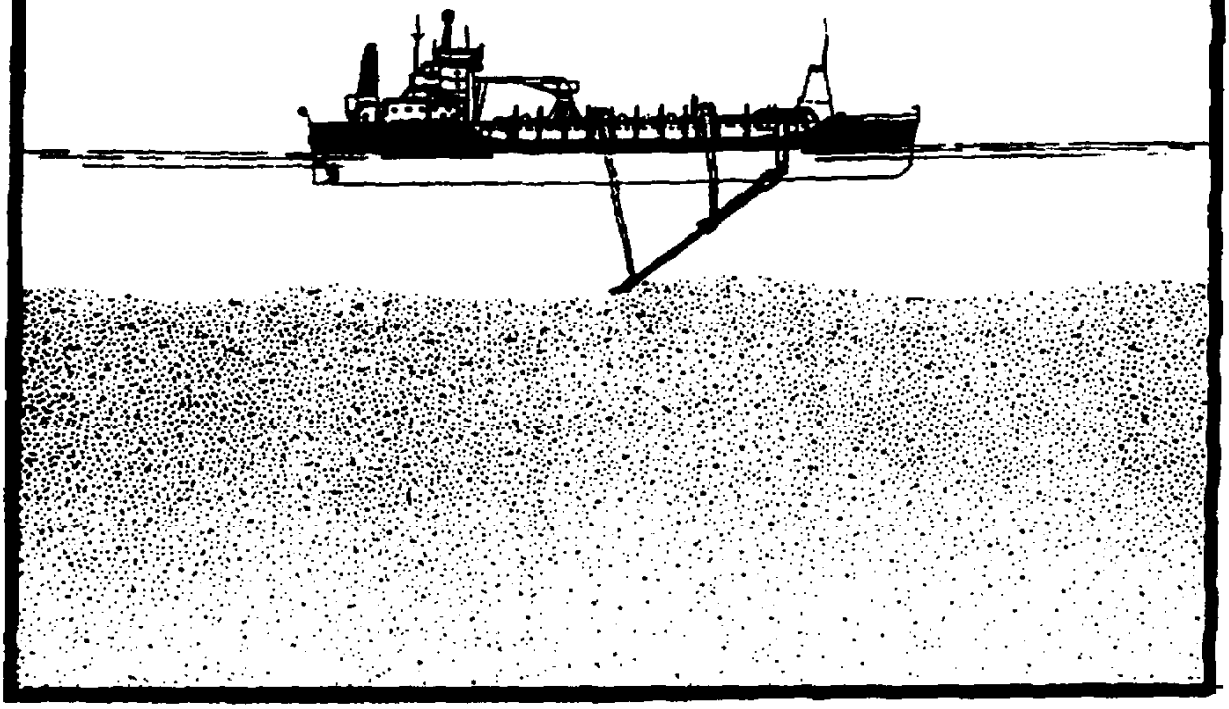
U.S. OUTER CONTINENTAL SHELF SAND AND GRAVEL RESOURCES

Programs, Issues and Recommendations

FINAL REPORT OF THE OCS POLICY COMMITTEE'S SUBCOMMITTEE ON OCS SAND AND GRAVEL RESOURCES

April 1993



U.S. OUTER CONTINENTAL SHELF SAND AND GRAVEL RESOURCES

Programs, Issues and Recommendations

FINAL REPORT OF THE OCS POLICY COMMITTEE'S
SUBCOMMITTEE ON OCS SAND AND GRAVEL RESOURCES

April 1993

Subcommittee members:

Charles Groat, *Chairman*, Louisiana

George Banino, Dunn Corporation

Charles Gardner, North Carolina

Gary Magnuson, Center for Marine Conservation

Paul Rusanowski, Alaska

Kenneth Weaver, Maryland

LIST OF ACRONYMS AND ABBREVIATIONS

ACOE	U.S. Army Corps of Engineers
BOM	Bureau of Mines
CZMA	Coastal Zone Management Act
DOI	Department of the Interior
EEZ	U.S. Exclusive Economic Zone
EPA	Environmental Protection Agency
ESP	Environmental Studies Program
FWS	U.S. Fish and Wildlife Service
GVP	Government View Procedure
INTERMAR	Office of International Activities and Marine Minerals
MMS	Minerals Management Service
NMFS	National Marine Fisheries Service
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
OCSLA	OCS Lands Act
USGS	U.S. Geological Survey

REPORT OF THE OCS POLICY COMMITTEE'S
SUBCOMMITTEE ON OCS SAND AND GRAVEL RESOURCES

TABLE OF CONTENTS

Executive Summary 1

1. **Introduction** 3
   1.1 Subcommittee Background: Rationale for Formation, Membership, Procedures 3

2. **Resources Background** 4
   2.1 Uses for Sand and Gravel in Coastal Areas 4
   2.2 Availability of Resources 6
   2.3 Economic Outlook for Offshore and Onshore Spurces of Supply 9

3. **Offshore Resource Development Activities** 10
   3.1 Private Sector 10
   3.2 Public Sector: U.S. State and Federal Agencies 14
   3.3 Constraints on Marine Mining Activities 17

4. **Environmental Issues** 20
   4.1 Impacts of Mining on Fisheries 21
   4.2 Impacts to Seafloor from Excavations 24
   4.3 Multiple Use Conflicts 24
   4.4 Coastal Erosion 25
   4.5 Onshore Impacts 25

5. **Issue Identification and Conflict Resolution** 27
   5.1 Public Perceptions of Offshore Mining and Related Development 27

6. **Legal Framework: General Considerations in Hard Mineral Leasing and Development** 29
   6.1 Current Legal Regime and Regulations 29
   6.2 Comparisons with Oil and Gas 30
   6.3 OCSLA Provisions for Hard Minerals Development: Viewpoints on Their Adequacy . . 30
   6.4 Alternative Legal Frameworks--Previous Recommendations 32

7. **MMS Marine Minerals Program** 34
   7.1 Present Structure and Resources 34
   7.2 State and Local Government Interactions 34
   7.3 Options for Dealing With Program Elements 34

8. **Findings, Conclusions, and Key Recommendations** 36

References 39

Appendices 43

LIST OF FIGURES

Figure 1. Known Recoverable Sand and Gravel Resources Offshore the Lower-48 States 8
Figure 2. Stationary Suction Hopper Dredge 11
Figure 3. Trailing Suction Hopper Dredge 11
Figure 4. Clamshell Hopper Dredge 12
Figure 5. Submerged Pump Mining Vessel 12
Figure 6. Marine Aggregate Extraction 13
Figure 7. MMS Federal/State Cooperative Arrangements 16
Figure A-1. Known Recoverable Sand and Gravel Resource Areas Offshore the North Atlantic States A-3
Figure A-2. Known Recoverable Sand and Gravel Resource Areas Offshore the Mid-Atlantic States A-4
Figure A-3. Known Recoverable Sand and Gravel Resource Areas Offshore the South Atlantic States A-5
Figure A-4. Known Recoverable Sand and Gravel Resource Areas Offshore Florida A-6
Figure A-5. Known Recoverable Sand and Gravel Resource Areas Offshore Louisiana, Mississippi, and Alabama A-7
Figure A-6. Known Recoverable Sand and Gravel Resource Areas Offshore Texas A-8
Figure A-7. Known Recoverable Sand and Gravel Resource Areas Offshore Southern California . . A-9
Figure A-8. Known Recoverable Sand and Gravel Resource Areas Offshore Central California . . A-10
Figure A-9. Known Recoverable Sand and Gravel Resource Areas Offshore Northern California . A-11
Figure A-10. Known Recoverable Sand and Gravel Resource Areas Offshore Oregon and Washington A-12

Executive Summary

Sand and gravel are essential resources for the rapidly expanding populations of coastal areas in the United States and are mainly used for construction aggregate and for nourishment of eroding beaches. Offshore sand is presently being used for beach nourishment and this use is growing. Demand for sand and gravel for construction is increasing in an atmosphere of decreased public and regulatory tolerance for its extraction from traditional onshore sources near market areas. There are strong indications that decreasing availability of onshore sand and gravel will make it necessary to seek new (non-traditional) sources for certain metropolitan coastal areas in the near future, and for other areas within the next decade. Hauling new supplies from more-distant onshore sources increases transportation costs and significantly raises final product prices to consumers, while importing material from abroad increases our balance of payment deficit.

The offshore areas surrounding the United States contain an abundant supply of sand and gravel, much of it near expanding metropolitan areas where demand is greatest. The detailed distribution and characteristics of these resources are known in only a few areas. Resource characterization studies will be necessary to better understand the resource development potential of specific localities. Costs will be greater for the Outer Continental Shelf (OCS) than for mining deposits closer to shore or onshore. Offsetting these costs may be the higher quality of the OCS resources and the environmental advantages of obtaining them from further offshore. These advantages have prompted interest in examining the feasibility of developing OCS sand and gravel.

Offshore mining of sand and gravel is an established industry in several areas outside the United States, most notably in Japan, the United Kingdom, the Netherlands, and Denmark. The technology developed and experience gained by these countries in dealing with economic and environmental considerations could prove useful for any future development of U.S. offshore sand and gravel resources. There are noteworthy considerations, however, that serve to discourage extraction and use of domestic offshore aggregate resources:

- The higher cost of mining OCS sand and gravel is a deterrent to near-term development.
- Uncertainties about the types and costs of environmental and regulatory requirements on operations and a general public concern about mining and offshore resource development.
- Limitations contained in the Jones Act which prohibit domestic use of foreign vessels, many of which contain advanced technology. Thus, U.S. offshore miners would have to use equipment that may not be able to extract OCS sand and gravel resources in an acceptable economic manner.
- The unacceptability to the mining industry of the Outer Continental Shelf Lands Act (OCSLA) regulatory regime for marine hard minerals. Without major modifications or a new regulatory framework specifically covering OCS sand and gravel, industry is unlikely to actively pursue the development of OCS sand and gravel for aggregate material.
- The lack of an appropriate method under the OCSLA for conveying rights to OCS sand for publicly-funded beach nourishment projects. Such a method is needed which would allow non-competitive access to the sand at little or no cost to the sponsoring agency.

