HISTORY OF OCEAN DUMPING

IN THE

GULF OF MEXICO

by

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ABSTRACT

The Gulf of Mexico is a unique ocean basin covering over 615,000 square miles. It is unique in that more than twenty major river systems in the United States and Mexico drain into this ocean. Through this diverse network two-thirds of the natural sediments and industrial pollutants of the United States find their way into the Gulf. Over 1.5 million square miles of the United States drain into the Gulf through this network. In addition to this, there is runoff from Mexico.

The physical and chemical parameters of the Gulf of Mexico are important in assessing the nature of this water body. The main currents, temperature, and salinity are those of most importance. The principle current is a branch of the Equatorial Current which passes through the Florida Straits and constitutes a section of the Gulf Stream. The average winter temperatures are between 65° and 75°F. The summer average is 84°F. The salinity average is determined to be around 36 parts per thousand (ppt).

Economically, the Gulf is very productive with respect to shrimp, oysters, and other fish. Offshore oil and gas leases also generate a substantial amount of income.

The Gulf of Mexico has also been used as a dumping grounds for the coastal states. Initially there was no control over dumping, but the Corps of Engineers was eventually given authority to overview this practice. Then in 1973, the Environmental Protection Agency took over and imposed a stringent permit system and designated specific dump sites. Eight separate permits were issued since then to industries. This paper discusses each permit issued and the contents of the permit. The different methods of discharging wastes vary and are also presented.

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INTRODUCTION

The report presents a historical look at the practice of ocean dumping in the Gulf of Mexico. The main purpose of this paper is to document the past and present ocean disposal practice in the Gulf of Mexico.

The initial part of this report defines the Gulf of Mexico with respect to physical, chemical, and biological characteristics. The currents, temperatures, and salinities are reported. A list of major river systems that drain into the Gulf is also presented. The economic importance with respect to fisheries, and oil and gas reserves is discussed.

The next part of the report discusses the history of ocean dumping in the Gulf of Mexico. This part is in turn divided into two sections, the Corps of Engineers permitting system, and the EPA permitting system. The method of permitting by the Corps and the location of dump sites is presented. There is some information on who is known to have been dumping and what they have dumped, and when the dumping took place. Under the EPA permitting system, there is much more information concerning dumping. Excerpts from the Marine Protection, Research and Sanctuaries Act of 1973, which defines the national policy toward ocean dumping, are given as well as the types of permits issued under this law. Actual permits issued by the EPA were obtained from the regional office in Dallas, Texas and reviewed. A summary of each permit was made and presented in this report.

Since the methods of discharging wastes from vessels differs from one to the other, a short section discusses the more commonly used methods. They include jet-dispersion, hopper-barge, wake mixing, and container discharge.

Finally, the summary and conclusion summarizes the important points in the report. Some general observations on the trends toward ocean dumping in the Gulf are also mentioned and discussed.

CHARACTERISTICS OF THE GULF OF MEXICO

For the purposes of this report, it is necessary to establish what is meant by the Gulf of Mexico. It is a partially landlocked arm of the Atlantic Ocean which is bounded on the north by the United States, on the south and west by Mexico and on the east by the western coast of Cuba. The Gulf is connected to the Atlantic Ocean by means of the Straits of Florida (110 miles wide) and to the Caribbean Sea by the Yucatan Channel (120 miles wide).

Size

The Gulf forms a huge ocean basin covering an area of approximately 615,000 square miles (Boykin, 1972). Its greatest length is 1100 miles, east to west, and its greatest width is 775 miles, north to south. The continental shelf is almost continuous around the margin of the Gulf, varying from 8 to as many as 135 miles wide. The average depth of the Gulf is about 4,700 feet, while the maximum depth, Sigsbee deep, is 12,425 feet below sea level (Boykin, 1972).

Currents

According to Sverdrup (1942), there are three different types of currents in the Gulf of Mexico. These are:

1) tidal currents,
2) currents caused by the stress of the wind on the sea surface,
3) currents related to water density.

Tidal currents are those formed due to the rising and falling of tides. They consist of horizontal movements of water which are needed to raise or lower the sea level at a particular location.

In the Gulf, these tidal currents have relatively high velocities due to the great width of the shallow continental shelf. The depth of the moving water is small, thus the velocity must be relatively great to provide the volume of water necessary for the change in tides.

Currents caused by the stress of wind upon the sea surface are set up as a result of two forces. When the wind blows upon the ocean, it exerts a frictional force upon the surface causing it to move. These surface layers of water, in turn, act upon the deeper layers and set them in motion also. Once this movement is established, the water is acted upon by the Coriolis effect. This is a deflecting force which is caused by the rotation of the earth. It is partially responsible for causing the current to curve and swirl instead of following a straight course.

The currents related to the distribution of density are the major semi-permanent currents of the oceans (Leipper, 1954). These ocean currents may be detected from the distribution of density as determined by relatively simple observations of temperature, salinity and pressure. This "pressure force" is the potential which causes water to flow from a region of high pressure to a region of low pressure.

However, little is known about these currents in the Gulf of Mexico. Most of the information is based upon the navigation records of ships sailing in the Gulf over many years. The pilot charts of the U.S. Navy Hydrographic Office embody a compilation of these data, which indicate different surface currents in summer than in winter (Figures 1 and 2).

The principal current is a branch of the Equatorial Current, which enters the Gulf of Mexico through the Yucatan Channel. It passes through the Straits of Florida and joins the Antilles Current to form the Florida Current which is the beginning of the Gulf Stream system.

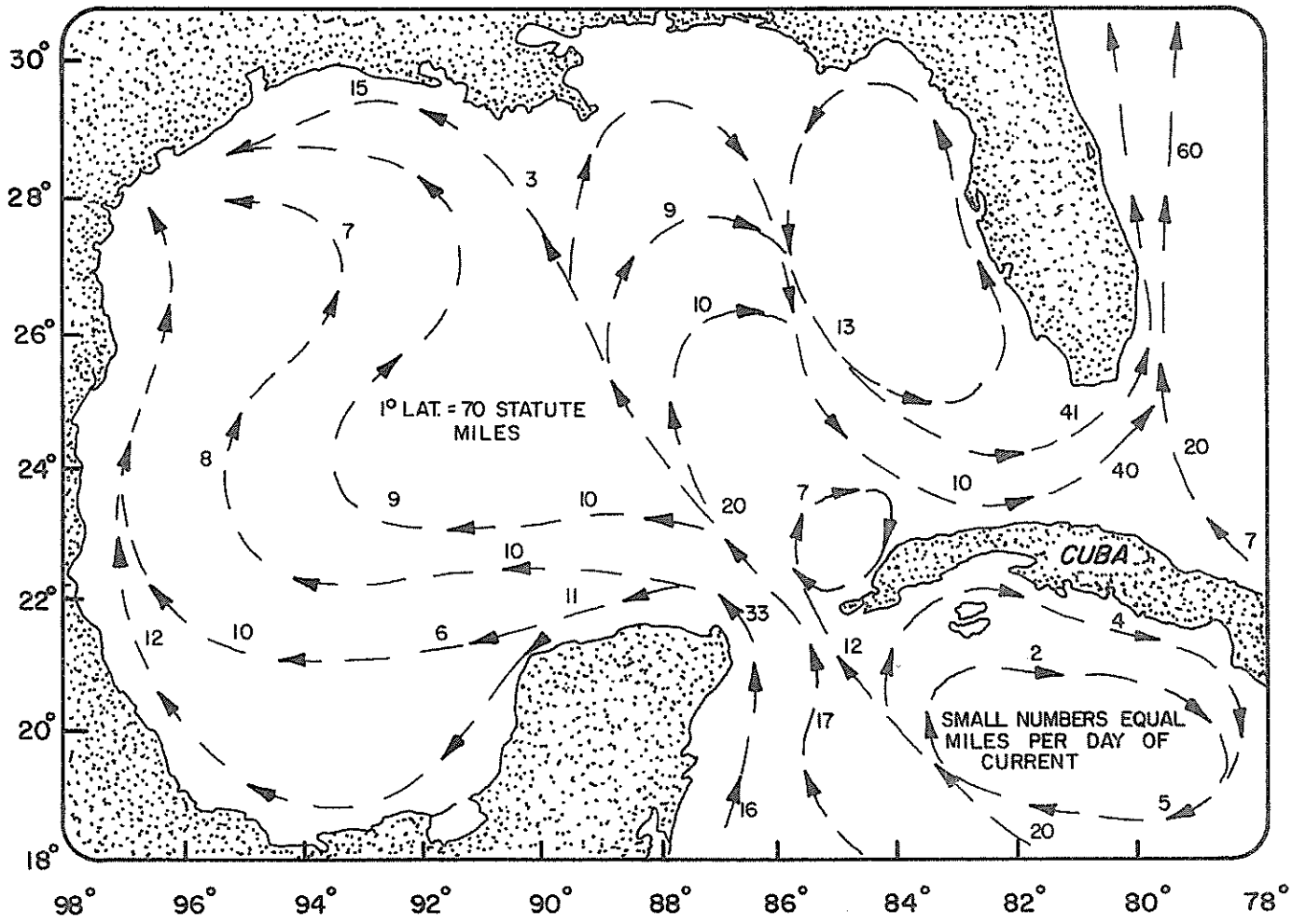

FIGURE 1

SURFACE OCEAN CURRENTS IN JUNE
GULF OF MEXICO
(LEIPPER, 1954)

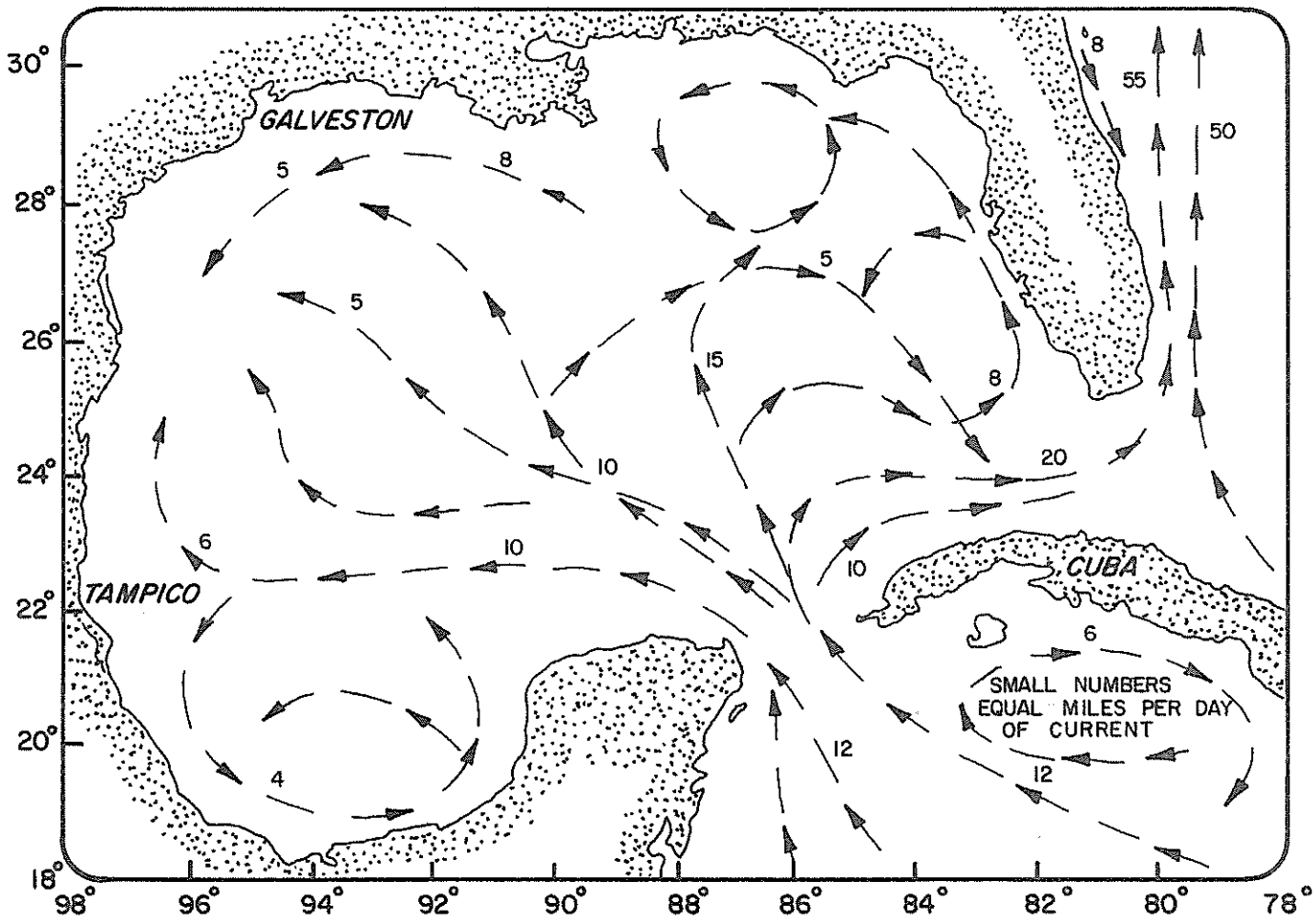

FIGURE 2

SURFACE OCEAN CURRENTS IN DECEMBER
GULF OF MEXICO
(LEIPPER, 1954)

River Systems

The distributive province of the Gulf of Mexico is an important factor to consider when examining its physical characteristics. This area includes more than twenty major river systems (Table 1) which cover in excess of 1.5 million square miles of the continental United States, plus over half of Mexico and the Yucatan Peninsula (Figures 3 and 4). The Gulf is the recipient of nearly two-thirds of the natural sediments and industrial pollutants of the United States, not to mention such runoff from Mexico (Moody, 1967).

Temperature and Salinity

The temperature and salinity readings of sea water have been shown by several researchers to be closely related. For this reason, they will be treated together under the same heading.

Like the currents, sea surface temperature studies of the Gulf have been based upon numerous observations taken by ships over a period of many years. Many of these observations were made by using instruments which comprised part of each ship's normal equipment. This fact would tend to indicate that there would be a certain amount of error in the accuracy of different thermometers and in the different methods used by each observer. However, due to the large number of observations (well over 200,000), the systematic errors would probably offset one another resulting in a figure very near the true average.

Compiling the data from these observations, investigators have found the average winter temperatures to be between 65° and 75°F. The summer average has been found to be 84°F. On the whole, these temperatures are found to be from eight to nine degrees higher than the average temperature in the Atlantic at the same latitude.

