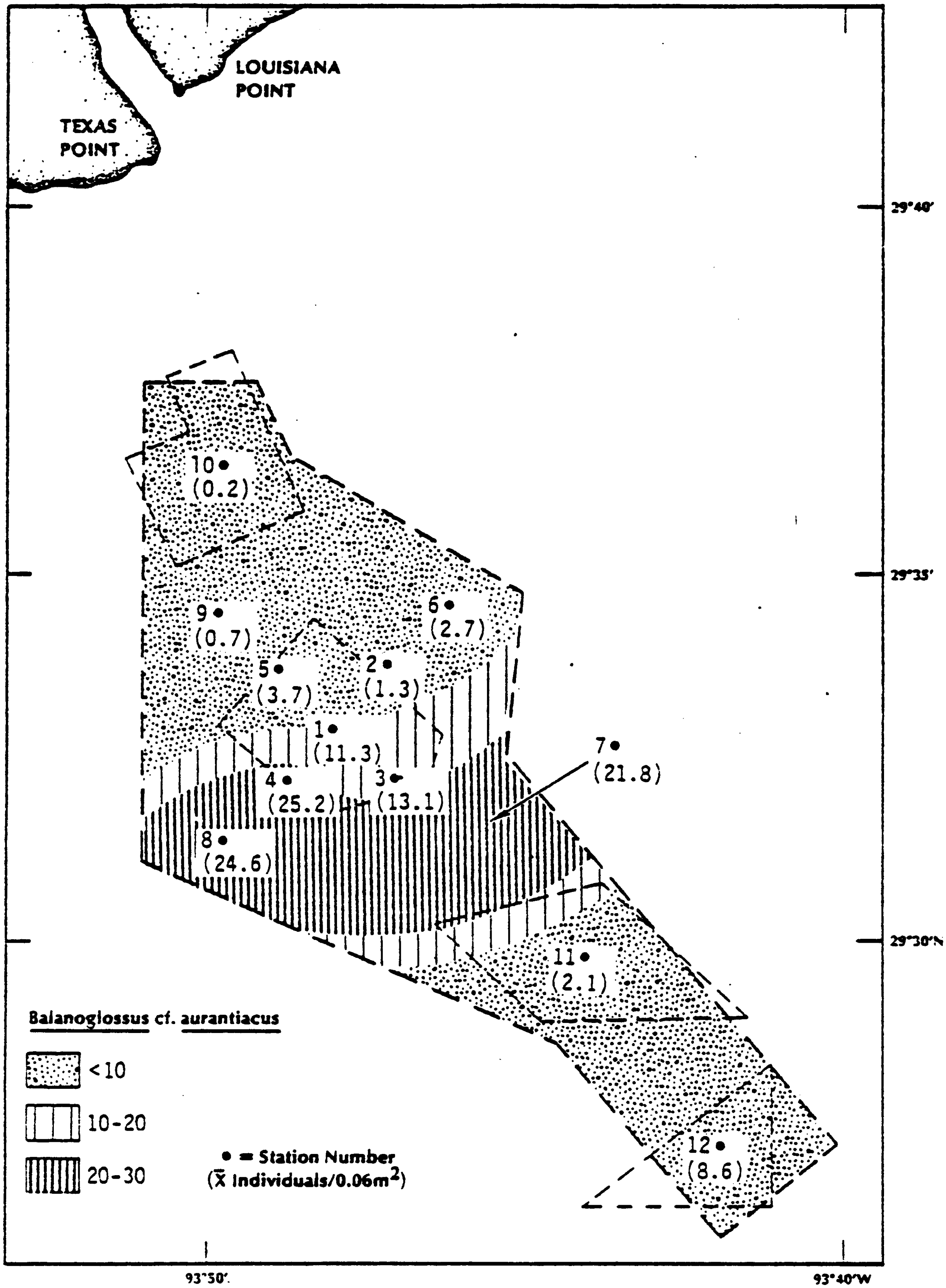

Figure A-3. Abundance of Balanoglossus cf. aurantiacus, Existing Sites and Vicinity (Pooled data from September 1979 and January 1980. Values are means of 10 replicates.)

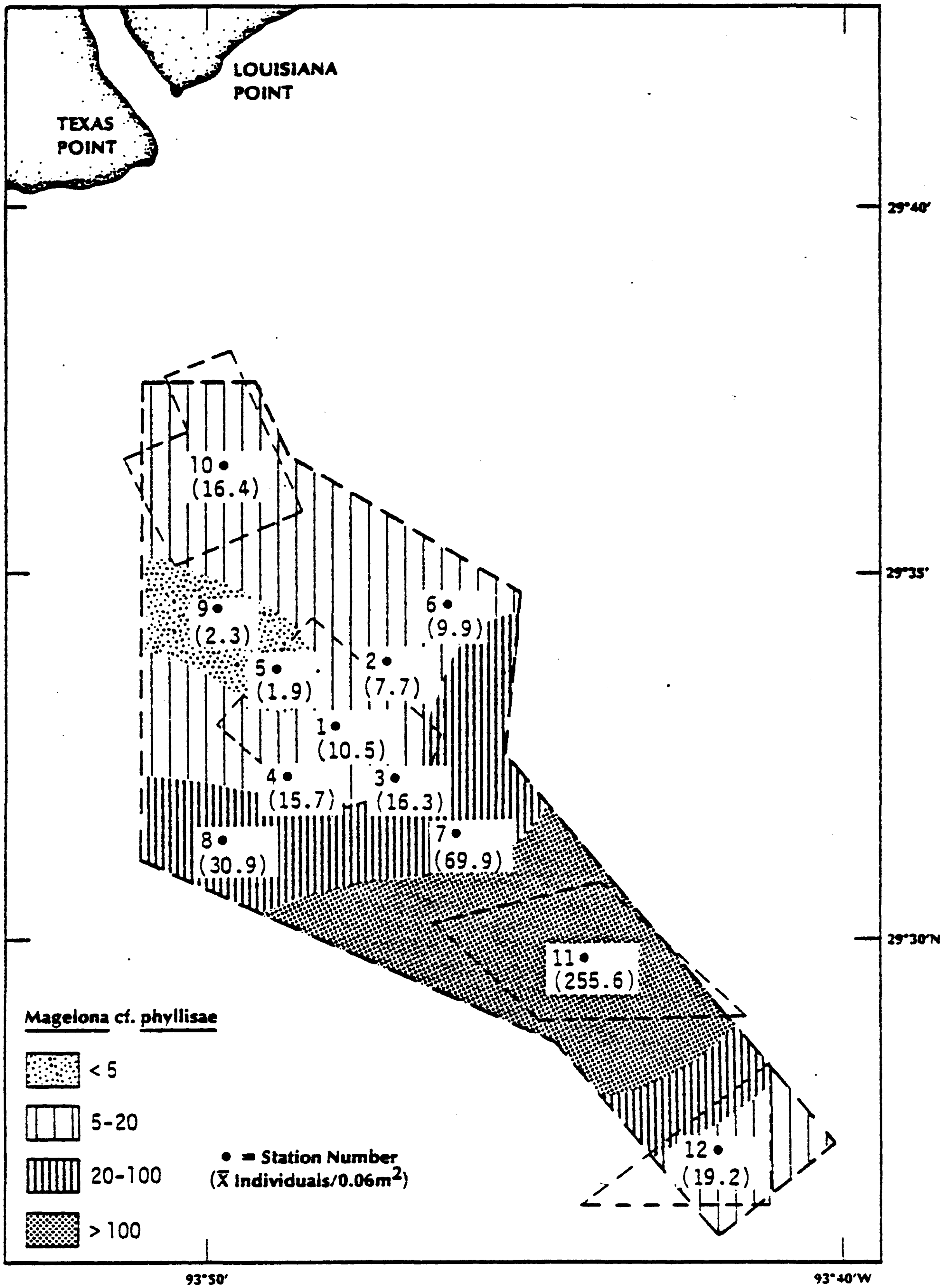

Figure A-4. Abundance of Magelona cf. phyllisae, Existing Sites and Vicinity (Pooled data from September 1979 and January 1980. Values are mean of 10 replicates.)

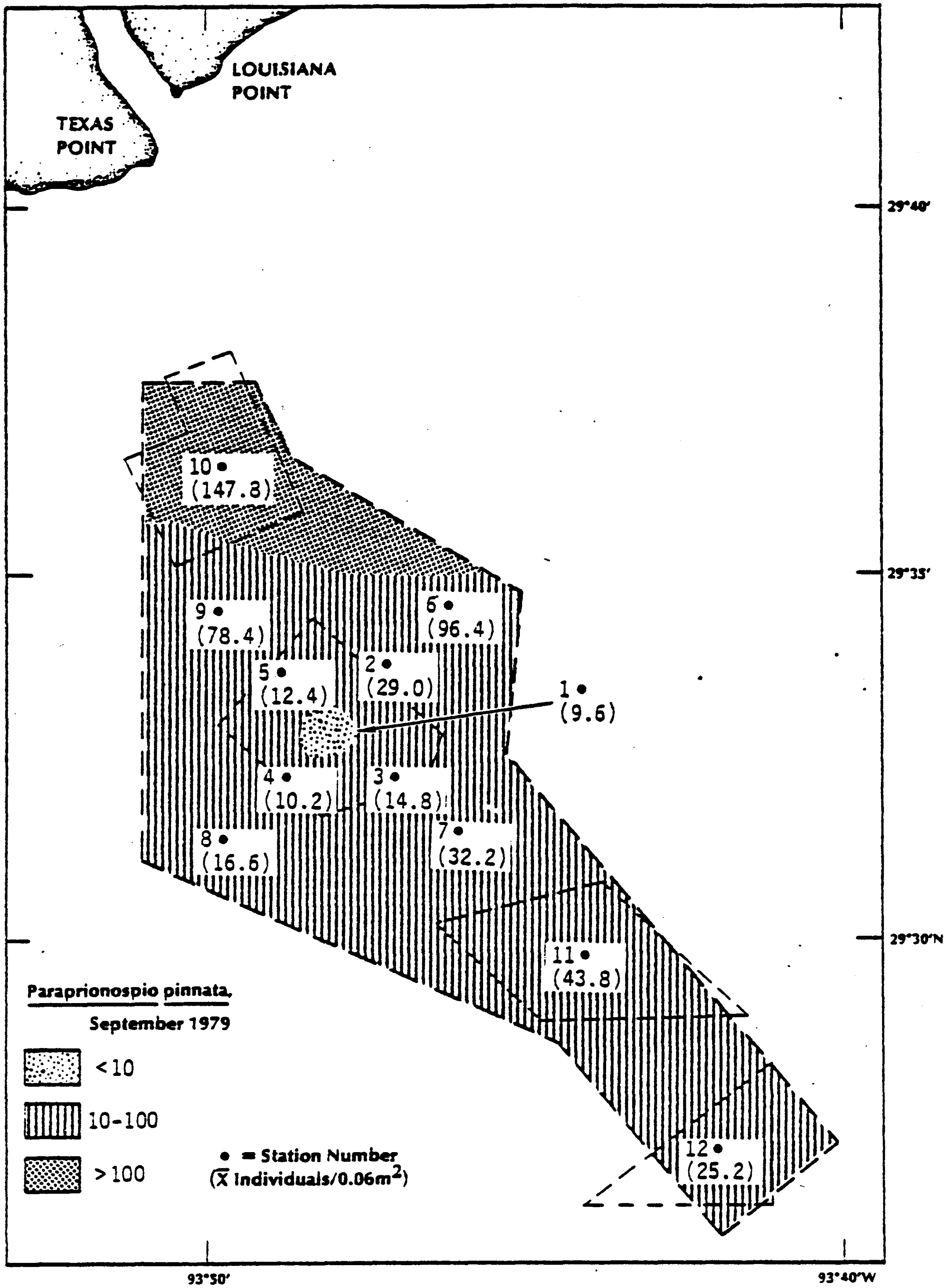

Figure A-5. Abundance of Paraprionospio pinnata, Existing Sites and Vicinity, September 1979
(Values are mean of 5 replicates.)

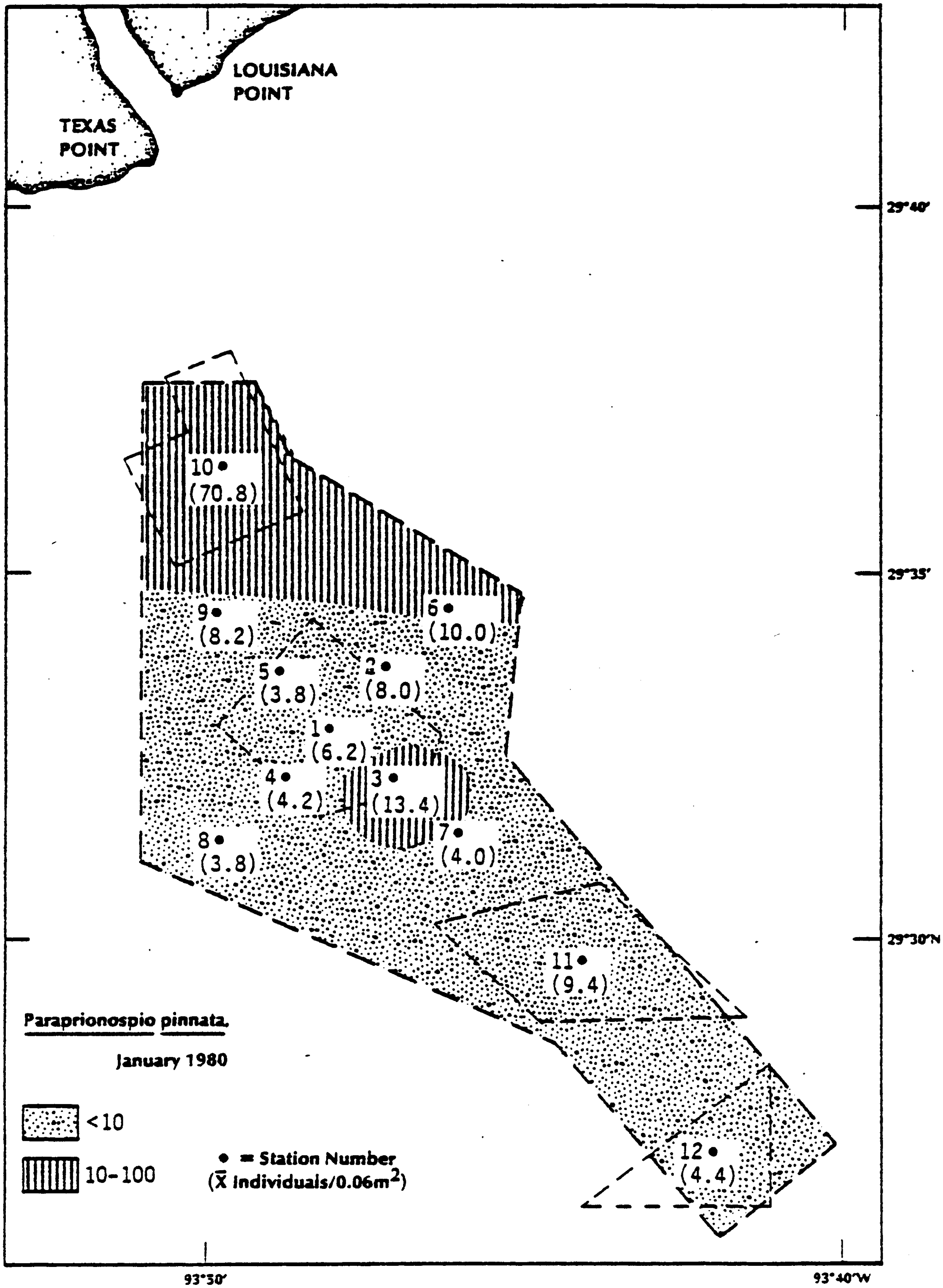

Figure A-6. Abundance of Paraprionospio pinnata, Existing Sites and Vicinity, January 1980
(Values are mean of 5 replicates.)

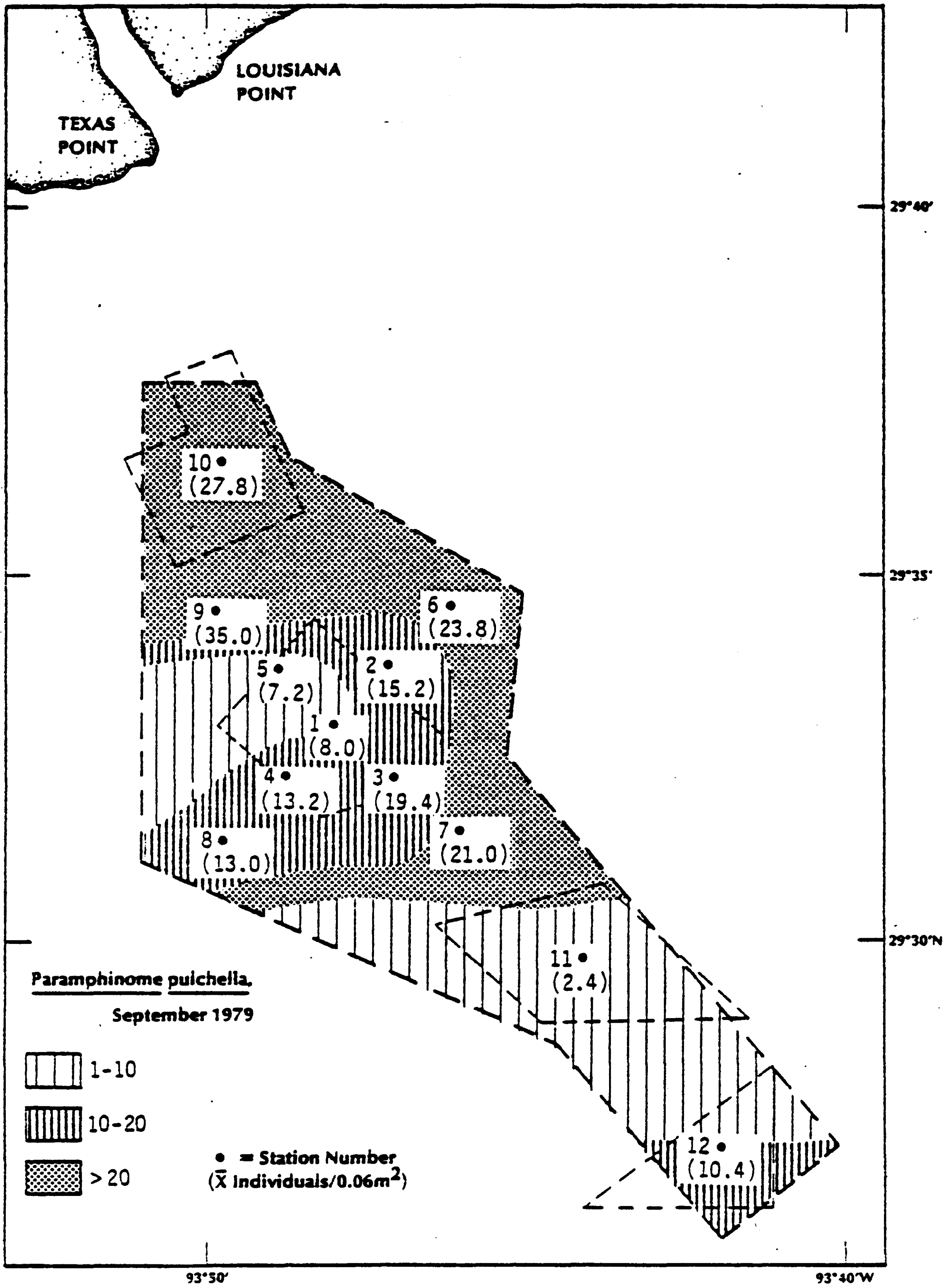

Figure A-7. Abundance of Paramphinone pulchella, Existing Sites and Vicinity, September 1979
(Values are mean of 5 replicates.)

