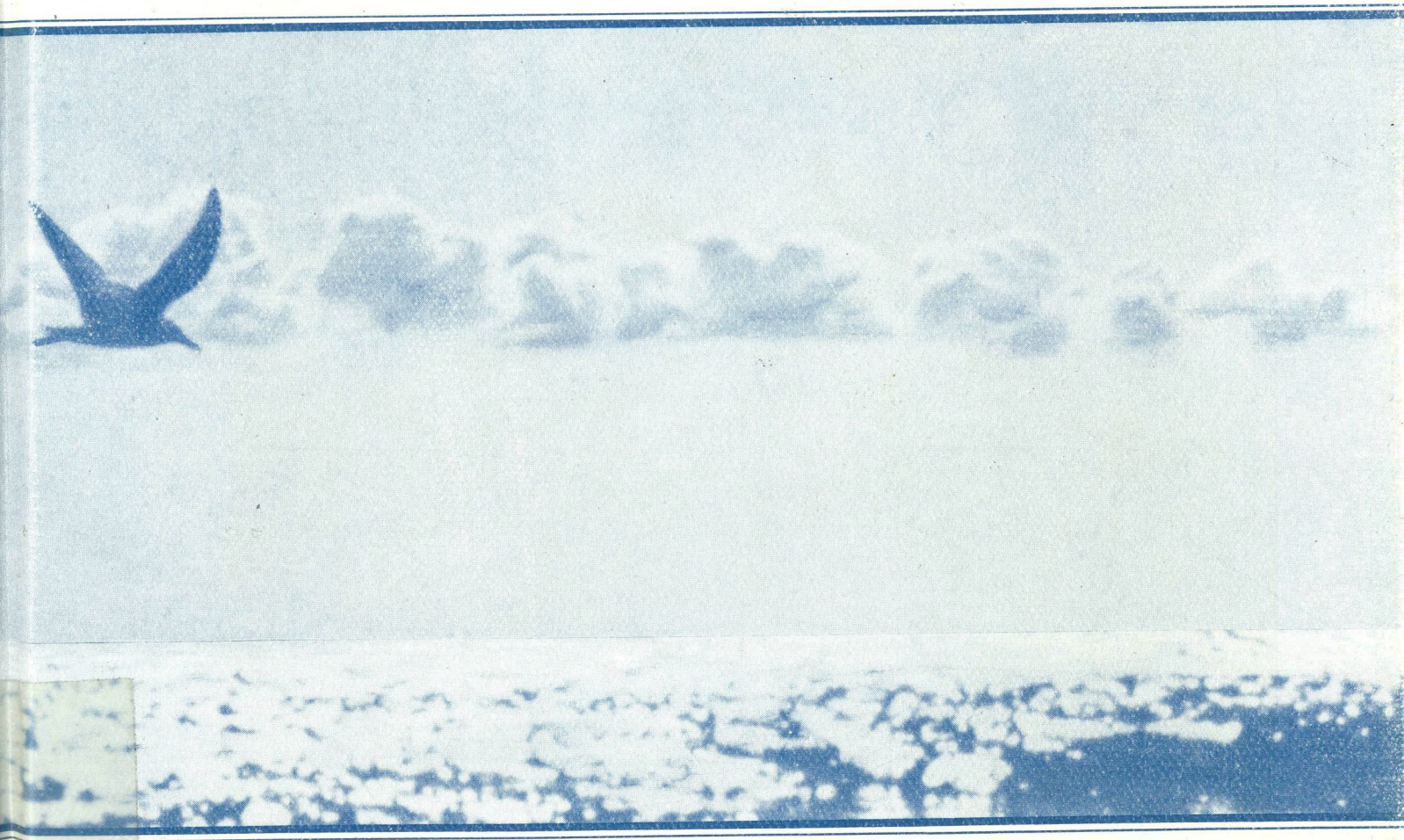
National Marine Pollution Program Plan

Federal Plan for Ocean Pollution Research, Development, & Monitoring Fiscal Years 1981–1985

September 1981



Interagency Committee on Ocean Pollution Research, Development, & Monitoring / *Federal Coordinating Council for Science, Engineering, & Technology*

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

THE ADMINISTRATOR

March 25, 1982

Dear Sirs:

It is my honor to submit the Federal Plan for the National Marine Pollution Program, Fiscal Years 1981-1985, as required by the National Ocean Pollution Planning Act of 1978, Public Law 95-273 (as amended).

Sincerely,

John V. Byrne

Enclosure

The President
President of the Senate
Speaker of the House of Representatives

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PREFACE

The National Ocean Pollution Planning Act of 1978, P.L. 95-273 (as amended), calls for the establishment of a comprehensive, coordinated, and effective Federal program for ocean pollution research, development, and monitoring. The Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), in consultation with other agencies, prepares biennially a five-year Federal Plan for the National Marine Pollution Program. The Plan is to include an inventory of existing Federal programs, an analysis of the extent to which existing programs assist in meeting priorities, recommendations for changes in the overall Federal effort where necessary, and a report on budget coordination efforts.

To carry out the purposes of the Act, an interagency committee was chartered within the Office of the President's Science Advisor. The interagency Committee on Ocean Pollution Research, Development, and Monitoring (COPRDM) is chaired by NOAA's Deputy Administrator and comprises senior representatives from eleven departments and independent agencies. Its mission is to identify cooperative research studies and conduct external evaluation of Federal efforts. The committee also seeks to avoid unnecessary duplication among Federal agencies and seeks better planning and more effective use of available funds, personnel, vessels, facilities, and equipment.

NOAA established the National Marine Pollution Program Office (NMPPO) to provide a focal point for coordinating Federal efforts on a day-to-day basis. This office is responsible for updating the five-year Plan and coordinating implementation of the recommendations of the Plan. An interagency task force provides agency representation to NMPPO in plan preparation and implementation.

The first five-year Plan was completed in the fall of 1979. Nearly 1,000 Federal projects were identified totaling approximately $165 million in FY 1978. This second Plan includes descriptions of marine pollution concerns, and identifies research and monitoring activities designed to address the problems. Appendix No. 1 consists of individual agency program descriptions containing research and monitoring plans. Appendix No. 2, the updated inventory, contains more detailed descriptions of individual agency programs on a project-by-project basis. For FY 1981 again nearly a thousand projects were identified, totaling expenditures now of approximately $172 million.

EXECUTIVE SUMMARY

The National Marine Pollution Program is the collective Federal effort for ensuring that research, development, and monitoring activities related to marine pollution are carried out efficiently and effectively. The Program includes coastal areas, estuaries, open oceans, and the Great Lakes. This Plan represents the second biennial milestone in the continuing interagency planning process called for by the National Ocean Pollution Planning Act of 1978. It summarizes accomplishments that have occurred since the first Federal Plan was published in the fall of 1979, describes priorities of future pollution activities and presents a strategy for improving the National Program. In summary, the Plan presents a strategy for acquiring, interpreting, and distributing information that can be used in making decisions on the management and conservation of marine resources.

The data used in preparing this document were collected in 1980 and early 1981 prior to the Administration's efforts toward national economic recovery. At that time, the interagency planning group identified priority problem areas requiring continuing emphasis, reviewed agency program objectives, milestones, and budget targets, and recommended actions for improving the program. Since that time, a comprehensive review of Federal agency programs and budgets has been under way to reduce Federal spending. As policies toward economic recovery are implemented the National Marine Pollution Program will change accordingly. Thus, this Plan does not contain information on agency programs and budgets after FY 1981. A supplement to this plan will be prepared as revised agency programs and budgets become available.

This Plan identifies opportunities for interagency collaboration and cooperation, and points out research areas that are worthy of special attention. Additionally, it identifies those areas that have been adequately addressed. The Plan gives general planning guidance and is not intended to provide detailed tactics for program implementation. Specifically, the Plan:

- Describes marine pollution areas that are being addressed by Federal activities.
- Within areas of concern, identifies research topics that require additional effort, and those that have been adequately addressed.
- Describes the relative importance of research in each area of concern by discussing existing information gaps, potential severity of the pollution problem, and Federally mandated functions.

- Presents specific recommendations for improving the program by redirecting existing resources toward the most productive and important areas, improving interagency coordination, or anticipating future problems.

This Executive Summary summarizes the recommendations and conclusions of the Interagency Committee and provides an overview of the activities that constitute the National Marine Pollution Program. More detailed information on all aspects of the planning effort is provided in the main body of the Plan.

FEDERAL EXPENDITURES IN OCEAN POLLUTION RESEARCH, DEVELOPMENT, AND MONITORING

The National Marine Pollution Program includes activities carried out by eleven Federal departments and independent agencies. The total Federal expenditure in FY 1981 for ocean pollution research, development, and monitoring studies is estimated to be $172 million. Amounts expended by individual departments and agencies are shown in the table for FY 1978 and FY 1981. The following four agencies accounted for nearly 70% of the total program budget in FY 1981: Bureau of Land Management ($35 million), EPA ($32 million), NOAA ($26 million), and DOE ($23 million). Over a three-year period (FY 1978 to FY 1981), the total Federal expenditures on ocean pollution research, development, and monitoring activities increased about $6 million or 4% of the FY 1978 budget ($164 million).

PROGRAM AREAS

The National Marine Pollution Program addresses a wide range of marine pollution areas of concern. For planning purposes, the following major areas of concern were used in analyzing the combined activities of the eleven agencies:

- Marine Waste Disposal -- Activities in this area are specifically directed at understanding better the effects of using the oceans for waste disposal. Disposal of dredged materials, industrial wastes, sewage wastes, radioactive substances, and brine generated by the strategic petroleum reserve are all included.

- Marine Mining -- Activities in this area provide information about the direct and indirect environmental consequences of recovering subaqueous deposits of various valuable or useful materials. Mining of oil and gas resources and sand, gravel and shell on the continental shelf, and recovery of minerals from the deep seabed are included.

FUNDING LEVELS FOR DEPARTMENTS AND AGENCIES -- FY 1978 AND FY 1981

Department or Agency	Funding Levels (Thousands of Dollars) FY 1978	FY 1981
Department of Agriculture	$ 115	$ 196
Department of Commerce		
National Oceanic and Atmospheric Administration	17,538	25,740
Department of Defense		
Army Corps of Engineers	2,365	8,491
Navy	6,437	2,750
Department of Energy*	15,670	22,736
Department of Health and Human Services		
Food and Drug Administration	2,620	2,670
National Institute of Environmental Health Sciences	1,278	1,886
Department of the Interior		
Bureau of Land Management	37,656	35,368
Fish and Wildlife Service	2,629	2,600
Geological Survey	16,107	13,230
Department of Transportation		
Coast Guard	8,803	3,390
Environmental Protection Agency	34,989	31,700
National Aeronautics and Space Administration	1,750	500
National Science Foundation	15,134	18,765
Nuclear Regulatory Commission	1,245	1,000
Total	$164,736	$171,022

*Current reorganization plans call for marine pollution elements of the Department of Energy to be transferred to the Department of Commerce

- Marine Energy -- Activities in this area address the environmental implications of extracting energy from the oceans. Ocean thermal energy conversion is considered separately; all remaining technologies (e.g., wave energy, tidal energy, biomass, etc.) are discussed as a group.

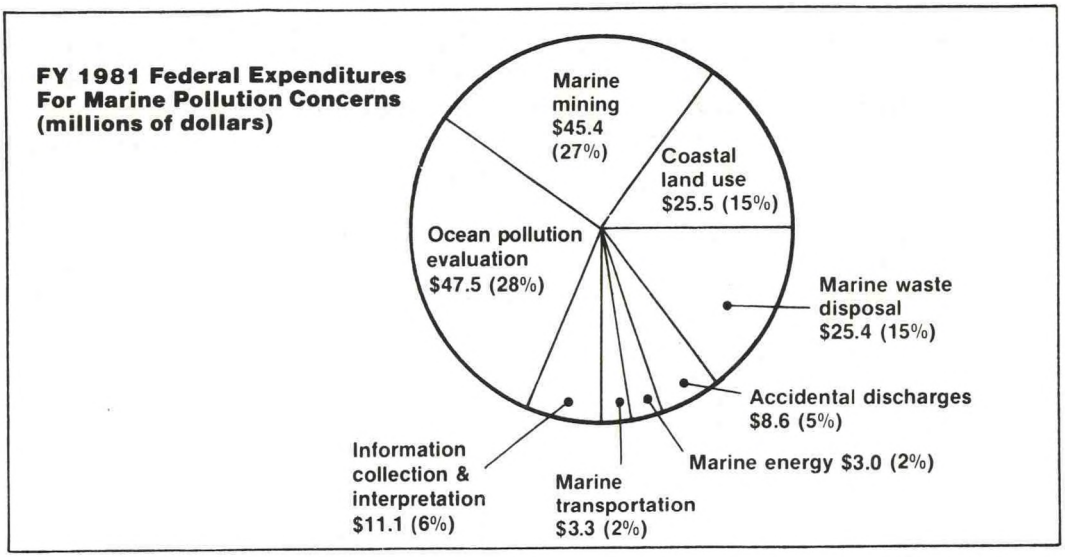
- Marine Transportation -- Activities in this area describe the environmental effects of routine shipping operations such as discharge of shipboard wastes, cargo transfer, and discharge of ballast.

- Accidental Discharges -- Activities in this area are directed at understanding the effects of accidentally discharged crude petroleum and petroleum products, and various harmful chemicals. Improving emergency spill response and developing cleanup technologies are also included.

- Coastal Land Use -- Activities in this area increase our knowledge of how coastal land use practices and patterns affect marine ecosystems. Siting, construction, and operation of coastal facilities; nonpoint source pollution; and increased use of coal are included.

- Ocean Pollution Evaluation -- This area includes research, development, and monitoring activities that are not directly related to a specific polluting activity, but that are essential to understanding the effects of ocean pollution on valuable marine resources, regardless of pollution source. Developing and evaluating environmental quality criteria, documenting existing environmental quality, describing natural variability in marine ecosystems, measuring acute and sublethal effects of specific pollutants on selected organisms, and studying cumulative or interactive effects of multiple pollutants or disruptions are among the many activities included.

- Information Collection and Interpretation -- Specific activities within the program ensure that information collected by marine pollution research, development, and monitoring is reliable and that information is made available to users. Data management, synthesis, and distribution; quality assurance; and development of measurement methodologies are included.



Estimates of FY-1981 expenditures in each of the program areas are provided in the figure above. Because many programs address more than one marine pollution area of concern, the information in the figure should be considered only as an indication of relative magnitude of expenditures in the marine pollution areas during FY 1981. The same is true of the more detailed information in the table on p. xii.

During FY 1981, the area of Ocean Pollution Evaluation accounted for the greatest expenditure of funds ($47.6 million), more than was spent in any of the areas that are more strictly defined by pollution source. Marine Mining received about 26% of the total expenditure, and was heavily dominated by studies of offshore oil and gas exploration, development, and production. Marine Waste Disposal and Coastal Land Use each accounted for approximately 25% of the total expenditures on marine pollution research, development, and monitoring. Marine Energy, Marine Transportation, Accidental Discharges, and Information Collection and Interpretation each accounted for less than 10% of the total FY-1981 expenditures.

PROGRAM ANALYSIS

Each of the marine pollution areas has been analyzed to evaluate current efforts and recommend future directions. The following information was used to conduct the analyses: descriptions of ongoing research, development, and monitoring activities funded by Federal and non-Federal sources; a listing of national research and information needs related to ocean pollution that was synthesized by the Interagency Committee; and a review of Federal mandates, responsibilities, and policies pertaining to each pollution area.

EXPENDITURES IN MARINE POLLUTION AREAS -- FY 1981

Marine Pollution Area of Concern		Thousands of Dollars
MARINE WASTE DISPOSAL		
Dredged Material		9,313
Industrial Waste		3,465
Sewage Waste		4,414
Radioactive Waste		2,186
Brine		6,034
	Subtotal	25,412
MARINE MINING		
Oil and Gas		44,968
Sand, Gravel, and Shell		420
Deep Seabed		34
	Subtotal	45,422
MARINE ENERGY		
OTEC		4,134
Other Technologies		34
	Subtotal	4,168
MARINE TRANSPORTATION		4,401
ACCIDENTAL DISCHARGES		8,645
COASTAL LAND USE		
Siting, Construction, and Operation of Coastal Facilities		10,003
Nonpoint Source Pollution		14,784
Increased Coal Use		712
	Subtotal	25,499
OCEAN POLLUTION EVALUATION		47,575
INFORMATION COLLECTION AND INTERPRETATION		
Data Management, Synthesis, and Distribution		5,109
Quality Assurance		881
Measurement Methodologies		5,060
	Subtotal	11,050
PROGRAM TOTAL		172,172

The results of the analysis include the following:

- An assessment of the relative importance of each pollution area within the context of national needs and problems.
- Within each pollution area, a description of specific information needs and a discussion of the importance of the information needs.
- Recommendations for actions that can be taken to improve the program.

Results for each program area are summarized below. The discussions below also indicate the relative importance of the areas of concern in the context of national marine pollution information needs. More detailed discussions of each program area are provided in Chapter 2.

Marine Waste Disposal

Marine Waste Disposal is one of the most important areas in the Program. Within the area of Marine Waste Disposal, it is recommended that industrial waste and municipal waste receive the most intense effort in the next several years. The oceans appear to possess a limited capability to assimilate some types of wastes without causing unacceptable or irreversible changes in marine ecosystems. Sufficient scientific information is not yet available to widely apply the assimilative capacity concept on a management basis. However, waste disposal policies are changing to allow the cautious and studied use of the oceans as a waste disposal medium. In the next 5 years, the National Marine Pollution Program should be responsive to the needs of changing waste disposal policies. The Program should provide the information required to support the establishment of new waste disposal management practices that may be developed as a result of policy shifts.

As discussed in the following sections work that will assist in making specific decisions related to waste management is already under way. To complement these continuing efforts, the Interagency Committee recommends the development of a conceptual model for waste management, the conduct of a waste management pilot study, and the development of an early warning monitoring system as described in Chapter 5. As pressure increases to reduce regulatory controls of ocean waste disposal, studies on the effects of ocean disposal are becoming increasingly important. It is anticipated that the studies identified above could be conducted at existing (FY 1981) funding levels and would not require additional appropriations.

Dredged material disposal

Dredging of new channels and maintenance dredging of existing channels are required to allow safe and efficient navigation conditions for commercial and recreational marine transportation. Channel dredging generates significant amounts of excavated sediment and water mixture. On the basis of volume, dredging is the largest single source of ocean-dumped materials. In FY 1981, about $9 million or 5% of the total marine pollution expenditure was allocated to research on dredged material disposal.

The following areas are now addressed by ongoing programs but are of continuing importance and should receive emphasis in the future:

- Chemical Effects on the Ecosystem -- The state-of-knowledge in this area must be assessed. Continuing studies are needed on the rates and mechanisms of pollutant releases, chemical forms that can be readily taken up by organisms, long-term fates, and acute and chronic effects.

- Disposal Management -- Future studies of dredged material disposal should provide information needed for long-term management of disposal activities. Potential disposal sites should be evaluated, future volume and quality of dredged materials estimated, alternative disposal methods assessed, and innovative dredging technologies evaluated for promoting development of long-term disposal strategies.

The following area is adequately addressed by ongoing programs:

- Physical Effects on the Ecosystem -- The Dredged Material Research Program, conducted by the Corps of Engineers, has laid groundwork at the generic level for studying physical effects of dredged material disposal. Ongoing COE and NOAA programs are studying physical effects on a site-specific basis at several disposal sites. The generic aspects of physical effects have been adequately addressed. Site-specific studies performed on a limited basis continue to provide valuable information on long-term physical impacts.

Industrial waste disposal

The U.S. Environmental Protection Agency has regulatory authority over disposal of industrial wastes by ocean dumping, outfalls, and incineration at sea. Reliable scientific information is required as a basis for regulation of disposal activities. It is estimated that about $3.5 million or about 2% of the total program budget was expended during FY 1981 on research, development, and monitoring activities related to the disposal of industrial waste.

The area of industrial waste disposal is addressed but is of continuing importance and should receive emphasis in the future. These focuses are recommended for future activities:

- Ecosystem Effects and Human Health Risks -- Information is needed on fates and chemical behavior of pollutants, rates of accumulation by organisms, human health risks, and sublethal effects of pollutants in industrial wastes.

- Management of Industrial Wastes -- To provide guidance for developing long-range management strategies for disposal of industrial wastes, the waste materials should be better identified and characterized, and disposal options should be compared on a rigorous basis. It is the responsibility of the industries involved to characterize their wastes. States and local governments should work together to develop and implement management strategies.

Sewage disposal

The principal human health risks resulting from sewage waste disposal are associated with the transmission of human pathogens and the ingestion of seafoods contaminated with toxic metals and synthetic organic compounds. In the Great Lakes there are additional risks from pathogens and toxics because the lakes supply drinking water. Other adverse impact include the loss of recreational and commercial resources where beaches or wetlands are fouled with floating waste materials or are closed to fishing and shellfishing because of sewage contamination. Many studies on outfalls are being conducted as a result of current legislation; the results of these studies should be assessed and presented for use in policy and decisionmaking. In FY 1981, about $4.4 million or 2.5% of the total marine pollution expenditure was allocated to research on ocean outfalls of sewage and ocean dumping of sewage sludge.

The following areas are now addressed by ongoing programs but are of continuing importance and should receive emphasis in the future:

- Effects of Sewage Outfalls -- Information generated as a result of programs initiated under 301(h) (exceptions to the Clean Water Act allowing for ocean disposal of primary treated sewage) should be synthesized and evaluated. Ecosystem recovery, at sites where ocean outfalls have been discontinued, should be evaluated.

- Management of Sewage Wastes -- Multimedium assessments of all disposal alternatives are needed for the management of sewage waste disposal. Special attention should be given to chemical composition of wastes, costs and benefits of various treatment technologies, assessments of different options, and disposal

site selection. Planning and implementation of sewage waste disposal is the responsibility of appropriate local or State governments.

The following area can be adequately addressed by ongoing programs:

- Effects of Sludge Dumping -- Ocean dumping research under way by EPA and NOAA includes baseline observations prior to dumping, experiments during dumping, and long-term field and laboratory observations. This program is also laying the groundwork for determining the changes in the marine ecosystem following cessation of sludge dumping at the recently deactivated Philadelphia dumpsite. However, additional information is needed to describe changes that occur in an ecosystem after dumping is stopped and to determine the impacts on the immediate dumping area and how far from the dumping site impacts occur. It is necessary to understand these effects to evaluate the implications of sewage sludge disposal.

Radioactive waste disposal

Disposal of radioactive wastes may pose environmental problems and a threat to human health. Safe disposal of wastes produced by the nuclear power industry is a factor affecting the industry's growth. A thorough understanding of the fate and effects of these materials in the marine environment is required to evaluate radioactive waste disposal options. The issue of radioactive waste disposal in the oceans includes both the disposal of low-level wastes and the seabed implacement of highlevel wastes. It is estimated that about $2 million or 1% of the total Federal marine pollution expenditure was devoted to research on radioactive waste disposal in FY 1981.

The following research areas are adequately addressed by ongoing programs:

- Environmental Risks of Subseabed Disposal of High-Level Radioactive Wastes -- Although subseabed disposal of high-level radioactive waste would not occur, at the earliest, until after 1995, decisions about whether to use this option will be made much earlier. Basic information is needed on the stability of deep-sea sediments when exposed to different temperature conditions that might exist in the vicinity of high-level waste disposal canisters. Information on sediment characteristics is also essential in order to evaluate different emplacement technologies. A better understanding of the advection and diffusion characteristics of deep ocean waters and the migratory patterns of deep-sea animals is important for identifying potential pathways of radioactive material back to man. Future activities should include the charting of the ocean floors at

and in the vicinity of potential disposal areas, reviewing data and analyses of sediment samples to assure that the sediments are effective barriers for confinement of the waste materials, and assessing the data on biological communities at the proposed disposal sites.

- Effects at Disposal Sites for Low-Level Wastes -- The EPA supports research to evaluate problems and limitations associated with ocean disposal as one alternative in a low-level radioactive waste management program. The objectives of the program are to determine the fate and behavior of the radioactive waste packages that were dumped in the Pacific and Atlantic Oceans between 1946 and 1970 so that predictions of future environmental impact can be made if use of the ocean disposal alternative is again contemplated.

- Management of Low-Level Wastes -- The EPA's Dumpsite Evaluation Program is considering sites for potential marine disposal of low-level wastes. Previously used radioactive dumpsites have been surveyed to assist in developing criteria for selection of potential disposal sites and for the development of practices for monitoring future dumpsites.

Brine disposal

A concentrated brine solution is produced during the development and operation of salt dome storage cavities associated with the Strategic Petroleum Reserve Program (SPRO). Mandated by the Energy Policy and Conservation Act of 1975, SPRO is intended to protect the United States from severe disruptions in the world oil supply by stockpiling crude oil. About $6 million was expended on brine disposal research during FY 1981.

The following area is considered to be of lesser importance in the context of national needs:

- Environmental Effects of Brine Disposal -- Substantial research and monitoring has been conducted over the past 5 years to assess the effects of brine disposal in the Gulf of Mexico.

The interagency program funded by DOE has adequately addressed the needs related to environmental implications of brine disposal. Results of these studies appear to justify a reduction in the intensity of effort in this area; information needs have been met.

Marine Mining

Many types of mineral resources are found in the oceans, and on or beneath the sea floor. At present, the most significant mineral

resources extracted from the continental shelf are offshore oil and gas. Funding in the Marine Mining area is dominated by Department of Interior expenditures in support of outer continental shelf oil and gas leasing programs. Sand, gravel, and shell mining, and deep seabed mining are of lesser environmental importance and receive lower funding levels for pollution research, development, and monitoring.

Oil and gas extraction

In 1980, offshore oil and gas production amounted to 8% and 23%, respectively, of total domestic production. More than 17,000 wells have been drilled on the Outer Continental Shelf (OCS), and 3,600 leases, totaling almost 18 million acres, have been issued. At the end of 1980, there were more than 2,200 active leases covering almost 11 million acres. Less than 15% of the potentially productive area of the OCS has been leased. The Department of the Interior estimates that between 10 and 50 billion barrels of oil and 40 to 180 trillion cubic feet of natural gas remain to be discovered and produced on the OCS, to a water depth of 200 meters. As the search for new sources moves into deeper waters and more harsh environments, technological capabilities for safe and accident-free exploration and recovery are challenged. In FY 1981, about $45 million or 26% of the total marine pollution expenditure was allocated to offshore oil and gas studies.

The following is an area of high importance that should receive attention in the future:

- Long-Term Effects Study -- A 10-year interagency research program should be planned and implemented to investigate the long-term, low-level adverse effects of OCS and other ocean use activities. This program should be jointly implemented by the Federal Government and private industry as OCS development takes place.

The following are important areas that are adequately addressed by ongoing programs:

- Pre-Lease Studies -- Pre-lease sale information collection is critical to the leasing process, but in the future can be limited to information that is essential for identifying proposed lease sale areas where OCS activities could cause unacceptable impacts to vulnerable resources. These studies should be carried out basinwide with the intent of identifying specific high-risk lease areas.

- Onshore Impacts of Offshore Activities -- BLM devotes about 5% of its Environmental Studies Program budget to studies of the various social and economic impacts resulting from OCS activities. This allocation is considered appropriate in the

context of national needs and problems; it is recommended that the program continue in the future and focus on the most severe socioeconomic effects.

Sand, gravel, and shell mining

Requirements for sand, gravel, and shell are expected to increase in the future, at least doubling by the year 2000. Deposits in coastal areas may contribute proportionately more to the total requirement as terrestrial deposits are depleted or become inaccessible through competition with other land use options, and as a result of environmental problems associated with terrestrial mining. Some analysts predict that sand and gravel mining will move into deeper waters, probably on the Atlantic continental shelf, within 5 to 10 years. In FY 1981, about $420,000 was expended for studies of sand, gravel, and shell mining.

Needs related to sand, gravel, and shell mining in the following areas are considered to be of lesser importance in the context of national marine pollution concerns:

- Immediate and Long-Term Effects -- Studies of the various environmental implications of sand, gravel, and shell mining.
- Management of Mining Operations -- Studies to provide information on dredging techniques and other management options.

In general, past and continuing research programs adequately address the needs in this area and the current level of effort is appropriate. However, as leasing activities move offshore, additional research efforts may be required.

Deep-seabed mining

Manganese nodules are fist-sized lumps of minerals found on the floors of all oceans and in some lakes. Deep seabed mining involves recovering these nodules and processing them to extract the minerals they contain. The economic value of these polymetallic deposits lies in their commercially attractive quantities of copper, cobalt, nickel, and manganese. Worldwide estimates place quantities of manganese nodules between 29.4 and 69.4 billion dry tons.

Environmental studies conducted to date on the impacts of nodule recovery operations have demonstrated that major adverse short-term impacts are not likely to occur. Additional studies in the following areas are of lesser importance in the context of national needs and should be continued in the future at a relatively low intensity:

- Impact of Nodule Recovery -- Further studies on the impact of nodule recovery operations are not planned for the immediate future. They should be considered for implementation in cooperation with industry when the first commercial mining operations begin, probably in 1988.

- Marine Impacts of Waste Disposal from Nodule Processing Operations -- Although mining cannot be initiated prior to 1988, permit applications are expected to be submitted in 1985. Because it takes at least two years to incorporate research results into a regulatory framework, the present research schedule will not allow results of needed studies to be used in formulating regulations for initial permit applications. Given the time-frame within which deep-seabed mining is likely to develop and the nature of other marine pollution problems, however, the planned level of effort is appropriate.

- Stable Reference Areas -- P.L. 95-283 requires negotiation with other deep-seabed-mining nations to establish "stable reference areas" -- areas of the ocean to be set aside where no manganese nodule mining will occur. These areas will provide undisturbed control regions against which the environmental effects of deep-seabed mining can be evaluated in the future. Although this concern is addressed in the five-year research plan, no Federal activities are planned at this time. This position appears to be appropriate, but could be reevaluated during the next Plan period.

Marine Energy

Of the many possible methods for extracting energy from the marine environment, Ocean Thermal Energy Conversion (OTEC) appears to be the most promising at this time. Therefore it is appropriate that nearly all Federal support of ocean pollution studies in the marine energy area was devoted to OTEC during FY 1981. The environmental consequences of OTEC and the other marine energy technologies appear to be minimal, at least during technology development and demonstration periods. Therefore, the entire area of marine energy studies is considered to be of lesser importance in relation to other national needs that must be met within the next five years.

Ocean thermal energy conversion

Ocean Thermal Energy Conversion (OTEC) is a process for extracting the energy stored in warm surface waters of the ocean. The OTEC process functions because of a temperature difference between warm surface waters and cold deep waters. Two OTEC processes -- closed cycle and open cycle -- show potential for being economically and technically

feasible in the near future. Information needs related to OTEC are focused on potential impacts of single OTEC plants and cumulative impacts of multiple OTEC facilities. Neither is considered to be of greatest importance within the context of marine pollution concerns. In FY 1981, about $4.0 million was expended on OTEC environmental studies.

Studies in the following areas are of lesser importance relative to national marine pollution concerns and are most appropriately conducted in the context of private sector development of the technology.

- Impacts From Single OTEC Plants -- As the industry develops, studies in the following areas may be required: entrainment and impingement, attraction and avoidance responses, biocide discharges, redistribution of deep waters, socioeconomic onshore effects, and effects of seafloor cables and pipelines.

- Cumulative OTEC Impacts -- Additional work remains to be done to assess the questions regarding large-scale cumulative impacts of commercial OTEC development. This work should estimate the cumulative effects on (1) oceanic physical properties (especially concentrations of nutrients and toxic substances), (2) biological properties (especially production and ecosystem integrity with special emphasis on the longterm risk to fisheries), and (3) climate of specific regions as well as the global climate.

Other energy technologies

A number of novel technologies have been proposed for extracting energy from the oceans (e.g., tidal energy, wave energy). If these technologies are implemented in the future, they will require environmental studies.

The environmental research needs associated with these technologies are of lesser importance in the context of national marine pollution concerns. Environmental studies will probably not be required within the period of time covered by this Plan.

Marine Transportation

Vessel sizes and designs are as varied as their functions. They range from small recreational craft used primarily in coastal waters to naval vessels used for national defense and the ships of the merchant marine fleet, which range in size up to several hundred thousand tons. Pollution from marine transportation is significant in certain situations, but the problems are well known, and for the most part, work toward their solution is well under way.

Studies on the environmental implications of marine transportation are adequately addressed by ongoing programs in the following areas:

- Implications of Routine Operational Discharges -- The maritime industry has developed solutions to the problems of waste from ships. Attempts are being made to refine these solutions and to provide more cost-effective alternatives. A real need from an enforcement perspective is for further research to improve enforcement schemes and to ensure effective use of the devices already available.

- Marine Transportation Patterns for Hazardous Materials -- Several Coast Guard programs indirectly contribute information to this problem area. The Pollution Incident Reporting System (PIRS) and Hazard Assessment Computer System (HACS) are discussed in detail in the section on accidental spills. The Coast Guard has examined the cost of consolidating and evaluating the available incomplete data, and determined that the benefit derived from such a project would not justify its cost. Consequently, no programs are planned to address this problem. In light of the increasing concern for hazardous materials in the environment, however, the costs and benefits of initiating a program in this area should be reevaluated.

- Offshore Crude Oil Terminals -- Regulations regarding the establishment of offshore terminals have been issued under the Deepwater Ports Act. The economics of offshore terminals have been thoroughly explored at the generic level. The remaining need is for site-specific, cost-risk/benefit analyses of offshore terminals on a case-by-case basis.

- OCS-Related Marine Transport -- Oil can be transported from offshore production areas to shore facilities by pipeline, tanker, or barge. The most appropriate transfer system for a particular well site is determined by a combination of economic and environmental concerns. Many types of vessels and transport systems can be involved in transport of oil from OCS production facilities. Loading-terminal spill records could be gathered and evaluated in order to identify preferred systems for different OCS situations.

Current funding levels for marine transportation studies are appropriate in the context of national marine pollution concerns.

Accidental Discharges of Oil and Hazardous Materials

Substantial amounts of oil and hazardous materials enter the marine environment as a result of accidental spills. Although the

focus in the past has been on the cleanup and mitigation of spilled oil, national concern has been shifting toward hazardous materials as the cause for most immediate concern. Much has been learned in the past 10 years about how to respond to oil spills, but far less is known for spills of hazardous materials. Unlike oil, whose properties are relatively uniform, hazardous materials have a wide variety of physical and chemical forms, complicating the response necessary for their cleanup and disposal. Methods for the cleanup and for mitigation of hazardous materials effects need further development. In FY 1981, approximately $8.6 million was expended on studies related to accidental discharge of oil and hazardous materials.

Spill containment and cleanup technology for oil in temperate climates now approaches the limits of technology. However, improvement is needed, particularly for response to oil spills in cold water and ice-covered areas. The interagency program for development of spill response technology is recognized as a highly productive effort. The Coast Guard, EPA, and other interested agencies have successfully coordinated their planning and resources to develop specialized hardware and methodologies for the cleanup of spills. No further actions toward coordination of this program are required by COPRDM. However, development of cleanup capabilities for hazardous materials should continue. Long-term effects of oil and hazardous materials spills are not well understood.

The following areas are addressed by ongoing programs but are of continuing importance and should receive emphasis in the future:

- Prevention, Containment, and Cleanup of Spilled Materials -- Prevention methods for reducing spills from transportation sources other than vessels should be developed as should methods for dealing with packaged and bulk hazardous materials cargo. Capabilities for prevention and cleanup in arctic waters need to be improved. Information on the use of chemical treatment for cleanup should be made available.

- Spill Response Capabilities and Contingency Plans -- To support response activities, information is needed on behavior of spilled hazardous materials, spill trajectory models, fate of spilled materials in ice-covered areas, recovery rates for impacted arctic areas, and identification of biologically sensitive areas.

- Environmental Impacts of Accidental Discharges -- Impacts of spilled materials on marine ecosystems should be assessed with particular emphasis on hazardous materials and long-term effects. In addition, selected studies are needed to define the scientific and technical aspects of damage assessment.

Coastal Land Use

Land use patterns and activities carried out in coastal areas can severely affect coastal and marine ecosystems. The effects of coastal facilities and the implications of nonpoint source pollution are two important areas that deserve thorough study. In addition, the effects to the marine environment of increasing coal use and export may become much more important in the future. The effects of single actions are largely the concern of State and local governments and studies in this area should be supported by them. However, cumulative aspects of coastal land use impacts are of high importance in the context of national needs.

Siting, construction, and operation of coastal facilities

Ports, power plants, sewage treatment facilities, refineries, seafood and lumber processing plants, and many other industries tend to be concentrated in coastal areas because they are dependent on marine transport, large volumes of cooling water, living marine resources, or use of oceans or lakes for waste disposal. Any of these facilities or land use patterns can have detrimental effects on sensitive coastal ecosystems, and the combined effects of several different types of facilities can be substantial. In FY 1981, it is estimated that $10 million was expended on studies related to the environmental implications of facilities in coastal areas.

The following area is addressed by ongoing programs but is of continuing importance and should receive emphasis in the future:

- Importance of Habitat Alteration -- The loss and alterations of critical habitats is the most important concern associated with the construction and operation of coastal facilities. Additional information is needed on the extent and rate of habitat modification, and on its significance to commercial and recreational species and environmental quality in general. Habitat loss should be documented and monitored at the regional and national level, the significance of habitat loss should be determined in terms of effects on fisheries stocks, and costs and benefits of restoration should be evaluated.

The following areas are of lesser importance in the context of national marine pollution concerns and should be supported at a modest level:

- Effects of Coastal Facilities -- The issues that have been identified for future research effort include energy facility siting (OCS leasing and development refineries, coal ports, power plants), canal dredging in wetlands, effects of freshwater diversion from rivers and estuaries, and studies of the

effects of timber harvesting on anadromous fisheries resources and their habitats in the Northwest and Alaska. These needs are now addressed by research and permitting programs conducted by NRC, EPA, NOAA, and DOE. Ongoing Federal programs can adequately fulfill these requirements, although relatively minor alterations in planned activities may be required within existing programs.

- Evaluation of Entrainment and Impingement -- Many data have been gathered and published on numbers and species of organisms that are affected by power plant cooling system entrainment and impingement. However, it is extremely difficult to evaluate these data in terms of net effects on fishery stocks. It is recommended that future research focus on entrainment and impingement mortality data as related to effects on fishery stocks, population modeling (including the phenomenon of compensation), the significance of sublethal effects resulting from entrainment and impingement, and regional cumulative effects of entrainment and impingement.

Nonpoint source pollution

Nonpoint source pollution is among the most difficult problems to address both from a scientific and a pollution management perspective. Reliable information is needed on the extent of nonpoint source pollution entering coastal marine areas and the Great Lakes. In FY 1981, approximately $15 million was expended on studies of nonpoint source pollution in coastal areas.

The following is an area of continuing concern that can be adequately addressed by ongoing programs:

- Assessing Sources and Fates -- Accurate information on all pollution inputs, including important nonpoint sources, is critical to regulatory evaluation of proposals for ocean disposal of wastes. Assessments are required to quantify amounts and rates of pollutant inputs. Chemical behavior, fates, and effects in the environment must also be determined. A continuing effort is required to quantify the amount and rates of input from nonpoint pollution such as biocides, nutrients, metals, and toxic organics. Primary emphasis should be placed on agricultural sources and urban runoff by applying a regional approach. Management and control of nonpoint source pollution is a state and local responsibility.

Increased use of coal

In the next 20 years, domestic coal use and steam coal export from the United States are expected to increase. Because of the diversity

of the issues related to coal use and export, no single Federal agency is responsible for regulating or researching all aspects of coal use that affect the marine environment. Therefore, it is desirable that interagency coordination and communication be promoted to ensure that sufficient research is conducted to provide the proper information required to assess and predict the implications to the marine environment of coal policies and coal use programs. In FY 1981, it is estimated that about $700,000 was expended to explore the implications of coal use and export to marine resources.

It is recommended that DOE, EPA, NOAA, the Corps of Engineers, and DOI work together using existing resources to compile and evaluate information already available on marine environmental implications of coal use and export.

The following areas associated with the marine pollution aspects of increasing coal use are of lesser importance in the context of national problems, and can be adequately addressed through improved interagency coordination of ongoing programs:

- Ocean Disposal of Coal Waste -- The information now available on coal waste disposal provides an inadequate basis for developing policies and management plans to deal with the huge volumes of coal waste that may be generated in the next 10 to 20 years.

- Primary and Secondary Impacts of Coal Export -- The direct impacts of increased coal export include the effects of fugitive dust and runoff from coal stored and loaded in coastal areas prior to export. An important secondary effect results from the harbor deepening and port improvements that will be needed to allow the use of larger, more cost- and fuel-efficient ships. The material dredged to enlarge or deepen channels must be disposed of, probably in the marine environment. Another implication associated with general enlargement and improvement of ports is habitat disruption or loss in coastal areas. If coal is transported to a port through a pipeline as a slurry, the discharge of slurry transport water may cause environmental impacts. Enlargement of ports and increases in shipping activity may elevate the risk of collision involving tankers carrying oil or hazardous materials. Available information could be synthesized to describe implications of coal export policy to the marine environment.

- Effects of Coal Power Plant Air Emissions -- Most of the increase in coal consumption in the United States will result from a proliferation of coal-powered electrical generating plants. Acid rain, which affects freshwater ecosystems, has recently been identified as a possible consequence of burning high-sulfur coal. In addition, polynuclear aromatic hydrocarbons

may condense on particulates emitted from coal-powered plants. More information is needed on the effects of these emissions, especially in the Great Lakes, which are freshwater and lack the pH buffering capacity of seawater. The U.S.-Canada agreement provides a good framework for assessing the implications of the acid rain phenomenon. Efforts are now under way to coordinate NOAA, EPA, and DOE research activities with conclusions drawn from the U.S.-Canada study through the Acid Rain Task Force.

Ocean Pollution Evaluation

A substantial portion of the Program is directed at studies that are not specific to a single pollution source, but rather address the effects on marine organisms and human receptors. This category includes studies on environmental quality criteria, natural variability in marine ecosystems, acute and sublethal effects of pollutants on selected organisms, cumulative and interactive effects, simulation models, and region-specific studies of pollution from all sources. In FY 1981, about $47.6 million or 28% of the total Federal expenditure in ocean pollution research, development, and monitoring was identified as contributing to this area.

Ocean Pollution Assessment studies are essential to understanding and predicting the impacts of pollution from all sources. These studies provide a broader perspective than source-specific studies alone. Because of the many different subject areas addressed within this category, the Federal effort, when viewed as a whole, appears more diffuse and complex than is the case in source-specific categories. This should not be interpreted as a criticism of individual programs, because the complexity results from the nature of the category and the system used to create it. It is recommended that a thorough examination of this portion of the program be undertaken by the Interagency Committee to identify opportunities for improved interagency coordination in support of the national program.

Information Collection and Interpretation

The final program area discussed here is not actually a field of research, but consists of the important support activities common to all of the other areas. The National Marine Pollution Program relies on the following three types of support activities: data management, synthesis, and distribution; quality assurance; and development of measurement methodologies. In combination, these support elements ensure that research results are accurate and reliable, made available in useful forms, and obtained by applying standardized state-of-the-art methods. It is estimated that in FY 1981 about $11 million or 7% of the total Federal expenditure was devoted exclusively to this area.

The following recommendations are based on a review of these support activities:

- Data management, synthesis, and distribution -- Existing programs should shift emphasis from functions supporting data collection and manipulation to functions generating synthesized information products. The Interagency Committee should form a working group to coordinate and make recommendations for implementing a responsive program in this area.

- Quality assurance -- A high-level policy commitment is made by all participating agencies to ensure that appropriate quality assurance programs appear as discrete elements in all marine pollution programs. Future program evaluations sponsored by the Interagency Committee should explicitly include assessments of associated quality assurance programs. NOAA should work with the National Bureau of Standards and EPA to ensure the availability of service mechanisms and quality assurance tools for the marine environment.

- Measurement methodologies -- Many existing measurement methodologies and techniques must be improved to make them more reliable, cost effective, and able to produce information more representative of conditions they are intended to measure. Development of new and better methodologies must be continued for meeting the challenges of current and planned programs.

CONCLUSIONS

This Plan is the result of an extensive interagency effort to improve the Federal program for ocean pollution research, development, and monitoring. The Plan discusses information needs and research programs, and makes suggestions for improving the efficiency and effectiveness of the National Program. Authority for allocation of funds is not linked directly to the Plan, which is intended primarily as a means for coordinating research activities between agencies. Conclusions, observations, and recommendations that pertain to various aspects of the continuing planning process follow:

1) Value of the Planning Process -- The activities required to prepare the Plan have caused Federal program managers to learn more about ocean pollution research, development, and monitoring activities within their own agencies as well as in other Federal agencies. The requirement to examine and plan ocean pollution activities has been a useful exercise for the agencies. An important result of the planning process is improved interagency coordination at the working level.

2) Improvement of the Planning Process -- On the basis of experience gained in preparing and producing the Second Federal Plan, several recommendations can be made for improving the planning process in the future.

- The interim between Federal Plans should be increased to four years with the additional time between Plans devoted to implementing recommendations.

- The Petroleum Review was valuable in providing a detailed evaluation of a major portion of the program. There is a need for closer evaluation of other portions of the Program. It is recommended that either the waste disposal or ocean pollution evaluation areas be addressed prior to publication of the next Plan.

- Agency Program Summaries (Appendix 1) should be updated on an annual basis to reflect significant changes.

- The Catalog of Federal Projects (Appendix 2) should be updated each year. A simpler technique for collecting information from principal investigators should be developed.

- Federal departments and individual agencies involved in the program should (1) assure that agency plans and activities are, to the maximum extent practicable, consistent with the Federal Plan, and (2) cooperate with the Chairman of the Interagency Committee in developing a coordinated budget review process, as required by the Act.

- The National Marine Pollution Program Office, as support staff for the Interagency Committee on Ocean Pollution Research, Development, and Monitoring, will continue to work with agencies to promote the implementation of Plan recommendations. Major agencies in the program are encouraged to provide, on a short-term basis, staff specifically assigned to assist in interagency coordination and planning.

I. The National Marine Pollution Program

Many challenges test the resourcefulness and ingenuity of this nation as it enters the last two decades of the twentieth century. Among the most demanding is the responsibility for using natural resources to the maximum benefit of the national economy while protecting and conserving the qualities of the environment that assure a continuing supply of renewable resources for the future and a healthy and high quality existence for mankind. The balance between use and protection is a challenge that can be met only through careful management based upon the best information possible.

The National Marine Pollution Program is the collective Federal effort for ensuring that research, development, and monitoring activities related to marine pollution are carried out efficiently and effectively. The Program includes coastal areas, estuaries, open oceans, and the Great Lakes. This Plan represents the second biennial milestone in the continuing interagency planning process called for by the National Ocean Pollution Planning Act of 1978. It summarizes accomplishments that have occurred since the first Federal Plan was published in the fall of 1979, describes priorities of future pollution activities and presents a strategy for improving the National Program. In summary, the Plan presents a strategy for acquiring, interpreting, and distributing information that can be used in making decisions on the management and conservation of marine resources.