There is considerable public concern regarding offshore mineral extraction, consistent with current negative perceptions of onshore mining and of OCS oil and gas development. Without a major innovative program to inform the public about the true impacts and potential comparative benefits of OCS sand and gravel development, there will likely be sufficient opposition to prevent offshore development from occurring if and when it becomes practicable. The present MMS outreach program is not adequate to deal with the issues, and the lack of an effective partnership with the public or State and local governments in decisionmaking, will likely slow any future offshore sand and gravel development.

The present staffing and budget of the MMS Office of International Activities and Marine Minerals (INTERMAR) is only minimally adequate to deal with current and future interest in OCS sand and gravel development. Demand pressures, increasing costs, and public concern about onshore resources has increased coastal States' interest in examining OCS resources as new supply sources of sand and gravel. Such an interest is evidenced by the large number of coastal States currently working with MMS in studies of offshore sand and gravel resources. The INTERMAR budget and staffing level is not commensurate with this high level of interest. Additionally, the present oil-and-gas-oriented MMS Environmental Studies Program has not provided the priorities and funding for the types of studies that are necessary to deal with important environmental issues surrounding offshore sand and gravel extraction.

The OCS Policy Committee provides the following recommendations to the Secretary of the Interior:

- The need for more detailed assessment and characterization studies of OCS sand and gravel resources should be met by expanded efforts in cooperation with the U.S. Geological Survey (USGS), U.S. Army Corps of Engineers (ACOE), and coastal States. A greater role for private industry in hard minerals resource assessment (e.g., through working groups, cooperative arrangements, changes in regulation to provide incentive measures, etc.) needs to be encouraged.

- The MMS, congressional representatives, coastal States, industry, and interest groups should work together in the development of new legislation that will provide a workable policy and appropriate procedures for managing offshore hard minerals development. The resulting regime should support the development of high-volume/low-value commodities. This effort could begin through the initiative of the OCS Policy Committee.

- Information to support OCS hard minerals development should be developed through a modified Environmental Studies Program at MMS and from information already gained from foreign offshore mining experiences.

- There needs to be an effective information transfer mechanism to accurately convey real issues to the public. Such a mechanism must be tailored to specific communities in order to educate them about offshore mineral issues. A programmatic assessment must be made to determine who is the most effective messenger. The continued use of State/Federal task force mechanisms is important.

- In 1988, a Policy Committee report on Improving the Process for Developing the 5-Year OCS Oil and Gas Leasing Program (the "Shirley Report") provided the Secretary with recommendations related to outreach and public perception. These concepts should be extended to the marine hard minerals program as well.

- Demonstration projects should be pursued to build public confidence in technology and increase public understanding of potential impacts and mitigation techniques. In the development of program documents, public concern needs to be equally addressed with science and technology.

- The MMS must forge linkages with producers and users of mineral materials to foster cooperation in the development of these emerging resources. The MMS should work with major industry groups (e.g., industry associations, ad-hoc working groups, marine mining companies, etc.) and institute a forum to involve them in program development.

- The presence of significant sand and gravel resources on the OCS and potential near-term demand for these resources makes it imperative that MMS have a strong, effective and adequately funded marine minerals program. The Department should give this program a high priority in its budgeting process.

1. Introduction

The Outer Continental Shelf Advisory Board was established by the Department of the Interior (DOI) to provide advice representing the collective viewpoint of coastal States, environmental interests, industry representatives, and other parties to the Secretary of the Interior, through the Director of the Minerals Management Service (MMS) in the performance of discretionary functions of the OCSLA, as amended (43 U.S.C. 1331 et. seq.), including all aspects of leasing, exploration, development, and protection of OCS resources. The function of the Board is solely advisory.

The Board is composed of the following committees: (1) a Policy Committee; (2) Regional Technical Working Group Committees; and (3) a Scientific Committee. The Committees establish subcommittees and study groups as they deem desirable--membership must be balanced in terms of points of view, functions to be performed, and the expertise required by these subcommittees and task groups (and may include nonmembers of the parent committee). Subcommittees and task groups report to the parent committee.

1.1 Subcommittee Background: Rationale for Formation, Membership, Procedures

At the November 20, 1991 meeting, the OCS Policy Committee recommended the formation of a subcommittee charged with examining the development potential of OCS sand and gravel resources and the role of MMS. As a result of this interest and the willingness of MMS to support the activities of a subcommittee, the Chairman appointed a Subcommittee on OCS Sand and Gravel Resources consisting of four members of the Policy Committee and two nonmembers. These members and their affiliations are:

Charles Groat	*Louisiana--Chairman*
Kenneth Weaver	*Maryland*
Paul Rusanowski	*Alaska*
George Banino	*Dunn Corporation (Nonmember, subsequently appointed to OCS Policy Committee)*
Charles Gardner	*North Carolina, Division of Land Resources (Nonmember of Policy Committee)*
Gary Magnuson	*Center for Marine Conservation (Alternate member of Policy Committee)*

The Subcommittee met 3 times over a 10-month period to study substantive matters related to the possible development of these OCS resources. A draft report was circulated to the Policy Committee for review and comment at the October 1992 meeting, and the final report was prepared for submission to the Secretary of the Interior (including findings and policy recommendations) following approval of the OCS Policy Committee at the Spring 1993 meeting.

The objectives of the U.S. OCS Sand and Gravel Resources Study were:

- To assess (based on available information) the potential of sand and gravel resources in the Federal OCS to help meet local and national needs, and identify necessary steps to take should more information be required;

- To assess the importance of OCS sand and gravel to coastal States for local needs such as beach nourishment and as a potential supply source for construction aggregate;[1] and

- To identify legal, environmental, political, technical, and economic issues regarding the potential development of OCS sand and gravel resources and make recommendations to the Secretary of the Interior on the steps to be taken to ensure that environmentally acceptable development of these resources is practicable--if and when such development serves the public interest.

When appropriate, specific recommendations or observations are included with each report section. The Subcommittee's findings and conclusions from this study, and its key recommendations for the Secretary of the Interior, are contained in Section 8, Findings, Conclusions, and Key Recommendations.

2. Resources Background

2.1 Uses for Sand and Gravel in Coastal Areas

Sand and gravel resources are abundant and widespread in the United States.[2] These resources are an important contribution to the economic well-being of the States and the Nation as a whole. In 1992, about 441 million cubic meters (i.e., about 806 million short tons)[3] of construction sand and gravel was produced in the U.S.--by tonnage, this production ranks second in the U.S. nonfuel minerals industry after crushed stone.[4] The demand for construction sand and gravel is forecast to continue growing based on expected increases in construction activity in the public sector and increases in single-family housing construction. For 1993, production of sand and gravel is expected in increase about 3.0 percent over 1992 production levels. This increase would follow a reported 2 percent growth in production for 1992 (Rock Products, 1992).

---

[1] "Aggregate" refers to any combination of sand, gravel, and crushed stone in a natural or processed state used for construction purposes (National Stone Association, 1991). For purposes of this report, shell resources are included in the term "gravel."

[2] Sand and gravel is any clean, unconsolidated, or poorly consolidated mixture of fine and/or coarse aggregate material found in a natural deposit. Most sand and gravel deposits are formed by deposition in water. Sand is defined by the American Society for Testing and Materials (ASTM) as rock particles ranging in size from .0029 to .187 inches (.0074 to .475 centimeters); gravel is defined as rock ranging from .187 to 3 inches (.475 to 7.62 centimeters). Although sand and gravel occur in the same deposit, the relative proportions of each vary greatly (National Stone Association, 1991; U.S. Bureau of Mines, 1992).

[3] Preliminary estimate from the Bureau of Mines (Bureau of Mines, 1993). For conversion purposes, 1 cubic meter (m^3) of aggregate weighs about 1.8278 short tons.

[4] Crushed stone is a term applied to rock that has been broken and/or crushed after quarrying. It can be composed of limestone, granite, traprock, or any other hard, competent rock. Crushed stone is the major alternative for gravel. New high-tech or advanced materials which can be used as construction material are not likely to have an impact any time soon as substitute products unless they become more competitively priced (U.S. Bureau of Mines, 1992).

Construction Aggregate

Most sand and gravel is used in construction, primarily as fine and coarse aggregate for making concrete[5] for civil works (highways, bridges, dams, airports) and commercial buildings. In residential buildings, concrete is used mainly for foundations. Sand and gravel also has an important use for road-base material in the construction and repair of highways, railways, and runways; and as aggregate in asphaltic concrete for paving highways and streets (U.S. Bureau of Mines, 1992). Construction sand and gravel has a low unit value and transportation is very costly; therefore, it should be produced and marketed locally, otherwise construction costs will greatly escalate.

Use of construction aggregates is greatest in areas of highest population and where there is extensive construction activity. About 50 percent of the U.S. population now lives within 50 miles of the U.S. coastline. According to the 1990 Census, the most dramatic population growth over the past decade was in coastal States. If this trend continues, expect to see increasing critical shortages of construction aggregate, especially in certain coastal metropolitan areas. (See Williams, Dood, and Gohn, 1990; U.S. Bureau of Mines, 1987).

Demand for construction aggregates is continuous. Nationwide projections from the Bureau of Mines for 1993 are for about 451 million cubic meters (i.e., about 825 million tons) of sand and gravel and in excess of 657 million cubic meters (i.e., about 1.2 billion tons) of crushed stone (Rock Products, 1992). In long-established markets like New England, the projected increase in demand for aggregates is modest, less than 1 percent per year (New England Governors' Conference, 1992). However, the passage of the Intermodal Surface Transportation Efficiency Act in 1991 and other public works projects will ensure a steady demand for aggregates. Yet, the availability from traditional sources in the U.S. is decreasing for this nonrenewable resource.