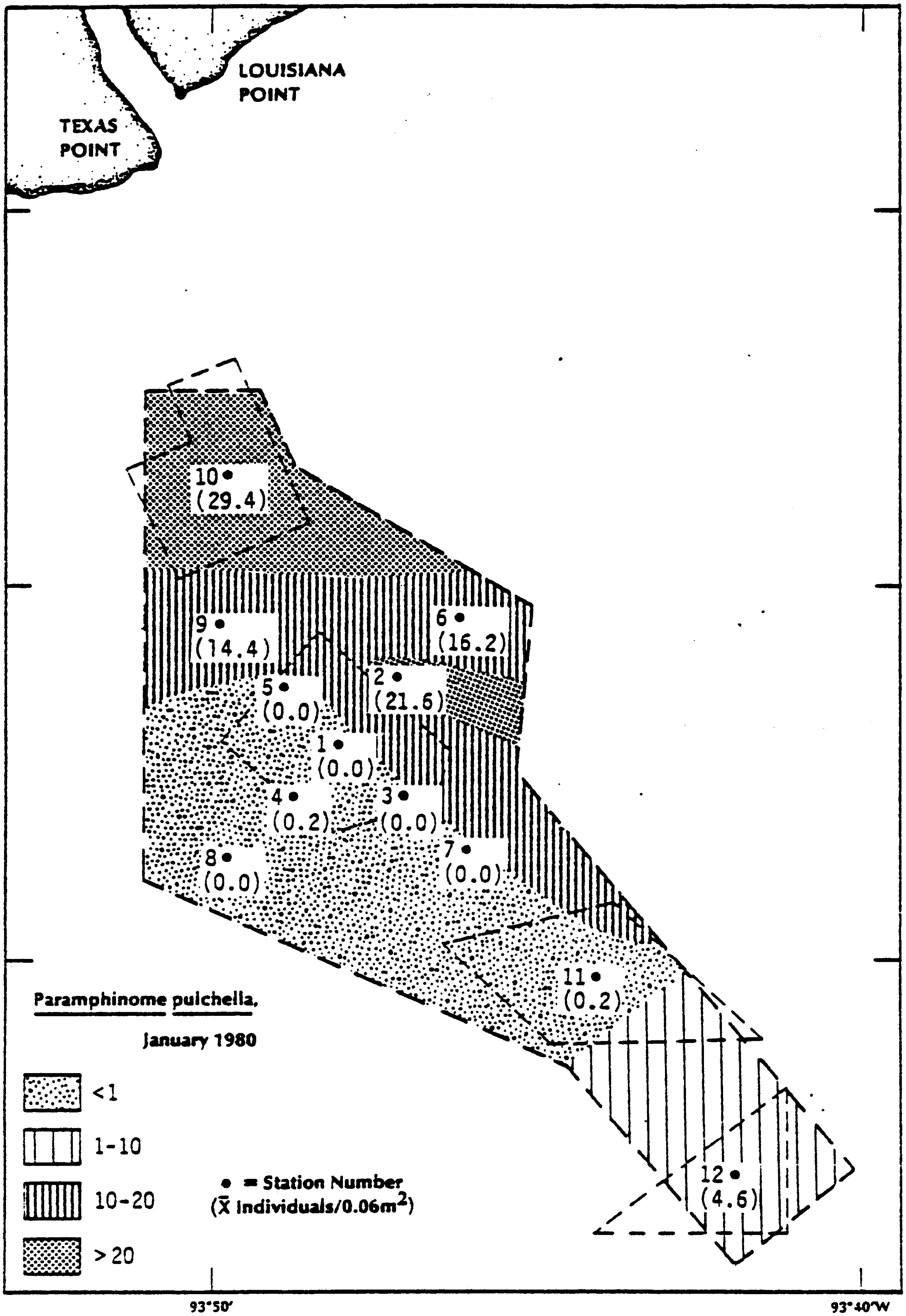

Figure A-8. Abundance of Paramphinome pulchella, Existing Sites and Vicinity, January 1980
(Values are mean of 5 replicates.)

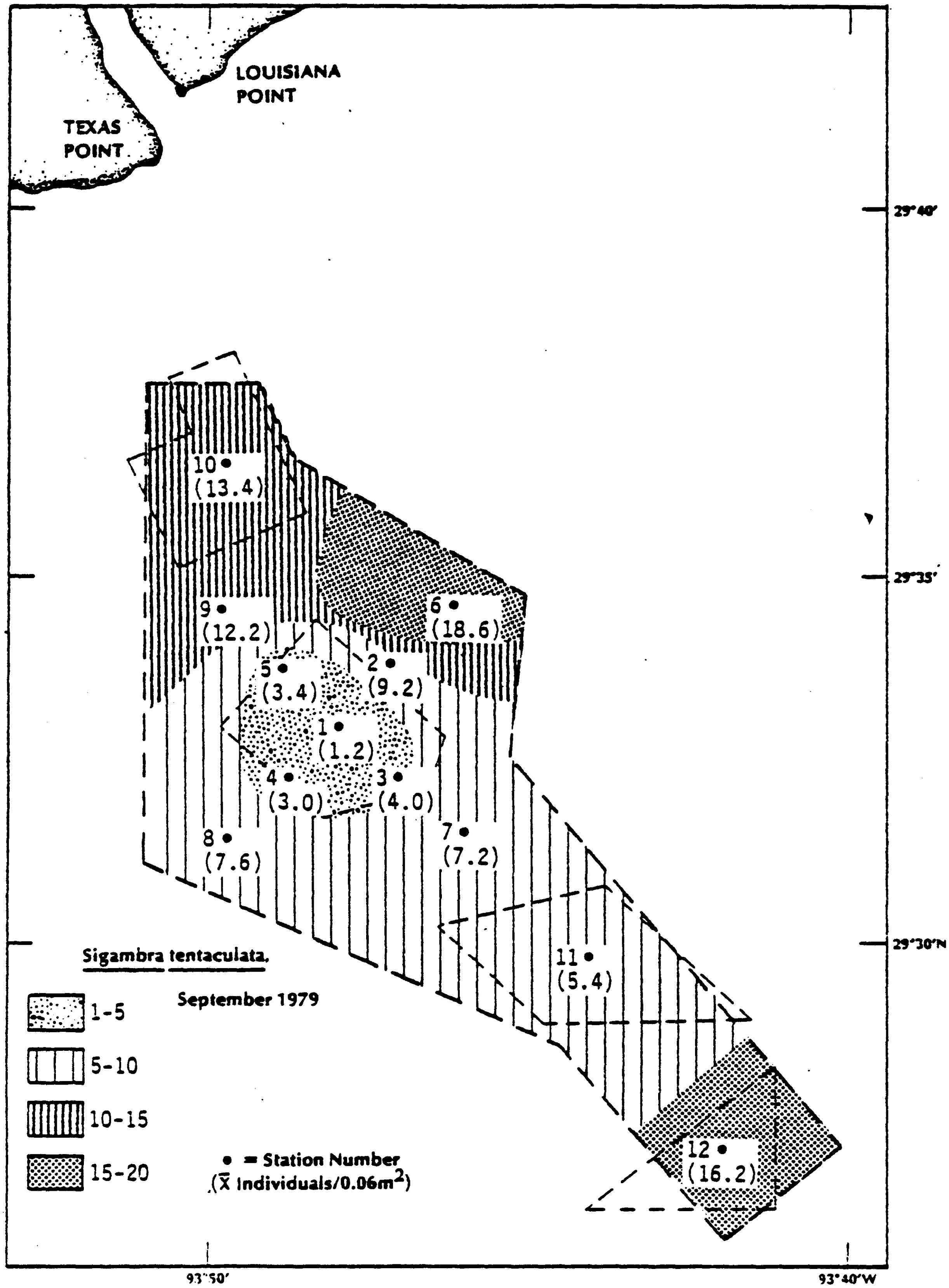

Figure A-9. Abundance of Sigambra tentaculata, Existing Sites and Vicinity, September 1979
(Values are mean of 5 replicates.)

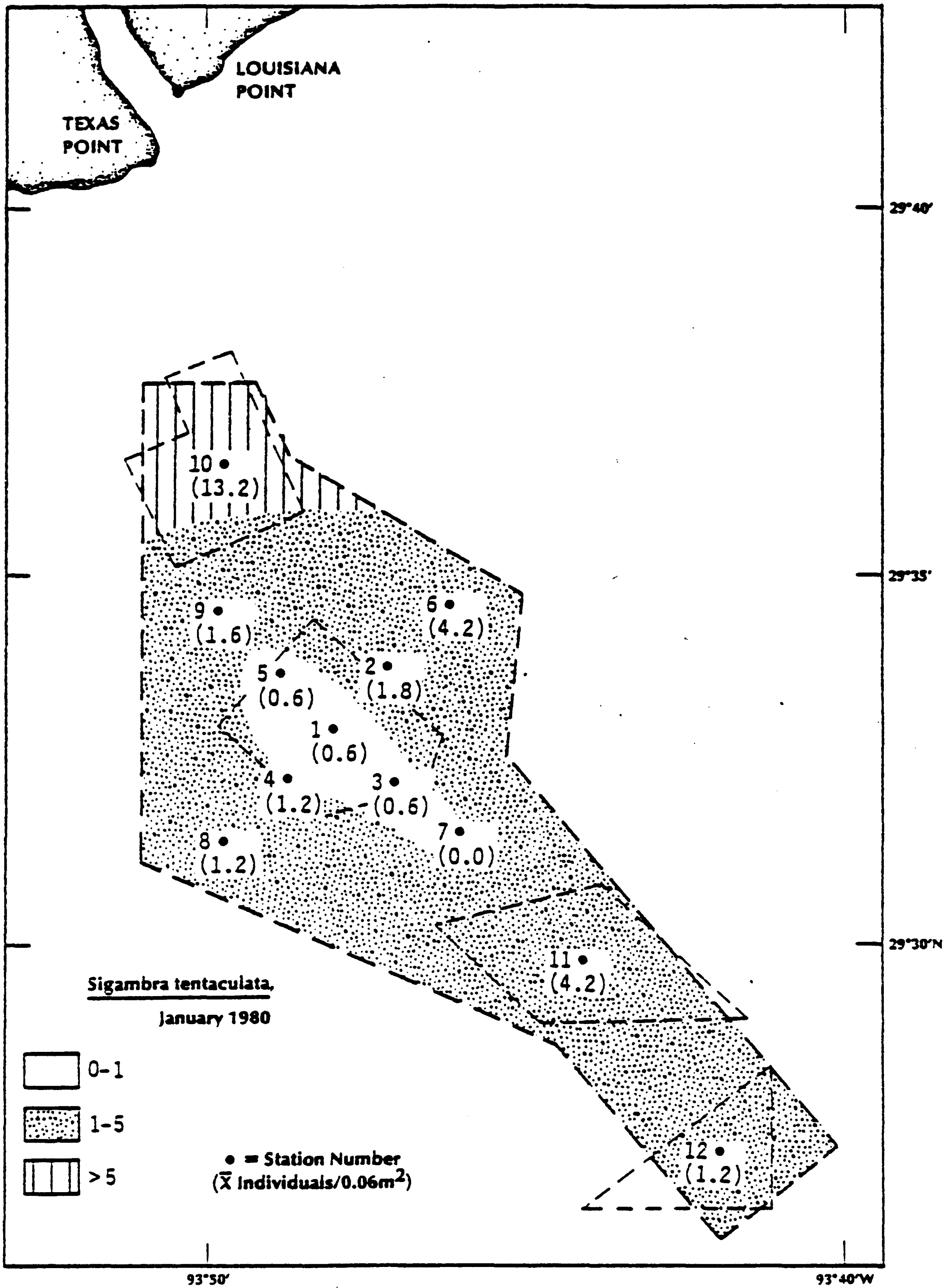

Figure A-10. Abundance of Sigambra tentaculata, Existing Sites and Vicinity, January 1980
(Values are mean of 5 replicates.)

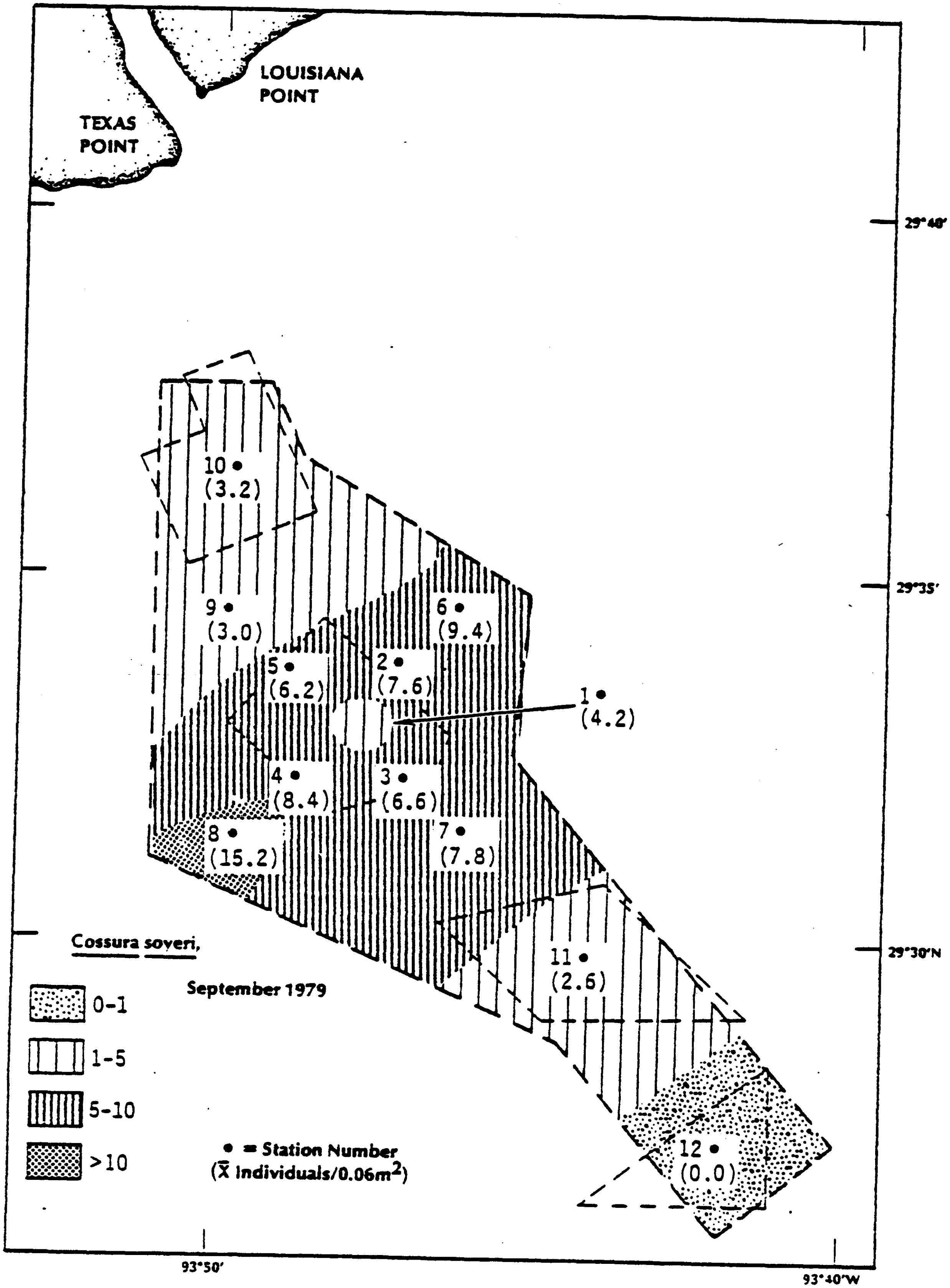

Figure A-11. Abundance of Cossura soyeri, Existing Sites and Vicinity, September 1979
(Values are mean of 5 replicates.)

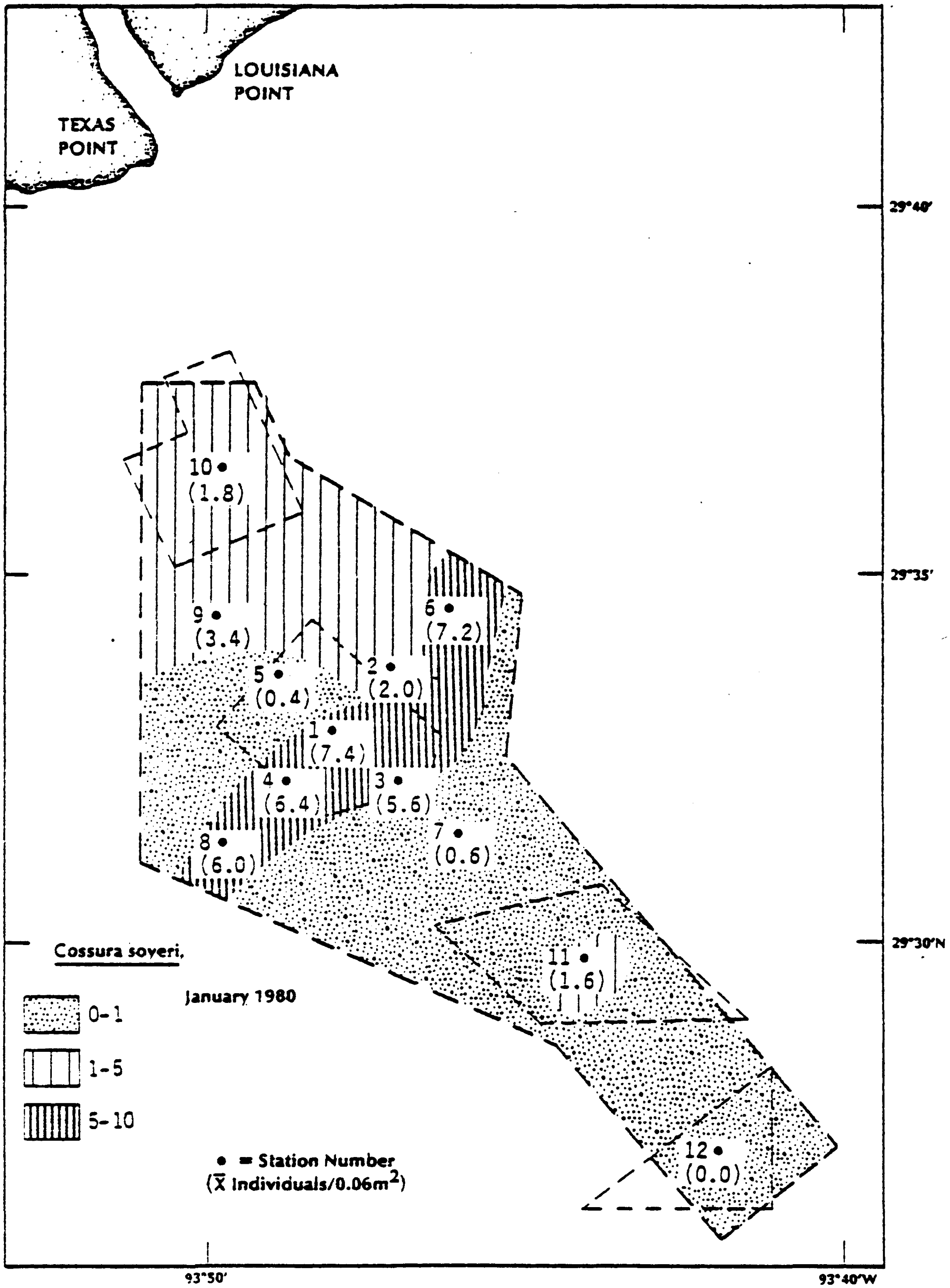

Figure A-12. Abundance of Cossura soyeri, Existing Sites and Vicinity, January 1980
(Values are mean of 5 replicates.)