TABLE 1

MAJOR RIVER SYSTEMS INCLUDED IN THE
GULF OF MEXICO DISTRIBUTIVE PROVINCE

Country	State	River System
United States	Texas	Rio Grande
		Nueces
		Colorado
		Brazos
		Trinity
		Sabine
	Louisiana	Mississippi
	Mississippi	Pearl
		Pascagoula
	Alabama	Mobile
		Alabama
	Florida	Apalachicola
Mexico	Tamaulipas	Rio Sota La Marina
		Tamesi
	Veracruz	Panuco
		Tuxpan
		Cazones
		Tecolutla
		Coatzacoalcos
	Tabasco	Rio de San Pedro
	Campeche	Candelaria
		Champoton

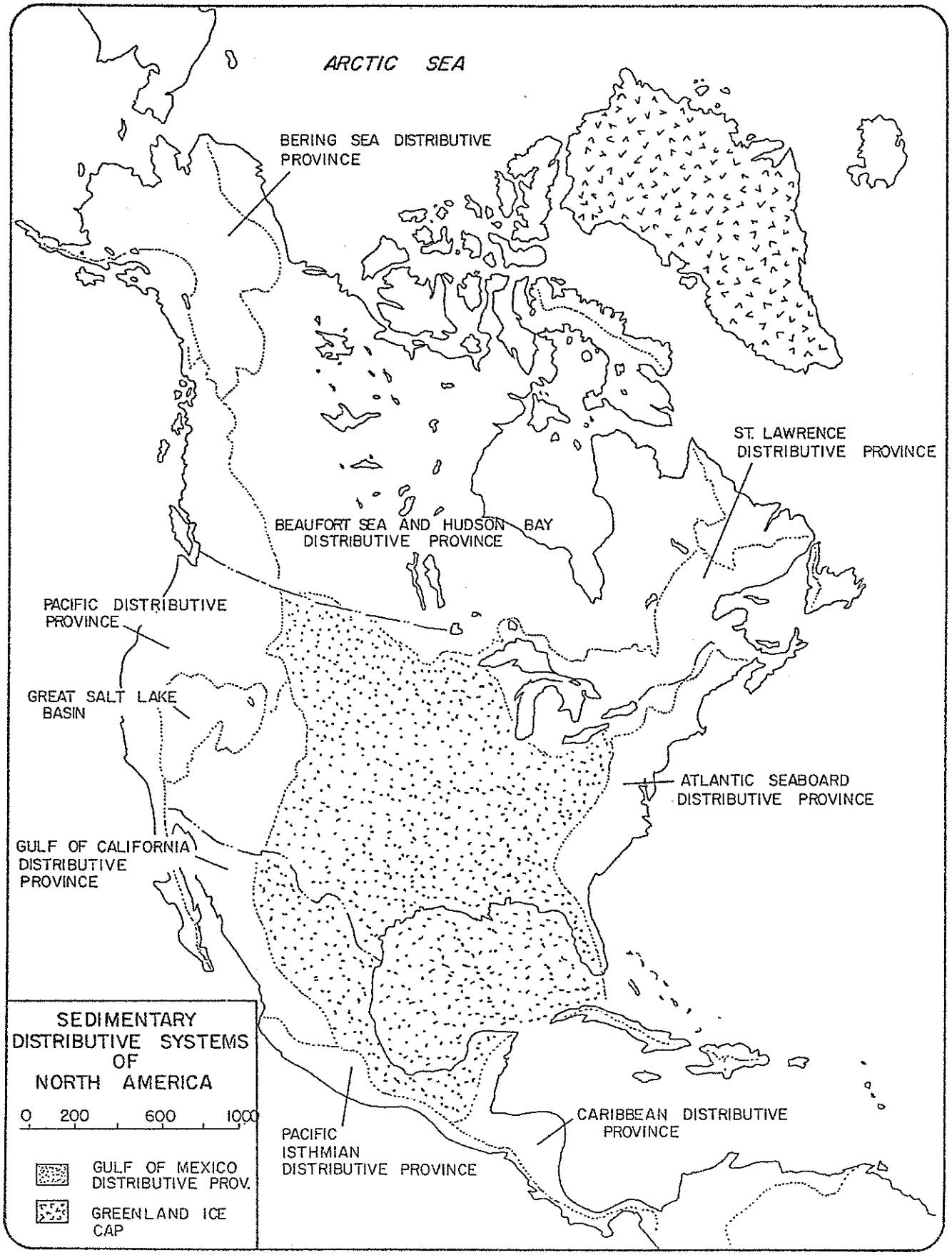

FIGURE 3

SEDIMENTARY DISTRIBUTIVE SYSTEMS OF NORTH AMERICA
(MOODY, 1967)

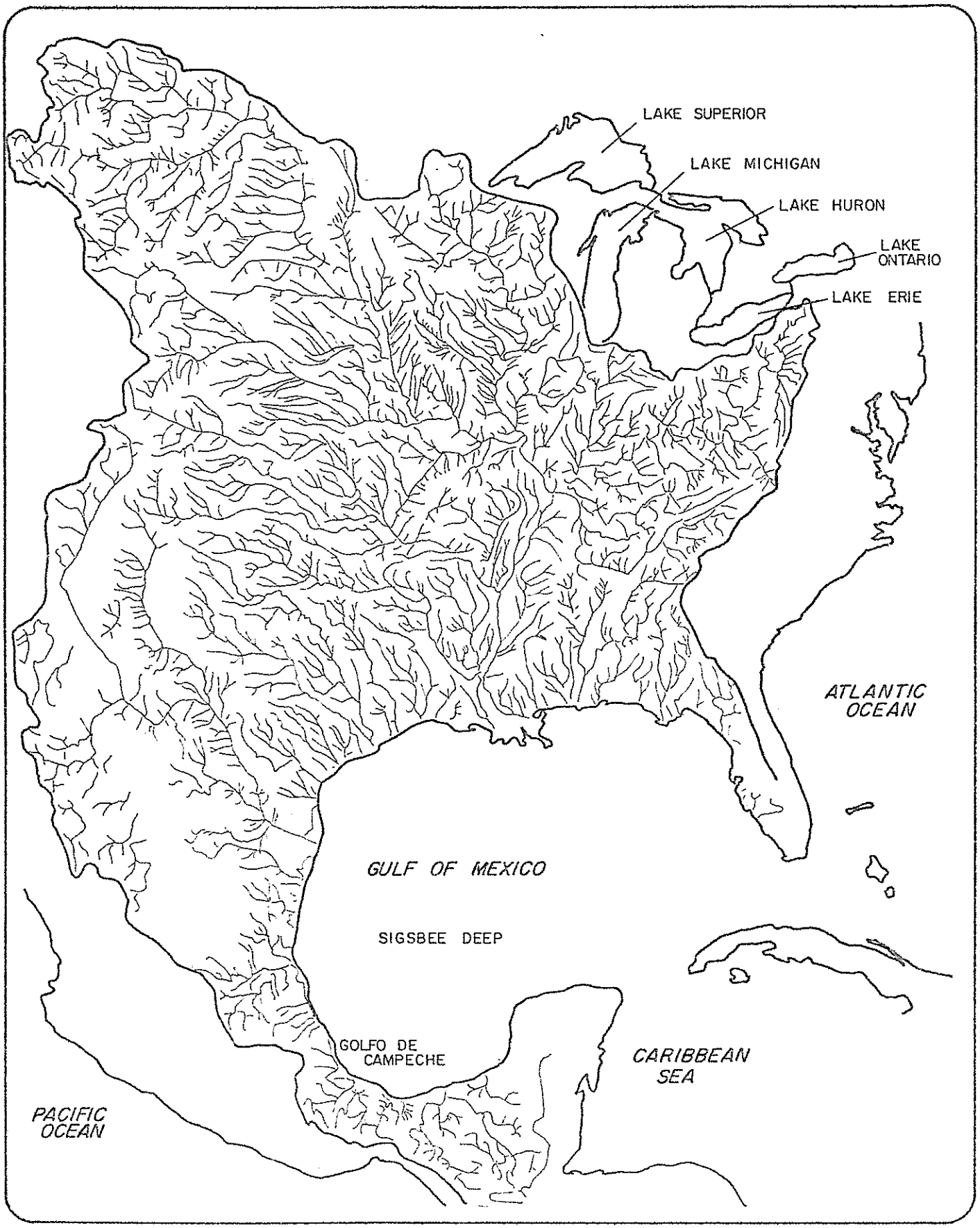

FIGURE 4
GULF OF MEXICO DISTRIBUTIVE PROVINCE
(MOODY, 1967)

Isotherms prepared from these data are shown in Figures 5 and 6 (Leipper, 1954). In the month of February (Figure 5), the average winter pattern shows a gradual decline in temperatures from 75°F in the southern Gulf to 65°F in the north. The average summer temperatures from August (Figure 6) show an evenness throughout the area at 84°F.

The annual range of surface temperatures varies from 15° to 20°F in the northern portion of the Gulf while in the central and southern portions the range is about 10°F.

Salinity is the measurement of the amount of dissolved salts in sea water. It is measured in grams of salt per kilogram of water (parts per thousand) and represented by the abbreviation ppt.

The average salinity of the Gulf has been found to be 36 ppt which is slightly higher than the 35 ppt average found in the Atlantic. The normal variation within the Gulf is between 35.0 and 36.6 ppt (Figure 7), although there are some extreme deviations due to specific natural phenomena. Water from the Mississippi River extends over 150 miles into the Gulf causing the salinity to be much lower than normal. Due to this influx, salinities of less than 24 ppt have been recorded several miles offshore. Often, high salinities have been reported as a result of extreme weather conditions. During droughts, the Laguna Madre of Texas has been known to have had salinities as high as 130 ppt.

Economic Importance

Being the ninth largest body of water in the world, the Gulf of Mexico is, obviously, very important economically. When compared with the eight other fishing regions of the United States, it is apparent why the Gulf region is so important.

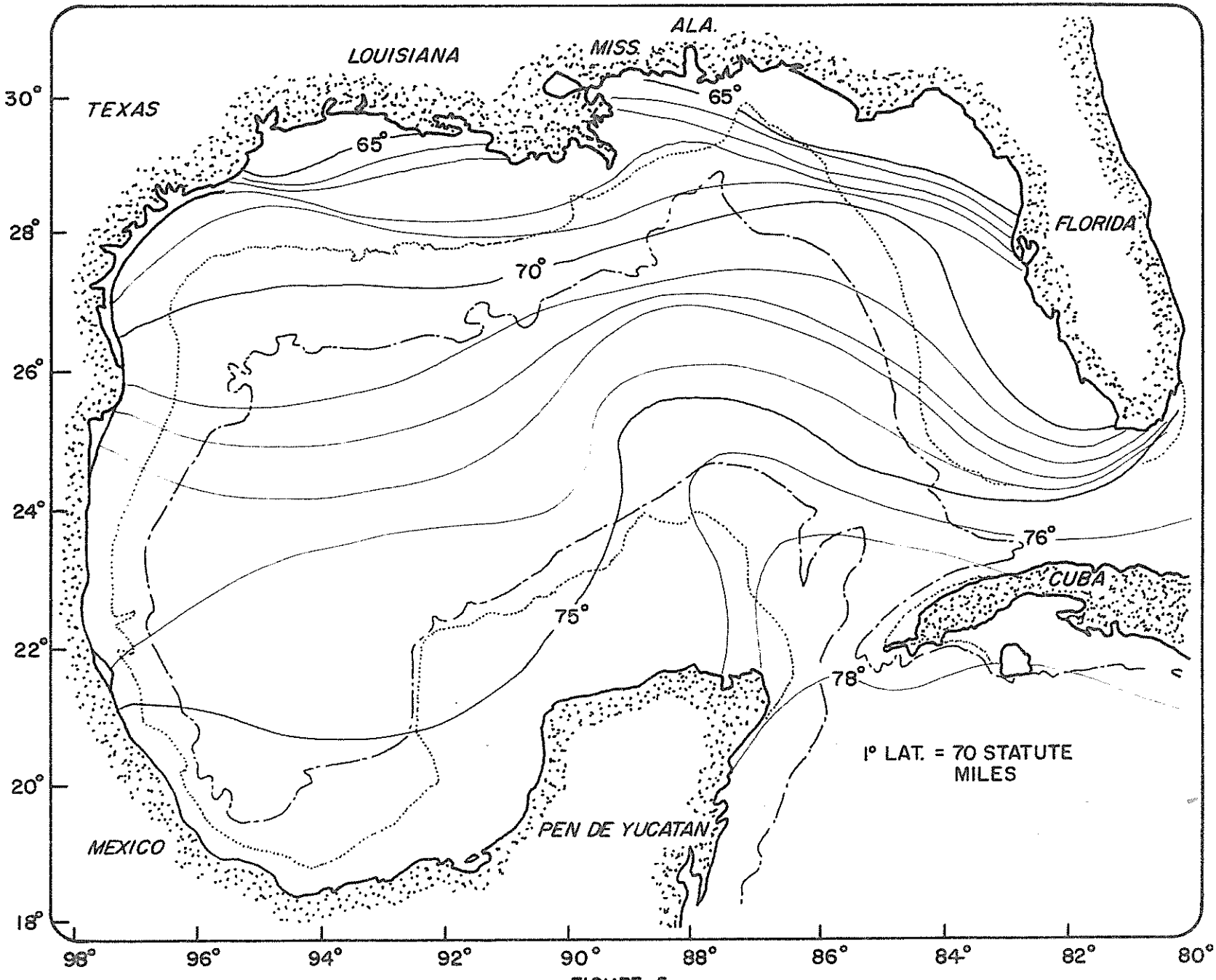

FIGURE 5

AVERAGE SEA SURFACE TEMPERATURE FOR FEBRUARY

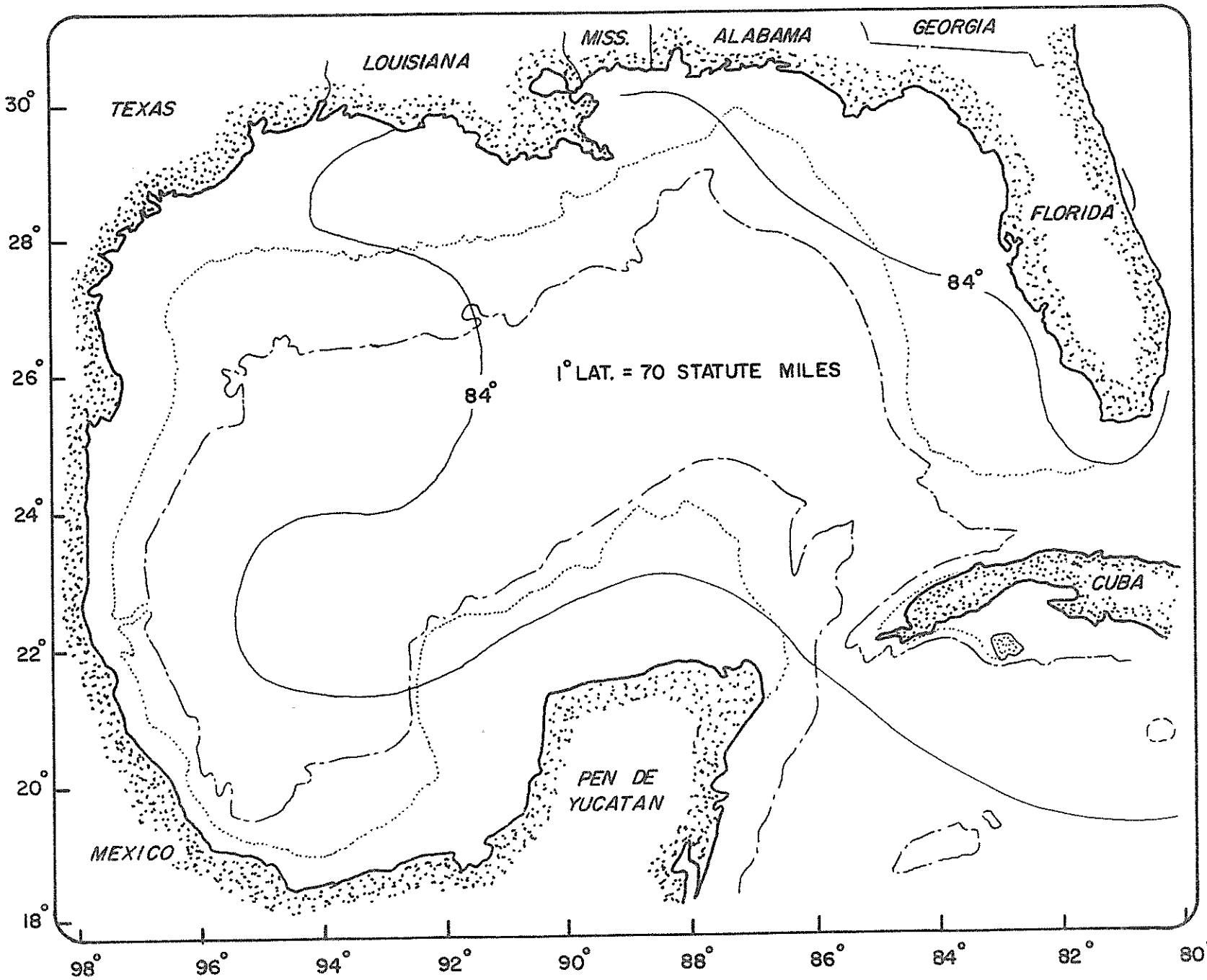

FIGURE 6

AVERAGE SEA SURFACE TEMPERATURE FOR AUGUST

(LEIPPER, 1954)

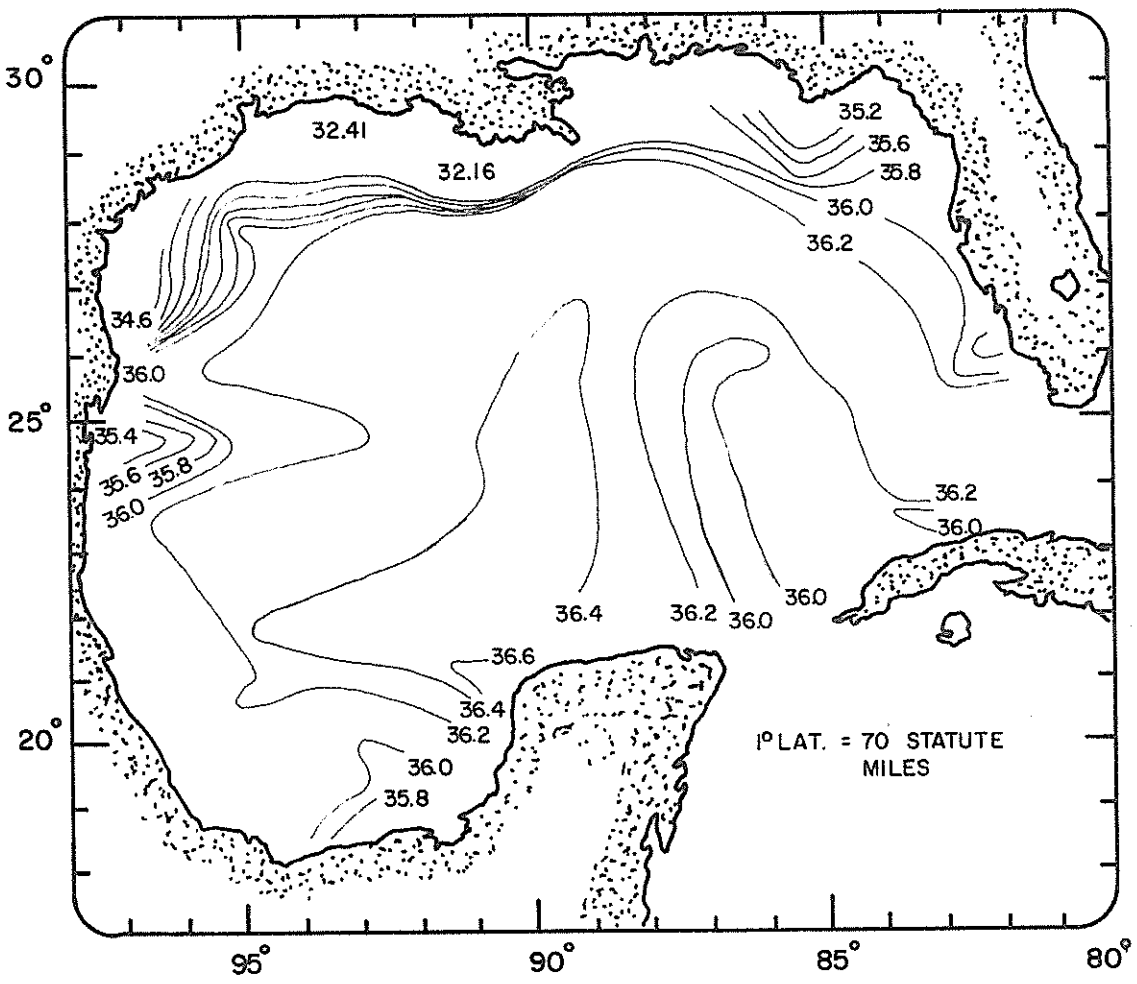

FIGURE 7

SURFACE SALINITIES (parts per thousand) GULF OF MEXICO

(CAPURRO AND REID, 1972)

Since 1900, the Gulf states have been second in construction of ships for the United States fishing fleet; in 1964 they were second in the number of fishermen employed; in 1968, they were first in overall total of the U.S. fish catch (1.317 billion pounds); and from 1954-1964 they provided 96 percent of the federal income from offshore oil and gas leases ($7.544 billion) (GURC, 1969)(Table 2).