Land-based deposits of sand, gravel, and stone have been the traditional sources of aggregates. As populations have grown, the original aggregate sources were mined out or the aggregate deposits were made unavailable by expanding land development. In this process, otherwise valuable sources of aggregate have been made unavailable by other land uses or by governmental land use restrictions. The result has been a continual need to find and develop new deposits of acceptable quality materials at an ever increasing distance from population centers. Currently, Boston is receiving aggregate from New Hampshire; the New York metropolitan area is being supplied from New Jersey, eastern Long Island, upstate New York, and, for some products, from Nova Scotia and Newfoundland. Researchers have predicted the complete depletion of currently available resources for the New York metropolitan market within 10 years (Courtney, 1979). The aggregate industry is reporting major difficulties in developing new sites, especially in and near major metropolitan areas where increasing land values; local zoning restrictions; environmental protection requirements; concerns about dust, noise, truck traffic, danger, and decline in property values; and depleted resources have contributed to local shortages and/or high delivered costs.[6]

---

[5] Made by mixing either Portland cement or asphalt with aggregate in precise proportions to form a rock-like structural product.

[6] Probably the best known example is Long Island, New York where little of the vast sand and gravel resource can still be mined, leading to the import of materials from other states. In New York City (Manhattan), aggregate costs are reported to be 3 times, or more, the national average price of $5 to $8 per ton, plus transportation costs (U.S. Bureau of Mines, 1990b).

Increasing demand will then have to be met by sources from further inland (requiring increasingly long and expensive transportation), from foreign suppliers, or from less traditional sources such as those found on the nearby ocean bottom.

Beach Restoration

Coastal erosion at widely varying rates affects all 30 coastal States and all of the U.S. island territories (Williams, Dood, and Gohn, 1990.) A substantial portion of the shoreline is considered to be "severely eroding." Sand management along the shoreline is fast becoming a significant issue for coastal States. Traditional approaches to prevent coastal erosion (jetties, groins, etc.) are no longer acceptable in some areas, having become too expensive, shown to be ineffective in the long run, or too damaging to the environment. Beach restoration, although expensive and short-lived in some cases, is a generally-accepted method of forestalling coastline erosion.[7] Beach restoration can (1) provide protection from storm damage for inland property, (2) enhance the value of coastal areas, (3) provide protection for landward wetlands and public infrastructure, (4) maintain a recreational beach, and (5) restore storm damaged beaches. Because of the large volumes required, a common source for sand has been the nearby ocean floor.

There have been numerous shore protection projects (particularly in New Jersey, Maryland, and Florida) authorized by Congress and implemented by the ACOE.[8] These projects are typically cost-shared up to 50 percent by the States. Because of long lead-times and uncertainty in obtaining Federal project authorization, some local communities are totally funding their own projects. Some beach restoration projects are accomplished by placing sand and gravel dredged from ACOE navigation-channel-maintenance projects onto nearby beaches (when environmentally acceptable and cost effective, as opposed to dumping dredged material offshore or at other disposal sites). Beach restoration project sponsors pay any incremental costs of placing the dredged material on the beach.

In many areas, experience gained from alteration of the ocean bottom, and the resulting impact on currents and beach erosion, have forced the dredging of sand to move further out into the ocean. While there has been considerable exploration for suitable sand and gravel sources close to shore, particularly by the ACOE, the knowledge of resources further out is limited.

2.2 Availability of Resources

A number of generalized studies and resource estimates show that the quantity of sand and gravel comprising the seabed of the U.S. continental margins is vast. However, the extent and economic

---

[7] Many scientists and others, however, contend that as coastal erosion is a natural process, government coastal management policies should focus on integrating development and natural systems rather than continuing expenditures on shore stabilization efforts. The purpose of this report is neither to debate or support any specific approach for addressing coastal erosion problems (e.g., coastal restoration vs. retreat policies) nor to debate the merits of marine vs. land-based sand and gravel production. Rather, the focus of this effort is to offer recommendations for an appropriate program if a choice is made to recover offshore sand and gravel resources for use as construction aggregate or as material for coastal restoration.

[8] However, it should be noted that beach nourishment activities under all ACOE authorities are constrained by current budgetary policy which precludes the use of ACOE civil works budget resources for recreation-oriented projects. Beach nourishment must be primarily for the purpose of hurricane and storm damage reduction, except where beach placement is the least costly alternative for disposal of dredged sand (ACOE, 1990).

recoverability of these resources is generally not adequately mapped and quantified. Various estimates show hundreds of billions of cubic meters of sand and gravel on the OCS--a huge amount compared to national demand--the total demand in the United States for construction sand and gravel was about 427 million cubic meters in 1991. Figure 1 is an overview map of known recoverable deposits of offshore sand and gravel for the "lower 48" United States.[9] Not all of the sand and gravel resources shown will be suitable for construction aggregate or beach restoration material. (Particularly offshore California--data shows sand mainly consists of fine particle sizes, which may have limited market use.) Sand and gravel must meet stringent physical and chemical quality specifications, depending on the particular end use. Economically recoverable resources ultimately will be identified on a site-specific basis, and probably will be located in water depths less than about 40 meters, and in areas relatively near major coastal markets.[10]

Detailed information, usually consisting only of localized data about grain size from the upper horizon of the ocean floor has been collected into a number of reports by the MMS, National Oceanic and Atmospheric Administration (NOAA), USGS and the ACOE. In addition to sediment data, detailed bathymetric maps are available showing the surface morphology of the ocean bottom--information helpful in interpreting the nature of sand and gravel deposits. Even though the amount of information is large, it has its limits in meeting the needs of the mining industry. While grain size is important, information about the physical characteristics of individual grains also are important and is not always available. Additionally, data are often based on samples taken from within the top meter of the ocean bottom while the bulk of the potential deposit is usually much deeper than that. Thus, industry members interested in pursuing ocean resources can use the existing information only as a guide for further investigation, recognizing that such investigations will be far more costly than more common land-based exploration.[11] Only a few studies have characterized specific deposits in sufficient detail to determine their suitability for use and minability in economic and environmental terms.

Appendix A summarizes some of the more recent general assessments of offshore sand and gravel resources, and presents examples of detailed local characterization studies needed by governments and industry before development decisions can be made. Currently, mapping and mineral reconnaissance are undertaken primarily by the government as private industry has not yet been willing to invest capital in seabed sand and gravel mapping and mineral investigations offshore the United States because of uncertainties about regulatory and economic issues.

---

[9] Note that significant sources of sand and gravel can also be found offshore Alaska, Hawaii, the Virgin Islands and Puerto Rico. Resources offshore Alaska are large and widespread, but are not expected to have significant near-term use due to lack of demand (except for use in some localized, small-scale beach restoration or oil and gas activity). The Virgin Islands, Puerto Rico, and Hawaii are experiencing severe shortages of sand and gravel for concrete aggregate and clean sand of suitable texture for beach nourishment. In Hawaii, the local unit price for construction-quality sand has reached $50 per cubic meter (i.e., about $28 per cubic yard). Typically, the island regions have narrow insular shelves and lack large sand bodies--resources consist of pockets of sand which contain potentially valuable material to help ameliorate the severe shortages of onshore material.

[10] Current production of marine sand and gravel in the United Kingdom reportedly occurs regularly to depths of 40 meters; and to 45/50 meters, depending on market prices.

[11] Locating and characterizing ore bodies are fundamental to developing a mining strategy. Geological ore-genesis models and large-area reconnaissance mapping are helpful in defining the regional context of potential ore deposits and in guiding exploration efforts, but this must be followed by site-specific mapping and in-situ sampling to evaluate and verify the deposit's economic value ([National Research Council, 1989].