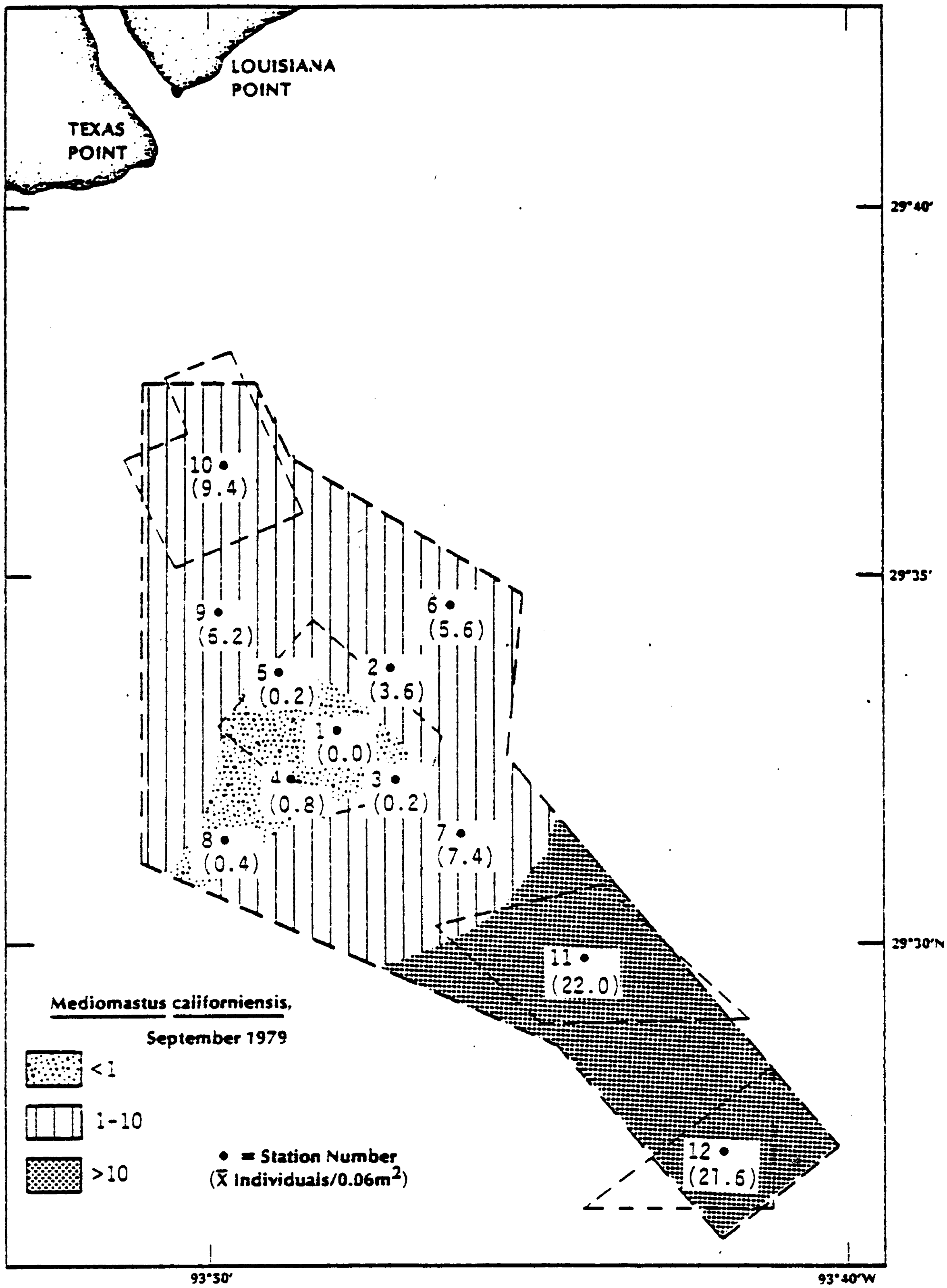

Figure A-13. Abundance of Mediomastus californiensis, Existing Sites and Vicinity, September 1979
(Values are mean of 5 replicates.)

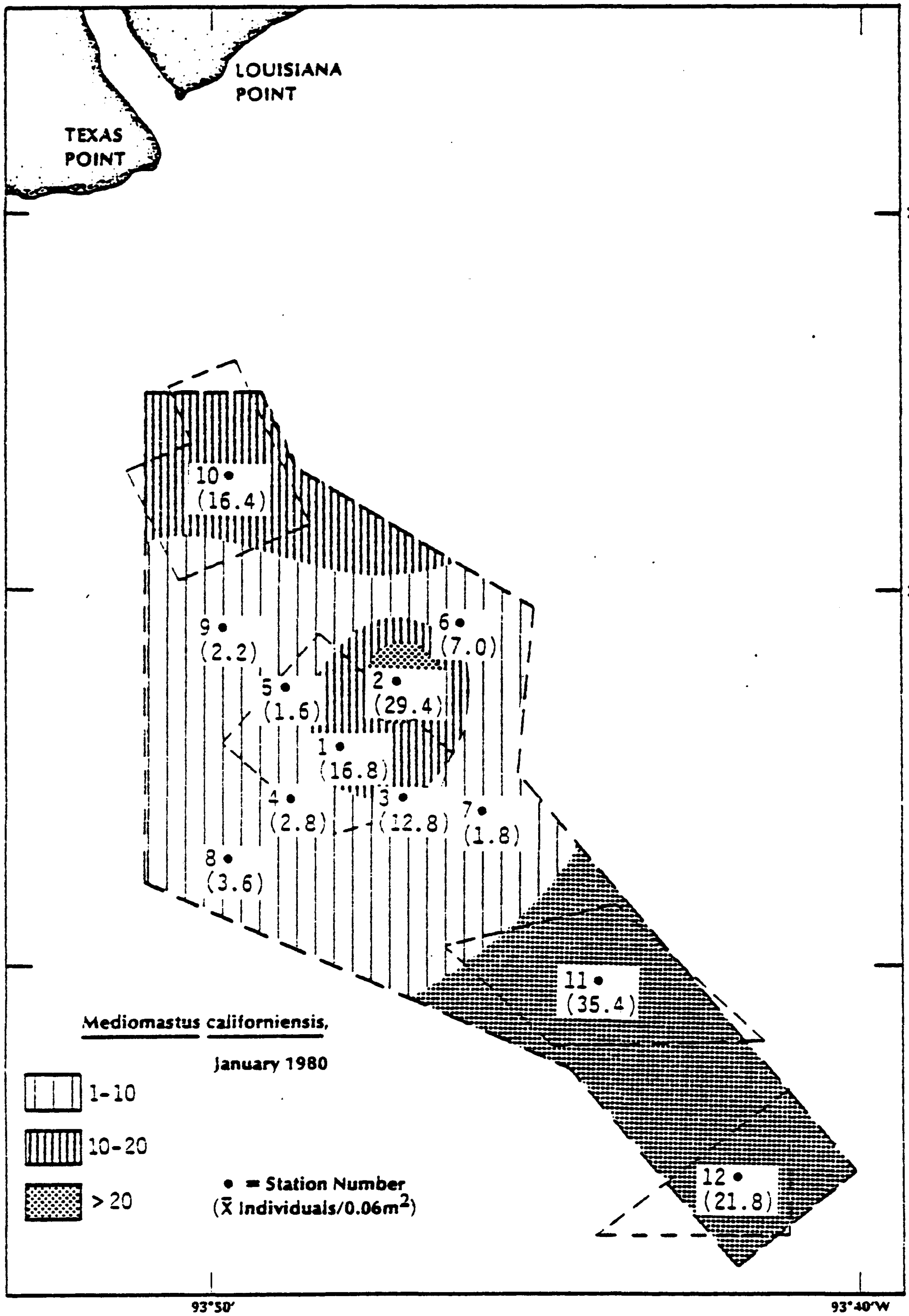

Figure A-14. Abundance of Mediomastus californiensis, Existing Sites and Vicinity, January 1980 (Values are mean of 5 replicates.)

the inshore-offshore gradient of mud to sand found in the study area. For example, Flint and Rabalais (1980) found that Paraprionospio pinnata was associated with poorly sorted, silty sediments containing less than 60% sand. Their results for this species are consistent with the findings of the present study: P. pinnata was associated with sandy muds.

Trophic information was used to calculate the percent composition of deposit and suspension feeders, carnivores, and omnivores at each station (Table A-14). The macrofaunal community comprised mainly deposit feeding species characteristic of areas with fine sediments (Gray, 1979). These organisms ingest sediments to digest micro-organisms living on mineral grains and detrital particles. This feeding group was widely distributed throughout the study area; however, lower percentages of deposit feeders were found in the area of Existing Site 3 (Figures A-15 and A-16). Dredged materials were dumped in the Existing Site 3 throughout most of September 1979; the somewhat lowered concentrations of deposit feeders in Site 3 may have been a result of these disposal activities. Carnivores were more abundant in the northern half of the study area, and presumably were associated with distributions of prey species (Figures A-17 and A-18). Omnivores and suspension feeders were not abundantly represented, and displayed no consistent spatial patterns of distribution.

Macrofaunal species and related densities reported here are similar to the findings of Keith and Hulings (1965) and Henry (1976) for the same general area. These authors found that the infaunal assemblage was typical of sand, mud, and mixed substrates; although the macrofaunal assemblage was dominated by polychaetes, the most abundant species were Balanoglossus sp., Cerebratulus lacteus and the gastropod, Nassarius acutus.

Epifauna

Trawls taken during September 1979 and January 1980 in the Existing Sites and vicinity yielded 25 species of finfish and 14 species of invertebrates (Table A-15). Abundant finfish during September included striped anchovy, Atlantic croaker, sea catfish and red drum. Gulf butterfish, banded drum, and Seatrout were more common during January.

TABLE A-14
PERCENT COMPOSITION OF DEPOSIT FEEDERS (D), SUSPENSION FEEDERS (S), CARNIVORES (C), AND OMNIVORES (O) AT EACH STATION

Station	September 1979					January 1980				
	D	S	O	C	Total %	D	S	O	C	Total %
1	35.1	27.9	1.0	12.8	76.8	68.9	0.0	7.1	8.3	84.3
2	44.8	0.0	7.2	32.4	84.4	19.3	69.7	0.5	6.5	96.0
3	42.8	10.4	5.0	20.7	78.9	56.9	0.0	9.3	9.1	75.3
4	53.6	0.0	3.4	26.1	83.1	63.5	0.0	17.0	7.3	87.8
5	51.0	0.0	6.1	31.2	88.3	31.1	1.4	23.9	26.3	82.7
6	55.7	0.0	7.9	17.5	81.1	45.4	6.0	4.3	23.0	78.7
7	56.9	0.0	3.3	13.4	73.6	69.9	1.1	8.3	5.1	84.4
8	65.8	0.0	4.1	16.6	86.5	63.8	0.0	12.8	9.0	85.6
9	55.9	0.0	7.0	33.5	96.4	35.4	0.0	6.4	50.8	92.6
10	67.3	0.0	5.2	23.5	96.0	54.5	0.0	7.1	18.1	79.7
11	78.2	0.0	4.4	4.3	86.9	73.7	2.5	2.9	5.2	84.3
12	53.7	0.0	15.9	13.2	82.8	67.0	1.1	2.6	5.5	76.2

Invertebrates were dominated by shrimps and squids. The most abundant species in September, 1979 were the shrimp, Solenocera vioscai, mantis shrimp, Squilla edentata edentata; in January, 1980, the brief squid, Lolliguncula brevis, and the white shrimp, Penaeus setiferus.

Microbiology

Finfish and shellfish collected in trawls in and near the Existing Sites usually contained undetectable counts of total and fecal coliform bacteria (Table A-16). The moderate count of total coliforms in the shrimp Xiphopeneus kroyeri (975 MPN/100 g) in January may be a result of contamination from local coliform sources. Possible sources of coliform bacteria in the survey area include runoff from Sabine Lake or disposal of coliform contaminated dredged

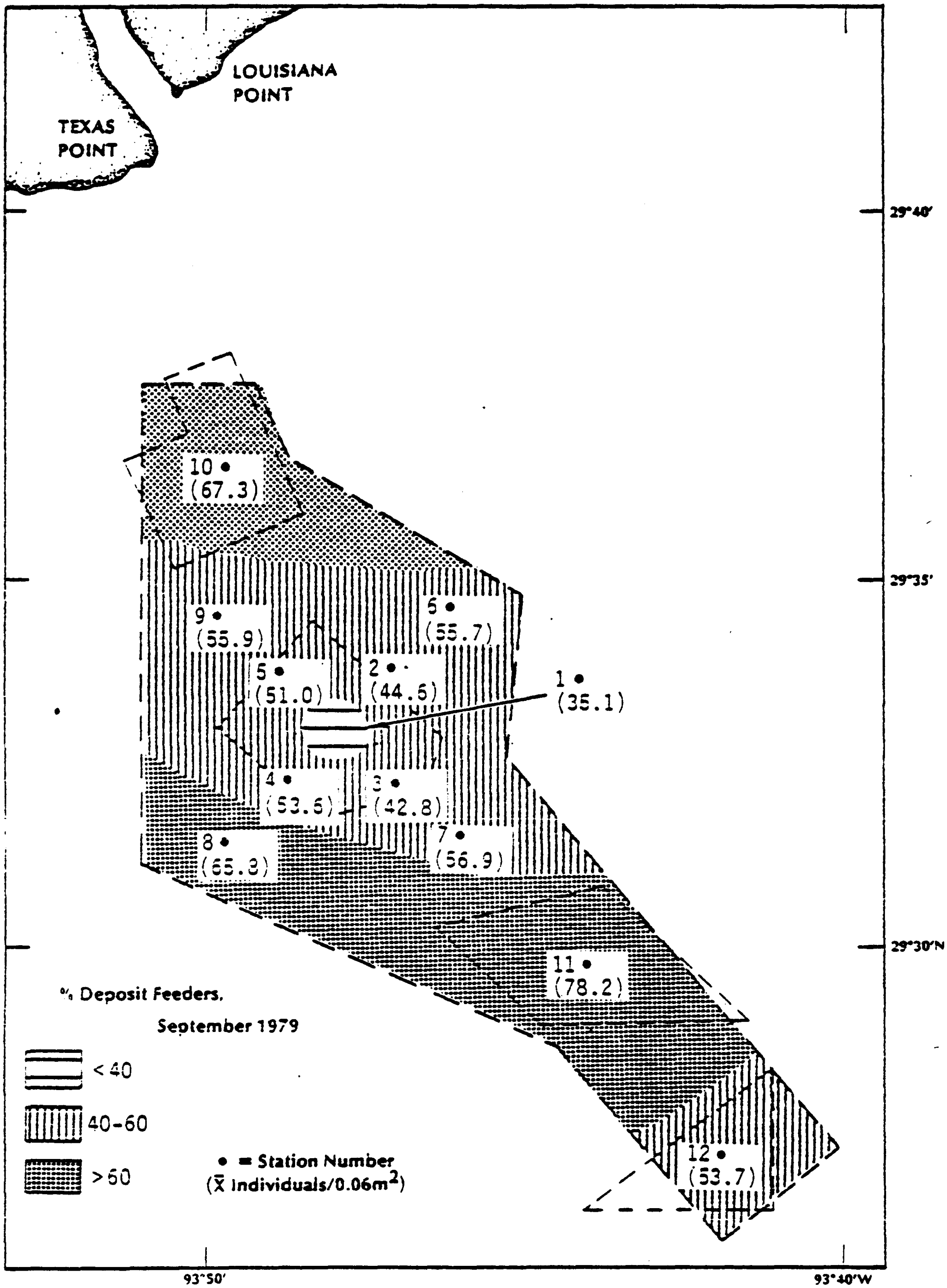

Figure A-15. Percent Deposit Feeders, Existing Sites and Vicinity, September 1979, Derived from Table A-10

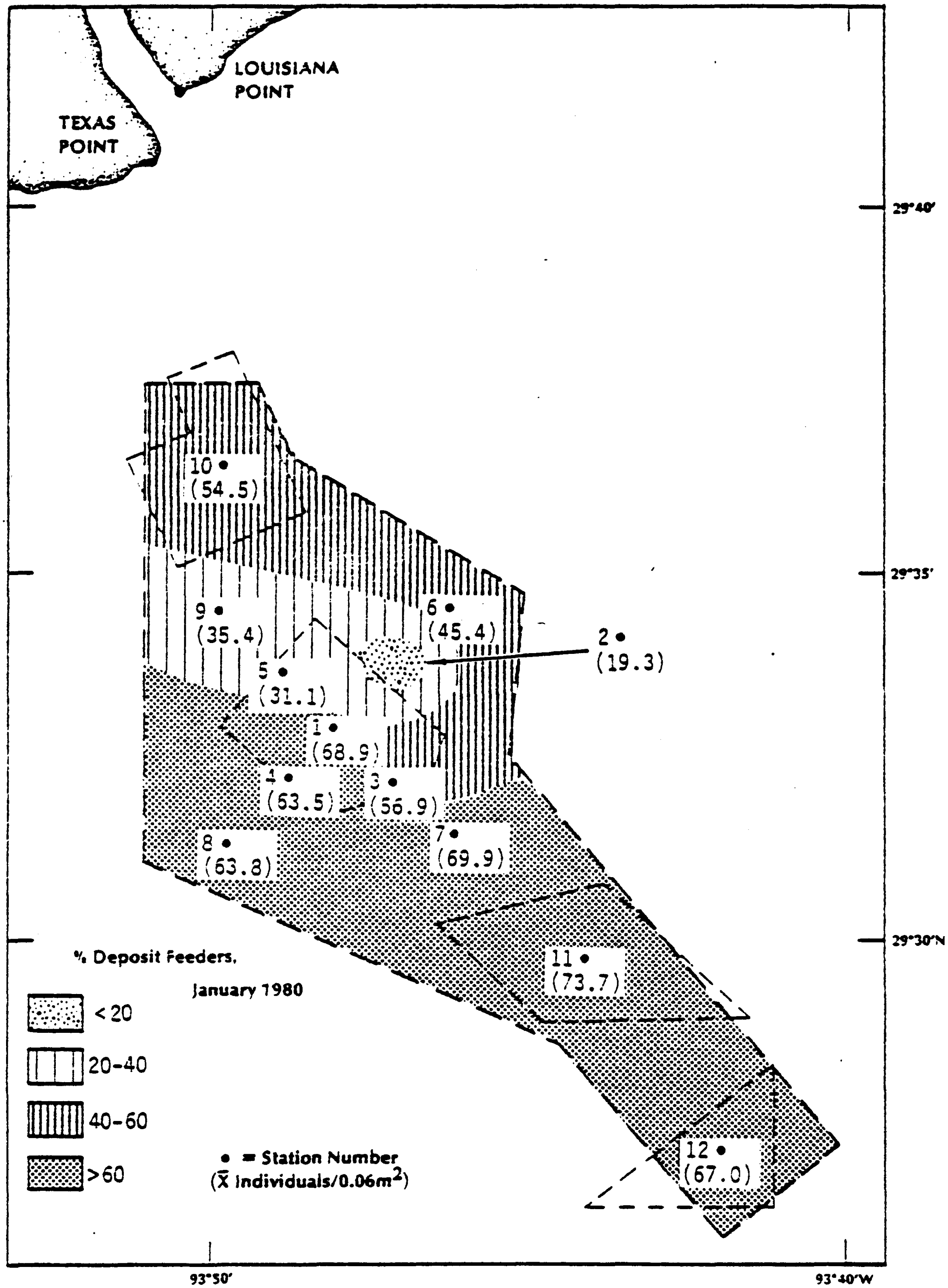

Figure A-16. Percent Deposit Feeders, Existing Sites and Vicinity, January 1980, Derived from Table A-11