RESOURCES AT STAKE

Ocean resources are valuable and varied, and in many instances we have realized only a fraction of their available potential. The catch of shellfish and fin fish in the United States during 1980 was nearly 4 billion pounds, valued at $2.2 billion. Yet this was only 46% of the total amount of fisheries products consumed in the United States; about 13 pounds of fish per person is imported each year.

Offshore deposits of oil and gas are another important ocean resource. Technology now exists to extract domestic oil and gas from subaqueous deposits on the continental shelf. Petroleum hydrocarbons taken from the U.S. shelf in 1979 amounted to 285 million barrels of oil and 4.6 trillion cubic feet of natural gas, 9% and 24%, respectively, of total domestic production. It is estimated that as much as 44 billion barrels of oil and 230 trillion cubic feet of gas remain in reserve on the outer continental shelf.

The capacity of the oceans to assimilate wastes is a valuable resource that could be used to the extent that dumping does not unduly affect the use of the oceans for other purposes. In some cases, the oceans provide an attractive option for the disposal of wastes. In 1979, 72 million tons of dredged material and 8.6 million tons of various types of industrial and municipal wastes were dumped into U.S. oceans. Recreational use of the coast and oceans is another resource. About 40% of the total U.S. population lives within easy driving distance of the oceans or Great Lakes. It is estimated that more than $4 billion is spent annually on ocean-related recreational activities in the United States. In many coastal resort areas seasonal expenditures by vacationers form the only economic base for small businesses.

Sea floor mineral deposits are an ocean resource of growing importance. Manganese nodules on the deep-sea floor contain nickel, copper, cobalt, and various other metals as well as manganese; polymetallic deposits on the midocean ridges are just now being explored. Large quantities of some of these metals, which are essential to U.S. industry, are currently imported from foreign countries. Reliance on potentially unstable areas of the world for key materials is a national security concern that could be reduced or eliminated by stockpiling minerals obtained through mining the deep seabed.

The Great Lakes serve as the primary source of drinking water for the nearly 50 million people living in the region. The oceans and lakes also provide media for shipping, sources of process or cooling waters for industry, potential thermal energy resources, and buffers essential for national defense. The ocean abounds with resources; only the most obvious have been touched on in this discussion. Others almost certainly remain to be discovered and explored.

NATIONAL GOALS AND PROGRAM OBJECTIVES

This document presents a strategy for the National Marine Pollution Program to meet the challenges of the 1980's. The goals originally presented in the first Plan have been revised; new goals and objectives have been adopted to focus the program more directly on applying

marine science information to the solution or avoidance of marine pollution problems. These goals and objectives expand on those in the first Plan by reflecting the perspectives and information needs of the policymaker, resource manager, and regulator.

As a result of the many and diverse possible uses of the ocean, it is inevitable that conflicts will arise among users. In many instances, ocean uses are in direct conflict, and competition for priority access to the oceans occurs in a political forum. Three broad policy goals form a basis for resolving these conflicts:

1) Ocean Resource Use Policy -- Encourage the use of the oceans, estuaries, and Great Lakes as sources of food, energy, and minerals, and as a maritime medium in such a way that no significant impact to human health, productivity, or aesthetic quality results.

2) Ocean Waste Disposal Policy -- Consider, along with other options, the use of the oceans, estuaries, and Great Lakes as repositories for the disposal of waste material and thermal energy when it is determined that no significant impact to human health, productivity, or aesthetic quality would result.

3) Ocean Conservation Policy -- Preserve and enhance the productivity and aesthetic quality of the oceans, estuaries, and Great Lakes.

The role of the National Marine Pollution Program is to facilitate the pursuit of these policy goals through the planning and conduct of Federal research, development, and monitoring activities. The role of the National Marine Pollution Program is to ensure that individual agency programs, when thoughtfully planned and carried out, do more than fulfill agency requirements. Many Federal departments and agencies are engaged in marine pollution studies -- each to fulfill requirements for specific missions and obligations. Programmatic decisions within each agency are made through competition among many priority areas, and research programs must be related to agency missions. This Plan is not intended to override or interfere with the responsibilities and mandates of individual agencies; it is intended to assure that the combination of separate agency programs also addresses the more encompassing national needs. By assuring that important research areas are not overlooked because they fall between agency jurisdictions, and that related programs are carried out cooperatively and without duplication, a more responsive and efficient program can be achieved.

The following objectives have been used as a basis for planning the National Marine Pollution Program:

- Effects of Ocean Use -- Evaluate the effects of ongoing and proposed activities for mineral and energy extraction, food production, and maritime transportation on human health, productivity, and aesthetic quality of the oceans, estuaries, and Great Lakes.

- Waste Disposal Management -- Assess the quantities of waste materials that might be disposed of in ocean, estuarine, and Great Lakes waters with no significant impact to human health, productivity, or aesthetic quality.

- Strategic Assessments -- Assess periodically, at the regional and national level, the status and trends of source loadings, ambient levels, and biological accumulations of critical pollutants in ocean, estuarine, and Great Lakes environments.

- Habitat Protection Research -- Identify and study the critical habitats of commercial and recreational marine species as they are affected by pollutants and physical disruption that would significantly reduce productivity and aesthetic quality.

- Spill Response and Assessment -- Support efforts to prevent, mitigate, and assess the effects of accidental releases of hazardous substances into the oceans, estuaries, and Great Lakes.

In setting priorities to which the National Marine Pollution Program should be responsive, the following theme must be kept in mind: use and protection goals for ocean resources must be achieved in an economically sensible manner. They must be approached through the implementation of policies and regulations whose costs do not outweigh their benefits. In the past, strict regulatory protection of the oceans has been developed on the grounds that risk to ocean ecosystems should be minimized. After 10 years of this approach, it has become apparent that the legislative quest to reduce risk to the oceans must be balanced by consideration of the risks to terrestrial, freshwater, and atmospheric environments, and economic and social costs. Although political viewpoints and public perceptions change through time, the basis for a conservative and protective approach to ocean use remains constant and valid. Ocean resources must be protected for both economic and environmental reasons. In very general terms, the objective of ocean resource management is to draw the regulatory line at a point where the maximum use of the ocean is allowed while all ocean resources remain protected. The precise position of this regulatory line will be influenced by special interests, public attitudes, political negotiation, and findings of scientific research. Ocean research can also be used to identify unnecessary or unjustifiably restrictive regulations.

PROGRESS SINCE THE FIRST PLAN

Eleven Federal agencies are involved in ocean pollution research, technology development, and monitoring, and in FY 1978, approximately $165 million was spent on nearly 1,000 individual projects. The most important accomplishment of the First Federal Plan was to describe, for the first time, all ocean pollution research, development, and monitoring activities supported by the Federal Government and to recognize the breadth of problems that these activities addressed. In addition, the first Plan organized this information into a framework identifying common problems addressed by many different activities.

The first Plan identified the following areas as requiring additional emphasis in pollution research and monitoring:

1) Effects on human health.
2) Effects on living resources.
3) Effects on recreational resources.
4) Coastal land use practices.
5) Municipal sewage outfalls.
6) Industrial waste disposal.
7) OCS oil and gas development.
8) Spill cleanup and response.

Studies were initiated in specific response to these needs, and many have been supported by funds appropriated under the National Marine Pollution Planning Act. These key initiatives are now under way:

- Studies to determine the fates and effects of trace metals, organometallics, and synthetic organics and to address problems related to human health and industrial waste disposal.

- Studies to better define marine ecosystem structure and the effects of chronic pollution on marine populations (for example, striped bass in San Francisco Bay). In particular, one study will examine the long-term effects of contaminants on the Gulf of Mexico ecosystem.

- Studies and surveys to evaluate the effects of coastal land use practices on estuarine and coastal marine areas. A particularly important initiative has been the strategic assessment program initiated by NOAA to map and model coastal pollution sources and differing land use practices, to allow evaluation of the effects of point and nonpoint effluents and facility siting on marine ecosystems.

- Studies to assess the effects of municipal waste outfalls.

- Examination of the effects of industrial waste disposal on the role of dissolved and particulate organic material in the fate of toxic heavy metals and organic compounds and of the transport and fates of PCBs in the Great Lakes and the Hudson River.

- Studies on the effects of OCS oil and gas development including the effects on arctic and subarctic marine species.

- Assessment of the IXTOC oil spill in the Bay of Campeche and damage related to the spill cleanup and response operations, to obtain important information on spill impact and recovery.

In spite of these and other recent initiatives, many of the needs identified in the first Plan still exist and appear as priority issues in this Plan.

To assure that overlap and duplication were avoided, the first Plan recommended evaluating activities in six areas where interagency involvement was substantial:

Area 1) Studies related to petroleum and petroleum products.

Area 2) Studies to define environmental baselines and pollutant distribution.

Area 3) Studies of fates and effects of hazardous materials, particularly persistent synthetic organics.

Area 4) Studies to develop transport models including airborne transport of pollutants into the marine environment.

Area 5) Studies to develop bioassay and microcosm methodologies.

Area 6) Studies to develop standard methodologies for monitoring, data management, and quality assurance.

Federal activities related to petroleum pollution (Area 1) constituted more than one-third of the National Marine Pollution Program budget in FY 1978. A major interagency review of these activities has been carried out (Appendix 3). That review has led to the recommendations that address petroleum pollution in this Plan. Much of the Federal effort related to studies in Areas 2-4 also deals with petroleum pollution problems and was considered in the interagency program review. Reviews of studies to develop bioassay and microcosm methodologies (Area 5) have not taken place but are being considered for 1982. Problems of developing approaches and methodologies for monitoring, data management, and quality assurance were addressed through a series of workshops and interagency working groups and are discussed in Chapter IV.

The first Plan made several managerial and technical recommendations related to research, monitoring, technology development and measurement technology, quality assurance, and data and information coordination and dissemination. Some of the recommendations called for application of broad approaches to planning the future of the National Marine Pollution Program, and others called for relatively specific actions. The broad approaches to research presented in the first Plan are still valid and have been applied, in general, in developing the recommendations in this plan. In addition, specific actions addressing other managerial and technical recommendations of the first Plan are presented in Chapter IV.

As a final set of tasks, the first Plan recommended that NOAA, as lead agency under the National Ocean Pollution Planning Act of 1978, and other Federal agencies accept certain responsibilities for implementing an effective interagency planning process and for conducting a well-coordinated National Marine Pollution Program. In response, NOAA established a separate office -- the National Marine Pollution Program Office -- within the Office of the Administrator to serve as an interagency focal point for the planning process and to coordinate implementation of Plan recommendations.

The Office of Marine Pollution Assessment under NOAA's Assistant Administrator for Research and Development has made substantial progress in developing the comprehensive ocean pollution program called for by Section 5 of the National Marine Pollution Planning Act and in implementing programs to fill gaps as provided for by Section 6.

The Environmental Data and Information Service (EDIS) under NOAA's Assistant Administrator for Oceanic and Atmospheric Services is implementing an improved process for disseminating marine pollution information in a timely manner and useful formats, as called for by Section 8 of the Act. EDIS convened a Workshop in January 1981 on Marine Pollution Information Management to further develop recommendations in the First Federal Plan. The Ocean Pollution Data and Information Network (OPDIN) was implemented in May 1981 with the establishment of the Central Coordination and Referral Office within the National Oceanographic Data Center. This office has arranged an in-depth review of Federal data and information systems and for the design and development of the information network. In addition, the Catalog of Federal Projects (Appendix 2) has been updated since the first Federal Plan, to provide information on current and planned projects for FY 1979, FY 1980, and FY 1981. The data on which the Catalog is based are now computer-accessible through the National Marine Pollution Information System which is maintained and operated by EDIS.

The Interagency Committee on Ocean Pollution Research, Development, and Monitoring (the Interagency Committee), under the auspices of the

Federal Coordinating Council for Science, Engineering, and Technology, has proved to be an effective mechanism for coordinating, at the policy level, the Federal effort in ocean pollution. A significant dialog has developed among program managers on the scope and direction of individual agency efforts and the need for improved cooperation among agencies that are conducting studies in related areas.

THE PLANNING PROCESS

This Plan is a strategic document; it identifies scientific and technical information needed to address marine pollution issues and indicates which information needs are of the highest priority. In many cases the Plan also recommends which Federal agency or group of agencies would be most appropriate to help fill information gaps and improve program efficiency over the Plan period. Implementation of recommendations is dependent on availability of resources within participating agencies. The Interagency Committee took a number of steps to improve the planning process after publication of the first Federal Plan. Building upon the first Plan, a comprehensive review of national needs and problems was undertaken. This review was initiated with a series of five regional conferences where representatives of Federal, State, and local governments, industry, academia, and public interest groups met to identify major marine pollution problems and the information required to better assess and mitigate the problems. In each region, a consensus was reached on highest priority needs. The conference reports provide a broad appraisal of marine pollution issues and information needs from a regional perspective (see inside back cover). All Federal agencies participating in the National Marine Pollution Program have prepared five-year program summaries that identify agency missions and goals and provide detailed information on accomplishments, milestones, and budget estimates for each program (Appendix 1).* These agency program summaries identify marine pollution problems and information needs from the Federal perspective. The regional conference reports and Federal agency program summaries were used by the Interagency Task Force in identifying the information needs and priorities presented in this Plan.

As part of the planning process, special activities have also been carried out since the first Plan. They include preparation of a catalog of research projects funded by agencies during FY 1980 - 1981 (Appendix 2), a review of oil pollution programs (Appendix 3), a series of monitoring workshops (References R-1 through R-7, and Working Paper 7), and an interagency review of quality assurance problems (Reference R-9). In addition, a summary of non-Federally funded ocean pollution studies in each region has been prepared and is published as an annex to each regional report.

*Appendix 1 is undergoing revision to reflect recent budget changes and will be released after completion of changes.

The data used in preparing this document were collected in 1980 and early 1981 prior to the Administration's efforts toward national economic recovery. At that time, the interagency planning group identified priority problem areas requiring continuing emphasis, reviewed agency program objectives, milestones, and budget targets, and recommended actions for improving the program. Since that time, a comprehensive review of Federal agency programs and budgets has been under way to reduce Federal spending. As policies toward economic recovery are implemented the National Marine Pollution Program will change accordingly. Therefore, this Plan does not contain information on agency programs and budgets after FY 1981. A supplement to this plan will be prepared as revised agency programs and budgets become available.

This Plan provides general guidance, identifies opportunities for interagency collaboration and cooperation, and points out research areas that are worthy of special attention. More specifically the Plan does the following:

- Describes Federal activities addressing the following areas of concern in marine pollution:
    - Marine Waste Disposal
    - Marine Mining
    - Marine Energy
    - Marine Transportation
    - Accidental Discharge
    - Coastal Land Use
    - Ocean Pollution Evaluation
- Within areas of concern, identifies research topics that require additional effort, and those that have been adequately addressed.
- Describes the relative importance of research in each area of concern by discussing existing information gaps, potential severity of the pollution problem, and Federally mandated functions.
- Presents specific recommendations for improving the program by redirecting resources toward the most productive and important areas; improving interagency coordination, or anticipating future problems.
- Presents priorities for action on which NMPPO will focus to coordinate implementation of activities designed to address current problems and anticipate emerging pollution issues.

As a strategy document, the Plan is not intended to provide a detailed tactical implementation scheme. It is primarily the responsibility of the individual agencies in the National Marine Pollution Program to execute the recommendations offered in the Plan. The National Marine Pollution Program Office acting on behalf of the Interagency Committee carries out the necessary staff work to ensure that actions follow the general guidance provided by the Plan.

SETTING NATIONAL PRIORITIES

All Federal agencies and departments set priorities for programs and budgets based upon their legislative mandates, executive branch policies and agency-specific missions. Programmatic decisions and priorities are made through a process of competition and trade-offs between many important and priority interests. Priorities reflected in this Plan result from a process that is very different from that used by individual agencies. Within this Plan, priorities are identified from the marine pollution perspective, which cuts across all agency interests and responsibilities. Recommendations in the Plan must be and are consistent with agency mandates; however, they are drafted within a broader context defined by marine pollution concerns. For example, the National Marine Pollution Program may place a fairly low priority on studies of the effects of brine disposal in the Gulf of Mexico because the problem is of relatively low significance when compared with other marine pollution problems. It is not inconsistent for the Department of Energy, however, in an attempt to complete the Strategic Petroleum Reserve as an essential element leading to the goal of energy independence for the nation, to place a much higher priority on brine studies since they are required to support environmental impact statements, which are necessary to keep the Strategic Petroleum Reserve Program moving ahead. The real challenge in drafting recomendations for the Plan is in balancing such competing interests to assure a National Marine Pollution Program that is more effective and responsive to the national need than are the separate programs of the participating agencies.

The relative importance of information needs for marine pollution was determined through a multistep process. First, criteria were established for weighing the importance of specific research or information needs. Subsequent judgments on priorities were made on the basis of these criteria:

1) Immediacy of pollution threat.
2) Value of polluting activity to the nation.
3) Intensity and extent of the polluting activity.
4) Value of the resources at risk.
5) Amount of useful information already available.
6) Relevance to agency/departmental mission.

7) Time frame in which information is required for decisionmaking.
8) Utility of information in preventing future pollution problems.

As a second step, five regional conferences were held to identify regional pollution concerns and key research and information needs as perceived by representatives from each region. Results of the conferences are summarized in Chapter IV, and presented in detail in conference reports (see inside back cover).

Members of the Interagency Task Force considered the needs and priorities identified through the regional conferences in light of their own agency perspectives and the results of reviews and working groups sponsored by the Interagency Committee. The result of the Task Force interaction is the needs and priorities as they appear in the Plan. The needs are presented in Chapter II, and priorities are addressed within the discussion of National Marine Pollution Concerns.

The most significant recommendations for improving the Federal effort appear in Chapter V. These recommendations involve the programs of several agencies. They require commitment to new directions for research, anticipation of upcoming problems, or cooperation among several agency programs. The recommendations suggest courses of action to be followed by specific agencies and, where possible, provide timetables for performance. Redirection of existing funds within an agency will allow implementation of these recommendations.

FEDERAL EXPENDITURES IN OCEAN POLLUTION RESEARCH, DEVELOPMENT, AND MONITORING

The total Federal expenditure in FY 1981 for ocean pollution research, development, and monitoring studies is estimated to be $172 million. Amounts expended by individual departments and agencies are shown in the table for FY 1978 and FY 1981 (p. 12). The following four agencies accounted for nearly 70% of the total program budget in FY 1981: Bureau of Land Management ($35 million), EPA ($32 million), NOAA ($26 million), and DOE ($23 million). Over a three-year period (FY 1978 to FY 1981), the total Federal expenditures on ocean pollution research, development, and monitoring activities increased about $6 million or 4% of the FY-1978 budget ($164 million).

AGENCY SUMMARIES

The following section is a brief overview of activities conducted by the departments and independent agencies participating in the National Marine Pollution Program. More detailed information on agency programs and activities can be found in Appendix 1.

FUNDING LEVELS FOR DEPARTMENTS AND AGENCIES -- FY 1978 AND FY 1981

Department or Agency	Funding Levels (Thousands of Dollars) FY 1978	FY 1981
Department of Agriculture	$ 115	$ 196
Department of Commerce		
National Oceanic and Atmospheric Administration	17,538	25,740
Department of Defense		
Army Corps of Engineers	2,365	8,491
Navy	6,437	2,750
Department of Energy	15,670	22,736
Department of Health and Human Services		
Food and Drug Administration	2,620	2,670
National Institute of Environmental Health Sciences	1,278	1,886
Department of the Interior		
Bureau of Land Management	37,656	35,368
Fish and Wildlife Service	2,629	2,600
Geological Survey	16,107	13,230
Department of Transportation		
Coast Guard	8,803	3,390
Environmental Protection Agency	34,989	31,700
National Aeronautics and Space Administration	1,750	500
National Science Foundation*	15,134	18,765
Nuclear Regulatory Commission	1,245	1,000
Total	$164,736	$171,022

*The National Science Foundation supports basic research in oceanography some of which is relevant to the goals of the National Marine Pollution Program.

DEPARTMENT OF AGRICULTURE

The United States Department of Agriculture (USDA) conducts research directed toward reducing the detrimental effects of agricultural practices on the quality of the marine environment. The studies include research on pollution problems caused by agricultural runoff, agricultural waste disposal, offsite and downstream effects of sediment, nutrients, and pesticides, transport and transformation of pollutants, and the effects of all these on organisms and ecosystems. USDA's research program was funded for $196,000 and accounted for less than 1% of the total FY-1981 marine pollution funding.

DEPARTMENT OF COMMERCE

The Department of Commerce (DOC) conducts marine pollution research, development, and monitoring through the National Oceanic and Atmospheric Administration (NOAA). Additional support or reimbursable programs are carried out from time to time by the National Bureau of Standards (NBS) and the Maritime Administration (MARAD).

NOAA conducts research on problems caused by polluting activities in the oceans and the Great Lakes. Research is conducted to determine effects of pollutants. The agency also is conducting a program to monitor the waters of the northeast coast and another to monitor the levels of certain contaminants in commercially important species of fish. Other NOAA programs include advancement of ocean engineering technology to support pollution programs, dissemination of marine pollution research information, and promotion of marine research by financial assistance through grants and contracts. NOAA's marine pollution research activities were funded for approximately $26 million during FY 1981 and accounted for 15% of the total marine pollution funding.

DEPARTMENT OF DEFENSE

The Department of Defense (DOD) conducts marine pollution research through the Army Corps of Engineers (Corps) and the Navy. The Corps has major and broad responsibilities within the Great Lakes, the oceans and their adjacent coastal areas. These responsibilities include navigation, flood control, regulation of dredged material disposal and fill activities, and coastal engineering. Research is undertaken to ensure that these responsibilities are undertaken efficiently and in an environmentally acceptable manner.

To avoid pollution from naval vessels and comply with environmental regulations, the Navy develops pollution abatement equipment for its ships. Unique requirements for equipment such as space and weight

constraints, manning criteria, reliability and the nature of generated wastes guide direction of the Navy program. The Navy also is working to develop techniques for detoxification of paint wastes resulting from hull grit-blasting operations. The Navy does not perform research on the effects of ship wastes on marine systems.

DOD's marine pollution abatement research activities were funded for approximately $12 million during FY 1981 and accounted for 7% of the overall marine pollution funding. The Corps budget for pollution research and development was about twice as large as that of the Navy in FY 1981.

DEPARTMENT OF ENERGY

The Department of Energy (DOE) conducts ocean pollution research that covers a broad spectrum of environmental activities and is designed to ensure that energy programs are consistent with national environmental goals and policies. Oceanographic research is conducted to determine the effects on the marine environment of nuclear power generation, oil and gas development, and solar, geothermal, ocean thermal, and biomass energy conversion activities. These research programs, funded for approximately $23 million, accounted for 13% of the total FY-1981 marine pollution funding. Current reorganization plans call for marine pollution elements of DOE to be transferred to the Department of Commerce.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Two components of the Department of Health and Human Services (DHHS) -- the Food and Drug Administration (FDA) and the National Institute for Environmental Health Sciences (NIEHS) -- conduct or support research programs relating to ocean pollution and their effects on human health. The FDA carries out regulatory and research activities to assure that both domestic and imported shellfish are safe for human consumption. Through its in-house research program and contracts and grants NIEHS conducts and supports research to develop an understanding of the factors in the marine environment that have an adverse effect upon human health. The Department's marine pollution research activities were funded for approximately $5 million during FY 1981 and accounted for 3% of the total marine pollution funding.

DEPARTMENT OF THE INTERIOR

Within the Department of the Interior (DOI), three agencies -- the Bureau of Land Management (BLM), the United States Geological Survey (USGS), and the Fish and Wildlife Service (F&WS) -- have

responsibilities for conducting ocean pollution research. DOI's research program, funded for approximately $51 million, accounted for 30% of the total FY-1981 marine pollution funding.

BLM is the administrative agency responsible for leasing submerged Federal lands for outer continental shelf (OCS) oil and gas development. OCS environmental studies supported by BLM provide environmental information and analysis on marine and coastal ecosystems to assist in decision making to support the leasing process and subsequent operational aspects of oil and gas development. Activities include mapping habitats and geological hazards, ecological characterization and biological assessments, studies of benthic and commercial fisheries, marine mammals and birds, studies of pollutant transport, and sociocultural and socioeconomic impact studies.

USGS is responsible for supervising the exploration, development, and production of OCS oil and gas development and for assuring that leases are developed in an environmentally acceptable manner. To accomplish this, USGS relies upon information obtained from BLM and conducts studies to determine the geological and environmental hazards that may affect offshore development.

F&WS conducts research and monitoring aimed at preventing or minimizing impacts on fish and wildlife in areas where various types of development are taking place.

DEPARTMENT OF TRANSPORTATION

Within the Department of Transportation (DOT), the United States Coast Guard conducts research and development to support enforcement and cleanup and mitigation responsibilities for accidental spills of oil and other hazardous substances in the oceans, and navigable waters of the United States. DOT's research, funded for approximately $3 million, accounted for 2% of the total FY-1981 marine pollution funding.

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) conducts research on pollution problems caused by ocean waste disposal, offshore oil and gas development, water quality deterioration, and effects of toxic materials and other contaminants.

EPA's research programs were funded for approximately $32 million during FY 1981 and accounted for 18% of the total marine pollution funding. Estimated funding projections show significant decreases during FY 1982 and FY 1983.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

The National Aeronautics and Space Administration (NASA) supports development and transfer of satellite technology to meet the needs of other Federal, State, and regional government agencies for new or improved methods of acquiring ocean pollution data.

Funding for NASA's support program was $500,000 during FY 1981 and accounted for less than 1% of the total marine pollution funding. Beginning with FY 1982, NASA will no longer participate in marine pollution studies.

NATIONAL SCIENCE FOUNDATION

Activities supported by the National Science Foundation involve broadly based biological, chemical, and physical oceanographic research related to improved understanding of the types of pollutants, rate of transport, and effects of these pollutants in the marine environment. Research related to the goals of the National Marine Pollution Program was funded for approximately $19 million during FY 1981 and accounted for 11% of the total Federal marine pollution funding reported in this Plan.

NUCLEAR REGULATORY COMMISSION

The Nuclear Regulatory Commission (NRC) is responsible for assuring that civilian activities involving the use of nuclear materials are conducted in a manner consistent with the protection of public health and safety and environmental quality. NRC's marine pollution research program was funded for $1 million during FY 1981 and accounted for less than 1% of the total marine pollution funding.

II. National Marine Pollution Concerns

The National Marine Pollution Program addresses a wide range of marine pollution areas of concern. For planning purposes, the following major areas of concern were used in analyzing the combined activities of the eleven agencies:

- Marine Waste Disposal -- Activities in this area are specifically directed at understanding better the effects of using the oceans for waste disposal. Disposal of dredged materials, industrial wastes, sewage wastes, radioactive substances, and brine generated by the strategic petroleum reserve are all included.

- Marine Mining -- Activities in this area provide information about the direct and indirect environmental consequences of recovering subaqueous deposits of various valuable or useful materials. Mining of oil and gas resources and sand, gravel, and shell on the continental shelf, and recovery of minerals from the deep seabed are included.

- Marine Energy -- Activities in this area address the environmental implications of extracting energy from the oceans. Ocean thermal energy conversion is considered separately; all remaining technologies (e.g., wave energy, tidal energy, biomass) are discussed as a group.

- Marine Transportation -- Activities in this area describe the environmental effects of routine shipping operations such as discharge of shipboard wastes, cargo transfer, and discharge of ballast.

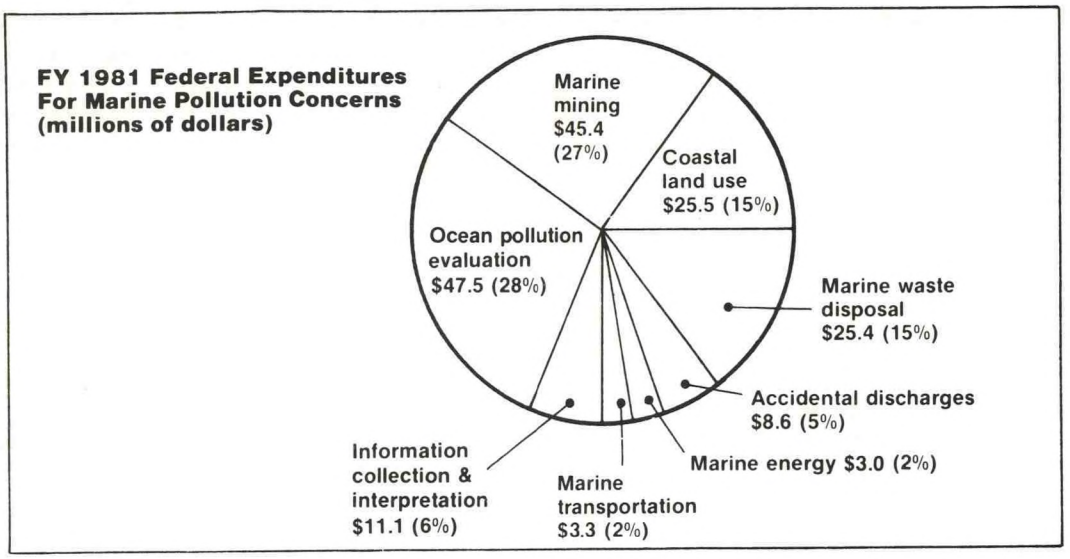
- Accidental Discharges -- Activities in this area are directed at understanding the effects of accidentally discharged crude petroleum and petroleum products, and various harmful chemicals. Improving emergency spill response and developing cleanup technologies are also included.

- Coastal Land Use -- Activities in this area increase our knowledge of how coastal land use practices and patterns affect marine ecosystems. Siting, construction, and operation of coastal facilities; nonpoint source pollution; and increased use of coal are included.

- Ocean Pollution Evaluation -- This area includes research, development, and monitoring activities that are not directly related to a specific polluting activity, but that are essential to understanding the effects of ocean pollution on valuable marine resources, regardless of pollution source. Developing and evaluating environmental quality criteria, documenting existing environmental quality, describing natural variability in marine ecosystems, measuring acute and sublethal effects of specific pollutants on selected organisms and studying cumulative or interactive effects of multiple pollutants or disruptions are among the many activities included.

- Information Collection and Interpretation -- Specific activities within the program ensure that information collected by marine pollution research, development, and monitoring is reliable and, that information is made available to users. Data management, synthesis, and distribution; quality assurance; and development of measurement methodologies are included.

Estimates of FY-1981 expenditures in each of these areas is provided in the figure on p. 19. Because many programs address more than one marine pollution area of concern, the information in that figure, and the detailed tables that follow, should be considered only as an indication of relative magnitude of expenditures in the marine pollution issues. In overview, $113.5 million or 66% of the total FY-1981 pollution budget was spent on pollution source-specific research. Among the source-specific concerns, marine mining activities attracted the largest commitment of funds. About $45.4 million was spent studying the effects of marine mining activities, primarily related to offshore oil and gas. Marine waste disposal and coastal land use each received about $25 million in research support during FY 1981, and accidental discharges, marine energy, and marine transportation were each allocated 5% or less of the total National Marine Pollution Program budget. The remaining $58.6 million was spent on activities that are not issue-specific, such as data management and synthesis, quality assurance, measurement methodologies, and ocean pollution evaluation.



Presentations on research activities in this chapter are organized by pollution concerns. Each presentation includes background information on the nature and magnitude of the polluting activity and a description of any legislation or regulatory controls that apply. The second portion of each presentation is entitled "Analysis and Conclusions" and provides first an overview of pertinent Federal research programs and activities, or a summary of existing scientific information on environmental effects of the polluting activity. The remainder of "Analysis and Conclusions" addresses national research or information "needs" that were developed from conference results.

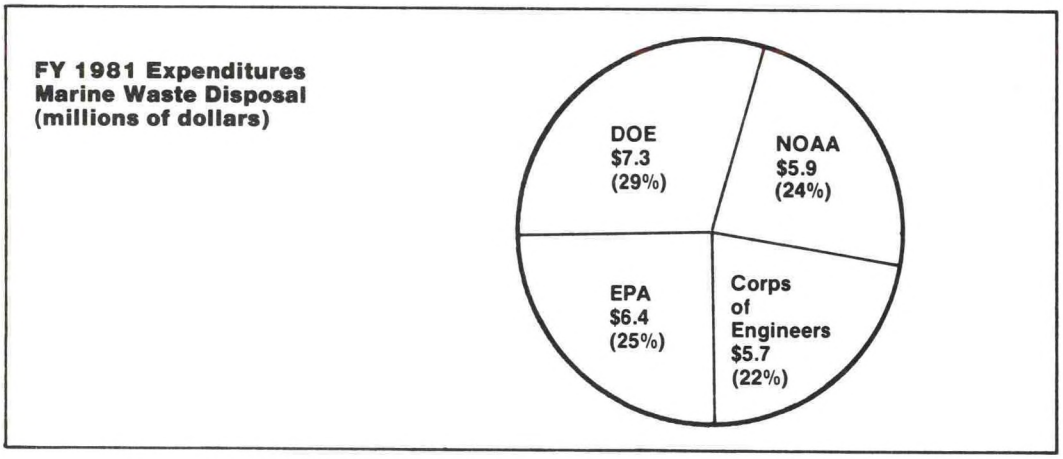
The approach used in addressing each need is to (1) explain the need, (2) identify Federal programs that address the need, and (3) offer a conclusion as to how well the need is satisfied by Federal programs. If required, a recommendation is made to describe how a program might be changed to improve response to the need.

MARINE WASTE DISPOSAL

Marine Waste Disposal is one of the most important areas in the Program. Some materials, such as dredged sediments, are now routinely disposed of in the oceans. Others, such as some types of radioactive wastes, may undergo ocean disposal in the near future. Pressure is growing to allow continued and increased disposal of sewage sludge in the oceans. For the purposes of this Plan, dredged material, industrial wastes, sewage wastes, radioactive materials, and brine discharges from Strategic Petroleum Reserve activities are considered under marine waste disposal. Each of these is discussed

separately in the following sections. In addition, some general aspects of ocean waste disposal are presented in Chapter 5.

The principal agencies conducting research on marine waste disposal are the Department of Energy, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, and the Army Corps of Engineers (the Corps). The FY-1981 expenditures for waste disposal were spread relatively evenly among the four agencies as shown in the following figure.



Department of Energy funds were largely devoted to studies of brine disposal, and the Corps research focused on disposal of dredged material. Research funded by NOAA and EPA was more evenly distributed among the major types of wastes discussed in this section. The following table provides information on funds expended and percent of budgets allotted for research on each type of waste disposal in FY 1981.

MATERIAL DISPOSED	DOLLARS (Millions)	PERCENT OF WASTE DISPOSAL BUDGET	PERCENT OF TOTAL POLLUTION PROGRAM BUDGET
Dredged material	$9.3	36%	5.4%
Industrial waste	3.5	14	2.0
Sewage waste	4.4	17	2.6
Radioactive waste	2.2	9	1.3
Brine	6.0	24	3.5
TOTAL	$25.4	100%	14.8%

DREDGED MATERIAL DISPOSAL

Dredging of new channels and maintenance dredging of existing channels are required to provide safe and efficient navigation conditions for commercial and recreational marine transportation. Channel dredging generates significant amounts of dredged material consisting of the sediment and water mixture excavated from areas dredged. On the basis of volume, dredging is the largest single source of materials that are ocean dumped. During 1979, more than 72 million cubic yards of dredged material were deposited in the marine environment (COE, 1980). Of the 1979 total, 68% was disposed of in the Gulf of Mexico, 18% in the Atlantic Ocean, and 14% in the Pacific Ocean. The total 72 million cubic yards of dredged material constituted nearly eight times the combined tonnage of industrial wastes, sewage sludge, construction debris, and other waste materials disposed of in the marine environment during 1979 (CEQ, 1980). Compared with other materials that are disposed of in the ocean, most of the dredged material excavated in the United States is relatively innocuous, in many instances containing no harmful pollutants and, in most of the remaining cases, containing only trace levels of contaminants. In these cases, the primary concern associated with disposal of the relatively innocuous materials centers around the direct physical effects of disposal. These physical effects include burial of organisms, increased levels of suspended sediments, and accretion of disposed materials (COE, 1978). However, dredged material taken from highly polluted areas is usually contaminated with harmful chemical constituents such as heavy metals, synthetic organics, and oil and grease. Open-ocean disposal of these materials carries the threat of acute or chronic toxic effects on marine organisms, and potential contamination of human food resources. Much research has been conducted to describe the effects of dredged material disposal in the marine environment, and to evaluate disposal options that may be preferable to ocean dumping. A regulatory process based on the results of such scientific research has evolved to evaluate dredged material for ocean disposal, and to designate and monitor disposal sites.

Proposals for disposal of dredged material in freshwater and in coastal areas to the outer boundary of the territorial sea are regulated under the Federal Water Pollution Control Act (FWPCA). The jurisdiction of the Marine Protection, Research, and Sanctuaries Act (MPRSA) extends outward from the baseline from which the territorial sea is measured. Therefore, a zone of jurisdictional overlap exists between the baseline and the outer boundary of the territorial sea where, strictly speaking, the provisions of both the FWPCA and the MPRSA would apply. To eliminate this problem, EPA and the Corps have reached an agreement stipulating that only the MPRSA will be applied in the zone of overlap. Therefore, the vast majority of ocean-disposed dredged material must be evaluated under the MPRSA and pursuant

regulations. The guidelines contained in the MPRSA take into account the international provisions of the London Ocean Dumping Convention. The intent of MPRSA, as it pertains to dredged material disposal, is to limit adverse ecological effects of ocean dumping. Title I of MPRSA stipulates that the Department of the Army reviews applications for permits and, when appropriate, issues permits for the transportation of dredged material to ocean disposal sites (Section 103). The Corps of Engineers has been designated by the Secretary of the Army to implement this authority. EPA designates ocean disposal sites and develops criteria for dredged material disposal. The Corps of Engineers reviews permit applications in accordance with the EPA criteria (Section 102). These review procedures are followed for applications to carry out private dredging operations. However, the bulk of dredged material is actually generated by Corps navigation projects, and MPRSA stipulates that the Corps must apply these same procedures and review criteria to disposal of materials generated by Corps projects. Title II of MPRSA requires that NOAA, in coordination with the EPA and the U.S. Coast Guard, conduct a continuing program of monitoring and research regarding the effects of ocean dumping of materials including dredged material.

In addition to the provisions of MPRSA and FWPCA, the Fish and Wildlife Coordination Act (FWCA) stipulates that Federal agencies involved in permitting or licensing dredging and dredged material disposal activities must consult with the F&WS and the National Marine Fisheries Service (NMFS) to ensure consideration of wildlife conservation.

The goal in regulating dredged material disposal is to allow dredging and disposal activities while avoiding unacceptable environmental risks. To ensure that the best practical procedures are employed in evaluating applications for ocean disposal of dredged material, the Corps of Engineers and EPA have worked jointly to develop a guidance manual for implementing Section 103 of MPRSA (EPA/COE, 1977). The manual summarizes and describes procedures for ecological evaluation of dredged material before ocean disposal. In overview, the permit evaluation and review process involves some or all of the following aspects: initial evaluation of sediment characteristics and potential for contamination; liquid, suspended-particulate, and solid-phase bioassay; evaluation of alternative disposal methods and justification for proposing ocean disposal; evaluation of bioaccumulation potential based on field or laboratory data; and general consideration of impacts on esthetics, recreation, economics, and other ocean uses. Recently a "matrix" approach has been applied on a trial basis in the New York District to assist in evaluating bioassay results. The purpose of the approach is to compare concentrations of specific pollutants (e.g., PCB, DDT, Hg) associated with dredged material with existing concentrations at the disposal site and at reference sites in the surrounding area. The Corps and EPA are

jointly evaluating the "matrix" approach and other innovative guidance methodologies to improve the regulatory process.

Permits may be approved under MPRSA for disposal of dredged material at one of more than 100 EPA-designated interim sites. In 1979, 50 of the designated sites were actually used for dredged material disposal. The amount of dredged material that is disposed of in the ocean varies from year to year as a result of major new work or improvement navigation projects, weather patterns, and the fluctuating nature of maintenance dredging activities. Between 1973 and 1979, total volumes placed in ocean disposal sites ranged from 41 to 99 million cubic yards annually; no consistent time trends were evident during that period (CEQ, 1980). In addition, more than 100 million cubic yards are dredged annually in coastal areas and disposed of by some means other than ocean dumping, e.g., upland disposal, beach nourishment (Samuels, 1981). Volumes of dredged material may increase because of future port improvements. On a regional level, disposal of dredged material from port improvements may have significant impacts. For example, it is anticipated that the improvements under consideration for Mobile and Norfolk would generate about 140 million and 35 million cubic yards, respectively.

Analysis and Conclusions

Dredged material disposal is recognized as a potential pollution threat in coastal areas. The severity of the threat can be controlled to a considerable degree by management of disposal activities. Research efforts conducted to date have concentrated on defining risks associated with dredged material disposal and evaluating the various disposal options, including ocean dumping. The principal Federal agencies involved in research on dredged material disposal are the Corps, EPA, and NOAA.

The Dredged Material Research Program (DMRP), conducted by the Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi, was completed in March 1978. The DMRP explored the physical and chemical impacts of dredged material disposal, and a variety of disposal alternatives, including beneficial uses of dredged material. The program was well planned, and DMRP results are thoroughly documented by technical reports on specific issues, synthesis reports, and summaries. At the planning and policy level, two major conclusions can be drawn from the results of DMRP (COE, 1978):

1) No single disposal alternative is preferable in all cases. Each dredging project is unique, and disposal options should be considered on a case-by-case basis.

2) An effective solution to the problem of dredged material disposal can be derived only from long-range regional planning and management of disposal activities.

The DMRP involved an expenditure of more than $32 million and covered a span of 5 years. The DMRP is the most comprehensive study performed on the disposal of dredged material and provides a large volume of background information along with the conclusions drawn from the engineering and scientific data accumulated during the study. Because of the limited time frame involved, 5 years, conclusions can be drawn only for the short term effects of the disposal of dredged material. To evaluate long-term effects, additional scientific and engineering data are needed. Therefore, the Corps of Engineers is continuing to collect data during FY 1982, although funds available to conduct the program are limited. Future Corps efforts will concentrate on those areas that relate to the long-term effects of dredging and disposal activities and will include the continuation of monitoring and evaluation of various parameters at selected DMRP field sites. Other ongoing or planned research activities of the Corps include monitoring and management studies conducted by the Corps district or division offices.

Past and ongoing EPA programs addressing dredged material disposal relate to the regulatory functions of the agency. Specifically, EPA, in conjunction with the Corps, is further developing bioassay techniques and innovative methodologies for evaluation of dredged material, researching the effects of PCB in dredged sediments, performing a field study at a dredged material disposal site, and conducting evaluations of potential dredged material disposal sites. Under the mandate of MPRSA, Section 201, the Department of Commerce, through NOAA, conducts a research and monitoring effort to improve our understanding of the effects of ocean dumped materials, including dredged material. Cooperative studies between NOAA and the Corps are being conducted at disposal sites in the New York Bight, near the mouth of Chesapeake Bay, and near the Mississippi River delta. These studies include baseline observations prior to dumping and long-term field and laboratory studies. Dredged material disposal is also being studied under the Long-Range Effects Research Program conducted under the mandate of MPRSA, Section 202.

Research or information needs related to the physical effects, chemical effects, and management of dredged material disposal have been identified. The needs and pertinent Federal activities are discussed below.

Physical effects on the ecosystem

This area is adequately addressed by ongoing Federal research programs. The disposal of dredged material may cause physical or

chemical effects. Important examples of physical effects include burial of bottom-dwelling organisms, effects of increased turbidity and sediment type alteration, and the implications of changes in bottom topography. It is necessary to understand these effects to evaluate the implications of dredged material disposal.

This area is adequately addressed by ongoing Federal research programs. The DMRP has laid groundwork at the generic level for studying physical effects of dredged material disposal. Ongoing COE and NOAA programs are studying physical effects on a site-specific basis at several disposal sites. The generic aspects of physical effects have been adequately addressed. Site-specific studies performed on a limited basis continue to provide valuable information on long-term physical impacts.

Chemical effects on the ecosystem

The chemical effects of dredged material disposal become important when toxic or harmful constituents are present in dredged sediments. Research topics related to these contaminants include release and bioavailability, long-term fates, acute and chronic effects, and bioaccumulation in marine organisms including human food resources. In cases where dredged material is contaminated, information on the impacts of the contaminants is essential in evaluating disposal alternatives. Information on the effects of contaminants in dredged material is considered to be a most important need.

DMRP explored the generic aspects of dredged material contamination including contaminant release during and immediately after disposal, effects of contaminants, and bioaccumulation potential. Ongoing EPA, NOAA, and Corps of Engineers research and monitoring projects are also continuing to increase our understanding of chemical impacts.

This highly complex issue is not yet fully understood. Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future. Studies of overall effects on biological communities and marine ecosystems should be emphasized to promote assessments of resource impacts. One way in which research on contaminated sediments might be advanced would be to carry out a synthesis and analysis of currently available information on the biological effects of contaminated sediment disposal. This would help describe the existing body of information, determine whether any conclusions can be drawn, and identify the most productive areas for future research. It is recommended that the value of such a study be determined by the Corps of Engineers, NOAA, EPA, and F&WS, and the study be conducted if appropriate. Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future.

Disposal management

Long-range management of dredged material disposal requires that basic information be available about potential disposal sites, estimated future volume and quality of dredged material, feasibility and cost of alternative disposal methods, prediction of impacts, and assessment of possible benefits of using innovative dredging technologies. In addition, disposal management requires development of a long-term strategy and provision of feasible disposal alternatives including ocean disposal. Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future.

Research, development, and monitoring related to this need fall largely within the purview of Corps of Engineers Headquarters, and coastal divisions and districts, and EPA and NOAA. In addition, the Corps and EPA are continuing to improve bioassay techniques for evaluation of dredged material prior to disposal.

There is a need for long-term regional planning for dredged material disposal. Information is required to develop regional management plans that would include projections of dredged material volumes and quality, rigorous analysis of the costs, risks, and benefits of the various disposal alternatives, development of several disposal options depending on the nature of dredged material involved, guidelines for selection of disposal options, and an assessment of the effects of the management program on ocean resources. More information is also needed to describe the cumulative effects of individual dredged material disposal actions on a regional and national basis. Where possible, evaluation of disposal impacts should be extended to the level of effects on fisheries stocks, recreational utility, and other ocean use impacts on a regional or national level.