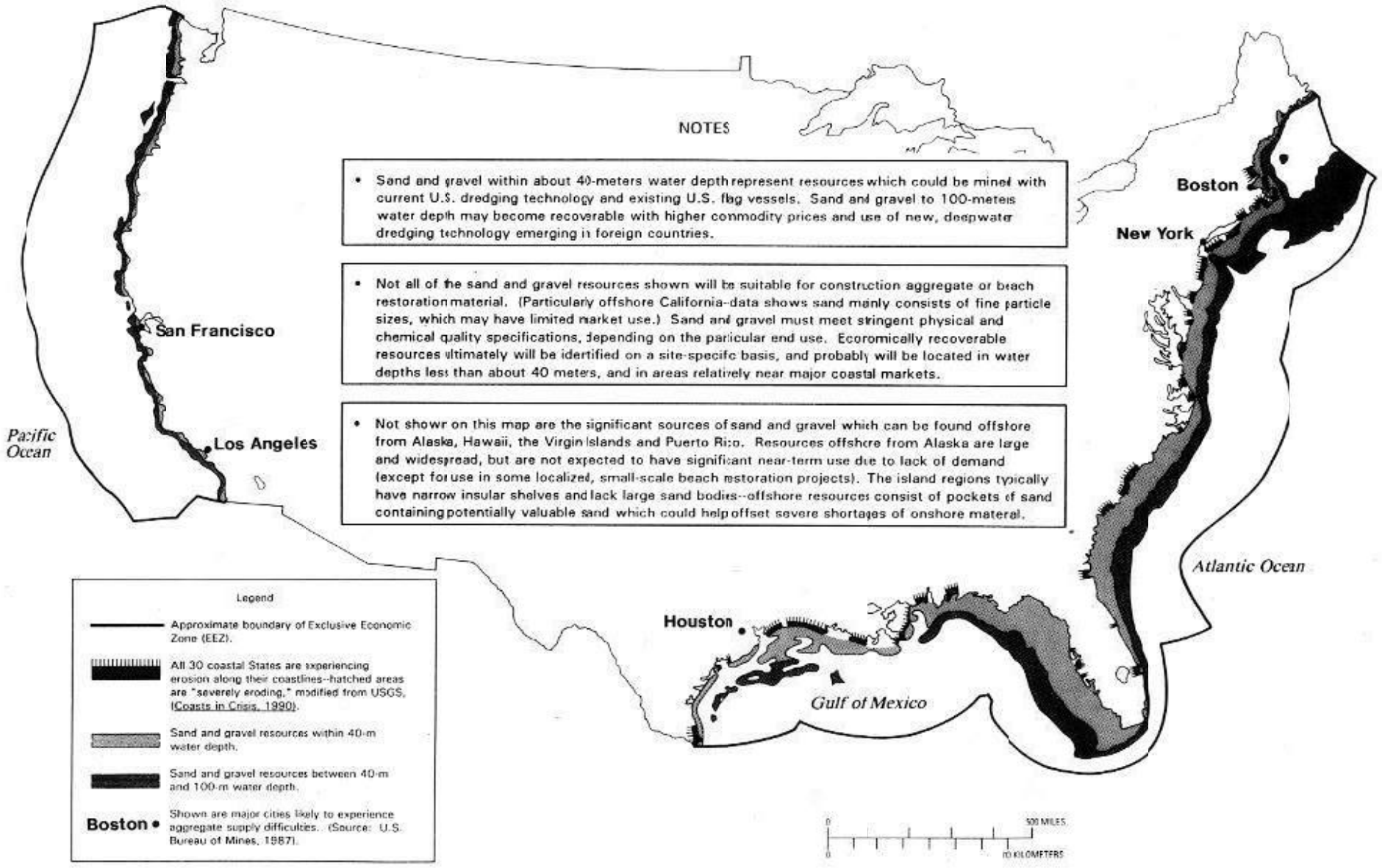


Figure 1. Known Recoverable Sand and Gravel Resources Offshore the Lower-48 States

2.3 Economic Outlook for Offshore and Onshore Sources of Supply

Construction aggregates are high-volume, low-value products where the cost of transportation quickly becomes the dominant control of price. In rural and suburban areas, the cost of a ton of sand can double with a truck haul distance of 50 miles; in urban areas, the distance can be as low as 10 miles. The existence of adequate quality aggregate materials greatly exceeds demand, but adequate amounts of these materials at a reasonable economic cost are often limited. Therefore, when comparing alternate sources of aggregates, the determining factor is often the transportation cost from the source to the end user. Prohibitive transportation costs in urban areas (often with roadway load restrictions), and the availability of land for discharging, stockpiling, and processing materials, make possible the consideration of marine mining. If adequate sources of aggregate on the ocean floor can be found close to the center of such urban areas, these materials could enjoy a considerable competitive advantage. Further, if the sand and gravel is loaded from the dredge onto barges, the material could be moved a long distance at low cost. Compared to truck transportation of aggregate, the cost of water-borne transportation can be one-third or less.

Costs for offshore sand and gravel increase with distance from the beach; this results from an increased transit time to and from the mine site and the need for larger and more sophisticated dredging vessels capable of operating in deep water and in difficult weather. If nearshore resources are depleted or are unacceptable for dredging because of environmental or coastal erosion concerns, coastal States will look to OCS sand and gravel sources even at higher project costs.

Particularly along coastlines where there has been extensive urban and suburban development, the ability to open a new aggregate source is limited. Land use and permitting requirements have made the process a long and expensive one. The permitting process can take up to 5 years, and 10 years has been the case in some instances. In many areas, including where excellent quality material exists close to urban centers, aggregates are no longer available due to land development or zoning that does not include mining as a permissible use. The aggregate industry's response to this unavailability has varied. In many cases, the answer has been to import material from many miles away using, where possible, lower cost modes of transportation such as trains or barges. In one case, in the New York metropolitan market, a producer obtained a dredging contract for channel maintenance and has used the dredged material as a source of aggregate. In all cases, however, the alternatives have led to increased costs, ultimately borne by the general population. As an alternative, some forward-thinking companies have considered marine mining. The investment in higher costs of marine mining would be offset against the cost of ever increasing transportation from land-based sources.

As costs for land-based aggregates continue to increase (if marine mining is not developed), other technologies will be developed. In some markets, such as Atlanta, where sand is scarce and rock is more abundant, increasing amounts of manufactured sand are being produced. While this is an expensive process, the cost is less than importing sand from over 100 miles away.

Currently, a limited amount of foreign coarse aggregate is imported into various parts of the East and Gulf coasts (about 0.93 million cubic meters), mainly from Mexico, Canada, and the Bahamas, with a limited amount coming from Scotland. In some areas along the south Atlantic and Gulf coasts, with limited local supplies of good quality aggregate, import prices may be less than delivered costs from inland sources, due to less expensive water transportation and back-haul pricing (where one commodity moves one way and pays for most of the cost of the round trip) (National Stone Association, 1991). If local onshore or marine sources of sand are not developed, it would not be surprising to see sand imported as well.

Recommendations

There are practically unlimited offshore deposits of sand along the continental margins; but much more detailed characterization work, along with environmental and engineering/economic studies, needs to be done to specifically identify suitable deposits that could be mined for either construction aggregate or beach nourishment and coastal restoration needs. It is advisable now to establish a basis for resource evaluation and to begin resource characterization should local and national interests require exploitation of these sand and gravel deposits in the near future.

The 1989 consensus report of the U.S. Exclusive Economic Zone (EEZ) Working Group on Hard Minerals (See Appendix C) includes some recommendations that are directly applicable to the need for the Federal Government to better characterize marine sand and gravel resources, to reduce development risks for industry (construction sand and gravel) and State/local governments (beach nourishment sand). The Working Group concluded that "The Federal government should ensure the early preparation and implementation of a comprehensive and systematic research plan, including the preparation of general topographic maps, geological survey reports, and environmental baseline data." It also concluded that the DOI (MMS, USGS, and Bureau of Mines (BOM)) should carry out geological surveys and should coordinate environmental studies with NOAA. Coordination between these Federal agencies, the ACOE, State geological surveys, academia, and industry will be essential to better define marine sand and gravel resources.

3. Offshore Resource Development Activities

3.1 Private Sector

Domestic Activities

There has been limited interest in marine mining offshore the U.S. in coastal State and Federal waters, chiefly because land-based supplies are still capable of meeting present needs. Other factors contributing to the lack of current interest in marine mining include: (1) current depressed market prices for mineral commodities relative to the higher costs of marine mining, (2) uncertainty in the legal/regulatory regime, (3) opposition based on environmental concerns, (4) uncertainty with respect to seabed-mineral-resource potential, and (5) need for technological developments in resource extraction or environmental monitoring. However, recovery of a variety of seabed minerals will likely become economically and technically feasible in the U.S. in the near future.

Since the early 1980's, sand and gravel has been mined from the entrance to New York Harbor. The operation helps maintain the Ambrose Channel for navigation for the ACOE, and the dredged material is sold by the operator (Amboy Aggregates) for concrete aggregate in the New York and Connecticut markets, as well as for fill-sand for construction projects. The operation produces about 300,000 to 600,000 cubic meters of sand and gravel annually, using a trailing suction hopper dredge mining to a depth of about 15 meters. The operator pays a production royalty to the State of New Jersey (or to the State of New York when operating there) for each unit of material sold.

In addition to the Amboy Aggregates operation, there is some nearshore, small-scale commercial extraction of seabed sand, gravel, and shell offshore a few coastal States such as Maryland, Louisiana, and California (see Appendix E). There are also numerous examples of large and small-

scale beach nourishment projects by the ACOE using seabed sand in coastal areas around the country. Examples of such projects can be found in Section 3.2.

The technological capability for dredging sand and gravel resources exists now, mainly as a result of dredging activity undertaken by and for the ACOE for navigation channels and harbor construction.[12] However, the number of dredges with ocean-going capabilities able to operate on the OCS is limited.[13] Current technology for U.S. flag ocean-going vessels allows economic recovery in less than about 40-meters water depth. The types of dredges capable of operating on the OCS that could be used for sand and gravel recovery are shown in Figures 2 through 5.[14]

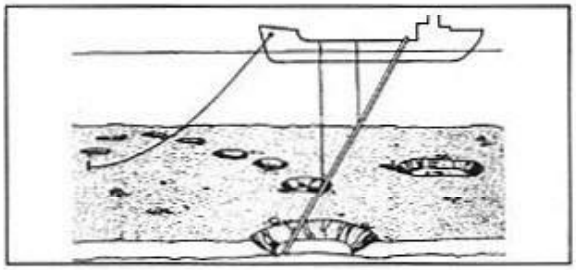


Figure 2. Stationary Suction Hopper Dredge
(Packer 1987) Dredge is anchored in position--suction pipe recovers sand and gravel to depths of about 20 meters (to 80 meters with a submersible booster pump). Resulting pits can be large, up to 20-meters deep and 10- to 100-meters in diameter. There is very little turbidity from excavation; existence of surface turbidity plume depends on material transport (hopper vessel, adjacent barge, pipeline). Commonly used in the U.S. (for channel and harbor dredging), Europe, and Japan.

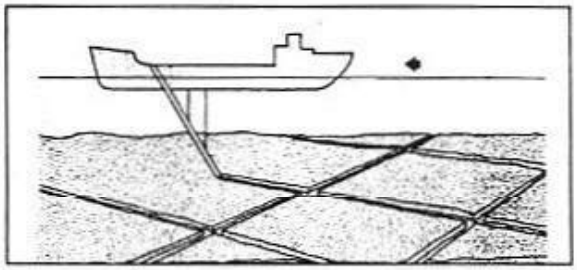


Figure 3. Trailing Suction Hopper Dredge
(Packer 1987) A self-propelled seagoing vessel that mines while in motion to depths up to about 50 meters--creates shallow trenches in seabed about 1- to 4-meters wide and up to .3-meters deep. Pump draws water and sediment slurry into hopper bins of vessel. Fine materials are washed overboard with the slurry overflow (can result in surface-turbidity plume). Widely used in the U.K. About 24 of this type dredge currently operate in the U.S.