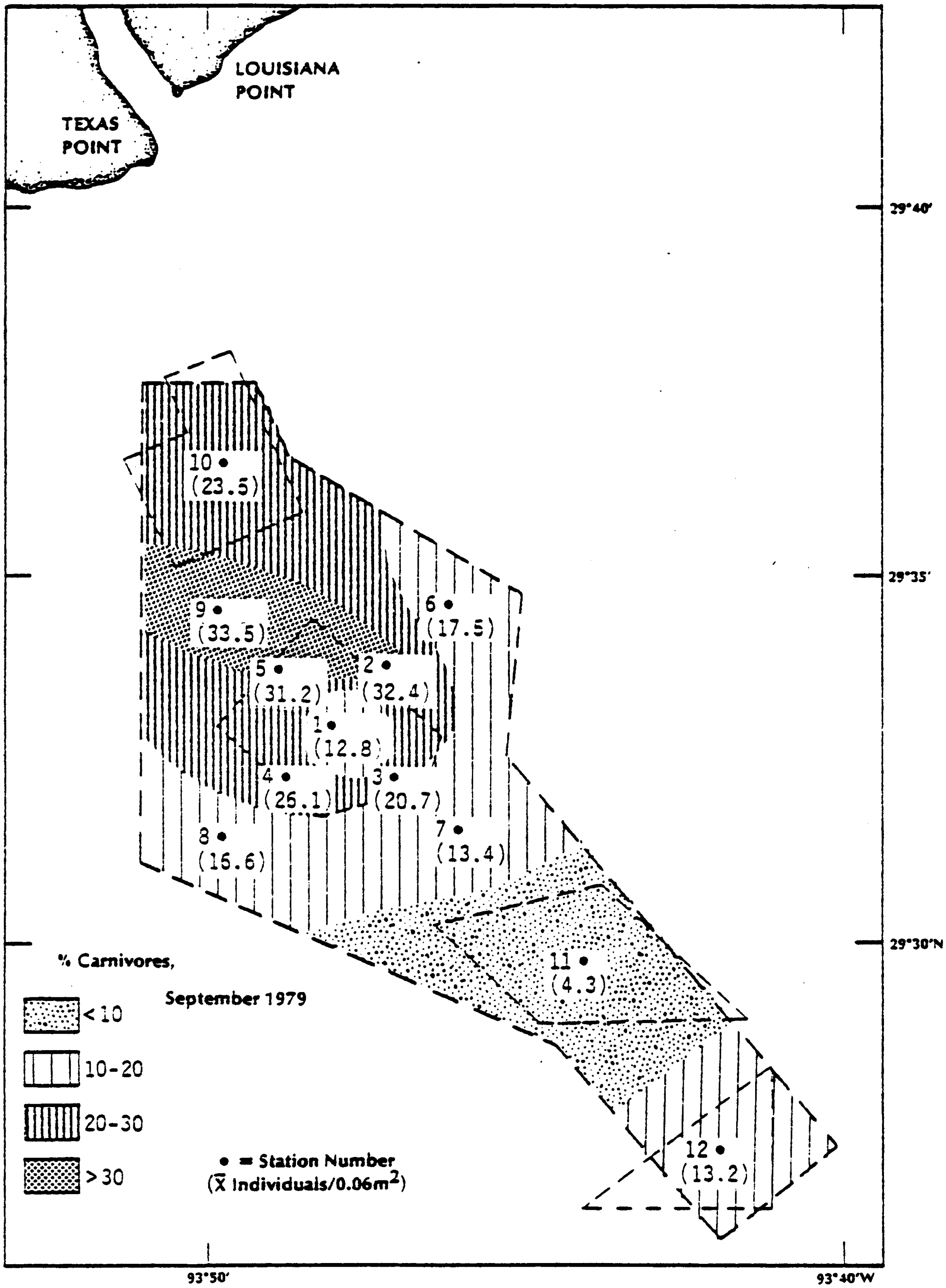

Figure A-17. Percent Carnivores, Existing Sites and Vicinity, September 1979, Derived From Table A-10

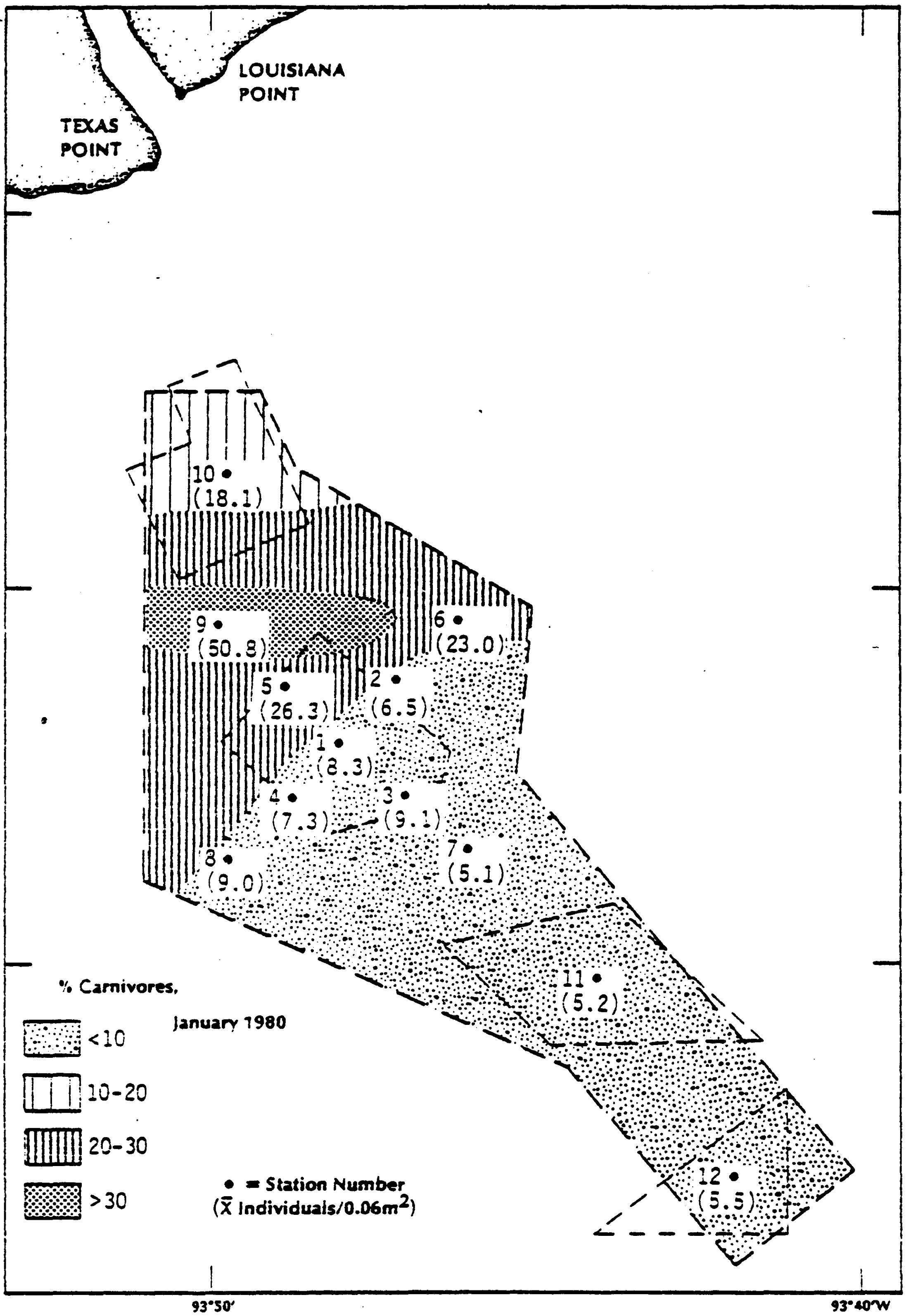

Figure A-18. Percent Carnivores, Existing Sites and Vicinity, January 1980, Derived From Table A-11

TABLE A-15
INVERTEBRATES AND FISH TRAWLED FROM THE EXISTING SITES AND VICINITY

Species	Common Name	Sept 1979			Jan 1980			
		Sta 1	Sta 6		Sta 1		Sta 6	Total
		Tow 1	Tow 1	Total	Tow 1	Tow 2	Tow 1	
CNIDARIA:								
Scyphozoa, unidentified	jellyfish	-	-	-	1	-	-	1
MOLLUSCA:								
Lolliguncula brevis	brief squid	-	-	-	20	120*	29	169
ARTHROPODA:								
Callinectes similis	blue crab	-	3	3	-	-	-	-
Hexapanopeus angustifrons	rock crab	-	-	-	1		-	1
Pagurus pollicaris	hermit crab	-	-	-	1	-	-	1
Penaeus aztecus	brown shrimp	-	12	12	-	-	-	-
P. setiferus	white shrimp	-	-	-	-	-	150*	150
Persephona mediterranea	purse crab	-	1	1	-	-	-	-
Portunus spinimanus	swimming crab	3	-	3	1	1	5	7
Solenocera vioscae	shrimp	43	12	55	-	-	-	-
Squilla edentata edentata	mantis shrimp	7	23	30	-	-	-	-
S. empusa	mantis shrimp	-	-	-	6	4	5	15
Trachypeneus similis	shrimp	-	-	-	11	1	-	12
Xiphosura kroyeri	red shrimp	1	-	1	-	-	-	-
ENGRAULIDAE - Anchovies:								
Anchoa hepsetus	striped anchovy	22	20	42	-	1	-	1
ARIIDAE - Sea catfishes:								
Arius felis	sea catfish	6	22	28	-	-	-	-
BATRACHOIDIDAE - Toadfishes:								
Porichthys porosissimus	Atlantic midshipman	11	2	13	-	-	-	-
GADIDAE - Codfishes:								
Urophycis floridanus	southern hake	-	-	-	1	2	10	13
SERRANIDAE - Seabasses:								
Centropristis philadelphica	rock seabass	2	2	4	1	-	-	1

TABLE A-15 (continued)

Species	Common Name	Sept 1979 Sta 1 Tow 1	Sept 1979 Sta 6 Tow 1	Sept 1979 Total	Jan 1980 Sta 1 Tow 1	Jan 1980 Sta 1 Tow 2	Jan 1980 Sta 6 Tow 1	Jan 1980 Total
CARANGIDAE - Jacks and pompanos:								
Chloroscombrus chrysurus	Atlantic bumper	11	-	11	-	-	-	-
Vomer setapinnis	Atlantic moonfish	1	-	1	-	-	-	-
SCIAENIDAE - Drums:								
Cynoscion arenarius	sand seatrout	4	-	4	2	10	19	31
C. nothus	silver seatrout	-	-	-	-	35	-	35
Larimus fasciatus	banded drum	-	-	-	26	11	22	59
Leiostomus xanthurus	spot	-	1	1	-	-	-	-
Menticirrhus americanus	southern kingfish	-	-	-	5	10	4	19
Micropogon undulatus	Atlantic croaker	-	40	40	1	2	7	10
Sciaenops ocellata	red drum	27	-	27	-	-	-	-
Stellifer lanceolatus	star drum	1	-	1	-	-	-	-
EPHIPPIDAE - Spadefishes:								
Chaetodipterus faber	Atlantic spadefish	9	1	10	-	-	-	-
TRICHIURIDAE - Cutlassfishes:								
Trichiurus lepturus	Atlantic cutlassfish	-	1	1	-	-	-	-
STROMATEIDA - Butterfishes:								
Peprilus alepidotus	harvestfish	1	-	1	-	-	-	-
P. burti	Gulf butterfish	-	2	2	-	20	38	58
TRIGLIDAE - Searobins:								
Prionotus rubio	blackfin searobin	-	-	-	1	-	-	1
P. tribulus	bighead searobin	-	-	-	5	-	13	18
BOTHIDAE - Lefteye flounders:								
Citharichthys macrops	spotted whiff	-	-	-	-	-	14	14
C. spilopterus	bay whiff	-	1	1	-	-	-	-
Etropus crossotus	fringed flounder	-	-	-	37	25	-	62
CYNOGLOSSIDAE - Tonguefishes:								
Symphurus plagiusa	blackcheek tonguefish	1	2	3	-	-	12	12

* Approximate count

TABLE A-16
TOTAL AND FECAL COLIFORM BACTERIA COUNTS
IN SPECIES TRAWLED FROM EXISTING SITES AND VICNITY

Station	Species	Total Coliform MPN/100g	Fecal Coliform MPN/100g
September 1979			
1	*Anchoa hepsetus*	<200	<200
	Xiphosura kroyeri	<100	<100
6	*Anchoa hepsetus*	<119	<119
	Penaeus aztecus	<200	<200
January 1980			
1	No suitable species collected	-	-
6	*Penaeus setiferus*	975	<250

materials. No coliform analysis data are available for dredged materials disposed at the Existing sites; consequently, the potential sources of coliform bacteria in the area cannot be specified.

SUMMARY

Survey measurements of water-column parameters were consistent with previous observations offshore of the Sabine-Neches estuary. Temperatures and salinities exhibited little vertical stratification; salinities were lower nearshore. Waters were well oxygenated at all depths during both surveys, but decreased slightly with depth. Turbidity and suspended solids levels decreased offshore. Concentrations of trace metals and chlorinated hydrocarbons in the water column were all low.

Sediments in the survey area showed a wide range in grain size, grading from fine to coarse in the offshore direction, with generally poor sorting. Concentrations of trace chemical constituents in sediments appeared to be related to the distribution of silt and clay content and were similar to previously reported levels. The exception was for oil and grease, which exhibited concentrations up to 5.5 mg/g. Dredged material disposal occurred in Existing Site 3 between 4 September and 4 October 1979; this did not result in any obvious differences in physical and chemical sediment parameters. Survey data did not provide evidence of any relationship between dredged material disposal and sediment grain size or concentrations of chemical constituents.

Distributions of benthic organisms were also apparently related to sediment grain-size trends. As expected, deposit feeders were the dominant feeding group and represented in excess of 50% of the fauna at most stations. The slightly lower percentage of deposit feeders in Existing Site 3 may be a result of dredged material disposal in the site during September 1979. No other biological parameters could be interpreted to reflect dredged material disposal. Species collected and their densities were similar to those observed in other studies in the area. Fish were generally abundant and diverse. Any effects of dredged material disposal could not be differentiated from the natural heterogeneity of the benthic environment.

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Appendix B

HURRICANE AND STORM EFFECTS UPON THE GULF OF MEXICO INNER SHELF CURRENTS

Appendix B

HURRICANE AND STORM EFFECTS UPON THE GULF OF MEXICO INNER SHELF CURRENTS

The northern Gulf of Mexico is periodically subjected to hurricanes and tropical storms. Some of the better-known marine effects of these hurricanes and storms are high winds, heavy rainfall, high waves, elevated sea levels, and strong currents. The magnitudes of these strong currents and their potential enviromental effects are discussed below.

MEASUREMENTS

The catastrophic nature of hurricanes and tropical storms have rarely permitted reliable measurements of the currents they produce. Few investigators have measured currents from storms because it is difficult to predict occurrences, and most instruments are not designed to withstand the severe conditions present. Three sets of data taken during the past 11 years give excellent forecasts of what can be expected. Near-bottom currents were measured in 1969 at a site 160 km from the closest approach of Hurricane Camille (Murray, 1970). Forristall et al. (1977) reported the results of Tropical Storm Delia passing directly over an instrumented platform in 1973. Currents in the fringe of Hurricane Anita in August and September 1977 were measured by Smith (1978).

In 1969, a current meter was placed 360m offshore (90m seaward of the Outer Bar), at a depth of 6.3m off the coast of the Florida Panhandle (Murray, 1970). One week after installation of the current meter, Hurricane Camille passed to the west. At its closest approach, the eye of Camille was about 160 km from the installation. The data presented by Murray (1970) showed the following chronological relationship:

- While the eye of the hurricane was more than 530 km (290 nmi) from the site, the normal 5- to 10-cm/s (0.10- to 0.12-kn) current speeds were observed near the bottom.

- With the eye between 400 and 530 km from the site, near-bottom currents averaged about 35 cm/s (0.69 kn). This increased veloc is attributed to a seaward growth of the longshore current in the surf zone.

- As the eye approached from a distance of 400 km to about 180 km, current speeds rose to average values of nearly 100 cm/s (1.96 kn), with pulses to 160 cm/s (3.14 kn).

- At the point where the eye of the hurricane was about 180 km from the installation, the current-meter speed impeller jammed and 7 hours later the meter broke away from its base.

In 1973, Tropical Storm Delia formed in the Gulf of Mexico, wandered generally northwest, and crossed the Texas coast about 50 km southwest of Galveston. During its travel it passed almost directly over a Buccaneer Oil Field platform, which had three current meters suspended on a taut wire between the platform and an 18,000-lb steel anchor (Forristall et al., 1977). The three current meters were 3m, 10m, and 16m above bottom, in a total water depth of 20m. Forristall et al. (1977) made the following observations during this storm passage:

- Tropical Storm Delia was a relatively weak storm (maximum wind velocities were about 60 kn) yet it produced water currents of 200 cm/s (3.92 kn), with the deepest current meter experiencing a maximum current of about 175 cm/s (3.43 kn).

- Scour on the bottom was such that the 18,000-lb steel anchor rotated 31° and shifted about 1m to the east during the strong currents.