INDUSTRIAL WASTE DISPOSAL

The manufacturing and processing techniques commonly used in our technological society convert raw materials into two types of outputs: products and wastes. Products are generally distributed and sold to consumers before final disposal; wastes may be processed and recycled, or, more commonly, disposed of in some other way. Industrial wastes may contain potentially harmful constituents including synthetic organics, heavy metals, and oil and grease. Commonly used disposal options for industrial wastes are secure landfills, ocean dumping, pipeline discharges to coastal and inland waters, and incineration. This discussion addresses the following industrial waste disposal options that involve the marine environment: ocean dumping, incineration at sea, and ocean outfalls.

Each of these activities differs from the others because of the type of discharge, the nature of the substances discharged, the level of treatment prior to discharge, or the regulatory procedures that apply. Therefore, background information on each of the three activities is presented separately below. However, research conducted on marine waste disposal is often pertinent to several disposal options. For example, basic fates and effects research conducted on a specific chemical constituent would provide useful information whenever that constituent enters the marine environment, regardless of the disposal technique used. To promote the application of general research to all three industrial waste disposal alternatives, a single group of research and information needs is presented in "Analysis and Conclusions," which follows the discussions of the options themselves.

Ocean dumping

When industrial wastes are ocean dumped, the waste materials are barged to a designated disposal site and discharged. The table below provides a summary of the volumes of industrial wastes that were ocean dumped from 1973 to 1979 (EPA, 1980b).

INDUSTRIAL WASTE OCEAN DUMPED
(Thousands of tons)

Geographic Locations	1973	1974	1975	1976	1977	1978	1979
Atlantic	3,643	3,642	3,322	2,633	1,784	2,584	2,577
Gulf of Mexico	1,408	938	120	100	60	0.17	0
Pacific	0	0	0	0	0	0	0
TOTAL U.S.	5,051	4,580	3,442	2,733	1,844	2,548	2,577

In 1979, about 2,577,000 tons of industrial wastes were dumped in the ocean. There has been a trend toward reduction of total ocean dumping of industrial wastes since 1973 when ocean dumping became regulated by the Federal Government. Industrial waste dumping has been reduced by about 30% in the Atlantic, totally eliminated in the Gulf of Mexico, and was not practiced in the Pacific between 1973 and 1979. Three industrial-waste dumpsites were used in the Atlantic during 1979. These are the acid waste site in the New York Bight Apex, the Deepwater 106 Dumpsite located 106 nautical miles southeast of New York Harbor, and the Puerto Rico site located 40 nautical miles

north of Puerto Rico. About 75% (by wet tons) of the industrial wastes ocean dumped in 1979 were acid byproducts of the titanium dioxide manufacturing process; the remaining 25% of the materials consisted of wastes from the manufacture of various chemicals including insecticides and pharmaceuticals.

Ocean dumping of industrial wastes is regulated under authorities assigned in the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA), as amended. Under the legislation, transportation of industrial wastes for the purpose of dumping in ocean waters, the territorial seas, or the contiguous zone is prohibited except when authorized by a permit issued by the Administrator of EPA. Title I of MPRSA establishes a permit system and assigns to EPA the responsibility for review of permit applications and granting of permits, designation of dumpsites, and establishment of criteria to be used in reviewing permit applications. Title II of MPRSA assigns responsibility to the Department of Commerce (implemented through NOAA) to conduct, in coordination with EPA and the U.S. Coast Guard (USCG), a comprehensive and continuing program of monitoring and research regarding the effects of dumping materials, including industrial wastes, into ocean waters, coastal waters, and the Great Lakes.

Incineration at sea

The first incineration at sea of chemical waste officially sanctioned in the U.S. occurred in the Gulf of Mexico between October 1974 and January 1975 when M/T Vulcanus incinerated 16,000 metric tons of organo-chlorine wastes at a designated site about 140 nautical miles southeast of Galveston, Texas (EPA et al., 1980). In 1977, 17,600 tons of chemical waste were incinerated in the Gulf of Mexico, and 12,100 tons were incinerated in the Pacific Ocean (EPA, 1980b). Nearly all incineration at sea has been conducted under research permits granted by EPA under authority provided by MPRSA. From studies of these early burns, it has been concluded that incineration at sea for organic chemical wastes does not cause unacceptable environmental consequences, at least on a limited basis for some chemicals and at these specific sites (EPA et al., 1980). Candidate wastes for incineration at sea are generated primarily by the following industries: petroleum refining, organic chemical production, synthetic fibers and resins manufacture, and pesticides production.

Although incineration at sea has been conducted on a limited basis, it is likely to become more common in the future. Increasing amounts of industrial waste are produced each year, and increased regulatory pressure through implementation of the Resource Conservation and Recovery Act (RCRA) is eliminating some of the traditionally used land-based disposal options because of potential environmental hazards. The effects of RCRA implementation will be to prohibit inexpensive but

potentially hazardous land disposal techniques, and to require costly site preparation, monitoring, and closure to ensure that industrial wastes are effectively isolated from the environment. As a result of these factors, RCRA implementation may indirectly promote incineration at sea, which will become more economically attractive as land disposal becomes more costly and highly regulated. Indicators of increasing pressure to promote incineration at sea are already evident. EPA (1980c) is considering designation of an incineration site in the North Atlantic. An ad hoc interagency work group has recently concluded that incineration at sea constitutes an environmentally acceptable and efficient means for destroying liquid, hazardous, organic chemical wastes (EPA et al., 1980).

Like ocean dumping, incineration at sea is regulated primarily under the authority of the Marine Protection, Research, and Sanctuaries Act and the London Ocean Dumping Convention. The responsibilities of Federal agencies are essentially the same as for ocean dumping.

Ocean outfalls

Industrial ocean outfalls are pipeline discharges of industrial wastes that directly enter estuaries, coastal waters, or oceans. Industrial wastes mixed with domestic and other municipal wastes are not specifically addressed in this section.

Ocean outfalls of industrial wastes are regulated by the EPA through the National Pollutant Discharge Elimination System (NPDES). In 1979, more than 5,000 NPDES permits were held for pipeline discharges by industries in coastal counties. In addition, about 7,500 operational discharges were associated with offshore oil and gas facilities. Pollutants that may be associated with various industrial effluents include synthetic organics, heavy metals, oxygen-consuming materials, suspended solids, and nutrients.

Authority for administration of the NPDES permitting procedure is assigned to EPA under Section 402 of the Clean Water Act. The Act requires that EPA establish limitations to effluent quality on an industry-by-industry basis. Specifically, for all point sources other than publicly owned treatment works, it is stipulated by the Clean Water Act that best practicable control technology currently available be attained by July 1, 1977, and best available technology economically achievable be attained by July 1, 1983.

In addition to the NPDES permit procedure described in Section 402 of the Clean Water Act, Section 403(c) of the Act requires the Administrator of EPA to develop ocean discharge criteria to be used in evaluating the effects of a discharge into the territorial seas, the contiguous zone, and the oceans. The provisions of Section 403(c)

apply only to coastal and ocean waters and demonstrate the special concern of the Congress for the protection of marine water quality and marine resources. Final regulations under Section 403(c) were published on October 3, 1980, in the Federal Register 45:65942-65954.

Analysis and Conclusions

Determining the implications of industrial waste disposal in the oceans is difficult for several reasons. Many potential toxicants are present in these materials. In addition, composition of waste varies depending on the industry and the stage at which wastes are generated in the overall manufacturing process. To provide an extra measure of safety, wastes to be ocean dumped or incinerated are taken offshore, where dispersion and dilution can better mitigate adverse effects. However, dilution further complicates evaluation of pollution impacts because the focus shifts from acute impacts to sublethal, but possibly significant, effects that may occur in marine organisms, even at low concentrations of the discharged materials. Both acute and chronic effects on marine organisms must be understood, and risks to human health evaluated. Industrial outfalls are quite numerous in some areas and may adversely affect coastal ecosystems known to be highly sensitive to chemical and physical disruption, and essential to the maintenance of commercial marine fisheries, and recreational and aesthetic resources.

EPA and NOAA are the principal Federal agencies that conduct research and monitoring on ocean disposal of industrial wastes. EPA research is largely related to the regulatory functions of the agency. The Marine Disposal Research Program conducted by EPA includes an emphasis on industrial wastes. Research conducted involves a general assessment of human health risk associated with industrial waste disposal, development of the benthic microcosm as an analytical tool for predicting contaminant fates and assessing effects, and development of bioassay techniques for evaluating potential disposal sites. Information generated by EPA's Water Quality Research Program may also improve understanding of the effects of industrial waste disposal. These studies include investigations on the transport, transformation, and fates of toxic materials in marine ecosystems, studies on the effects of toxic materials on marine organisms, and evaluation of water quality criteria.

Within NOAA, the Ocean Dumping Program conducts research and monitoring on the effects of dumping waste materials in the ocean. Field research and monitoring are being conducted at the Deepwater 106 and Puerto Rico dumpsites to study the fate and effects of disposed industrial wastes. Complementary laboratory studies are also performed. In addition, the objectives of the Long-Range Effects Research Program are to determine potential long-range effects of ocean dumping on

human health and ocean ecosystems, develop early warning systems to detect adverse changes in ecosystems, and improve understanding of basic ecosystem attributes and functioning. NOAA's Ocean Resources Coordination and Assessment Program is collecting inventory information on all pollution discharges, including industrial effluents, on a coast-by-coast basis (excluding the Great Lakes) with the following schedule for completion:

Gulf of Mexico	- FY 1981
Alaska and West Coast	- FY 1982
East Coast	- FY 1983

In addition, the Microconstituents Program collects information on levels of contaminants in marine organisms.

The Food and Drug Administration, Department of Health and Human Services, also conducts a program relating to industrial waste. The Pesticides and Metals in Fish Program monitors and assesses contaminant levels in seafood.

Research or information needs related to the management of industrial wastes and the effects and risks associated with industrial waste disposal have been identified. The needs and pertinent Federal activities are discussed below.

Management of industrial wastes

Long-range planning and management of industrial waste disposal is essential to anticipate and mitigate pollution problems. Such planning requires that basic scientific and engineering information be available on future disposal requirements, options, risks, and costs. For example, the following tasks should be addressed:

- Identify wastes that will be generated on a national and regional level in the next 10 to 20 years.
- Characterize constituents of wastes and assess the potential for adverse environmental effects under various disposal options.
- Determine feasibility, environmental risk, and economic cost of the various disposal options, including land-based options and recycling.
- Develop long-range management strategies that would indicate preferred options for various wastes, potential sites for disposal, and any regulatory changes that would be appropriate.

Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future.

EPA regulatory programs conducted under the mandates of the Marine Protection, Research, and Sanctuaries Act, and the Clean Water Act, and coordinated activities in EPA's Office of Research and Development are now addressing this need. In addition, NOAA research programs provide basic information that can be used in predicting the fates of disposed materials and their effects in marine ecosystems. However, these issues are complex, and in many cases detailed site-specific analyses are required. Support for research and development that will provide information needed for management of industrial wastes should be continued. In addition, individual industries in the private sector should be encouraged to characterize and evaluate their respective waste products. States and local governments should work together to implement management strategies.

Ecosystem effects & human health risks

Waste disposal management decisions must be based on an understanding of the fates of contaminants in marine ecosystems, their effects on organisms, and the pathways by which humans may be exposed to contaminants. Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future. Future emphasis is required in the following areas:

- Fates and transformations of disposed materials.
- Bioaccumulation of contaminants in commercial and recreational marine species.
- Human risk assessment models including health risks associated with various waste constituents, containment levels in human food resources, and consumption patterns in various human populations.
- Effects on marine ecosystems, especially in sensitive coastal areas.
- Significance of chronic sublethal effects in marine organisms (e.g., mutagenicity, community alteration, reduced fecundity).
- Effects on fisheries yields.
- Field verification of laboratory results.

Most of these issues are under study by EPA or NOAA. However, the current level of effort in EPA is now limited by availability of funding; it is estimated that in FY 1981 less than $600,000 was expended

on industrial waste disposal research under EPA's Marine Disposal Research Program. The acquisition of information on the fates and effects of ocean disposal industrial waste could be accelerated by (1) improved coordination and communication between managers of NOAA and EPA research programs, and (2) increased funding to EPA's Marine Waste Disposal Program.

SEWAGE DISPOSAL

Disposal of the various types of wastes generated by the densely populated coastal areas has created economic, environmental, and political conflicts. Historically, the nation's rivers, estuaries, and coastal waters have received municipal waste discharges since collection and treatment of domestic wastes was initiated. Prior to the 1970's, ocean disposal was largely unregulated, and adverse impacts on human health and the environment were observed. The principal hazards to human health from sewage waste disposal are associated with the transmission of human pathogens and the ingestion of seafoods contaminated with toxic metals and synthetic organic compounds. In the Great Lakes there are additional risks from pathogens and toxics because these waters are used as a source of drinking water. Food poisoning, dysentery, and transmission of a variety of human and animal parasites are commonly associated with the discharge of untreated sewage waste. Other adverse impacts are the loss of recreational and commercial resources where beaches or wetlands are fouled with floating waste materials or are closed to fishing and shellfishing because of sewage contamination.

Public concern over the pollution of coastal waters during the 1970's precipitated the enactment of two major legislative measures aimed at improving the quality of the marine environment. The Marine Protection, Research, and Sanctuaries Act of 1972 (P.L. 92-532), also known as the Ocean Dumping Act, was enacted to regulate ocean dumping of all materials and prevent or strictly limit the dumping of any material that would adversely affect human health, welfare, amenities, the marine environment, ecological systems, or economic potentialities. The Act was further amended in 1977 mandating that the ocean dumping of harmful sewage sludge cease by December 31, 1981 (NACOA, 1981).

The Federal Water Pollution Control Act, also known as the Clean Water Act, regulates, among other things, municipal waste disposal by pipeline discharge into the oceans. The Act was substantially amended in 1972 (P.L. 92-500) to establish a single standard for the nation as a whole by requiring all publicly owned treatment works (POTW) to achieve by 1983 an effluent water quality based on secondary treatment. Exemption from the secondary treatment mandate for coastal POTW dischargers on a case-by-case basis was later provided under Section 301(h) of P.L. 95-217 in the 1977 amendments. The EPA regulations

developed under the Clean Water Act also require compliance with State water quality standards.

EPA authority under the Ocean Dumping Act includes review, award, and enforcement of ocean dumping permits, designating and managing disposal sites, and developing criteria to evaluate ocean dumping permit applications. EPA's posture has been, until recently, that any practical (i.e., feasible and available) disposal alternative is preferable to ocean dumping. However, on the basis of new information about environmental effects and economic costs of ocean dumping and its alternatives, and the increasing rate at which sewage wastes are generated at the national level, the EPA is reevaluating its restrictive position (EPA, 1981).

During the 1970's EPA, under its ocean dumping permit program, developed stringent tests and criteria to restrict ocean dumping. The environmental impact criteria require that the candidate material pass two bioassay tests: a test for toxicity of the liquid, suspended particulate, and solid phases; and a bioaccumulation test. Failure of either test results in permit denial, except for emergency or research permits. However, owing to problems in the testing procedure, the results of these tests have been ambiguous.

EPA's permit program authorized by Section 402 of the Clean Water Act establishes limits on pollutants that can be discharged from municipal point sources through outfalls, including sludges and wastewater effluents, into marine waters. The factors used to evaluate whether a discharge will cause "unreasonable degradation" of the marine environment include the chemical constituents of the discharge, their potential for causing adverse impacts on the environment and to human health, the sensitivity and importance of the biological community, and the impact on special aquatic environments and fisheries. Upgrading of POTWs to secondary treatment as required by this Act will significantly improve the quality of wastewater effluents but will result in the generation of greater volumes of sewage sludge.

The Ocean Dumping Act prohibits ocean dumping of harmful sludge after December 31, 1981, and EPA regulations under the Clean Water Act will prohibit the disposal by outfall pipes after July 1985. However, there is mounting evidence that the environmental effects and costs of other methods of waste disposal would exceed those of disposal in the oceans, and the scientific information available to date does not justify the total ban on ocean disposal of harmful sewage sludge (NOAA, 1979a). The feasibility of land disposal is limited by shortage of available land near urban centers and the threat of pollution to groundwater resources. Recycling of sludge is possible, but expensive. Tertiary treatment would cost substantially more than the currently used treatment levels. For all of these alternatives, sludge solids remain and would have to be disposed

of on land unless they were incinerated. Incineration could contribute significantly to the air pollution problems already existing in many heavily populated areas.

Sewage effluents that have been treated still contain substantial quantities of suspended solids, toxic metals, synthetic organic compounds, fecal coliforms, and other potentially pathogenic microorganisms. Effluents also contain oxygen-demanding organic substances, and various forms of the nutrients nitrogen and phosphorus (NACOA, 1981). Secondary sewage treatment is moderately effective in reducing the number of pathogenic microorganisms. Combined primary and secondary treatment reduces the fecal coliform level in the effluent. Discharge of the effluents through outfall pipes is regulated by the EPA under Sections 402 and 403 of the Clean Water Act (as amended). Sewage effluents are discharged directly into the oceans through outfall pipes, primarily by Los Angeles, New York, Boston, and Miami.

Sludge is a byproduct of sewage treatment. In primary treatment plants, floatable materials are removed and solids are settled to produce the sludge. In a secondary treatment plant, bacteria are employed to decompose dissolved and colloidal organic matter from the wastewater stream, and the bacterial debris becomes part of the sludge. Generally, a portion of secondary sludge is anaerobically digested, a process that decomposes much of the solid organic matter to gaseous byproducts such as methane. This process reduces the coliform and viral content of the sludge to very low levels. The chemical composition of sewage sludge is highly variable and depends on the content of receiving wastes, the level of treatment, and operating efficiency of plants. POTWs receive wastewater streams from a variety of sources, including residences, businesses, small industries, and even major industries in some instances. Many cities have combined sewer systems, with rainwater and street runoff entering the POTWs along with sanitary wastes. During the treatment process, the fates of particular constituents, organic and inorganic, are dependent upon the specific physical, chemical, and biological conditions of plant operations. Generally, however, the sludge concentrates toxic metals (cadmium, copper, lead, mercury, and zinc), pathogens, organic matter, petroleum hydrocarbons, and synthetic organic compounds such as polychlorinated biphenyls (PCBs).

About 6 million dry metric tons of sewage sludge are produced annually by the 14,500 POTWs in the United States. Sewage sludge generation is projected to increase to about 10 million dry metric tons per year by 1990, after all POTWs have converted to secondary treatment. In the United States sewage sludge is disposed of by land application (20%); landfill (40%); incineration (residual ash landfilled) (25%); and ocean disposal (15%) (Vaccaro et al., 1981). In 1979, 5.9 million wet metric tons of sewage sludge were ocean dumped, and 2.8 million wet metric tons were discharged through the

Los Angeles and Boston outfalls. (As a rule of thumb, wet sludge may be assumed to consist of 90% water and 10% solids.) Discharges through outfalls are regulated by EPA under Sections 403 and 405 of the Clean Water Act and those by ocean going vessels under Section 102 of the Ocean Dumping Act.

Under Title II of the Ocean Dumping Act, NOAA has the lead responsibility for conducting comprehensive research and monitoring on the fates and effects of ocean dumping. NOAA has concentrated its research and monitoring efforts at the 12-mile dumpsite in the New York Bight, where much of the dumping occurs, at the 106-mile dumpsite, which is primarily used for industrial wastes, and at the the recently deactivated Philadelphia sewage sludge dumpsite. The efforts include baseline observations prior to dumping, experiments during dumping, and long-term field and laboratory observations. Studies at the Philadelphia dumpsite continue to describe any changes that occur following the cessation of dumping. NOAA's region-specific research programs to determine the fate and effects of pollutants such as sewage include the Hudson-Raritan Estuary Project, the New York Bight Project, Puget Sound Project, the Great Lakes Pollution Studies, and the Habitat Investigations Program.

Analysis and Conclusions

Sewage effluents and sewage sludge are recognized as pollutants and pose a potential threat to the marine environment. However, other sources of contaminants also contribute to the pollution of the coastal waters. The GAO estimated that less than one-half of the pollutants entering the waters is from municipal treatment plants and other regulated point sources (CEQ, 1980). The remaining amount is contributed by the combined discharges of estuaries and rivers, direct runoff from nonpoint sources, atmospheric fallout, and ocean dumping (NOAA, 1979a).

EPA's effort related to the ocean disposal of sewage is focused on evaluation of ocean dumpsites and studying the impacts of discharges from ocean outfalls. Under EPA's Dumpsite Evaluation Program, conducted by the Office of Water and Waste Management, ocean dumping sites are being evaluated. Evaluation consists of biological, water, and sediment surveys followed by assessment of the environmental effects that would result from use of the dumpsite.

The Ocean Outfall Research Program (Municipal Waste Disposal) deals with the fate and effects of the discharge of wastewater effluents. The research involves assessment of the impacts associated with municipal wastewater discharges into estuarine and marine environments. Emphasis is placed on the following areas: marine food chain contamination by toxic materials; transport and transformation of pollutants in the marine environment; assessment of human risk associated with the consumption of contaminated seafood; and surveys of

sediment quality and benthos contamination near municipal outfalls. In addition, studies on ecosystem level effects of wastewater pollution (and pollution abatement), monitoring techniques (including bioassays), and site-specific outfall studies (including the use of remote survey techniques) are being conducted.

EPA is studying also sewage treatment and sludge disposal options not related to ocean disposal, such as landfill applications, incineration, and composting. These may be considered alternatives to ocean disposal of sewage wastes.

Research and information needs related to the effects of ocean outfalls, the effects of ocean dumping, and management of sewage wastes have been identified. The needs and pertinent Federal activities are discussed below.

Effects of sewage outfalls

More information is needed on the fates and effects of materials discharged through outfalls to describe the implications to marine populations including long-term sublethal effects on aquatic species, and human health risks. Full understanding is needed of marine food webs and the movements of various waste constituents through marine ecosystems. Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future.

EPA's Municipal Waste Program provides basic information needed to implement Section 301(h) of the Clean Water Act, which allows relaxation, under certain conditions, of the requirement for secondary sewage treatment. Research is conducted on marine food chain contamination by toxic materials, transport and transformation of pollutants, human health risks associated with seafood consumption, and sediment quality and contamination of benthic communities near outfalls.

NOAA conducts research to determine the fates and effects of human-induced and natural changes on the abundance, distribution, and functioning of living marine resources, assess the health of fishery stocks, and assess risks to human health associated with ingestion of contaminated seafood.

Present research programs conducted by EPA and NOAA should continue. In addition, EPA should perform a review and synthesis of the statistical data resulting from site-specific studies conducted by states in conjunction with Section 301(h) waivers. EPA should use the review to determine the overall value and effectiveness of secondary municipal waste treatment, and of the 301(h) exemption program. The review should be completed by the end of 1984. To accomplish this, planning for the review should be initiated in FY 1982.

Effects of sludge dumping

Sewage sludge contains substances that are potentially harmful to living marine resources, ecosystems, and human health. More information is needed to describe changes that occur in an ecosystem after dumping is stopped and to determine the impacts on the immediate dumping area and how far from the dumping site impacts occur. In general, this area is adequately addressed by ongoing Federal research programs.

NOAA's Ocean Dumping Program includes baseline observations prior to dumping, experiments during dumping, and long-term field and laboratory observations. This program is also laying the groundwork for determining the changes in the marine ecosystem following cessation of sludge dumping at the recently deactivated Philadelphia dumpsite.

These are complex issues that have not been fully addressed. NOAA and EPA should continue research to determine the effects of dumping. Continuing and improved coordination between EPA and NOAA is required. EPA should focus on case-specific studies directly related to the regulatory process, and NOAA should conduct research to obtain a more general understanding of natural and altered marine ecosystems, with the expectation that dumping will continue or resume at certain sites. Studies should focus on ecological effects beyond the designated dumpsites. In particular, research should be conducted on the pathways and fates of key pollutants such as PCBs and heavy metals.

As dumping of sludge is discontinued at a specific site, NOAA should conduct monitoring; research activities to obtain information on the changes in the marine ecosystems should continue. NOAA's study of the abandoned Philadelphia dumpsite is under way.

Management of sewage wastes

Long-range management of sewage disposal requires multimedium assessments including the environmental impacts, economic costs, and energy consumption of disposal methods including land application, landfill, land and ocean incineration, and ocean disposal using barges or outfalls. Specifically, the following actions are needed:

- Determine the volumes of sewage to be generated in coastal areas during the next 20 years.
- Compare the disposal options, such as ocean dumping or outfall disposal of sludges.
- Quantify cost and describe effectiveness and environmental gain of the different levels of treatment technologies.

- Conduct special environmental and economic studies related to Section 301(h) exemptions.

- Select the most appropriate ocean disposal sites.

Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future. The EPA has only recently begun a program to compare directly the environmental risks and costs of various methods of land disposal, incineration, and ocean disposal.

Higher levels of treatment result in cleaner effluent discharges while producing larger quantities of sludge containing concentrations of heavy metals. Decisions have to be made to determine the most appropriate level of treatment, the preferred method of waste disposal, and the best site for disposal.

Although planning and implementation of sewage disposal programs are the responsibility of State and local governments, EPA and NOAA should assist in determining the effects of various ocean disposal options. The following require special attention: (1) determining the chemical composition of wastes entering POTWs in order to remove contaminants through treatment; (2) determining the relationships among treatment type, effluent quality, environmental effects, and human health effects; and (3) selecting the ocean disposal sites that are the least disruptive to the marine environment.

RADIOACTIVE WASTE DISPOSAL

For the past three decades, radioactive wastes have been produced by a variety of activities in the United States. Low-level wastes generated by medical, industrial, and research activities contain low-level but potentially harmful quantities of radionuclides. High-level waste is produced by our national defense programs and generally requires shielding and long-term isolation from the environment. Substantial quantities of both high- and low-level wastes are generated by the nuclear power industry. There is no method of reducing the time that a particular substance remains radioactive; therefore, the wastes must be effectively isolated from the environment until they become harmless. While the medical use of radioactivity can be beneficial to man, uncontrolled exposure may be harmful. Because of the increasing volumes of wastes generated by the various activities, waste disposal management has become an urgent national concern. Safe disposal of the waste produced by the nuclear power industry is one of the factors affecting the industry's growth (NOAA, 1980b). A thorough understanding of the fate and effects of these materials in the marine environment is required to evaluate radioactive waste disposal options.

On February 12, 1980, culminating nearly 2 years of technical and policy review, the nation's first comprehensive program for managing radioactive waste was announced. Under this program, priority efforts for the disposal of high-level radioactive waste will be focused on land-based mined repositories with the use of emplacement in stable ocean sediments as a longer range alternative. The Department of Energy (DOE) will have lead responsibility for planning the non-regulatory waste management program and interfacing with the regulatory agencies, i.e., the Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC) (Congressional Record, 1980).

Because low-level and high-level radioactive wastes are fundamentally different in character and in disposal requirements they are discussed separately. Three study needs of major importance are then identified as subjects for Analysis and Conclusions.

Low-Level Waste Disposal

Between 1946 and 1970 the Atomic Energy Commission (AEC) licensed the dumping of more than 86,000 containers of low-level radioactive wastes at 28 recorded dumpsites in the Atlantic and Pacific Oceans and the Gulf of Mexico. The Farallon Islands sites received approximately 97% of the radioactive materials dumped in the Pacific Ocean. Approximately 96% of the recorded radioactive metals dumped in the Atlantic were received in two sites more than 100 miles off Sandy Hook and approximately 150 miles apart. Only two dumps were made in the Gulf of Mexico (EPA, 1980e).

In 1960, the AEC placed a moratorium on the issuance of new licenses for at-sea disposal of nuclear waste and designated two land locations at Idaho Falls, Idaho, and Oak Ridge, Tenn., as interim low-level waste burial sites for AEC licensees. In 1962, the first permanent commercial disposal site on land for low-level radioactive waste (in Nevada) was licensed and available for use by private organizations. Shortly thereafter, licensed facilities for commercial land burial were established in Illinois, Kentucky, New York, South Carolina, and Washington. As land burial facilities became available, AEC stopped issuing new licenses to commercial firms to collect radioactive waste to be dumped. Between 1965 and 1970 only a small amount of low-level radioactive waste was dumped, largely because land disposal is cheaper. Capacities have been reached at three of the six commercial sites, and only three sites remain open. In addition, the DOE has 14 active and 2 closed land burial sites (NSF, 1971).

Ocean dumping was discontinued in June 1970 following a policy recommendation by the President's Council on Environmental Quality (CEQ) in its 1970 report to the President. This report recommended that low-level wastes be dumped only when "no practical alternative

offers less risk to man and his environment" (CEO, 1970). This policy was incorporated into AEC regulations and, in 1972, was included in the Ocean Dumping Act. The Ocean Dumping Act, among other things, designates the EPA as the agency responsible for issuing ocean disposal permits and for environmental guidelines and standards applicable to ocean disposal of radioactive waste.

High-Level Waste Disposal

High-level radioactive wastes are generated by facilities that reprocess irradiated nuclear reactor fuel. Spent nuclear reactor fuel assemblies, if discarded, are also high-level wastes. Materials contaminated with transuranic elements from the reprocessing of reactor fuels and the fabrication of plutonium to produce nuclear weapons also require long-term isolation methods. High-level wastes are temporarily stored at reactor sites and at Federally managed sites in Washington, South Carolina, and Idaho. The United States has never disposed of its high-level wastes in the oceans, and in 1972 two major legislative initiatives were enacted prohibiting future disposal of high-level wastes into coastal waters and rivers. The Ocean Dumping Act, in addition to regulating ocean disposal of low-level waste, prohibits the dumping of high-level waste and radiological warfare agents in ocean waters. Soon after the Ocean Dumping Act was enacted, the Clean Water Act was amended to extend the prohibition to all navigable waters. Although not immediately contemplated, subseabed emplacement of high-level radioactive wastes is a future option. Present international conventions preclude the dumping of high-level wastes in the oceans; it is uncertain at this time, however, if these conventions extend to the emplacement of high-level wastes in the geologic formations of the subseabed.

Analysis and Conclusions

In 1971, the National Academy of Sciences (NAS) concluded that, in terms of ecological effects, the consensus of the scientific literature was that radionuclides are not likely to be significantly deleterious to populations of marine organisms at the dose rates estimated for the most contaminated environments. Although the NAS predictions are subject to revision in the light of new knowledge, there has been no evidence to date that past practices for radioactive waste disposal in the oceans have jeopardized the health of humans or any marine species (Dyer, 1976; Hawkins, 1980).

In 1978, scientific experts reviewed the status of our scientific knowledge on all ocean pollutants and recommended areas where further study was necessary. These experts concluded that to date, no impacts on human health have been documented from the ocean disposal of

radionuclides and no effects harmful to marine organisms are known, even at the sites of large discharges. These experts did recommend, however, that existing dumpsites be monitored for leakage of radionuclides to test the validity of present assumptions about the retention of disposed materials in the sediments, and to provide a basis for the selection of potential future disposal areas for low-level wastes (NOAA, 1979f).

Research and information needs related to existing low-level disposal sites, management of low-level wastes, and the possible subseabed disposal of high-level wastes have been identified. The needs and pertinent Federal activities are discussed below.

Effects at disposal sites for low-level radioactive wastes

Existing disposal sites provide an excellent experimental situation to study the physical, chemical, and biological processes that incorporate, transform, and accumulate radioactive elements and cause these toxic substances to migrate from the disposal canister to biological receptors (including humans). In general, this area is adequately addressed by ongoing Federal research programs.

The EPA supports research to evaluate problems and limitations associated with ocean disposal as one alternative in a low-level radioactive waste management program. The objectives of the program are to determine the fate and behavior of the radioactive waste packages that were dumped in the Pacific and Atlantic Oceans between 1946 and 1970 so that predictions of future environmental impact can be made if use of the ocean disposal alternative is again contemplated.

Since September 1980 EPA and NOAA have been discussing the areas where NOAA could assist EPA in its study of the long-term impacts of low-level ocean disposal and have jointly developed a monitoring plan. EPA and NOAA plan to enter into a memorandum of understanding by September 1981 to implement the monitoring plan.

Studies undertaken by EPA and NOAA should employ existing disposal sites to determine release rates of radioactive materials to sediments and water, to detect uptake by organisms, particularly sedentary species, and to identify bioaccumulation processes. Monitoring programs should be designed to detect any physiological or morphological abnormalities in resident biota and to identify in situ conditions where more subtle physiological processes involving radionuclides might be studied.

Management of low-level radioactive wastes

A disposal management strategy based on social, environmental, and economic factors is needed to determine the appropriate technique

for low-level waste disposal on land and in the oceans. In general, this area is adequately addressed by ongoing Federal research programs.

The EPA's Dumpsite Evaluation Program is considering sites for potential marine disposal of low-level wastes. Previously used radioactive dumpsites have been surveyed to assist in developing criteria for selection of potential disposal sites and for the development of practices for monitoring future dumpsites.

Environmental risks of subseabed disposal of high-level radioactive wastes

Assuming the environmental and technical feasibiity, the technology for subseabed disposal will be another 10 years, at least, in developmental stages. Under present national and international laws, ocean dumping of high-level radioactive wastes is prohibited. However, on both the national and international levels, the subseabed disposal option for emplacement in submarine geologic formations is being considered as a potential technical alternative.

The Subseabed Disposal Program focuses on an investigation of the environmental and technical feasibility of subseabed disposal of high-level radioactive wastes. This program is considered a long-range concept for waste isolation and is still in the evaluation stage. The program's nearterm objective is to determine whether the deep-ocean sediments are effective barriers for confinement of wastes emplaced within geologically stable and biologically inactive regions of the deep-ocean floor.

Although the subseabed disposal of high-level radioactive waste would not occur, at the earliest, until after 1995, decisions to employ this disposal option will probably be made much earlier. Environmental risks must be assessed before decisions to dispose of high-level wastes in the subseabed can be made. Basic information is needed on the stability of deep-sea sediments when exposed to different temperature conditions that might exist in the vicinity of high-level waste disposal canisters. Information on sediment characteristics is also essential in order to evaluate different emplacement technologies. A better understanding of the advection and diffusion characteristics of deep ocean waters and the migratory patterns of deep-sea animals is important for identifying potential pathways of radioactive material back to man. This area is adequately addressed by ongoing Federal research programs.

DOE and NOAA have under consideration a memorandum of understanding for cooperation to investigate the feasibility of seabed emplacement. NOAA's involvement and assistance could be in activities such as site surveying and charting of the ocean floor (using the oceanographic fleet), assessing engineering emplacement methods, reviewing the

characteristics of deep-water biological communities, reviewing data on ocean sediments as geological barriers, using the satellite system to transmit data, and assessing pollution on site.

During the period of time covered by this Plan (through FY 1985), DOE and NOAA should undertake activities to designate environmentally acceptable and geologically stable disposal sites. These joint activities should include the charting of the ocean floors at and in the vicinity of potential disposal areas, reviewing data and analyses of sediment samples to assure that the sediments are effective barriers for confinement of the waste materials, and assessing the data on biological communities at the proposed disposal sites.

BRINE DISPOSAL

A concentrated brine solution needing disposal results from the development and operation of salt dome storage cavities associated with the Strategic Petroleum Reserve Program (SPRO). Mandated by the Energy Policy and Conservation Act of 1975 (P.L. 94-163), SPRO is intended to help protect the United States from severe disruptions in the world oil supply by stockpiling crude oil. To store crude oil, cavities are formed in salt dome structures by injecting freshwater or seawater, which forms a concentrated salt solution by dissolving a portion of the solid salt structure. After alternating injections of water and withdrawals of saturated brine, the cavity is completed in which crude oil may be stored. The storage area is equipped with separate pipes to the top and bottom of the cavity. Crude oil pumped in through the top pipe rides above the saturated brine, which is denser than the oil. The addition of oil to the top layer forces brine up and out through the pipe at the bottom of the cavity. Crude oil is extracted by pumping seawater to the bottom of the cavity, thus forcing oil out through the pipe at the top of the cavity.

All SPRO salt dome storage sites are located along the coast of the Gulf of Mexico from Texas to Louisiana. Sixteen dome cavities were available to SPRO because of previous salt dome storage by the chemical and petroleum industries. Some existing cavities will be used as is, some will be expanded, and a limited number of new cavities will be created to provide the total volume needed. Large volumes of brine at 280 parts per thousand, about eight times the concentration that occurs in full-strength seawater, are produced by the process of cavity formation. For example, to mine a new 100-million-barrel storage cavity, a volume of about 700 million barrels (111 billion liters) would be injected as seawater and extracted as brine. During the routine operation of filling the cavity with crude oil, a volume of saturated brine equal to the volume of emplaced oil would normally be discharged. Seawater injected to effect removal of crude oil dissolves salt from the cavity walls, causing storage area growth as

a byproduct of crude-oil removal. This limits the number of fill cycles a storage cavity can undergo. SPRO engineers generally assume a cavity lifetime of five cycles over a period of at least 25 years (NOAA, 1980c). Currently, about 160 million barrels of crude oil are stored under SPRO (DOE, 1980). It is planned that by 1989, 750 million barrels of oil will be stored and maintained in Gulf Coast salt dome cavities.

Disposal of large volumes of nearly saturated brine solution is the primary marine environmental problem associated with SPRO. The brines are normally discharged into the Gulf of Mexico through diffusers to promote rapid dilution to background salt concentrations. However, the brines are denser than seawater and tend to flow along the sea floor, affecting bottom-dwelling organisms until sufficient dilution has been achieved. In addition, hydrocarbons and other harmful constituents may be dissolved in or entrained with the brine discharge. Brine discharges are regulated by the EPA under the National Pollution Discharge Elimination System (NPDES).

Analysis and Conclusions

To assess the environmental implications of brine discharges, the fate of brines should be predicted and monitored, and effects on marine ecosystems studied. In addition, any other potentially harmful chemical constituents found in brine require special studies.

A substantial research and monitoring program was initiated in 1977 to study the environmental implications of SPRO brine discharges. The program is funded by DOE and managed by the Environmental Data and Information Service (EDIS) in NOAA. Between 1977 and 1982, about $14.5 million was invested in modeling the fate of discharged brine and studying the effects of the discharges in the Gulf of Mexico. In general, the results of the studies indicate that the environmental effects of SPRO brine disposal are of relatively little consequence in most cases. In the future, environmental studies and monitoring are planned to continue, but possibly at a reduced level.

Information needs in this area are considered to be of lesser importance in the context of national marine pollution concerns. The interagency program funded by DOE adequately addresses the needs related to environmental implications of brine disposal. Results of earlier studies appear to justify a reduction in the intensity of these studies; information needs have been met.

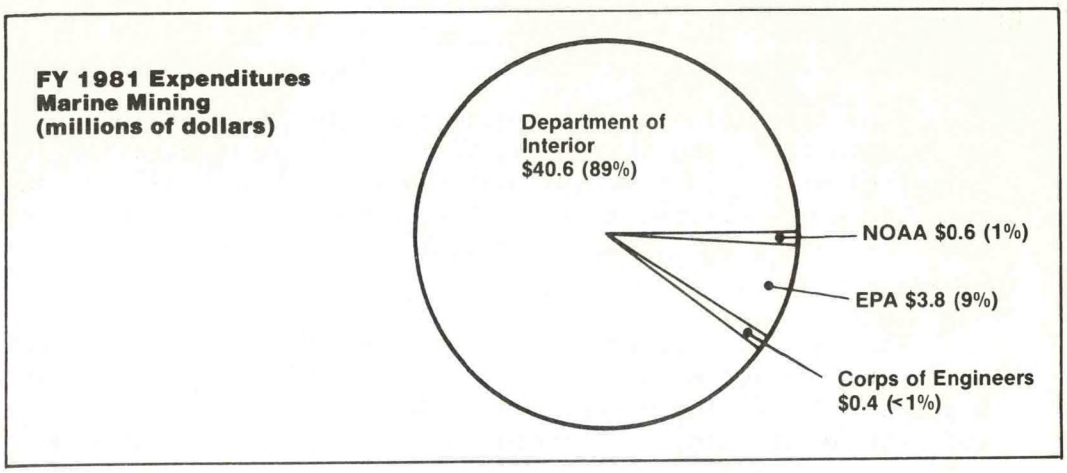
MARINE MINING

Many types of mineral resources are found in the oceans, and on or beneath the ocean floor. At present, the most significant mineral resources extracted from the continental shelf are oil and natural gas. Although limited amounts of sulfur and salt are also extracted from the shelf, pollution concerns surrounding these operations are minimal.

This section presents discussions on oil and gas extraction; sand, gravel, and shell mining; and deep-seabed mining of manganese nodules. The following table provides information on funds expended and percent of budgets allotted for research on each type of marine mining in FY 1981:

TYPE OF MINING	DOLLARS - FY 1981 (Millions)	PERCENT OF MARINE MINING BUDGET	PERCENT OF TOTAL POLLUTION PROGRAM BUDGET
Oil and gas extraction	$45.0	99%	26%
Sand, gravel, and shell mining	0.4	1%	<1%
Deep-seabed mining	<0.1	<1%	<1%
TOTAL	$45.4	100%	26%

The marine mining budget was dominated by Department of Interior research allocations for oil and gas extraction, which accounted for more than $40 million or about 89% of the total expenditures on marine mining. Marine mining research conducted by EPA was also largely related to oil and gas activities. The relatively small amount spent by NOAA and the Corps was primarily for research on deep-seabed mining, and on sand, gravel, and shell mining, respectively.



OIL AND GAS EXTRACTION

The United States, as an industrialized nation, is currently dependent on petroleum and natural gas for energy. Although the United States has significant oil and gas reserves available from sources within its boundaries, daily consumption far exceeds domestic supplies; consequently, foreign oil and gas must be imported to meet domestic needs. Escalating oil and gas prices, coupled with uncertainties in supply because of politically unstable suppliers, have led to an increased effort within the United States to accelerate the search for new domestic sources of oil and gas as well as to increase production from known reserves. As a result of major policy shifts dependence on foreign oil has been decreasing slowly since 1977. At the present time we are importing 27% of our oil supply at a cost of over $90 billion per year (Nystrom, 1981).

The development of oil and gas resources began in the United States in the late 19th century. Since that time tens of thousands of wells have been drilled in the continental United States. As readily available deposits became more difficult to locate and extract, the search for oil and gas moved from inland sites to coastal areas, then to shallow wetlands and eventually to deeper offshore areas on the outer continental shelf (OCS). Offshore oil and gas production is now a substantial portion of total domestic production. In 1980, offshore oil and gas production amounted to 8% and 23% respectively of total domestic production (DOI, 1981). More than 17,000 wells have been drilled on the OCS, and 3,600 leases, totaling almost 18 million acres, have been issued (Radlinski, 1979). At the end of 1980, there were more than 2,200 active leases covering almost 11 million acres (DOI, 1981). Less than 15% of the potentially productive area of the OCS has been leased. The Geological Survey estimates

that between 17 and 44 billion barrels of oil and 117 to 230 trillion cubic feet of natural gas remain to be discovered and produced on the OCS, and continental slope of the United States. As the search for new sources moves into deeper waters and more harsh environments, technological capabilities for safe and accident-free exploration and recovery are challenged.

In addition to providing needed energy for the nation, OCS oil and gas resources are also a sizeable national asset. States have jurisdiction over the oil and gas resources that lie within State waters, i.e., in most cases from the coastal baseline to 3 miles offshore, but the Federal Government controls development of resources from 3 miles to the outer limit of U.S. jurisdiction. Over the past quarter century more than $26 billion has flowed into the U.S. Treasury as bonus payments, rents, and royalties from oil and gas leasing on Federal lands. In 1980 income to the Federal Treasury from OCS oil and gas operations amounted to more than $5 billion (DOI, 1981).

The first offshore wells were drilled in 1896 along the coast of southern California, where natural oil seeps are common. However, extensive offshore development did not begin until 1954 in the Gulf of Mexico after passage of the Outer Continental Shelf Lands Act. The Gulf of Mexico has remained the focus of most offshore development activity since that time. More recently, exploration has begun on newly leased areas in the Atlantic and California as well as Alaska. Under the accelerated leasing schedule now proposed, new lease areas will be offered in virtually all coastal areas of the United States except for the Pacific Northwest (Oregon and Washington). The most promising unproven development areas, however, are off the coast of Alaska in the Bering and Beaufort Seas.

The Canadians have begun to extract natural gas from sites in Lake Erie. Exploratory drilling in the lake is also being carried out by the United States. However, since the resource lies within waters under the jurisdiction of the states surrounding the lake, it is not subject to Federal OCS policies.

The primary national laws governing development of the OCS are the Outer Continental Shelf Lands Act as amended (1978) and the National Environmental Policy Act of 1969. The first statute gives the Department of the Interior responsibility for managing the development of Federal OCS oil and gas resources; the second requires that Environmental Impact Statements be prepared for OCS development. On the basis of the value of oil and gas reserves as estimated by the U.S. Geological Survey, the Department determines which OCS areas will be proposed for leasing and how and when leasing will occur. A 5-year schedule of leasing activities is prepared. Proposed sites and the schedule are publicized, information on potential consequences of lease activities in the area is collected and evaluated, specific tracts for leasing are

selected for sale, an Environmental Impact Statement is prepared, additional public and Federal reviews take place, and eventually the sale occurs. All of these activities will take place in 21 months under the proposed accelerated leasing schedule.

Environmental concern related to OCS development has three focuses:

(1) The potential impact of OCS development in coastal areas, i.e., increased populations, marine transport, facilities and construction siting, etc.

(2) The effects of normal OCS exploration and production (i.e., chronic low-level spills and leaks, presence of equipment and people, increased noise levels, etc.), on the marine environment.

(3) The likelihood of accidental spills or well blowouts and their potential impact on marine resources.

The Federal Government and several other organizations have sponsored many studies aimed at oil pollution and assessment of the impact of OCS activities. In the past few years, a sizeable portion of the Federal marine pollution budget has been directed to this purpose. In the summer of 1980, the Interagency Committee carried out a comprehensive program review to examine all current Federally funded studies related to oil pollution. Conclusions and recommendations in this Plan are based in large part on information that emerged from the review. A report summarizing the review and its findings is available as Appendix 3 to this Plan.

Oil in the marine environment has been studied extensively for the past 10 years. Although unanswered questions will remain on the subject of research for many years, some conclusions are generally accepted by those who have studied the issue. Effects of spilled oil in the marine environment (in the short term) are by and large not catastrophic. The impact in coastal areas, particularly marsh and shallow estuarine environments, may be disastrous and sometimes result in long-term ecosystem alteration and economic hardships, but the number and extent of these vulnerable areas is limited, and impacted sites generally recover to maintain a population similar to that which existed before the spill within fewer than 10 years (COPRDM, 1981). This generalization does not apply to populations of top predators such as birds and mammals whose recovery rates are unknown but could be very low for species with low reproductive rates.

The frequency with which major spills occur is very low. It is estimated that 120,000 metric tons of oil are released to the oceans each year as a result of offshore oil and gas operations; this amounts to about 2% of the total annual oil input to the oceans (NAS, 1981).