---

[12] Approximately 80 percent of ACOE maintenance dredging and 100 percent of construction dredging are performed through contracts with private sector dredging firms. The ACOE awarded 241 industry contracts for removal of over 143 million cubic meters of material in 1991. Seventeen percent was moved by hopper dredge (suction) and 70 percent was moved by pipeline (suction), while only 4 percent was moved by bucket (mechanical). A significant portion of the dredged material is placed on beaches (when it meets quality standards and placement is cost effective) to help restore and protect the coastline.

[13] Privately owned and operated dredges of various types, sizes, and configurations operate in 38 States. The dredges are primarily engaged in projects for the ACOE, involving river and harbor channel maintenance, beach nourishment, and harbor construction. Given the types of activities performed by the domestic dredging fleet (primarily nearshore, lake and river activities), the majority of available U.S. flag dredges need not (and do not) have the capability for ocean operations. It is estimated that only about 10 to 30 out of approximately 660 dredges currently operating in the U.S. could conceivably operate on the OCS. Availability of these dredges would depend upon existing workloads and company policies concerning open ocean work.

[14] Other dredge-vessel designs (e.g., bucket ladder or bucket-wheel suction) also can be used for offshore sand and gravel extraction. Conventional cutter-suction-pipeline dredges typically are designed for environments with low levels of wave action and, thus, are infrequently used in the ocean. Additionally, new technology involving underwater robotics and/or offshore platforms may sometime in the future be used for offshore sand and gravel mining.

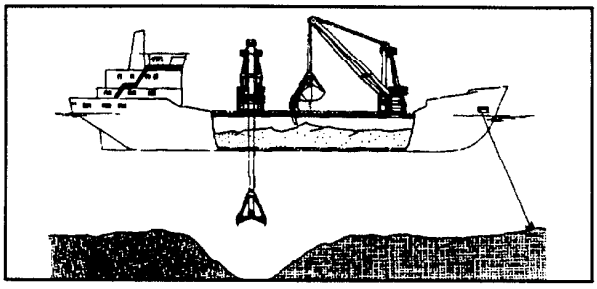


Figure 4. Clamshell Hopper Dredge
(Packer 1987) Buckets (sizes 1 - 7.6 m^3) are mechanically activated to "bite into" seabed to remove material (typically for low-cost/low-volume mining close to shore). Material may be loaded into its own hopper or onto a separate barge. Resulting small pits leave irregular seafloor topography. May result in turbidity plume throughout water column.

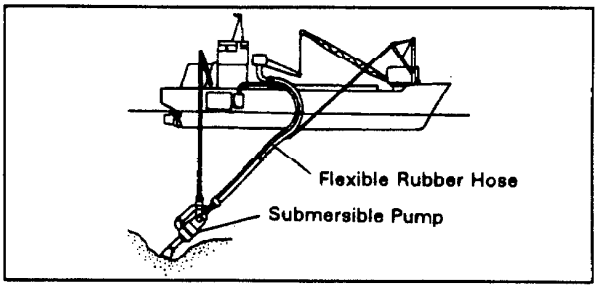


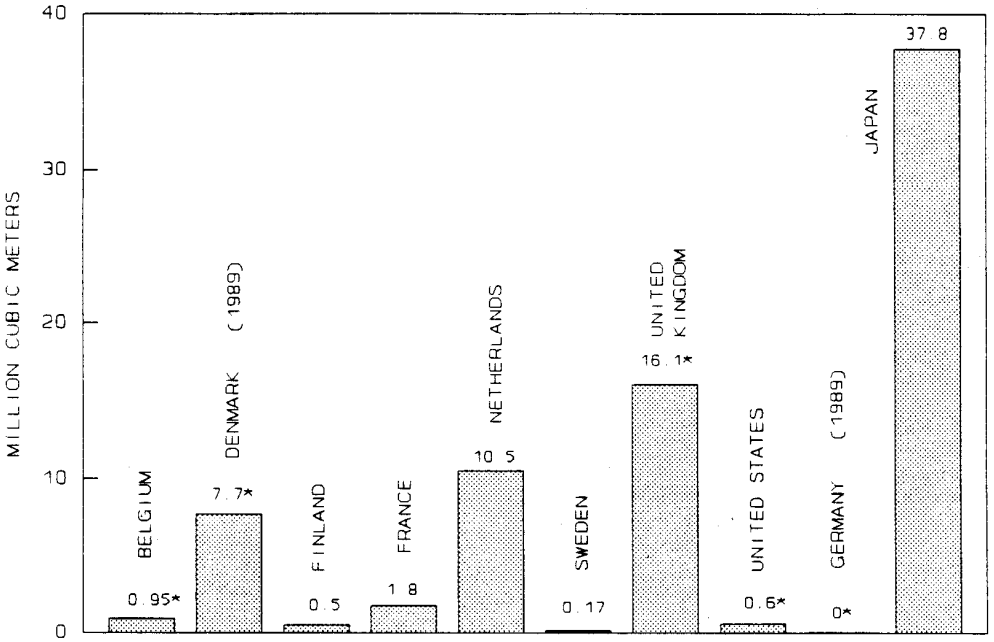
Figure 5. Submerged Pump Mining Vessel
(Rock Products, 1989) In Japan, aggregate mining has moved into deeper waters, so booster pumps or submersible pumps must be used with the suction dredge. Komatsu has developed a full-scale, large-capacity submersible pump to extract aggregate to 100-meter depth.

Foreign Activities

Aggregates for construction and fill (by volume) are the most important marine mineral commodities currently being mined in the world. Outside of the U.S., marine mining for sand and gravel is a long-established industry. Japan and the United Kingdom (U.K.) account for about 75 percent of the marine aggregate production in the world (See Figure 6). The most extensive marine mining occurs in Japan, where approximately 540 dredges produce 33 to 43 million cubic meters of sand (and some gravel) annually for use in concrete and for fill. This is about 20 to 25 percent of all sand and gravel mined in Japan. More than 300 companies are involved in seabed aggregate mining, but most are small, local operators. Suction dredges are used for construction and civil works (harbors and land reclamation) projects. Mechanical dredges (clamshell bucket) also are common in the marine sand mining industry through a number of smaller companies. These stationary mining systems are favored in Japan, in spite of the large holes created in the seabed (about 5-meters deep), because Japan's seabottom undulates substantially, and coastal trawling for bottom fish is not popular (Rock Products, 1989). Recently, with mining companies moving further offshore, new large-capacity submersible pumps have been designed that reportedly enable extraction of marine aggregate in water depths up to 100 meters (see Figure 5).

The other major marine sand and gravel mining area is northern Europe, mainly in the North Sea, where about 100 dredges annually produce 20 to 30 million cubic meters of sand and gravel, largely for use as concrete aggregate. Some countries report offshore sand mining for beach restoration projects as well. The U.K., the Netherlands, Denmark, and France have been the major producers. The U.K., which started the industry in 1925, has a fleet of 48 sand and gravel dredges (37 trailing-suction dredges and 11 stationary dredges) and produces about 16 to 20 million cubic meters per year from marine mining--an estimated 15 percent of its total construction aggregate. Locally along its coast, the marine aggregate contribution exceeds 50 percent. Four major dredging companies produce more than 90 percent of the U.K.'s marine aggregate production, operating large fleets that include high-capacity ocean-going vessels. The U.K. government policy is to encourage marine mining extraction (where environmentally acceptable) because it reduces pressure to mine onshore land of agricultural or environmental value. About 1 to 3 million cubic meters of seabed aggregates are exported from the U.K. to France, Belgium, Holland, and Germany.

Figure 6. Marine Aggregate Extraction, 1990 Reported Production



Source of data: International Council For the Exploration of the Seas, 1991; (Japan--personal communications).

* Also reported additional marine sand production for beach nourishment purposes.

In the U.K, the Crown Estate controls the nonfuel mineral rights on the continental shelf. The Crown Estate grants licenses for prospecting that are exclusive to the licensed company or companies, short term, and closely defined. After prospecting, if the area contains sufficient extractable reserves, the company may apply for a mining license. Then, a process called the Government View Procedure (GVP) begins, which involves extensive consultation among various government departments, local coast protection and planning authorities, fisheries interests, and offshore operators. If the GVP reveals a risk from dredging of adverse effects on the coastline, or if consultation within government departments results in an unfavorable "government view," the license will not be issued. A major source of opposition to granting new dredging licenses comes from the fishing industry. If the GVP is favorable, a license may be granted for a period of 25 years with royalties reviewed at 10 and 20 years (licenses are reviewed for compliance every 6 months). The license stipulates the area, the amount of material that can be extracted annually, the commercial terms, and any government-specified requirements. In the U.K., there are about 100 production licenses covering 5 main offshore areas.

The Netherlands possesses a very large, experienced, and advanced dredging industry. The Netherlands is a recognized world leader in dredge engineering research, beach nourishment, construction, and study of environmental impacts from dredging. There are about 60 trailing-suction hopper and 116 suction dredges in the Netherlands. Some equipment is engaged worldwide in all types of marine construction work. The world's largest dredge, built in the Netherlands, was launched in May 1992. It can dredge to a depth of 80 meters and the hopper

capacity is 11,750 cubic meters. Material can be discharged using any of three methods (through bottom doors, pumping ashore up to 5 miles, or pumpout through a fall pipe to 300 meters depth).

In both Europe and Japan, the initiative for obtaining rights to mine resides with the applicant.[16] Typically, upon application, governmental units will review the application in terms of the proposed activity size and location, with concerns for shoreline and environmental protection. Allocation of mining rights can be exclusive to the first applicant or non-exclusive to many companies. The size of the permitted area is specified as well as when mining can occur during the year. All countries impose some combination of upfront application fees and royalties due the government for each unit of material removed.