By 1967, 17 oil companies were paying over $510 million annually in offshore Gulf leases. In this same year, $180 million was spent on offshore seismic work and there were 93 offshore rigs operating in the Gulf. The number of offshore rigs is brought into perspective when one considers that at that time, there were only 19 off of Alaska and 17 off of California (GURC, 1969).

Since the recent shortages of available oil, the presence of offshore rigs in the Gulf has expanded drastically. The increase in the number of these rigs has become so rapid, that an accurate, up-to-date figure would be difficult to obtain.

TABLE 2

RELATIONSHIPS IN SELECTED OCEAN-RELATED INDUSTRIES OF FIVE GULF COASTAL STATES TO ALL 23 U. S. COASTAL STATES, INCLUDING THOSE BORDERING THE GREAT LAKES, 1965

(GURC, 1969)

	Selected Industries Total	Industries With 50 or More Employees	Fisheries	Manufacturing Fresh or Frozen Package Fish	Ship & Boat Building & Repair	Water Transportation	Wholesale Trade - Fish & Seafood
1. Number of Industries Reporting Covered Employments Under the Federal Insurance Contributions Act;							
All Coastal States	10,491	967	2,686	433	1,612	4,009	1,481
Gulf Coastal States	3,665	307	1,143	97	415	1,581	377
Gulf % of Total	35%	31%	43%	23%	26%	39%	25%
2. Number of Persons Employed;							
All Coastal States	297,509		13,021	18,762	79,745	158,626	14,449
Gulf Coastal States	81,618		4,506	6,039	8,420	48,911	3,901
Gulf % of Total	27+%		35%	43%		31%	21%
3. Taxable Payrolls Reported to Social Security Administration;							
All Coastal States	365,493		14,864	12,820	119,356	193,738	13,209
Gulf Coastal States	73,195		3,928	3,559	21,140	40,905	2,700
Gulf % of Total	21±%		26-%	28-%	18±%	21%	21%

HISTORY OF OCEAN DUMPING IN THE GULF OF MEXICO

An increase in population followed by economic and industrial growth brought about the utilization of our oceans for waste disposal. In 1800, the population of the United States was 5,305,937 and only four cities could boast of a population in excess of 10,000 inhabitants. At this time, removal by large sewers and cesspools were common and acceptable methods of waste disposal. As the population increased with the growth in industry, these methods became obsolete. The utilization of rivers and inland waterways as receiving bodies for wastes grew rapidly. In addition, many industries discharged directly into municipal sewer lines. This practice introduced toxic chemicals into the treatment plants, thus more often than not, compounding the problem.

When the first attempts were made to improve municipal disposal practices, the manurial value of the wastes were examined. The fertilizer value was investigated and large profits were envisioned. However, while debate ensued regarding the aesthetic and public health ramifications of this practice, U.S. coastal cities considered the fact that the public economy and interests could best be served by direct discharge into the water bodies of sufficient size which would prevent waste oxidation from becoming offensive (Waring, 1903). Those arguing for land disposal brought out the point that the nutrients present in the sludges would be lost to the sea and would not be returned to land (Rafter and Baker, 1893). This objection was later dismissed as scientific investigations revealed the presence of a rudimentary food web.

Some major cities took advantage of the fertilizer potential of sludge and put it to use. Sludge contains a spectrum of micro-nutrients that are not normally found in chemical fertilizers. Chicago, Schenectady,

Houston, and Milwaukee were just a few of the cities that processed and sold dry digested sludge as a soil conditioner. In Melbourne, Australia raw sewage was used for over 50 years to irrigate pasture lands. Miami, Florida in 1956 started using sewage sludge to fertilize the 30 acres of land surrounding the plant site (Adler, 1971).

For many inland cities the practice of land disposal was the only disposal method available. Economically, ocean disposal was not reasonable. Coastal cities had both options available for their use initially. However, the large influx of people and growth into these coastal cities put a higher price and demand on the land. Industrial growth occurred more rapidly on the coastal areas than in the inland cities. Their wastes contained constituents that could be potentially harmful in a health related sense. Therefore, alternatives to land disposal had to be considered. In 1902 the Encyclopedia Brittanica announced ocean disposal as a "cleanly method" because man's activities were not unduly affected by this disposal method and because the waste constituents were assumed to return to man in the form of fish, shell-fish, and seaweed.

Adopting this philosophy, many cities and industries started barging their wastes out into the oceans. By the 1940's this practice was very widespread and rarely questioned. Pollution of inland waters, estuaries, and coastal areas became a more pressing problem. This was more of a reality and posed a greater impact on the health of the people. Ocean pollution was intangible to the public and presented no immediate effect. The public instead focused their attention on industries discharging wastes into rivers and estuaries. During the 1950's, industry, after numerous fish kills had already taken place, realized that their wastes

contained too many toxic constituents to be discharged into inland waters. With this realization, they began to barge certain wastes to deep ocean sites for disposal.

Corps of Engineers' Letters of No Objection

Ocean dumping in the Gulf of Mexico is not very well documented. Before the enactment of Public Law 92-532, the "Marine Protection, Research and Sanctuaries Act of 1972", permits were not required of companies or individuals desiring to dump wastes in the Gulf. Not until April 23, 1973, when permits were available from the regional EPA offices were permits required for ocean dumping. Prior to this date, the U.S. Army Corps of Engineers had jurisdiction over ocean disposal. Under the Refuse Act of 1899, the Corps governed the disposal of waste materials in navigable waters (so presumably because of this duty's similarity to ocean dumping, they were also given control over ocean dumping).

Industry would first contact the appropriate regional Corps Headquarters to obtain permission to discharge their wastes. The Corps required that data concerning the characteristics and quantity of the waste be submitted to them. Expert opinions had to be included testifying to the appropriateness of the practice. The Corps then submitted the proposals to various state and federal agencies for review. There were no official procedures available so the agenices chosen for review varied from one district to the other. The Galveston Headquarters requested review by the Texas Parks and Wildlife Department, the south-central Federal Water Pollution Control Agency Office, the Texas State Department of Health, and the Department of the Interior. The New Orleans District contacted the Louisiana Wildlife and Fisheries Commission, the Louisiana

Stream Control Commission, and the Department of the Interior. Based mainly upon the reviews, the Corps then proceeded to assess the environmental impact of the industrial waste. If the discharge did not appear to pose a threat to man, a "letter of no objection" was issued to the applicant. In this manner, the Corps was able to develop a preliminary method for screening the disposal of toxic materials into international waters. It is not known if all waste disposal operations during this time were reported. Table 3 presents an incomplete list of industrial activity prior to April 23, 1973.

In December of 1971, the Galveston District Engineer rescinded all "letters of no objection" in his area because it appeared that industrial disposal operations were not occurring at the designated 400 fathom dump sites. Twelve boats of one shrimp fleet picked up over 100 barrels of waste in waters as shallow as 18 fathoms. At this time, a few companies were disposing of their wastes in fifty-five gallon drums. No routine inspections of their disposal operations were ever made to determine where these companies were actually dumping their wastes. Whether the occurrence of waste barrels in shallow waters resulted from physical forces or negligence was not proven. It is also unknown in what manner the rescinded industries disposed of their wastes between December of 1971 and April 23, 1973.

Corps of Engineers Disposal Sites

The selection of waste disposal sites was invested in the Secretary of the Army in accordance with Section 4 of the Rivers and Harbors Act of March 3, 1905 and Section 7 of the Rivers and Harbors Act of August 8,

TABLE 3

The following is an incomplete listing of industrial activity occurring in the Gulf of Mexico prior to the enforcement date of PL 92-532, April 23, 1973 (U.S. Army Corps of Engineers)

SHELL CHEMICAL CORPORATION, Deer Park, Texas

From 1958-1969, 30 to 35 barges/year each containing 7000 barrels of waste of which 40% was chlorinated hydrocarbons. Also, 950 drums/year of waste (84,000 gallons) resulting from EPON^{R} manufacture.

From January 1, 1970 to September 27, 1970, 47 barges of chlorinated hydrocarbon wastes and 832 EPON waste drums. No further data.

ROHM AND HAAS, Deer Park, Texas

From January 1960-August 1970, 49 barges containing approximately 83,000 tons of mother liquor (ammonium sulfate, amides, alcohols) was to be terminated after construction of a new plant (1970). Did not happen though.

From February to August 1971, 63 barges were dumped containing 107,100 tons of waste.

CHAMPION PAPER, Pasadena, Texas

From June 1955 to May 1958, 41 barges totaling 250,000 gallons of sulfate black liquor were dumped. Only one dump after May 1958 occurred, June 2, 1969.

ETHYL CORPORATION

From December 1957 to February 26, 1973, 39,725 industrial barrels containing sodium and calcium sludge were disposed. Approximately 496 barrels/trip.

AMERICAN CYANAMIDE, New Orleans, Louisiana

No objection obtained August 19, 1965. No further data, waste acid 28,000 tons/year.

TABLE 3 (continued)

HUMBLE OIL AND REFINING, Baton Rouge, Louisiana

Dumped from January 31, 1964 to December 30, 1969. No further data.

Received permission from U.S. Army Corps of Engineers, New Orleans District Office in early 1964. Disposed of a spent phenolic caustic solution in an area about 40 miles from the mouth of the Mississippi River beyond the 400 fathom curve. Utilization of treatment facilities eliminated ocean disposal on December 30, 1969.

LUBRIZOL CORPORATION, Deer Park, Texas

Letter of no objection 1967. Sulfide wastes. However, never used.

DU PONT, LaPorte, Texas

From 1964, inorganic salts, miscellaneous organics.

DU PONT, Belle, West Virginia

From 1969, Terephthalats, styrene sulfonates.

DU PONT, Beaumont, Texas

From 1960-1962, caprolactam waste.

From 1962-1968, caprolactam waste and acrylonitrile wastes.

From 1968-1970, acrylonitrile wastes.

From 1970-1972, acrylonitrile wastes and methanol wastes.

From 1972-1973, acrylonitrile, methanol and nitrobenzene-aniline wastes.

1917. The authority was limited to the establishment of dump sites in waters adjacent to and waters constituting approaches and entrances to certain ports.

In the 1950's various industries began to barge their wastes to sea for disposal. The Corps of Engineers took action to insure that this practice was controlled. They required that each industry submit with its letter of intent to dump a description of the area to be used as the dump site. Because of the lack of jurisdiction beyond the three mile limit the Corps could only suggest that dumping operations occur beyond the 100 fathom line in the Gulf of Mexico. Thus, economic considerations coupled with an arbitrary depth contour produced a number of concurrently active dump sites. These dump sites located off of the Texas coast are illustrated in Figure 8. Shown here are three relatively close industrial chemical dump sites. These roughly correspond with Site B in Figure 10. In addition, two sites previously used for explosive wastes disposal are represented by the X's. Classified under these wastes were unserviceable or obsolete ammunition such as shells, mines, solid rocket fuels, propellants, and chemical agents. These two areas in the Gulf have been listed as inactive since 1968. The major spoil banks and artificial reefs are also shown in the figure.

Types of Waste Dumped

For the most part only two kinds of waste material have been disposed of in the Gulf of Mexico: dredge spoils and industrial wastes. Disposal of dredge spoils started around 1926 and has continued ever since then. Dredge spoils consist of various concentrations of sand, silt, clay, and detritus, rocks, and municipal or industrial sludges. Most dredging operations are conducted under the supervision of the Corps of Engineers.

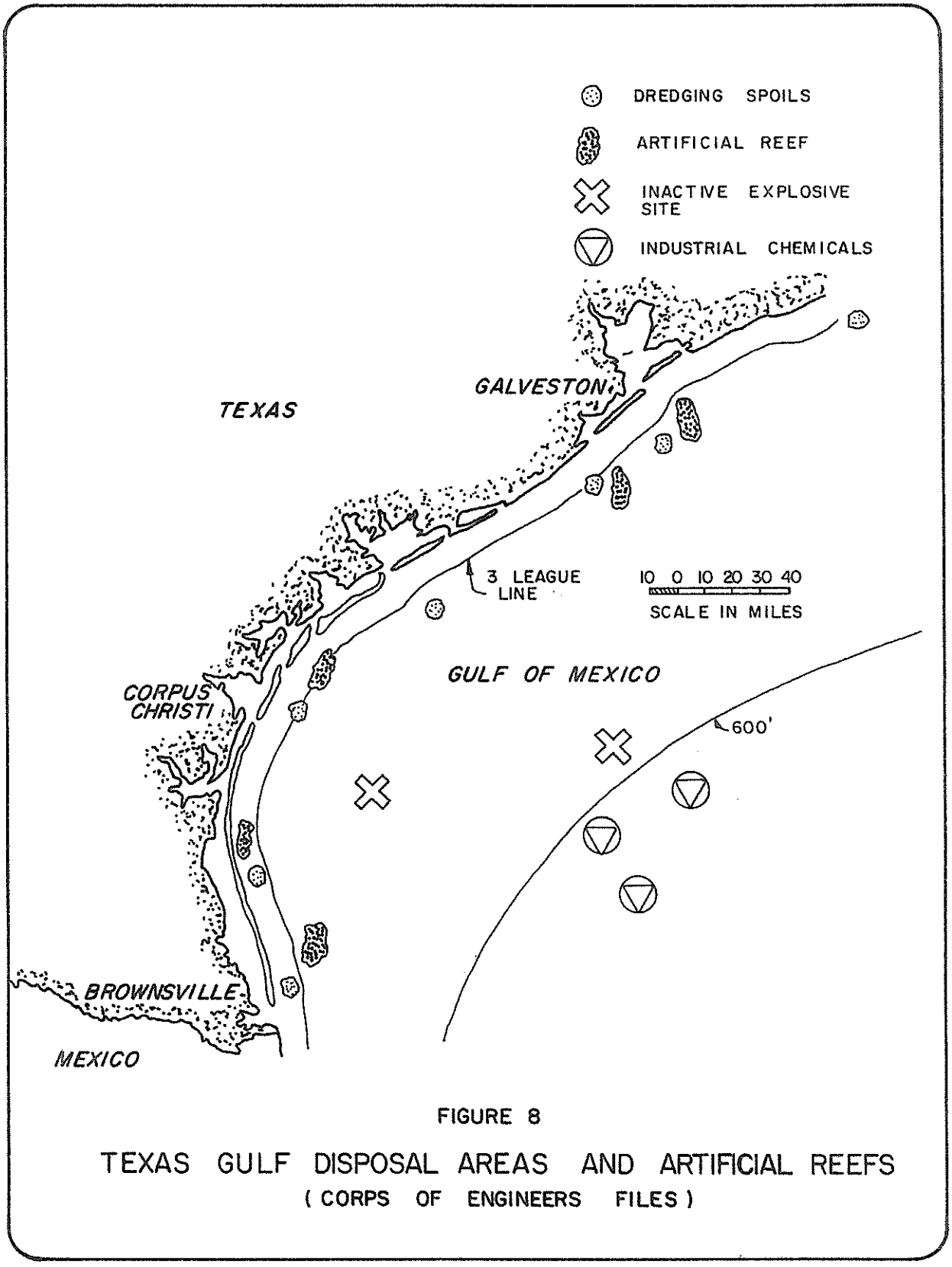

FIGURE 8

TEXAS GULF DISPOSAL AREAS AND ARTIFICIAL REEFS

(CORPS OF ENGINEERS FILES)

The spoils were normally disposed of in waters less than 100 feet deep. In 1968, 94.9% of all disposal in the Gulf of Mexico consisted of dredge spoils. The remaining 5.1% was made up of industrial wastes.