The greatest problems still to be resolved relate to the possible long-term, low-level effects of OCS activities on entire marine ecosystems. These potential effects, the result of chronic low-level exposure to oil and disruption from multiple sources, will most likely be subtle and obscure. They may or may not be significant, and are likely to be of most concern in sensitive tidal estuaries with their extensive marshes that are the critical nursery habitats for most commercial fish species. There may be significant effects on species already endangered by low population levels. Limited studies of long-term effects have been carried out in historic OCS areas. There is however, considerable controversy surrounding the interpretation of results of these studies. Major adverse effects on marine resources have not been proved; nevertheless there still remain numerous concerns regarding the nature and extent of longer term effects.

Analysis and Conclusions

Research needs related to extraction of gas and oil are discussed below along with present activities of Federal agencies and recommendations for further action.

Pre-lease studies

To determine which OCS areas should be leased, for what values and under what conditions, much information must be collected and evaluated prior to a lease sale. The intention is to estimate potential impacts -- economic, social, and environmental -- resulting from OCS development in a proposed area and to use this information to delete or modify conditions of operation. This information is also used to prepare Environmental Impact Statements. Characterization information, specific to the lease area or to potentially impacted coastal areas, is collected describing resident marine populations and endangered species, fishery resources, meteorological and geological conditions, physical oceanography characteristics, and air and water quality and ice hazards where appropriate. This area is adequately addressed by ongoing Federal research programs.

The Bureau of Land Management (BLM) of the Department of the Interior is the Federal agency responsible for administration of the OCS leasing program. The main science program supporting the OCS leasing process is the Environmental Studies Program whose primary purpose is to collect the information necessary for regulating OCS development -- before a lease is granted as well as during exploration and production phases. Within this program, BLM coordinates and manages all OCS-related environmental studies within the Department of the Interior. The Environmental Studies Program is carried out under contract with private scientific organizations and academic institutions

and by interagency agreements and memoranda of understanding with other Federal agencies. Since 1975, NOAA has managed most of the environmental studies program for Alaska under the Outer Continental Shelf Environmental Assessment Program (OCSEAP). In addition, the Fish and Wildlife Service (F&WS) and U.S. Geological Survey (USGS) are actively involved in the Environmental Studies Program. F&WS collects characterization information on potentially affected fish and wildlife resources. The USGS carries out studies to estimate the potential value of the oil and gas resource at specific sites and to identify geohazards. A recent change in administration policy, however, has shifted responsibility for tract-specific geohazard studies from USGS to industry. Other Federal agencies, primarily EPA and NOAA, carry out research programs that contribute information to pre- and post-leasing decisions. In FY 1980, the Environmental Studies Program spent $35 million, most directed toward collecting pre-leasing information. Programs of the other Federal agencies not directed exclusively at pre-lease information amounted to about $4.4 million.

Available information appears to support the conclusion that in temperate waters where extensive development has already taken place, except for selected highly vulnerable coastal areas, the short-term effects of OCS development are not significant. (This statement cannot be made as conclusively for arctic areas where development is just beginning.) Consequently, the likelihood that inadequate environmental information will result in bad leasing decisions is not high. Furthermore, environmental considerations are only one set of factors influencing leasing decisions. Economic, social, and political considerations are also significant.

Pre-lease studies as carried out until FY 1981 should be reduced to provide only the information necessary to identify areas highly vulnerable to adverse impact from OCS development. The study coverage need not be specific for each proposed tract, but may be extended to entire regions or basins with the objective of identifying highly vulnerable areas that should not be leased, or potentially vulnerable areas where further study should be concentrated before leasing decisions are made. Steps in this direction are already being taken by BLM. While the intention is to accelerate the leasing process, the modified approach also makes good sense from the environmental perspective.

Long-term effects of OCS exploration and production

The most significant questions that remain unanswered for OCS development are those concerning the effects on ecosystems of long-term, chronic low-level exposures resulting from the accidental spills, leaks, and disruptions caused by development activities. Whether OCS

development is deleterious in the long term is heavily debated. Much controversy focuses on impact studies, particularly scientific methodologies and interpretation of environmental data; consequently, studies of long-term effects are among the most important marine pollution needs. Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future.

One of the earliest reported studies was funded by the petroleum industry and executed by the Gulf Universities Research Consortium. This 2-year study, which looked at low-level but short-term impacts, has been questioned as not being adequately rigorous. Summary reports published in 1974 apparently do not accurately reflect the data and reservations of some of the investigators, and the study conclusions cannot be extrapolated to predict longer term effects. From 1975 to 1978 EPA and NOAA cooperated in the Buccaneer Field Study which attempted to evaluate the impact of OCS activities in a Gulf of Mexico gas field. The limited scope and time frame for this study make wide-scale application of its conclusions questionable. The National Academy of Sciences is currently revising its authoritative 1975 report, "Petroleum in the Marine Environment," to incorporate knowledge acquired since its original publication. This revision, scheduled for completion in 1982, should resolve some of the controversy and provide guidance for future oil pollution research.

Of particular concern in open-water areas are the effects on entire ecosystems of drilling muds, drill cuttings, and formation waters discharged during exploration and production. These discharges may contain low concentrations of metals and drilling mud additives that are known to be toxic in laboratory studies. In coastal environments, there is the additional concern for the effect of chronic leakage from wells and pipelines. Other potential problems are the effects of OCS construction. Installation of drilling rigs or gravel islands to support development endeavors may contribute to destruction of fishery habitats or affect fish populations and behavior.

Long-term, low-level effects are likely to be subtle and difficult to assess. New approaches and methods must be developed for their detection. The most reliable approaches will probably involve investigations in areas such as organism growth, reproduction, behavior, and biochemical transformation. A useful index will be changes in community composition. These changes result from all of the less easily measured effects listed above. Approaches using fish and bird populations and their behavioral alterations may also prove useful.

A necessary element in any study to assess the long-term effects of chronic low-level pollution is the determination of natural or baseline conditions against which new conditions can be compared to detect changes. Marine environments are characterized by great

physical variability that causes large fluctuations in biological populations and distributions. Because of this variability, it is difficult to establish any kind of reference on which to construct a program that can demonstrate the ecological perturbations that may be occurring. The methodology that has been used to date, primarily unfocused monitoring, is generally unsuited to assessing the environmental effects of chronic low-level effects. Only in coastal areas with fairly stable environments can such an approach be cost effective and successful. Such coastal areas however, are few in number. Better methods must be developed for establishing baselines in open-water marine environments.

The need for estimation of environmental recovery rates, especially for areas in the Arctic, is as important as the need for long-term effects research. A knowledge of recovery rates is essential for predicting long-term impacts on commercial fisheries and on the subsistence lifestyle of native populations, which rely on the maintenance of adequate levels of birds and mammals.

Very few studies addressing long-term effects in either historic or frontier lease areas are currently carried out by the Federal Government. Although many laboratory studies are under way, few field studies are in progress. EPA and NOAA have sponsored studies of areas where natural oil seeps occur in Southern California; some conclusions regarding the long-term impact of low-level exposure on resident populations may be extrapolated to predict potential OCS impacts.

Laboratory studies sponsored by EPA include a project addressing the fate and behavior of oil in ecosystems, focusing on benthic organisms in contaminated sediment with the objective of developing numerical criteria for describing the quality of contaminated environments. EPA has also sponsored mesoscale microcosm studies to evaluate the effects of oil on small ecosystems contained within controlled environments.

NOAA, through the National Marine Fisheries Service, is conducting studies of chemosensory and behavioral effects of oil on some representative marine organisms (crabs) and fish. NOAA has developed analytical methodology for hydrocarbon measurements and has also investigated metabolic byproducts caused by petroleum components. Other NOAA studies have investigated cytotoxic and mutagenic effects on fish eggs and larvae, and physiological responses of fish to low levels of oil.

NIEHS is working at a very basic level to understand cellular perturbations due to some petroleum-related compounds. BLM has sponsored tissue structural studies on the Bowhead Whale in an effort to learn more about Bowhead physiology and develop methods for providing bioassay type information for these large endangered animals.

EPA has conducted toxicological studies on drilling fluids and plans to terminate this program in FY 1982. Although controversy exists on the direct and indirect detrimental impact of drilling fluids, the greatest uncertainty still focuses on their long-term effects.

Other Federal agencies have responsibilities during exploration and production phases of OCS development. Three biological task forces have been established by the Department of the Interior to advise on aspects of oil and gas operations that affect biological resources in several lease sale areas -- Georges Bank, Mid-Atlantic, and Beaufort Sea. Although the scope of responsibilities varies somewhat, the primary role of the task forces is to develop technical advice and recommendations for USGS on OCS activities.

The Coast Guard formulates regulations concerning the safety of life and property; USGS formulates regulations regarding the safety of drilling practices and monitors development activity. It is primarily the responsibility of industry to develop the necessary safety and preventive technology to avoid blowouts and spills, but USGS also carries out some studies along these lines to support its regulatory and monitoring responsibilities. None of these contributes to long-term effects studies.

It is concluded that a long-term interagency research program should be planned and implemented to investigate the potential long-term, low-level effects of oil and gas development on the OCS as well as other ocean use activities. This program should be jointly implemented by the Federal Government and private industry as OCS development takes place (See Chapter V, OCS Environmental Studies).

Onshore impacts of offshore activities

The opening of offshore areas for petroleum development has repercussions on land. Increased populations in coastal areas, which could result from OCS development, could be accompanied by expansions in construction, energy consumption, and waste disposal, as well as increased pressure on adjacent marine environments. In some undeveloped areas, the economic and social impacts resulting from OCS activities may be significant. Unfortunately, the historic record from past OCS activities is not sufficient to assess the sensitivity of the assumptions above. In the Gulf of Mexico the historic record of OCS onshore impacts was not compiled as development proceeded. Recent efforts to assess those impacts have been partially successful but demonstrate the difficulties associated with separating the impacts of several activities on one area. In the remaining OCS areas, development has not been sufficient to produce significant measurable onshore impacts. This area is adequately addressed by ongoing Federal research programs.

BLM devotes approximately 5% of its annual Environmental Studies Program budget to studies of social and economic impacts resulting from OCS operations. A substantial portion of this investment is used to assess the impacts of potential OCS operations on native and non-native populations in Alaska. These studies include cultural as well as social and economic impacts. In the remaining OCS areas, social, economic, and other secondary impacts of OCS development are projected using the Harris econometric model. Special studies are designed to provide critical information not developed by the model. In the Gulf of Mexico these special studies have included an assessment of the impacts of the IXTOC oil spill on the Texas coast, the economic benefits of OCS platforms for the recreational fishing industry, and a series of "coastal characterizations." The characterizations provide information on local socioeconomic systems and relate changes in these systems through the past 25 years to various causes. USGS prepares "Summary Reports" to document some post-sale activities that can be related to socioeconomic impacts. These reports are limited to the most direct impacts resulting from the sale and do not address all secondary impacts. To date, no sale has produced a significant measurable impact.

The socioeconomic research related to OCS oil and gas activities lacks a coherent and comprehensive theme. Major research efforts include impacts on undeveloped areas (principally Alaska) and the effects of oil spills on social or economic resources. In many instances, environmental research cannot be coupled with parallel socioeconomic research to produce reliable impact analyses. In OCS areas other than Alaska, relevant socioeconomic data need to be synthesized on a regional basis, to determine their applicability to impact assessment and potential post-sale monitoring.

A standard approach to assessing and monitoring the social and economic impacts of OCS development needs to be developed. Such monitoring should parallel environmental monitoring of OCS activities to produce a comprehensive analysis of development impacts. The standard approach should be designed to incorporate specific characteristics of various OCS areas without major alterations of the strategy, and should reflect the full range of social and economic problems associated with OCS development. The wide range of social-science expertise available should be fully utilized in planned programs.

SAND, GRAVEL, AND SHELL MINING

There is a large demand in the United States for sand, gravel, and fossil oyster shell. These materials are primarily used as construction aggregate although considerable amounts of clean sand are also required for beach nourishment, and fossil shell may also be used for the production of cement, masonry block, and poultry feed,

or as cultch in the establishment of new oyster beds (Esprey, 1977). The primary means by which these materials are extracted from subaqueous deposits is hydraulic dredge, although mechanical dredges may also be used. In the mid-1970's, about 900 million short tons per year of sand, gravel, and shell were mined and sold in the United States (Duane, 1976). Of the total, about 5% (45 million tons) was sand and gravel dredged from subaqueous deposits, and about 3% (20 million tons) was fossil shell mined from subaqueous deposits.

Sand and gravel mining is most common along the California, Great Lakes, and northeast coasts; shell mining occurs mostly along the coast of the Gulf of Mexico. Requirements for sand, gravel, and shell are expected to increase in the future, at least doubling by the year 2000. In addition, deposits in coastal areas will contribute proportionately more to the total requirement as terrestrial deposits are mined out or become inaccessible through competition with other land use options, and as a result of environmental problems associated with terrestrial mining. Some analysts predict that sand and gravel mining will move into deeper waters, probably on the Atlantic continental shelf, within 5 to 10 years (NOAA, 1979f). On the U.S. continental shelf, 13 billion cubic yards of sand and gravel (mostly sand) has been inventoried along the 28% of the inner shelf that has been surveyed by the Army Corps of Engineers (Williams and Meisburger, 1981). In addition, USGS has conducted resource inventories on the middle and outer continental shelf. It is possible that large volumes of sand and gravel could be required in the future for offshore construction of deepwater ports or lightering stations, nuclear power plants, desalinization plants, waste treatment facilities, or other offshore construction projects.

Regulation of sand, gravel, and shell mining is a joint State-Federal concern when the deposit is located within State waters (defined for most coastal states as being within 3 miles of the baseline from which the territorial sea is measured). All sand, gravel, and shell mining in the United States now occurs within State waters. Most coastal states have developed a permitting procedure that may grant the successful applicant an exploration permit and a mining permit or lease, and require the payment of a lease fee or royalty to the State treasury. In addition, as mandated by the Rivers and Harbors Act of 1899, the Department of the Army, represented by the Corps of Engineers, reviews applications and issues permits for mining in navigable waters. Thus, a commercial sand, gravel, or shell mining operation is generally required to acquire permits from both the State and the Corps. In the review of permit applications, the Corps coordinates with appropriate State agencies, the EPA, and NOAA. According to the Outer Continental Shelf Lands Act of 1953, as amended, the mining of sand, gravel, or shell deposits occurring beyond State waters on the continental shelf would be regulated by the Department of the Interior. The Secretary of the Interior assigns responsibility

for regulation of OCS mineral mining to BLM and USGS. No Department of the Interior leasing program is now in place for offshore sand and gravel or shell mining. In the absence of such a program, no such mining can legally occur beyond State waters. The Department of the Interior called for expressions of interest in offshore mining of hard minerals in the Federal Register of January 5, 1981 (p. 1037). If an adequate level of interest in leasing offshore areas is expressed by commercial operators, the Department of the Interior will consider developing a leasing program. One likely area of interest is the Beaufort Sea, where gravel may be mined for the construction of artificial islands used as bases for extracting offshore oil.

All mining of sand, gravel, and shell now under way in the United States occurs in shallow coastal areas, which are highly productive and are also subject to impacts from other types of pollution. Therefore, the potential exists for environmental harm to result from coastal mining practices. Adverse effects may result from disruption of benthic habitat, burial of organisms by siltation, increased levels of suspended particulates, and alteration of current and erosion patterns caused by changes in bottom topography. Recovery from the disruptions may be rapid (within months), or adverse effects may persist, depending on the specific situation. For example, borrow pits are known to persist, accumulate very fine sediments, and develop anoxic conditions in bottom layers. In addition, shoreside stockpiling, processing, and transport of sand, gravel, and shell may also have environmental implications.

Analysis and Conclusions

For the reasons outlined above, mining of sand, gravel, and shell is recognized as a pollution threat of relatively minor consequence in the marine environment. A considerable amount of research, development, and monitoring effort has already been directed at this issue.

Much of the information on physical effects of dredging generated by the Corps Dredged Material Research Program (DMRP) is applicable to sand, gravel, and shell mining (COE, 1978). In addition, past and continuing Corps, USGS, and NOAA activities include biological effects studies, an inventory of offshore sand and gravel resources, studies of subaqueous borrow pits created as a result of beach nourishment, and studies of borrow pit effects on current and erosion patterns in coastal areas. Corps studies are also evaluating the feasibility of emplacing dredged material in existing borrow pits as a disposal option. NOAA has conducted effects studies and resource inventories in the Great Lakes, New York Bight, Mid- and South Atlantic, Southern California, Virgin Islands, and Hawaii.

Research or information needs related to the effects of sand, gravel, and shell mining, and the management of these activities

have been identified. These needs, discussed below, are considered to be of lesser importance in the context of national marine pollution concerns.

Immediate and long-term effects

Because it is predicted that national requirements for sand, gravel, and shell will continue to increase, and proportionately more of these materials will be taken from subaqueous deposits, it is important to understand and predict the environmental consequences of mining activities. The spectrum of these consequences has been briefly discussed above. If a trend develops toward Federal leasing for offshore mining, information on the environmental implications of these activities should be acquired to assist in developing the leasing procedure.

Past and ongoing NOAA and Corps programs address the immmediate and long-term effects of sand, gravel, and shell mining. Past Federal, State, and private research has adequately described the effects of sand, gravel, and shell mining in general. Site-specific research and monitoring may increase the level of understanding in certain cases.

A trend toward mining in deeper water might require research to determine whether significant effects are associated with mining farther offshore. If OCS oil activities and hard-mineral mining occur in the same area, BLM is prepared to apply research results to both activities when appropriate.

Management of mining operations

Very large amounts of sand and, to a lesser extent, gravel and shell are available on the continental shelf. Therefore, the location of a mining operation is somewhat flexible, and sites may be selected with consideration of environmental factors. In addition, a number of alternative dredging techniques and other management options are available. This flexibility makes sand, gravel, and shell mining a prime candidate for operation management to minimize adverse environmental effects. However, good management must be based on good information. Resources should be inventoried, reconnaissance and monitoring studies conducted, mining techniques evaluated and improved, and criteria developed for selection of sites and techniques.

Resource inventories have been conducted by NOAA, USGS, and the Corps. Development of improved dredging techniques is continuing in the Corps. Management of mining activities in State waters is largely a State responsibility; therefore the precise role of the Federal Government is difficult to define. If the Department of the Interior

decides to lease offshore areas for sand and gravel mining, resource inventories and effects studies should be conducted to support development of the leasing process.

DEEP-SEABED MINING

Deep-seabed mining involves recovering manganese nodules from the floors of the oceans and processing to refine the minerals in these nodules into commercial materials. Manganese nodules are fist-sized lumps of minerals found on the floors of all oceans and in some lakes. They occur in areas of low sediment deposition and are the result of slow accretion processes that concentrate minerals from surrounding waters and sediments. The economic value of these polymetallic deposits lies in their commercially attractive quantities of copper, cobalt, and nickel as well as manganese. Worldwide estimates place quantities of manganese nodules between 29.4 and 69.4 billion dry tons (DOI, 1976).

Exact composition of the minerals within the nodules varies with geographic location. Most commercially attractive nodules are thought to lie in an east-west belt in the east central Pacific Ocean at depths of 4,000 to 5,000 meters. This area, approximately 13 million km^2, is estimated to have higher concentration of nodules than other surveyed areas and to contain between 4 billion and 15 billion dry tons of this material. This high density coupled with high average percentages of economically important nodule metals (1.25% nickel, 1.03% copper, 0.23% cobalt and 25.2% manganese) provides the incentive for initial commercial exploitation of this region (NOAA, 1981a).

Four metals found in the nodules are essential to industrial production in the United States and around the world; nickel, manganese, and cobalt are critical components of steel and other alloys, and copper is essential to the power, electronic, and computer industries. Although the United States is the world's largest producer of copper, it consumes more than is available domestically. Furthermore, the United States is almost entirely dependent on foreign sources for nickel, cobalt, and manganese, and because cobalt and manganese are imported from potentially unreliable sources, they could become of severe strategic significance within the near future. Consequently the incentives are both economic and strategic for development of deep-ocean mining technology to recover the mineral resources of the deep seabed.

The geographic areas of the deep seabed most likely to be exploited in first-generation mining are areas that are currently in international waters under the jurisdiction of no one nation. If the pending Law of the Sea treaty enters into force, however, these areas will be subject to some amount of international jurisdiction. Five international

consortia, four with American participants, are currently interested in exploitation of manganese nodules. On the basis of an analysis of metal supply and demand, it has been projected that the first mining activities, those in the Pacific manganese belt, will progress through three generations between the years 1988 and 2040. The first generation, from 1988 to 1995, could involve the initial consortia mining nodules at rates compatible with world demand for nickel, with processing plants located on land. Second-generation mining, from 1995 to 2010, could involve an additional 5 to 10 mining consortia, some associated with large processing plants accommodating several mine sites, some of which might be sea-based. Third-generation mining could be maintained until 2030 or 2040 and could level off with 25 to 30 operational sites at one time and 10 to 20 processing plants worldwide (NOAA, 1981a). Although exact sizes of mining sites have not yet been determined, estimates call for areas of approximately 40,000 km^2.

Although commercial mining operations have not started, a generalized scheme can be predicted. A typical mining operation will employ a surface vessel to which is attached a nodule "collector" that is towed or propelled along the ocean floor beneath the mother ship. Nodules and sediments will be skimmed off the seabed surface by the collector, with the majority of sediments being winnowed out before the nodules are transported to the surface by a connecting pipeline. Additional sediment will be removed at the surface, and the relatively "clean" nodules transferred to another vessel, to be taken to processing plants on land (for the first-generation operations). The processes to be used for mineral refinement are uncertain at present since the industry is new and process modifications or development may be required. Similarly, the exact location of processing plants and the mode of waste disposal are not yet decided. Under preliminary consideration for location of the first processing plant are the Gulf of Mexico, the U.S. Pacific Coast, and the island of Hawaii.

To encourage the orderly development of the deep-seabed mining industry and assure appropriate environmental safeguards as the industry develops, the Deep Seabed Hard Minerals Resources Act (P.L. 96-283) was passed by the United States Congress in 1980. This legislation sets up a licensing and regulatory scheme for U.S. citizens under the Department of Commerce (NOAA) and requires that NOAA draft and implement a 5-year research plan and environmental assessment program addressing the environmental consequences of deep-seabed mining, sea-based processing, and ocean disposal of processing wastes. It provides for reciprocity with other nations carrying out similar activities with appropriate environmental protection.

Because of the relatively large quantities of materials involved, marine environmental concerns related to deep-seabed mining revolve around (1) disruption of the sea-floor and associated benthic biota,

(2) ecological consequences of the surface discharge plume, and
(3) environmental effects of the ocean disposal of wastes from the refining processes.

Analysis and Conclusions

Initial environmental concerns focused on the potential impact of increased concentrations of suspended particulates on the benthic and surface biota, and on potential changes resulting from introduction of bottom water, sediments, and abraded nodule fragments to the near-surface environment. These concerns were investigated by NOAA under the Deep Ocean Mining Environmental Study (DOMES) program, which began in 1975. DOMES examined the environmental conditions in the area of the tropical Pacific where mining would first occur and monitored industry field tests conducted in 1978.

As a result of the DOMES program, it has been concluded that many of the original environmental concerns are probably insignificant. However, several questions are still unresolved, and many of the DOMES conclusions need to be verified by experience under realistic mining conditions. Because of the nature of the industry field tests, only near-field (5 to 10 km from the point of operations) and short-term (less than 1 week) effects were monitored; effects of a potentially catastrophic nature were not detected. Although commercial recovery of manganese nodules is not expected within the next 5 years, legislation requires that regulations for exploration and recovery be issued within that time frame.

Three kinds of information are needed relative to deep-seabed mining. These needs, discussed below, are of lesser importance in the context of national marine pollution concerns and should be continued in the future at a relatively low intensity.

Impact of nodule recovery

As a result of investigations carried out under the DOMES program, much basic information has been obtained on the nature and extent of disruption likely to be caused by the recovery system (NOAA, 1981a). Typically the collector head will scrape the sea floor to a depth of 10 cm, disturbing about 70% of the sea floor in the area mined. Most of the sediment collected by the mining head will be discharged near the sea floor and is expected to resettle relatively close to the collector track. However, a substantial fraction of this material will be extremely fine and will settle very slowly, subjecting large benthic areas (3,000 to 5,000 km^2) to elevated particulate levels for a period of a year or so as a result of one ship's mining activity (NOAA, 1981d).

Behind the mother ship, the surface sediment plume will be detectable for 100 km or more, with a width of 20 to 30 km; however, the average particulate loading in this plume will be fairly low. Particulates will significantly reduce the amount of light available for photosynthesis by the phytoplankton but this effect is expected to be temporary (a maximum of 50% reduction in primary productivity, decreasing to insignificant amounts within 3 to 4 days) and relatively local (20 x 2 km behind the ship). Additionally, laboratory and field experiments indicate that nutrient enrichment due to introduction of bottom waters and changes in species composition or mortality rates due to increased particulate loading are unlikely.

There has been concern that dissolved trace metals could be introduced to near-surface waters as a result of the discharge of bottom materials from the mother ship. No such increase has been detected during field or laboratory tests.

Because of the short duration and intermittence of industry field tests (i.e., only 54 hours of continuous mining), the DOMES program monitored only short-term and near-field effects; thus, several preliminary conclusions have been based on only one or two data points. Additional information is needed to evaluate the longer term, far-field effects and to verify preliminary conclusions reached in DOMES I & II. More detailed measurements are especially needed in order to verify and improve the predictive models developed in DOMES. Since these models form the basis for impact prediction and monitoring programs, this aspect of the research programs is essential.

Very little is known about the biology of deep-sea organisms or the role they play in deep-ocean food webs. Of particular concern is the impact on the benthos of various rates of resedimentation due to the benthic plume as well as recolonization rates of deep-sea organisms after an area has been mined.

The Deep Seabed Hard Mineral Resources Act requires industry to monitor the environmental effects of exploration and commercial recovery activities. Monitoring plans for environmental assessment must be agreed upon by NOAA and become part of the conditions of exploration licenses and commercial recovery permits. Data submitted by the licensee and permitee will form the major input for determination of the short- and long-term impacts from marine mining. However, some independent research by the Government will be required to define effective monitoring strategies and to evaluate the significance of the resulting data.

Further studies on the impact of nodule recovery operations are not planned for the immediate future. They should be considered for implementation in cooperation with industry when the first commercial mining operations begin, probably in 1988.

Marine impacts of waste disposal from nodule-processing operations

First-generation processing plants will be located on land; their waste products will be subject to the same permit and regulatory requirements as other industrial operations. One option being considered by industry for waste disposal is at-sea discharge through outfall pipes or ocean dumping. In order to assess the acceptability of such disposal, information on the potential effects of these wastes on the marine environment must be obtained and evaluated. Because the industry is new, the nature and characterization of processing technology and consequent wastes have not been determined, and meaningful effects studies cannot be carried out. However both should be possible by the mid-1980's when demonstration processing plants are expected to be operative. At that time, reject material more representative of commercial scale wastes will be available. There is a contradiction in the timing of studies since waste characterization and effects studies need to begin early in order to give industry and government a preliminary indication of the acceptability of ocean disposal. It will be the Government's responsibility to issue specific guidelines for toxicity testing of processing wastes and monitoring the environment after wastes have been disposed in the ocean. It is also the responsibility of Government to evaluate the acceptabiity of waste disposal plans proposed by industry. Applications for commercial recovery, which will include waste disposal plans, may be filed as early as 1984. A limited amount of research by the Government may be required in order to evaluate disposal options. The majority of research, however, will have to be conducted by industry since it is industry's responsibility to provide to the Government sufficient information on wastes and their behavior in seawater for determining potential environmental impact.

Initial research requirements should focus on obtaining first-order estimates of waste characteristics so that potential problem areas can be identified and appropriate studies planned. Key concerns are whether waste components are inert or react with seawater to form undesirable compounds and physical characteristics.

Federal activities include a five-year research plan (FY 1981 - FY 1985) (NOAA, 1980b) that addresses all environmental concerns related to deep-seabed mining and ocean disposal of processing wastes. This Plan was developed by NOAA in consultation with other agencies and places initial emphasis on characterization of processing waste. Later studies recommend emphasizing field work in conjunction with industry equipment tests. A cooperative program between NOAA and the Bureau of Mines is under way in FY 1980 - FY 1983 to characterize probable processing wastes. An additional program is funded by NOAA and EPA on ocean disposal strategies, and the Bureau of Mines is funding a study of onshore disposal of processing waste.

The planned decrease for FY 1981 and FY 1982 from minimal levels in FY 1980, will affect planning for long-term effects research and monitoring of continuous industry mining tests scheduled for 1984. Consequently, studies designed to improve estimates of long-term impacts cannot be completed in time to incorporate results into permit conditions from initial applications.

Although mining cannot be initiated prior to 1988, permit applications are expected to be submitted in 1985. Since it takes at least two years to incorporate research results into a regulatory framework, the present research schedule will not allow results of needed studies to be used in formulating regulations for initial permit applications. Given the time frame within which deep-seabed mining is likely to develop and the nature of other marine pollution problems, however, the planned level of effort appears to be appropriate.

Stable reference areas

P.L. 95-283 requires negotiation with other deep-seabed mining nations to establish "stable reference areas" -- areas of the ocean to be set aside where no manganese nodule mining will occur. These areas will provide undisturbed control regions against which the environmental effects of deep-seabed mining can be evaluated in the future.

Existing data should be analyzed to determine what, if any, additional studies must be conducted to provide the Department of State with the information necessary for international negotiations regarding these stable reference areas.

Although this concern is addressed in the deep-seabed mining five-year research plan, no Federal activities are planned until such an analysis is completed. This position appears to be appropriate, but could be reevaluated during the next five-year research plan period.

MARINE ENERGY

Over the past few years, costs of imported and domestic oil and gas exploration and development have increased. As a result, alternative energy technologies in the oceans have received considerable attention as a potential energy source. Among these, Ocean Thermal Energy Conversion (OTEC) has been projected to have the greatest potential for producing usable amounts of energy. Research and development in other ocean energy technologies have included ocean winds, currents, tides, waves, salinity gradients, and aquatic biomass conversion, but have been limited. Therefore, environmental research

conducted on OTEC is discussed separately here and the other technologies are treated as a group. The following table provides information on budgets for environmental research on marine energy technology in FY 1981 exclusive of offshore fossil and nuclear energy development.

ENERGY TECHNOLOGY	DOLLARS (Millions)	PERCENT OF MARINE ENERGY BUDGET	PERCENT OF TOTAL POLLUTION PROGRAM BUDGET
OTEC	$3.0	99%	2%
Other	<0.1	1	<1
TOTAL	$3.0	100%	2%

Expenditures for pollution research related to marine energy technologies are dominated by OTEC funds from the Department of Energy. However, all support for the OTEC program has been eliminated from the FY 1982 DOE budget.

OCEAN THERMAL ENERGY CONVERSION

Ocean Thermal Energy Conversion (OTEC) is a process for using the energy stored in warm surface waters of the ocean to produce energy. The OTEC process is driven by the temperature differential between warm surface waters and cold deep waters. Two OTEC processes -- closed cycle and open cycle -- are believed to be economically and technically feasible in the near future.

The closed-cycle process employs a working fluid (such as freon or ammonia) in an enclosed system of pipes. The fluid is vaporized by passing through a heat exchanger warmed by ocean surface waters. The vapor is then passed through a gas turbine to produce work, and is finally condensed by passing through another heat exchanger cooled by cold water drawn up from the ocean depths. The process is repeated continuously, using warm ocean surface waters as the energy source.

In the open-cycle process, seawater itself is used as the working fluid. Warm surface water is pumped into an evaporator in which the pressure is reduced to the point where the seawater boils and about 1% evaporates. The resulting steam passes through a turbine to produce work and is then condensed into a liquid in a cold-water heat exchanger. Because dissolved salts do not accompany the surface water when it is evaporated, the condensed steam is freshwater, and

is a valuable byproduct. To maintain the efficiency of the open-cycle process, it is necessary to remove noncondensable gases, such as oxygen and carbon dioxide, before the steam passes through the turbine. These gases must be discharged to the atmosphere, reinjected into the water being discharged from the OTEC plant, or used in the onboard production of a product.

The earliest commercial applications of OTEC are expected to employ the closed-cycle process. Some of these will take the form of OTEC facilities moored or fixed to the seabed or partially located on land. However, the OTEC process can also be implemented on ships, which couple energy-intensive manufacturing operations with OTEC plants moving freely over the ocean surface, following optimal water temperature differences while producing energy.

A temperature difference of at least 18°-20°C between surface and deep ocean waters is projected to be sufficient for cost-competitive operation of the OTEC process in selected markets today (NOAA, 1981b). With a temperature difference of 20°C, a 100-MWe (megawatts electrical capacity) plant would require intake of surface water at a rate of 400-700 cubic meters per second. Similar flows of cold ocean water from depths would also be required. Lesser flowrates would be required in areas of greater temperature differential for the same power output, and correspondingly greater flow rates would be necessary in areas of smaller temperature differential. Areas of the ocean under United States jurisdiction where temperature differences provide the most promising conditions for OTEC development include the Gulf of Mexico area and tropical islands such as Hawaii, Puerto Rico, Virgin Islands, Guam, and the Commonwealth of the Northern Mariana Islands.

Recognizing the need for a defined, stable, legal regime to enable private industry to proceed with commercial development of OTEC, Congress enacted the Ocean Thermal Energy Conversion Act of 1980 (Public Law 96-320). The Act assigned NOAA responsibility for implementing the legal regime, including developing a licensing system, and monitoring licensee compliance with diligence and environmental protection requirements. The Administrator of NOAA was further directed to develop a program plan for OTEC environmental effects assessment and to initiate an effects assessment program. The first program plan was submitted to Congress in the summer of 1981 (NOAA, 1981c).

Development of OTEC technology has been the responsibility of the Department of Energy, in close cooperation with private industry. This activity was stimulated by passage of the Solar Energy Research, Development, and Demonstration Act (Public Law 93-473) in 1974.

As part of its responsibility for developing OTEC technology DOE has conducted studies assessing environmental effects associated with

commercial OTEC development. NOAA is responsible for the Federal OTEC licensing program and for assessing environmental effects related to Federal licensing activities and long-term effects.

NOAA and DOE have coordinated activities to assure the full and timely development of the necessary environmental data. The NOAA OTEC Environmental Effects Assessment Plan (NOAA, 1981c) was designed to complement ongoing DOE studies so that programs of the two agencies together will meet identified needs.

Analysis and Conclusions

Information requirements for OTEC have two focuses. Studies in the following areas are of lesser importance in the context of national pollution concerns. Studies in these areas have already been undertaken by DOE and further analyses are most appropriately funded in the context of private-sector development efforts.

Assessment of impacts from single OTEC plants

Near and far-field effects of commercial OTEC development must be determined to anticipate, define, and, if necessary, mitigate environmental impacts that may occur. This will require the conduct of research in the following areas:

- Entrainment and Impingement -- The quantity of marine biota that will be entrained by OTEC facilities or impinged on intake screens under normal operating conditions has been estimated. These estimates must be experimentally verified. Assessments must be made of possible effects on composition and abundance of organisms in the vicinity of OTEC facilities.

- Attraction and Avoidance -- The ecological effects of planktonic and nektonic species being attracted or repelled by OTEC platforms must be assessed.

- Biocide and Working Fluid Discharges -- The effects on marine biota of biocides and other chemicals associated with OTEC activities must be determined.

- Redistribution of Deep Ocean Waters -- Water mass displacements resulting from OTEC operations have been predicted, and the site-specific effects of this redistribution on phytoplankton and productivity should be determined. Possible positive effects on mariculture should also be evaluated.

- Environmental and Socioeconomic Effects Onshore -- Shoreside socioeconomic impacts may result in temporary population

increases and associated pressures on coastal ecosystems. These impacts should be assessed.

- Seafloor Cables and Pipelines -- The effects on benthic organisms and habitats resulting from emplacement of submarine electrical transmission cables or pipelines must be determined.

In particular, there is a need to assess the long-term effects of these multiple factors on commercial and recreational fisheries. DOE has carried out programs addressing most of the problem areas identified above. In addition, it has engaged in several at-sea OTEC demonstration projects which have shown the environmental effects of OTEC to be relatively inconsequential.

Assessment of cumulative OTEC impacts

The OTEC Act of 1980 specifically requires NOAA to assess cumulative effects of large-scale commercial OTEC development. The NOAA Administrator is directed to establish upper limits on the total number or capacity of OTEC plants to be licensed, either in specific geographic locations or overall, if assessment demonstrates a need for such limits.

Assessments of cumulative impacts of OTEC development were made in 1980 under DOE auspices. These activities included a workshop to consider the possible environmental consequences of OTEC operation on the natural physical, chemical, and biological processes of the oceanic systems (DOE, 1981). Additional work remains to be done to assess the larger and more significant questions regarding large-scale cumulative impacts of commercial OTEC development. This work should estimate the cumulative effects on (1) oceanic physical properties (especially water movements and temperature), (2) oceanic chemical properties (especially concentrations of nutrients and toxic substances), (3) biological properties (especially production and ecosystem integrity with special emphasis on the long-term risk to fisheries), and (4) climate of specific regions as well as the global climate.

OTHER ENERGY TECHNOLOGIES

The Department of Energy (DOE) and private industry have supported the research and development of several ocean energy technologies. For most of the new technologies, 10 to 15 years of additional research and development will be needed to determine whether the concepts are technically and economically worthy of commercialization (Stovaugh and Yergin, 1979). The following only briefly describes the development status and the known or anticipated environmental consequences of the new ocean energy conversion technologies (Oceanus, 1980).

- Ocean Geothermal Energy -- By tapping thermal energy from submarine geothermal springs, electricity can be generated. During FY 1979-1981, DOE supported studies to predict the long-term effects upon shelf biota from offshore power plant thermal discharges. The studies reveal that the discharge may have considerable impact on the chemistry and biology of the shelf. Enrichment of radionuclides (radium and radon) and biologically active heavy metals (lead and copper) emitting from point sources have been observed, and primary productivity of shelf biota appears to be depressed.

- Ocean Currents Energy -- Ocean currents can be used to generate energy by utilizing hydroturbines under platforms moored in ocean current streams. With the use of computers and models, calculations indicate that the major environmental effect of this type of installation could be very small changes in the speed of the ocean current stream.

- Tidal Energy -- With intermittent success, attempts have been made to harness power from the ocean tides since the middle ages. France has operated a tidal-energy power plant since 1967, and other foreign countries have invested large amounts of money to explore the feasibility of the concept. The DOE has recently contracted to develop plans for a pilot plant. It is believed that tidal power plants will contribute little to environmental pollution.

- Wave Energy -- Wave power technologies require large floating structures, either in the form of ships or secured platforms. The environmental consequences of wave energy conversion are not known. However, it is believed that installation of structures near the coastlines could impact marine life, beach formation, and other coastal processes.

- Biomass Energy -- The development of open-ocean farming of kelp for producing methane through biomass conversion has been supported by DOE and private industry since the mid-1970's. Seaweed culture and processing as a large-scale commercial operation is still very much in its infancy and little is known about the effects of those activities on the marine environment. On the positive side, it has been determined that seaweed culture serves as a biological tertiary sewage treatment system by removing nutrients, particularly nitrogen, from the effluents of secondary sewage treatment. Cultivation of seaweeds in the vicinity of sewage outfalls has proved to be beneficial in improving the water quality.

- Salinity Gradient Energy -- Technology to produce salinity gradient energy, derived from the large osmotic pressure

difference between freshwater and saltwater, is in the development stages. The environmental impact of salinity gradient power stations at the mouths of rivers would probably be minimal except for the aqueduct structures necessary to bring together different-salinity waters from the two sources. The byproduct discharge is saltwater close to its natural state, which creates no environmental impact. Techniques to protect marine animals that could be sucked into inlet pipes should be considered in the design of operational plants. Corrosion, biological fouling, and siltation may be problems associated with some types of technologies. Brines interfacing with freshwater or seawater in regions without continuous currents may produce undesired environmental impacts.

- Offshore-Wind Energy -- Towers for offshore-wind energy conversion systems would be enormous and must rise either from the seabed or from floating stations. Underwater pipeline or cable must be provided between the offshore resource and the onshore energy user. The concept of using offshore winds to generate energy at sea is new, and environmental consequences are unknown. However, it is believed that this technology will face environmental problems similiar to those faced by the oil industry when offshore development began. Increased ship traffic between platforms and coastal areas could contribute to pollution, and the presence of the operating systems could disrupt marine life.

Analysis and Conclusions

The technological risks associated with developing alternate ocean energy sources are great compared with potential gains in the short term. Costs, operating efficiency, and long-range needs are uncertain. Decisions on commercial feasibility cannot be made without several years of additional research and development.

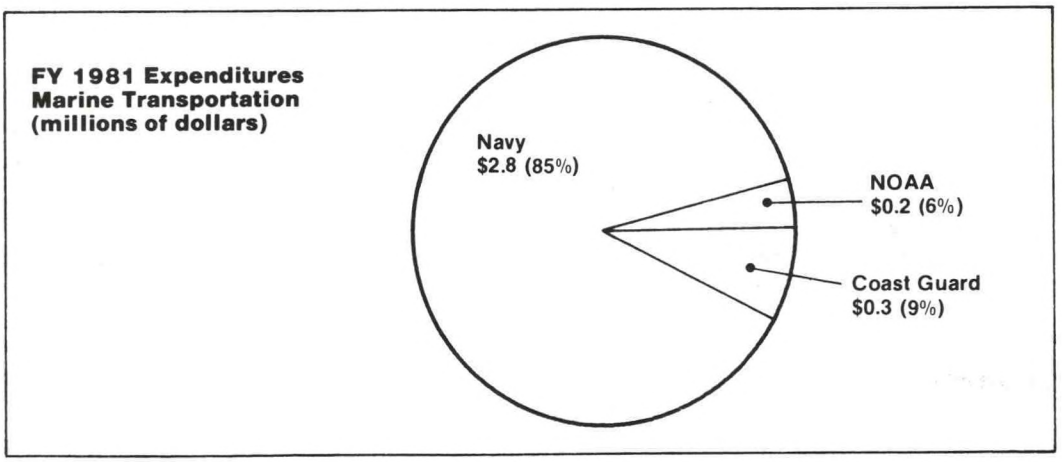
Except for DOE's geothermal environmental research program, which will end in FY 1981, no Federal research activities are envisioned for the period covered by this second Federal Plan.

Information needs in this area are considered to be of lesser importance in the context of national marine pollution concerns. It is concluded that the present level of research activity is appropriate, considering the stage of technology development and the period of time covered by this Plan. However, it would be useful to monitor the development of these technologies and to initiate pollution studies as they become appropriate.

MARINE TRANSPORTATION

Contaminants from marine transportation activities enter the sea intentionally as a result of routine operational discharges, and unintentionally as a result of accidental spills. Unintentional spills are discussed in the section on accidental discharges. In FY 1981, about $3.3 million was spent on pollution abatement equipment and research concerning the environmental effects of marine transportation. That constitutes about 3% of the total Federal expenditures for marine pollution research.

The research was conducted by the Department of the Navy, the U.S. Coast Guard, and NOAA. Navy expenditures in FY 1981 amounted to $2.8 million; the Coast Guard spent $300,000 and NOAA spent less than $200,000.



Marine transportation plays a major role in international trade; it is estimated that ships carry 70%-75% of the volume of the world's foreign trade. Ocean shipping is a growth industry. Despite the international tensions of the past quarter century, world trade has increased at an average annual rate of 8%. Between 1950 and 1970 dry-cargo shipments increased fourfold; oil cargo carryings expanded by a factor of more than 7 (Heine, 1976). The interdependence of industrial and developing nations has become a fact of life, and almost without exception, producers and consumers are virtually dependent upon shipping in the exchange of raw materials for manufactured products.

Vessel sizes and designs are as varied as their functions. They range from small recreational craft used primarily in coastal waters to defense-related naval vessels and ships of the merchant marine fleet up to several hundred thousand tons in size. Pollution from

marine transportation is significant in certain situations, but problems are well recognized and, for the most part, work toward their solution is well under way.

With respect to ships that maintain sizeable crews such as naval vessels and some transport ships, the pollutants are the large amounts of domestic waste products such as sewage, food waste, and trash from the human activities on board. For recreational vessels, sewage disposal from marine sanitation devices in highly populated, confined harbors and anchorages is the primary pollution concern. This source of pollution is widely recognized; the problems have been identified and work is under way to apply technology and develop techniques that will enable vessels to eliminate pollution discharges economically.

Other problems are related to the movement of crude oil and concern (1) offshore unloading terminals (deep-water ports) and the cost/risk ratio associated with use of these terminals for offloading large tankers, and (2) identification of systems most reliable for transfer of oil from OCS production areas to shoreside facilities.

Perhaps the most publicized source of pollution is operational discharge of oil by tankers in the merchant marine fleet. Because tankers cannot safely navigate ocean waters with empty tanks, they take on seawater as ballast after the cargo is discharged. When a ship gets close to its loading destination, the ballast water is discharged to make room for the oil cargo. Thus the ballast seawater, contaminated with oil from the previous cargo or from tank washing, is sometimes intentionally discharged into the ocean. Many nations now prohibit this practice within waters under their jurisdiction, and international standards limiting oily discharge on the high seas are developing. Regulation, coupled with the increased value of oil, has led to development of new and better techniques such as segregated ballast, crude-oil washing systems, and oil/water separation systems for minimizing contamination of ballast water. Nevertheless, enforcement of regulations and standards is still a problem.

Discharges from ships are strictly regulated under existing U.S. law, including the Clean Water Act, the Port and Tanker Safety Act, and the Marine Protection, Research, and Sanctuaries Act. As a practical matter, however, the execution of these laws has been limited to enforcement of equipment standards and requirements established by regulation. Statutes limit dumping, including that of garbage and refuse from ships, and require that oil not be discharged from ships in concentrations that will result in a "visible sheen." Because of limitations on enforcement capabilities, these standards are normally enforced only for major polluting incidents.

There has been extensive international activity through the Intergovernmental Maritime Consultative Organization (IMCO) of the

United Nations in the areas of environmental protection and maritime safety. The United States is an active member of IMCO. Protocols developed through that organization set design, construction, and equipment standards for vessels, primarily tank vessels and chemical carriers. IMCO standards also include equipment standards for oil/water separators and oil content monitors to restrict the discharge of oil at sea.

Analysis and Conclusions

Three information needs relate to marine transportation. Studies on the environmental implications of marine transportation are adequately addressed by Federal activities in the following areas:

Environmental implications of routine operational discharges

Disposal of shipboard wastes has traditionally been a matter of discarding them over the side. Bilge water, sewage, and solid wastes are still routinely discharged while vessels are on the high seas. Oceangoing vessels with sizeable passenger or crew complements generate large amounts of waste in the form of bulk trash, food wastes, sewage, and gray water. An aircraft carrier, for example, can have a crew of 5,000 or more and generates daily more than one-quarter million gallons of liquid domestic wastes. It would be useful to know what effects these discharges have on the coastal marine environment, but little effort has been spent on studying the environmental implications of such disposal. Research is needed on impacts of ship discharges in coastal areas that are enclosed and have poor flushing action.