Hurricane Anita passed from east to west across the northwestern Gulf of Mexico in August and September 1977. During the storm, two current meters operated 21.5 km off the Texas coast near Port O'Connor. These instruments were 2m and 10m above bottom in 17m of water. The following observations were made (Smith, 1978):

- The closest approach of the storm center to the instruments was about 350 km.

- Maximum current speeds reached 80 cm/s (1.57 kn) for the upper current meter and 70 cm/s (1.37 kn) for the lower.

- Current speeds near the bottom exceeded 50 cm/s (0.98 kn) continuously for 4 days.

STORM FREQUENCIES

For the northeastern portion of the Texas coast, some estimates can be made about the probability of events similar to Hurricanes Anita and Camille, and Tropical Storm Delia. Henry and McCormack (1975) show probabilities of tropical storms and hurricanes affecting specified 60-mile sections of the Texas coast. These data suggest that any point along the northeastern part of the Texas coast has about a 33% probability of tropical storm or hurricane occurrence within 25 nmi each year.

In addition to extremely close storm occurrences, it is important to know how often hurricanes pass at moderate distances. An examination of the plots of hurricane paths from 1954 to 1975 (DOI, 1978) suggests that, on the average, hurricanes pass within 400 km of the northeastern Texas coast at least once a year.

By combining such frequency estimates with the measurements of Murray (1970), Forristall et al. (1977), and Smith (1978) the following data appear:

- About once every 3 years, bottom currents within 60 to 70 km of the northeastern Texas coast will probably reach maximum speeds near 200 cm/s (3.92 kn).

- On the average of once a year, bottom currents should have speeds of at least 50 cm/s (0.98 kn) for several consecutive days at a time.

IMPLICATIONS

SEDIMENT MOVEMENT

Under the sponsorship of the Dredged Material Research Program (DMRP), Moherek (1978) conducted flume experiments on sediments taken from the Existing Galveston Site. The four different sediment types tested showed different mixtures of sand, silt, and clay, and represent the typical sediment characteristics of Inner Shelf sediments in the Gulf of Mexico. Moherek (1978) determined the critical shear stress and corresponding water speed "...necessary to initiate rapid erosion of the dense bed." From both theoretical considerations of open-channel flow and direct observation, the speed at the transition into rapid erosion was about 24 cm/s. The velocity and critical shear stress values did not significantly vary from one type of sediment to another, suggesting that resistance to erosion was mainly due to the degree of cohesive force acting between sedimentary particles (Moherek, 1978). This is reasonable whenever a high percentage of the material is in the silt and clay range.

At velocities above that corresponding to the critical shear stress, two processes will be active in contributing to sediment transport. First, sediment will be drawn up and away from the bottom and carried along as a suspended load. Second, sediment will move along the bottom as bedload. In effect, the entire surface of the bottom will be in motion above the critical shear stress value. The depth of this motion (bedload), below the surface of the bottom, increases with the speed of the water above the bottom. At a water speed just above the critical value, the moving layer may, theoretically, be only the thickness of a single sediment grain. As speeds increase, this layer may expand to several centimeters in thickness. Quantification is difficult in such matters, but some generalizations are possible.

If the critical water speed is about 24 cm/s (0.47 kn), then at values of 50 to 60 cm/s (0.98 to 1.18 kn), erosion of the bottom is likely and definitely more than a single-grain thickness layer will be in motion as bedload. For values of water speed in the range of 150 to 200 cm/s (2.94 to 3.92 kn), massive movement of bottom sediments will take place. At least several centimeters of the bottom will be in motion as bedload.

MOUNDING

Mounds created by disposal of dredged material on the Inner Shelf of the Gulf of Mexico are not likely to be stable features. Rapid bottom currents, created by storms and hurricanes, remove any mound-like structures in two principal ways. First, a mound on the relatively flat and smooth Inner Shelf is a distinct and anomalous topographic feature. A mound creates additional turbulence in strong current flows, and probably increases the erosive power of the moving water, which differentially erodes the mound. Second, a mound projects up from the smooth bottom, through the normal boundary layer, and into higher velocity layers above. Thus, the mound experiences higher stresses on its upper surfaces and the higher portions are eroded faster than the natural flat bottom.

OXYGEN DEPLETION

In nearshore areas where significant amounts of fine sediments (silts and clays) settle during calm periods, it is possible that substantial amounts of organic matter also settle out. This condition can cause the upper layer, or a layer near the surface of the sediments, to become anoxic and sulfide-bearing. If strong currents occur in such a location and stir up the bottom, the near-bottom waters could be depleted of oxygen and contain hydrogen sulfide. An example of this type of situation was observed near Sabine Pass, Texas, after Hurricane Cindy in 1963 (Keith and Hulings, 1965).

BENTHOS

Increased current speeds and bedload movement during hurricanes and storms directly affect shallow-water benthic communities. Species that inhabit unstable, sandy sediments are usually better able to withstand storm turbulence than species in muddy sediments. However, mass mortalities can occur in either habitat during hurricanes (Keith and Hulings, 1965).

Storms and hurricanes increase surface-sediment suspension, which cause the clogging of filtering structures in suspension-feeding animals. As bedload increases, smaller, less-mobile fauna are buried and smothered; depressed oxygen concentration and the presence of hydrogen sulfide aggravate the effect. Powerful bottom currents erode or bury benthic communities, uproot newly settled larvae, and sweep away surface-dwelling organisms (Oliver et al., 1977). Radical changes in salinity due to influx of fresher water cause mass mortality of all but the most euryhaline species (Keith and Hulings, 1965).

The long-term impacts of these disturbances are decreases in abundance and diversity and interruption of community succession. Disrupted areas are reinhabited and dominated by opportunistic species. The opportunists are eventually displaced by more competitive species; the latter are usually species which dominated before any disruptions. The rate and extent of recolonization is primarily dependent on the degree of sediment alteration during the disturbance. Significant changes in silt content can exclude indigenous species, prolong recolonization, or promote a rapid introduction and proliferation of new colonizers.

Appendix C

ESTIMATION OF INITIAL MIXING

Appendix C

ESTIMATION OF INITIAL MIXING

The Ocean Dumping Regulations allow limiting permissible concentrations (LPC) of materials (EPA, 1976) to be exceeded at the disposal site immediately following dumping. However, no LPC of any material may be exceeded after a 4-hour initial mixing period. The following discussion is taken from Appendix H of the Implementation Manual (EPA/CE, 1977) which describes methods of estimating volumes of initial mixing that can be used to calculate the maximum concentration of liquid and suspended particulate phases at the disposal site after initial mixing.

When no field data are available for the generation of a mathematical model, the Ocean Dumping Regulations permit use of the release zone method to estimate initial mixing. The liquid and suspended sediment phases are assumed to be evenly distributed after 4 hours in the volume of water "....bounded on the surface by loci of points constantly 100m from the perimeter of the conveyance engaged in dumping activities, beginning at the first moment in which dumping commences, and ending at the last moment (the release zone) and extending to the ocean floor, thermocline, or halocline if one exists, or to depth of 20m, whichever is shallower."

At the Existing Sites, the water column is well mixed throughout most of the year, although freshwater lenses may appear in surface waters during periods of high runoff. However, for the purpose of the dilution calculation, the mixing zone is considered to extend to the ocean floor, which is shallower than 15m at all sites.

The following data are used in initial mixing calculations for the Sabine-Neches ODMDS's:

Appropriate depth value (d)
Disposal Area No. 1 = 10.7m
Disposal Area No. 2 = 10.4m
Disposal Area No. 3 = 11.3m
Disposal Area No. 4 = 7.0m

Length of disposal vessel (ℓ)	= 107m
Width of disposal vessel (w)	= 18m
Speed of disposal vessel (u)	= 1.5 m/s
Time required to empty vessel during discharge (t)	= 800s
Bulk density (P_b)	= 1.5
Particle density (P_d)	= 2.6
Density of liquid phase (P_w)	= 1.0
Total volume of disposal vessel (V_t)	= 1600 m^3
Percent clay in dredged sediment	= 50%
Percent silt in dredged sediment	= 40%

VOLUME OF INITIAL MIXING ZONE, V_m

The volumes (V_m) of the initial mixing zones, available during disposal operations at the Sabine-Neches Waterway Disposal Areas, were calculated as:

$$V_m = \pi(100)^2 d + 200 wd + (200 + w) (ut + \ell) d$$

for Disposal Area No. 1,

$$V_m = 3.1416 (100)^2 (10.7) + 200 (18) (10.7) + (200 + 18) (1.5 [800 + 107)] (10.7) = 3,423,379 m^3;$$

for Disposal Area No. 2,

$$V_m = 3.1416\ (100)^2\ (10.4) + (200)\ (18)\ (10.4) + (200 + 18)\ (1.5\ [800] + 107)\ (10.4) = 3,327,396\ m^3;$$

for Disposal Area No. 3,

$$V_m = 3.1416\ (100)^2\ (11.3) + (200)\ (18)\ (11.3) + (200 + 18)\ (1.5\ [800] + 107)\ (11.3) = 3,615,344\ m^3;$$

and, for Disposal Area No. 4,

$$V_m = 3.1416\ (100)^2\ (7.0) + (200)\ (18)\ (7.0) + (200 + 18)\ (1.5\ [800] + 107)\ (7.0) = 2,239,594\ m^3.$$

VOLUME OF LIQUID PHASE, V_w

The estimated volume of liquid phase discharge at the Sabine-Neches Waterway Disposal Areas was calculated as:

$$V_w = \frac{P_b - P_d}{P_w - P_d}\ (V_t) = \frac{1.5 - 2.6}{1.0 - 2.6}\ (1600\ m^3) = 1100\ m^3$$

PERCENT LIQUID PHASE AFTER INITIAL MIXING, C_w

The percent liquid phase after initial mixing was determined as:

$$C_w = \frac{V_w}{V_m}\ (100)$$

for Disposal Area No. 1,

$$C_w = \frac{1100\ m^3}{3,423,379\ m^3}\ (100) = 0.032\%$$

for Disposal Area No. 2,

$$C_w = \frac{1100\ m^3}{3,327,396\ m^3}\ (100) = 0.033\%$$

for Disposal Area No. 3,

$$C_w = \frac{1100\ m^3}{3,615,344\ m^3}\ (100) = 0.030\%$$

and, for Disposal Area No. 4,

$$C_w = \frac{1100\ m^3}{2,239,594\ m^3}\ (100) = 0.049\%$$

VOLUME OF SUSPENDED PARTICULATE PHASE, V_{sp}

The estimated volume of suspended particulate phase discharged during disposal operations was calculated as:

$$V_{sp} = (V_t - V_w)\ \frac{(P_c + P_s)}{100} = (1600 - 1100)\ \frac{40 + 50}{100} = 450\ m^3$$

PERCENT SUSPENDED PARTICULATE PHASE AFTER INITIAL MIXING, C_{sp}

The percent suspended particulate phase after initial mixing was determined as:

$$C_{sp} = \frac{V_{sp}}{V_m}\ (100)$$

for Disposal Area No. 1,

$$C_{sp} = \frac{450\ m^3}{3,423,379\ m^3}\ (100) = 0.013\%$$

for Disposal Area No. 2,

$$C_{sp} = \frac{450 \text{ m}^3}{3{,}327{,}396 \text{ m}^3} (100) = 0.014\%$$

for Disposal Area No. 3,

$$C_{sp} = \frac{450 \text{ m}^3}{2{,}239{,}549 \text{ m}^3} (100) = 0.020\%$$

and, for Disposal Area No. 4

$$C_{sp} = \frac{450 \text{ m}^3}{3{,}615{,}344 \text{ m}^3} (100) = 0.012\%$$

Appendix D

DISPOSAL COSTS AND ECONOMIC FEASIBILITY

Appendix D

DISPOSAL COSTS AND ECONOMIC FEASIBILITY

The total cost of dredging material from the Sabine-Neches Waterway Entrance Channel is the sum of:

- Operating costs of the hopper dredge,
- Monitoring and surveillance costs, and
- Income lost from resource development.

The cost components will be compared for the alternative disposal sites: the Existing Sites and the Deepwater Area. Specific operating cost information is available and relative costs are determined for monitoring and surveillance. No loss of income from resource development results from the disposal activities at any of the sites.

After determining the relative costs of disposal at the Existing Sites and Deepwater Area, the criterion of reasonable incremental cost is applied to determine which alternatives are economically feasible as disposal sites.

RELATIVES COSTS

DREDGING

The cost of operating a hopper dredge similar to the one used in the Sabine Entrance Channel (capacity 3,000 yd^3) is about $775,000 a month, or about $1,000 per hour. The cost may vary depending on the type of material dredged, amount of time lost to dredge maintenance and weather, the dredge's production rate and operation time, and net hopper capacity per disposal cycle (EHA, 1979). A disposal cycle includes loading the dredge with material, transporting the material to a disposal site, emptying the hopper, and returning to the channel being dredged.

Disposal at the Existing Sites involves the shortest transit time of any of the alternative sites. The time required for a disposal cycle is about 1.725 hours, equivalent to $1,725. A Deepwater Site would require greater transit times and increased cost.

The hopper dredge can transport about 1,046,000 yd^3 a month to the site if the dredge operates 600 hours per month. Thus, dredging of more than 4.0 million yd^3/yr of material would require about 4 months. Disposal at the Deepwater Area would require more time to complete, dredging would cost more, and would affect other projects needing the same hopper dredge. If the Deepwater Area was used, the amount of time necessary to dredge 4 million yd^3/yr of material (assuming 600 hours operating time per month) would be about 62 months.

Operating costs of disposal were estimated for the Existing Sites and Deepwater Area, and are presented in Table D-1. The cost for the Existing Sites was estimated at $1,725 per complete cycle, and the estimated cost for the Deepwater Area was $63,158 per complete cycle.

MONITORING AND SURVEILLANCE

The costs of monitoring and surveillance would be greater at the Deepwater Area than at the Existing Sites because of the increased distance from shore. The increased distance would require more costly and time-consuming methods of surveillance, in addition to requiring increased shiptime for monitoring.

ECONOMIC FEASIBILITY

Use of the Deepwater Site as an alternative to the Existing Sites would increase operating, monitoring, and surveillance costs.

TABLE D-1
OPERATING COSTS FOR THE ALTERNATIVE SITES

Alternative	Travel Distance (nmi)	Travel Time* (hr)	Price† ($)	Production** (yd^3)
Existing Sites				
1	0.5	1.6	1,600	1,125,000
2	1.5	1.8	1,800	1,000,000
3	1.5	1.8	1,800	1,000,000
4	0.1	1.7	1,700	1,058,823
Deepwater Area				
	135††	28.5	28,500	63,158

* 1.5 hours pump/dump + (travel distance x 2)/10 kn = total travel time.

† Price for one complete cycle.

** Monthly production rate, assuming 600 hours operation/month and a net capacity of 3,000 yd^3/cycle.

†† 135 nmi is the minimum distance to reach the Deepwater Alternative Site chosen by Pequegnat et al. (1978).

Appendix E

CORPS OF ENGINEERS PUBLIC NOTICE OF MAINTENANCE DREDGING SABINE-NECHES WATERWAY, TEXAS

Appendix E

CORPS OF ENGINEERS PUBLIC NOTICE OF MAINTENANCE DREDGING SABINE-NECHES WATERWAY, TEXAS

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77550

SWGCO-M

PUBLIC NOTICE NO. SN-M-1 23 September 1974

MAINTENANCE DREDGING
SABINE-NECHES WATERWAY, TEXAS

This public notice is issued in accordance with provisions of established Federal regulations, Title 33 CFR 209.145, concerning the policy, practice and procedures to be followed by the Corps of Engineers in connection with the disposal of dredged material in navigable waters or the transportation of dredged material for the purpose of depositing in ocean waters associated with Federal projects.

This notice is being distributed to all interested State and Federal agencies and known interested persons in order to assist in developing facts and recommendations concerning the proposed continuation of maintenance dredging activities. Comments must be submitted to the District Engineer at the above address on or before 23 October 1974.

Laws under which the proposed dredging is to be reviewed:

Federal Water Pollution Control Act
Marine Protection, Research and Sanctuaries Act of 1972
Coastal Zone Management Act of 1972
National Environmental Policy Act of 1969
Fish and Wildlife Act of 1956
Migratory Marine Game-Fish Act
Fish and Wildlife Coordination Act
Endangered Species Act of 1973
National Historic Preservation Act of 1966

PROJECT: Sabine-Neches Waterway, Texas

PROJECT LOCATION: Near Sabine Pass, Port Arthur, Beaumont and Orange in Jefferson and Orange Counties, Texas.

PROJECT DESCRIPTION: The Sabine-Neches Waterway is a Federally maintained project extending from the Gulf of Mexico through a jettied entrance at the mouth of Sabine Pass to Port Arthur, Beaumont and Orange, Texas via the Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and the Neches and Sabine Rivers, a total of approximately 75 miles. The project includes deep-draft channels 42 feet deep and 800 feet wide across the Sabine Bank in the Gulf of Mexico and over the Sabine Pass outer bar; 40 feet deep and 800 to 500 feet wide through the jetty channel; 40 feet deep and 500 feet wide to Port Arthur; 40 feet deep and 400 feet wide to Beaumont via the Neches River; and 30 feet deep and 200 feet wide to Orange via the Sabine River. The Federally maintained project also includes numerous basins of various widths and depths such as an anchorage basin, turning points, turning basins, maneuvering basin and a slip. The maintained Federal project also includes a channel 12 feet deep and 100 feet wide in Adams Bayou and a channel 13 feet deep and 100 feet wide in Cow Bayou.

DISPOSAL AREA: The project utilizes 56 disposal areas (see drawings). Disposal Areas Nos. 10, 28, 45, and 58 have been discontinued because of environmental considerations and their locations are not shown on the attached drawings. Sabine Entrance Channel uses Disposal Areas Nos. 1 through 4 which are open water disposal areas located south of the Gulf end of the West Jetty and are used for the disposal of material excavated by the Government-owned hopper dredge.

The Sabine Pass Channel uses confined Disposal Areas Nos. 5 and 6 located on the east bank of the channel in Louisiana. These areas are utilized for disposal of materials excavated by contract pipeline dredges. The dredge water is returned via drainage and outfall ditches, after passing through controlled spillways.

The Port Arthur Canal uses confined Disposal Areas Nos. 7 and 8. The disposal areas are located on the south and north banks of the canal, respectively, and are used for disposal of materials excavated by contract pipeline dredges. The dredge water is returned to the project waterway through a controlled spillway.

The Port Arthur Turning Basins use confined Disposal Area No. 9 which is located on the west bank of the Turning Basins and is used for disposal of materials excavated by contract pipeline dredges. The dredge water is returned via a controlled spillway and outfall canal to the GIWW.

The Sabine-Neches Canal uses confined Disposal Areas Nos. 8, 11, 12, 15, 29, 29A and 28B which are located adjacent to or near the canal. The areas are used for disposal of materials excavated by contract pipeline dredges. The dredge water is returned to the canal via controlled spillways, outfall canals and ditches.