The dumping of chemical wastes began around 1952 and supposedly was to be restricted to the areas shown in Figures 9 and 10.

Industrial wastes cover a broad range of chemicals, but those most commonly referred to are waste acids, refinery wastes, pesticides, paper mill wastes, oil drilling wastes, pharmaceutical wastes, and others.

In the Gulf of Mexico, sewage sludge disposal was minimal if present at all.

In Figures 9 and 10 the darkened rectangular areas represent dredge spoil disposal sites. Hopper dredges or barges transport the spoils to these sites for dumping. The volume dumped annually varies because of project funding, priorities and natural variations in streamflow and sedimentation. Due to cost of running the dredges, many are run 24 hours a day, 7 days a week. Many channels require continuous dredging such as the Houston Ship Channel. In this instance, the dredge spoils are piped onto spoil islands or onto the banks of the channel; therefore, not all dredging operations require ocean disposal.

The large areas designated A and B in Figures 9 and 10 were specifically set aside by the Corps of Engineers in the early 1950's for disposal of industrial chemicals. Area A just south of New Orleans was initially used in March 1955 by the Ethyl Corporation of Deer Park, Texas. They disposed drums containing a sodium-calcium sludge. In June of 1969, Amoco Chemicals Corporation was granted a "letter of no objection" by the regional Corps of Engineers Office to dump a sodium-calcium sludge

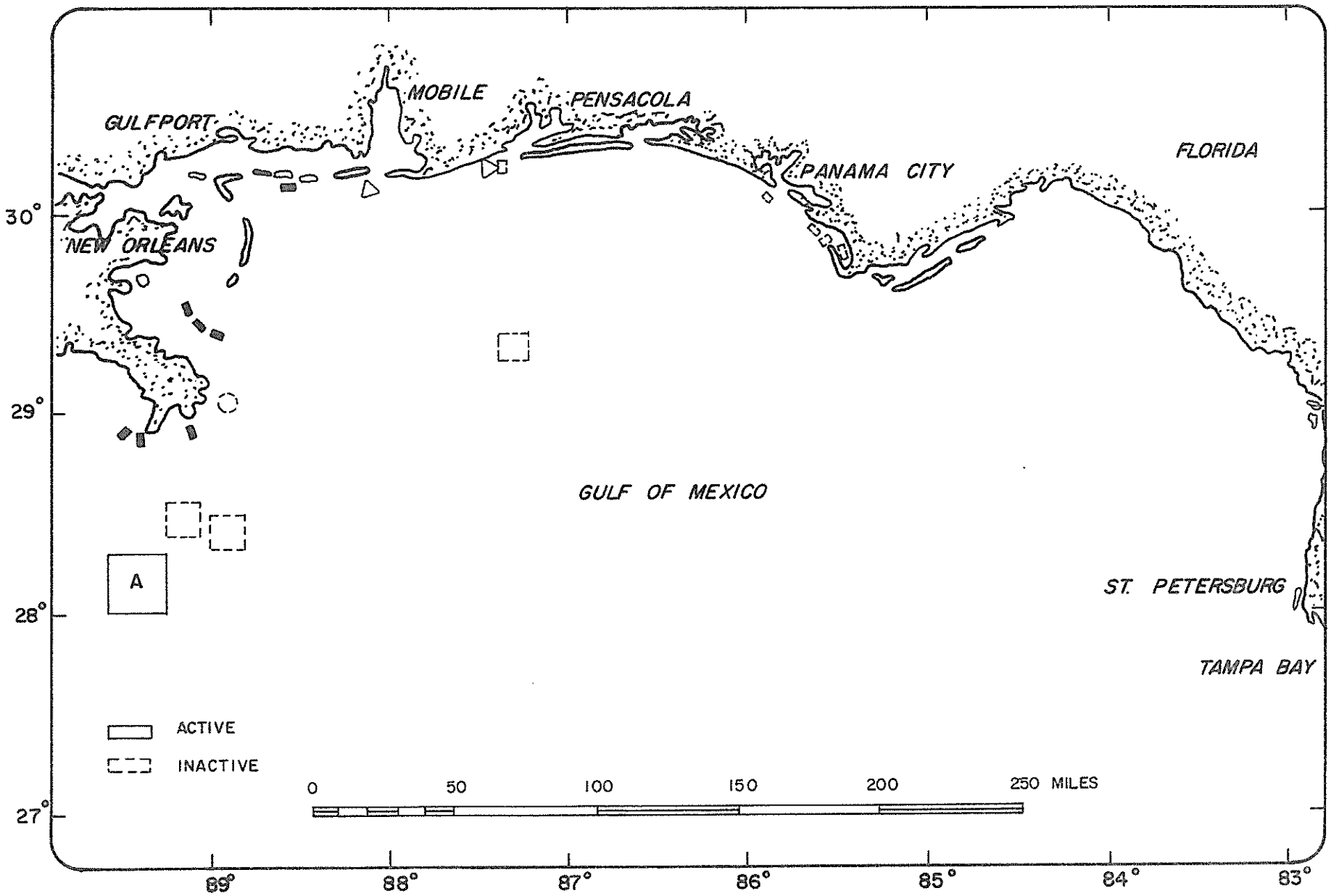

FIGURE 9

EASTERN GULF OF MEXICO WASTE DISPOSAL AREAS

(EPA FILES)

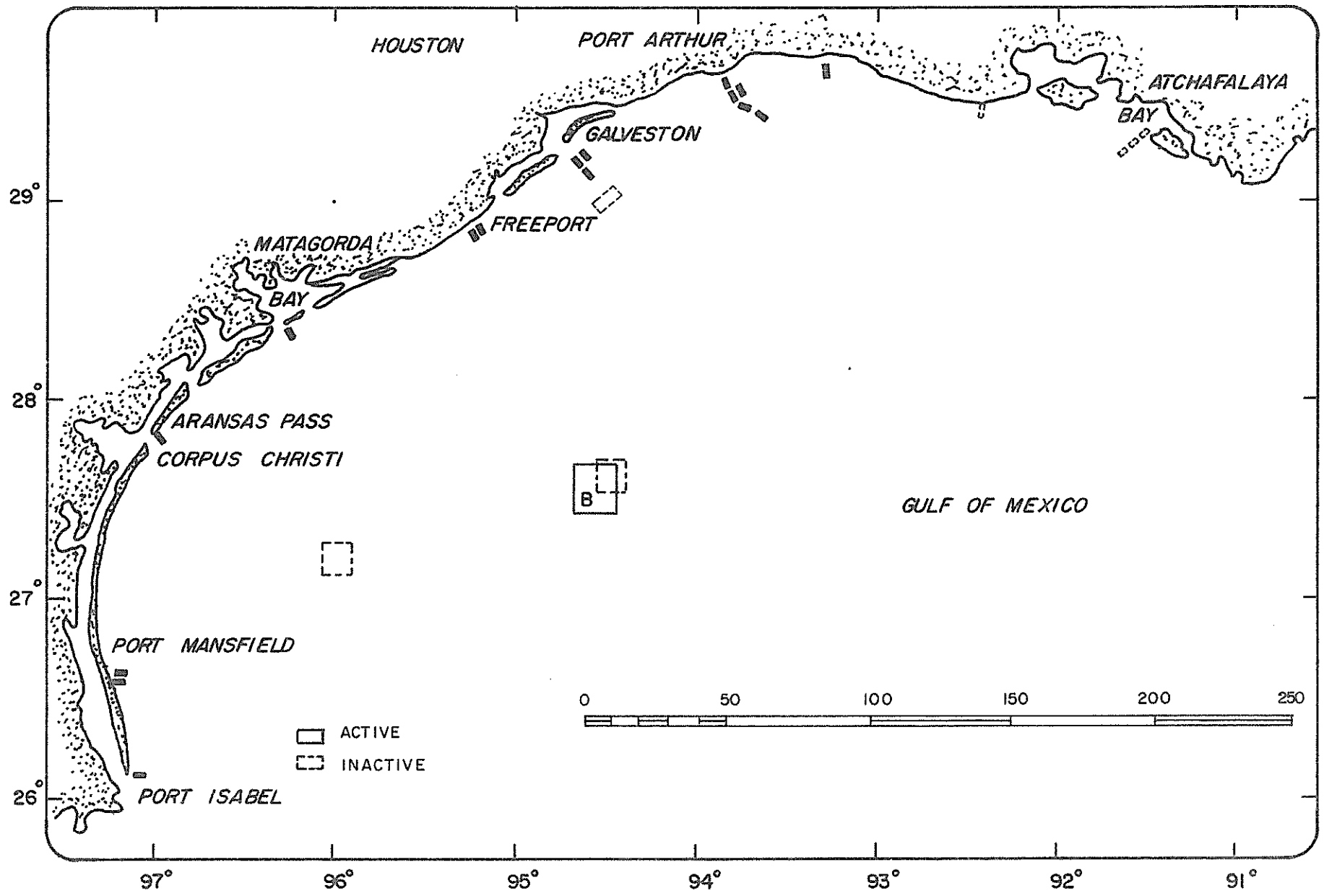

FIGURE 10

WESTERN GULF OF MEXICO WASTE DISPOSAL AREAS

(EPA FILES)

in Area A also. The New Orleans District Engineer formalized the boundary coordinates to this dump site just prior to Amoco's activities in Area A.

Area B is known to have been in use since at least 1955. The Galveston Corps of Engineers designated Area B as a dump site in their letters of no objection. They referred to it as "Site 100", 110 miles south of Galveston and in 100 (200,400) fathoms or more.

The actual total tonnage of material dumped within the specified areas is not exactly known. Ship operators may not have always been capable of navigating within the designated dump sites.

According to the report entitled "Ocean Waste Disposal in Selected Geographic Areas" (Interstate Electronics Corporation, 1973), 169,000 tons of chemical wastes were barged out to be disposed at Site A in 1969. In Area B of the same year, 235,000 tons were destined there for disposal. In the years since then, the dumping at Site B has increased about five-fold, whereas Site A has decreased in activity to 13 percent of what it was in 1969.

FEDERAL REGULATIONS

Public Law 92-500

On October 18, 1972 with passage of the "Federal Water Pollution Control Act Amendments of 1972", the beginning of a new era in the awareness and responsibilities of water pollution control began. The main goal of this Act "is to restore and maintain the chemical, physical and biological integrity of the Nation's waters" (Sec. 101.(a)). This law is very comprehensive in scope and covers all aspects of water pollution including the oceans. In paragraph 6 of subsection (a) of Section 101, the law states that "it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans". The main provisions of this Act specifically dealing with the marine environment are a water quality surveillance system for monitoring the quality of navigable waters including the contiguous zone (Sec. 104(a)(5)), coordinated research efforts on pollution problems of the estuarine zone (Sec. 104n), an annual water quality assessment and an inventory of all point sources of discharge of pollutants into all navigable waters, including those of the contiguous zone (Sec. 305), and limitation on discharges into the navigable waters and a national contingency plan for removal of oil and other hazardous substances (Sec. 311).

Public Law 92-532

The Act that really revolutionized the practice of ocean dumping was the "Marine Protection, Research and Sanctuaries Act of 1972". Known also, as Public Law 92-532 it was passed on October 23, 1972,

just five days after the Federal Water Pollution Control Act Amendments. It is very specific concerning the national policy toward ocean dumping.

The opening section is very explicit concerning the policy and purpose of the Act:

> Section 2. (a) Unregulated dumping of material into ocean waters endangers human health, welfare and amenities, and the marine environment, ecological systems and economic potentialities.
>
> (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, or amenities, or the marine environment, ecological systems, or economic potentialities.
>
> To this end, it is the purpose of the Act to regulate the transportation of material from the United States for dumping into ocean waters, and the dumping of material, transported from outside the United States, if the dumping occurs in ocean waters over which the United States has jurisdiction or over which it may exercise control, under accepted principles of international law, in order to protect its territory or territorial sea.

The Act defines the materials to be dumped as any matter that fits the following descriptions, but not limited to these: dredged material, solid waste, incinerator residue, garbage, sewage, sewage sludge,

munitions, radiological, chemical and biological warfare agents, radioactive materials, chemicals, biological and laboratory waste, wreck or discarded equipment, rock, sand, excavation debris and industrial, municipal, agricultural and other wastes (Sec. 3(c)). However, oil as defined in Section 11 of PL 92-500 and sewage from vessels as defined as Section 13 of the same Act do not apply in this instance.

This Act designates the Administrator of the Environmental Protection Agency to issue permits for ocean disposal and to overview the whole practice. In conjunction with the EPA, four other government agencies share responsibility for implementing the Federal Ocean Dumping program. They are the U.S. Army Corps of Engineers, the Department of Transportation (Coast Guard), and the Department of Commerce (NOAA).

The Corps of Engineers is responsible for issuing permits for the disposal of dredge spoil. The issuance of permits and the selection of disposal sites are made in consultation with the Environmental Protection Agency. The term "dredged material" as defined in the Federal Register means any material in excess of one cubic meter when used in a single or incidental operation, excavated or dredged from navigable waters, including without limitation, runoff or overflow which occurs during a dredging operation or from a contained land or water disposal area. Excluded from this is any material which is extracted for any commercial use other than fill. The Corps has to insure that the material will not produce or result in an adverse effect on municipal water supplies, shellfish beds, wildlife, fisheries, or recreational areas.

The Coast Guard is given the duty of surveillance and enforcement of the permit requirements. Materials are periodically spot-checked to see if they are in compliance with the permit. In the case of toxic

materials the Coast Guard escorts the barge to the dump site. The Coast Guard also collects data on the materials being dumped.

The National Oceanic and Atmospheric Administration (NOAA) carries out monitoring of the disposal sites as well as the adjacent areas. They also review the applications for ocean dumping and consult with the Environmental Protection Agency on environmental concerns.

ENVIRONMENTAL PROTECTION AGENCY PERMITS

Under the Marine Protection, Research and Sanctuaries Act of 1972 (PL 92-532), no person may transport by barge or other type of vessel any material destined for ocean disposal without a permit from the regional Environmental Protection Agency. This stipulation became effective on April 23, 1973. The EPA issued five different types of permits; general, emergency, interim, special and research.

There are some materials which are deemed too hazardous for ocean dumping and will never under any conditions be given a permit for ocean disposal. They are: high-level radioactive wastes which are wastes resulting from the operation of extraction cycles in a facility for reprocessing irradiated reactor fuels or irradiated fuel from nuclear power reactors; materials produced for radiological, chemical or biological warfare; materials insufficiently described in terms of their physical, biological and chemical properties, and persistent inert synthetic or natural materials which may float or remain in suspension.

Wastes containing the following constituents in concentrations greater than trace contaminants will not be allowed dumped by the EPA: organohalogen compounds and compounds which may form organohalogen compounds in the environment; mercury and mercury compounds; cadmium and cadmium compounds; and crude oil, fuel oil, heavy diesel oil, lubricating oils, hydraulic fluids, and any combinations of these, insofar as these are not regulated under PL 92-500.

Also prohibited are materials containing living organisms which would extend the range of biological pests, viruses, pathogenic microorganisms or other agents capable of infesting, infecting or altering

the normal populations of organisms. And in addition, materials that would degrade uninfected areas or introduce viable species not indigenous to an area are prohibited.

General Permits

A general permit allows the dumping of galley waste from ships and any other non-toxic materials that are produced in small quantities. They are also issued for burials at sea and target ships. The permit will also specify the quantity of allowable discharge and the sites for the disposal. There is no expiration date on the permits so no renewal is ever required.

Emergency Permits

An emergency permit is issued for the disposal of prohibited wastes if it is shown or proven that these wastes pose an unacceptable risk to human health and there is no other feasible solution to the problem but to dump the wastes in the oceans. A permit of this type is issued after consultation with the Department of State and other appropriate agencies. This permit cannot be renewed.