In Japan, seabed mining is regulated primarily by the prefectures (roughly analogous to a U.S. State). Applicants (usually an association of firms) must submit a mining application to the local government authority which reviews the application relative to specific regulations that govern mining off its coast (environmental control, sea traffic, offshore structures, fisheries, etc.) Because Japan is one of the leading fishing countries in the world, the biggest concern over seabed mining has been raised by fishery interests. Due to the depletion of sand in shallower waters, increasing conflict with fisheries, and recent concerns about increasing coastal erosion, the Japanese government has been calling on companies to move operations to deeper waters (50- to 100-meters water depth).

3.2 Public Sector: U.S. State and Federal Agencies

Jurisdiction over mining activities in U.S. offshore waters is divided between the Federal Government and the coastal States. Coastal States manage the resources located within the territorial sea (within 3 miles of the coast, or within 3 marine leagues of the coast offshore Texas and the west coast of Florida).[18] In 1983, the U.S. extended its "sovereign rights and jurisdiction" over the natural resources of the ocean out to 200 nautical miles--the EEZ.[17] The MMS is primarily responsible for administering the DOI's role in activities associated with mineral resource development on the Federal OCS. These activities relate to the leasing, exploration, development, production, and royalty management of these mineral resources. As discussed in Section 6.1, the MMS exercises authority, under section 8(k) of the Outer Continental Shelf Lands Act, over mining on the OCS, beyond State seaward boundaries. Additionally, offshore mining activity is subject to a variety of other Federal laws and regulations, that may influence if or how mining can take place in U.S. waters.

---

[15] The U.S. is the only country which has a cash competitive bidding process for conveying marine hard mineral development rights to private companies, but Australia and Canada are considering implementing bidding systems for cases where competitive interest in the resource exists.

[16] In 1988, President Reagan issued a proclamation extending the U.S. territorial sea from 3 to 12 miles to protect national security interests; however, no State seaward boundary has been increased to this distance.

[17] The area encompassed by the U.S. EEZ is vast--3.9 billion acres of submarine land (approximately 1.7 times the 2.3 billion acres of onshore U.S. territory). Water depths vary from the shallow continental insular shelves, where surface waves affect the seabed, to regions where depths exceed 4000 meters (National Research Council, 1989).

Federal Activities

From 1954 through 1990, MMS completed eight OCS nonfuel mineral lease offerings for salt, sulphur, phosphate, and hard minerals (gold). To date, there has not been a lease sale held for OCS sand and gravel resources. Limited industry interest to date in prospecting for sand and gravel is reflected in the limited number of geological and geophysical permits issued by MMS for the OCS.

In 1983, MMS established a Headquarters Program Office to provide policy and direction on a national initiative to develop the marine mineral resources of the U.S. Outer Continental Shelf.[18] The MMS's Marine Minerals Program has a core staff of 14 in the Office of International Activities and Marine Minerals. This office functions as a liaison for agency involvement in international activities, provides policy direction for management of OCS hard minerals, and regulates marine hard mineral resources on the OCS. Eight professionals in two divisions of INTERMAR are responsible for the marine hard minerals program for the entire OCS. Other MMS offices from Headquarters and the four OCS Regions assist INTERMAR with leasing, resource evaluations, environmental analysis, and operational aspects of the program (see Section 7).

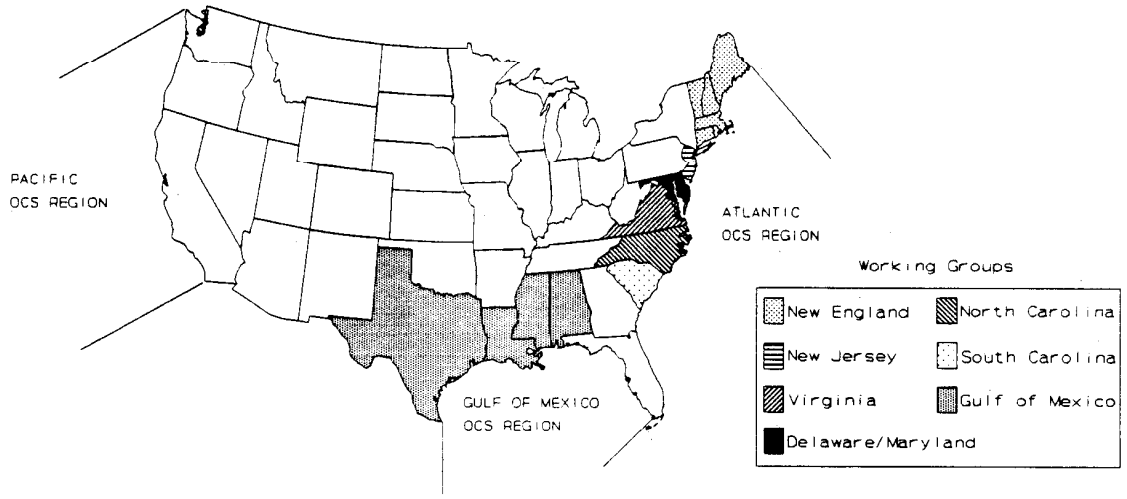
In 1989, in response to industry's request for improved regulatory certainty, MMS enacted a three-tiered regulatory program governing hard minerals mining in Federal marine waters. Regulations cover prospecting activities related to geological and geophysical exploration and scientific research, leasing of hard minerals, and post-lease operations.

As it has evolved, MMS's Marine Minerals Program has as its near-term focus, sand for coastal restoration, and sand and gravel for domestic construction aggregate needs. Mid-term and long-term projects include investigating cobalt-rich manganese crusts and phosphorite, but these activities are not within the scope of this report. The MMS is currently working with 16 coastal States in cooperative projects for purposes of evaluating and achieving the potential of the OCS as a domestic source of sand and gravel (see Figure 7). A brief description of each near-term project under MMS Federal/State Cooperative Arrangements is provided in Appendix B.

Many other Federal agencies have some direct responsibilities for activities on the OCS and in State waters, and must be consulted in the overall mineral leasing process. For example, other than the overall leasing and management responsibilities of MMS (including appropriate environmental impact documentation in accordance with the National Environmental Policy Act (NEPA)), review and clearance from other agencies is required, for example, from the Department of Commerce with respect to ocean fisheries management and administration of the Coastal Zone Management Act; from the Environmental Protection Agency (EPA) with respect to the effects of mining and processing on the environment; and from the ACOE and the Coast Guard for dredging and navigation effects. All affected agencies, including the EPA, will review any NEPA documents. A further discussion of these agencies and their responsibilities as they relate to MMS OCS hard mineral activities are listed in Appendix D.

[18] This was in support of the President's March 1983 Exclusive Economic Zone proclamation extending U.S. ocean jurisdiction to 200 miles and the policy behind it that asserted the national security significance and importance to the U.S. economy of this area as a future source of strategic and other minerals.

Figure 7. MMS Federal/State Cooperative Arrangements, OCS Sand and Gravel



The ACOE has a wide range of responsibilities involving design, construction, operation and maintenance activities related to harbors, navigation waterways, and coastal and wetlands protection. Through its civil works program, the ACOE works with States to identify and assist in the construction of projects (cost-shared with States) for coastal restoration and protection against erosion, including beach nourishment.

The ACOE is also involved in virtually every navigation dredging operation performed in the United States, dredging about 210 million cubic meters of material each year. Beneficial uses (including use as material for beach nourishment) is a potential form of disposal for much of this dredged material.

An ACOE-authorized project is one alternative for States and local governments to pursue for beach erosion control. Such projects may use dredged material from navigation projects or be conducted as a special project (typically requiring authorization from Congress) designed for protection of shores and wetlands.

Whether States undertake shore protection efforts independently or through ACOE-authorized projects, the DOI advises that, if sand and gravel from the OCS is identified as source material for projects, the OCSLA requires issuance of a mineral lease by the MMS prior to sale or removal of any sand and gravel. (See discussion in Section 6.3 and Appendix D.)

State Activities

All coastal States have unique statutes governing exploration and mining on State lands, including offshore areas under State jurisdiction (see Appendix E). The States, as general purpose governments, also have water quality, wildlife, coastal zone management, and other laws that affect seabed-resource development. Typically, States require intergovernmental coordination and

consultation with environmental and coastal management agencies and some require special public hearings.

There is currently little marine mining in State waters. Sand, gravel, shell, and possibly placer gold are the only materials currently having near-term commercial market potential. Existing operations under leases or permits issued by individual State governments include sand and gravel dredging in the Ambrose Channel in lower New York Harbor; sand and gravel dredging in Lake Erie; shell extraction offshore Louisiana; fossil oyster shell dredging in Chesapeake Bay, Maryland; sand and shell mining in San Francisco Bay; and a gold mining operation (now shut down) offshore Nome, Alaska. Also, there are numerous State-sponsored, noncommercial beach restoration programs using offshore sand from State waters.

Coastal States have increasingly focused on beach restoration projects in response to a growing awareness of erosion problems. In most cases, projects have been funded by a combination of Federal, State and local sources. Such projects include:

- In Ocean City, Maryland, the ACOE spent $44 million--cost shared by Federal (65%), State (17.5%), and local (17.5%), governments--in a 3-year restoration project which included pumping about 5 million cubic meters of sand from State waters to replenish 6 miles of beach. Proponents say such projects are needed to protect valuable real estate and encourage vacation visitation--each summer, Ocean City has about 4 million visitors and generates about $85 million a year to the State in tax revenue. After a January 1992 storm, an additional 1 million cubic meters of sand was pumped onshore at a cost of $12.2 million (Federal cost share was 75%). State officials claimed that the previous beach replenishment project prevented more severe storm damage, which could have run as high as $93 million without the added beach area.

- In Florida, beach restoration is an accepted method used to control beach erosion. Beach restoration provides protection for upland properties and maintains a recreational beach. In the late 1970's, $64 million was spent replenishing Miami Beach with 13 million cubic meters of sand. There are numerous projects undertaken annually (typically involving the ACOE) to replenish Florida beaches.