The Neches River Channel uses Disposal Areas Nos. 12 through 27 located on the banks of the Neches River for contract pipeline disposal operations. Disposal Areas Nos. 12 through 17, 22 through 24, and 26 are presently confined areas with spillways. Disposal Areas Nos. 18 through 21 will have levees constructed at ends of existing side levee systems during future dredging periods to inclose the areas and prevent material flow onto marsh habitat. Drainage will be controlled in Areas Nos. 12 through 24 and 26 by spillways and the effluent will be directed into Neches River Channel through outfall canals and ditches. Disposal Area No. 25 is a partial leveed area where effluent water is allowed to return to the Neches River via an outfall ditch. Disposal Area No. 27 is a large unleveed disposal area with perimeter and interior unimproved roads. The effluent water is allowed to return to the Neches River through ditches and culverts.

The Sabine River Channel, Orange Municipal Slip and Orange Turning Basin use Disposal Area Nos. 29 through 37. Disposal Areas Nos. 29, 29-A and 29-B are inclosed areas. The remaining disposal areas which are presently unconfined will be inclosed to contain materials excavated by contract pipeline dredges. The dredge water will be returned to the waterways via spillways, outfall canals and ditches.

The Cow Bayou Channel and Orangefield Turning Basin use Disposal Areas Nos. 30-A, 38 through 44 and 46 through 57. These disposal areas will be leveed to confine materials excavated by contract pipeline dredges. The dredge water will be returned to Cow Bayou Channel via spillways and ditches.

Adams Bayou Channel will use Disposal Area No. 31. The area will be leveed as and when necessary to confine the material dredged by contract pipeline dredge. The dredge water will be returned to Adams Bayou Channel via spillways and ditches.

COMPOSITION AND QUANTITY OF MATERIALS: Materials dredged from the Sabine-Neches Waterway consist of fine grained sands, clays, shell and silts. Shoaling in the project waterway is the result of littoral drifts and tidal action in the Gulf of Mexico and alluvial deposits occurring during high water periods in the Sabine and Neches Rivers. The shoaling rate of the project is approximately 10.2 million cubic yards annually.

METHOD OF DREDGING: A Government-owned hopper dredge is used to maintain the Entrance Channel (Sabine Bank Channel and the Sabine Pass Jetty and Outer Bar Channels). Pipeline contract dredges are utilized to maintain the remaining portions of the project from the Jetty Channel to the upper limits of the project chanels. Turning points, the anchorage basin, the slip, turning basins, and the maneuvering basin are maintained when necessary with the adjacent channel work. Data concerning the channel dredging frequencies, annual shoaling rates, types of dredging plant utilized, last date maintained and future scheduling are shown on the attached Table I.

PROPERTIES ADJACENT TO DISPOSAL AREAS: Disposal Areas Nos. 1 through 4 are located in the Gulf of Mexico at Latitudes, Longitudes 29° 27', 93° 42'; 29° 30', 93° 44'; 29° 33', 93° 48' and 29° 36', 93° 49' respectively. The disposal areas and adjacent waters are used for sport and commercial fishing.

Disposal Areas Nos. 5 and 6 are located in Louisiana on the east side of the Sabine Pass Channel. The disposal areas eastern boundaries are bound by State Highway 82 and marshlands.

Disposal Area No. 7 is located on the west bank of the Port Arthur Canal. The western portion of area is bound by State Highway 87 and the southern area is bound by marsh and low-land areas.

Disposal Area No. 8 located in Sabine Lake is bound on the east by Sabine Lake and on the west by Pleasure Island.

Disposal Area No. 9 is bound by the Gulf Intracoastal Waterway (GIWW) to the south, Taylors Bayou and industrual areas to the north, Port Arthur Turning Basin and Taylors Bayou to the east, and Taylors Bayou Outfall Canal and marshlands to the west.

Disposal Area No. 11 located in Sabine Lake is bound on the east, north and south by Sabine Lake and on the west by Pleasure Island.

Disposal Area No. 12 is bound on the north and west by State Highway 87 and a county road, on the east by an abandoned section of the Sabine-Neches Canal, and on the south by low-lying areas, marshlands and partial industrial developments.

Disposal Area No. 13 is bound on the north by the Neches River, on the east by a county road, and a developed area, on the west by State Highway 87, and on the south by State Highway 87, a county road and Disposal Area No. 12.

Disposal Area No. 14 located on the south bank of the Neches River is bound by the Atlantic Refining Company in the north, State Highway 87 and Disposal Area No. 13 on the east, marshland to the south, and an Atlantic Refining Company access road and low-lying areas on the west.

Disposal Area No. 15 is located on Humble Island and is bound by Old River Cove on the north and east, the Sabine-Neches Canal and the Neches River on the south, and marshlands on the west.

Disposal Area No. 16 is located on the south bank of the Neches River and is bound by the Neches River on the north, the Molasses Branch and marshland on the south and west, and marshland on the east.

Disposal Area No. 17 is located on the south bank of the Neches River is bound by the Neches River on the north, a county road and marshland on the south, marshland on the east, and marshland and industrial development on the west.

Disposal Area No. 18 is located on the north bank of the Neches River and bound by the Neches River on the south and west, and canal and Disposal Area No. 19 on the north, and marshland on the east.

Disposal Area No. 19 is located on the north bank of the Neches River and is bound by the Neches River on the south, the Bessie Heights Canal and Disposal Area No. 20 on the west, an unnamed canal and Disposal Area No. 18 on the east, and marshland to the north.

Disposal Area No. 20 is located on the north bank of the Neches River and is bound by the Neches River on the south, the Bessie Heights Canal and Disposal Area No. 19 on the east, Grays Bayou and marshland on the west, and marshland to the north.

Disposal Area No. 21 is located on the north bank of the Neches River and is bound by the Neches River on the south, marsh areas to the east and north, and an oxbow (Old River) on the west.

Disposal Area No. 22 is located on an island and is bound by the Neches River on the south and an oxbow (Old River) on the remaining sides.

Disposal Area No. 23 is located on the south bank of the Neches River and is bound by the Neches River on the north, marshland on the west, railroad tracks to the south, and Smith Bluff on the east.

Disposal Area No. 24 is located on the north bank of the Neches River and is bound by the Neches River on the west, the Reserve Fleet Anchorage on the south, and marshland on the north and east.

Disposal Area No. 25 is located on the west bank of the Neches River and is bound on the east by the Neches River, on the north and south by private maintained canals and marshland and on the west by a railroad and marshland.

Disposal Area No. 26 is located on the north bank of the Neches River and is bound on the south by the Neches River, on the north and east by Star Bayou, and on the west by an oxbow (old river portion of the Neches River).

Disposal Area No. 27 is located on the north bank of the Neches River and is bound by the Neches River on the south, north and west, Timber Harbor and an oxbow (Old River) on the east, and marshland on the north.

Disposal Area No. 29 is located north of the Sabine-Neches Canal near the mouth of the Sabine River. The area is bound by the Sabine-Neches Canal on the south, Little West Pass on the north and east, and Sabine Lake and Hickory Cove on the west.

Disposal Area No. 29-A is located on the north bank of the Sabine River. It is bound by the Sabine River on the south and east, Coon Bayou and marshland on the west, and marshland on the north.

Disposal Area No. 29-B is located on the north bank of the Sabine River. It is bound by the Sabine River on the east, Shell Canal and marshland on the north, and marshland to the west and south.

Disposal Area No. 30 is located on the west bank of the Sabine River. It is bound by the Sabine River on the east, Cow Bayou and marshland on the south, and marshland on the west and north.

Disposal Area No. 30-A is located on an island to the north of the Sabine River. It is bound by the Sabine River on the south, Cow Bayou Channel on the west and natural Cow Bayou on the north and east.

Disposal Area No. 31 is located on west bank of the Sabine River. It is bound on the east and south by the Sabine River, on the west by Adams Bayou Channel and marshland, and on the north by a railroad spur and the Orange Municipal Wharf facilities.

Disposal Area No. 32 is located in Louisiana on a cutoff island and is bound by the Gulf Intracoastal Waterway on the south and the Sabine River on the north, east and west.

Disposal Area No. 33 is located in Texas on Pavell Island to the east of the Sabine River. It is bound by marshland on the south and the Sabine River on the east, north and west.

Disposal Area No. 34 is located to the north of the Sabine River. It is bound by the Sabine River on the south and east, the Orange Municipal Slip on the west, and a railroad spur and partial industrial development area on the north.

Disposal Area No. 35 is located on east bank of the Sabine River. It is bound by the Sabine River on the west and south, by Phoenix Lake and marshland on the east, and marshland on the north.

Disposal Area No. 36 is located in Louisiana on the southern tip of Harbor Island near Orange, Texas. It is bound by the Sabine River on the east, west, south, and by Levingston Shipyard to the north.

Disposal Area No. 37 is located in Louisiana on the west bank of the Sabine River and is bound by the Sabine River on the west, Phoenix Lake on the south, and marshland on the east and north.

Disposal Area No. 38 is located on the south bank of Cow Bayou Channel and is bound on the north by Cow Bayou Channel, on the south by Shell Canal and marshland, on the east by Sabine River, and on the west by marshland.

Disposal Area No. 39 is located on the north bank of the Cow Bayou Channel. It is bound by Cow Bayou Channel on the west, natural Cow Bayou on the south and east and marshland on the north.

Disposal Area No. 40 is located on an island bound on the north by Cow Bayou Channel and on the east, west and south by natural Cow Bayou.

Disposal Area No. 41 is located on the north bank of Cow Bayou Channel and is bound on the south by Cow Bayou Channel, on the west by State Road 1442, and on the north and east by marshland.

Disposal Area No. 42 is located on an island south of Cow Bayou Channel and is bound on the north by Cow Bayou Channel and on the east, west, and south by natural Cow Bayou.

Disposal Area No. 43 is located on the north bank of Cow Bayou Channel and is bound on the south by Cow Bayou Channel, on the west by natural Cow Bayou, on the east by State Road 1442, and on the north by marshland.

Disposal Area No. 44 is located on an island north of the Cow Bayou Channel and is bound by natural Cow Bayou.

Disposal Area No. 46 is located on the north and south banks of the Cow Bayou Channel. It is bound by natural Cow Bayou on the south, east and west and marshland on the north.

Disposal Area No. 47 is located on the north and south banks of the Cow Bayou Channel. It is bound by natural Cow Bayou on the north, east and west and marshland on the south.

Disposal Area No. 48 is on an island south of Cow Bayou Channel. It is bound by natural Cow Bayou on the south, east and west and Cow Bayou Channel on the north.

Disposal Area No. 49 is on an island north of Cow Bayou Channel. It is bound by natural Cow Bayou on the north, east and west and Cow Bayou Channel on the south.

Disposal Area No. 50 is located on the north and south banks of the Cow Bayou Channel. It is bound by natural Cow Bayou on the east, west, and south and marshland on the north.

Disposal Area No. 51 is on an island north of Cow Bayou Channel. It is bound by natural Cow Bayou on the east, north and west and Cow Bayou Channel on the south.

Disposal Area No. 52 is on an island north of the Cow Bayou Channel and is bound by natural Cow Bayou on the north, east and west and Cow Bayou Channel on the south.

Disposal Area No. 53 is located on the southeastern tip of an island south of the Cow Bayou Channel. It is bound by natural Cow Bayou on the east and south, marshland on west and Cow Bayou Channel on the north.

Disposal Area No. 54 is located on an island west of the Cow Bayou Channel and is bound by Cow Bayou Channel on the east and marshland on the west, south, and north.

Disposal Area No. 55 is located on the east banks of both Cow Bayou and Cow Bayou Channel and is bound on the west by both waterways and on the north by State Road 105 and on the south by marshland.

Disposal Area No. 55-A is located on an island east of Cow Bayou Channel and is bound by natural Cow Bayou on the north and east and Cow Bayou Channel on the west.

Disposal Area No. 56 is located on the west bank of natural Cow Bayou. It is bound on the east by natural Cow Bayou and on the north, west and south by marshland.

Disposal Area No. 57 is located on the west bank of Cow Bayou Channel. It is bound on the east by Cow Bayou Channel and on the west, south and north by marshland.

Disposal Area No. 58-A is located on an island east of the Cow Bayou Channel and is bound by natural Cow Bayou on the north, east and south and Cow Bayou Channel on the west.

DREDGING BY OTHERS: There are six principal firms which perform maintenance dredging adjacent to the Sabine-Neches Waterway. The private dredging is primarily in the vicinity of the Sabine-Neches Canal and the Neches River. The firms normally contract independently and the dredge material is deposited in confined disposal areas described herein. The estimated annual quantity of material dredged from non-Federal facilities is about 160,000 cubic yards.

DESIGNATION OF DISPOSAL SITES: The proposed disposal sites have not been previously designated by the Administrator, Environmental Protection Agency. However, the use of these sites has been previously coordinated with EPA.

COORDINATION: The following is a list of Federal, State and local agencies with whom these activities are being coordinated.

Advisory Council on Historic Preservation
Region VI Environmental Protection Agency
U. S. Department of Commerce
U. S. Department of Interior
Eighth Coast Guard District
Division of Planning Coordination, State of Texas
Texas Parks and Wildlife Department
Texas Historical Commission
Orange County Navigation & Port District
Beaumont Navigation District
Port of Beaumont Navigation District of Jefferson County

Port of Port Arthur Navigation District of Jefferson County
City of Port Arthur, Texas
City of Port Neches, Texas
City of Beaumont, Texas
City of Orange, Texas
City of Starks, Louisiana
Commissioners' Court of Orange County, Texas
Commissioners' Court of Jefferson County, Texas
Office of State Planning, State of Louisiana
Louisiana Wild Life and Fisheries Commission
Police Jury of Cameron Parish, Louisiana
Police Jury of Calcasieu Parish, Louisiana
Department of Public Works, State of Louisiana
Louisiana Stream Control Commission

ENVIRONMENTAL IMPACT STATEMENT: Continued maintenance dredging of Sabine-Neches Waterway will significantly benefit the economic and social well-being of the public. The adverse and beneficial effects of dredging and disposal of dredged material on navigation, fish and wildlife, water quality, aesthetics, ecology, land use, etc., will be evaluated in accordance with the National Environmental Policy Act of 1969 (PL 91-190). An Environmental Statement will be prepared and is scheduled to be placed on file with Council on Environmental Quality in the Fall of 1975 after having been coordinated with the above mentioned agencies.

The shoaling rates in the Sabine-Neches project will not permit postponement of maintenance of the channel until after an environmental statement is filed with Council on Environmental Quality without serious impairment to the navigability of this project.

Any person who has an interest which may be affected by the disposal of this dredged material may request a public hearing. The request must be submitted in writing to the District Engineer within 30 days of the date of this notice and must clearly set forth the interest which may be affected and the manner in which the interest may be affected by this activity.

Designation of the proposed disposal plan for dredged material associated with this Federal project shall be made through the application of guidelines promulgated by the Administrator EPA in conjunction with the Secretary of the Army. If these guidelines alone prohibit the designation of this proposed disposal plan, any potential impairment to the maintenance of navigation, including any economic impact on navigation and anchorage which would result from the failure to use this disposal plan will also be considered.

The proposed transportation of this dredged material for the purpose of dumping it in ocean waters will be evaluated to determine that the proposed dumping will not unreasonably degrade or endanger human health, welfare, or amenities of the marine environment, ecological system, or economic potentialities. In making this determination, the criteria established by the Administrator, EPA pursuant to Section 102(a) of the Marine Protection, Research and Sanctuaries Act of 1972 shall be applied. In addition, based upon an evaluation of the potential effect which the failure to utilize this ocean disposal site will have on navigation, economic and industrial development, and foreign and domestic commerce of the United States, an independent determination will also be made of the need to dump this dredged material in ocean waters, other possible methods of disposal, and appropriate locations for the dumping.

COMMENTS: Persons desiring to express their views or provide information to be considered in evaluation of the impact of continued maintenance dredging are requested to mail their comments to:

District Engineer
Galveston District, Corps of Engineers
ATTN: SWGCO-M
P. O. Box 1229
Galveston, Texas 77550

with specific reference to Public Notice No. SN-M-1 dated 23 September 1974.

DON S. McCOY
Colonel, CE
District Engineer

2 Incl
1. Table I
2. Dwg dtd Sep 74
(4 sheets)

TABLE I

METHOD OF DREDGING DATA

Normal Dredging Reach	Dredging Method	Dredging Frequency (Months)	Annual Shoaling in CY	Last Maintenance	Next Scheduled Maintenance
Entrance Channel (1)	HD	12	4,100,000	Aug 74	May 75
Sabine Pass Channel	PL	24	500,000	Feb-Jun 74	(3)
Port Arthur Canal	PL	24	1,000,000	Feb-Jun 74	(3)
Port Arthur Turning Basins & Junction Area Port Arthur Canal	PL	18	500,000	Jan-Mar 74	Nov 75
Sabine-Neches Canal	PL	24	1,000,000	Nov 70-Nov 71	Mar 75
Lower Neches River and Upper Sabine-Neches Canal (Sec. "B")	PL	24	2,000,000	Jul 73-Mar 74	(3)
Middle Reach Neches River	PL	60-72	200,000	Mar-Aug 74	(3)
Upper Reach Neches River	PL	60-72	200,000	May 71-Apr 72	(3)
Sabine River Channel	PL	36	700,000	Jul 73-Mar 74	Jan 75
Cow Bayou Channel	PL	(2)	(2)	(2)	(2)
Adams Bayou Channel	PL	(2)	(2)	(2)	(2)

NOTES:

HD - Hopper Dredging
PL - Contract Pipeline Dredging

(1) Includes Sabine Bank Channel and Outer Bar and Jetty Channels.
(2) Adams and Cow Bayou Channels have not been maintained since construction. Available depths in the channels currently support the using traffic. However, maintenance will be scheduled in the future should available depths prove inadequate.
(3) Dredging will be scheduled after 30 June 1976 based on dredging frequencies or emergency requirements.

APPENDIX F

SABINE-NECHES, TEXAS
OCEAN DREDGED MATERIAL DISPOSAL SITE
SITE EVALUATION STUDY

The Corps of Engineers (CE) has indicated a continuing need for EPA designated Ocean Dredged Material Disposal Sites (ODMDS) for disposal of dredged material from operation and maintenance dredging. The CE also has indicated a need for EPA designated ocean sites for consideration along with other disposal alternatives during the planning of other dredging operations.

An ODMDS was interimly designated by EPA in January 1977 for the disposal of dredged material resulting from the operation and maintenance dredging of the Sabine-Neches Waterway System. The interim designation expires in February 1983. This study was implemented to determine if the Existing Sites or an alternative ocean disposal site should be permanently designated for (1) Disposal of dredged material resulting from the operation and maintenance dredging of the Sabine-Neches Waterway System, and (2) As an alternative in the planning of disposal of dredged material from other dredging projects in the Sabine-Neches area.

Background

The Marine Protection, Research, and Sanctuaries Act (MPRSA), of 1972, as amended and the EPA implementing Ocean Dumping Regulation and Criteria (ODR) provide the basis for designation of ocean dumping sites. Each of these has affected the sequence of events in the process of permanently designating ocean disposal sites.