Interim Permits

An interim permit is issued to an applicant if the materials desired to be dumped are in excess of the limiting permissible concentrations or when the constituents that have been identified as trace elements are in excess of the levels at which they may be dumped under a special permit. An interim permit is issued for no more than one year. An interim permit cannot be renewed, but a new one can be issued for another year provided that during the time period of the first permit, certain conditions are

met or followed. To initially obtain an interim permit the permittee must present his case for ocean disposal of their wastes. An environmental assessment of the potential environmental impact is required for a permit. Also, the permittee must show the alternative methods of treatment and disposal that they are researching or developing to eventually eliminate the need for ocean disposal of their waste. During the year under this type of permit any of the constituents that are above the limiting or set standards must be reduced or at least an attempt be made to reduce their concentrations below the stated levels. When this is accomplished, a special permit may be applied for.

Special Permits

Special permits may be issued only if the constituents in the waste material to be dumped are properly identified both qualitatively and quantitatively, and meet the criteria set down for certain compounds. Only if these waste constituents are present in "trace" amounts will a permit be issued. The constituents in question are organohalogen compounds, mercury and mercury compounds, cadmium and cadmium compounds, crude oil, fuel oil, heavy diesel oil, lubricating oils, hydraulic fluids, and any mixture containing these. There are some materials that are classified or required to have special care; these are the heavy metals; organosilican compounds and compounds that may form these in the environment; inorganic processing wastes; petrochemicals, organic chemicals, and organic processing wastes; biocides; oxygen-consuming organic matter; radioactive wastes not prohibited; materials immiscible with seawater; and any materials listed as hazardous substances or toxic materials in Section 311(6)(2)(A) and 307(a) of PL 92-500.

Special permits have a designated expiration date which can be no later than three years from the date of issue. Special permits can be renewed at the end of the specified expiration date. Revisions can be made at any time to the original or existing permit by filing an appropriate application explaining the reasons for wanting a change.

Research Permits

A research permit is issued for the disposal of wastes whereby the effects of these wastes on the environment are to be studied. However, it must be shown that the knowledge gained from such research far outweighs the damage that is done to the environment. A research permit may be issued for only up to eighteen months. It can be renewed after this expiration date.

ENVIRONMENTAL PROTECTION AGENCY PERMIT PROCEDURE

Application Requirements

Application forms for ocean disposal in the Gulf of Mexico are obtained through the regional EPA Office in Dallas, Texas. Applications can be made by letter and must contain at a minimum, the following information:

1.) Name and address of applicant;

2.) Name of the person or firm and the name or other identification and usual location of the conveyance to be used in the transportation and dumping of the material involved;

3.) Physical and chemical description of the material and the number, size and physical configuration of the materials and any containers to be dumped;

4.) Quantity of material to be dumped;

5.) Means of conveyance and anticipated dates and times of disposal;

6.) Proposed dump site; and if this site is not one of the designated dump sites, a detailed report of the proposed dump site is necessary;

7.) Proposed method of disposal at the site;

8.) Identification of the specific process or activity giving rise to the production of the waste material;

9.) Information concerning previous methods of disposal of the waste;

10.) A description of available alternative means of disposal of the material, with explanations of each alternative and its applicability.

A $1,000 processing fee must accompany each application. If the dump site is other than those designated by the EPA an additional $3,000 is charged. For renewal of existing permits a $700 processing fee is required.

Provided that the applicant meets all the requirements in the application, the EPA will hold a public hearing concerning the application.

All state and local water pollution agencies that could be directly or indirectly affected by the dumping in question are notified. The local Corps of Engineers office is given a notice of the application as well as the Coast Guard. The EPA must consult with the regional officials of the Departments of Commerce and Interior and the Regional Director of the NMFS-NOAA. Within 30 days after the hearing, the Administrator or Regional Administrator will make a final decision regarding the permit. Figure 11 illustrates the permit procedures.

General Conditions

A set of general conditions are written into the permits and are the same in each permit initially unless they are amended later on. A set of special conditions are present, but these will vary from one application to the other. These conditions are specific to each type of waste. A list of the general conditions taken from the permits are as follows:

1. All transportation and dumping authorized herein shall be consistent with the terms and conditions of this permit.

2. a. Transportation to, and dumping at any location other than that authorized by this permit, shall constitute a violation of the terms and conditions of this permit.

b. Transportation and dumping of any material more frequently than or in excess of that identified and authorized by this permit, or dumping of material not authorized by this

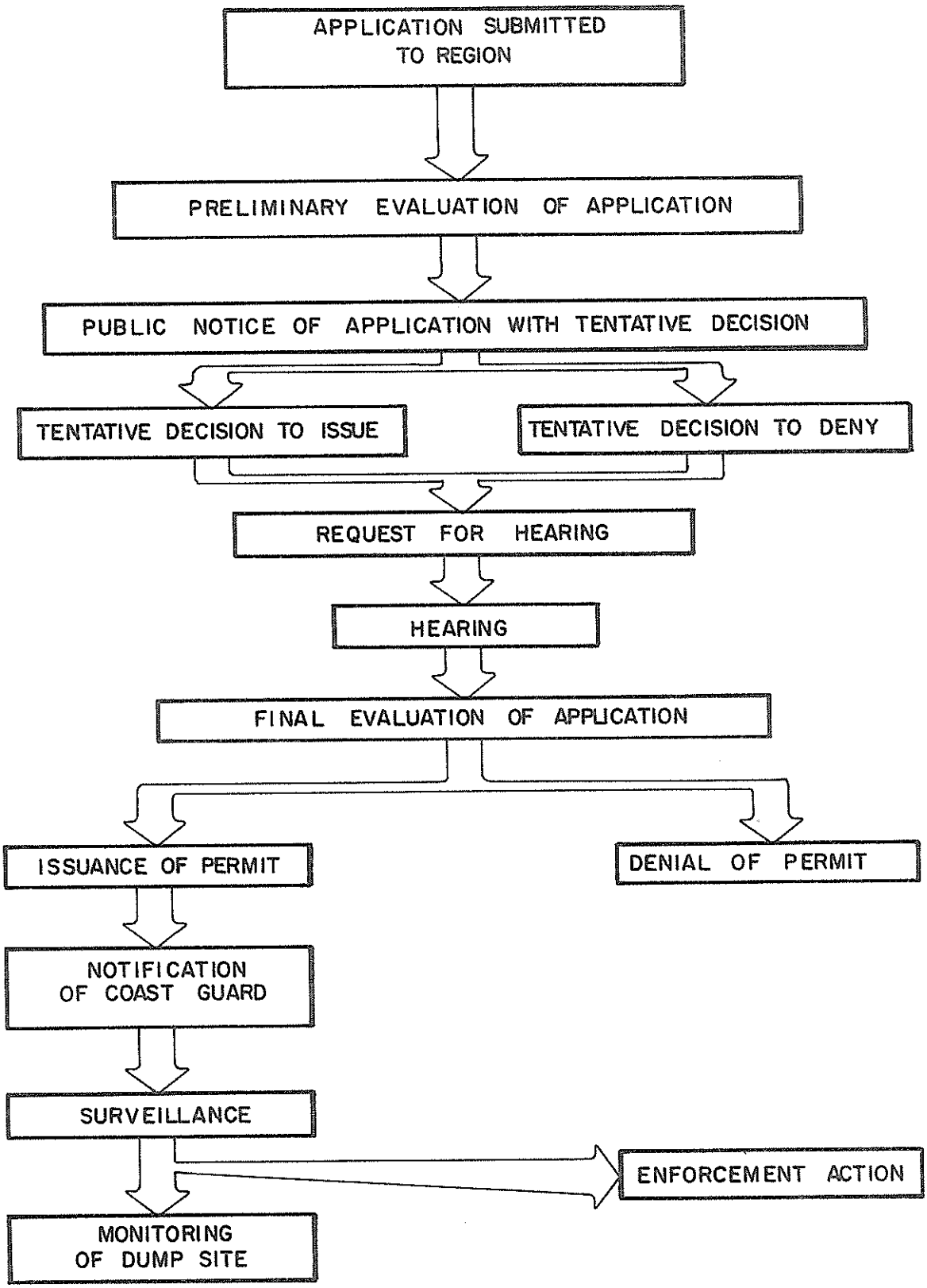

FIGURE II

PERMIT PROCEDURES

(EPA, 1975)

permit, shall constitute a violation of the terms and conditions of this permit.

c. Permittee shall comply with each and every condition, provision and limitation in this permit and compliance with one or more, but less than all conditions, provisions and limitations shall not constitute a ground or grounds of defense in any proceeding against permittee for violation of one or more of such conditions, provisions or limitations.

3. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

a. Violation of any term or condition of this permit;

b. Misrepresentation, inaccuracy or failure by the applicant to disclose all relevant facts in the permit application;

c. A change in any condition or material fact upon which this permit is based that requires either a temporary or permanent reduction or elimination of the authorized transportation or dumping including, but not limited to, changes in conditions at the designated dumping site, and newly discovered scientific data relative to the granting of this permit;

d. A determination by the Regional Administrator that the permitted dumping has resulted, is resulting or may result in imminent and substantial harm to human health or welfare or the marine environment;

e. Failure to keep the records and/or to notify appropriate officials of dumping activities;

4. The permittee shall allow the Regional Administrator and/or the U.S. Coast Guard, and/or their authorized representatives, upon the presentation of credentials;

a. To enter into, upon, or through the permittee's premises, vessels or other premises or vessels under the control of permittee, where, or in which, a source of material to be dumped is located or in which any records are required to be kept under the terms and conditions of this permit or the Act;

b. To have access to and copy any records required to be kept under the terms and conditions of this permit or the Act;

c. To inspect any monitoring equipment or monitoring method required in this permit; or,

d. To sample any materials discharged or to be discharged.

5. The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges nor does it authorize any injury to private or public property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

6. This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or, except as authorized by this permit, the undertaking of any work in any navigable waters.

7. Within 48 hours of the completion of each barging operation, permittee shall forward by depositing in the United States mail to the Regional Administrator a report which shall be verified in accordance with the provision of 18 U.S.C. 1001, by a responsible officer or employee of Permittee, which report shall contain as a minimum, the following:

a. The total amount of material dumped and the amounts, in percent and poundage, of each constituent thereof. The content of the constituent shall be verified by an analysis of the material dumped which shall be performed prior to such dumping operation. Records of such analyses, when requested by the Regional Administrator, shall be included with such report.

b. A statement of the Greenwich mean time at which each barging operation was commenced, the latitude and longitude of the place where each barging operation was commenced, and the Greenwich mean time and the latitude and longitude of the place where each barging operation ceased, as well as the latitude and longitude of the mid point of the course made good if such barging operation extended over a period of six hours.

c. Fathometer records of the entire run during which barging operations or dumping operations were taking place shall be submitted.

8. Permittee shall notify by telegram the U.S. Coast Guard (local Captain of the Port) and the Regional Administrator not later than 24 hours prior to the departure from

permittee's facility of any tug or vessel which is to depart to sea for a barging operation. Included in such notification shall be a statement of the amount of materials to be dumped and all constituents thereof as determined by chemical analysis.

9. The permittee shall maintain complete records, which shall be available for inspection and copying by the Administrator, the Regional Administrator, or their designees, of:

a. The nature, including a complete description of relevant physical characteristics of material dumped pursuant to the permit.

b. The precise times and locations of dumping.

c. Any information relevant to the assessment of the impact of permitted dumping activities on the marine environment or human health or welfare.

10. The permittee shall, at the end of each six month period, beginning with the date of this permit, make a report to the Regional Administrator of the following information:

a. Information in the records to be kept pursuant to Paragraph 9 of the General Conditions,

b. A summary of the 48 hour reports required by Paragraph 7 of the General Conditions, and

c. Any additional records or reports required in the Special Conditions of this permit.

11. The permittee shall make an additional report in accordance with the requirements of Paragraph 10 of the General Conditions at the expiration of this permit, unless renewed.

12. Reports required by Paragraphs 10 and 11 of the General Conditions shall be received by the Regional Administrator within 30 days following the end of the required reporting period.

13. If the dumping of material which is regulated by this permit is dumped due to emergency to safeguard life at sea in locations or in a manner not in accordance with the terms of this permit, the permitee shall make a full report in accordance with the provisions of 18 U.S.C. 1001, within 30 days to the Regional Administrator of the emergency and the actions taken.

14. The reporting requirements contained in this permit are in addition to any reporting requirements of any other state or federal agency.

15. In the event any portion of the authorized dumping or transporting is done by a person, firm or corporation other than the named permittee, any and all reports required hereunder shall be jointly executed by both permittee and such other person, firm or corporation in accordance with the provisions of 18 U.S.C. 1001 by an officer or employee of such other person, firm or corporation.

16. The performance of any transportation or dumping authorized by this permit, by any person, firm or corporation other than the named permittee shall not relieve permittee from full responsibility for compliance herewith, nor shall the issuance of this permit to permittee relieve such other person, firm or corporation from responsibility for compliance herewith, nor shall the existence of any such contractual or other relationship between permittee and any other such person, firm or corporation operate to relieve either part from responsibility for compliance with this permit or the Act or both.

17. Terms used in this permit which are defined in Section 3 of the Act shall have the same meaning herein.

18. The applicant shall submit, within 90 days of the effective date of this permit, to the Regional Administrator and the appropriate Captain of the Port, U.S. Coast Guard, a Spill Prevention, Containment and Countermeasure Plan for any spillage or total loss of the material while loading or transporting through the territorial sea.

CASE HISTORIES

As stated by the law, effective on April 23, 1973 all persons desiring to dispose of wastes in the oceans first need a permit to do so. In April and May of 1973, the EPA office in Dallas, Texas issued seven permits. Those receiving permits at this time were: GAF Corporation, Texas City, Texas; Shell Chemical, Deer Park, Texas; Ethyl Corporation, Baton Rouge, Louisiana; and E. I. DuPont de Nemours and Company. DuPont had four different facilities receiving permits; one each in Beaumont, Texas; LaPorte, Texas; LaPlace, Louisiana; and Belle, West Virginia.

Table 4 presents the companies receiving permits and the duration of their dumping activity in the Gulf of Mexico. The bars represent the permits that the company has received from the Environmental Protection Agency. The shorter bars underneath the main bars designate amendments to the original permit. For example, GAF received an amended version of their original permit on August 1, 1973. The major breaks between bars are periods when no permits were issued. During this period, the EPA extended all permits due to the publishing of new and final ocean dumping regulations.

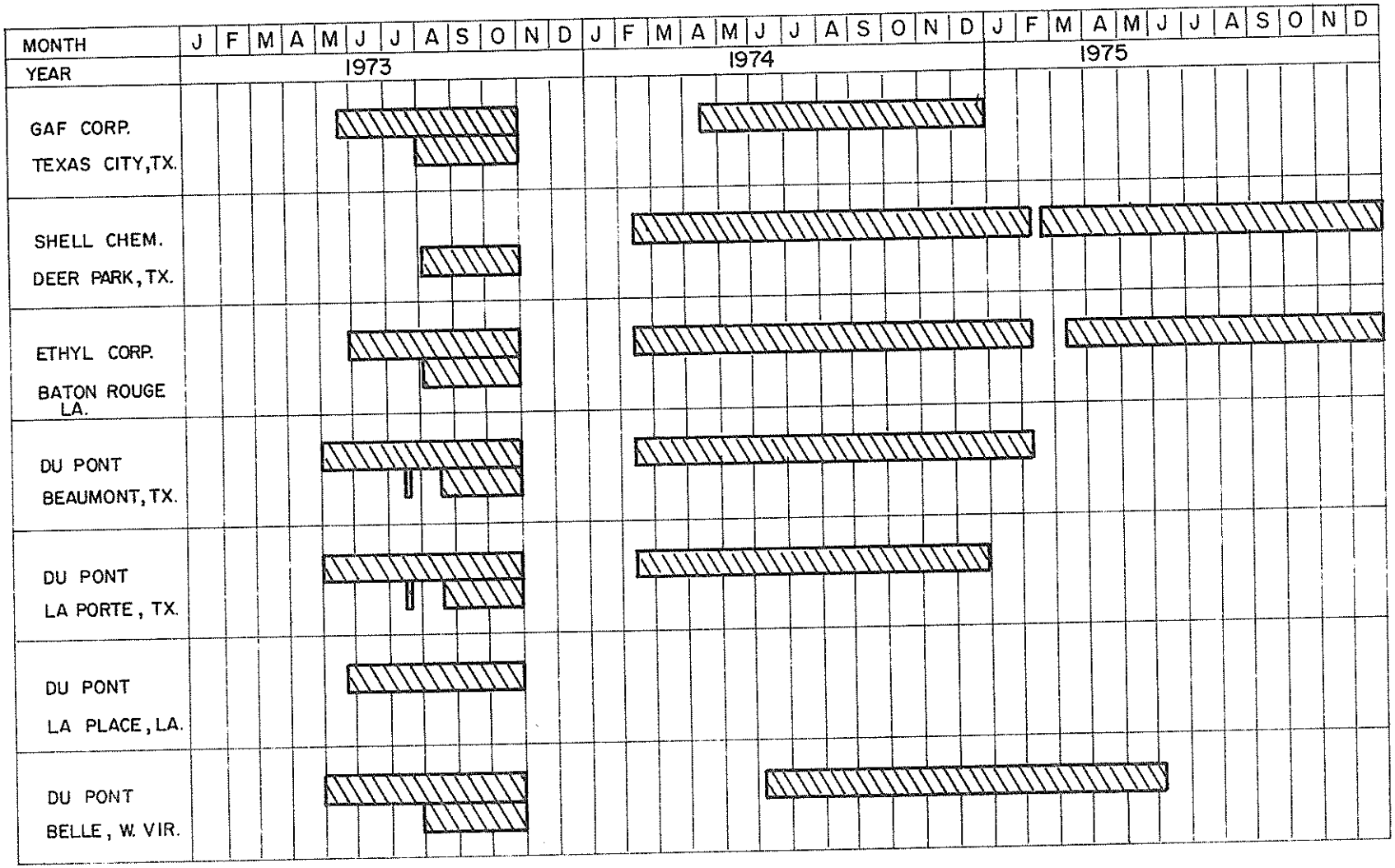

TABLE 4

DISPOSAL PERMITS GRANTED SINCE 1973 FOR DISPOSAL IN THE GULF OF MEXICO

GAF CORPORATION, TEXAS CITY, TEXAS

On April 12, 1973, the GAF Corporation in Texas City applied to the EPA Region VI office for a permit allowing them to barge certain wastes out into the Gulf and dispose of them. The application was reviewed and found to be suitable. On May 18, 1973, a permit was issued to GAF to barge certain designated wastes to a specific location in the Gulf of Mexico in accordance with stated general and special conditions. The expiration date on the permit was November 1, 1973.