- In the Gulf of Mexico, as of 1989, 35 beaches were replenished with varying degrees of success. About 80 percent of the projects received some Federal funding. Fifteen percent of the Gulf restoration projects have been fully funded by State and local sources. Some communities cannot meet Federal funding requirements, nor are willing to pursue the lengthy Federal funding process. Delays associated with the process have led some communities to fully fund their own projects (Dixon, 1989).

Most coastal States also collect and/or manage marine minerals data. About 20 coastal States participate in MMS's Continental Margins Program which funds State marine minerals research under an annual cooperative agreement with the Texas Bureau of Economic Geology. State research projects focus on both petroleum and hard minerals and range from general surveys of a State's seabed to detailed geologic studies and economic evaluations of specific mineral occurrences.

3.3 Constraints on Marine Mining Activities

The mining industry, in general, contends that there are significant economic, institutional, and legal constraints that diminish its current interest in marine mineral extraction. Other than the

current economic climate and low mineral prices relative to the high cost of ocean exploration and development, the concern is with the uncertain legal and regulatory climate (discussed further in Section 6). This uncertainty, coupled with yet-to-be-determined environmental protection requirements, makes investment in marine minerals impractical because of high development risk. Particularly with sand and gravel, sufficient onshore resources and low unit prices serve to sustain interest in only land-based resources, but the aggregate industry recognizes that this situation is changing and that, in the future, marine sources may be the only economic alternative in some areas of the country.

Cost is one of the principal barriers to marine aggregate development. It takes a favorable competitive position to justify the high costs. Cost will include not only mining, but the initial investment in exploration, investment in mining equipment not readily available, and expensive wharfs and processing areas. Further, there are less certain costs associated with permitting and environmental studies that no doubt will be required.

Before any large-scale offshore aggregate production, much more resource information will have to be developed for one or more specific areas. The existing data base can be improved to provide more detailed information and encourage development. However, the level of detail normally required to open a new mining site will probably have to be developed by the aggregates producer once a prospective site is selected.

Compared to regulations for land-based mining, the OCS hard minerals regulations and the application of those regulations are uncertain to the mining industry (see Section 6). Current regulations require that once money has been spent by an aggregates producer to identify a prospective site, its availability is subject to an open bidding process where the high bidder gains the right to mine. This is in sharp contrast to the normal situation where the miner gains control of the property before any significant expenditure is made. If exploration and permitting are successful, the miner is assured of having the use of the resource he has identified.

Several provisions of the U.S. cabotage laws (the Jones Act) inhibit the development of a domestic marine mining industry.[19] U.S. and foreign industry experts contend that marine mining in the U.S. could benefit greatly from the use of mining vessels and technology now being used in Europe, but current U.S. Customs Service interpretations of Jones Act prohibitions prevent use of such foreign vessels in U.S. waters. For sand and gravel dredging, technology and equipment for marine operations exist in the United States, but the number of vessels that can operate safely in the open ocean and that are capable of deep-water dredging for specific projects, is limited (see footnote 13). New, state-of-the-art vessels and techniques for particular mining purposes are not

[19] The Jones Act refers specifically to Section 27 of the Merchant Marine Act of 1920 (46 U.S.C. 883), but is popularly used to refer to several U.S. laws governing the domestic transportation of merchandise and passengers by water. Under Section 27 of the Merchant Marine Act, foreign vessels are prohibited from transporting mined materials to shore for processing or sale. Further, specifically with respect to dredging and dredge-mining activities, another section of the law (46 U.S.C. 292) requires that any vessel engaged in dredging activities in the U.S. must be U.S.-built. Additionally, Public Law 100-329 requires that any dredged material that is transported from points within the U.S., within the EEZ, or between a point in the U.S. and the EEZ, must be transported in U.S.-built, -owned, and -documented vessels. According to the U.S. Customs Service, the combined effect of these provisions reserves the dredging trade in U.S. territorial waters and the EEZ to U.S built dredges and transport vessels only (transport vessels must also be U.S.-owned and U.S.-documented.)

now available in the U.S. and American shipyards have no experience in building such vessels.[20] Thus, the fledgling U.S. marine mining industry may be caught in a dilemma where they are unable to utilize new high-technology foreign vessels and reluctant to invest capital in placing new, high-technology ship building orders with inexperienced and untrained American shipyards (Grover, 1990).

While mining of sand and gravel from the ocean bottom is common in several countries including Japan and England, the activity is little known in the U.S. The public view of marine mining is generally unknown, but proposals can expect to be met with concern. Impacts from land-based mining lead to great public concern, particularly for new sites, and mining in the marine environment will no doubt lead to serious questions by the public as well. Experience in other countries demonstrates that marine aggregate mining can occur in an environmentally acceptable manner with appropriate controls and safeguards. However, there is continuing, ongoing research to ensure that any unacceptable environmental effects from dredging can be mitigated if the demand for marine aggregates continues to grow (Ransom, 1987). Marine mining in the U.S. will require education and demonstrations to show that mining impacts can be tolerated and are a reasonable or better alternative to the costs and impacts of land-based mining.

Recommendations

Development of a domestic marine mining industry, like any economic activity, will be determined by forces of product supply and demand. However, development will also be influenced by public perception, environmental concerns, and regulatory requirements. When forecasts of economic returns from ocean mining justify the high investment costs, industry can respond by developing new, appropriate exploration and mining technology. For marine sand and gravel extraction, technology and ocean mining equipment exist now, as they do for the resources to perform beach restoration. As managers of OCS minerals development, the DOI and MMS should seek to identify and remove any barriers to the development of a viable industry. First steps should include consultation with other Federal agencies (e.g., U.S. Customs Service, ACOE, USGS) and private industry to identify measures which would improve the legal and regulatory framework governing ocean mining and to adopt measures which would help broaden the Nation's knowledge of the resource base for OCS minerals.

Over the years, regulatory mechanisms for managing marine sand and gravel extraction in foreign countries have evolved in order to address the concerns expressed by other ocean users (such as the fishing industry) and the issue of potential coastal erosion. The experience of foreign governments in the planning, permitting, and management of marine aggregate extraction can provide valuable insight for approaches that can be used in the U.S. offshore mining program. In particular, the U.K. experience shows that potential conflict may be avoided by early identification of the location of economically recoverable mineral resources relative to sensitive areas for fisheries and areas of potential coastal erosion. Also, the U.K. Government View Procedure and consultation mechanism with fisheries concerns should be examined for its applicability in the United States.

[20] New foreign vessel designs provide capabilities for deeper water dredging, for multiple applications and discharge methods, and for shallow vessel draft enabling material unloading close to shore.

4. Environmental Issues

Many studies have been conducted on the environmental effects of marine aggregate dredging.[21] Initial impacts can vary from minimal to severe, and disruptions can range from short to long term. The sensitivity of the area involved determines the extent of impact (Congress, 1987). The most obvious effect on the offshore environment from marine sand and gravel dredging is mechanical, due directly to removal of substrate and indirectly to redeposition of suspended sediment and turbidity (Thompson, 1973). Dredging with a stationary hopper dredge (figure 2) will leave a deep hole in the sea bottom, but turbidity throughout the water column will be less than with other dredging equipment. Trailing suction hopper dredges are suited to offshore conditions, and appear to cause the least ecological harm and interference with bottom fisheries. To shallowly dredge sand deposits over extensive areas, and allow a layer of sand to remain might cause less harm than to dredge deep pits covering a limited area (Thompson, 1973). Depending upon the mining scenario used, the trailing suction hopper dredge (figure 3) could disturb a larger area of the seabed but will remove only about the top 20 centimeters of the sea bottom in one pass, which would help promote repopulation of the area. Clamshell (figure 4) and bucket-ladder dredging can create deep holes or generally lower a large area of the seabed.. Turbidity problems are greatest with this type of equipment because material washes out of the buckets throughout the water column as the sand is brought up to the dredge.

The direct physical effects of the mining activity on the local biology of an area is one of the most critical factors which must be carefully evaluated before operations can take place. There will be some degree of direct mortality in the mining area and the physical disruption from dredging can alter benthic habitats. If the sediments in the project site after mining differ markedly from the original composition, then only limited recolonization of the mined area may occur or a different community may become established. The process of recolonization is largely dependent on the environment at large and the nature of the sediment and habitat change (Drucker, 1991).

Indirect effects of the mining activities to local biology may also be induced by increased turbidity within the water column. Water quality changes associated with the increased amount of material within the water column may result in the inhibition of reproduction and growth in some organisms, such as mollusks, while stimulating other populations, such as phytoplankton, due to the increased nutrient content. Phytoplankton production, however, may also be affected by increased turbidity, which alters photosynthetic processes by limiting the amount of light entering the water column (Windom, 1976). In localized areas, mining activities may also have the potential to interfere with the seasonal migration of some anadromous fish species. Both bottom-dwelling and water column fish populations may be affected by the habitat disruption and sediment changes due to loss of specific food sources.

Some reduction in fisheries harvest could occur from displacement of individual fishermen in dredging areas (but this should be localized and of limited duration). Regional commercial harvests should not be affected by mining operations, unless areas of higher sediment toxicant levels were introduced into the water column, which could affect harvests of mollusks and crabs. In some cases, the scarps (trenches and pits) left in the sea floor by mining operations are seen as a positive impact by recreational fishermen as they tend to attract many prized recreational species. Past experience in New York Harbor, where there are bottom areas disturbed by past mining, has

[21] The most recent summary has been prepared by Hammer et al, 1993, which also discusses in detail possible mitigation measures. The executive summary of this study is forwarded with this report.

shown that these areas create new micro-habitats that are very effective in attracting existing and new fisheries resources.