Present regulatory requirements for greatly reduced oil discharges in coastal areas and new requirements prohibiting discharges on the high seas are forcing the installation of oil/water separators on many ships. The "clean" water discharged from this equipment contains a small amount of oil (usually less than 15 parts per million, an amount less than that which will produce a "visible sheen"). An evaluation is needed of the effects of discharging this "clean" water directly into the marine environment, particularly in confined port areas where the cumulative effect of many ships may be significant.

The Navy is developing high-capacity and low-capacity oil/water separators that will reduce installation and maintenance costs and improve the dependability of oil waste treatment systems. Furthermore, the Navy is developing continuous oil content monitors for use downstream of the oil/water separators to permit automatic operation and a recycle mode when the effluent does not meet national and international standards. The Navy is also developing simple, reliable oil/water separators that fit within existing tankerage on crowded

ships. These efforts are directed towards meeting the needs of naval vessels having unique mission-related characteristics; the information obtained should also have application throughout the shipping industry because of the emphasis on reliability, simplicity, and cost effectiveness.

The maritime industry has solutions to the problems of handling oily wastes from ships. Attempts are being made to refine these solutions and to provide alternative, more cost-effective solutions. A real need from an enforcement perspective is for further research to improve enforcement schemes and to ensure effective use of the devices already available.

Marine transportation patterns for hazardous materials

To develop effective measures for minimizing risks from the transport of hazardous materials, additional information must be gathered on methods and routes of transport. Information on ship storage methods, characteristics, routing, cargo types and volumes, spill histories, and tank-cleaning practices could be useful for better planning as well as formulation of necessary regulations and control schemes. These concerns are of particular importance in the Great Lakes, Gulf, and North Atlantic coast areas where the marine transport of hazardous materials is most significant. Such information would also be useful in formulating policies for recommendation to IMCO for implementation of international standards.

Also required is an assessment of the relative contributions to contaminant loading by activities and facilities other than vessels. Marine terminals, ancillary land transport, navigational errors, and cargo transfers between carriers are all sources of hazardous material in the marine environment. An identification of the major contaminant sources from the marine transportation industry could be used to limit the entry of these pollutants to the marine environment more effectively. Most vessels carrying certain dangerous cargoes are required by regulation to notify the Captain of the Port of their destination and cargo; however, cargoes and vessels in some geographic areas are exempt from this requirement. By regulation, vessels must also carry and preserve a dangerous-cargo manifest, or storage list. These documents are not readily available for analysis without industry cooperation.

Several Coast Guard programs indirectly contribute information to this problem area. The Pollution Incident Reporting System (PIRS) and Hazard Assessment Computer System (HACS) are discussed in more detail in the section on accidental spills.

The Coast Guard has examined the cost of consolidating and evaluating the available incomplete data, and determined that the benefit derived from such a project would not justify its cost. Consequently, no programs are planned to address this problem. In light of the increasing concern for hazardous materials in the environment, however, the costs and benefits of initiating a program in this area should be reevaluated.

NOAA, through its Office of Ocean Resources Coordination and Assessment, is conducting a strategic assessment of U.S. coastal and ocean regions. This program is identifying and quantifying contaminant inputs from all land-based and ocean-based sources of pollution in these areas. Once compiled, this information will permit an assessment of the relative contribution of marine transportation activities to contaminant inputs in U.S. coastal and ocean waters.

Offshore crude-oil terminals

In 1975, the average crude-oil tanker was less than 50,000 DWT; the average size today is 100,000 DWT, and the 1985 projected average size is 200,000 DWT. At the present time no east coast port is able to accommodate 200,000 DWT tankers. There are three possible approaches to solving this problem: harbors and channels can be dredged to allow for the passage of supertankers; supertankers can anchor offshore and be lightered by smaller tankers that will take the oil into port; offshore crude oil terminals can be built so that supertankers can unload their cargo at sea and have the oil transported through pipelines to port facilities. Of the three alternatives, the use of offshore terminals is considered to be the option with most advantage and least hazard to the environment. Regulations regarding the establishment of offshore terminals have been issued under the Deepwater Ports Act. The economics of offshore terminals have been thoroughly discussed (Porricelli and Keith, 1973). The remaining need is for site-specific, cost-risk/benefit analyses of offshore terminals on a case-by-case basis.

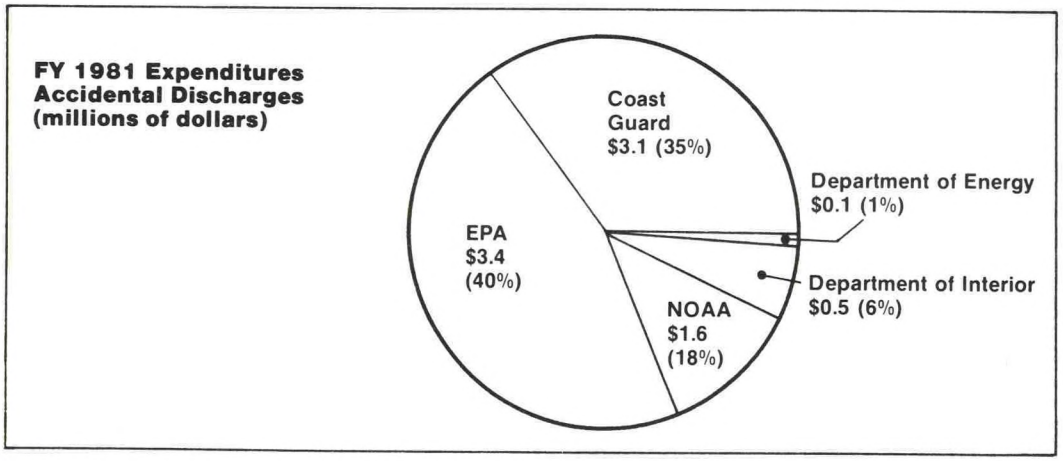
OCS-related marine transport

Oil can be transported from offshore production areas to shore facilities by pipeline, tanker, or barge. The most appropriate transfer system for a particular well site is determined by a combination of economic and environmental concerns. Many types of vessels and transport systems can be involved in transport of oil from OCS production facilities. Loading-terminal spill records could be gathered and evaluated in order to identify preferred systems for different OCS situations. Regulations on siting of terminals and placement of pipelines do exist. Actual selection between alternative transport systems is determined by industry after economic review.

ACCIDENTAL DISCHARGES OF OIL AND HAZARDOUS MATERIALS

Oil spills are one of the most highly visible and emotion-causing forms of ocean pollution. Recently, it has been recognized that spills of hazardous materials may, in many cases, pose a more serious threat to marine ecosystems than oil spills. Research and development attempt to describe the effects of accidental discharges, and to improve the effectiveness of response and cleanup procedures. In FY 1981, about $8.6 million was spent by the Federal Government on spills research. This constitutes about 5% of the total Federal expenditures on ocean pollution research.

The major contributors to spills research in FY 1981 were the EPA ($3.4 million) and the Coast Guard ($3.1 million). NOAA spent about $1.6 million, and the Departments of Interior and Energy each spent less than $1 million.



Substantial amounts of oil and hazardous materials enter the marine environment as a result of accidental spills. Although the focus in the past has been on the cleanup and mitigation of spilled oil, national concern has been shifting toward hazardous materials as the cause for most immediate concern. Much has been learned in the past 10 years about how to respond to oil spills; far less is known for spills of hazardous materials. Unlike oil whose properties are fairly uniform, hazardous materials have a wide variety of physical and chemical forms, complicating and making much more difficult the response necessary for their cleanup and disposal. Methods for the cleanup and mitigation of hazardous materials are not well established.

Major attention is generally given to the spectacular accidents that occur when large oil tankers go aground or break up, discharging

vast amounts of oil into the sea -- oil that often drifts toward shore to foul public beaches and contaminate estuarine breeding grounds and productive shellfish beds.

A prime example of a major spill is that of the Amoco Cadiz; the tanker went aground off the coast of France in 1978, spilling 228,513 tons of crude oil. The largest spill of record occurred between June 1979 and March 1980 when a Mexican oil well, IXTOC No. 1, had a blowout in the Gulf of Mexico, releasing an estimated 476,000 tons of crude oil before it was brought under control (NAS, 1981).

Although major attention is given to these highly visible accidents, substantial amounts of oil and hazardous materials enter the marine environment through far less spectacular means. Spillage during loading and unloading operations in ports and harbors, pipeline leakage, equipment failures, spills from land vehicles and storage facilities on shore are all sources and causes of accidental discharges that eventually enter the marine environment. Oil contained in urban and river runoff (spent oil and grease that wash from the streets and sewers of cities) are major contributors to the oil content of the oceans and Great Lakes.

About 35% of the total annual oil pollution added to the seas is a result of accidental discharges from oil transportation (by tankers, pipelines, barges, etc.) (NAS, 1981). A small amount enters from OCS activities (less than 2%). The remainder enters from coastal facilities and wastes, land runoff, and natural seeps and is not treated in this discussion of accidental spills. Comparatively small amounts of oil enter from U.S. offshore petroleum production. With nearly 29,000 wells drilled in marine waters there have been only two spills greater than 1,000 barrels from offshore platforms in Federal waters since 1970. Both involved stored oil, not loss of well control (Watt, 1981). There have, however, been numerous smaller spills and at lease one major accident -- the Santa Barbara blowout in 1969.

Between 1973 and 1979 the number of reported oil spills averaged between 11,000 and 12,000 annually. In 1980 preliminary data indicate a drop to less than 8,000. About 50% of all spills were small, amounting to less than 50 gallons each, and contributed less than 1% to the total oil spilled. The large spills, 100,000 gallons or more, were few in number, less than 0.1%, but accounted for about 50% of the volume of oil spilled. More than half of the spilled oil resulted from structural failures such as tank and hull ruptures on ships and barges, and pipeline leaks and ruptures. By far the largest amounts of oil are spilled in rivers rather than on open coastal or ocean waters or beaches. Substantial amounts are spilled on the Atlantic and Gulf coasts with only minimal amounts in the Great Lakes and on the Pacific coast (Coast Guard, 1980). These figures do not include spills from OCS development and production.

Statistics for hazardous material spills are similar. Between 1973 and 1979 the number of reported spills has been between 220 and 299 annually; preliminary data show the number dropped to 133 in 1980. More than 50% of the spills are 500 gallons or less and account for less than 2% of the total spilled. The upper end of the scale is less consistent annually, but the greatest fraction of hazardous materials appears to be spilled in accidents involving 50,000 gallons or more. The largest causes of accidental release (more than half) are structural failures in tanks and hulls and other equipment, and most occur during non-transport-related activities. Hazardous material discharges appear to take place most frequently in rivers along the Atlantic Coast. The following table summarizes reported oil and hazardous material discharges in U.S. waters since 1973.

OIL AND HAZARDOUS MATERIALS SPILLS
SUMMARY*
(Gallons)

YEAR	OIL		HAZARDOUS MATERIALS	
	NUMBER	VOLUME	NUMBER	VOLUME
1973	10,995	15,352,511	237	434,547
1974	11,902	16,709,911	220	908,840
1975	10,868	21,724,215	239	462,420
1976	11,700	24,352,135	299	2,135,006
1977	12,605	9,979,381	289	1,433,291
1978	11,950	14,343,396	261	2,163,846
1979	10,556	9,091,637	234	423,490
1980	7,837**	7,332,699**	133**	625,465**

* Coast Guard (1980)
** Preliminary Data

From the turn of the century to the early 1970's, Federal maritime responsibility for enforcement of antipollution laws, principally the Refuse Act of 1899, rested with the U.S. Coast Guard and the Corps. After the Torrey Canyon oil spill in 1967 and the Santa Barbara blowout in 1969, Congress passed several pieces of legislation that dealt specifically with oil and hazardous materials pollution at the national level.

The Marine Protection, Research, and Sanctuaries Act (P.L. 92-532) deals with ocean dumping and research on the effects of ocean disposal and establishment of sanctuaries. This law concerns the control of ocean-disposed waste materials; it requires the Coast Guard's surveillance and enforcement activities to assure compliance with permits issued by EPA or the Corps, and establishes procedures to monitor environmental effects of dumping practices at sea.

The Ports and Waterways Safety Act (P.L. 92-340) relates to the control of vessels for safety and pollution abatement purposes. Signed into law in July 1972, this act provides statutory authority for Federal agencies to deal with safety hazards of maritime transportation and with pollution from vessels carrying bulk cargoes of oil or hazardous substances. This act was incorporated as Section 2 of the Port and Tanker Safety Act of 1978 (P.L. 95-476).

The overriding legislation, which became the backbone of Federal response to pollutant discharges into the environment, is contained in the Federal Water Pollution Control Act (P.L. 92-500), later amended to become the Clean Water Act. In the past 9 years, the provisions, annexes, and amendments of the FWPCA have formed the basis for most marine environmental protection activities. Federal law does not allow discharge of oil or hazardous materials into the environment. The FWPCA required the establishment of a National Oil and Hazardous Substances Pollution Contingency Plan (EPA, 1980) and brought outer continental shelf and deepwater port areas under the Clean Water Act.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (P.L. 96-510) is commonly known as CERCLA or Superfund. It establishes expanded liability funds and policies for cleanup actions related to releases of hazardous substances from spills and waste disposal sites. With the exception of its provisions on damage assessment, it does not directly cover oil. Among other provisions, the law requires that all unauthorized hazardous material releases be reported; it also establishes liability for damages resulting from loss or injury to natural resources and provides funds for spill response activities including cleanup actions. The fund is intended to extend to costs for assessing these damages.

The primary international organization directly concerned with accidental discharges in the marine environment is the United Nations International Maritime Consultative Organization (IMCO). The United States has endorsed IMCO conventions covering safety, design, and construction standards for tankers intended to reduce accidental spills. In addition, the United States has safety and prevention standards for foreign ships using U.S. ports. Within the private sector, several additional agreements exist; one is the

Tanker Owner Voluntary Agreement. These agreements provide some limited liability for oil spill cleanup and damage costs in areas outside the jurisdiction of the United States.

The major provisions of Section 311 of the FWPCA are for the spillers' liability for restoration and cleanup. The Federal Government is responsible for monitoring cleanup operations and providing technical assistance. The Federal Government assumes responsibility for cleanup and restoration when the spiller is unknown, unwilling, or unable to undertake effective cleanup, or when the spill results from an act of God.

The National Oil and Hazardous Substances Pollution Contingency Plan establishes the principal Federal mechanism for any operations undertaken in response to pollution discharges occurring in navigable waters, adjoining shorelines, and the high seas of the United States. This National Contingency Plan (NCP) establishes a Federal interagency capability for initiating operational aspects of identification, prevention, containment, and cleanup of oil and hazardous materials spills, and related mitigation activities. Although the NCP briefly considers environmental damages resulting from pollutant discharges, it deals primarily with operational aspects of mitigation rather than the broader consequences of spills. Three principal operational components are identified in the NCP: the National Response Team (NRT), the Regional Response Team (RRT), and the On-Scene Coordinator (OSC). The NCP identifies the national and regional policy, organization, structure, and responsibilities of Federal agencies and other response organizations. Agencies with major cleanup responsibilities identified in the NCP are EPA and the Departments of Transportation, Commerce, Interior, and Defense.

The Environmental Protection Agency is responsible for providing expertise on the effects of pollution discharges including public health and safety aspects, evaluation of control techniques and the assessment of environmental damages. EPA is required to provide an OSC to direct operational aspects of inland spills. Coast Guard responsibilities include the command, control, and surveillance of all marine discharges and the provision of the OSC for spills in coastal regions, the Great Lakes, ports, and harbors. NOAA is responsible for supporting the Coast Guard OSC by supplying scientific information such as marine environmental data, assessment of living marine resources, and maps and charts of spill areas. NOAA is also required to provide essential meteorological, hydrologic, and oceanographic data. USGS provides expertise in oil drilling, production, handling, and pipeline transport. F&WS advises on the protection of land, wildlife, and fish resources, including migratory birds, endangered species, and anadromous fish. Responsibilities of the Department of Defense include assistance in dealing with critical pollution discharges, maintenance of navigational channels, and marine salvage operations.

Organized by EPA and NOAA, Scientific Support Coordinators can be called on to provide scientific and technical assistance. Their primary function is to coordinate all scientific programs dealing with spill response. They are responsible for coordinating scientific resources and for undertaking scientific tasks requested by the OSC or RRT. These can include spill trajectory analysis, chemical and biological sampling and analysis, and location and evaluation of environmentally sensitive regions. In addition, the SSC, when requested, assists the OSC assessing damage to impacted areas.

Considerable research and development have taken place to support Federal responsibilities in cleaning up accidental discharges. In the summer of 1980, the Interagency Committee carried out a comprehensive review of the work being done. Conclusions and recommendations in the following discussions are based in part on information that emerged from the review. A report summarizing the entire review and its findings is available as Appendix 3 to this Plan.

Analysis and Conclusions

Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future. Information needs relating to four aspects of accidental discharge are discussed below. Current Federal activities are described and recommendations are offered for needed research.

Prevention, containment, and cleanup of spilled materials

The first line of defense for accidental spills is prevention. However when oil or hazardous materials are spilled into the marine environment, decisions must be made on how best to minimize their impacts. In some cases the most effective mitigation measures may involve actions to prevent spilled material from reaching sensitive areas; in others it may require cleanup of the receiving water body or impacted coastal areas. In some cases it may involve no cleanup actions at all.

Techniques and hardware for the prevention of spills and blowouts from oil rigs for the most part have been developed. Although this is primarily the responsibility of private industry, the Federal Government must evaluate and judge the adequacy of proposed prevention schemes and must therefore keep abreast of technology development, especially as it advances to provide capabilities in deeper water and in arctic areas.

The USGS Conservation Division has responsibility for regulating drilling activities on the OCS. USGS carries out preventive technology

development programs for drilling operations, including research to improve response to drilling accidents such as blowouts. The Conservation Division also funds development of equipment for safety inspection of offshore rigs.

The Federal Government is also responsible for supervising and in many cases cleaning up and mitigating effects of spills that are not handled by private industry. This responsibility entails the development of techniques for use under varying environmental conditions for containment, cleanup, and recovery of spilled materials that may be floating on the surface, dispersed in the water column, or lying on bottom sediments. In addition to cleanup capabilities, policy and procedures must also be developed for the ultimate disposal of recovered materials and contaminated debris.

Other development needs are for equipment and gear for the protection of cleanup personnel, and instrumentation for the detection of unreported spills. Much consideration has been given to the use of dispersants in oil spill cleanup; policies and procedures for their use must now be developed.

The development of cleanup and disposal-related technology are among the most important needs, most particularly for hazardous materials but also for oil in arctic areas.

For many years the cleanup and containment of oil has been a major endeavor of Federal research and development programs. The Coast Guard, EPA, and the U.S. Navy participate in programs for development of equipment (booms and barriers) to contain oil for further cleanup action or direction away from vulnerable areas, for recovery (skimming systems), and for disposal (oil/water separators and incineration systems). All systems operate effectively in calm water, but performance generally decreases in heavy seas. Development of equipment for responding to spills of hazardous materials is only beginning. Although development of oil cleanup equipment and techniques for cold environments and ice-covered areas is still continuing within the Coast Guard, both Coast Guard and EPA have shifted the focus of their programs to the problems encountered in responding to hazardous material spills.

EPA operates a unique facility in Edison, N.J., for the testing and development of cleanup and containment equipment. OHMSETT (the Oil and Hazardous Materials Simulated Environmental Test Tank) is specifically designed to test cleanup gear under a variety of controlled environmental conditions. The facility is operated by a contractor for EPA; primary sources for its funding are EPA, Coast Guard, and Navy. Private industry and other agencies use the facility on a reimbursable basis.

The interagency program for development of response technology, consisting primarily of Coast Guard and EPA activities, is a particularly good example of a successful and highly productive endeavor. The Federal program review (Appendix 3) found that within the resources available, emphasis and priorities were generally well placed. Cooperation between the Federal agencies is good, and a successful mechanism exists for even further productivity with increased allocation of resources. OHMSETT activities are planned by an interagency committee which has proved to be an excellent device for interagency cooperation. No further actions toward coordination of this program are planned by the Interagency Committee.

Both EPA and DOE have supported programs to evaluate dispersants in oil spill mitigation. Most studies indicate that dispersants can be effective in lessening the impacts of spilled oil. However, decisions to use them must be made on a case-by-case basis. With respect to the ultimate disposal of cleaned-up materials, EPA is evaluating various incineration techniques, and the Department of Energy has evaluated combustion for the in situ removal of oil from water or damaged vessels.

Technology for oil spill cleanup on open waters has reached its practical limit within the context of existing knowledge on the behavior of oil in seawater (NAS, 1981). Except in specialized environments such as ice-covered areas, existing equipment represents an acceptable compromise between state-of-the-art and cost effectiveness. Such is not the case for hazardous materials. Consequently the Federal program emphasis has appropriately shifted in that direction over the past few years.

1) It is recommended that response development activities be expanded to include methods for preventing spills from transportation sources other than vessels (railroad, trucking, and pipelines) and for dealing with spills of packaged and bulk hazardous materials.

2) Considering the planned acceleration of OCS activities in arctic and deeper OCS areas, with resultant increases in oil transport, development programs for OCS spill prevention and for cleanup and recovery systems in arctic waters should be expanded.

3) A great deal of scientific information on the behavior and effects of some types of dispersants has been reported in the technical literature. Most of this information is not directly available or usable by the OSC, which must make the case-by-case decisions on when and to what extent dispersants should be used, if at all. Therefore, it is recommended that EPA undertake the synthesis of this information and prepare

guidelines for use by field personnel, on the use of dispersants for oil spill treatment.

Spill response capabilities and contingency plans

Effective response to spills of oil and hazardous materials requires that information and scientific support be readily obtainable near the scene of the response actions. Among the most important information requirements are these:

- Technical details on the behavior and appropriate cleanup responses for hazardous materials.
- Spill trajectory models to predict paths and points of likely impact.
- In arctic areas, capabilities to predict ice movements and behavior of ice-trapped pollutants, and recovery rates of impacted ecosystems.
- Identification of biologically sensitive or vulnerable areas.

The Coast Guard carries out several programs that collect and consolidate information relevant to spills. All discharges of harmful quantities of oil and hazardous materials are required by law to be reported to the Coast Guard, which maintains a computerized data base composed of this information. The Pollution Incident Reporting System (PIRS) can be programed to generate various types of information products for use in the management and planning of spill response programs. The Coast Guard also maintains the Chemical Hazards Response Information System (CHRIS), which catalogs and maintains data for 985 hazardous chemicals. A basic element of CHRIS is the Hazard Assessment Computer System (HACS), which uses analytical models to predict the behavior of chemicals spilled on water and calculates the hazards presented by such spills. Other CHRIS elements are being developed to produce predictive information on hazardous materials behavior under more complex cleanup and containment conditions for water, sediments, and air, and to estimate potential damage on the basis of population and vulnerability information.

Spill trajectory models have been developed by several agencies. The USGS has developed a model for prespill planning purposes. NOAA maintains a short-range trajectory modeling capability that can be transported into the field for use at the spill response site and a long-range model that can be used for prespill planning. Both NOAA and the Coast Guard have specialized models for predicting spill trajectories in the Bering Sea.

NOAA, through the BLM-funded OCSEAP program as well as through its own programs, has investigated the behavior of oil in ice and carried out studies leading to the prediction of ice behavior and movements, particularly for the Bering Sea. The Coast Guard has also carried out studies in related areas. Most of this work has been carried out in the laboratory as bench scale experimentation or theoretical calculations.

Limited field verification has been possible. One controlled spill in Prudhoe Bay was organized by a private industry group in the winter of 1981. Joint tests with the Coast Guard are anticipated for 1982. The Canadian Federal Government has an active arctic clean-up research and development program. As part of the Arctic Marine Oil Spill Program (AMOP) controlled oil spills under ice and in open water have taken place. The Baffin Island Oil Spill (BIOS) project is organized as part of AMOP and is a joint international experiment with the United States and Norway to evaluate the use of dispersants, to identify and evaluate effective cleanup procedures and countermeasures for cold-water environments, and to evaluate effectiveness of protective and cleanup procedures in a cold-water environment.

Several agencies perform coastal mapping activities that contribute to spill contingency planning and identification of sensitive and vulnerable areas. NOAA, under the Office of Resource and Coastal Assessment (ORCA), produces large-scale strategic assessment maps that identify resources, uses, and potential conflicts in coastal areas. F&WS produces larger scale coastal characterization and ecological inventory maps identifying fish and wildlife habitats. NOAA's Hazardous Materials Response Program prepares environmental sensitivity studies for direct application in planning spill response activities. These indices characterize coastal areas according to their vulnerability. Several State and local governments have also undertaken preparation of similar types of vulnerability maps for use in their own coastal areas.

1) Several agencies, NOAA, Coast Guard, and USGS, have programs to develop models of spill trajectories and models describing the movement and behavior of oil. Much of the work has direct application in cold-water and arctic environments. Workshops on oil spill modeling have taken place, but the scope of modeling programs is still unclear and the extent to which programs may duplicate or miss important problem areas cannot be judged. Periodic workshops should be convened through the Interagency Committee to maintain a dialog between oil spill modelers and model users, to assign lead responsibility for implementing recommendations of previous workshops, and to assure that unnecessary duplication does not occur.

2) Environmental sensitivity indices have not yet been prepared for all coastal areas. It is recommended that mapping programs

be continued, with first attention given to new projects that will develop indices for New England (except for Massachusetts whose index has been completed) and the portions of the Gulf coast not yet described.

Environmental impacts of accidental discharges

A great deal of effort has been expended over the past ten years to study the effects of spilled oil in the marine environment. Although significant controversy surrounds many of the results, it is generally agreed that in the short term, except for localized sensitive areas such as marshes and intertidal flats, large-scale catastrophic damage does not occur; within 10 years or less, oiled environments appear to recover to support communities similar to those that existed before the spill, at least in temperate climates. Much less information is available about impacts of hazardous material spills, and for this reason studies of the effects of hazardous materials spills are of the greatest importance.

A major aspect of the oil spill problem that has not yet been well studied, however, is that of long-term effects. There is little firm knowledge concerning the long-term effects of spills and chronic low-level releases that occur as a result of shipping in coastal areas and OCS petroleum production operations. Studies to evaluate the impacts of oil in coastal areas have been carried out at sites of major oil spills; however, many are not focused on long-term consequences. Similar studies at sites of hazardous material spills have, in general, not been undertaken. Although some studies of historic OCS areas have been made, there is widespread disagreement on the findings. Although they do indicate the lack of major adverse impacts, doubts are expressed regarding the adequacy of these studies for determining long-term effects. One concern is the possible effect on marine species already endangered by low population levels -- some whales and turtles, for example. The National Academy of Sciences' update of its 1975 publication, "Petroleum in the Marine Environment" is expected to define remaining questions on the long-term consequences of oil spills and chronic low-level petroleum releases. This will establish a sharper focus for continuing research programs.

A necessary element in any study to assess the long-term effects of chronic low-level pollution is the determination of natural or baseline conditions against which new conditions can be compared to detect changes. Open-water marine environments are characterized by great physical variability, which causes large fluctuations in biological populations and distributions. Because of this variability, it is difficult to establish any kind of reference on which to construct a program to identify ecological perturbations. The methodology that has been used to date, primarily unfocused monitoring, is generally

unsuited to assessing the environmental effects of chronic low-level effects. Only in limited coastal areas with fairly stable environments can such an approach be cost effective and successful. Better methods must be developed for establishing baselines in open-water marine environments.

A few studies addressing long-term effects of oil spills are currently carried out by the Federal Government. Academic institutions and other organizations also have programs addressing the impacts of spilled oil in coastal areas. However, the effects of hazardous material spills have not been studied to the same extent. EPA and NOAA have sponsored studies of areas where natural oil seeps occur in southern California; some conclusions regarding the long-term impact of low-level exposure on resident populations may be extrapolated to predict potential impacts from OCS activities and repeated small oil spills.

Laboratory studies sponsored by EPA include a project addressing the fate and behavior of oil in ecosystems focusing on benthic organisms in contaminated sediment with the objective of developing numerical criteria for describing the quality of contaminated environments. EPA has also sponsored mesoscale microcosm studies to evaluate the effects of oil on small ecosystems contained within controlled environments.

NOAA, through the National Marine Fisheries Service, is conducting studies of chemosensory and behavioral effects of oil on some representative marine organisms (crabs) and fish. NOAA has developed analytical methodology for hydrocarbon measurements; they have also investigated metabolic byproducts caused by petroleum components. Other NOAA studies have investigated cytotoxic and mutagenic effects on fish eggs and larvae, and physiological responses of fish to low levels of oil.

NIEHS is working at a very basic level to understand cellular perturbations due to some petroleum-related compounds. BLM has sponsored tissue structure studies on the Bowhead Whale in an effort to learn more about Bowhead physiology and develop methods for providing bioassay type information for these large endangered animals.

The recommendation for a long-term interagency research program to address the long-term effects of OCS development was made earlier in this chapter in the discussion on Oil and Gas Extraction. The experiment design for that program should include elements that directly address the long-term effects of spilled oil and key hazardous materials.

Equally important is the estimation of environmental recovery rates for oil-damaged ecosystems, especially for areas in Alaska and the Arctic. Environmental recovery rates should be studied at sites of major spills such as those of the Amoco Cadiz and Torrey Canyon.

Field studies should be coupled with laboratory work in evaluating the effects of spills, and study results should lead to predictive capabilities for assessing potential spill effects.

Damage assessment

The need for damage assessment arises because spills and unauthorized releases of oil and hazardous materials cause harm to the environment. Legal requirements allow the Federal Government to seek financial compensation for losses of natural resources resulting from spills and other unexpected discharges of polluting materials. At the present time, considerable uncertainty surrounds the nature of damage assessment programs, particularly regarding the extent and type of research necessary to support damage claims. The legislative intent to restore or require compensation for public resources destroyed or damaged as a result of spills and other unauthorized discharges, is clear. Much less clear is the means by which resource damage can be defined in quantitative and economic terms.

Federal and State laws provide ample authority for the recovery of damages to natural resources. For only a small portion of spills, however have damages ever been recovered. It appears that the principal reason is the inordinate cost associated with traditional methods for assessing pollution damage to natural resources.

It is generally agreed that a damage assessment program should aim to establish a generic plan or protocol that provides a structure for the studies and activities necessary for damage assessment. Within this structure, there must be standardized and established procedures to identify the important damaged entities and estimate their values. Unfortunately, there is not much agreement on how this should be accomplished. Three steps are involved in damage assessment. First, the alteration of natural conditions must be demonstrated. Second, it must be demonstrated that the alteration is a result of the release or discharge. Third, a monetary value must be assigned to the loss. Any one of these steps can be a major undertaking depending on the rigor and defensibility desired. Primary concerns focus on issues such as these:

- What constitutes damage and how should it be measured?
- How can economic values be placed on non-market entities like wetlands and habitats?
- How can a short-term damage assessment program address long-term effects?

- Where should the line be drawn to distinguish between studies solely for the purpose of damage assessment and basic-research studies to understand ecosystem impacts?

Damage assessment studies have been attempted for many years. The Clean Water Act provides for recovery of some pollution damages. Most, if not all states have laws providing for various types of recovery. Not until the passage of the Superfund legislation however, has there been the mandate to develop Federal regulations addressing damage assessment procedures. The law requires that regulations be developed by December 1982, that they be cost effective, provide protocols for long- and short-term assessment, and be revised every two years to take new developments into account. The Superfund legislation provides that any assessment of damages determined by procedures established by these regulations, will stand as facts in legal proceedings. Challengers must prove otherwise if they disagree. The purpose of these provisions is to allow assessment of damages at minimum cost, allowing the extension of damage assessment to small spills where assessment costs might otherwise outweigh recovery costs. Responsibility for development of damage assessment regulations has been assigned to the Department of the Interior. The formulation of regulations to deal with issues identified above can go a long way toward defining, at least in a legal sense, the studies necessary to support damage assessment. Until regulations are developed, little guidance can be provided for program planning. The ultimate fate of information from all types of damage assessment programs, including the extent to which validity is accepted or disputed, rests with the courts in initial tests of the adequacy of Superfund damage assessment regulations, and subsequently with both the courts and managers of the Superfund in deciding damage claims. Although objective scientific information should be a major consideration in settling claims, in reality, it will be but one of many elements considered in reaching a decision. Serious consideration should be given to the type of damage assessment program necessary and the relative costs of such programs in light of the value and usefulness of the information they provide.

As noted in previous sections, many studies assessing effects of oil spills have been carried out. Some of these may be applicable to damage assessment. However, the relationship between "effects" and "damage" must be better defined before a determination can be made of just how directly applicable these studies may be.

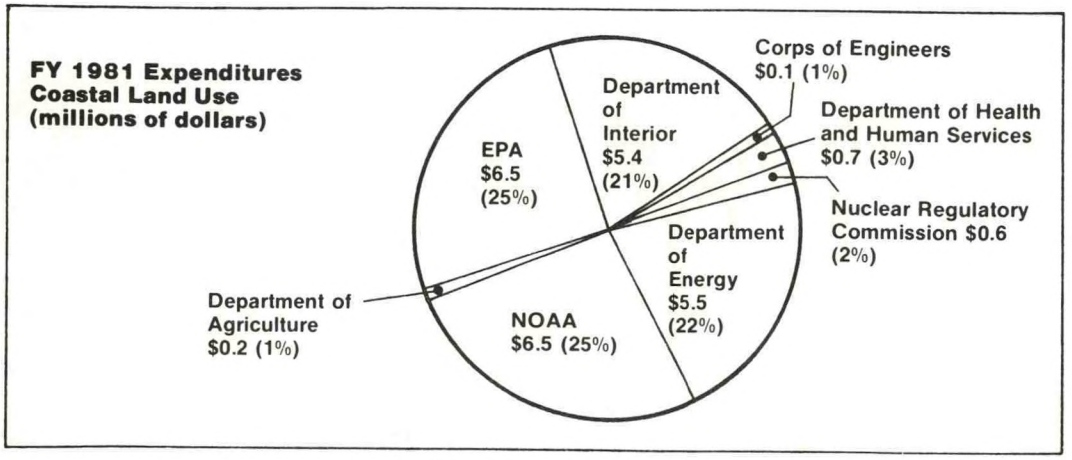
Although very few damage assessment studies have been carried out with the primary purpose of establishing economic values, NOAA, through ORCA and in cooperation with several French and American universities, is conducting a comprehensive economic damage assessment of the Amoco Cadiz oil spill. The purpose of this assessment is to develop and test a series of methodologies for measuring the most significant

economic costs associated with major oil spills. In addition, a major Federal program was begun with the IXTOC spill in the Gulf of Mexico. However, the major portion of the program was never funded. Limited studies were planned through an interagency policy group composed of representatives from DOI, NOAA, EPA, and the State of Texas, and are continuing. They focus on a socioeconomic analysis of the impact, effects on reproduction of endangered turtles, and analysis of water and sediment samples collected during and after the spill.

The range of options available for types of scientific programs to provide damage assessment information and contribute to the development of regulations should be defined and presented for review by policymakers. Specific programs to address damage assessment should not be planned, however, until Federal policies regarding the extent and intention of damage assessment are clarified in the form of regulations.

COASTAL LAND USE

Land use in coastal areas can severely affect nearby marine ecosystems. Research programs are investigating the effects of coastal facilities and nonpoint source pollution. The implications to the marine environment of the trend toward increasing use and export of coal are a special concern. The effects of single actions are largely the concern of State and local governments, and studies in this area should be supported by them. However, cumulative aspects of coastal land use impacts are of high importance in the context of



national marine pollution concerns. The following table provides information on funds expended and percent of budgets allotted for research on these three aspects of coastal land use in FY 1981.

ISSUE	DOLLARS (Millions)	PERCENT OF COASTAL LAND USE BUDGET	PERCENT OF TOTAL POLLUTION PROGRAM BUDGET
Siting, construction, and operation of coastal facilities	$10.0	39%	6%
Nonpoint source pollution	14.8	58	9
Increased coal use	0.7	3	<1%
TOTAL	$25.5	100%	15%

Although research on the effects of coastal land use attracted only 15% of the total Federal marine pollution budget in FY 1981, 8 of the 11 agencies in the program conducted research that applied to coastal land use issues. This reflects the diversity of mechanisms by which land use can affect coastal ecosystems. In FY 1981 the principal agencies studying the effects of coastal land use were EPA, NOAA, and the Departments of Interior and Energy. Each of these spent $5-7 million. Activities supported by the Department of Agriculture, Corps, NRC, and Department of Health and Human Services accounted for about 6% of the total.

SITING, CONSTRUCTION, AND OPERATION OF COASTAL FACILITIES

Many activities require access or proximity to marine or estuarine waters, or the Great Lakes, and the facilities associated with these activities tend to be concentrated in coastal areas. For example, ports, power plants, sewage treatment facilities, refineries, seafood and lumber processing plants, and many other industries are located in coastal areas because they are dependent on maritime transport, large volumes of cooling water, living marine resources, or use of the oceans for waste disposal. In addition, many recreational facilities such as marinas, public beaches, amusement parks, and hotels, motels, and condominiums tend to be concentrated in coastal areas. In many regions, general residential development also occurs near estuarine or marine waters, where waterfront properties are considered highly desirable. Any of these facilities or land use patterns can have detrimental effects on sensitive coastal ecosystems, and the combined effects of several different types of facilities can be substantial. The mechanisms by which coastal facilities and general development can adversely affect marine ecosystems include the following:

- Habitat destruction or alteration.
- Entrainment and impingement of marine organisms.
- Nonpoint source pollution.
- Accidental discharges of harmful materials.
- Intentional discharges of waste materials.

Loss and alteration of critical habitat is probably the most significant effect associated with coastal facilities. Estuarine and coastal habitats such as grass beds, marshes, mangrove swamps, and shallow areas serve as breeding and nursery grounds for the majority of recreational and commercial marine species. The construction of coastal facilities frequently requires filling or draining wetlands and dredging shallow areas to create channels. It is estimated that between 1950 and 1969, nearly 650,000 acres of important estuarine habitat were lost through dredging and filling (CEQ, 1979). On a national basis, this amounts to about 4% of the total acreage classified as important estuarine habitat. However, on a regional basis, habitat loss can be highly significant. For example, in California between 1947 and 1967, it is estimated that 67% of the important estuarine habitat was dredged or filled (Ringold and Clark, 1980). Another measure of habitat destruction is provided by data on acreage of coastal wetlands. In 1780, it is estimated that about 11 million acres of coastal wetlands were in existence. By 1954, the acreage was reduced to 8.2 million acres, and in 1978 only 5.7 million acres, or 52% of the original amount, remained (Ringold and Clark, 1980). Between 1954 and 1978, the rate of loss was 104,000 acres per year. If destruction of wetlands continues at this rate, no coastal wetlands will remain after the year 2033.

Physical effects that alter but do not destroy a critical habitat are more difficult to monitor and assess. For example, the normal salinity regime of an estuary can be altered by withdrawal of upstream freshwater for irrigation or human consumption, channel dredging, locks and dams, and land use patterns. Alteration of the salinity regime can then affect the health of commercial or recreational species within the estuary, reduce the reproductive success of marine species that breed in the estuary, lower primary productivity, alter the food web, upset the balance between predator and prey populations, or kill beds of vegetation that stabilize the substratum, provide food to herbivores, and provide shelter to prey species. Adverse effects of salinity changes on critical habitats have been observed in the brackish waters of the Mississippi River, San Francisco Bay, and Great South Bay (Long Island) (CEQ, 1979).

A different type of adverse impact occurs when large volumes of water are withdrawn from rivers, estuaries, or coastal waters and are passed through a power plant for cooling purposes. Aquatic organisms become impinged on intake screens (generally quarter-inch mesh) as water is drawn into the plant. Although many plants have systems of moving screens that return the organisms to the water, some mortality and sublethal effects still occur. Smaller organisms, juveniles, and eggs are able to pass through intake screens and enter the power plant. While passing through the cooling system, entrained organisms are subjected to mechanical stress and thermal changes, and may become exposed to toxic substances. Although some organisms appear able to pass through power plants without sustaining serious harm, high mortality results in certain species and age classes. There are now about 1,400 power plants generating electricity in coastal areas of the United States (Ringold and Clark, 1980). Not all of these plants use once-through cooling, but a very large volume of water is used and millions of aquatic organisms are affected annually. At the present time there is a trend toward the more costly closed-cycle cooling systems, which employ cooling towers to cycle and re-use water for cooling, thereby reducing the amount of water withdrawn. If this trend continues, the effects of entrainment and impingement will probably become less significant in the future.

Nonpoint source pollution occurs when runoff entering a body of surface water carries pollutants from the land, such as petroleum hydrocarbons and lead from parking lots, pesticides and nutrients from residential lawns or agricultural fields, pathogens from faulty septic systems, or toxic materials from industrial areas (e.g., copper from a dry-dock hull-sanding area). In many areas nonpoint source pollution is increased by the presence of coastal facilities and, in most regions, nonpoint source pollution accounts for a major portion of the contaminants that enter coastal waters. The problem of nonpoint source pollution is specifically addressed in the next section of this chapter.

The operation of some coastal facilities can result in large accidental spills, or chronic unintentional discharges of harmful substances into coastal waters. For example, it is estimated that, on the average, each fueling of a pleasure craft at a recreational marina results in the spillage of one fluid ounce of gasoline or diesel fuel (Richardson et al., 1975). Oil and grease also enter the waters around a marina in bilge discharge and as a result of lubrication and maintenance. The effects of chronic discharges may become locally important in areas where coastal facilities occur at high densities, or when major portions of the coastal area are affected. The research needs associated with accidental discharges of harmful materials are discussed elsewhere in this chapter, in the section entitled "Accidental Discharges of Oil and Hazardous Materials."

Intentional pipeline discharges of waste materials into coastal areas frequently occur from coastal facilities. Major discharges include publicly owned sewage treatment works, electricity-generating facilities, food-processing industries, and discharges from offshore oil and gas exploration, production, and development activities. Pollutant levels in pipeline discharges are regulated on an industry-by-industry basis under the National Pollution Discharge Elimination System (NPDES). Research and information needs related to industrial effluents and municipal sewage outfalls are addressed in the "Marine Waste Disposal" section of this chapter.

Analysis and Conclusions

Several Federal agencies conduct research to address the problems caused by many different types of coastal facilities and the variety of ways in which they can affect the marine environment. During FY 1981, a total of 17 programs in 7 agencies carried out research to assess the impacts of coastal facilities during FY 1981. Excluding efforts on nonpoint source pollution and other pollution causes discussed elsewhere in this chapter, the major agencies conducting research on coastal facilities are DOE, USGS, and EPA. Each of these agencies expended more than $1 million on coastal facilities research in FY 1981. In addition, NOAA, Corps, and NRC conduct research in this area but spent less than $700,000 each in FY 1981.

The objectives of the Cooling Systems Program conducted by DOE are to provide an environmental basis for designing and selecting power plant cooling systems (open vs. closed systems), to develop models to assess the significance of entrainment and impingement by power plants, and to conduct other studies on the environmental implications of cooling systems. This program will be terminated in FY 1982 and thereafter its objectives will be assumed by DOE regional programs. The following DOE regions conduct environmental research on specific energy-related facilities such as conventional and nuclear

power plants, oil refineries, nuclear fuel processing operations, and onshore support facilities for offshore development: Northeast, South Atlantic Bight, California Bight, Northwest, and Great Lakes. In addition, the Estuarine Program of DOE conducts research on estuarine ecosystems, food webs, and the ways in which energy-related facilities may affect critical habitats.

The Water Resources Division Program, conducted within the USGS, gathers critical hydrologic information on groundwater and surface water, which is essential to evaluating the effects of coastal facilities. In addition, the Earth Sciences Application Program supports studies in estuaries and coastal regions to provide information to land use managers and planners.

Two programs conducted by EPA relate to the environmental effects of coastal facilities. The Energy Related Research Program addresses some of the implications of energy facilities located in coastal areas, primarily the effects of using biocides and antifoulants in power plants. In addition, the Great Lakes Research Program is addressing the effects of electric power generation on yellow perch and other fish populations.

The Habitat Investigations Program conducted within NOAA addresses problems related to the effects of habitat loss, and physical and chemical habitat alteration. Research is directed toward linking habitat disruption, including that caused by coastal facilities, to effects on living marine resources. In addition, the Ocean Resources Coordination and Assessment Program includes efforts to evaluate the effects of coastal facilities on marine ecosystems.

The Corps Coastal Engineering Program includes research to evaluate the effects of coastal modifications that may be required to support or protect coastal facilities. NRC's program, entitled Environmental Impact Assessment Research -- Nuclear Plant Aquatic Impacts, assesses the potential impacts due to construction and operation of nuclear power plants. Applicants for nuclear plant construction permits are required to provide information on the existing environment at the site for the assessment by NRC staff. Research conducted under the program supports staff assessment function by developing analytical methods and providing verification data.

Three research and information needs related to the environmental effects of coastal facilities are discussed here, and appropriate Federal activities are identified. The other research needs relevant to coastal facilities are discussed elsewhere in this document, as indicated above.

Importance of habitat alteration

The loss and alteration of critical habitats is the most important concern associated with the construction and operation of coastal facilities. Additional information is needed on the extent and rate of habitat modification, and on its significance to commercial and recreational species and environmental quality in general. Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future.

At the present time, this need is addressed primarily by NOAA's Habitat Investigations Program and to a lesser extent by the Estuarine Program and Regional Programs conducted by DOE. In addition, research funded or conducted by F&WS is applicable to coastal situations. For example, F&WS is now conducting a national inventory of wetlands. It is recommended that plans for future research include emphasis in the following areas:

1) Quantify habitat loss -- Document and monitor habitat destruction and modification at the State or regional level. This would include estimates of acreage for the various critical habitats prior to human disruption; measurements of existing acreage that is undisturbed, slightly modified, and severely modified; and estimates of the rates at which habitats are being destroyed or altered at the present time.

2) Evaluate habitat loss-- Determine the significance of various critical habitats, such as high salt marsh, low salt marsh, subaqueous grass beds, and mangrove swamps, in terms of effects on fishery stocks. Measure productivity of various ecosystem components to improve understanding of energy flow through estuarine and coastal marine ecosystems. Determine the importance of salinity alteration in wetlands. Evaluate the importance of subtidal and intertidal mud, gravel, and sand habitats to assist in facility site decisions and to assess the value of artificial rock habitats such as breakwaters and jetties.

3) Assess habitat restoration -- Compare the costs and benefits of creation, restoration, and enhancement of the various critical habitats to determine feasibility of habitat restoration efforts.

These research areas are, for the most part, consistent with research that is now under way or planned. However, current funding levels may not be sufficient to procure and evaluate information within the time frame required for making decisions at local and national levels.

Effects of coastal facilities

Information is required on specific proposals for constructing facilities in coastal areas to develop siting techniques and to make projections of impacts. The issues that have been identified for increased research effort include energy facility siting (OCS leasing and development refineries, coal ports, power plants), canal dredging in wetlands, effects of freshwater diversion from rivers and estuaries, and studies of the effects of timber harvesting on anadromous fisheries resources and their habitats in the Northwest and Alaska.