The waste in question was composed of the following constituents:

sodium chloride/sulfate

2,5-dichlorobenzoic acid (Na salt)

2,5-dichloro-6-Nitrobenzoic acid (Na salt)

3,4-dichloro-6-Nitrobenzoic acid(Na salt)

2,3-dichloro-6-Nitrobenzoic acid (Na salt)

2,5-dichloro-4-Nitrobenzoic acid (Na salt)

2,5-dichloro-3-Nitrobenzoic acid (Na salt)

The specific gravity of the waste was given to be between 1.05-1.15. The permittee was authorized to dump not more than 18,000 tons of material per month, and during the course of the month not more than 4,800 tons per trip was allowed and at a frequency not more than four times a month unless a smaller barge was used. Then the frequency of trips could not be greater than ten times a month. The discharge of the waste material from the barge could not be greater than 7,000 pounds per minute while maintaining a speed of not less than five knots.

Within ninety days of the issuance of this permit (#730D007), an implementation schedule was due showing the steps that the permittee was undertaking that would eventually eliminate the need for ocean disposal

of the designated wastes either by advanced treatment or alternate disposal methods. A study to determine the short and long term effects of their dumping activity on the environment was also required. And finally, the applicant was required to analyze the waste material for metals and determine if they were below the limiting levels. The following metals were required to be analyzed: mercury, cadmium, arsenic, lead, zinc, selenium, vanadium, beryllium, chromium, manganese and nickel.

GAF applied for and received an amendment to their permit No. 730D007 on July 31, 1973. Only two changes were made to the special conditions; one being the addition of another barge with which to haul and dump the wastes. The capacity of this barge was 5,000 tons which was over the 4,800 ton limit for wastes per trip. The second change concerns the discharge rate. During the period between July 30, 1973 and August 17, 1973, a discharge rate of 20,000 pounds per minute, rather than the normal 7,000 pounds per minute was allowed. This high discharge rate was also allowed in permit No. 730D007 only from May 18, 1973, to June 1, 1973. This amended permit is known as permit No. 730D007A.

This permit expired on November 1, 1973. Not until April 15, 1974 did GAF receive another permit to continue ocean dumping. During this period between November 1 and April 15 GAF did not ocean dump any wastes. Prior to receiving the next permit (No. 730D007B), GAF had to submit an analysis of the metals in their waste. They reported on August 1, 1973 the following metals and their concentrations:

arsenic	<0.02
beryllium	<0.05
cadmium	<0.002

chromium	0.29-1.8
lead	0.04-0.20
manganese	0.10-0.90
mercury	0.002-0.0002
nickel	0.29-1.50
selenium	0.007-0.008
vanadium	<0.10
zinc	0.13-0.85

This permit became effective on April 15, 1974 and expired on December 31, 1974. The permit allowed for the disposal of the same wastes as in the previous permits. Only this time, the concentrations of each waste that could not be exceeded was expressed in ppm rather than in percent as was previously done. Also, two metals, mercury and cadmium, were identified and they could not be present in amounts greater than 0.002 ppm. Certain physical/chemical properties were also reported with their limiting standard. The allowable dumping load per month was also increased from 18,000 tons to 23,400 tons per month. The dumping site remained essentially the same, but the barges were ordered to navigate around the Flower Gardens by a radius of 15 nautical miles, and by a radius of 5 nautical miles around Stetson Bank and Claypile Bank. This permit expired on December 31, 1974 and was not renewed. GAF stopped the practice of ocean disposal for their wastes.

A study undertaken by GAF Corporation and done by D. L. Klein entitled, "Engineering Feasibility Study of Alternate Surface Disposal Systems for Amiben Wastes" was completed and published on September 25, 1974 outlining the various alternatives to amiben waste disposal. The

following is a description of each method or process:

1) Disposal Wells - the waste is pH adjusted, filtered and injected into a 6000 feet deep well that is properly cemented. The cost is estimated at $1.71/ton.

2) Acidulation, Incineration - the waste is acidified, the organics precipitated out, separated and incinerated. The remaining salt water is injected down a well.

3) Acidulation, Resin Absorption, Incineration - this method is the same as above, but the remaining salt water is purified with an organic absorbent resin before deep-well injection.

4) Acidultation, Carbon Absorption, Incineration - same as above, but activated carbon is used instead of a resin.

5) Evaporative Concentration, Incineration - the waste is concentrated in a multiple effect evaporator and injected into an incinerator. The scrubber water and evaporator condensate are combined and injected into a well. The cost is estimated at $6.46/ton.

It should be noted that the methods listed above are in order of decreasing feasibility.

Alternative Processes:

1) Wet Oxidation Process

2) Molten Salt Incineration

3) Ozonation Process

4) Chemical Fixation

5) Biological Treatment

6) Chemical Reduction

7) Ultrafiltration

GAF Corporation currently disposes their wastes down 6000 foot wells which extend into the Miocene sands. This method also turned out to be economically more feasible than ocean dumping. Ocean disposal of the same waste costs $8.33/ton, and deep well injection cost $1.71/ton. The cost quoted for ocean disposal was a fixed cost set by the barge operator. The amount of waste produced per day is estimated at 300 to 600 tons.

ETHYL CORPORATION, BATON ROUGE, LOUISIANA

The Ethyl Corporation in Baton Rouge, Louisiana applied to the EPA regional office for an ocean dumping permit in April, 1973. They were issued a permit effective May 25, 1973 with an expiration date of November 1, 1973. This permit allows only for the transport of material from the Baton Rouge plant, and the Houston plant, for disposal of waste in the Gulf of Mexico.

The chemical composition of the waste was identified as a sodium-calcium sludge. The constituents were: metallic sodium, metallic calcium, calcium oxide, sodium oxide, and sodium and calcium chloride. Analyses of metals detected copper at an average concentration of 1 ppm. The waste was packed into fifty-five gallon steel drums and sealed. Sodium chloride was used as fill material at both ends of the drum and also provided added weight to ensure proper sinking of the drum. A minimum of six one-half inch holes were punctured in the drums on the top and the bottom, and at 90 degrees apart around the center of the drums. The drums were disposed of in waters approximately 500 fathoms deep and discharged from the barge at intervals of 500 feet. Not more than 700 barrels per trip were allowed and this was also the maximum amount per month permitted. A violent reaction occurs when the drums hit the water and begin to sink. The drums normally react below the surface.

The permittee also was required to submit an implementation schedule showing how or what the company plans to do regarding alternate methods or processes of treating and disposing the waste other than by ocean dumping. This was required within ninety days of issuance of the permit.

Also, studies had to be done to determine the long and short-term effects of the dumping on the environment. This permit was given the number 730D009.

An amended version of the previous permit was issued on August 3, 1973 (No. 730D009A). The only changes were in the percentages of the constituents that were not to be exceeded in the waste. The total sodium was reduced 3%, and the total calcium was reduced 1%. The permittee was also given an extension in submitting a report on the long and short term effects of the dumping. This permit expired on November 1, 1973, but was extended by EPA until February 1974.

Another permit was issued on February 13, 1974 (#730D009B), and the expiration date set at February 13, 1975. The waste material remained the same, but up to 0.75 pounds of cadmium and 0.10 pounds of mercury were allowed to be dumped per barge trip. The number of drums per trip had been increased to 800. The interval between drums was lowered to 270 feet. The drums were still required to be specially marked identifying the waste and the facility it came from. The cadmium concentration in the waste from the Houston plant had to be reduced to at least 0.6 mg/kg by December 15, 1974, or this waste would be prohibited from dumping. Up to this time, wastes from the Houston facility were transported over to Baton Rouge and from there barged out to the disposal site. This requirement was met. Houston wastes were not prohibited from dumping.

On March 12, 1975, Ethyl Corporation was issued permit No. 730D009C, an interim permit not to exceed one year. This permit contained more stringent, special conditions, and if these were not met, the permit would be revoked before its expiration date. In all of the previous permits, it was stated that the permittee had to investigate and achieve

alternatives to ocean dumping. Up to this date, the Ethyl Corporation had not satisfactorily completed this requirement. Ethyl had said that based on years of experience and investigation of many other disposal systems, sea disposal was preferable from the standpoint of hazard to people and the environment and from energy considerations to any known alternative. This permit required Ethyl to start a development program immediately to determine an alternate way of treating and disposing their sodium/calcium sludge. A report on the progress of this undertaking was due on or about August 15, 1975. It was at this time that the Regional Administrator was to decide whether or not Ethyl's permit should be revoked. The report showed that Ethyl is making a concerted effort, involving a significant portion of their corporate resources, to develop alternatives to ocean dumping. This report was submitted and was satisfactory to EPA. The permit has not been revoked. One of the reasons for an investigation into alternatives is that the behavior of the drums and the waste is not known with certainty.

Also written into this report, Ethyl Corporation had to reduce the cadmium concentration in the waste from the Houston plant. The concentration had not been consistently below the required 0.6 mg/kg level. By July 1, 1975, they had to report on the treatment or processes required for cadmium reduction. They have to meet this reduction level by December 30, 1975. Reports were submitted to the EPA on cadmium reduction in July and October of 1975.

E. I. DU PONT DE NEMOURS, LA PORTE, TEXAS

The E. I. DuPont de Nemours facility located in LaPorte, Texas, received an ocean disposal permit on May 1, 1973. The permit expired on November 1 of that same year and was designated as permit No. 730D004. The composition of the dumped waste consisted of sodium chloride, sodium sulfate, sodium bromide, potassium chloride, methanol, methylene chloride, formaldehyde, sodium carbonate, ammonia, and other organics. Six heavy metals were present in varying amounts, but only two required special consideration, cadmium and mercury. Within 180 days of the effective date of this permit, cadmium had to be lowered to a concentration of 1 ppb and mercury to 3 ppb or less. The allowable waste loading permitted was 35,000 tons per month and not more than 4,800 tons per trip. The discharge rate up to May 15 was 14,000 pounds per minute; after that date the rate had to be reduced to 7,000 pounds per minute moving at five knots.

Implementation schedules showing the steps taken to eliminate ocean disposal and bioassay, dispersion, and bioaccumulation studies had to be immediately undertaken. DuPont complied with this requirement and submitted their studies to the Dallas, Texas regional office of the Environmental Protection Agency.

A temporary supplement to this permit was issued on July 19, 1973. The chromium concentration in the waste was not meeting the level required so the level was raised from 0.02 to 0.80 ppm. In accordance with this the permittee had to continue the studies on chromium analytical difficulties.

An amendment to the permit was granted on August 22, 1973. The reporting requirements of General Condition No. 8 were changed allowing

the permittee to delay reporting of the metal analyses until the barge is underway or has arrived at the dump site. The 24-hour advance report being reduced to 12 hours was the only other change.

DuPont was issued its last permit on February 13, 1974, and it expired on January 1, 1975. Under this permit the allowable tons per month was 39,000 up to July 1; after this, it was reduced to 26,000 tons per month. The barges on their way to the dump site had to navigate around the Flower Gardens, and Stetson and Claypile Bank. Ocean disposal from the LaPorte plant was terminated on December 23, 1974.

E. I. DU PONT DE NEMOURS, BEAUMONT, TEXAS

The E. I. DuPont de Nemours and Company facility in Beaumont, Texas received their first ocean dumping permit on May 1, 1975, with an expiration date of November 1, 1973. The permit was given the number 730D002. The waste permitted to be dumped was composed of the following constituents: acrylonitrile, acetonitrite, heavy nitriles, HCN, $(NH_4)_2SO_4$, methanol, propanol, iso-butanol, dinitrophinol, benzene, dinitrobenzene, nitrobenzene, and aniline. Also present in the waste were some traces of heavy metals such as chromium, copper, lead, mercury, zinc, and cadmium.

DuPont could not dump more than 24,000 tons of this waste per month and not in excess of 4,800 tons per trip. Also no more than five trips per month could be made unless a smaller barge with less than 2,500 ton capacity is employed. Then, the trips per month should not exceed 12. The waste could be discharged at a rate greater than 7,000 pounds per minute while moving at a speed not less than 5 knots. DuPont could use four different barges for disposal, only one had a 4,800 ton capacity; the other three were smaller.

Implementation schedules were required within ninety days and environmental studies of their wastes effects on the oceans ecosystem had to be initiated. The cadmium present in the waste could not exceed 1 ppb and DuPont was ordered to identify and treat the source of this cadmium to meet the requirements within 180 days from the effective date of the permit. The environmental studies consisted of bioassay, bioaccumulation, and dispersion studies. DuPont completed these studies and the other requirements concerning cadmium and forwarded all the information to the EPA Regional Office in Dallas, Texas.

The permittee was also given until May 15, 1973 to meet the required discharge rate of 7,000 pounds per minute. Until then, they were able to discharge at a rate of no greater than 35,000 pounds per minute, which was five times greater than the proposed rate.

On July 19, 1973, the Environmental Protection Agency issued a temporary supplement to ocean dumping permit No. 730D002. Its effective date was 1:00 p.m., July 19, 1973, and expired 12:00 midnight on July 22, 1973. DuPont was not able to meet the requirements concerning the allowable concentration of mercury in the waste. The first permit said mercury could not exceed 3 ppb. In this temporary supplement, this concentration was raised to 21 ppb. In accordance with this, DuPont had to locate, analyze, and treat the source of mercury without regard to the expiration date of this supplement, to a concentration not to exceed 3 ppb.

DuPont applied for an amendment to their ocean dumping permit and received it on August 22, 1973. This permit was known as permit No. 730D002A. The only change was to the reporting requirements of General Condition No. 8. The change allowed DuPont to delay reporting of the metals and BOD analyses until the barge was underway or had arrived at the dump site. In addition, the 24 hour advance report was reduced to 12 hours.

On November 1, 1973, permit No. 730D002A expired. A new permit was issued for ocean dumping on February 13, 1974. DuPont had permission to dump between November 1 and February 13, although no new permit had been issued. The new permit issued was known as permit No. 730D002B and expired on February 13, 1975. DuPont actually ceased dumping on February 10, 1975. In this permit not as many waste constituents were dumped as in the

previous permit. The reason for less waste constituents was that treatment facilities were installed. Deepwell disposal and bio-oxidation were put into use, thereby altering the waste characterization of the methanol and acrylonitrile waste. The materials being dumped were: HCN, $(NH_4)_2SO_4$, dinitrophenol, benzene, nitrobenzene, and aniline. Cadmium and mercury were present and could not exceed in concentration 13 and 22 ppb, respectively. The allowable dumping load per month was 33,400 tons, up 9,400 tons from the previous permit. When transporting the described waste to the dump site, the barge or ship must navigate around the Flower Gardens, Stetson Bank and Claypile Bank. There was also a stipulation that the waste be discharged underwater using a dispersion nozzle.