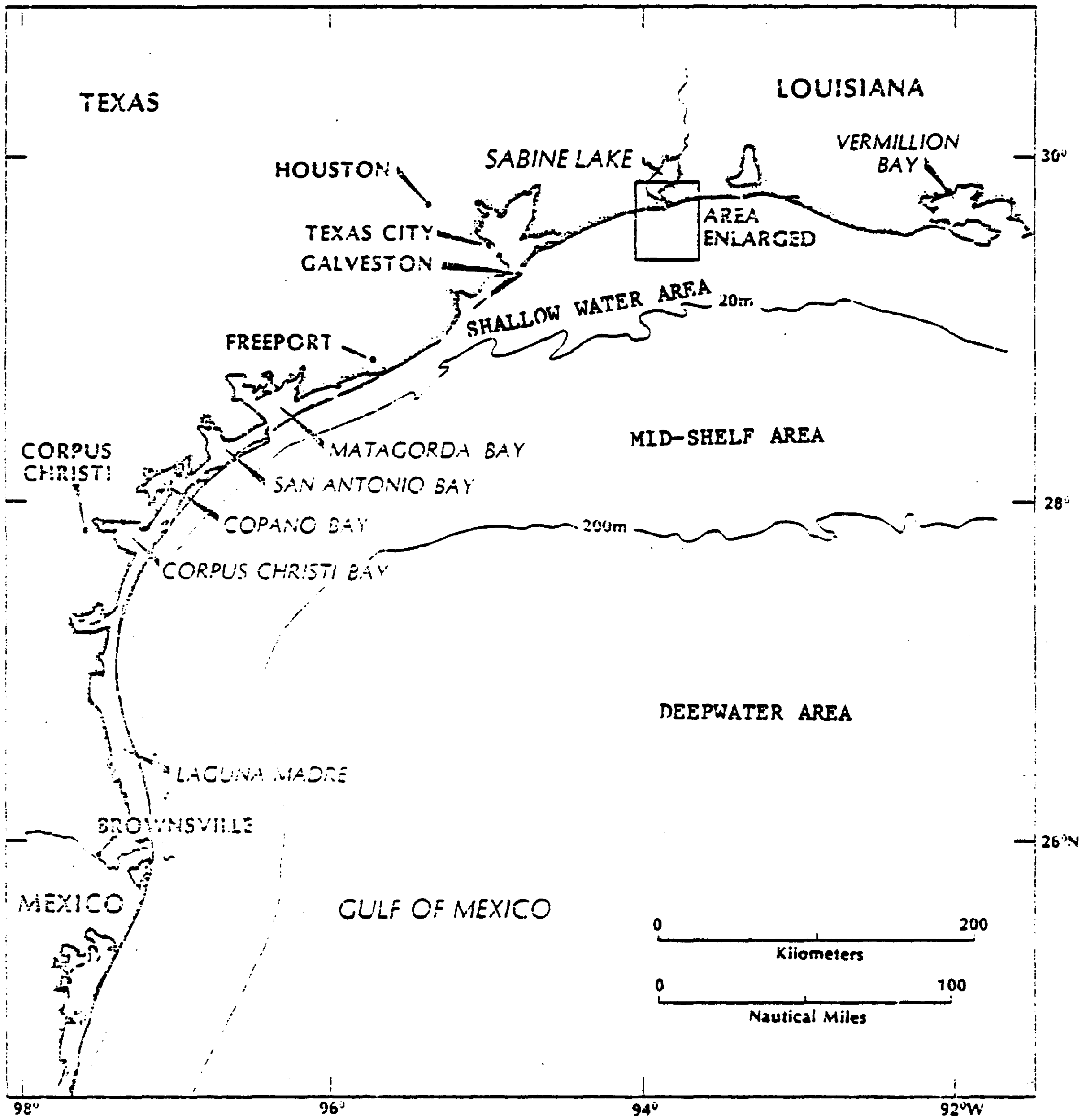
TEXAS
LOUISIANA
HOUSTON
SABINE LAKE
VERMILLION BAY
AREA ENLARGED
TEXAS CITY
GALVESTON
SHALLOW WATER AREA
20m
FREEPORT
MID-SHELF AREA
MATAGORDA BAY
CORPUS CHRISTI
SAN ANTONIO BAY
COPANO BAY
200m
CORPUS CHRISTI BAY
DEEPWATER AREA
LAGUNA MADRE
BROWNSVILLE
MEXICO
GULF OF MEXICO
0
200
Kilometers
0
100
Nautical Miles
30°
28°
26°N
98°
96°
94°
92°W

Figure F-1.

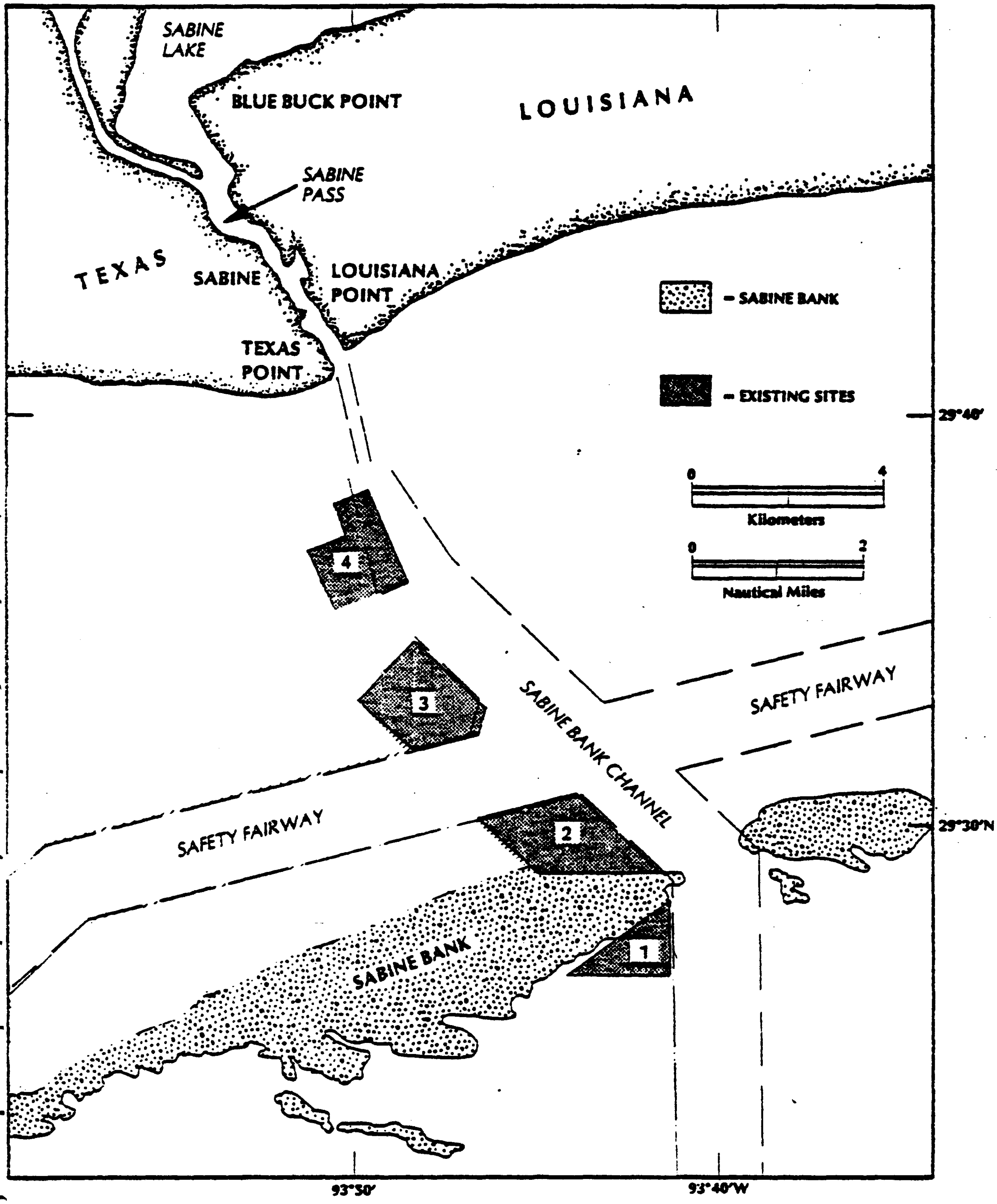

Figure F-2 Existing Sites

Marine Protection, Research, and Sanctuaries Act

The MPRSA, passed by the Congress October 23, 1972, provides the basis "---to regulate the transportation for dumping, and the dumping of the material into the ocean waters---". Among other things, the MPRSA established a permitting system for controlling dumping into the ocean. The permitting system is administered by the EPA Administrator (non-dredged material) and the Secretary of the Army (dredged material). The designation of appropriate locations for dumping into the oceans is provided for as a part of the permitting system.

Section 102(a) stipulates factors that EPA shall consider in the review and evaluation of permit applications. Section 102(c) states "The Administrator may, considering the criteria established pursuant to subsection (a) of this section, designate recommended sites or times for dumping and, when he finds it necessary to protect critical areas, shall, after consultation with the Secretary, also designate sites or times within which certain materials may not be dumped."

Section 103(c) establishes a permitting program to be administered by the Secretary of the Army "---for the transportation of dredged material for the purpose of dumping it into ocean waters---". Section 103(b) states in part "---the Secretary shall also make an independent determination as to other possible methods of disposal, and as to appropriate locations for the dumping. In considering appropriate locations, he shall, to the extent feasible, utilize the recommended sites designated by the Administrator pursuant to Section 102(a)---".

Ocean Dumping Regulations and Criteria

The ODR were issued to implement the provisions of the MPRSA. Section 228.4 establishes "Procedures for designation of sites." Section 228.4(e)(1) states "Areas where ocean dumping of dredged material is permitted subject to the specific conditions of Dredged Material permits issued by the U.S. Army Corps of Engineers will be designated by EPA by promulgation in this Part 228, and such designation will be made based on environmental studies of each site, and on historical knowledge of the impact of dredged material disposal on areas similar to such site in physical, chemical, and biological characteristics. All studies for the evaluation and potential selection of dredged material disposal sites will be conducted in accordance with the appropriate requirements of §§228.5 and 228.6---".

Section 228.5 describes the general criteria for selection of sites to be used for ocean dumping. Section 228.6 describes the specific criteria for site selection.

Site Designation

At the time of issuance of the ODR, a number of ocean disposal sites existed for which a continuing need was indicated. However, the necessary studies to fully evaluate these sites had not been completed. Because of this, the EPA approved the sites on an interim basis for a period not to exceed three years pending the completion of baseline or trend assessment surveys and designation for continuing use or termination of use. It was stated "the sizes and use specifications are based on historical usage and do not necessarily meet the criteria stated in this part" (228.12).

On 11 January 1977, EPA promulgated final ODR and Criteria to implement MPRSA. The Regulations set forth criteria and procedures for the selection and designation of ocean disposal sites. In addition, the regulations designated 129 ocean sites for the disposal of dredged material to allow the CE to fully comply with the purpose and procedural provisions of the MPRSA. These sites could be used for an interim period by the CE, pending completion of site designation studies as required by the Regulations. Use of the interim-designated sites by the CE would be dependent on compliance with the requirements and criteria contained in EPA's Ocean Dumping Regulations and Criteria.

BASIS FOR SITE SELECTION

General Criteria for Site Selection

Section 228.5 of the Ocean Dumping Regulations describes general criteria for selection of sites to be used for ocean dumping. In brief, the general criteria state that site locations will be chosen "...to minimize the interference of disposal activities with other activities in the marine environment..." and so chosen that "...temporary peturbations in water quality or other environmental conditions during initial mixing...can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations or effects before reaching any beach, shorelines, marine sanctuary, or know georgraphically limited fishery or shellfishery." In addition, ocean disposal site sizes "...will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to prevent adverse long-range impacts." Finally, whenever feasible, EPA will "...designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used."

EVALUATION OF OCEAN DISPOSAL ALTERNATIVES

PURPOSE

The purpose of this study is to evaluate and compare the environmental and economic characteristics of areas and sites that could be used for the disposal of dredged material from Sabine-Neches Entrance Channel. This study also provides the basis for eliminating unacceptable sites and areas from further consideration and study (under present conditions) to prevent efforts and resources from being expended unnecessarily. Thus attention could then be focused on those areas that are preferable, thereby permitting a more detailed evaluation of desirable sites and areas.

METHODOLOGY

The general criteria were used to make an initial appraisal of alternative ocean sites off the coast of Sabine-Neches, Texas suitable for designation for the disposal of dredged material. Based on the initial evaluation three areas were considered as a potentially suitable environment in which to locate an ocean disposal site. Those selected include: (1) shallow-water (depths from 0 to 20 m, approximately 0 to 20 nmi offshore), (2) mid-shelf (depth from 20 to 200 m, approximately 20 to 80 nmi offshore) and (3) deepwater slope (depths greater than 200 m approximately 90 nmi offshore) all of which are in the vicinity of Sabine Neches, Texas.

The four existing interim designated ODMDS located within the shallow-water environment will be looked at instead of the entire Shallow-Water Area for the following reasons:

- considerable data have been collected and is available on the existing sites.
- no apparent adverse effects have been detected from previous dumping of dredged material at these sites.
- the ODR state that "EPA will wherever feasible, desighate ocean dumping sites...that have been historically used."

At the present time the Mid-Shelf and Deepwater Areas contain no specific ODMDS's. If it is determined in the study that dredged material disposal in either of there areas is preferred, a suitable size and location for a site will be determined.

The proposed action is the final designation of a Sabine-Neches ODMDS for the disposal of material dredged from the Sabine-Neches Channel Systems. The screening of the sites is based on the 11 specific criteria listed at 40 CFR §228.6 of the Ocean Dumping Regulations. EPA established the 11 criteria to constitute "...an environmental assessment of the impact of the use of the site for disposal." In the following section the 11 specific criteria are used to evaluate the three alternatives initially chosen as potentially sites for disposal: The Interim Sites, the Mid-Shelf Area, and the Deepwater Area.

(1) GEOGRAPHICAL POSITION, DEPTH OF WATER, BOTTOM TOPOGRAPHY AND DISTANCE FROM COAST (40 CFR §228.6[1])

The Continental Shelf off the Texas coast slopes seaward at a fairly uniform and gentle rate of about 5.5 m per 5,000 m (i.e., gradient of 0.001). At roughly the 200 m mark the Continental Slope begins and continues down at a rapid rate to a depth of 1500 m or more.

EXISTING SITES

The Existing Sabine-Neches Ocean Dredged Material Disposal Sites 1, 2, 3, and 4, are adjacent to the Entrance Channel at distances ranging from 16 to 2.7 nmi from shore (Figure F-2).

Bottom topography within each of the Existing Sites is flat with no unique features or significant relief. Each varies only in distance from shore and depth.

Minimum water depth is 5 m along the northern boundary of site 4. The depth gradually increases with increasing distance from shore, to a maximum of 13.0 m at the southern boundary of site 1.

MID-SHELF AREA

The Mid-Shelf Area begins approximately 25 nmi South of Sabine-Neches at the Shelf Break zone, and extends to the end of the Continental Shelf approximately 90 nmi offshore. The region has depths ranging from 20 to 200m. This is a large area from which a suitably sized ODMDS could be selected.

TABLE F-1
GEOGRAPHIC CHARACTERISTICS OF THE EXISTING SITES

Site	Corner Coordinates	Distance from Shore (nmi)	Area (nmi^2)	Depth (m)
Existing Sites				
Site 1	29°28'03"N, 93°41'14"W 29°26'11"N, 93°41'14"W 29°26'11"N, 93°44'11"W	16	2.4	11-13
Site 2	29°30'41"N, 93°43'49"W 29°28'42"N, 93°41'33"W 29°28'42"N, 93°44'49"W 29°30'08"N, 93°46'27"W	11.8	4.2	9-13
Site 3	29°34'24"N, 93°48'13"W 29°32'47"N, 93°46'16"W 29°32'06"N, 93°46'29"W 29°31'42"N, 93°48'16"W 29°32'59"N, 93°49'48"W	6.8	4.7	10
Site 4	29°38'09"N, 93°49'23"W 29°35'53"N, 93°48'18"W 29°35'06"N, 93°50'24"W 29°36'37"N, 93°51'09"W 29°37'00"N, 93°50'06"W 29°37'46"N, 93°50'26"W	2.7	4.2	5-9

DEEPWATER AREA

The Deepwater Area is located about 90 nmi south from Sabine-Neches Harbor entrance. This is a large area from which a suitably sized ODMDS could be selected. This region has depths ranging from 200 m to >1500m in depth. The bottom is steeply sloped and consists of fine sediments.

(2) LOCATION IN RELATION TO BREEDING, SPAWNING, NURSERY, FEEDING, OR PASSAGE AREAS OF LIVING RESOURCES IN ADULT OR JUVENILE PHASES 40 (CFR §228.6[2])

The entire shelf region supports valuable commercial fish and shrimp fisheries. Whereas areas off the shelf support a relatively insignificant commercial fisheries.

EXISTING SITES

The Existing Sites are between the shrimp spawning grounds of the Mid-Shelf and the important nursery area of Sabine Lake, therefore they could be passageways of commercially valuable species (EHA, 1979). However, the sites represent only a minor portion of the entire range of shrimp along the Gulf coast and thus would only affect a small percentage of the existing population. Many commercially and recreationally important species of fish also occur in this region; however, most recognized breeding and spawning grounds occur in the productive marshes and estuaries of the coastal region or in the midwater areas of the Gulf (Chittenden and McEachran, 1976).

Henningson (1977), in a study off Sabine-Neches, found that disposal of dredged material at the Existing Sites is apparently not detrimental to free-swimming animals (nekton). Some nekton, including fish, may actually be attracted to the turbid water which result from disposal activities to seek food or protection from predators (EHA, 1979).

Commercially and recreationally important species in the Gulf may breed, spawn, or feed at or near the Existing Sites. These species are typical of nearshore western Gulf waters; therefore, the Existing Sites represents only a small portion of their geographic range.

MID-SHELF AREA

The Mid-Shelf Area supports, valuable commercial fish and shrimp fisheries. The brown shrimp grounds, which extend offshore in depths from 22 to 91 m, are within the area. Chittenden and McEachran (1976) state that dimersal fish biomass and diversity are higher in the brown shrimp grounds than within the shallow white shrimp grounds (3.5 to 22 m). Several offshore banks that represent valuable fishery resources areas exist within the Mid-Shelf Area.

Numerous hard-bottom banks are in the Mid-Shelf Area off Texas Point, in waters 50m to 200m deep, and contain extensive tropical - fish, coral and algal-sponge communities. In 1979, the Secretary of the Interior while discussing oil and gas exploration in the Gulf of Mexico, recommended that there areas be designated as "Biologically Sensitive Areas" for the protection of biological and cultural resources (DOI, 1979). The most important of these banks are the East and West Flower Garden Banks in water 200m deep along the edge of the Continental Shelf. The National Oceanic and Atmospheric Administration (NOAA) has proposed the Flower Garden Banks be designated as a marine sanctuary (DOC, 1979).

DEEPWATER AREA

The Deepwater Area may be a feeding area for oceanic fish. However, there are no well defined migratory pathways in the area. A Deepwater Site will avoid the shallow-water habitats of valuable shellfish and finfish. This area is outside the principal economic and sports fisheries regions, including the royal red shrimp and pelagic fisheries.