These needs are now addressed by research and permitting programs conducted by NRC, EPA, NOAA, and DOE. Ongoing Federal programs can adequately fulfill these requirements, although relatively minor alterations in planned activities may be required within existing programs.

Evaluation of entrainment and impingement

Many data have been gathered and published on numbers and species of organisms that are affected by power plant cooling-system entrainment and impingement. However, it is extremely difficult to evaluate these data in terms of net effects on fishery stocks. This area is adequately addressed by ongoing Federal research programs.

Research and assessment in this area fall within the purview of DOE, NRC, and EPA. It is recommended that future research focus on entrainment and impingement mortality data as related to effects on fishery stocks; population modeling, including the phenomenon of compensation; the significance of sublethal effects resulting from entrainment and impingement; and regional cumulative effects of entrainment and impingement.

NONPOINT SOURCE POLLUTION

Nonpoint source pollution is among the most challenging of water pollution problems. The Government Accounting Office estimates that less than one-half of the pollutants entering the nation's waters are from regulated sources and municipal treatment plants (U.S. Comptroller General, 1977). In contrast to the important progress made during the 1970's in controlling industrial point source discharges and in upgrading municipal sewage treatment facilities, progress with nonpoint sources is negligible (CEQ, 1980). Management and control of nonpoint source pollution is a State and local responsibility. However, information on all pollution inputs, including nonpoint sources, is useful to the Federal role of regulating ocean dumping and discharge activities.

The distinction between point and nonpoint sources of water pollution is not always clear. Point sources generally discharge into surface waters through a discrete pipe, outfall, or ditch, and nonpoint sources generally discharge in a more diffuse way, for example, land runoff. Nonpoint source pollution is primarily the result of precipitation falling and moving over and through land and into surface water bodies. In some cases nonpoint source pollution is the result of human practices, for example, irrigation. All land use activities are potential nonpoint sources of pollution. The quality and nature of pollutants carried will vary with the type of activity occupying a parcel of land and the quantity of water that will move over the land surface.

Nonpoint sources of pollution are often classified as urban and non-urban runoff. Urban runoff occurs in areas of relatively high population density that are largely impervious to water because of the large area covered by roads, sidewalks, parking lots, and buildings. Non-urban runoff occurs in all land areas other than urban, such as agricultural lands, animal feedlots, pasture land, and forest land. Non-urban areas are more pervious than urban areas and absorb a higher percentage of precipitation into the soil.

The effects of nonpoint sources on water quality can be significant, depending on the annual hydrologic cycle and the types of land uses within a region. Estuaries and adjoining coastal areas may be particularly affected. Nearly the entire United States is drained by river systems that eventually discharge into coastal waters. Depending on the pollutants and the characteristics of the river system they enter, various amounts of nonpoint source pollutants are ultimately discharged into coastal waters.

Water pollution from nonpoint sources is estimated to affect about 90% of the drainage basins in the United States (EPA, 1978). Pollution discharges from nonpoint sources greatly exceed the discharges from point sources. In fact, it has been concluded (U.S. Comptroller General, 1977) that national water quality goals cannot be achieved without some control of nonpoint source pollution.

Although the Clean Water Act gives EPA no specific authority to regulate pollution from nonpoint sources, EPA has addressed nonpoint source pollution problems through the Water Quality Management Program, created by Section 208 of the Act. In carrying out its responsibilities under Section 208, EPA has focused on two nonpoint sources -- urban storm runoff and agricultural runoff. Regional planning agencies or States must prepare "208" or "WQM" plans to identify and propose solutions to water quality problems. The plans must include both point and nonpoint sources in surface and groundwaters. However, the plans are not binding.

EPA grants under Section 106 of the Clean Water Act assist State and interstate agencies in the prevention, reduction, and elimination of water pollution, including that from nonpoint sources. EPA and State representatives will recommend revisions of Section 106 management policies and allocation formulas by FY 1982.

Although many 208-plans recognize urban runoff as an important water quality problem, controls are difficult to implement. EPA's Nationwide Urban Runoff Program will gather data on urban runoff and will test control methods. There are various techniques for decreasing pollution from currently unregulated nonpoint sources. Known as Best Management Practices (BMPs), they include such practices as soil tilling, which minimizes soil erosion in rural areas, and street sweeping, which minimizes total suspended solids in urban runoff (EPA, 1980a). For the nation to have clean waters, it must become a high national priority to ensure that BMPs are properly installed, maintained, and operated (CEQ, 1980). Since 1978, EPA, the States, and regional agencies have selected 30 different areas in which to develop BMPs (EPA, 1980g).

EPA and the Department of Agriculture (USDA) are cooperating in selecting, funding, and managing projects to improve control of agricultural runoff. A Model Implementation Program has begun in several agricultural areas to test BMPs, to determine farmers' attitudes, and to document costs. The projects were planned for a 3-year period ending September 1980 but may be extended on an individual basis. Another EPA-USDA demonstration program for the control of rural nonpoint source pollution is the Rural Clean Water Program. Administered by the Agricultural Stabilization and Conservation Service of USDA, projects will last 3 to 10 years. Approximately 12 projects were initiated during FY 1980.

Analysis and Conclusions

Assessing the contribution of nonpoint sources to marine pollution problems is difficult. However, a preliminary attempt has been made by ORCA (see Appendix 1 for more information). ORCA has used a data base developed by Resources for the Future, Inc., to estimate pollutant discharges from both point and nonpoint sources, for all coastal counties in the United States. Although preliminary, these estimates indicate that nonpoint sources are major pollution contributions in all U.S. coastal regions. ORCA is currently updating, expanding, and modifying this data base as a part of its program of strategic assessments of the Nation's coastal and ocean regions. The expanded data base will contain an inventory of all land-based sources of pollution (point and nonpoint sources) in all ocean coastal areas in the contiguous United States and Alaska (excluding the Great Lakes)

as well as ocean-based stationary sources in coastal waters within the 200-mile fishery conservation zone of the United States. When completed this data base will allow a better determination of the contribution of nonpoint source pollution to marine pollution problems.

One major information need has been identified. Although this area is now addressed by ongoing programs, it is of continuing importance and should receive emphasis in the future.

Assessing sources and fates

Reliable and comprehensive information is needed on the extent and nature of nonpoint source pollution entering coastal marine areas and the Great Lakes. More specifically, mass loadings, major transport pathways, sinks, and chemical derivatives of key pollutants need to be identified. This information is essential, not only to aid in developing better strategies to control nonpoint sources, but also to provide a quantitative estimate of background levels for better management of point sources and for assessing the assimilative capacity of coastal and estuarine waters.

The strategic assessment program at NOAA is starting to inventory the flux of land-based sources of pollution, including nonpoint sources, through coastal areas.

A concerted effort involving Federal, State, and local governments is required to quantify the amount and rates of input of nonpoint source pollutants such as biocides, nutrients, metals, and toxic organics. Primary emphasis should be placed on agricultural sources and urban runoff. The information acquired should be summarized for subregions or watersheds and for major pathways to coastal estuaries and wetlands.

INCREASED COAL USE

The United States is at a turning point in energy production and consumption patterns. The historical trend of increasing energy use in the United States is clear. Total energy consumption in the United States increased from 35 quadrillion Btu in 1950 to 77 quadrillion Btu in 1978 (DOE, 1978). In the last century, the predominant source of energy shifted first from wood to coal, and then to petroleum and natural gas. U.S. dependence on imported oil has resulted in unacceptable economic and political consequences. The extent to which this dependence can be reduced will depend on the effectiveness of several possible solutions, which include more widespread conservation efforts, improved energy efficiency, increased production of

oil and gas, implementation of nuclear power, development of alternative resources (e.g., solar, wind, geothermal, biomass), and increased use of coal through direct combustion and implementation of coal liquefaction and gasification technologies. Coal has a potentially important role in the energy future of the United States. The future use of coal has important implications to the marine environment.

Since 1948, total coal consumption in the United States has remained relatively constant, varying from 10 to 14 quadrillion Btu (DOE, 1978). A decline in industrial, commercial, and residential use of coal after World War II was counterbalanced by moderate growth in coal use for generating electrical power. Future use of coal will depend on levels of oil consumption. If less oil is used, it is likely that more coal will be used in the nation as a whole. Depending on the level of oil use, it is estimated that in 1990, coal will constitute 25% to 32% of the total energy consumed in the United States (DOT/DOE, 1980). In 1975, coal energy constituted only 19% of the total energy consumed in the United States. Therefore increasing coal consumption, in both absolute and relative terms, is clearly indicated.

In addition to producing coal for domestic use, the United States is a major exporter of coal. In 1977, the United States exported 66 million short tons of coal, more than any other nation in the world (Interagency Coal Export Task Force, 1981). This constituted more than 25% of the total world coal exports. The two basic uses of exported U.S. coal are metallurgical processing and steam generation.

Exports of metallurgical coal were approximately 60 million short tons in 1979 and are expected to grow slowly at about 1.5% annually. In contrast, exports of steam coal are predicted to increase substantially (COE et al., 1980; Interagency Coal Export Task Force, 1981). The following are estimates of future annual coal exports from the United States:

YEAR	METALLURGICAL COAL EXPORTS	STEAM COAL EXPORTS	TOTAL U.S. EXPORTS OF COAL
1985	70	28	98
1990	80	64	144
2000	90	197	287

Source: Interagency Coal Export Task Force (1981).

These export levels are largely based on projections of world demand for steam coal. Expansion of the U.S. infrastructure for transportation and export of coal will be required, for increasing export levels to be met.

Analysis and Conclusions

The predicted increase in U.S. coal production, consumption, and export may affect marine ecosystems through various pathways, including the following:

- Disposal of wastes from coal-powered generating plants, and from liquefaction or gasification processes.
- Primary and secondary effects of coal transport, export, and handling in coastal areas.
- Coal power plant emissions, potentially includes acid rain effects.

The broad range of these issues is matched by the range of Federal agencies that have interests or responsibilities concerning coal use and its effects in the marine environment. The principal Federal agencies concerned include DOE, EPA, Corps, and NOAA. Following is a summary of some environmental aspects of coal transport, export, and use, showing pertinent legislation and responsibilities of Federal agencies:

ENVIRONMENTAL ASPECT	LEGISLATION	PRINCIPAL AGENCY RESPONSIBILITIES
Ocean dumping of coal wastes	MPRSA	Dumpsite designation -- EPA Criteria for dumping permits -- EPA Long-term effects research -- NOAA Dumpsite monitoring - NOAA
Discharge of coal pipeline slurry waters	FWPCA	Effluent guidelines and permits -- EPA
Land transport and handling of coal wastes	RCRA	All aspects -- EPA
Disposal of materials dredged to improve harbors for coal export	MPRSA FWPCA	Dumpsite designation -- EPA Criteria for dumping permits -- EPA Permit review and granting -- Corps Long-term effects research -- NOAA Dumpsite monitoring -- NOAA

No Federal program has been established exclusively to consider all the implications of coal policy in the marine environment. Therefore,

it is especially important to use interagency coordination to ensure that sufficient research is conducted to support decisionmaking and that unnecessary duplication of effort does not occur between agencies.

The trend toward increasing coal use and export has been recognized in its early stages. Therefore, the opportunity is available to plan and manage future coal use to gain the maximum benefit while giving full consideration to the environmental implications of these practices. Research and information needs related to coal waste disposal, coal export, and coal burning in power plants have been identified. The following areas associated with the marine pollution aspects of increasing coal use are of lesser importance in the context of national problems, and can be adequately addressed through improved interagency coordination of ongoing programs.

Coal waste disposal

When coal is burned to generate power, or when coal is subjected to liquefaction or gasification technologies, the mineral content (ash) of the coal is left behind as a residue. Ash content of coal varies from 5% to 25%, with typical values approximating 10% (Steele et al., 1979). In direct combustion, about 20% of the coal ash is left as bottom ash, and the balance goes up the stack as fly ash. Before fly ash leaves the stack, at least 95% of it is collected by various devices and becomes a solid waste byproduct of combustion. The other major source of solid waste in direct combustion is the stack gas scrubber that removes SO_2 from combustion product gases. Coal gasification and liquefaction produce solid wastes that are similar to those generated by conventional combustion. The annual waste generation of three types of coal facility are as follows (Steele et al., 1979):

FACILITY TYPE	SOLID WASTE (tons/year)
1,000-MW power plant (75% capacity)	475,000
250 x 10^6 SCF/day gasification plant (90% capacity)	805,000
50,000 Bbl/day liquefaction plant (90% capacity)	845,000

In addition to the obvious potential for huge volumes of coal residues, these solid wastes contain tar, spent catalysts, trace metals, polycyclic organics, cyanide, and other potentially harmful constituents. The National Advisory Committee on Oceans and Atmosphere (NACOA, 1981) has identified increasing coal use as a significant new source of solid waste and estimates that 50 million tons of coal wastes will be produced annually by the year 2000. Ocean dumping

will inevitably be considered one of several alternatives for disposal. Marine impacts may also result from storage, transport, or land disposal of coal wastes in coastal areas. More basic information is needed on the fate and effects of coal wastes in the marine environment to assist in making decisions on handling and disposal of these materials. Under current regulatory procedures, it appears that bottom ash and fly ash would, in general, pass the bioassay requirements and, therefore, would not be excluded from ocean dumping on that criterion. However, fly ash may be floatable under some conditions and therefore may not be acceptable for ocean dumping. Scrubber sludges are not likely to pass the bioassay requirements without some type of treatment.

EPA Region II granted a research permit for a single dump of about 2,000 tons of a mixture of 80% fly ash and 20% bottom ash at the Deepwater 106 Site in late summer of 1980. Initial surveys indicate that most of the disposed material descended rapidly to the bottom. The remainder of the ash quickly dispersed in the upper layers of the water column. Bioassay and bioaccumulation tests were also conducted by the applicant in conjunction with the research dump; the disposed materials passed these tests.

The information available on coal waste disposal provides an inadequate basis for developing policies and management plans to deal with the huge volumes of coal waste that may be generated in the next 10 to 20 years. EPA and NOAA should work jointly to define better the behavior and effects of coal wastes in the marine environment. Such a program should address these questions:

- What is the fate of disposal fly ash and bottom ash?
- Are there any adverse effects associated with dumping ash?
- What treatment, if any, is required for the safe disposal of scrubber sludge in the ocean?
- How close to shore can coal wastes be dumped safely?
- What are the effects of repeated dumps over a prolonged period?

Coal export

As discussed above, coal export from the United States is expected to increase substantially in the next 20 years. All U.S. coal exports leave the country by ship. Effective total coal export capacity for the United States is about 94 million short tons per year (Interagency Coal Export Task Force, 1981). The major portion of U.S. coal exports

is now handled by a limited number of ports. On the Atlantic coast, the ports are Philadelphia and others in Delaware Bay, Baltimore, and Norfolk and Newport News, often referred to as "Hampton Roads." On the gulf coast, the ports are Mobile and New Orleans. On the west coast, Long Beach and Los Angeles have a relatively small coal export capacity (Interagency Coal Export Task Force, 1981). It is clear that expansion of capacity will be needed to meet future export requirements. It is difficult to predict which ports will bear the major portion of the increased shipping because final delivered price of coal on the export market is not extremely sensitive to cost differences among ports and port locations. However, harbor improvement projects have been proposed for Hampton Roads, Baltimore, Mobile, and New Orleans. Channels leading to all of these ports are proposed to be deepened to 50-55 feet, thereby allowing access by vessels of the 100,000 DWT class. In addition, the capacity to export coal may potentially be developed at a number of new sites on all three U.S. coasts (Interagency Coal Export Task Force, 1981).

The direct impacts of increased coal export include the effects of fugitive dust and runoff from coal stored and loaded in coastal areas prior to export. An important secondary effect results from the harbor deepening and port improvements that will be needed to allow the use of larger, more cost- and fuel-efficient ships. The material dredged to enlarge or deepen channels must be disposed of, probably in the marine environment. Another implication associated with general enlargement and improvement of ports is habitat disruption or loss in coastal areas. If coal is transported to a port through a pipeline as a slurry, the discharge of slurry transport water may cause environmental impacts. Enlargement of ports and increases in shipping activity may elevate the risk of collision involving tankers carrying oil or hazardous materials.

Very little Federal research is being conducted specifically on the coastal impacts of coal handling and export. The effects of dredged material disposal are discussed elsewhere in this document.

Research needed to address the environmental ramifications of harbor dredging and port improvement is treated elsewhere in this chapter. Slurry transport water discharges and the fugitive dust emissions may require some research to describe environmental effects in coastal areas. Other types of impacts are discussed above in "Siting, Construction, and Operation of Coastal Facilities."

Coal burning in power plants

Most of the increase in coal consumption in the United States will result from a proliferation of coal-powered electrical generating plants. Acid rain, which affects freshwater ecosystems, has

recently been identified as a possible consequence of burning high-sulfur coal. In addition, polynuclear aromatic hydrocarbons may condense on particulates emitted from coal-powered plants. More information is needed on the effects of these emissions, especially in the Great Lakes, which are freshwater and lack the pH buffering capacity of seawater.

The United States and Canada are engaged in a joint research-management effort to learn about and control the acid-rain problem. EPA is scheduled to complete a special assessment of aquatic effects in 1982. NOAA is scheduled to complete a special assessment of natural resources in 1983, and a special assessment of global trends in 1984.

The U.S.-Canada agreement provides a good framework for assessing the implications of the acid-rain phenomenon. Efforts should be made to coordinate NOAA, EPA, and DOE research activities with conclusions drawn from the U.S.-Canada study.

OCEAN POLLUTION EVALUATION

Preceding sections in this chapter have discussed marine pollution studies that address problems arising from specific polluting activities such as waste disposal or marine transportation. In contrast, the Ocean Pollution Evaluation category includes research, development, and monitoring efforts that are not directly related to a specific polluting activity, but that are essential to understanding the impacts of ocean pollution from the receptor point of view, and are required to assess the effects of pollution on the resources or humans likely to be impacted regardless of source. These activities are considered under this category:

- Developing and evaluating quality criteria for water, sediment, and tissues of marine organisms.
- Documenting existing environmental quality and ecosystem conditions in coastal regions, offshore areas, and the Great Lakes.
- Observing and quantifying daily, seasonal, and long-term natural variability in various ecosystem attributes.
- Measuring the acute and sublethal effects of specific pollutants on selected organisms.
- Documenting the sources, transformations, and fates of pollutants in marine ecosystems.

- Studying the interactive effects of several pollutants or disruptions.

- Developing and validating simulation models of marine and Great Lakes ecosystems.

- Conducting region-specific studies of ecosystems and pollution problems.

The best method for classifying programs within the context of this Plan has not always been obvious. Determining whether programs should be classified under a specific polluting activity category such as waste disposal or marine transportation, or under the category of Ocean Pollution Evaluation is difficult because the information collected by the program may be applicable to more than one category. Although the approach has limitations, in most cases, legislative mandates were used to assist in placing programs in categories. For example, the BLM Environmental Studies Program, which is intended to provide information for leasing OCS mining areas, has been placed in the marine mining category, but NOAA's Great Lakes Research Program, which is intended to develop an understanding of Great Lakes ecosystems and the effects of pollution from all major sources, is included in the Ocean Pollution Evaluation category.

It is estimated that about $47.5K or 28% of the total Federal Marine Pollution Program was expended for studies in the Ocean Pollution Evaluation category during FY 1981. As shown in the table below, 8 of the 11 agencies participating in the program conducted Ocean Pollution Evaluation activities.

AGENCY	DOLLARS (Millions)	PERCENT OF OCEAN POLLUTION EVALUATION BUDGET	PERCENT OF TOTAL PROGRAM BUDGET
DOC (NOAA)	$ 7.8	16%	4.5%
DOD	.3	1	.2
DOE	6.2	13	3.6
HHS	3.1	7	1.8
DOI	2.5	5	1.4
EPA	8.6	18	5.0
NSF	18.8	39	10.9
NRC	.3	1	.2
TOTAL	$47.6	100%	27.6%

The major agencies that carry out studies directed toward Ocean Pollution Evaluation include the National Science Foundation (NSF), EPA, NOAA, and DOE. Combined, these agencies accounted for more than 85% of the funds expended in this area during FY 1981. NSF supports scientific research in general biological, physical, and chemical oceanography. EPA conducts studies under the Water Quality Research, Wetlands Research, Great Lakes Research and Monitoring, Chesapeake Bay, and Anticipatory Research Programs. Support for EPA Great Lakes study will be reduced starting in FY 1982, and the Chesapeake Bay Program, nearing the end of planned activities, is now being phased out. Activities conducted by NOAA that are applicable to the Ocean Pollution Evaluation area include portions of the Long Range Effects Program, New York Bight Project, Hudson-Raritan Estuary Project, Puget Sound Project, Great Lakes Pollution Studies, Habitat Investigations Program, Microconstituents Program, and Ocean Resources Coordination and Assessment Programs. DOE activities that are considered part of the Ocean Pollution Evaluation category are conducted under the Marshall Islands, Physiological Ecology, Northeast Regional, Estuarine, South Atlantic Bight, California Bight, Northwest Regional, Great Lakes, and Carbon Dioxide Programs.

Analysis and Conclusions

Ocean Pollution Evaluation studies are essential to understanding and predicting the impacts on marine resources of pollution from all sources. These studies provide a broader perspective than source-specific studies alone. This broader perspective encompasses a more thorough consideration of background conditions, natural variability, cumulative and synergistic effects, and protection of specific resources. Because of the many different subject areas addressed within this category, the Federal effort, when viewed as a whole, appears more diffuse and complex than is the case in source-specific categories. This should not be interpreted as a criticism of individul programs because the complexity results from the nature of the category and the system used to create it. Many studies are well planned and executed; however lack of overall guidance at the national level makes it difficult to assess the extent to which overall national needs are being met.

Because of the large number of agencies and programs involved in this area, the variety of efforts carried out, and the fact that cause-specific research not included in this category is often relevant, it is concluded that a more thorough examination of this category and a more comprehensive analysis of all pertinent scientific efforts carried out under the Program should be conducted by the Interagency Committee to determine whether the Federal Program could

benefit from improved interagency coordination. The Interagency Committee review would attempt to:

- Develop a strategy for performing the comprehensive analysis of scientific efforts pertinent to this area, based on the most important assessment and evaluation needs.
- Accurately describe the activities that each agency is supporting within the area.
- Identify research areas that need additional effort.
- Identify opportunities for improved coordination between agencies.

III. Regional Marine Pollution Concerns

Many marine pollution problems are addressed most appropriately on a regional basis so that the unique environmental attributes and problems of the region can be considered. To identify regional pollution problems and concerns, the National Marine Pollution Program Office (NMPPO) conducted conferences in five ocean pollution regions in the summer of 1980. In addition to providing a regional viewpoint, the conferences were heavily attended by people not associated with the Federal Government, and therefore also provided a non-Federal perspective. Summaries of regional conferences were published as Working Papers 2 through 6 (see inside back cover). The working papers present detailed accounts of regional marine pollution concerns and research, development, and monitoring needs, as perceived by conference participants.

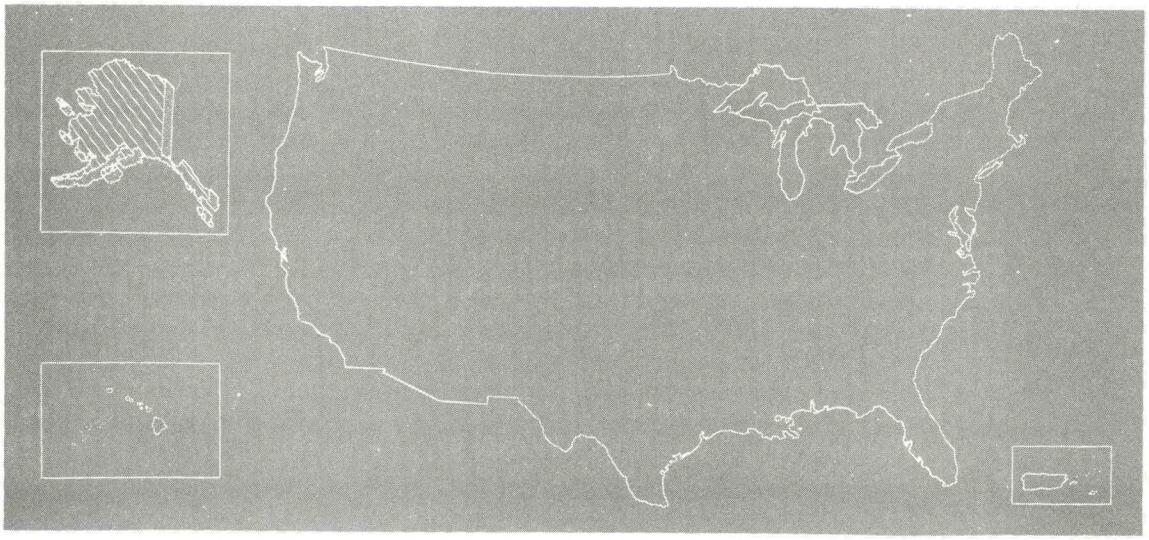
The conference reports have been used heavily in the development of this Plan. They formed the basis for identifying needs and priorities for national research, development, and monitoring. In addition, the conference reports were a key consideration in working group deliberations that were used to generate the recommendations presented in this Plan.

In FY 1981, about $87.7 million or 51% of the total Federal marine pollution research expenditure was devoted to region-specific research. The distribution of expenditures among regions is provided in the following table:

REGION	DOLLARS (Millions)	PERCENT OF REGION-SPECIFIC FUNDS	PERCENT OF TOTAL POLLUTION PROGRAM BUDGET
Alaska	$19.7	22%	11%
Great Lakes	12.1	14	7
North and Mid-Atlantic	23.5	27	14
South Atlantic and Gulf	21.2	24	12
West Coast	11.2	13	7
TOTAL	$87.7	100%	51%

A summary of pollution problems and needs has been extracted from each regional conference report; these summaries are presented below. Unfortunately, the summaries cannot relay all the information included in the conference reports. However, they identify the key regional pollution issues and indicate regional attitudes and concerns. For more detailed information, the conference reports should be consulted.

ALASKA REGION



With a land area of 375 million acres and a total population (1977) of 410,000, Alaska has a lower population density than any other state. There has been insufficient opportunity for widespread impact on the natural environment, but the potential for broad impact is present, because the future of Alaska lies in continued and expanded use of its natural resources: forestry, agriculture, terrestrial and marine minerals, and fisheries.

Alaska can be divided into three major geographical regions, each with its unique present and potential pollution problems: the Gulf of Alaska, Bering Sea, and Arctic.

The Gulf of Alaska region stretches from the Canadian border south of Ketchikan to the Aleutian arc. Some of the most severe weather in the world is found in the Gulf in winter. More than 70% of the Alaskan population reside in this region, making it more diverse and concentrated in industry than other areas of Alaska.

Forest management in this region poses problems, particularly with transportation of logs. Tanker transport of oil from Valdez is a major concern because of potential oil spill catastrophes.

The Bering Sea region has a much lower population. The coastline has major rivers and deltas along with extensive lagoonal margins. Storm conditions are frequently severe in the Bering Sea. There is an annually migrating ice cover, and the region is characterized by a very large shelf area with a complex circulation system. The primary resource of the region is fish; one of the most productive shelf regions in the world is found in the eastern Bering Sea. Damage to the resources of this region could result from the marine disposal of fish-processing wastes, chronic or massive oil spills, mining-dredging operations, and remote coastal community sewage disposal problems.

The Arctic region includes the Chuckchi and Beaufort Sea coasts, which are shallow and lagoonal. Coastal waters remain ice-covered for most of the year. The marine pollution concerns of the area include the lack of information on oil spills in the arctic marine environment, the impact of industrial development on endangered species and on the lifestyles of native inhabitants, the impact of domestic waste discharge and gravel dredging, and future impacts of offshore oil development.

IDENTIFIED NEEDS

Four working groups studied these important sources of pollution to place priorities on Alaska's information needs:

- Urban liquid and solid waste and seafood-processing wastes; formation waters and drilling muds.
- Forestry activities and products.
- Offshore oil exploration and development.
- Marine transportation, mining, and dredging.

Urban Liquid & Solid Waste, Seafood-Processing Wastes; Formation Waters and Drilling Muds

Urban solid waste enters marine waters indirectly through leachates that combine with freshwater drainages feeding estuaries. Known effects are discoloration of water and altered intertidal macrophytic community structure. Untreated or primary treated domestic wastes are discharged by the majority of Alaskan communities, but little is known about the effects of disposal practices. Seafood-processing waste discharge has taxed the assimilative capacity of the receiving environment, resulting in loss of benthic populations and habitat, and a reduction in use by pelagic species. Formation waters are hydrocarbon-contaminated waters found in association with petroleum brought to the surface at producing wells. The current focus on drilling muds is on examining the long-term, sublethal effects in shallow and/or poorly flushed marine waters, where accumulations of heavy metal constituents are likely to occur.

The highest priority needs associated with these subjects are listed below:

1) Evaluation of hydrographic and monitoring data from existing seafood-processing locations to select future suitable disposal sites.

2) Evaluation of seafood-processing waste management alternatives and disposal technology.

3) Chemical and biological monitoring at selected sites over time to evaluate water quality effects.

4) Evaluation of small-scale (on-site) waste treatment technologies as effective economic alternatives to central treatment.

5) Development of innovative, cost-efficient biological and chemical monitoring indices sensitive to long-term input of municipal liquid wastes.

6) Examination of existing and projected seafood waste loading in selected areas.

7) Determination of seasonal hydrographic structure and water circulation for municipal locations.

8) Chemical characterization of Prudhoe Bay production water.

9) Promotion of 96-h LC_{50} and chronic laboratory toxicological studies of formation waters on larval and other sensitive species.

10) Oceanographic circulation studies in coastal areas of oil and gas development.

Forestry Activities and Products

Pollution from pulp mills is introduced through air and water emissions as well as solid wastes. Varying effluent levels are affecting the marine coastline of southeast Alaska. The transportation and storage of logs in marine waters affect the environment through emission of leachates, bark accumulation, and physical perturbation. Harvesting can have direct or indirect effects: changes in temperature and turbidity, changes in nutrients, and habitat modification.

Research is needed to determine the following:

1) Behavior and effects of chemicals used in reforestation and protection practices.

2) The effects of upland development on the marine environment.

3) The effects of log transfer and storage on the marine environment.

4) The effect of pulp mill effluents on the marine environment.

Offshore Oil Exploration and Development

Information needs were established for three regions: Gulf of Alaska, Bering Sea, and Arctic. Six general problem areas were explored for each region:

1) Sources of pollutants/perturbations, and contaminant baselines.

2) Environmental hazards to development.

3) Pollutant behavior and pathways in the environment.

4) Targets/receptors (living resources, organisms, populations, and habitats at risk) of pollutants and developmental disturbances.

5) Responses of targets (including potential increased attraction of organisms by habitat alterations) to pollutants.

6) Evaluation of the effectiveness of preventive, mitigating, and remedial measures.

Specific information needs, in order of importance for each region, are as follows:

Gulf of Alaska

1) Evaluation of preventive, protective, remedial, and mitigating measures (i.e., discharge permits, oil spill response requirements, etc.).

2) Translation of highly technical data into a useful form for decisionmakers, verification of laboratory studies by field work, selection of organisms to fulfill long-term monitoring needs, and study of organism responses to pollutant and dispersant agents.

3) More information on sources and background levels of contaminants. Evaluation of existing models and information on the pathways and behavior of potential pollutants. More complete survey data, especially seasonal information on organisms and processes.

4) Evaluation and monitoring of geohazards.

Bering Sea

1) Basic research on populations and organisms (natural variations, distributions and biological processes).

2) Data on sources of pollutants and contaminants (also information on pathways -- ice and open-water periods as well as suspended-sediment interactions).

3) Response of targets to pollutants: Examine such responses as microbial degradation and the interaction potential between pollutants and detrital carbon utilization pathways, along with the effects on larvae, pelagic eggs, etc.

4) Ice, geological, and weather hazards capable of causing polluting accidents.

5) Evaluation of spill response capability and plans.

Arctic

1) Increased understanding of arctic populations, basic biology of species and processes, and habitats.

2) Increased knowledge of pathways (ice-covered, transition, open-water, sediment).

3) Survey data on sources of pollutants and contaminants (offshore/onshore seeps, secondary sewage) and responses of organisms and populations.

4) Hazards (ice, erosion, subsea permafrost, storm surges capable of causing polluting accidents).

5) Documentation and evaluation of arctic-specific strategies for oil drilling and operations.

Marine Transportation and Mining/Dredging

Many significant marine problems result from transportation and mining/dredging activities. Expansion of petroleum and commercial fishing industries will increase the potential for petroleum (and related products) discharge, which threatens the abundant fishery resources and significant tourist and recreational resources. Both petroleum and fishery industries in Alaska introduce chemical pollutants. Also, present and projected chemical product facilities pose a threat of large-volume spills. The increase in harbor development and small boat operations may increase the discharge of untreated or partially treated sewage. The development of disposal sites for marine mining and dredging is also of primary concern. Proposed petrochemical development could introduce a number of hazardous wastes. All of the coastal activities will result in habitat modification to some degree.

The priority activities to provide information related to these problems are as follows:

1) Create an environmental-sensitivity atlas for coastal areas affected by potential oil spills.

2) Perform research on fate and effects of spilled oil in Alaska's unique environment, particularly with respect to cleanup.

3) Define effects of continuous, low-volume oil discharges along with the transfer of effects between trophic levels.

4) Establish design criteria for facilities to dispose of waste oil.

5) Conduct research on the nature and effects of anticipated waste materials to provide a scientific basis for evaluation of petrochemical and hazardous waste disposal alternatives.

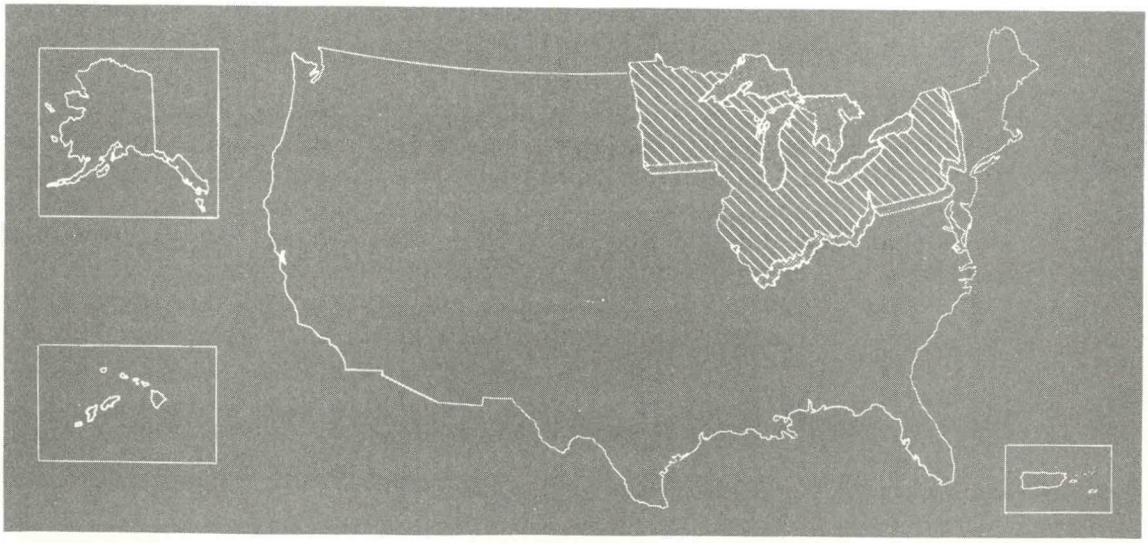
6) Perform research on impacts (including socioeconomic) of various types of coastal facilities on marine and adjacent coastal environments.

7) Study effects of dredged material/mining tailings on marine habitat.

8) Carry out research to establish toxicity levels related to amounts of dredged material and mineral-processing wastes.

9) Evaluate sublethal effects of dredging and mine tailings.

GREAT LAKES REGION



The Great Lakes region is defined as the U.S. coast bordering Lakes Ontario, Erie, Huron, Michigan, and Superior, and the adjoining waters of the Great Lakes. The Great Lakes are a resource of economic and aesthetic value to both Canada and the United States. Water from the Great Lakes is used on a daily basis for hydropower generation,

power plant cooling, manufacturing, agriculture, and domestic uses including drinking water. Great Lakes shipping transports 85 million tons of iron ore and 30 million tons of grain yearly. Coal, limestone, steel, and other products create such a major waterborne commerce that more cargo was shipped through the locks at Sault Ste. Marie than passed through the Panama Canal last year. The 9,500 miles of shoreline and 95,000 square miles of water surface provide ample recreational opportunities for the millions of tourists who contribute over $5 billion to the region's economy each year. The region's agriculture contributes $20 billion to the U.S. economy. About-one fourth of the nation's manufactured goods are produced in the region, including 70% of U.S. steel and 23% of the chemicals that the United States produces.

There are marked differences between the northwest and southeast portions of the Great Lakes region. Lakes Superior and Huron are heavily forested and support the paper and lumber industry, mining, chemical manufacturing, and iron ore production. Lake Michigan also supports forestry and agriculture and is heavily industrialized in the southern area. Lake Erie supports both agriculture and industry. Lake Ontario contributes to tourism in the region.

The convergence of people and industry, coupled with the natural characteristics of the Great Lakes, has created major problems. Unlike the ocean, the Great Lakes are a relatively closed system. Each lake basin drains into the next. Even the Lake Michigan cul-de-sac eventually drains through Lakes Huron, Erie, and Ontario. Any addition of contaminants today may take centuries to be flushed out of the system. Another characteristic of the system is the significance of atmospheric sources of pollutants to the lakes. A major source of PCBs to Lake Superior is atmospheric fallout. Thus any efforts to improve Great Lakes water quality must consider air and land issues as well. In addition, the Great Lakes are used as a resource by both Canada and the United States. Thus, regulation and management of the resource are complicated by international considerations.

Any threat to Great Lakes water quality is particularly significant because of one fact: the Great Lakes are freshwater. Their waters are consumed directly as municipal water supplies at the rate of 3 billion gallons a day. In fact, 95% of the available fresh water in the United States is contained in the Great Lakes. The highly industrialized society of the Great Lakes basin has found the lakes a convenient dumping ground. The large agricultural and mining industries of the region produce vast amounts of waste and runoff that eventually enter the lakes. Although much of the Great Lakes could still be considered pristine, a significant portion is sufficiently polluted to pose a threat to human health as well as to ecosystem viability.

The human health problems associated with Great Lakes pollution are perhaps the most disturbing. The accumulation of toxic wastes over nearly a century of heavy industry has now become the pollution problem of the region. The mechanisms by which toxic wastes reach the human population are numerous. Soluble wastes that enter the Great Lakes are likely to end up in municipal water supplies. Other toxics enter the aquatic food web and often accumulate in fish; these fish are consumed as a result of both sports fishing and commercial fishing. Airborne particulate pollutants enter the Great Lakes by both dry and wet deposition. Many of these particulates are carcinogens and end up in municipal water supplies.

IDENTIFIED NEEDS

The Great Lakes Regional Conference was organized in the following six panels: Food and Fiber Production Water Uses; Industrial Water Uses; Municipal Water Uses; Recreation and Wildlife Water Uses; Social, Economic, and Institutional Water Uses; and Transportation Water Uses. A review of the Panels' deliberations revealed six problem areas that represent the most significant pollution issues in the Great Lakes. These issues are discussed briefly below and are all considered to be of highest priority.

Contaminants and Toxics

Conventional water purification techniques do not remove many contaminants and toxic materials from municipal water supplies. The information or research needs associated with this problem relate to persistent and/or highly toxic materials already in the environment, and to possible new contaminants or toxics. The panel identified these needs:

1) Identification of new contaminants and their sources.

2) Techniques for safe storage, disposal, or destruction of these materials.

3) Use of sophisticated techniques (including mathematical modeling) to monitor the transport, fate, and effects of hazardous wastes.

4) Programs to inform the public on the effects of these materials.

Eutrophication

The problem of accelerated eutrophication in the Great Lakes was identified more than 20 years ago, and is still an issue of major concern today. This is not surprising; these large lakes respond slowly to remedial measures. The recognition of the eutrophication problem prompted considerable research, and the results have been used in managerial decisions to reduce phosphorus and nitrogen loads to the lakes. However, these managerial decisions have often been based on incomplete or inconsistent data. For example, simulation models for one Great Lake are usually not applicable to another.

An increase or reduction of phosphorus discharge of only 0.25 mg/L (0.25 ppm) can mean billions of dollars added to the cost or saved on sewage treatment.

The following basic information needs were identified:

1) Precise and reliable data on the causes of eutrophication in the Great Lakes.

2) Guidelines for land use to reduce pollution problems.

3) Research on pollutant interaction (e.g., phosphorus with toxics) and the ecosystem effects of these interactions.

4) Description of the response of Great Lakes biota to eutrophication.

Habitat Modification

The Great Lakes region has undergone extensive physical and chemical changes since the beginning of colonial settlement. These changes were the most extensive and rapid during the industrial revolution. The function and structure of the Great Lakes ecosystems, although relatively poorly understood, have been significantly and possibly irreparably changed by habitat modification. The productivity of the fish stocks in the Great Lakes has been changed, as has the predominance of species found in the lakes. All of the other forms of wildlife have also been influenced by extensive habitat modification. The effect on wildlife has been most pronounced in the nearshore zone and in wetlands. Harbor and channel dredging, dredged material disposal, disposal, nearshore landfills, and nearshore farming in the Great Lakes region have adverse effects on habitats, but these effects are not fully quantified or understood.

The following information needs were identified:

1) Description of the complete habitat needs (physical, chemical, and biological) of all important species.

2) Inventory of habitat types and description of the rate and nature of loss or modification.

3) Increased understanding of Great Lakes ecosystem structure and function.

4) Specific studies on the habitat implications of eutrophication and hazardous waste disposal.

Social, Economic, and Institutional Considerations

The issues raised in the social, economic, and institutional problem areas were not research problems per se, but rather involved the manner in which the conference attendees viewed the function of government agencies in the Great Lakes region. The heart of this problem is the complex tangle of local, regional, and Federal agencies, which is hampering efforts for effective pollution control. Many agencies are assigned the same or similar regulatory responsibility, yet they seem to set contrary or conflicting regulations. Another concern was the possibility that managerial decisions were made without considering results of pollution research and monitoring in the Great Lakes Region. In spite of the various data bases established by government or private research organizations, availability of data and useful assessment have not increased adequately. Along with the institutional problems of government, industry has expressed concerns over the economic burden of pollution control. The cost of the many programs to control Great Lakes pollution is extremely high. The public and private sectors are willing to pay for expensive environmental programs, but expect results in a reasonable amount of time.

Some of the social, economic, and institutional needs discussed at the Great Lakes Regional Conference are not within the purview of the national marine pollution research planning process. However, a summary of recommended activities follows:

1) Review the activities, responsibilities, and authorities of government agencies at all levels with the intent of improving coordination.

2) Develop effective mechanisms for the dissemination of information garnered from research efforts.

3) Promote involvement of scientists in public affairs.

4) Define economic and social implications of environmental regulation.

Major Discharges

The discharge of any material to the Great Lakes in large volume will present a pollution problem. The release of hazardous wastes or nutrients that exacerbate eutrophication is a major consideration. But there are also many innocuous materials that can cause adverse effects when discharged in large quantities. For example, most chloride salts are not particularly harmful when discharged in small quantities, but the large amount of chloride released into the Great Lakes has significantly altered the chloride concentrations of four of the five Great Lakes, and the release of chlorides is expected to increase in the near future. Other major discharges also adversely affect the Great Lakes. Runoff from heavy rainstorms can carry a variety of compounds depending on whether it comes from agricultural lands, street runoff, or combined sewers. In the case of combined sewers, these major discharges carry many pathogens that present hazards to human health.

Another type of major discharge that affects the Great Lakes is atmospheric fallout. The heavy air pollution burden of the industrialized Great Lakes region carries a high phosphorus load. This phosphorus enters the lakes by both dry and wet deposition and furthers eutrophication. Acid rain also affects the Great Lakes, but not by lowering the pH of Great Lakes water; the low pH of rainwater falling on the Great Lakes drainage basin tends to mobilize chemicals that would normally remain bound in the soil. Certain chemicals may also be formed in the atmosphere by interactions between low-pH water vapor and particulates. These chemicals then are washed into the Great Lakes by precipitation. Acid rain is not likely to lower the pH of Great Lakes waters because of the enormous buffering capacity of these lakes and the geologic composition of the drainage basin.

The following specific needs were identified:

1) Determination of the immediate human health hazard posed by major discharges; identification of particularly hazardous discharges and control mechanisms available.

2) Study of the long-term effects of major discharges including reduction in water quality, interactions of multiple pollutants, and new or unexpected sources of major discharges.

Risk Analysis

The use of risk analysis as a tool in aiding the study of pollution-related problems and their remedies was considered highly useful by the conference attendees. A complete consideration of environmental risks appears to be rarely or incompletely used in pollution-related management or regulatory decisions. The current base of information may be inadequate to permit the use of risk analysis in some areas of policy decisions on Great Lakes water quality and pollution control.

Recognized needs could be met by the following activities:

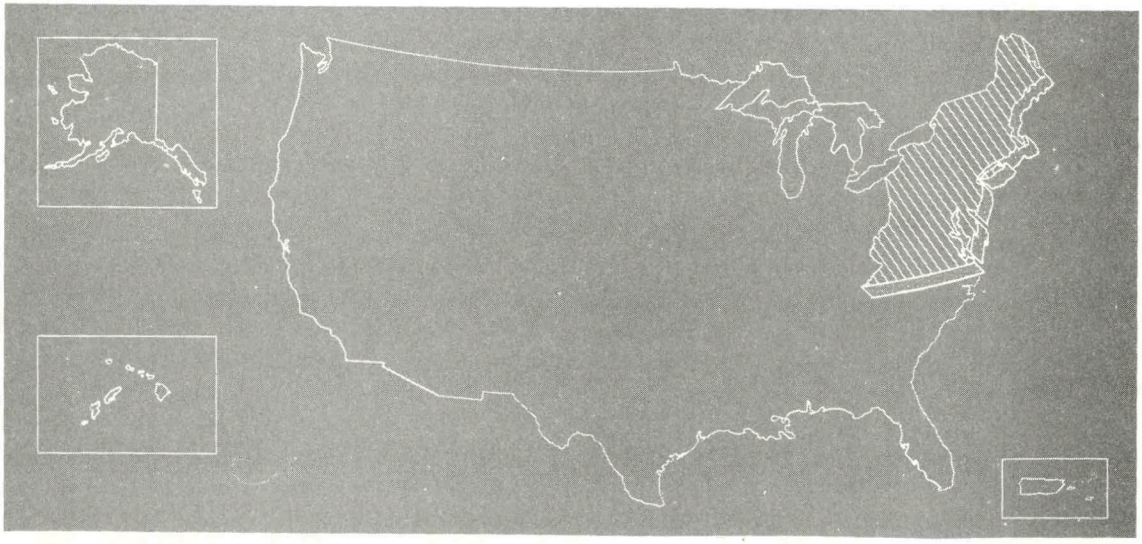
1) Improve risk analysis techniques as applied to water quality changes.