E. I. DU PONT DE NEMOURS, PONCHATRAIN WORKS, LOUISIANA

E. I. DuPont de Nemours and Company, located at Ponchatrain Works in LaPlace, Louisiana, received a permit for ocean disposal of certain wastes on May 22, 1973- It was designated permit No. 730D005. The expiration date was November 1, 1973. The waste to be disposed was divided into seventeen different codes, and each was given a specific code number with which to identify the constituents. The wastes were:

Code No.	
1	80-90% dichlorobutene, 20% maximum organic high boilers, 1-1.5% CuCl, 1.5-3% quarternary ammonia salts.
2	90-100% carbonaceous solids, 10% maximum dichlorobutene.
3	variable mixture of carbonaceous solids, high boiling tars, dichlorobutene.
4	20% NaCl brine, 30% organic amines and salts, 35% chloroprene dimers, 10% chloroprene and dichlorobutene high boilers, 5% phenothiazine and parater-tiary butyl catechol residues.
5	chloroprene polymers
6	90% carbonaceous solids, 10% aqueous hydrochloric acid.
7	100% cyanoprene polymer with residual quantities of sodium cyanide and dicyano-butene.
8	same as No. 7
9	carbonaceous solids slurry in water containing traces of organics and NaCN.

10	NaCl brine, dicyanobutene, benzene, trace quantities of cyanides and copper.
11	100% carbon solids, trace cicyanobutene
12	65% NaCl brine, 20% carbonaceous and polymeric organic solids, 15% filter aid and diatomaceous earth precoat, 100 ppm Cu, 200 ppm HCN and NaCN.
13	inert shell and dirt
15	polystyrene ion exchange resin pellets, trace organics and complexed Cu and CN.
17	inert shell and dirt
18	carbonaceous solids slurry in acidic aqueous solution.
19	carbonaceous solids slurry in water, trace organics.

With thirty days after issuance of this permit, the permittee had to submit an implementation schedule to impound, divert, or hold wastes No. 1, 4, and 12 in lieu of ocean disposal. This schedule had to be in operation by November 1, 1973.

The permit allowed that not more than 1,000 barrels per month could be dumped and not more than 1,000 per trip. The barrels were to be discharged at intervals of at least 500 feet or more. The containers were to be marked with some sort of identification telling the nature of the contents and the person disposing them. DuPont insured that the drums had an excess weight beyond the weight of the sea water displaced by the volume of the drum. This insured the sinking to the bottom of the drums. DuPont attempted to leave, if possible, no air spaces in the sealed drums because if an air space of one inch or less existed, the drum might be subjected to deformation and buckling at high pressures.

DuPont submitted a report on alternatives and their feasibility with respect to ocean disposal. They could discharge the waste into the Mississippi River, but this would be more undesirable than ocean dumping. Landfill disposal or accumulation of the drums on the plant site was also considered. Obviously this was not practicable. Sooner or later they would run out of space to put the waste. But, more so, the waste was water soluble and, therefore, able to leak. This was undesirable for landfill because of the possibility of groundwater contamination. There was also the possibility that if stored in drums, they might corrode and leak. These two methods could be potentially more hazardous to human health than by ocean disposal.

Incineration was also mentioned, but the present facilities were not adequate or applicable to the waste in question. Off-plant vendor treatment was considered, but it had its limitations. Not all of the wastes were produced in large amounts, so enough storage space was required to accumulate the wastes until there was sufficient quantity to send off. This could also depend upon the capacity of the vendors' facility. Another problem lies in scheduling pickups and transporting by rail or truck hazardous or undesirable wastes.

After investigative studies, DuPont came up with what they felt was the most promising method of completely eliminating ocean disposal. They proposed a multi-purpose incineration facility that can burn combustible solids and high solids content liquids as well as roasting inert solids to destroy trace contaminants.

Permit No. 730D005 expired on November 1, 1973. DuPont-Ponchatrain Works did not renew the permit. DuPont actually terminated ocean dumping from this facility on October 30, 1973. Instead, they resorted to incineration as proposed.

E. I. DU PONT DE NEMOURS, BELLE, WEST VIRGINIA

The DuPont facility in Belle, West Virginia, obtained an ocean dumping permit on May 1, 1973 to dump their wastes in the Gulf of Mexico. The permit was numbered 730D006 and expired on November 1, 1973. The wastes to be disposed of were: sodium terephthalate, ethylene glycol, sodium chloride, sodium sulfate, ammonium chloride, sodium styrene sulfonate, methanol, dimethyl carbonate, and adipic acid. Many of the heavy metals were also present such as antimony, mercury and cadmium. Sixty days after issuance of this permit, DuPont had to identify and analyze the sources of antimony, mercury, and cadmium. Within 180 days the mercury in the effluent had to be reduced to 3 ppb or less. The concentrations of these metals were, in fact, controlled to less than:

Antimony	1365 ppm
Mercury	0.02 ppm
Cadmium	0.04 ppm

No more than 7,500 tons of waste was allowed to be dumped per month, nor more than 4,800 tons per trip at a frequency not to exceed twice a month. The discharge rate was not to exceed 7,000 pounds per minute at a minimum moving speed of 5 knots.

The plant facility producing this waste was located in West Virginia, but the permit specifically stated that the port of departure for the ocean disposal of the waste must be Lake Charles, Louisiana. DuPont had to ship the waste to Louisiana and barge it from there to the specified dump site.

Implementation schedules showing a sequence of actions leading to the elimination of ocean disposal and alternative means of treatment and disposal were required within ninety days of issuance of this permit.

Bioassay, dispersion, and bioaccumulation studies had to be undertaken to assess the long and short term effects of the waste in question. These studies were completed and submitted to the Environmental Protection Agency in Dallas, Texas.

On July 31, 1973, DuPont received an amended version of the original permit. This permit, No. 730D006A, gave the permittee an extension on the requirement to treat, eliminate or reduce mercury, cadmium, and antimony to the required levels. This permit expired on November 1, 1973. DuPont re-applied for and received a new permit on July 6, 1974, good for exactly one year. This disposal site was changed from the previous permits and the dumping rate was increased as well. The allowable tons per month was set at 14,000. The discharge rate was increased to 12,700 pounds per minute. The permit also required that the antimony concentration and the spent glycol stream be removed from the waste before ocean disposal.

SHELL CHEMICAL COMPANY, DEER PARK, TEXAS

Shell Chemical Company in Deer Park, Texas received an ocean dumping permit in April 1973. The permit number was 730D008. The expiration date was November 1, 1973. Shell received permission to dump three categories of wastes: organic wastes, digested sludge and spent caustic. The organic wastes were composed of the following constituents: trichloropropane, tetrachloropropyl ether, dichloroethane, trichloroethane, dichlorobutane, dichloropropene, dichloropropane, allyl chloride, dichlorohydrin, glycerine, tetrachloroethane, trichloroethylene, tetrachloroethylene. The metals content was chromium, lead, nickel, mercury, cadmium, zinc, copper and arsenic. Shell was allowed only to dump a maximum of 55,000 barrels of this waste during the permit's time period. The digested sludge was made up of: sludge solids, extractable oil, cadmium, beryllium, chromium, copper, lead, mercury, nickel, vanadium and zinc. 87,500 barrels of this waste was the total load permitted. The spent caustic soda was made up of sodium carbonate, sodium sulfite, sulfides, extractable oil and the same metals as in the digested sludge. 62,500 barrels of this material was allowed to be dumped under this permit.

Only 34,200 barrels of waste was allowed to be dumped each month with no more than 8,000 barrels per trip or week. No barge load could contain more than 27% of the organic waste. If the wastes were not containerized, the waste could not exceed a discharge rate of 600 gallons per minute while moving at a speed of 5 knots.

Implementation schedules had to be submitted within ninety days containing a sequence of actions leading to the elimination of ocean dumping. Shell was required to submit a plan for land-based disposal of the organic wastes to be in operation by June 30, 1976. Studies on

the long and short term effects of their ocean dumping on the environment was also required. Due to the mercury and cadmium present in the wastes Shell needed to identify the sources of these metals and submit a plan to treat or eliminate the sources. The mercury had to be reduced to a concentration of 3 ppb and cadmium to 1 ppb.

The wastes had to be analyzed for their BOD, COD, and TOC properties by August 1, 1973. In addition, the bottom sediments at the dump site had to be analyzed for any accumulation of wastes.

Shell has conducted extensive research into possible effects of the bio-sludge on marine life including toxicity and bioassay tests on fish and shrimp. These tests show that the disposal operations present no threat to the marine environment. A special nozzle is used to disperse the wastes as they are pumped out of a barge. The wastes are rapidly dispersed and are free of oil and do not leave a floating slick.

The digested biological sludge is 97% water and is a by-product of the waste water treatment facility at Shell's Deer Park Manufacturing Complex. Except for its salt content, the waste is similar to that produced in the treatment of municipal wastes. About one fourth of the sludge is burned in a special incinerator.

On August 2, 1973 Shell received an amended permit (No. 730D008B). The only change from the previous permit was that a different barge was being used to haul the wastes to the dump site.

On November 1, 1973 the permit expired, but Shell received an extension. On February 13, 1974 Shell was issued an interim permit, No. 730D008C. It had an expiration date of February 13, 1975. The wastes to be barged are blends of the spent caustic and digested biological sludge. Under this permit no organic wastes were allowed to be dumped. A prohibited barging zone was placed around the Stetson and Claypile reefs. The barges also have to navigate around the Flower

Gardens. The discharge rate was increased to a maximum of 12,000 pounds per minute and the discharge must be through an underwater dispersion nozzle.

A progress report and test results for treatment of the caustic waste was due by June 1, 1974 and an implementation plan by July 1, 1974. Also, projects to reduce the quantities of biosolids were required.

On February 20, 1975 Shell received a special permit (No. 730D008D). The expiration date is Midnight, February 19, 1976. Only the digested biological sludge is permitted to be dumped. No more than 100,000 tons of this sludge can be dumped under this permit. No single trip can exceed 3,250 tons.

Alternate means of disposing this sludge were considered and researched. Under consideration are the following operations:

1) Incineration - Shell's waste water treatment facility includes a sludge incincerator which was designed to dispose of all the facilities' excess biological wastes. However, technical problems resulting from salt in the wastes have significantly reduced the efficiency of the incinerator.

Despite considerable research efforts by the design consultant and Shell, including additions and changes to the original equipment, the incinerator at this time can only dispose of about 25% of the plant's bio-sludge. Duplicating or expanding this incinerator has been ruled out because it is inefficient, unreliable, and requires a substantial amount of fuel. Shell is continuing its efforts to improve the operation of this incineration and has contracted a leading consultant to investigate new technology which might make incineration a feasible alternative.

2) Spray irrigation and land farming - The high salt content of the wastes has prevented successful disposal by these methods. However, Shell is continuing to conduct research at its Biological Sciences Research Center at Modesto, California, into the possibility of mixing the wastes with soil in such a way that crops could be grown on it.

3) Use as fertilizer - Shell has investigated the possibilities of selling or using the bio-sludge as fertilizer, but the salt content of the wastes precludes such use.

4) Landfill - The sludge could be dried and used as landfill, but putrification during drying of the wastes would create a substantial odor problem. A landfill operation would also require substantial real estate and property for such use is not readily available.

On October 10, 1974 the Environmental Protection Agency granted the Shell Chemical Company of Deer Park, Texas and the Ocean Combustion Services, B.U. a permit (730D008C) for waste incineration in the Gulf of Mexico. This was the first time that incineration of dangerous chemicals was to take place in the oceans off of the United States by an American Company. This practice is common among European countries.

Shell was given permission under the research permit to burn 4,200 metric tons of organic-chlorine waste aboard the incinerator ship the Vulcanus. The Vulcanus is owned by a German firm called Hansa Lines. The primary constituents in the waste were: trichloropropane, tetrachloropropyl ether, dichloroethane, trichloroethane, dichlorobutene, dischloropropene, allyl chloride, and dichlorohydrin. Listed as alternatives to ocean incineration were direct dumping into the Gulf, storage on land until their land incinerator is in operation, upgrading or alteration of the waste produce to enable reuse, and incineration by

another company. Direct dumping poses too much of a danger to the environment in the long and short term. There were too many dangers in land storage such as leaks, accidental ignition, or spillage due to natural catastrophes. At that time, Shell did not have the storage capacity to hold the amount of wastes being generated. They were producing about 1,900 metric tons per month. At that rate, Shell had capacity for only six months. It was possible to upgrade the waste, but only around 20% of it. Shell was sending 160 tons per month to the Rollins Environmental Services, Inc. in Houston for incineration. This company just did not have the capacity to take care of Shell's waste. From 1954 up to 1973 Shell had been dumping the waste into the ocean.

Given these alternatives the regional administrator granted Shell the opportunity to incinerate as long as the process was well monitored. The results of this first trip would decide whether or not Shell would be granted an interim permit to continue ocean incineration. This first permit expired on October 26, 1974 after which the EPA would decide to issue another permit.

Certain conditions had to be met by the permittee. The incineration of the waste could only start when the combustion chamber reached a temperature of 1200°C. The Vulcanus had to maintain a minimum average combustion temperature of 1400°C, a running four hour average. However, they were allowed to determine the combustion efficiency as a function of average temperature. Two four-hour burns at 1100°C, 1200°C, 1300°C and 1500°C were examined. An efficiency of 99.9 percent had to be maintained except during evaluation of combustion efficiency. To maintain such a high efficiency, a waste feed rate of 20 metric tons per hour was

required. The incineration took place approximately 200 miles southeast of Galveston. During the burning there shall be no less than an effective wind speed of 10 knots passing the incinerator stacks.

On board the Vulcanus were monitoring equipment which constantly measured the temperature at two points in the incinerator. A time clock showing when the operation was in progress was also present. An automatic camera taking pictures at every 15 minute interval was focused on the control panel. Governmental authorities installed, inspected and sealed this equipment on board. A Beckman 109A flame ionization detector was used to periodically make stack tests to monitor the hydrocarbon emissions.

Based upon the favorable results of the first incineration, Shell was given another permit on November 28, 1974 to burn an additional 4,200 metric tons of that particular waste. This permit expired on December 16, 1974. All of the conditions and requirements laid down in the first permit carried over to this one except for two of them. An average flame temperature of 1350°C instead of 1400°C was specified. The waste feed rate was changed from 20 metric tons per hour to 25 metric tons per hour. These changes assured a combustion efficiency of around 99.9%. Again, on December 12, 1974, Shell was issued a third permit to burn 4,200 metric tons of waste. It expired on January 20, 1975 after which time the Vulcanus headed back to Europe to fulfill previous commitments.

PRESENT DUMP SITES

At the April 1974 offshore disposal hearings in Houston, Texas pressure was exerted by various conservationist groups to have the Western Gulf dump site relocated because of its proximity to the Flower Gardens, the northern most active coral reefs in the world. The Environmental Protection Agency complied with the request and made the southern boundary of the dump site the northern boundary of the new site. When industries applied for renewal or amendments to their existing permits, this change was written in under special conditions. This site is referred to as the Western Gulf Disposal Site. The other site shown in Figure 12 is termed the Louisiana Dump Site.

The Western Gulf Site is about 140 miles southeast of Galveston on the lower part of the continental shelf. The Louisiana Site is located about 60 miles south of the Mississippi River mouth just off the western side of the Delta. The topography is irregular due to the high inflow of sediments from the river. The area is subject to landslides due to the instability of the sediments. The sedimentation rate at the Louisiana site has been estimated by Huang and Goodell (1970) to be 30 cm per 1,000 years.