(3) LOCATION IN RELATION TO BEACHES AND OTHER AMENITY AREAS (40 CFR §228.6[3])

EXISTING SITES

Amenities in the vicinity of the Exising Sites include fishing and boating activities. Disposal of dredged material will not affect these activites adversely because affects will be limited to a turbidity plume at the site that will disperse within a few hours after disposal.

The beach will not be adversely affected by disposal activities at the Existing Sites because a prevailing southwesterly current carries material away from shore.

MID-SHELF AREA

The Mid-Shelf Area is more than 25 nmi from the nearest land, therefore, disposal would have no significant adverse impact on beaches, fishing and other coastal and nearshore amenities.

DEEPWATER AREA

The Deepwater Area is more than 90 nmi from the nearest land, therefore, disposal would have no significant adverse impact on beaches, fishing and other coastal and nearshore amenities.

(4) TYPES AND QUANTITIES OF WASTES PROPOSED TO BE DISPOSED OF AND PROPOSED METHODS OF RELEASE, INCLUDING METHODS OF PACKING THE WASTE, IF ANY (40 CFR §228.6[4])

Sediments to be dumped at the Existing Sites results from the dredging of the Sabine Entrance Channel, which includes Sabine Bank, Outer Bar, and Jetty Channels. Materials dredged from the Entrance Channel are dumped at the Existing Site closest to the area of dredging. The average annual amount dumped at the Existing Sites from 1960 to 1979 was 4.5 million yd^3 and is not expected to change significantly in the near future. Dredged sediments are predominantly clay or clayey silt.

All dredged material dumped in the ocean must conform to the EPA dredged material criteria listed at Section 227.13(b) of the Ocean Dumping Regulations.

A hopper dredge has been used for the dredging of the Sabine Entrance Channel. The unpacked dredged material is released when the bottom doors on the hopper are open.

(5) FEASIBILITY OF SURVEILLANCE AND MONITORING (40 CFR §228.6[5])

EXISTING SITES

Monitoring and surveillance are feasible at this location. The sites proximity to shore and shallow depths makes it less costly and complicated to monitor than the alternate areas.

MID-SHELF AREA

Monitoring and surveillance are feasible at this location. The Mid-Shelf Area, would require longer cruise time, more complicated sampling and monitoring techniques therefore it would cost more than for the Existing Sites.

DEEPWATER AREA

Monitoring and surveillance are feasible at this location. The Deepwater Area would require longer cruise time, more complicated sampling and monitoring techniques, therefore it would cost more than the Existing Sites and Mid-Shelf Area.

(6) DISPERSAL, HORIZONTAL TRANSPORT AND VERTICAL MIXING CHARACTERISTICS OF THE AREA, INCLUDING PREVAILING CURRENT DIRECTION AND VELOCITY, IF ANY (40 CFR §228.6[a])

Existing information indicates most material falls to the bottom immediately after disposal. A small fraction of the fine materials settles as individual particles. Although there is some turbidity of short duration, the material is dispersed over a wide area.

EXISTING SITES

In shallow-water areas, most dredged material falls to the bottom immediately after dumping and only a small portion of the finer fraction is lost from the main settling surge (Pequegnat et al., 1978). This small portion disperses as individual particles. Bottom currents measured 6.5 nmi off Texas Point average 0.23 kn and flow in a south-southwesterly direction. These currents are capable of transporting the dispersed dredged material over a wide area.

Bottom currents become quite strong during storms, when powerful rip currents redistribute coarse sediments along the Texas-Louisiana coast (DOE, 1978). Periodically, hurricanes also produce currents strong enough to prevent shoaling due to the accumulation of dredging material. Evidence of this is the lack of shoaling at any of the Existing Sites despite the approximately 88 million yd^3 of material that has been dumped in the past 50 years.

MID-SHELF AREA

The effects of disposal at Mid-Shelf sites have not been extensively studied because the Mid-Shelf region "...does not contain many disposal sites and few studies have been undertaken with respect to the fate of dredged material deposited on the open Shelf (Holliday, 1978)".

However, current direction is generally in a southwesterly direction and it is reasonable to assume that suspended sediments will be transported away from beaches.

DEEPWATER AREA

Shoaling is less likely to occur in deep water than shallow water due to spreading and dispersion of the sediment as particles settle through at least 200 m of water (Pequegnat et al., 1978). In deep water, e.g., the Deepwater Area, bottom water motions are generally not considered sufficient to move deposited sediments (Hirsch et al., 1978; Holliday, 1978), although Pequegnat et al (1978) stated that internal waves may contribute to sediment transport along the Continental Slope.

(7) EXISTENCE AND EFFECTS OF CURRENT AND PREVIOUS DISCHARGES AND DUMPING IN THE AREA (INCLUDING CUMULATIVE EFFECTS) (40 CFR §228.6[7])

Dredged material disposal causes decreases in abundances of benthic fauna due to burial (similar to results from storm activity) but fairly rapid recolonization in the nearshore environment occurs within 3 months after disposal operations cease. Organisms which colonize the affected areas are members of the surrounding, unaffected areas, and no nuisance species are recruited (Henry, 1976).

EXISTING SITES

No significant changes in diversity have occurred in the benthos of the disposal sites off Texas Point, based on a comparison of 1974 samples with samples taken from 1951 to 1954; however, minor reductions in abundances of benthic infauna are apparent (CE, 1975a). This loss in abundance is apparently a result of repeated dumping of materials onto immobile benthic organisms. Studies have shown that the populations being reduced are capable of recolonization within a few months (CE, 1975a). In addition, trawl data indicated that free-swimming animals in the disposal area did no differ from animals occurring in undisturbed areas (CE, 1975a). Surveys conducted for EPA by Interstate Electronics Corporation (IEC) in 1979 and 1980 also indicated no significant differences in the benthic community inside and outside the sites; however, low abundances of some dominant species were recorded at Site 3.

MID-SHELF AREA

Although the disposal of dredged material has not occurred at the Mid-Shelf Area, if disposal were to occur (Oliver et al 1977) contended that recovery of benthic populations from the disposal of dredged sediments is slower with increasing depth because populations in deeper water are adapted to more stable environmental conditions. Thus, peturbations (e.g., periodic burial by dredged sediments) decrease environmental stability and would affect Mid-Shelf organisms to a greater extent than those found in shallow waters.

DEEPWATER AREA

Athough the disposal of dredged material has not occurred at the Deepwater Area, if disposal were to occur (Oliver et al 1977) contended that recovery of benthic populations from the disposal of dredged sediments in slower with increasing depth because populations in deeper peturbatrions (e.g., periodic burial by dredged sediments) decrease environmental stability and would affect Deepwater organisms to a greater extend than those found in the Mid-Shelf and Shallow Water Area.

(8) INTERFERENCE WITH SHIPPING, FISHING, RECREATION, MINERAL EXTRACTION, DESALINATION, FISH AND SHELLFISH CULTURE, AREAS OF SPECIAL SCIENTIFIC IMPORTANCE AND OTHER LEGITIMATE USES OF THE OCEAN (40 CFR §228.8[8])

EXISTING SITES

Existing Sites 2, 3, and 4 partially extend into the navigational safety fairway; however, they have not represented hazards to shipping. Sediments dredged from the channel are dumped within site boundaries but outside the safety fairway. Fairways were only "established to control the erection of structures therein to provide safe approaches through oil fields in the Gulf of Mexico to entrances to the major ports along the Gulf Coast (33 CFR 209.135)."

Existing Sites 1 and 2 are near Sabine Bank, a major commercial and recreational fishery area. Prevailing bottom currents may carry dumped material at Site 2 towards Sabine Bank, but the rise at the bottom edge of the Bank will cause the material to be transported along rather than over the central portion of the Bank.

Existing Sites 1, 2, and 3 are in an area of important commercial shrimping (Grid Zone 17), which extends 60 nmi along the Texas-Louisiana coast, and from the shoreline to about 90 nmi offshore. The sites are in waters 10m to 13m deep, a primary shrimping area of this zone. In 1977, 25% of the catch effort for shrimp in Zone 17 occurred within this area. This effort resulted in a catch of approximately 24% of the total shrimp catch for Zone 17 (Ekberg, unpublished). Thus, it does not appear that previous disposal operations have significantly interfered with or altered such activities.

Oil and gas exploration and production could potentially be affected by disposal activities. Existing Sites 2 and 3 are presently being leased for oil and gas exploration and already contain oil production platforms and gas pipelines. As long as the density of these platforms and pipelines in these areas remains low, no significant conflict between the two uses of the disposal area should occur. However, if additional structures are placed within the disposal site, particularly Existing Site 3, it may be necessary to restrict dumping due to navigational hazards.

No present-day or impending mineral extraction or desalination projects exist in the area of the Existing Sites (CE 1979a).

MID-DEPTH AREA

Numerous hard-bottom banks are in the Mid-Shelf Area off Texas Point, in waters 50m to 200m deep, and contain extensive tropical - fish, coral and algal-sponge communities. In 1979, the Secretary of the Interior while discussing oil and gas exploration in the Gulf of Mexico, recommended that these areas be designated as "Biologically Sensitive Areas" for the protection of biological and cultural resources (DOI, 1979). The most important of these banks are the East and West Flower Garden Banks in water 200m deep along the edge of the Continental Shelf. The National Oceanic and Atmospheric Administration (NOAA) has proposed the Flower Garden Banks be designated as a marine sanctuary (DOC, 1979).

Active oil and gas exploration and drilling occur in this sector of the Continental Shelf off Sabine-Neches Texas. Fixed structures (e.g., oil platforms) would present navigational hazards to the hopper dredges used in channel maintenance, and collisions might result in oil spills. Supply vessels service the platforms and thus add to navigational hazards. Disposal at a mid-depth site might result in dredged material temporarily covering underwater structures associated with drilling.

A mid-shelf site would be located on the far side of the drilling platforms and associated structures, but exploration and discoveries of oil and gas might occur producing more surface rigs which could interfere with disposal operations.

DEEPWATER AREA

Interference with shipping would be minimal at the Deepwater Area. Fishing, desalinization, recreation, and mineral extraction activities do not occur in the Deepwater Area; therefore, a disposal site within this area would not interfere with any of these activities.

(9) THE EXISTING WATER QUALITY AND ECOLOGY OF THE SITE AS DETERMINED BY AVAILABLE DATA OR BY TREND ASSESSMENT OR BASELINE SURVEYS (40 CFR §228.6[9])

EXISTING SITES

The Shallow-Water Area is a dynamic, high-energy environment. Water quality and ecology are influenced by nearshore mixing processes, runoff, and seasonal storms. Nearshore waters of the Gulf Coast are naturally turbid (Lee et al., 1977).

Phytoplankton and zooplankton studies conducted southwest of the Existing Sites revealed seasonal differences in species composition; however, diatoms dominate the phytoplankton community and copepods dominate the zooplankton community (SEADOCK, 1976).

Fish and shrimp dominate the nekton community of the Existing Sites, and species are typical of those reported from western gulf coastal waters (CE, 1975a). Several of these species are commercially and recreationally important, including Atlantic croaker, Atlantic bumper, seatrout, menhaden, catfish, and brown and white shrimp.

The benthic community of the Existing Sites is characteristic of sand and mud habitats, and is dominated by worms, the most abundant of which are the acorn worm, Balanoglossus cf. aurantiacus, and the nemertean, Cerebratulus lacteus.

Chemical constituents of the water at the Existing Sites do not exceed the EPA (1976) water-quality criteria (CE, 1978a,b). According to Horne and Swirsky (1979), concentrations of all measured constituents in the water (except dissolved ammonia, nitrate, and organic nitrogen) were below analytical delections limit. The three exceptions occurred in relatively low concentrations; however, no appropriate water-quality criteria regulating concentrations of these constituents apply.

MID-SHELF AREA

There is no specific water quality or ecological data available. However, it is reasonable to assume that the disposal of dredged material at the Mid-Shelf Area would have only a temporary effect on water quality. Disposal at the Mid-Shelf Area could adversely affect the existing water quality primarily in the East and West Flowder Gardens Areas. The species composition of bottom-dwelling organisms may be a altered as a result of change in sediment type of the site due to disposal of dredged material.

DEEPWATER AREA

Specific data are sparse for the Deepwater Area but general information is available. The water quality of the area is typical of clean open ocean water (i.e., with low concentrations of nutrients and suspended solids). Pelagic fish species reported from deep waters of the western Gulf include the tilefish, tunas, billfish, and swordfish (Pequegnat et al., 1978); polychaetes typically dominate the benthic community at these depths (Grassle, 1967).

(10) POTENTIALITY FOR THE DEVELOPMENT OR RECRUITMENT OF NUISANCE SPECIES IN THE DISPOSAL SITE (40 CFR §228.6[10])

EXISTING SITES

No changes in species composition at the Existing Sites have resulted from disposal operations (CE, 1975a). Trawl and benthic data also indicated that "the disposal area at the time of sampling did not differ from other nearby undisturbed areas...disposal of dredged material has contributed little to changing the character of the faunal communities in the vicinity of Sabine Pass" (CE, 1975a).

MID-SHELF AREA

Changes in the benthic infaunal community caused by the introduction of dredged material could occur. However, there is no component of the dredged material which could cause development or recruitment of nuisance species.

DEEPWATER AREA

Changes in the benthic infaunal community caused by the introductin of dredged material could occur. However, there is no component of the dredged material which could cause development or recruitment of nuisance species.

(11) EXISTENCE AT OR IN CLOSE PROXIMITY TO THE SITE OF ANY SIGNIFICANT NATURAL OR CULTURAL FEATURES OF HISTORICAL IMPORTANCE (40 CFR §228.6[11])

EXISTING SITES

Neither the Texas Antiquities Committee nor the Louisiana Division of Archaeology and Historic Preservation Office has found evidence of natural or cultural features of historic importance in the area, but they noted that unknown sunken prehistoric sites may exist.

According to the CE (1975a), sunken vessels which exist in the offshore disposal area should not be permanently affected by disposal operations.

MID-SHELF AREA

Flower Gardens Bank is a natural feature of importance within the Mid-Shelf Area.

DEEPWATER AREA

No known natural or cultural resources of historic important area present at or in close proximity of the Deepwater Area. No shipwrecks were discovered at the site by the U.S. Department of the Interior (DOI, 1978).

DISPOSAL COSTS

The cost of operating a hopper dredge, such as the one with a 3,000 yd^3 capacity is about $775,000 per month, or $1,000 per hour. The costs vary with such factors as type of material dredged, amount of time lost to dredge maintenance and weather, the dredge production rate, operation time, and net hopper capacity per disposal cycle (EHA, 1979). A disposal cycle includes loading the dredge hopper with dredged material, transporting the material to a disposal site, emptying the hoppers, and returning to the channels being dredged. Only the transportation and monitoring costs would increase for a more distant disposal site. Loading the hopper dredge and the actual disposal the ODMDS would be unaffected.

Based on evaluation of specific cost estimates for the transportation portion of the dredgding process are not available. However, since the closest point of the Mid-Shelf and Deepwater Area is many times the distance to the Existing Sites, the transportation factor would correspondingly increase by close to the same factor. In the New York area, Conner et al. (1979) reported that transportation costs for dredged material ranged from 4 to 6¢/yd^3/nmi. Applying these estimates to Sabine-Neches gives an increase in dredging costs from $1.02 to 1.34/$yd^3$ at the Interim Sites to $4.51 to 6.58/$yd^3$ at a site in the Deepwater Area. This represents a 442 to 491% increase in the dredging cost/yd^3.

MONITORING COSTS

The cost of monitoring would be higher at a site located further from shore because the distance to the site is greater and the increased depth in the deeper waters would require more costly time-consuming monitoring techniques.

Surveillance costs would not increase significantly at the Deepwater Site. Under the Interagency Agreement with the Coast Guard, the CE has assumed primary responsibility for CE and CE-contracted disposal operations.

CONCLUSION

From the results of the data presented above on the environmental and socioeconomic characteristics of the three alternative ocean disposal sites, and from costs associated with dredged material transport, two Areas can be eliminated from further consideration (Deepwater and Mid-Shelf) and the Existing Sites are recommended for final designation.

Based on the foregoing evaluations it is concluded that the Existing Sites are preferrable for the disposal of dredged material for the following reasons:

- Benthic sampling data indicate that despite 20 years of disposal, "no significant changes have occurred in the faunal communities as a result of dredging and disposal operation," with the exception of some reduction of infaunal abundances (CE, 1975a). In addition "because the areas have been used for many years future changes in the benthic community cannot reasonably be expected from continued disposal" (CE, 1975a).

- This is a high-energy erosional zone and can generally accept large volumes of dredged material with little apparent net change to the bottom.

- Numerous studies have been done on the sites and a wide variety of data is available there by eliminating the need for expensive data collection and analysis.

- The site is within the inlet zone and is adjacent to Sabine-Neches Channel. This provides easy access for dredging disposal activities, and reduce costs.

- Studies have shown that there are no unique fisheries in the area.

Reasons for the elimination of the Mid-Depth and Deepwater Areas from further consideration for the disposal of dredged material at this time is as follows:

MID DEPTH AREA

- Significant active oil and gas exploration and drilling occur in this sector of the Continental Shelf off Sabine-Neches. Numerous fixed structures (e.g., oil platforms) would present navigational hazards to the hopper dredge used in the channel maintenance, and collisions with the platforms might result in oil spills. Supply vessels service the platforms and thus add to navigational hazards. Disposal at a Mid-depth site could result in dredged material temporarily covering underwater structures associated with drilling.

- Another negative factor for against locating a disposal site in 20m to 200m depths off Sabine Texas comes from Pequegnat (1978) who noted that the area is "where the great brown shrimp fishery exists." Several studies, however, reported that disposal of uncontaminated dredged material does not adversely affect shrimp (Wright, 1978; EHA, 1979; Henningsen, 1977).

- A site located in the Mid-Shelf area would require greater transit times and therefore, cost more.

- The disposal of dredged material is most likely to adversely affect bottom-dwelling or benthic organisms (Wright, 1978). Disposal at a Mid-depth Site would more likely have a long-term effect on the benthos than would disposal at a shallow-water site (Oliver et al., 1977).

- Adverse effects on the unique Flower Garden Bank Area could develop if a site in this area were improperly located.

DEEP WATER AREA

- The primary reason against recommendating designation of the Deepwater Site as a ODMDS is transportation costs. It is estimated that dredging costs will increase 442 to 491% if the disposal area was changed from the Interim Sites to the Deepwater Area.

TABLE F-2

	Distance (nmi	Travel Time (min)*	Dredging Cost (per yd^3)	Transportation Cost (per yd^3)	Total Cost (per yd^3)
Existing Sites	2.7	25	0.91 to 1.18	0.11 to 0.16	1.02 to 1.34
Mid-Shelf Area	25	133	0.91 to 1.18	0.80 to 1.18	1.71 to 2.36
Deep-water Area	90	600	0.91 to 1.18	3.60 to 5.40	4.51 to 6.58

* Assume a speed of 9 kn
Assume a cost of 4 to 6¢/yd^3/nmi