2) Define the data base required for successful use of risk analysis.

3) Identify causes of past failures to employ risk analysis in the Great Lakes region.

4) Describe potential benefits from the use of risk analysis.

NORTH AND MID-ATLANTIC REGION



The North and Mid-Atlantic region is defined as extending from the U.S.-Canada border in Maine south to the boundary between Virginia and North Carolina. The region includes the coastal area and extends to the edge of the continental shelf.

The North and Mid-Atlantic region may be divided into two areas. The North Atlantic area extends south from Maine to New York. The area is characterized by narrow open inlets, cool fertile waters, and large tidal ranges. Heavy spring runoff locally dominates coastal circulation, but natural erosion and sedimentation are not severe problems. The Mid-Atlantic area stretches from New York to Cape Hatteras and includes New York Harbor, Raritan Bay, Delaware Bay, and Chesapeake Bay. It is characterized by large estuaries, sandy beaches, and barrier islands. Parts of this area have undergone considerable degradation as a result of heavy urban and industrial development.

Both areas serve the Washington-New York-Boston megalopolis as recreational sites and waste disposal sites, and they also contain commercially important fisheries. Lobsters, clams, and scallops are harvested in the North; cod, haddock, herring, and flounder fisheries are especially productive. In the Mid-Atlantic waters, oyster and blue crab constitute the largest commercial fisheries, the latter being the largest of its kind in the world. The Chesapeake Bay estuary provides wintering grounds for great flocks of ducks, geese, and whistling swans. Productivity in both areas is potentially endangered by increased runoff, waste disposal, dredging, continued industrialization, and transportation-related pollution.

The area is also a major shipping and industrial center. Hampton Roads, for example, handles more than half of the nation's exports of coal to Europe and Japan. The Boston, Baltimore, Philadelphia, and New York ports handle about one-half of the exports and imports of the nation -- a vital function in an increasingly interdependent world. Refineries in Philadelphia, Delaware, and New Jersey provide fuel and petrochemicals for all of the eastern seaboard. Lighters and barges use the coastal waters and major rivers to distribute refined products from Maine to Virginia. OCS oil and gas exploration is now under way, and production in Baltimore Canyon or Georges Bank could occur in the future.

In the North Atlantic area, marine pollution is confined to relatively localized areas; e.g. estuary modification presents a problem in Boston, Providence, and Portsmouth. Pollution increase with the development of a petroleum industry in Georges Bank might change this situation drastically. It is not clear whether the well-developed ocean circulation and strong tidal currents characteristic of the area, which provide a tremendous flushing capacity, will mitigate the effects of pollution. Long-term effects of polluting activities in the Mid-Atlantic are not well understood. The New York Bight fish kill of 1976 caused by bottom-water anoxia and the closing of Long Island beaches because of waste washing onshore are readily observable indicators of pollution. Other changes, such as tainting of seafood organisms and higher incidences of fish and shellfish

disease, are indicators of the harmful effects of toxic metals, PCBs, and other polluting substances. Decreases in the striped bass population may be attributable to pollution-related problems.

IDENTIFIED NEEDS

A synthesis of the North and Mid-Atlantic Conference proceedings resulted in identification of nine highest priority, four high priority, and six priority needs and problems. Sewage disposal, bioassay and biological monitoring, ocean pollution disasters, and dynamics of pollutant dispersal were considered high priority. Priority needs and problems were oil and gas development, physical modification of the coastal zone, radioactive material, alternative energy sources, offshore mining, and vessel operations. The highest priority needs are summarized below.

Dredging and Dredged Material Disposal

The major problem related to dredging and dredged material disposal centers on the disposal of contaminated materials. There is a need to develop a dredged material management plan for each major port within the region. The following is a summary of important needs for the North and Mid-Atlantic region:

1) Establish criteria to characterize dredged materials in terms of pollutants and toxicity; determine the correlations between stress on the biota and the bulk concentrations of pollutants; establish reliable and effective bioassay and bioaccumulation tests; determine the long-term ecological effects of low concentrations of pollutants; decide how to select acceptable dumping sites.

2) Before and during dredging, determine the mechanisms and rate of exchange of contaminants between sediment and water column and the redistribution of contaminants in the dredged area.

3) Give reliable criteria to evaluate the effects of ocean disposal of dredged material. Compare those consequences with the effects (and costs) of land disposal.

4) Develop innovative processing methods to reduce contaminants before disposal, and new alternatives for disposal of contaminated materials.

5) Quantify effects of dredged material disposal. Study the rate of recovery of the biota at abandoned dumpsites.

Monitoring

The development of a comprehensive monitoring system would improve capabilities to describe long-term changes in Northeastern coastal waters or estuaries and to distinguish significant changes in the "health" of those systems from inherent natural variations. The information would provide adequate warning signals of potentially serious changes, useful in resource management and decision making. The following specific needs are recognized:

1) Develop monitoring procedures (frequency, intensity, techniques, parameters) to fulfill objectives.

2) Concentrate efforts on potential problem areas, e.g., dumpsites.

3) Present data in a form useful to both scientists and managers.

Information & Data Management, Synthesis, and Evaluation

Monitoring is a necessary but insufficient precursor for good management decisions. Information and data must also come from a wide variety of sources, and be readily accessible and evaluated. There now exists no coordinated system for organizing, accessing, and managing the vast amounts of data and information generated from coastal and marine pollution control and monitoring research.

At the conference it was suggested that a prototype regional data and information management system be established to include the following:

1) An inventory of all past and ongoing research on coastal planning and marine pollution.

2) An inventory of experts/researchers and research institutions.

3) Bibliographic information, concentrating on grey literature.

4) Pertinent data and an inventory of other existing support data; an instruction manual for users, and a minimal staff at a central location to assist users.

5) An inventory of gaps in the information base, and research to assist in recommendations for research needs and priorities.

Industrial Waste Disposal

Industrial wastes are a necessary consequence of our manufacturing economy. The enormous amount of chemical waste generated each year by

industry has created a national disposal problem. Specific ocean dumping sites and at-sea incineration provide options for disposing of these wastes.

The following industrial waste disposal information needs were identified:

1) Emphasis on in situ methodology, with focus on processes rather than acquiring data. Monitoring, planning, and scheduling should be cast in terms of physical oceanographic processes, for without knowledge of the driving mechanisms the ecological problems cannot be resolved. Representative data might include growth, reproduction, behavior, and pathology.

2) Acids and bases: The known effects are mainly short-term; long-term sublethal effects must be determined. Further work on mutagenic effects is needed. A first priority is to identify specific acids/bases that may be acceptable for disposal at sea, and the levels of impurities that may be harmful. When certain wastewaters are disposed of at sea from moving barges, the organisms most immediately affected are plankton. Information is needed on the speed with which populations repair themselves by reproduction and by recruitment, i.e., bringing in new previously unexposed organisms. The significance of varying degrees of mortality on the higher trophic levels in the disposal area should also be assessed.

3) At-sea incineration: How do repeated exposures to residues of toxic materials falling in water affect the various biological communities? What happens when planktonic organisms drift within a polluted water mass that maintains its integrity for relatively long periods (e.g., anticyclonic eddies)? What effect will stack emissions have upon pelagic or migratory birds?

Increased Use of Coal

Conversion of power plants and ships from oil to coal will introduce several new environmental problems. First, fire and dust problems are associated with storage, transportation, and handling of coal. Next, coal burning causes air pollution problems. Finally, there are disposal problems with soot, fly ash, bottom ash, scrubber sludge, and other solid wastes. In many instances the oceans will be the final sink for some of the coal byproducts. Possible environmental impacts on marine waters and organisms from a shift to coal for power production should be estimated and assessed now so that information can be used in planning and decisionmaking.

The following key information needs were identified at the regional conference:

1) Estimate the magnitude of coal usage in the future and project the locations of future coal-fired power plants in the coastal region.

2) Obtain engineering/design data on process costs, including costs of changes in coastal land use and transportation patterns as part of total energy production (per kW) costs.

3) Estimate potential timing and rates of conversion and the probable increases in waste for 1980 to 2030.

4) Determine the effect of leachate and fugitive dust from coal piles in the marine environment.

5) Determine the effects of disposal of fly-ash and/or other solid wastes in the marine environment.

6) Investigate the indirect effects of acid rain and the atmospheric transport of combustion products, such as polycyclic aromatic hydrocarbons and other harmful compounds.

Chlorinated Discharges

Water disinfection, wastewater (sewage) treatment, and the electric power industry consume and discharge in waste, large amounts of chlorine. The waste discharge products can be extremely toxic. Up to several percent of chlorine decays by forming halocarbons, including trihalomethanes. For the most part, the nature and persistence of other decay products are not yet known even though there is evidence that some decay products are bioactive. Some compounds produced by chlorination are also mutagenic. Furthermore, the increasing number of chlorine discharges from treatment plants may be affecting migratory behavior in anadromous fish.

The following specific information needs were recognized at the regional conference:

1) The fate of chlorine-produced halocarbons in the environment should be determined, and potential for biomagnification should be elaborated.

2) The mutagenic components of chlorinated wastewater should be identified, and their effects on the environment assessed.

3) Adequate and accurate analytical methods for monitoring chlorine produced oxidants and chlorine decay products must be developed.

4) Study of sublethal biological effects, such as alteration in development and behavioral modifications affecting feeding ecologies and reproductive behavior of commercially important species, must be increased.

Biological Assessment

The principal significant effects of changes in the coastal waters and the estuaries are those that injure the biota and the related ecosystem processes. However, present methods for biological assessment of existing or potential changes are inadequate for measuring impacts or estimating the effects of proposed changes.

Methods for predicting impacts should be evaluated in terms of their appropriateness and effectiveness in specific situations. The most useful and effective methods should be further refined, and statistical methods should be developed to improve use of data.

New York Bight

The conference participants identified the New York Bight as representative of problems in similar environments all over the world. Information about the Bight is not adequate, even after extensive, long-term studies. For example, sources of hydrocarbons, including polynuclear aromatic hydrocarbons, have not been well established. Information is not available to define the rate of input of toxic materials to the Bight from net estuarine flow; and quantitative data on sources of toxic materials are sketchy. A major need is the determination of contaminant budgets (sources, fates, concentrations) in the Bight area.

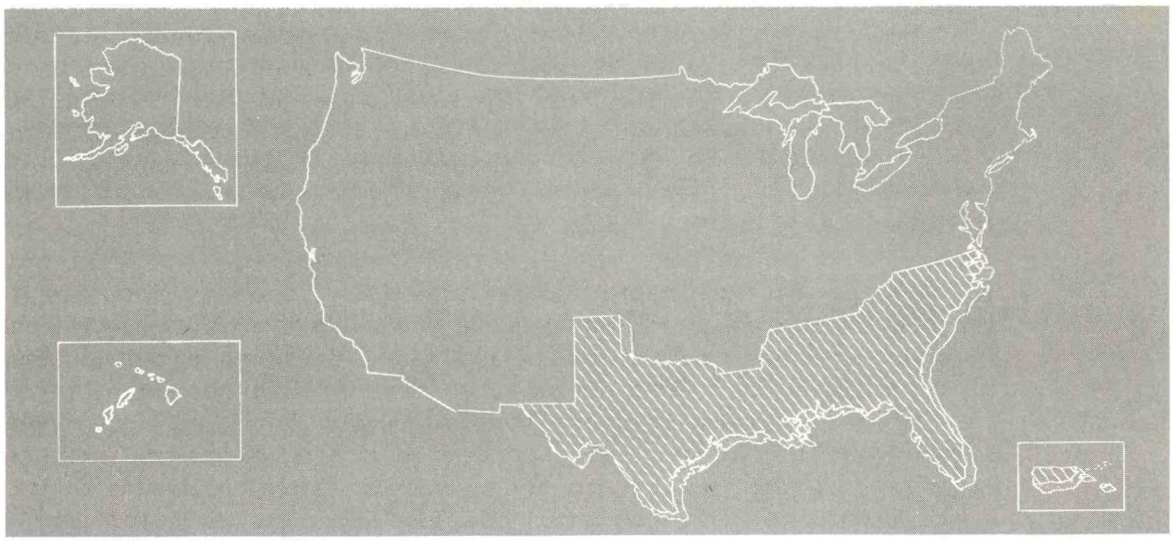
Coastal Power Plant Cooling

Conventional once-through cooling water systems have three basic types of potential impact on the marine environment. Nektonic organisms may be destroyed on screening devices at intakes. Plankton that passes through intake screens and thus through the system will experience thermal, mechanical, and chemical stresses; and marine organisms in the receiving waters are exposed to a thermal effluent. Considerable site-specific work has been done dealing with impingement, entrainment, and thermal effluent effects.

An alternative to the once-through cooling system is the cooling tower. Although cooling towers have been employed widely for inland freshwater power plants, they have not been used at coastal sites with ocean water. The environmental impacts of saltwater cooling towers have not been fully examined so far.

The volumes of reports that detail local effects of coastal power plants contain the basic information necessary to approach this problem. A systematic review of such material should be undertaken by competent marine scientists with the objective of identifying common positive and negative features to guide future designs. The alternative of using cooling towers in coastal regions should be studied thoroughly to assess both risks to the environments and impact on human health and safety.

SOUTH ATLANTIC AND GULF REGION



The South Atlantic and Gulf region is defined as extending south from the Virginia-North Carolina border, around the Florida Keys, and along the Gulf of Mexico through the coast of Texas. The region also includes the U.S. Virgin Islands and Puerto Rico. The coastline from North Carolina to Texas contains more than 17 million acres of estuarine habitat which is about 60% of the estuarine acreage in the contiguous United States. These estuarine systems support a large and diverse commercial and recreational fishery, which dependency is represented by the fact that about 96% of the commercial fishery yield in this region consists of species of fish and shellfish that utilize estuarine habitat for at least some phase of their life cycle.

These estuarine areas are subject to ever-increasing coastal development, which, in turn increases the impacts on living marine resources. Along the Gulf coast, the rate of population growth is three times the national average. More than 138,000 acres of Gulf coastal wetlands have been filled, and 70% of all the material dredged in the United States originates in the New Orleans, Galveston, and Mobile Corps of Engineer districts. About 10% of the entire Gulf coast is closed to shellfishing because of sewage discharges.

Widespread industrial and agricultural development also are contributing to marine pollution problems in this region. Extraction, refinement, and transportation of petroleum hydrocarbons constitute a growing industry along the Texas and Louisiana coast, and offshore extraction of oil is planned off the coasts of Georgia and the Carolinas. A majority of the oil spills in the United States already occur in this region and the percentage will probably increase with further development of the petroleum industry. Relocation of light and heavy industry from other regions of the United States is resulting in increased discharges of waste chemicals. Large-scale clearing of land in coastal areas is lowering water quality, increasing siltation, and accelerating eutrophication of estuarine waters. In particular, Mobile Bay, Mississippi Sound, Escambia Bay, and Galveston Bay have experienced large-scale degradation of water quality. In the Virgin Islands and Puerto Rico, the effects of sand and gravel mining are of particular concern.

IDENTIFIED NEEDS

Following is a summary of information needs grouped into high-, medium-, and lower (but important) priority categories as determined by conference panels.

High Priority

1) A better understanding of the physical-chemical interactions between suspended sediments and potentially harmful chemicals.

2) More studies on sources, fates, and effects of pollution in nearshore areas.

3) Studies on sources, fates, and effects of contaminants associated with urban drainage, along with complicating factors arising from coastal habitat modification due to urban runoff discharges, biocides, and biostimulants.

4) Knowledge of assimilative capacity of each coastal ecosystem based on ecosystem characterization, environmental stress

indicators, and cumulative effects of "minor" actions, and unknown synergisms.

5) Long-term studies to evaluate the chronic effects of toxic compounds.

6) Long-term studies of particular problem areas: studies of pristine areas to establish a data base prior to resource use; studies to gain more knowledge of fishery stocks and factors associated with their depletion; studies on effects of drill muds and cuttings on sediment-sparse areas; studies on effects of seafood-processing wastes; studies on the effects of increased release of domestic sewage on oyster beds.

7) More detailed knowledge of physical oceanographic processes that transport and transform pollutants.

8) A regional monitoring program for key chemicals based on identification of chemical transportation patterns nearshore.

9) Techniques for ecological damage assessment (including "early warning" techniques for detecting environmental change).

10) Research on the formation, fate, and effects of oil emulsions. Studies of oil spill cleanup chemicals to determine effectiveness, fate, and effects.

11) A comprehensive, unified program to map sensitive areas on regional coastlines.

12) Development of improved bioassay techniques for industrial discharge monitoring and for the study of long-term chronic effects of contaminated dredged material disposal.

13) Examination of current evaluation procedures to determine their ability to predict risk to human and ecosystem health from marine disposal of exotic organics.

14) Examination of the potential impact from one-time disposal of massive amounts of "clean" dredged material.

15) Determination of the cumulative effects of pollution from several sources. Development of a systematic methodology to evaluate the hazard potential of various sources.

16) Field data for verification and development of circulation and dispersion models.

17) Detailed guidelines and goals for baseline studies. More baseline data on nearshore waters.

Medium Priority

1) An understanding of the sediment-loading characteristics, sources, and effects from dredge-and-fill operations and poor erosion control.

2) Determination of trophic relationships and the reestablishment of benthic communities.

3) An understanding of the direct and indirect effects of suspended particulates.

4) Data on the relationship between quantities or species of fish and the presence of platforms and natural reefs.

5) Development of a chemical monitoring program to measure pollutant levels in nearshore systems.

6) An assessment of the environmental impacts of oil spill cleanup techniques.

7) An assessment of the effects on human health of activities involving oil and hazardous chemicals.

8) Monitoring studies to assess impact of inadequate municipal waste treatment systems.

9) Development of techniques to mitigate the impacts of polluted dredged material in the coastal zone and open ocean.

10) In regard to dredged, deep-water ports, development of data on special environmental problems associated with the disposal of massive volumes of dredged material in short periods.

Lower Priority

1) Technology development for improved measurement techniques, concurrent laboratory and field biological and chemical measurements, and combined biological and physical measurements.

2) Improved mass transport and circulation models, and inclusion of sediments and sediment transport in circulation models.

3) Data on the sources, fates, and effects of biostimulants and biocides in the Gulf of Mexico region.

4) Data on the sources, quality, quantity, method of transfer, and effects of airborne contaminants.

5) Establishment and evaluation of the socioeconomic and environmental trade-offs between constructing a deep-water port using various dredged material disposal methods and not building the port at all.

6) Establishment of criteria for evaluating alternative methods for disposing huge volumes of dredged material.

7) Determination of the adequacy of present bioassay techniques (in regard to long-term effects) for the regulation of dredged material disposal and evaluation of risk to the receiving ecosystem, including effect on human health.

8) An assessment of the adequacy of present dredged material dumpsites in the coastal zone and open ocean for continuing disposal of present and increasing volumes of material.

9) Evaluation of the need for regulations to govern the monitoring of fates and effects of disposed dredged material.

10) Cost-effectiveness evaluation of traditional and new techniques to evaluate the long-term effects of disposed dredged material.

11) Development of feasible and cost-effective methods of reducing the need for dredging in harbors and channels.

12) Examination of interest in developing and implementing innovative use of clean dredged material.

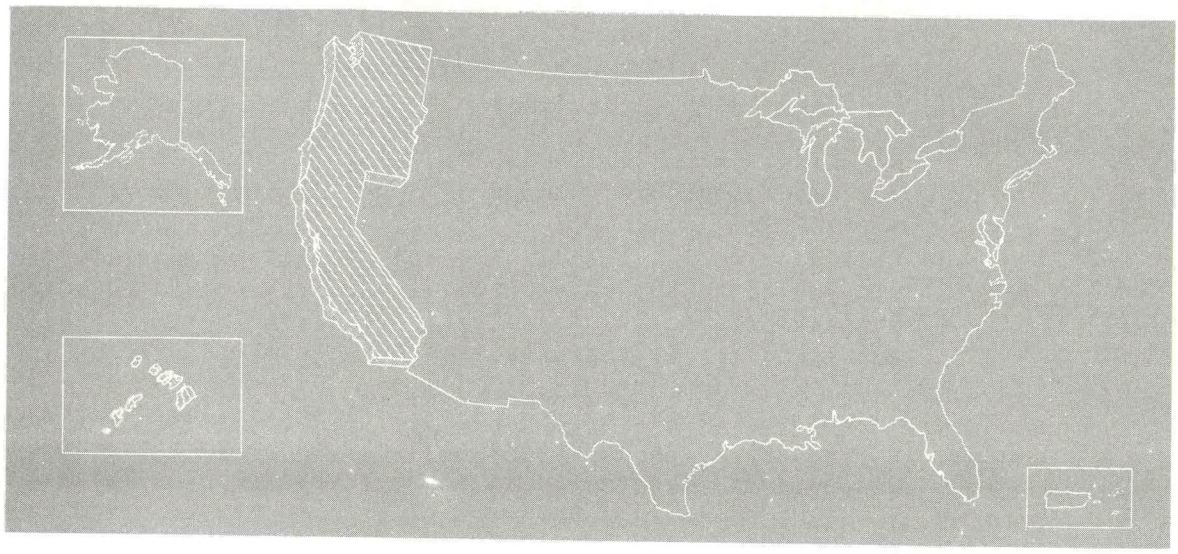
Unspecified Priority

1) Information on the effects of chronic discharges from lightering operations (i.e., the offshore transfer of crude oil from large to smaller tankers).

2) Data on the impact of cold water discharged from liquified natural gas (LNG) facilities.

3) Understanding of the effects of natural C_1 to C_4 hydrocarbons on the ecosystem.

WEST COAST REGION



The West Coast region is defined as extending from the U.S.- Canada border on the west coast south to the U.S.-Mexico border, and includes Hawaii and the Pacific Islands. There are at least three distinct areas in this region: the southwest, the northwest, and the Pacific Islands. The southwest is characterized by a narrow continental shelf and continental border off the southern portion of California. The region is densely populated, with large, highly industrialized areas of development. Shipping (particularly petroleum transportation), oil and gas development, municipal and industrial waste disposal, and recreation are found in high concentrations throughout the area. These present a threat to commercial and sport fisheries, bird and mammal migration routes, kelp beds, and recreation areas, all of which are major resources. The area is fortunate in that there is a high ecological awareness and environmental concern. Oil and gas exploration and developpment continue, however, and additional lease sales are expected in the area.

The northwest area includes the Strait of Juan de Fuca and Puget Sound, both of which, as marine shipping centers, are potential pollution areas. Important fisheries found throughout the region include salmon, shellfish, and other marine species. Harbor porpoises, sea lions, harbor seals, and the rare humpback whale also are found in the area. The bays and sounds are increasingly threatened by many chemical constituents of industrial discharges.

The Hawaiian Islands and Pacific Islands (Guam, American Samoa, Trust Territory of the Pacific Islands, and the Commonwealth of Northern Mariana) constitute an area with unique attributes:

- Lack of continental shelf around islands.
- Low nutrient levels in oceanic waters.

- Limited freshwater supplies on islands.
- Most polluting industries related to food production.
- Potential for OTEC development.
- Presence of coral and reef communitites.

The uniqueness of this region requires that research, development, and monitoring activities be tailored to fit the special attributes and problems.

IDENTIFIED NEEDS

The regional conference addressed the following current and potential sources of pollution in the region: land use practices, marine waste disposal, marine energy, and marine mining. The conference also considered information and research needs in each of several geographic subdivisions of the region, but these are not summarized because of space limitations.

Land Use Practices

Coastal pollution problems in the Pacific region result from industrial and sewage treatment, agricultural practices (including forestry), urban runoff, major geological events (i.e., Mount St. Helens), industrial activities in coastal areas, and dredging and filling. Nontoxic waste control should be distinguished from toxic waste control, because the two present very different problems and needs. It is imperative as well that nonpoint sources be investigated.

Some specific needs related to land use practices are listed below:

1) Create data distribution and synthesis systems to provide available resource information (including maps) to decision makers.

2) Improve monitoring programs to determine the effects of industrial effluents and other pollutant sources. Develop monitoring strategies and correlation techniques to achieve the best standard methodology for determining the effects of toxic wastes. Research is also needed on developing toxic waste management, improving assimilative-capacity models, and describing the effects of effluents in the ecosystem.

3) Develop a data system for gathering all available resource information on sewage discharge locations and treatment processes, and incorporate the information into an easily understandable format for decision makers.

4) Conduct a nonpoint source monitoring program to study effects on coastal ecosystems. This effort should include research on selected city storm drains and river systems to determine pollutant loads, water quality, and the condition of the biota. Evaluation or monitoring methods should also be capable of quantifying results of the best management practices used in agriculture and forestry, particularly for sediment, nutrients, pesticides, and coliform bacteria.

5) Document the physical changes in the Columbia River estuary resulting from accumulation of Mount St. Helens volcanic material and from dredging. Effects of changes on estuarine organisms should also be documented.

Marine Waste Disposal

The Pacific region is subject to disposal of municipal wastes, industrial wastes, radioactive and hazardous materials, and dredged material disposal.

The following high-priority needs were recognized:

1) Improve ecological monitoring techniques. If possible, develop biological indices to identify marine ecosystems that are in the process of change, degradation, or recovery.

2) Determine regional differences in the capacity of ecosystems to assimilate wastes.

3) Determine affected fish and shellfish populations and their distribution, to establish the relationship between disease occurrence and the quality of water and sediment.

4) Further examine open coastal and insular current patterns and variations over time.

5) Study the effects of seawater on coliform bacteria, and determine the relationship between coliforms and the presence of human pathogens.

6) Collect data from site-specific studies to develop water quality criteria (or modify existing criteria) for Hawaii and the Pacific Islands.

7) Monitor dumpsites to assess the fate and effects of radioactive and hazardous materials wastes, and determine proper storage or disposal of the wastes.

8) Perform studies to determine the effect of waste discharge on biological communities and condition of the food web, including examination of effects on humans.

9) Collect and evaluate data on effects of coastal development on ecosystems.

10) Increase emphasis on biological assessment of oil and hazardous materials spills as part of the spill response effort.

11) Increase studies on paralytic shellfish poisoning to include the role and pathways of toxins and the cause of blooms.

12) Conduct more surveys of accidental spills to study the fate and effects of hazardous materials in the marine environment.

Marine Energy

In the northwest coastal area of the Pacific region, dependence is expected to increase on the combination of nuclear and hydroelectric power systems. Industry and automobile transportation require the import of oil and LNG. Nuclear power plants in submarine and surface ships are located in this area. In California, a decrease in the use of nuclear power with increased use of fossil fuels has increased pollution potential. Additional offshore oil drilling is expected to occur in the vicinity of Santa Barbara and Long Beach. Oceanic and tidewater refineries may develop as a result of imported Alaskan crude. The major energy option for Hawaii will be OTEC. Opportunities now exist for protecting the living resources from adverse effects due to energy operations and catastrophes.

The following research and information needs were identified at the regional conference:

High-priority needs

1) Identify locations of spawning areas, nursery grounds, and adult populations of marine animals with respect to energy production and transportation.

2) Assess various power plant sites in terms of threat to the environment.

3) Characterize local environments in terms of physical, chemical, and biological effects likely to result from common energy activities.

4) Assess the environmental effects of coal power plants with emphasis on the effects of airborne particles entering the marine environment.

Medium-priority needs

1) Study the present use of the ocean as a disposal site for nuclear power plant and submarine components. Consider both routine and emergency procedures.

2) Monitor the home ports of nuclear vessels for radioactivity and adverse effects.

3) Study the environmental effects of substituting ocean water for freshwater in energy production and processing.

4) Study thermal discharge as a source of advantageous alteration of the environment.

5) Investigate environmental side effects of using biocides in power plants.

Lower-priority needs

1) Assess the implications of possible future widespread use of OTEC on migratory fish.

2) Study the effects of disposing coal slag and ash wastes in the marine environment.

Marine Mining

With the exception of OCS oil and gas, there is little mining activity in the Pacific region. However, sand and gravel mining on the outer continental shelf may begin in the near future.

The following needs were identified at the regional conference:

1) Identify marine and coastal populations and habitats that will be significantly affected by marine mining. Integrate this information into the decision-making framework for marine development activities. Develop monitoring programs to assess effects of offshore activity on marine and coastal environments.

2) Identify and describe geologic hazards (both coastal and offshore) that could affect marine mining.

3) Conduct studies to further the knowledge of transport and circulation of water-soluble pollutants and particulate suspensions and bedloads in the oceans to improve forecasting of pollutant courses.

4) Describe background levels of toxicants and other pollutants associated with marine mining, and assess effects on specific representative marine groups.

5) Model pollution effects to increase the accuracy of predicting environmental impacts of developing offshore resources.

6) Evaluate threats of marine mining to human health.

7) Perform damage assessment studies to determine whether damages to marine and human resources from marine mining are compensable. Predict social costs of marine mining activities to assist in making development decisions.

IV. Collecting & Using Information

Four types of programs play major supporting roles in the National Marine Pollution Program; all pertain to the collection and use of marine pollution information. Information management, monitoring, quality assurance, and development of measurement methodologies are activities that benefit many aspects of the overall program. Requirements to improve and support programs in these areas are common to most agencies. The following table provides estimates of the funds expended in Federal programs for three of these activities.

AREA	DOLLARS (Millions)	PERCENT OF TOTAL POLLUTION PROGRAM BUDGET
Data management, synthesis, and distribution	$5.1	3%
Quality assurance	0.9	<1%
Measurement methodologies	5.1	3%
TOTAL	$11.1	6%

The cost of monitoring programs is not reported as a discrete element here; monitoring programs have been included as integral portions of the programs they support.

INFORMATION MANAGEMENT, SYNTHESIS, AND DISSEMINATION

The drafters of the National Ocean Pollution Planning Act of 1978 recognized that marine pollution research and monitoring could make a

significant contribution to wise use and conservation of the resources of the oceans only if results were translated into forms useful to those involved in decisionmaking. As a result, Section 8 of the Act charged the Administrator of the National Oceanic and Atmospheric Administration (NOAA) with ensuring that the results and information from ocean pollution research, development, and monitoring programs conducted or sponsored by the Federal Government be disseminated in a timely manner, and in useful forms. The importance of dissemination was recognized in the first Federal Plan. It called for establishment of an ocean pollution data and information network to coordinate information exchange and develop information products to meet the needs of the public and decision makers. The recommended network is intended to foster interchange of data and information between Federal agencies, not to replace existing agency programs.

NOAA obtained funding in FY 1981 to begin implementation of the network recommendation. An initial structure for the network was developed. The proposed structure consisted of a series of regional offices to provide rapid, focused responses to requests for data, data products, and information, as well as a central office to direct the overall network effort and assure effective national coordination. Proposed regional offices would be established by drawing on existing Federal, State, or academic capabilities and providing seed money to permit identification of key local contacts, data bases, and information systems of relevance to marine pollution problems. Liaison would be maintained with this cadre of personnel familiar with regional marine pollution issues and with work in progress to assure that the most recent, unpublished literature and data from marine pollution research, development, and monitoring would be readily available and that experts could be reached for personal consultation with decisionmakers when necessary. The central office would be the source of Federal funds for the network, at least in the early phases, and would be responsible for oversight of the regional network, and for providing national coordination by integrating information from the regional level with national data and information systems.

To define the network concept and determine the scope of the necessary program response, NOAA convened a workshop on marine pollution information management in February 1981. Representatives of academia, private industry, public interest groups, and government organizations participated and were organized into panels to discuss requirements for digital data, data synthesis, and information management in the network context. The workshop participants arrived at key recommendations regarding implementation of the data and information network concept:

- Regional access to the network is crucial to its utility (as is a regional approach to pollution problems).

- Use of existing facilities should be emphasized in developing the network.
- A reasonable system of cost recovery for services rendered should be incorporated into the network system.
- Regional and central offices should identify and make available sources for information synthesis and analysis functions.
- A major effort should be launched to make recent, unpublished literature available at the local/regional level.

As a first step in implementing the network proposal, as refined by workshop participants, NOAA established the central office for the Ocean Pollution Data and Information Network (OPDIN) in May 1981. The initial task of that office is to design and implement the network concept, with particular emphasis on establishing effective regional offices where the scope of marine pollution problems and regional research efforts warrant them. In developing the network, heavy emphasis will be placed on establishing linkages between major agencies involved in marine pollution work.

In addition to development of the information network concept, other initiatives have been undertaken since the first Federal Plan was released. A quarterly newsletter, "Coastal Ocean Pollution Assessment News", has been initiated with the support of NOAA. National in scope, it includes the Great Lakes and concentrates on coastal marine pollution problems and their impacts. Support has also continued for publication of "Coastal Oceanography and Climatology News", a newsletter that also disseminates information related to marine pollution.

RECOMMENDATIONS

Enhance Data Synthesis Capabilities

Major emphasis should continue to be placed on identification and development of synthesis capabilities. Scientific data analyses often fail to satisfy the needs of decisionmakers for clear and concise statements of the potential environmental impacts of alternative management decisions. The ability to reduce masses of raw data to a clear projection of potential impacts (along with a meaningful statement of the uncertainties in those projections) is inadequate at present. For the network to satisfy its statutory purpose, this need must be met. To improve information synthesis capabilities, it is important to locate sources of local expertise on marine pollution problems and maintain close liaison with those personnel. This assures

access to the most recent literature and provides for effective face-to-face interaction between scientists, researchers, and decisionmakers. Also important is the feedback relationship between users and information product generators. Valuable first steps would be to identify both private sector and government synthesis capabilities and to make arrangements for their use and expansion as necessary through contractual or interagency arrangements.

The Interagency Committee should form a working group to coordinate and make recommendations for a responsive program in this area.

Generate Timely Synthesis Products

NOAA should undertake an early effort to prepare synthesized information products on high-priority marine pollution problems of broad national interest. These syntheses should be anticipatory, and the effort should be designed to build expertise, at the central office level, for rapid analysis of current marine pollution issues. These syntheses would be intended for a broader, rather than regional, audience and would summarize the existing state of knowledge and uncertainty, as well as define key scientific policy issues on marine pollution problems receiving national attention from legislative, regulatory, and judicial perspectives. As a first step in this direction, an assessment of marine pollution problems associated with increased export and domestic consumption of coal will be undertaken.

Synthesis of existing information on regional waste disposal problems would be another important activity of the central office, or a selected regional office. The synthesis report should include information on current and projected waste generation rates, associated levels and trends in marine pollution levels, and current and projected methods of disposal on a cross-medium basis.

Increase Access to Unpublished Literature

A special effort should be made to assure that recent, unpublished literature is made available at the local level by means of locally held literature collections maintained in readily accessible locations such as public or university libraries.

Improve Quality Control on Data Inputs

Quality control of data and information to be integrated into the Ocean Pollution Data and Information Network should receive priority attention. Data should be provided by the network only with proper documentation and quality controls or disclaimers, when necessary.

MONITORING

Marine pollution monitoring is a management tool. It is one of several techniques for gathering marine pollution information. Its role in the national program is twofold: on one hand it serves to warn against unacceptable impacts of human activities on the marine environment and, on the other, it provides a long-term data base that can be used for evaluating and forecasting natural changes in marine ecosystems and the superimposed impacts of human activities.

Marine pollution monitoring activities have been undertaken as a result of requirements in several pieces of legislation. The legislation, however, is not always explicit with regard to use of the information collected through monitoring or its appropriate function in the overall management scheme. A comprehensive summary of the major laws was given in Working Paper 2 of the first Federal Plan. The major laws are these: The National Environmental Policy Act of 1969 (P.L. 91-180), the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500), The Marine Protection, Research, and Sanctuaries Act of 1972 (P.L. 92-532), and the Clean Water Act of 1977 (P.L. 95-217). Also requiring monitoring are several laws involving fisheries and wildlife protection and management, and legislation involving coastal waterways and the development of the coastal zone. Coordinated action among several Federal agencies is often required to accomplish monitoring objectives. The effects of national legislation are also felt by many organizations at State and local levels; consequently local governments, as well as industrial and municipal dischargers, undertake a variety of marine pollution monitoring activities.

The first Federal Plan recommended that a National Ocean Pollution Monitoring Plan be developed for inclusion in the second Federal Plan. It further recommended that this monitoring plan be based on an assessment of existing monitoring programs and provide for the use and integration of their data and for the generation of useful information products.

Steps toward implementing this recommendation were taken by the Office of Marine Pollution Assessment (OMPA) in NOAA. With the cooperation of other Federal agencies and many State and local organizations, workshops were organized to assess present needs and the programs addressing them. The individual regional reports are listed on the inside back cover; the summary report, entitled "An Assessment of the Great Lakes and Ocean Pollution Monitoring in the United States," is Working Paper 7 of this Plan. The need for development of a national monitoring program has been recast in modified form as a result of these workshops and subsequent deliberations. It is now believed that the real need is for organizing and structuring existing programs into regional monitoring networks rather

than establishing a new national program for monitoring. The discussion that follows is based in large part on the results of the monitoring workshops and Working Paper 7.

PRESENT PROGRAMS

At the Federal level the Environmental Protection Agency (EPA) has the primary role in marine pollution compliance monitoring. EPA is charged with the development, revision, and enforcement of standards involving water quality, industrial and municipal discharges, and ocean-dumped wastes and dredged materials. Through the National Pollutant Discharge Elimination System (NPDES), some of which is administered by the States, EPA requires and oversees compliance monitoring by dischargers to ensure that established standards are met.

The Food and Drug Administration (FDA) of the Department of Health and Human Services maintains the National Shellfish Sanitation Program, and monitors pesticides and metals in fish to prevent the introduction to interstate commerce of contaminated food products.

Three agencies have major roles in marine pollution monitoring in the Department of the Interior: (1) The Bureau of Land Management assesses the likely impact of offshore oil and gas development on the marine environment; (2) the Fish and Wildlife Service protects fish and wildlife and their habitats in the nation's freshwaters, including estuaries, bays, and the Great Lakes; and (3) the U.S. Geological Survey (USGS) maintains water quality monitoring of the nation's rivers, streams, and estuaries.

NOAA in the Department of Commerce has responsibilities to research and monitor the effects of ocean dumping and disposal of waste materials in the oceans, and for monitoring seafood products (in conjunction with FDA) to aid fishery management. NOAA also conducts a program that monitors the ocean waters of the northeast coast of the U.S.

Additional activities related to marine pollution monitoring are or have been funded or conducted by the U.S. Army Corps of Engineers, the National Aeronautics and Space Administration, the Department of Energy (DOE), the Department of Agriculture, the Nuclear Regulatory Commission, and the National Science Foundation.

WORKSHOP CONCLUSIONS

The regional workshops organized by NOAA/OMPA were held during the fall and winter of 1980-1981. The most significant needs identified were the following:

- Regional planning, coordination, and information dissemination -- The strongest support and consensus was expressed for this requirement.

- Active inventory -- There was strong support for an "active" inventory of regional marine pollution monitoring activities that would be kept up to date to provide program details to all users.

- Regional data storage and dissemination -- As opposed to a national or central data center, the establishment of regional data storage and dissemination centers received strong support.

- Data Comparability -- Comparability of data, data collection apparatus, and data analysis methodologies are still major concerns. A broad quality assurance program, methods of intercalibration, and publications of approved standard reference methods received wide support. In regard to standardization of methodology, the establishment of multiple or alternate standards with set intercalibration procedures was preferred against the adoption and enforcement of one preset rigid standard.

- Review and Assessment -- A very strong need was recognized by local agencies and industry and directed to regulatory agencies. Periodic reviews and critical scientific assessments of programs were requested (1) to assure that the programs meet required objectives and (2) to allow modification of the programs to make them more cost effective without sacrificing management objectives. It was also recognized that Federal and State regulations and standards should be specifically tailored to local ecosystems and local problems, and that they should not be determined or limited by broad national criteria.

- Leadership responsibility -- The need for an organizational entity to execute a leadership role was recognized, and it was recommended that, in the absence of local initiatives, NOAA should undertake such responsibilities.

Not as recommendations, but as general conclusions, the following points were also made during the workshops: (1) Most marine pollution monitoring programs carry out compliance monitoring; i.e., they have a very narrow objective, essentially that of assuring the maintenance

of certain established standards. After this primary function has been served, data are rarely, if ever, used further, though they could be of value for other, broader management decisions, or for the management needs of other organizations; (2) some data collected to check compliance with ambient water quality standards have no value for controlling industrial discharges. These data are used only to prepare compliance reports required as part of the NPDES permit program. With minimal modifications of these programs, useful data could be collected and used to assess pollution impacts on the ecosystem; (3) the vast majority of funds expended on marine pollution monitoring programs is absorbed by data collection activities. Little emphasis is placed on providing information products in forms suitable for management decisions, at local as well as Federal levels. There is a need to increase data synthesis and interpretation significantly.

The present complex array of monitoring programs exists because the programs are conducted in response to numerous regulations. The Federal role is to assure that (1) appropriate safeguards (regulations and management schemes) are in place, and (2) efforts are continuously made to make useful and appropriate information available to all who require it. In fulfilling Federal responsibilities, it is not only important to meet the specific needs identified above, but also to assure that these programs are implemented so that the whole is greater than the sum of its original parts. One approach to such enhancement can be through a national marine pollution monitoring network as proposed in the following section.

RECOMMENDED NATIONAL MONITORING NETWORK

Fulfillment of Two Monitoring Roles

The Interagency Committee proposes that a national marine pollution monitoring network, composed of well-defined regional monitoring networks, be organized. The framework of this national network should be based on the dual roles of monitoring, i.e., (1) warning against imminent harmful impacts from recognized sources, and (2) evaluation and forecast of long-term impacts. Two types of monitoring approaches fulfill these roles -- compliance monitoring and trend assessment monitoring. The warning role can be accommodated through continued implementation of most of the compliance monitoring programs already under way. These programs, assuring that predetermined standards and criteria are not exceeded, are by and large in existence at local levels. Other programs may be needed to contribute to trend assessment monitoring. Although trend assessment programs are not required for legal compliance, they can satisfy needs for long-term impact evaluation and forecast. Trend assessment may be viewed as the long-term, "scientific-environmental" aspect of monitoring.

In the proposed framework, compliance monitoring and trend assessment monitoring are not independent endeavors. Activities under the two are integrated so that a spectrum of observations evolves, from a single-point observation of an effluent for enforcement purposes on one end of the scale, to observations of region-wide ecological or oceanographic changes on the other end of the scale. Different management objectives require careful selection of monitoring strategies; for example, pristine areas far from human influence need only a few widely spaced stations and infrequent measurements. Where large impacts are anticipated, near coastal urban and industrial centers, the monitoring station net must be tighter and the observation frequency higher. The "edge" or circumference of impacted zones must also be monitored to determine whether the size and location of the impacted area are changing. Specific monitoring strategies that form the elements of this network, including statistical treatments, need to be developed by competent planners within the regions.

In establishing a national framework, management must be emphasized rather than the collection of additional data. The national program should not create large new data collection requirements. Also, it should not replace or subsume existing programs; the aim is to coordinate existing programs, incorporating their data into regional data bases, and adding missing elements to achieve warning and trend assessment capabilities. By efficient data and information management through regional networking, a national program can become more effective than the simple combination of its components, and those who participate will benefit through access to a much broader, regional data base.

Evolution From Existing Programs

During the first years of the development of the proposed national monitoring network, compliance monitoring activities should continue unchanged. Additional benefits to these programs will accrue with time, as ecological and environmental trend assessment monitoring programs improve our understanding of marine ecosystems and thus allow for the reduction of costs and complexity in present programs. As an eventual outcome, the national program could lead to an overall reduction of compliance monitoring by limiting observations to those that are necessary for characterizing contaminant input, and occasional spot checks of near-field environmental effects in immediate-impact zones.

Assessments of pollutant concentration trends as well as establishment of early warning systems must initially rely on compliance monitoring data. The aim of this part of the program is to obtain an overview on the regional or national scale. At present the most promising, cost-effective approach to such a broad overview is

the use of sentinel organisms; such a technique should be employed when suitably perfected.

The ecological and trend assessment monitoring programs tie the short-term, near-field data of compliance monitoring to long-term regional variations. The objective is to identify major, significant changes, and to establish whether these were caused by natural variability, resulted from human activities. Information from programs, such as fisheries and shellfish surveys, catch statistics, etc., should be incorporated into the data base. It may be necessary to initiate limited additional surveys in areas of critical habitats such as kelp beds, coral reefs, and coastal marshes, to obtain all necessary information. Also, regional programs will have to be initiated to determine major changes in "ocean climatology," in order to tie water mass changes to the physical and chemical control of primary production, which in turn affects the higher levels of the food web. This will be one way to tie natural oceanographic variations to possible ecological consequences, a necessary understanding if human impacts on marine ecology are to be understood.

Present environmental laws and regulations restrict the introduction of known toxic materials into the environment and require elaborate testing programs to determine toxicity of new materials. The program developed under the national framework is designed to test the assumption that this largely untested system of environmental laws and regulations will, given time, (1) reduce the inputs of toxic materials to the oceans, (2) reduce the potential for surprise pollutants, and (3) lead to much better knowledge of the inputs that do remain.

Monitoring programs will continue to rely on research to assist development of new monitoring methodologies and the interpretation of results. Pollutant effects research and general research on ocean ecosystems will be needed for continual improvement of the national program.

Organization, Participation, and Responsibilities

Appropriate geographic areas should be identified and designated monitoring regions. Within each an individual or organization should serve as focal point, with the role of coordinating marine monitoring programs and disseminating associated monitoring information and data in that region. In keeping with its leadership responsibilities under the National Ocean Pollution Planning Act, NOAA will carry out the lead responsibility for this initiative, and where appropriate personnel from other agencies are not available in the region, NOAA will undertake the coordination role through use of NOAA personnel or appropriate outside organizations. Initial responsibilities of the regional coordinator will be to bring together representatives of

principal monitoring agencies for periodical exchange of information and discussion of common problems. Among first responsibilities should be formation of a task group or groups, composed of representatives of EPA, NOAA, and other concerned agencies, with at least two responsibilities:

1) Assess existing data systems and devise a cost-effective approach to make one of the existing data storage/retrieval systems more useful; an end-product of this exercise should be a proven, working, data storage and retrieval system within each region to be maintained jointly by the agencies involved. Some efforts in this area have already been initiated under the Ocean Pollution Information Network.

2) Identify information products required within the region and work with data centers and agencies to assure that these products are developed.

In time and as the need arises, additional monitoring organizations can be included and responsibilities of the task group expanded to address specific monitoring issues, eventually defining and establishing the regional monitoring network.

QUALITY ASSURANCE

It has long been recognized that quality assurance is essential in any program involving measurement data and information collection; marine pollution programs are no exception. An appropriate quality assurance program ensures that the information collected is as reliable as necessary for its intended purpose. Reliability is achieved through the use of standardized methods, instrument certification and calibration, auditing procedures, and intercalibration programs throughout sample collection, measurement, and recording. An appropriate quality assurance program must be an integral part of every marine pollution program even though the quality assurance elements and degree of sophistication will vary according to the end use of the information collected.