In May 1973, DuPont of Belle, West Virginia was assigned the Western Gulf Disposal Site for its terephtalate and ethylene glycol wastes. Later that year, DuPont requested to change sites to the Louisiana Dump Site. The Environmental Protection Agency held public hearings on December 19, 1973 and March 28, 1974 concerning this request in New Orleans. The request was turned down because the site was too close to shore for that type of waste. The Environmental Protection Agency then assigned

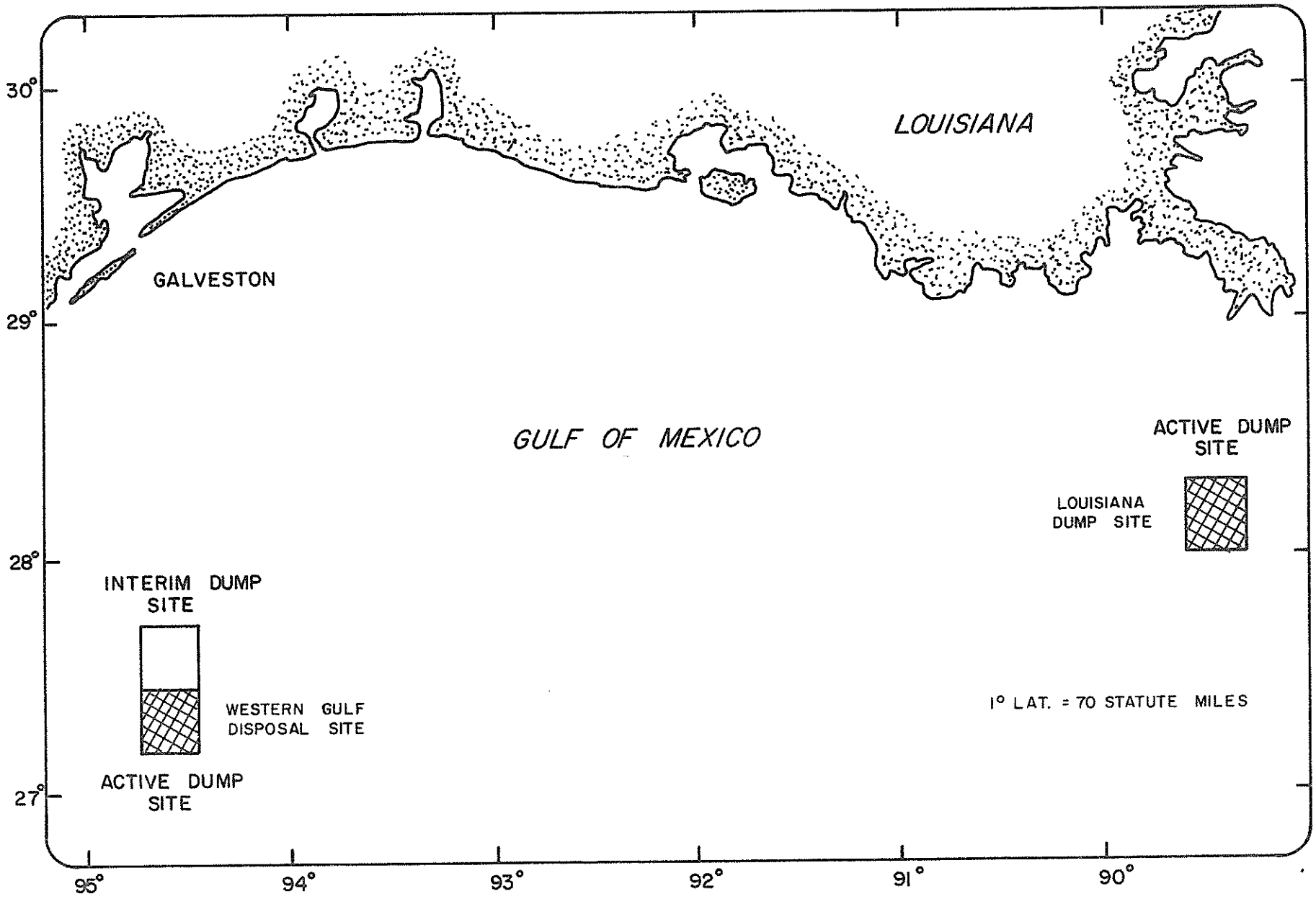

FIGURE 12

INTERIM AND ACTIVE DUMP SITES IN THE GULF OF MEXICO

(EPA FILES)

DuPont a new site whose center was 27°N and 87°W. An environmental survey of the area was made by DuPont and the site was approved for interim use on June 7, 1974. The State of Florida objected to this and obtained a ten day injunction against use of this site. They argued that they had not received a public notice as required by the law and that the current patterns might transport the waste to their coastal waters. Therefore, on June 25, 1974 the Environmental Protection Agency withdrew the site from interim use. On May 16, 1973 the Environmental Protection Agency published in the Federal Register the approved interim dumping sites. These are presented in Table 4.

TABLE 5

APPROVED INTERIM DUMP SITES IN THE GULF OF MEXICO

EPA REGION VI

Location	Size (square miles)	Depth (feet)	Primary Use
Latitude and Longitude			
Calcasieu Pass, Area A, 29°45',93°21'	1.0	6+	Dredged materials
Calcasieu Pass, Area B, 29°45',93°20'	1.0	6+	Do.
Calcasieu Pass, Area C, 29°42',93°21'	5.0	18+	Do.
Calcasieu Pass, Area D, 29°35',93°17'	5.0	18+	Do.
Southwest Pass, 28°52',89°31'	2.0	45+	Do.
Waste disposal area, 27°12'-27°28'N,94°28"-94°44'W	16 miles by 16 miles	2,400	Chemical wastes
Waste disposal area, 28°0',28°20',89°15',89°35'	20 miles by 20 miles	2,400+	Do.
Off Sabine Pass, Tex., Area A, 29°37',93°50'	Approximately 5--	24	Dredge materials
Off Sabine Pass, Tex., Area B, 29°37',93°48'	Approximately 3--	30	Do.
Off Sabine Pass, Tex., Area C, 29°40',93°51'	Approximately 4--	6	Do.
Off Galveston, Tex., Area A, 29°19',94°40'	Approximately 2.5	36	Do.
Off Galveston, Tex., Area B, 29°20',94°39'	Approximately 2.5	30	Do.
Off Galveston, Tex., Area C, 29°17',94°40'	Approximately 7--	36	Do.
Off Galveston, Tex., Area D, 29°22',94°43'	Approximately 8--	12	Do.

26 degrees, 50 minutes North latitude
27 degrees, 10 minutes North latitude
86 degrees, 50 minutes West longitude
87 degrees, 10 minutes West longitude

26°20' North latitude
27°00' North latitude
93°20' West longitude
94!00' West longitude

(39 FR 20206, June 7, 1974; 39 FR 37057, October 17, 1974; 39 FR 40018, November 13, 1974)

METHODS OF WASTE DISCHARGE

Several methods are employed in the discharge of waste cargoes from barges into the Gulf of Mexico. These are: 1) dumping the waste from a bottom-opening hopper barge, 2) discharging by pumping the wastes through nozzles located at the bottom of the barge, 3) discharging the waste directly into the barge wake, or 4) dumping the wastes in 45 gallon steel containers.

Dumping from a Hopper-barge

This technique is the simplest way of discharging waste materials into the sea and has seen extensive use for both dredge spoil and municipal sludge. The waste cargo normally consists of two phases, a solid phase and a liquid phase. The solid phase is characterized by a discrete set of settling velocities, solid densities and concentrations while the liquid phase is miscible with ambient ocean water.

After its release from the barge, the waste cloud will descend because of its momentum and buoyancy. If the waste is denser than the receiving waters, the cloud will continue to descend although in an ever slowing manner because of drag resulting from the clouds passage through the water column and changes in cloud buoyancy brought about by the entrainment of surrounding seawater. At this point, the solids within the cloud tend to settle out and the cloud could reach a neutrally buoyant position. Thus, the cloud tends to collapse vertically and spread out horizontally seeking a hydrostatic equilibrium within the ambient fluid. As the cloud comes close to a neutrally buoyant position, it may have a horizontal velocity close to that of prevailing currents. At the same time, the concentration of the waste material is greatly

reduced. If the density stratification of the water column is not strong enough, the waste cloud will ultimately hit the bottom and spread out at the bed while the settling of solids continues.

Jet Dispersion

Numerous barges discharge waste materials through submerged nozzles, either by pumping or gravity while the barge is underway (normally 5 knots). Near the nozzle, the flow is that of a jet in a cross-current. The jet entrains ambient seawater and momentum while also experiencing a drag force from the surroundings caused by the pressure difference between the upstream and downstream sides of the jet. Thus, as the jet grows in size, it also bends over in the direction of the prevailing current. The waste material is diluted by means of seawater entrainment and solid particles, if any, settle out as the situation allows. As the jet goes further downstream, it becomes less active and the influence of the ambient density structure dominates. The jet then spreads horizontally seeking a neutral buoyant position. Just as in the preceeding case, bottom encounter is also a possibility for the generated waste plume.

Mixing in the Wake of a Barge

The mixing process which occurs in the wake of a barge is so complicated that it is impossible to describe analytically. In the initial mixing phase, the buoyancy effect is of secondary importance because of the strong turbulent mixing occurring in the barge wake. However, as turbulence subsides, the buoyancy, if the waste is denser than seawater, will make the waste plume descend through the water column to seek a neutrally buoyant position while it is convected downstream by the ambient current.

Container Discharge

In this technique, industrial wastes which are not suitable for direct discharge, i.e. spent ion-exchange resins, high-boiling tars, etc., are containerized in 45 gallon barrels. In some cases, the barrels are ballasted with gravel to 520-590 pounds to insure sinking. The concept behind this disposal method is that the wastes can do no harm in deep water because bottom currents are negligible and molecular diffusion predominates. In addition, if the barrels are dropped in an area of high sedimentation rate or of active submarine landslides such as the Louisiana dump site, the barrels and their contents will be completely immobilized. However, barrel life-time in oxygenated sea-water has been estimated (Burton, 1973) to be only five years; a time perhaps too short to allow total sediment coverage. Also, nothing is known of the effects of barrel corrosion products on benthic organisms.

RECENT DEVELOPMENTS

Sewage Sludge Disposal

On July 23, 1975, it was reported in the Houston Chronicle that the City of Houston is planning to apply for a permit to dump 50 tons of sewage sludge a day into the Gulf of Mexico. Joe Johnson, the Assistant Public Works Director, said that the proposed dumping would last for only four years. By that time the 69th Street Fertilizer Plant should be completed. Thereafter, all the city's sludge will be sent to the fertilizer plant to be converted into fertilizer. Johnson stated that 40 tons of waste are being converted into fertilizer daily and 50 additional tons are being discharged into the Houston Ship Channel and Galveston Bay.

The city argues that disposing of this sludge in the Gulf would prevent further polluting of the Ship Channel and Galveston Bay. The sludge to be dumped is termed "digested and stabilized sludge". Houston's sludge will contain small amounts of organic matter. It is the city's opinion that sludge of this nature would not be great enough to pose any harm to the environment.

The proposed dump site is the same one now being used by the Shell Chemical Company, 150 miles south of Galveston. The city acknowledges that there may be times when it will be impossible to dump that far out. Factors such as high seas or unfavorable weather could hinder barge transportation to the dump site. Houston plans as an alternative to bury the sludge onshore during these instances.

Ocean Incineration

Incinceration of wastes at sea by specially equipped vessels has been a common practice in Europe and other foreign countries. This

practice did not take place ever in the United States prior to October 10, 1974. On this date the Environmental Protection Agency's regional office in Dallas, Texas granted a permit to Shell Chemical of Deer Park, Texas for the purpose of ocean incineration in the Gulf of Mexico. Employed for this purpose was the German-owned incinerator ship, Vulcanus. On its initial voyage, it burned 4,200 metric tons of an organo-chlorine waste. The first burn was favorable so Shell was issued subsequent permits on November 28, 1974 and on December 12, 1974. This last permit expired on January 20, 1975 after which time the Vulcanus returned to Europe.

Combustion of the organo-chlorine waste at 1400°C converts the waste to carbon dioxide, water, and hydrochloric acid. In a general report issued in January of 1974 by the Center of Biological Studies and Research and of Oceanographic Medicine (CERBOM), the National Institute for Health and Medical Research (Nice, France), Dr. M. Aubert and colleagues came up with the following conclusions:

1.) The process (incineration at sea) does not seem to bring about changes in the biological mass.

2.) Smoke entering the marine environment does not seem to have an effect on the productivity. However, if this smoke comes into the sea in large volumes, there are some indications, such as discoloration of the Diogenes sp., showing that the neutralization is not perfect.

3.) No phenomenon of accumulation through the nutrition chain takes place, neither for the mercury, nor for the lead, nor for the chlorinated hydrocarbons. We did not yet investigate the possible presence of other toxic materials such as

cadmium or benzopyrenes, which would exist in the soots, but anyway, they have not caused any disturbance in the various links of the nutrition chain we have studied.

Based on these findings by Dr. M. Aubert, ocean incineration does not pose any harm to the marine environment. It appears to be a far better alternative to direct disposal into the oceans. The short-term effects of incineration are known and prove to be negligible; however, until long-term effects are known, no final judgement can be made about ocean incineration. In the Gulf of Mexico area alone, five to ten million tons of chlorinated hydrocarbon products are produced per year. Resulting from this are as much as 400,000 tons of chlorinated hydrocarbon residues that need to be disposed of. Incineration at sea may very well be able to alleviate the disposal problems associated with these wastes.

Besides Shell Chemical Company, the U.S. Air Force is showing an interest in ocean incineration. In February of 1975 they proposed ocean incineration of its stocks of Herbicide Orange. On March 24, 1975, notice was published in the Federal Register of the receipt of the application for ocean incineration (EPA, 1975). The Air Force was requesting a research permit to allow for incineration of 4,200 metric tons of Herbicide Orange in the Pacific Ocean at a site to be determined. Public hearings were held in April, 1975 in San Francisco and in Honolulu. The Air Force presented testimony showing that no harm would be incurred to the marine environment or cause any effects to the air. The Air Force also indicated that they will carry out pilot plant studies to investigate reprocessing of Herbicide Orange. No final decision on ocean incineration will be made until the pilot plant studies are completed.

SUMMARY AND CONCLUSIONS

Since the late 1960's when the initial thrust of the environmental movement began, people have become more concerned and cognizant of what has been happening and what is currently occurring to the environment. The first stage of the movement was basically ecology oriented. People worried about pollution in general, that which affected the air, rivers, lakes, and the land. More people became aware that the natural balance between organisms and their surroundings was being altered, seemingly for the worse. This prompted the organization of ecology groups and clubs to combat pollution in order to preserve the environment. Pressure exerted on legislators by these and other groups produced action, and as a result the Federal Water Pollution Control Act was amended in 1972. This in turn laid down the foundation for other pollution-oriented laws to be drawn up.

Five days after the passage of this law, a law governing ocean dumping was published. It is known as the "Marine Protection, Research and Sanctuaries Act of 1972". This law specifically designates the Environmental Protection Agency as the permitting agency for ocean dumping. The Corps of Engineers remains in charge of dredge spoil permits. Previous to this law, the Corps was involved in permits pertaining to ocean disposal. They received their authority under the Rivers and Harbors Act of 1899 to regulate ocean dumping. Regulation of this practice by the Corps in the Gulf of Mexico was rather sketchy (Smith and Browns, 1969). Incomplete records or no records at all were maintained by the Corps offices in Mobile, Alabama and Galveston, Texas. As a result, little is known about past dumping practices in the Gulf of Mexico. So called

"letters of no-objection" were issued by the regional district offices to those persons or industry desiring to dump wastes in the Gulf. The Corps did designate certain areas in the Gulf where dumping was permissible. In contrast to ocean disposal, the Corps kept very concise records of dredge disposal.

In 1970, the Environmental Protection Agency was formed and in 1972 they were given jurisdiction over ocean disposal of any type waste. Under their authority, all persons desiring to dump wastes in the oceans were required by law to obtain a permit. This became effective April 23, 1973. Five different types of permits were made available by the EPA. They were general, interim, special, research, and emergency permits. The type of permit issued depends on the type, quantity, and toxicity of the waste, and the frequency of waste disposal. In or around April of 1973, seven permits were issued to companies by the regional office of the EPA in Dallas, Texas for the purpose of ocean dumping in the Gulf of Mexico. The Dallas office, Region VI, was made responsible for any disposal operations which occur in the Gulf of Mexico. The EPA granted ocean dumping permits to the GAF Corporation, Shell Chemical Company, the Ethyl Corporation, and four different DuPont facilities, two in Texas, one in Louisiana, and one in West Virginia. All of these initial permits expired on Novmeber 1, 1973. The EPA issued letters to these companies at this time, telling them that they could continue their dumping while the EPA reviewed their previous permit conditions. Based on this review, new permits were issued to the seven companies to continue their dumping practices early in 1974.

One of the conditions of the permits was that the permittee must state alternative means of disposing their wastes. For example, when

the permit issued to GAF Corporation expired in December of 1974. They did not renew it; instead GAF started using deep well disposal for their wastes. The DuPont Company also changed methods, now utilizing the processes of carbon absorption and incineration in place of ocean disposal. As the other permits began to expire, the companies utilized other alternative disposal means.

Shell Chemical Company is one facility still dumping into the Gulf of Mexico, and their permit expires on February 19, 1976. They are disposing of a digested biological sludge. The Ethyl Corporation is also dumping into the Gulf. They are dumping a containerized waste consisting of a sodium-calcium sludge. The expiration date for this permit is March 12, 1976.

The government's goal of zero pollutant discharge into rivers and waterbodies is resulting in a greater accumulation of waste residues to be ultimately disposed of. The greater the amount of pollutants removed from waste streams does not only increase the volume of waste, but also creates a more concentrated and a more toxic waste. Therefore, unless the waste is recycled, there will be an increase in waste material to be disposed of in the future, both in volume and in toxicity. To accommodate this trend, more efficient treatment facilities will be required as well as methods of ultimate disposal.

With the advent of ocean incineration and development of more efficient waste disposal alternatives, ocean disposal in the Gulf of Mexico is being significantly reduced and may even cease in the future. At the present time, more and more companies are going to alternative methods. However, with the increasing demand for natural gas and oil, the feasibility of some alternatives is fast becoming economically

unsound; thus, there is a demand to return to ocean dumping. Until the long-term or chronic effects of ocean disposal can be completely assessed, no absolute decision concerning ocean disposal should be formulated. It appears that ocean dumping in the Gulf of Mexico will steadily continue to decline until ocean dumping is proven to be one of the more practical and safe methods of waste disposal.

This demand for a return to ocean disposal remains and may be strengthened by future high waste treatment requirements which generate greater masses of residues. Thus, the quest for knowledge relating to ocean dumping should continue.

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