The cost of quality assurance programs can be substantial. It has been estimated to be as high as 40%-50% of total program costs where absolute traceability and accuracy are required and as low as 4%-5% where minimal checks are sufficient and facilities have been established. It is essential that the cost of quality assurance be justified by the need for accuracy or traceability and that it be included in program budgets. One of the primary benefits of requiring adequate quality assurance programs is in the secondary application of data. If data quality can be verified, secondary users are more

likely to accept data from other sources and thus, once collected, information will have multiple users.

The first Federal Plan recognized the importance of quality assurance and the need for development of quality assurance program elements. An interagency working group was formed to address quality assurance problems in the Federal marine pollution program. The group identified and discussed a variety of issues; some of the conclusions they reached were not expected. Their report (Report of the Ad Hoc Working Group on Marine Pollution Measurement Quality Assurance, February, 1981) has been considered by the Interagency Committee and forms a significant portion of the discussion and recommendations that follow.

Primary conclusions are these:

- Appropriate quality assurance must be an integral part of all research and monitoring programs.

- It is probably not useful to attempt to develop a set of quality assurance guidelines applicable to all marine monitoring programs. The breadth of monitoring activities being carried out is so wide and the necessary quality assurance programs are so varied that guidelines sufficiently broad to apply to all may be too general to be useful.

- There are available at the implementation level many "tools," such as standard methods handbooks and reference materials, for use in quality assurance programs. There may be a need however to adapt these tools further for saltwater samples and to provide leadership in organizing and consolidating the various tools and service mechanisms to help in quality assurance program planning.

Quality assurance concepts are not new; quality assurance societies exist, voluntary standards groups concern themselves with quality assurance, and guidelines exist for specific types of measurement programs. Yet, in spite of the recognized need for quality assurance, and the existence of many of the necessary tools and guidelines for implementing quality assurance programs, the inadequacy of existing quality assurance programs has been a criticism of nearly every study of environmental monitoring programs. Quality assurance is also an area where operational personnel constantly seek assistance from the Federal level.

It appears that the major reason quality assurance has remained an issue in many Federal data-gathering efforts is the lack of commitment at the policy development level. Some agencies, EPA for example, have made a substantial commitment to quality assurance by insisting

that all contracted work adhere to EPA established quality assurance procedures and standards. Other agencies may have incomplete quality assurance programs or no requirement that quality assurance be an integral part of all programs. A high-level commitment to such a policy, as well as the support necessary to enforce it by all agencies participating in the National Marine Pollution Program, will go a long way toward reducing concern about quality assurance in the Federal program. The recommendations that follow address the need for policy level commitment to quality assurance and assign responsibility for support services necessary.

RECOMMENDATIONS

Commitment at Policy Level

All agencies should assure that adequate attention is given to quality assurance. As a first step, each agency should establish policy requiring all measurement and monitoring programs to include, as a discrete element, an appropriate quality assurance program.

Evaluation of Quality Assurance Adequacy

All program evaluations conducted by the Interagency Committee should include, as a separate element, evaluation of the quality assurance aspects of the program. This analysis should include review of agency plans, policy directives, allocation of resources, quality control procedures, and performance, and should be carried out by a person or persons with appropriate expertise. Results of this quality assurance analysis should be published as a discrete part of the total program evaluation.

Provision for Adequate Tools and Service Mechanisms

NOAA, working with the National Bureau of Standards, and EPA should take lead responsibility for assuring that adequate tools for implementing quality assurance programs in marine waters are available. By working with and through existing programs in the USGS, EPA, American Society of Testing Materials (ASTM), and other concerned groups, quality assurance service mechanisms should be established to conduct auditing and certification programs as required.

MEASUREMENT METHODOLOGIES

Measurement methodologies are an important part of the research and monitoring programs they support. Sound and reliable equipment and techniques must be developed and used throughout the National Marine Pollution Program. Initial development emphasis should be placed on improving existing methodologies and hardware to make them more reliable, cost effective, and foolproof. Simplified, rugged, and reliable equipment and procedures must be developed for use in the field by unskilled operators. Bioassay methodology must continue to be improved to produce meaningful and repeatable information. Sentinel organism approaches to support monitoring requirements must also be developed.

A longer term need, provided that costs can be reduced, is for advanced technology in forms of telemetry, remote-sensing applications, and trace chemical sampling and analysis techniques. Prime deterrents, however, to advanced technology development are the difficulty in assessing future program requirements to the extent necessary for a systems design and the lack of willingness to make budget and planning commitments to the necessary, longer term program elements.

Nevertheless, measurement methodology development has made some progress since the last Plan was published. The Interagency Committee and several agencies sponsored a workshop on biosensing in April 1980. The report is Reference 1, listed on the inside back cover of this document. EPA, the Corps of Engineers, and NOAA continue to work on bioassay development; a workshop sponsored by the Interagency Committee is planned for FY 1982. NOAA is developing an expendable dissolved-oxygen sensor as well as sensors for oil thickness and oil presence. NOAA has also developed advanced analytical methodology for laboratory use and has investigated the use of biological enzymes for hazardous material detection. NASA has continued to search for marine pollution applications for the remote sensing technology developed through the space programs; however, beginning in FY 1982, this search will be discontinued.

V.
Priorities for Action & Conclusions

This chapter presents recommendations for major actions that bring together many of the most significant program recommendations made throughout the document. These Priorities for Action structure program recommendations into specific actions with assigned lead responsibilities. In its support capacity to the Interagency Committee, the National Marine Pollution Program Office will focus on coordinating the implementation of these priorities for action. This chapter presents some observations and conclusions about the Plan and the interagency planning process.

PRIORITIES FOR ACTION

This Plan provides recommendations at two levels. First, in Chapters II and IV, specific recommendations are made for research on each of the national marine pollution concerns. These specific recommendations are in response to research and information needs derived from important regional concerns summarized in Chapter III. In addition, this chapter presents recommendations for major actions that will accomplish the initial steps toward eliminating the most important shortcomings of the National Program that were recognized in Chapters II through IV. These recommendations for major action require commitment to new directions for pollution programs, anticipation of upcoming problems, and cooperation among several agencies. The recommendations in this chapter identify and describe specific actions that should be taken, and assign responsibilities to agencies to carry out the suggested actions. Additional funding will not be required to implement these recommendations. Recommendations are made for major actions in the following areas:

- Waste Disposal
- OCS Environmental Studies
- Increased Coal Use
- Organizing for Better Program Support

WASTE DISPOSAL

This discussion addresses conventional (non-nuclear) wastes such as dredged material, industrial wastes, and municipal wastes. Attitudes and policies related to ocean disposal of wastes are changing. Regulatory measures developed in the past decade were intended to approach a "zero risk" policy for ocean disposal. Recently it has become more widely accepted that the oceans possess a capability to assimilate some types of wastes in limited amounts without causing unacceptable or irreversible changes in marine ecosystems. Sufficient scientific information is not yet available to widely apply the assimilative capacity concept on a management basis. However, waste disposal policies are now starting to change to allow the cautious and studied use of the oceans as a waste disposal medium. In the next 5 years, the National Marine Pollution Program must be responsive to the needs of changing waste disposal policies. The Program must provide the information required to support the establishment of new waste disposal management practices that may be developed as a result of policy shifts.

Prior to the passage of the National Environmental Policy Act (NEPA) in 1969, there was no official national policy for environmental protection, and disposal of many waste materials was virtually uncontrolled. NEPA made official the policy that environmental effects of major Federal actions must receive primary consideration and that additional economic costs would be required when justified by environmental benefits. Although NEPA provided the first comprehensive statement of U.S. environmental policy and initiated the process of environmental impact assessment for major Federal actions, NEPA did not provide for specific regulation of activities that could cause environmental harm. A series of regulatory statutes followed. These laws were intended to protect against environmental degradation through Federal regulation of waste disposal in the various environmental media:

- Clean Air Act (as amended in 1970) -- Regulates emissions into the atmosphere.
- Marine Protection, Research, and Sanctuaries Act (1972) -- Regulates dumping in ocean waters seaward of the baseline from which the territorial sea is measured.
- Federal Water Pollution Control Act (amended in 1972, and subsequently) -- Regulates discharges and other activities in navigable waters and the territorial sea.
- Resource Conservation and Recovery Act (1976) -- Requires "cradle to grave" control and accounting of transportation and disposal of all hazardous wastes on land.

These statutes and their implementing regulations set the mood for the 1970's. Every environmental medium was protected, and as control technology developed further, regulatory requirements sometimes became more strict. The escalating costs of technology development and product modification were passed along to consumers who frequently did not understand the effect of environmental regulation on product cost.

The goal of environmental protection and enhancement pursued through legislation and regulation in the last decade is a worthy one. However, wastes continue to be generated, and must be disposed of in some manner. Protection of each medium without thorough consideration of detrimental effects on other media is not a workable approach. Rather than to protect each environmental medium through a separate set of regulations, a fundamentally different and more rational approach is to encourage reduction of waste generation and then, for remaining wastes, to select the disposal method and medium that cause the least of acceptable disruption to the environment and entail a reasonable economic cost. Recently, support for this type of approach to the management of waste disposal has been growing. For example, a workshop held in 1979 at Crystal Mountain, Washington, concluded that, although severe environmental degradation has occurred in some coastal areas, the assimilative capacity of U.S. coastal waters has, in many cases, not been fully used (NOAA, 1979). In a report published in January 1981, the National Advisory Committee on Oceans and Atmosphere (NACOA) recommends "that Congress and the Executive Branch adopt an integrated approach to waste management. This requires that the Environmental Protection Agency modify its existing medium-by-medium approach to waste disposal. Wastes should be disposed of in the manner and medium that minimize the risk to human health and the environment..." (NACOA, 1981). The spring 1981 issue of Oceanus (24-1) is another illustration of changing attitudes about waste disposal practices. This volume is entitled "The Oceans as Waste Space?" and is devoted entirely to exploring different perceptions and aspects of using the oceans for disposal of wastes.

Agency positions on ocean waste disposal are also changing, as demonstrated by recent Congressional testimony. The Deputy Assistant Administrator of the EPA Office of Environmental Processes and Effects Research presented testimony to the Natural Resources, Agriculture, Research and Environment Subcommittee of the House Committee on Science and Technology on May 27, 1981. In his testimony on ocean dumping, he stated that "Most recently, the Agency has recognized the need to take a fresh look at the ocean dumping policy. This recognition stems from a number of factors; for example, increasing problems are being encountered with a number of land disposal sites.... Excessively stringent controls on ocean dumping may impose unnecessary costs or impacts on some other sector of the environment...." The Agency currently has its regulatory policy with respect to ocean dumping under

careful review." At the same hearing, the Acting Administrator of NOAA recognized the value of the "comparison of the relative impacts of [sewage] sludge disposal into the various [environmental] media..." and called for the development of a "procedure for evaluating the degree and extent of contamination involved in each disposal option. There must also be a method for developing a management approach based on information about the degree of risk and extent of contamination." The Acting Administrator also recommended that a "regional waste disposal management strategy should be developed for the entire New York-New Jersey region by Federal, state, and local governments."

In consideration of growing pressure to use the oceans for waste disposal, caution is appropriate. Adverse effects on ocean ecosystems are difficult to understand and significant effects in the ocean may not be as easily detected as those on land. Political pressure in making waste disposal management decisions should be tempered by scientific and engineering information that quantifies the real costs and risks of the alternatives. In the next 5 years, the National Marine Pollution Program must strive to provide the information and interpretation needed to support and promote improved waste disposal management. The National Marine Pollution Program will be concerned with providing the best possible information on disposal options that would affect the marine environment.

Recommendations for Action

In addition to the waste-specific recommendations made in Chapter II, the magnitude of the waste disposal problem and the importance of changing attitudes and policies indicate that a recommendation for major action is required to ensure that decisions and policies are based on the best scientific information possible. Therefore it is recommended that the activities described below be undertaken.

Impact assessment and prediction

Conceptual Model

Two different projects are proposed to provide the information and protocols needed for making waste management decisions. First, a conceptual model should be developed to aid in assessing the risks and impacts associated with ocean disposal options. The model would address interrelationships among magnitude and type of waste inputs from all sources; pollutant transformations and movements through the ecosystem; contaminant levels in ecosystem components; acute and chronic effects on humans and marine organisms; seasonal and long-term natural variability; disruption to the ecosystem from other sources; and the capability of the marine environment to assimilate finite

amounts of certain wastes over time. Although the model would be qualitative, it would illustrate the types of information needed to predict the implications of marine waste disposal options. The model could be used to organize and evaluate existing information and to guide the aquisition of new information. It is recommended that the conceptual model be developed jointly by EPA and NOAA with participation by other agencies as appropriate. If required, NMPPO would support assistance by academic specialists in this area during FY 1982.

Regional Pilot Study

Second, it is proposed that the conceptual model described above be applied in a specific geographic region to assess the usefulness of the the model and the feasibility of the regional approach to waste management. Application of the model would involve collecting and synthesizing existing information within the region, and conducting research and monitoring to generate new data as required. The objective of the regional study would be to provide information on the marine impacts of various waste disposal options necessary for multimedium analyses and comparisons. The specific nature and format of the information required depends on procedures for comparison that are not yet developed. But some general questions can already be identified in preparation for a multimedium analysis of options:

- How much material will be disposed, and at what rates? What chemical constituents in the material are potentially harmful?
- What is the immediate fate of the material after disposal? What is the long-term fate of various chemical constituents in the marine ecosystem?
- What are the likely effects on marine resources including commercial and recreational fisheries, aesthetic resources, and other ocean uses?
- How will the proposed action contribute to cumulative pollution effects in the region?
- What are the risks to human health and well-being?

It is recommended that EPA assume the lead role in conducting this study, with substantial involvement by NOAA and participation by other Federal agencies as required. Specific responsibilities in the overall effort will be negotiated among the involved agencies as the project evolves, but the following may be used for initial guidance:

TASK	PRIMARY AGENCY RESPONSIBLE
Selection of region	EPA/NOAA
Identification of waste disposal issues	EPA
Understanding (or conceptual model) of marine ecosystems	NOAA
Information from regulatory procedures (bioassays, mixing zones, etc.)	EPA
Assessment of waste disposal impacts and cumulative effects	NOAA
Synthesis of information for multimedium analyses	EPA
Evaluation of pilot study, identification of regional information needs, and more general requirements	EPA/NOAA

The pilot study should be initiated, at least in the planning and data evaluation stages, during 1982. A report on the value of this approach to the region, and the feasibility of using these methods on a national basis, should be completed during FY 1985. If required, those activities that may be of value to the region would continue past FY 1985. The level of effort required to conduct this study will depend on the region selected, the degree to which existing Federal, State, and local programs can be incorporated, the need for site- and region-specific research and monitoring, and the exact requirements for the multimedium analysis. Estimates of funding requirements and identification of sources should be developed in FY 1982 during the planning stages.

Early warning monitoring

In addition to developing the capability to predict the impacts and risks of ocean disposal of wastes, it is essential that ecosystems be protected against damage that was not anticipated in the decision-making process as disposal of wastes becomes more common in coastal areas. Trend assessment monitoring should be carried out around disposal areas to provide early warning of such damage. It is expected that this type of monitoring could be provided through the network proposed in Chapter IV by coordination of existing monitoring programs

(Federal, State, and local), and through better management of data that are already collected on a routine basis. NOAA, with cooperation of EPA and other agencies as required, should assume lead responsibility for determining the level of monitoring required to provide early warning and for ensuring that such a program be implemented on a national basis.

OCS ENVIRONMENTAL STUDIES

The process followed for leasing OCS tracts for oil and gas exploration involves collecting and assessing information on potential impacts (environmental, social and economic) of OCS-related activities on proposed lease sites and affected coastal areas. This information helps the Bureau of Land Management (BLM), the agency responsible for administration of the OCS leasing process, determine which areas to lease and what restrictions, if any, may be necessary during exploratory and production phases. Much of the collected information is characterization, intended to identify the possible environmental consequences of OCS activities. Of particular concern are detrimental effects that may result from oil well blowouts and spills or discharges associated with drilling and production operations.

Oil in the marine environment has been studied extensively for the past 10 years. There are still many unanswered questions; however, some conclusions are generally accepted. Effects of spilled oil in the marine environment (in the short term) are by and large not catastrophic in temperate climates. The impact in coastal areas, particularly marsh and shallow estuarine environments, may be disastrous and sometimes result in long-term ecosystem alteration and economic hardships, but the number and extent of these vulnerable areas are limited. Impacted sites generally recover to maintain a population similar to that which existed before the spill within fewer than 10 years. Furthermore, major spills from offshore wells are rare. The most significant issues still to be resolved for oil in the marine environment relate to possible long-term, low-level effects of OCS activities on entire marine ecosystems. These potential effects, the result of chronic exposure to low levels of oil and disruption from multiple activities in coastal and OCS areas, will most likely be subtle and obscure. They may or may not be significant. Effects are likely to be of most concern in sensitive coastal areas such as marshes and estuaries; there may be catastrophic effects on species already endangered by low population levels. Limited studies of long-term effects have been carried out in historic OCS areas. There is, however, considerable controversy surrounding the interpretation of study results. Although major adverse effects on marine resources were not observed in these historic areas, both the nature and extent of longer term effects are still questionable.

The National Academy of Sciences is currently revising its 1975 report, "Petroleum in the Marine Environment," to incorporate knowledge acquired since its publication. This revision, scheduled for completion in 1982, should help to resolve some of the controversy regarding the long-term studies that have been conducted in the past.

During the early years of OCS leasing, BLM carried out an extensive environmental studies program aimed at providing "baseline" or "benchmark" information for use in preparing environmental impact statements and against which future changes could be measured. This program generated large amounts of scientific data with accompanying substantial expenditure of funds. Basic criticism of this approach centered around the delayed return on investment and the uncertainty of just how useful these data would be. In 1978 BLM redesigned the environmental studies program to provide information of more direct significance to the immediate leasing process. (This program in FY 1981 amounted to $35 million.) Although it is generally acknowledged that the BLM environmental studies, as redirected, are being used in the immediate decision-making process, there is concern that larger questions and longer term problems are not being adequately addressed with the new approach, and that large amounts of money are being directed toward collecting environmental data that are of minimal importance in the overall decision to lease or not to lease.

Because of the pressing national requirement for increasing domestic sources of petroleum, recent changes have been made in BLM policy in an attempt to accelerate the OCS leasing process. These changes compress the time frame for making decisions on which tracts will be leased and focus pre-leasing information collection on area-wide "basins" rather than individual tracts. The likelihood of large-scale adverse impacts resulting from inadequate environmental information being available during the decision-making process is not high. Minimal studies directed at identifying the most environmentally vulnerable tracts for removal from the leasing schedule could suffice. However, additional attention must be given to significant remaining questions. Studies of the long-term effects of drilling and production operations must be initiated first to determine their significance, and then to identify means for minimizing any significant impacts that are found.

Recommendations for Action

In view of the conclusions that have been drawn about OCS environmental studies, it is recommended that the following actions be undertaken:

Limits on pre-lease studies

Collection of pre-lease sale information should be limited to that essential for identifying proposed lease sale area where OCS

activities could result in unacceptable impacts on highly vulnerable resources. These studies should be carried out basin-wide with the intent of identifying specific high-risk lease areas.

Long-term studies

As recommended in Chapter II, a 10-year interagency research program should be planned and implemented to investigate the potential long-term, low-level effects of oil and gas development on the OCS and on other ocean use activities. This program should be implemented by the Federal Government with the cooperation of private industry as OCS development takes place.

To assume responsibility for this endeavor, a subcommittee will be formed; under the Interagency Committee it will be led by BLM and have participation by all other agencies with relevant programs and interests. The subcommittee, with staff support from the National Marine Pollution Program Office, will select two study areas for investigation. One will be representative of an historic OCS area, the other of a frontier area. Experimental designs for both areas will be developed with the advice and review of non-Federal scientists and industry personnel as well as those representing Federal programs and interests. The research plan thus developed will address concerns for long-term effects from all polluting sources including spills of hazardous materials; however, OCS activities will be the primary focus. It should be organized so that funding can be committed in 3- to 5-year allocations and provide for periodic review and assessment every 3 years so that research directions can be altered as necessary to reflect experience and new information. Clear roles should be defined for all participating agencies and for private industry. As integral parts of the plan, provisions should be made for adequate quality control, for the use of monitoring where necessary, and for synthesis and distribution of data and information resulting from the program.

Implementation of the study Plan will be carried out by BLM with cooperation by other Federal agencies in terms of funding and other resources as available.

After 5 years, the necessity or desirability of extending these concepts to other geographic areas should be evaluated on the basis of the information and knowledge gained through this program.

INCREASED COAL USE

In the next 20 years, domestic coal production in the United States is expected to increase. More power plants will be converted from petroleum to coal, the use of coal liquefaction and gasification technologies will increase, and coal exports will probably double or

triple by the year 2000. The following could produce undesirable effects in the oceans and the Great Lakes:

- Disposal of fly ash, bottom ash, and scrubber sludge from coal-powered generating plants and from liquefaction and gasification processes.
- Primary (e.g., slurry transport water discharge) and secondary (e.g., disposal of dredged material from harbor improvement) impacts of coal transport, export, and handling in coastal areas.
- Coal power plant emissions with the potential of causing acid rain.

Recommendations for Action

Because of the diversity of the coal use issue, no single Federal agency is responsible for regulating or researching all aspects of coal use that affect the marine environment. Therefore, it is essential that interagency coordination and communication be promoted to ensure sufficient research to provide the information required to assess and predict the implications to the marine environment of coal policies and coal use programs. A synthesis of available information should be conducted to predict the implications of coal policy to the marine environment, and to identify areas for future research. The key Federal agencies and departments involved include the Department of Energy, the Army Corps of Engineers, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, and the Department of the Interior.

It is recommended that these agencies assume the responsibilities described below to anticipate the need to understand the effects of coal policy on marine ecosystems.

Department of Energy

- Produce and make available the best possible predictions of future coal recovery rates, domestic use patterns, and export levels.
- Serve as a clearing house for research results generated by all agencies and, on the basis of these results, perform programmatic assessments of coal policy impacts on the marine environment.

Environmental Protection Agency

- Perform research, in coordination with NOAA, on the feasibility of all the various disposal options, including ocean dumping, for fly ash, bottom ash, and treated and untreated scrubber sludges. This research would include conducting toxicity studies, developing screening procedures for selecting disposal options, and identifying disposal sites.

National Oceanic and Atmospheric Administration

- Perform research, in coordination with EPA, on the immediate and long-term effects of dumping fly ash, bottom ash, and treated and untreated scrubber sludges in the ocean. This research would concentrate on field studies to determine the fate and effects of disposed coal wastes.

Corps of Engineers

- Identify ports that will or might be improved, estimate volumes of dredged material that would be generated, and perform impact assessments to identify environmental problems that could result from harbor improvements required for increased shipment of coal.

Department of the Interior

- Provide information on policies and activities related to leasing Federal lands for coal recovery.

ORGANIZING FOR BETTER PROGRAM SUPPORT

The National Marine Pollution Program is underpinned by four elements common to the programs of all agencies: information management, quality assurance, monitoring, and development of measurement methodologies. These elements are the "tools" necessary for implementing programs and like the tools of any trade, they must be appropriately developed, used, and maintained if reliable quality products are to be delivered at minimal cost. Strong coordinated programs in these four areas will improve the overall Federal program by making collected data available and usable to multiple users and by providing more directly useful synthesized information, i.e., information products that result from integration and assessment of data collected from multiple and scattered sources.

The first plan recognized these elements as important program responsibilities and made recommendations for addressing their deficiencies. Some progress has been made, but much remains to be accomplished.

Recommendations for Action

Information management, synthesis, and distribution

The primary need in the area of information management is to change focus from functions supporting data collection and manipulation to functions generating synthesized products. The need has been well recognized and documented since the first Plan appeared, and approaches are being sought within the information management community. A present goal is to develop the capability through the establishment of a data and information network and produce one major synthesis report on the problems associated with increased use of coal. It is recommended that the Interagency Committee establish a working group to formulate approaches for the synthesis of information on ocean pollution.

Monitoring

The first Federal Plan recommended that a national marine monitoring program be established. Since the first Plan was released, ideas on this subject have changed. Further assessment of monitoring needs and ongoing programs has led to a somewhat altered perception of how monitoring can best address national problems.

As one of many "tools" for carrying out the National Marine Pollution Program, monitoring has received a great deal of attention, some of it not always favorable. Much of the dissatisfaction has arisen from the fact that many monitoring programs appear to be ends in themselves rather than means to an end. Marine monitoring accomplishes the systematic observation of marine systems. If the information collected through systematic observation is not part of a larger objective, monitoring has little meaning. In the past, many monitoring programs have been designed without the end objective or with very limited objectives; consequently, information collected appears to exist for its own sake or is of very limited value.

Many monitoring programs now exist. Some are carried out by the Federal Government, others by State and local governments, some by private companies. Many are very well executed technically. Current thinking on the appropriate Federal role is that efforts should be directed toward organizing existing Federal programs into a national framework, recognizing the contributions of other programs, and

taking the initiative to fill gaps in the framework through modification and implementation of Federal programs. As part of this gap-filling endeavor, appropriate monitoring programs should be designed to support the new initiatives in this Plan for a Regional Waste Management Pilot Study, trend assessment monitoring of ocean disposal sites, and the long-term effects program.

Quality assurance

The need for appropriate measures to assure the reliability of collected information is never disputed; however, implementation of such measures is often overlooked. This Plan calls for a high-level policy commitment from all agencies of the Interagency Committee to include discrete, appropriate quality assurance requirements in all marine pollution programs. Furthermore, future Committee-sponsored program evaluations should explicitly include assessments of associated quality assurance programs. The Plan also recommends that NOAA work with the National Bureau of Standards (NBS) and EPA to make available service mechanisms and quality assurance tools for the marine environment.

Measurement methodologies

Measurement methodologies form a substantial portion of the foundation upon which research and monitoring programs are built. Without sound techniques for collecting observational information, scientific data could not be recorded and there would be little basis for establishing facts and drawing conclusions.

Two needs for measurement methodology development must be met. One is for improvement of existing methodologies and techniques to make them more cost effective and reliable. The objective should be to develop simplified, more foolproof hardware and techniques, in some cases for use by unskilled personnel in field environments.

The second requirement is for new and better methodologies to meet the challenges of current and planned programs. In many cases, temporary modifications of existing techniques have continued to become the unsatisfactory but accepted norm because no better alternatives were available. A prime deterrent in meeting the need for development of advanced technology is the difficulty in assessing future technology requirements. Also of significant influence is the lack of willingness in a climate of fiscal austerity to make the long-term budget and planning commitments that are necessary for advanced development which has implicit but deferred payoff.

CONCLUSIONS

This Plan is the result of an extensive interagency effort that has involved a large number of people. Regional representatives have assisted in identifying research and information needs; agency representatives have been involved in evaluating research and information needs and in providing descriptions of activities within their respective agencies; Federal scientists and program managers have contributed to the various analyses and reviewed the conclusions found in the Plan; and a large number of Federal and non-Federal specialists have participated in the Petroleum Review (Appendix 3). This section presents conclusions, observations, and recommendations that pertain to various aspects of the continuing planning process.

Utility of the Plan

Different portions of the Plan present different types of information. Chapter I provides perspective by presenting overview information on the National Program objectives, components, activities, and a program report on the planning process. Chapter II explains the nature of the problems associated with various pollutant sources, describes information needs and the Federal activities that address them, and provides conclusions or recommendations at the program level for each need. Chapter II can be used by managers of Federal programs to identify related activities in other agencies and to promote interagency coordination. Chapter III provides a summary of regional pollution concerns. In planning Federal ocean pollution research, development, and monitoring activities, it is essential that special regional problems and concerns be considered. Chapter IV provides discussion and recommendations concerning the supporting elements of the National Program. Chapter V provides major recommendations for action which, if followed, will improve the Program's response to national information needs.

Limitation of the Plan

The Plan discusses information needs and research programs, and makes suggestions for improving the efficiency and effectiveness of the National Program. Funding changes must be accomplished by individual agencies through the Federal budget process. The recommendations in the Plan should be used by or within agencies to assist in making budget decisions.

Value of the Planning Process

The activities required to prepare the Plan have caused Federal program managers to learn more about ocean pollution research, development, and monitoring activities within their own agencies, and in other Federal agencies. For example, the Agency Program Summaries (Appendix 1), in addition to being a valuable tool in preparing the Plan, have been used for many other purposes. The requirement to examine and plan ocean pollution activities as a discrete unit has been a useful exercise for several agencies. The many people who have participated in the various aspects of Plan preparation have gained interagency exposure and contact with people working in similar areas. The result of this exposure is improved interagency coordination at the working level.

Improvement of the Planning Process

On the basis of experience gained in preparing and producing the second Federal Plan, several recommendations can be made for improving the planning process in the future.

- The interim between Federal Plans should be increased to 4 years with the additional time devoted to implementing Plan recommendations.

- The Petroleum Review was extremely valuable in providing a detailed evaluation of a major portion of the program. There is a need for similar evaluation of other portions of the program. It is recommended that either the Waste Disposal or Ocean Pollution Evaluation areas be addressed prior to publication of the next Plan.

- Agency Program Summaries (Appendix 1) should be reviewed for update on an annual basis.

- The Catalog of Federal Projects (Appendix 2) should be updated each year. A simpler technique for collecting information from principal investigators should be developed.

- Federal departments and individual agencies involved in the program should (1) assure that agency plans and activities are, to the maximum extent practicable, consistent with the National Plan, and (2) cooperate with the Chairman of the Interagency Committee in developing a coordinated budget review process, as required by the Act, for assuring that individual agency and overall Plan priorities are reviewed and coordinated in a systematic fashion.

- The National Marine Pollution Program Office, as support staff for the Committee on Ocean Pollution Research, Development, and Monitoring, will continue to work with agencies to promote the implementation of Plan recommendations. Major agencies in the program are encouraged to assign staff on a short-term basis specifically to assist in interagency coordination and planning.

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Supplement: National Ocean Pollution Planning Act

Public Law 95-273
95th Congress

An Act

May 8, 1978
[S. 1617]

To establish a program of ocean pollution research, development, and monitoring, and for other purposes.

National Ocean Pollution Research and Development and Monitoring Planning Act of 1978.
33 USC 1701 note.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Ocean Pollution Research and Development and Monitoring Planning Act of 1978".

33 USC 1701.

SEC. 2. FINDINGS AND PURPOSES.

(a) FINDINGS.—The Congress finds and declares the following:

(1) Man's activities in the marine environment can have a profound short-term and long-term impact on such environment and greatly affect ocean and coastal resources therein.

(2) There is a need to establish a comprehensive Federal plan for ocean pollution research and development and monitoring, with particular attention being given to the inputs, fates, and effects of pollutants in the marine environment.

(3) Man will increasingly be forced to rely on ocean and coastal resources as other resources are depleted. Our ability to protect, preserve, develop, and utilize these ocean and coastal resources is directly related to our understanding of the effects which ocean pollution has upon such resources.

(4) Numerous departments, agencies, and instrumentalities of the Federal Government sponsor, support, or fund activities relating to ocean pollution research and development and monitoring. However, such activities are often uncoordinated and can result in unnecessary duplication.

(5) Better planning and more effective use of available funds, personnel, vessels, facilities, and equipment is the key to effective Federal action regarding ocean pollution research and development and monitoring.

(b) PURPOSES.—It is therefore the purpose of the Congress in this Act—

(1) to establish a comprehensive 5-year plan for Federal ocean pollution research and development and monitoring programs in order to provide planning for, coordination of, and dissemination of information with respect to such programs within the Federal Government;

(2) to develop the necessary base of information to support, and to provide for, the rational, efficient, and equitable utilization, conservation, and development of ocean and coastal resources; and

(3) to designate the National Oceanic and Atmospheric Administration as the lead Federal agency for preparing the plan referred to in paragraph (1) and to require the Administration to carry out a comprehensive program of ocean pollution research and development and monitoring under the plan.

33 USC 1702.

SEC. 3. DEFINITIONS.

As used in this Act, unless the context otherwise requires—

(1) The term "Administration" means the National Oceanic and Atmospheric Administration.

(2) The term "Administrator" means the Administrator of the Administration.

(3) The term "Director" means the Director of the Office of Science and Technology Policy in the Executive Office of the President.

(4) The term "marine environment" means the coastal zone (as defined in section 304(1) of the Coastal Zone Management Act of 1972 (16 U.S.C. 1453(1))); the seabed, subsoil, and waters of the territorial sea of the United States; the waters of any zone over which the United States asserts exclusive fishery management authority; the waters of the high seas; and the seabed and subsoil of and beyond the Outer Continental Shelf.

(5) The term "ocean and coastal resource" has the same meaning as is given such term in section 203(7) of the National Sea Grant Program Act (33 U.S.C. 1122(7)).

(6) The term "ocean pollution" means any short-term or long-term change in the marine environment.

SEC. 4. COMPREHENSIVE FEDERAL PLAN RELATING TO OCEAN POLLUTION.

33 USC 1703.

(a) LEAD AGENCY FOR PLAN.—The Administrator, in consultation with the Director and other appropriate Federal officials having authority over ocean pollution research and development and monitoring programs, shall prepare, in accordance with this section, a comprehensive 5-year plan (hereinafter in this Act referred to as the "Plan") for the overall Federal effort in ocean pollution research and development and monitoring. The Plan shall be prepared and submitted to Congress and the President on or before February 15, 1979, and a revision of the Plan shall be prepared and so submitted by February 15 of each odd-numbered year occurring after 1979.

Responsibility.

Submittal to President and Congress.

(b) CONTENT OF PLAN.—The Plan shall contain, but need not be limited to, the following elements:

(1) ASSESSMENT AND ORDERING OF NATIONAL NEEDS AND PROBLEMS.—The Plan shall—

National priorities.

(A) identify those national needs and problems, which relate to specific aspects of ocean pollution (including, but not limited to, the effects of ocean pollution on the economic, social, and environmental values of ocean and coastal resources), which exist and will arise during the Plan period;

(B) establish the priority, based upon the value and cost of information which can be obtained from specific ocean pollution research and development and monitoring programs and projects, in which such needs should be met, and such problems should be solved, during the Plan period; and

(C) contain, if pursuant to the preparation of any revision of the Plan required under subsection (a) it is determined that any national need or problem or priority set forth in the preceding version of the Plan should be changed, a detailed explanation of the reasons for the change.

(2) EXISTING FEDERAL CAPABILITY.—The Plan shall contain—

Existing Federal capability.

(A) a detailed listing of all existing Federal programs relating to ocean pollution research and development and monitoring (including, but not limited to, general research on marine ecosystems), which listing shall include, with respect to each such program—

(i) a catalogue of the Federal personnel, facilities, vessels and other equipment currently assigned to, or used for, the program, and

(ii) a detailed description of the existing goals and costs of the program, including, but not limited to, a categorical breakdown of the funds currently being expended, and planned to be expended, to conduct the program; and

(B) an analysis of the extent to which each such program, if continued on the basis and at the funding level described pursuant to subparagraph (A)(ii), will assist in meeting the priorities set forth pursuant to paragraph (1)(B) during the Plan period.

(3) POLICY RECOMMENDATIONS.—If it is determined, as a result of the analysis required to be made under paragraph (2)(B), that the priorities set forth pursuant to paragraph (1)(B) will not be adequately met during the Plan period using the existing Federal capability described pursuant to paragraph (2)(A), the Plan shall contain those recommendations for changes in the overall Federal effort in ocean pollution research and development and monitoring which would ensure that those priorities are adequately met during the Plan period. Such recommendations may include, but need not be limited to—

(A) changes in the goals to be achieved under various existing Federal ocean pollution research and development and monitoring programs;

(B) suggested increases and decreases in the funding for any such existing program consistent with the extent to which such program contributes to the meeting of such priorities;

(C) specific proposals for interagency cooperation in cases in which the pooling of the resources of two or more Federal departments. agencies, or instrumentalities under existing programs could further efforts to meet such priorities or would eliminate duplication of effort; and

(D) suggested legislation to establish new Federal programs considered to be necessary if such priorities are to be met.

Budget review.

(4) BUDGET REVIEW.—The Plan shall contain a description of actions taken by the Administrator and the Director to coordinate the budget review process for the purpose of ensuring interagency coordination and cooperation in (A) the carrying out of Federal ocean pollution research and development and monitoring programs; and (B) eliminating unnecessary duplication of effort among such programs.

"Plan Period."

(c) For purposes of this section, the term "Plan period" means—

(1) with respect to the Plan as required to be submitted on February 15, 1979, the period of 5 fiscal years beginning on October 1, 1978; and

(2) with respect to each revision of the Plan, the period of 5 fiscal years beginning on October 1 of the year before the year in which the revision is required to be prepared under subsection (a).

33 USC 1704.

SEC. 5. COMPREHENSIVE OCEAN POLLUTION PROGRAM IN THE ADMINISTRATION.

Establishment.

(a) ESTABLISHMENT OF PROGRAM.—The Administrator shall establish within the Administration a comprehensive, coordinated, and effective ocean pollution research and development and monitoring program. The Administrator shall carry out all projects and activities under the program in a manner consistent with the Plan.

(b) CONTENT OF THE PROGRAM.—The program required to be established under subsection (a) shall include, but not be limited to—

(1) all projects and activities relating to ocean pollution research and development and monitoring for which the Administrator has responsibility under provisions of law (including, but not limited to, title II of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1441-1444)) other than paragraph (2);

(2) such projects and activities addressed to the priorities set forth in the Plan pursuant to section 4(b)(1)(B) that can be appropriately conducted within the Administration; and

(3) the provision of financial assistance under section 6.

SEC. 6. FINANCIAL ASSISTANCE.

33 USC 1705.

(a) GRANTS AND CONTRACTS.—The Administrator may provide financial assistance in the form of grants or contracts for research and development and monitoring projects or activities which are needed to meet priorities set forth in the Plan pursuant to section 4(b)(1)(B), if such priorities are not being adequately addressed by any Federal department, agency, or instrumentality.

Grants and contracts.

(b) APPLICATIONS FOR ASSISTANCE.—Any person, including institutions of higher education and departments, agencies, and instrumentalities of the Federal Government or of any State or political subdivision thereof, may apply for financial assistance under this section for the conduct of projects and activities described in subsection (a), and, in addition, specific proposals may be invited. Each application for financial assistance shall be made in writing in such form and manner, and contain such information, as the Administrator may require. The Administrator may enter into contracts under this section without regard to section 3709 of the Revised Statutes of the United States (41 U.S.C. 5).

Contract authority.

(c) EXISTING PROGRAMS.—The projects and activities supported by grants or contracts made or entered into under this section shall, to the maximum extent practicable, be administered through existing Federal programs (including, but not limited to, the National Sea Grant Program) concerned with ocean pollution research and development and monitoring.

(d) ACTION BY ADMINISTRATOR.—The Administrator shall act upon each application for a grant or contract under this section within six months after the date on which all required information is received by the Administrator from the applicant. Each grant made or contract entered into under this section shall be subject to such terms and conditions as the Secretary deems necessary in order to protect the interests of the United States. The total amount paid pursuant to any such grant or contract may, in the discretion of the Administrator, be up to 100 percent of the total cost of the project or activity involved.

(e) RECORDS.—Each recipient of financial assistance under this section shall keep such records as the Administrator shall prescribe, including records which fully disclose the amount and disposition by such recipient of the proceeds of such assistance, the total cost of the project or activity in connection with which such assistance was given or used, the amount of that portion of the cost of the project or activity which was supplied by other sources, and such other records as will facilitate an effective audit. Such records shall be maintained for three years after the completion of such project or activity. The Administrator and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access, for the purpose of audit and examination, to any books, documents, papers, and

Recordkeeping.

Accessibility.

records of receipts which, in the opinion of the Administrator or of the Comptroller General, may be related or pertinent to such financial assistance.

33 USC 1706.

SEC. 7. INTERAGENCY COOPERATION.

The head of each department, agency, or other instrumentality of the Federal Government which is engaged in or concerned with, or which has authority over, programs relating to ocean pollution research and development and monitoring—

(1) shall cooperate with the Administrator in carrying out the purposes of this Act;

(2) may, upon written request from the Administrator or Director, make available to the Administrator or Director, on a reimbursable basis or otherwise, such personnel (with their consent and without prejudice to their position and rating), services, or facilities as may be necessary to assist the Administrator or the Director to achieve the purposes of this Act; and

(3) shall, upon a written request from the Administrator or Director, furnish such data or other information as the Administrator or Director deems necessary to fulfill the purposes of this Act.

33 USC 1707.

SEC. 8. DISSEMINATION OF INFORMATION.

The Administrator shall ensure that the results, findings, and information regarding ocean pollution research and development and monitoring programs conducted or sponsored by the Federal Government be disseminated in a timely manner, and in useful forms, to relevant departments, agencies, and instrumentalities of the Federal Government, and to other persons having an interest in ocean pollution research and development and monitoring.

33 USC 1708.

SEC. 9. EFFECT ON OTHER LAWS.

Nothing in this Act shall be construed to amend, restrict, or otherwise alter the authority of any Federal department, agency, or instrumentality, under any law, to undertake research and development and monitoring relating to ocean pollution.

33 USC 1709.

SEC. 10. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Administration for the purposes of carrying out this Act not to exceed $5,000,000 for the fiscal year ending September 30, 1979.

Approved May 8, 1978.

LEGISLATIVE HISTORY:

HOUSE REPORTS: No. 95-626 pt. 1 (Comm. on Science and Technology) and 95-626 pt. 2 (Comm. on Merchant Marine and Fisheries).

CONGRESSIONAL RECORD:

Vol. 123 (1977): Aug. 3, considered and passed Senate.

Vol. 124 (1978): Feb. 28, considered and passed House, amended.

Apr. 24, Senate agreed to House amendment.

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Public Law 96-255
96th Congress

An Act

May 30, 1980
[H.R. 6615]

To amend the National Ocean Pollution Research and Development and Monitoring Planning Act of 1978 to authorize appropriations to carry out the provisions of such Act for fiscal years 1981 and 1982, and for other purposes.

National Ocean Pollution Research and Development and Monitoring Planning Act of 1978, amendment.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 10 of the National Ocean Pollution Research and Development and Monitoring Planning Act of 1978, as amended (33 U.S.C. 1709), is amended—

(1) by striking out "and" after "1979,", and

(2) by striking out "1980." and inserting in lieu thereof "1980, not to exceed $3,000,000 for the fiscal year ending September 30, 1981, and not to exceed $4,000,000 for the fiscal year ending September 30, 1982.".

Lead Federal agency for plan.

SEC. 2. Section 4(a) of the National Ocean Pollution Research and Development and Monitoring Planning Act of 1978 (33 U.S.C. 1703(a)) is amended by striking out "February" immediately after "submitted by" and inserting in lieu thereof "September".

Name change. 33 USC 1701 note.

SEC. 3. Section 1 of the National Ocean Pollution Research and Development and Monitoring Planning Act of 1978 is amended by striking out "Research and Development and Monitoring".

Approved May 30, 1980.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 96-893, Pt. 1 (Comm. on Merchant Marine and Fisheries) and No. 96-893, Pt. 2 (Comm. on Science and Technology).

SENATE REPORT No. 96-691 accompanying S. 2687 (Comm. on Commerce, Science, and Transportation).

CONGRESSIONAL RECORD, Vol. 126 (1980):

May 5, considered and passed House.

May 15, considered and passed Senate in lieu of S. 2687.

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☆U.S. GOVERNMENT PRINTING OFFICE:1982—576-043 / 2

NATIONAL MARINE POLLUTION PROGRAM
FEDERAL PLAN FOR FY 1981-1985
Supporting Documents*

Appendix 1: Agency Program Summaries: Ocean Pollution Research, Development, and Monitoring — Fiscal Years 1981-1985 †

Appendix 2: Catalog of Federal Projects — Fiscal Years 1981-1985

Appendix 3: Marine Oil Pollution: Federal Program Review — April 1981

Working Papers

No. 1:	Assimilative Capacity of U.S. Coastal Waters for Pollutants
No. 2:	Report of Alaska Region Conference on Marine Pollution Problems
No. 2 (Annex):	Summary of Non-Federally Funded Marine Pollution Research, Development, and Monitoring Activities: **Alaska Region**
No. 3:	Report of Great Lakes Region Conference on Marine Pollution Problems
No. 3 (Annex):	Summary of Non-Federally Funded Water Pollution Research, Development, and Monitoring Activities: **Great Lakes Region**
No. 4:	Report of South Atlantic and Gulf Regions Conference on Marine Pollution Problems
No. 4 (Annex):	Summary of Non-Federally Funded Marine Pollution Research, Development, and Monitoring Activities: **South Atlantic and Gulf Regions**
No. 5:	Report of North and Mid-Atlantic Regions Conference on Marine Pollution Problems
No. 5 (Annex):	Summary of Non-Federally Funded Marine Pollution Research, Development, and Monitoring Activities: **North and Mid-Atlantic Region**
No. 6:	Report of West Coast Region Conference on Marine Pollution Problems
No. 6 (Annex):	Summary of Non-Federally Funded Marine Pollution Research, Development, and Monitoring Activities: **West Coast Region**
No. 7:	An Assessment of the Great Lakes and Ocean Pollution Monitoring in the United States, June 1981

References

R-1	Report of the 2nd Interagency Workshop on In-Situ Water Quality Sensing: Biological Sensors, Pensacola Beach, Fla., April 28-30, 1980
R-2	Towards a National Marine Pollution Policy, Proceedings of the Marine Pollution Policy Workshop, June 25-27, 1980, Center for Ocean Management Studies, University of Rhode Island
R-3	Report of Northeast Regional Workshop on Ocean Pollution Monitoring, Stonybrook, N.Y., September 10-12, 1980
R-4	Report of Southwest Regional Workshop on Ocean Pollution Monitoring, Pasadena, Calif., November 18-20, 1980
R-5	Report of Western Gulf Regional Workshop on Ocean Pollution Monitoring, New Orleans, La., December 16-17, 1980
R-6	Report of Southeastern Regional Workshop on Ocean Pollution Monitoring, Atlanta, Ga., January 27-28, 1981
R-7	Report of Great Lakes Regional Workshop on Ocean Pollution Monitoring, Ann Arbor, Mich., February 10-12, 1981
R-8	Report of Northwest Regional Workshop on Ocean Pollution Monitoring, Seattle, Wash., January 6-8, 1981.
R-9	Proceedings of the Workshop on Marine Pollution Information Management, February 1981, NOAA, Environmental Data and Information Service
R-10	Report of the Ad-Hoc Working Group on Marine Pollution Measurement Quality Assurance, February 1981

*Information about availability of these documents can be obtained from the National Marine Pollution Program Office, NOAA, U.S. Department of Commerce, Washington, D.C.

†Appendix 1 is undergoing revision to reflect recent budget changes and will be released after completion of changes.