The following section discusses some of the potential impacts to the environment that could be expected from marine mining of sand and gravel. Many impacts will be essentially limited to the mined areas and the period of mining; other effects, mainly seafloor and habitat alteration, may last for several years or longer. Impacts discussed fall into five categories: turbidity, sedimentation, seafloor disturbance, coastal erosion, and onshore activities.[22] Potential impacts from mining must be assessed on a site-specific basis before a judgement can be made concerning the level of severity. Additionally, in discussing potential environmental effects from marine mining, it is important to note that marine sand and gravel production may serve to offset land-based development and its associated impacts onshore, which may be more severe or direct (if located close to population centers)--e.g., dust, truck traffic, and noise. Such tradeoffs should be considered when examining the costs and benefits of specific OCS sand and gravel proposed projects.

For the OCS, potential impacts would be identified and appropriate mitigation measures determined as part of MMS's environmental review process including input from interest groups and the public during the early stages of this process. (See for example: Final Environmental Impact Statement (EIS) for the Norton Sound Lease Sale (MMS, 1991). This EIS document also contains an extensive discussion of potential impacts associated with offshore dredging.)

Marine mining operations on the OCS would have to conform to MMS operating regulations (see section 6.1). A lessee is required to conduct activities in accordance with applicable lease stipulations and the MMS approved operating plan. Lease stipulations are restrictions or required mitigation measures to protect against adverse impacts to marine biota or other marine organisms, or to other aspects of the marine environment associated with the offshore operation.

4.1 Impacts of Mining on Fisheries

Turbidity Plumes

Turbidity routinely occurs as a natural result of rough weather conditions and from discharge of sediment-ladened rivers into the ocean. It can also result from fishing activities (e.g., trawling operations, scallop dredging), harbor dredging, military maneuvers, and construction at sea. Turbidity is a fairly common occurrence in nearshore areas, so various plant and animal species have become somewhat acclimated to it. Because natural turbidity occurs less often on the OCS, effects from turbidity (especially if persistent) on the various species existing there is less well understood. Turbidity plumes will be created by the resuspension of fine materials generated during marine sand and gravel mining operations. These plumes may occur at the seafloor as the dredgehead or cutter impacts the seabed or at the surface if waste material is discharged overboard from the operating vessel. In a continuous mining operation, a continually-renewed turbidity plume is created. Sediment concentration in any one area decreases as the point of discharge moves away, but is replaced by another area. Turbidity may also occur as the dredged material is raised to the surface, dependent upon the mechanical system being used for material removal.

---

[22] The discussion is not exhaustive. For example, potential effects on air and water quality (e.g., from spilled oil) associated with actual vessel operation is not discussed herein. The likelihood of significant environmental effects from actual vessel operation only is extremely low (MMS, 1988). The reader is referred to the study by Hammer, et al, for additional information.

The settling characteristics of the plume and the manner in which this material will behave within the water column is largely dependent upon the specific properties of the dredged material, including size distribution, specific gravity of the individual particles, and their concentrations. The largest of these plumes is normally created by systems designed to reject fine material, such as silt or clay, at the seabed during removal of the seabed substrate or at the surface when non-economic material containing a large amount of this fine material is discharged into the surface waters. In operations which involve overwash or onboard processing of the dredged material, there likely would be more of a surface plume created than in instances where the processing is undertaken onshore, such as is done in the U.K. and Japan. Garvin et al, 1991, have developed a modeling approach for turbidity plumes from dredging based on ambient conditions, composition of dredge materials, production rates and water quality standards. One of the products of the modeling is a predictive nomograph which defines the operational window within which compliance with water quality standards is certain with a high degree of confidence. The model can also be used to predict the areal extent and turbidity of a plume from a particular dredging operation.

The turbidity plume associated with marine mining for sand and gravel could locally affect the fisheries resources inhabiting the area.[23] Increased sedimentation may smother non-mobile benthic dwellers within a few hundred meters of the mining operation (the distance will depend largely on local bottom circulation patterns). Particulate matter may damage filter feeders and gilled organisms. Additionally, the turbidity will reduce the penetration of sunlight into the water column and consequently reduce primary production in the nearsurface areas. The increase in turbidity will dissipate quickly with distance from the source and will disappear within days after mining operations cease. Depending on the type of material disturbed on the seabed, the water column may become enriched with certain nutrients (leading to increased productivity in certain types of plankton). Such effects would be localized and would end with cessation of mining operations or would be of short duration as mining moved to different areas (MMS, 1988).

Secondary problems may occur if sediments, containing contaminated material such as heavy metals, are released in the water column producing an increase in concentration of these metals over normal background concentrations. Although the potential effects of these toxicant are very dependent on the specific variables which may be found at each individual site, it is expected that any effects would be more geographically wide-spread than the direct physical effects of dredging. Contaminants introduced into the marine environment are rarely found in more than trace amounts in the OCS. Moreover, in natural mineral deposits exposed to seawater, the biologically active metals are in essentially insoluble forms and generally are biologically inert (Cruickshank, 1987). Due to factors such as dilution, precipitation, and adsorption, the release of significant amounts of dissolved metals from mining operations is unlikely (MMS, 1988).

Feeding, spawning, and migratory activities could also be disrupted by turbidity plumes. A review of the current literature suggests that these effects are generally minor and of short duration. Fine particles suspended in the water column would, in theory, be most harmful to pelagic species. Researchers have concluded that fish such as mackerel, herring, and turbot will avoid areas of increased turbidity. As a result, they will be temporarily excluded from a portion of their

[23] Increased turbidity can also affect marine mammals. Sediment plumes might reduce the ability of visually feeding marine mammals to locate their prey and thereby diminish their feeding success. Marine mammals could also be affected by marine mining activities through impacts associated with the release of previously sediment-bound sources of toxicant, collision impacts, and/or noise. Effects should be minimal because steps would be taken to avoid interaction with marine mammals, and mammals would be able to leave and feed outside the areas of plumes (MMS, 1988).

geographic range. This dislocation will only be for a short time due to the rapid dispersion of the suspended particles as the plume flows horizontally away from the mining site with the natural currents. Exposure to a plume can have toxic effects on some species but such effects are dependent on the duration of exposure and the concentration of the particles. Sublethal effects could be decreased growth of suspension-feeding organisms, such as mollusks, and potential decreases in normal physiological and biological functions which may result from increased turbidity or elevated toxicant in the water column. Gill irritation and fin rot have been found in laboratory experiments to be potential side effects of prolonged exposure. With the ability of pelagic fishes to avoid the area of increased turbidity, gill irritation, fin rot, and other toxic effects will be minimized.

Sedimentation

The dispersal of the turbidity plume results in sedimentation as the particles fall to the seafloor. Effects at the seafloor, particularly those resulting from resedimentation, the actual destruction of the biota, and the change in seafloor topography, will generally be more important than effects of changes in the water column. The size of the area affected can be minimized by subsurface discharge or other techniques that force the particulate material to settle closer to its source, resulting in a heavier accumulation over that smaller area (Cruickshank, 1987). For offshore mining at Nome, Alaska, the MMS predicted sedimentation would be limited to less than 3 kilometers from the dredge operation (MMS, 1991).

Potential effects on aquatic organisms are dependent on the feeding mode, life habit, degree of mobility, and sensitivity of life stage (adults are much more tolerant in some species while juveniles and eggs are in others). All of these factors vary among bottom dwelling species. It is anticipated that major mortality of the benthic community will occur directly at the mining site and for a short distance down current where smothering of benthic organisms from resedimentation would occur. As the distances from the mining site increases, increasing numbers of species and individuals would be able to survive the decreasing level of resedimentation. Additionally, potentially lethal or sublethal effects may also be expected to occur, such as fouling feeding structures, increased predation, and decreased prey. Overall, it is expected that the total area physically affected by the mining operation would be well within 1 to 2 kilometers of the mining site. The less mobile species, such as mollusks, crabs, and some species of demersal fish, will be affected to a greater degree than the more mobile species. In addition, if a species demonstrates a higher degree of habitat or location fidelity, it may be affected to a greater extent. The most susceptible fishery species are the bivalve mollusks. Many of the commercially valuable species in this group can be found in the well-sorted larger-grain-size offshore environment which would be potential sand and gravel mining sites. Overall, there would not be the potential to affect the population level of these typically wide-ranging species substantially, except for certain species having limited distribution (MMS, 1988). The likelihood of such impacts would be carefully considered during environmental review, and should, if possible, be minimized or avoided.

Oysters, quahogs, and lobsters (including eggs) may endure some increased sedimentation. Filter feeders seem to have the highest tolerance levels although there is a level beyond which any organism will die. Mussels and adult bay scallops are the only species that can suffer long-term ill effects in tests conducted. In general, the potential impacts on invertebrates should be minor. Bottom dwelling fish were found to avoid areas of increased sedimentation for spawning purposes. However, effects from dredging on certain bottom spawning species (e.g., herring, winter flounder, sand eels, rock sole) would have to be carefully considered, and avoided if possible, as the spawning areas of these species may be affected by sedimentation.

4.2 Impacts to Seafloor from Excavations

Some negative impacts will be experienced within the actual mining site. Slow moving and stationary benthic organisms most likely will be destroyed by the dredge. The more persistent and wide ranging effects of offshore mining operations would be the modification of habitat. In areas of higher energy, it is expected that the physical effects would be evident for about one year or less--storm events and the natural high energy regime in these areas should help to mitigate the physical effects of mining operations. However, in areas of moderate or low energy regimes, potential impacts could be greater or longer-lasting. The major concern resulting from habitat modification would involve those species which spawn demersal eggs and have specific spawning grounds. Disturbance of these spawning areas directly by mining activities or by resedimentation could affect the population level of some species if the activity is extensive enough (MMS, 1988).

A complete return of the site to pre-mining conditions can be slow. Recolonization of the natural benthic prey species of the fishery resources could take a number of years. It has been estimated that the average recovery period will be 2 to 3 years. Recolonization of the mined area by neighboring communities is highly dependent on the similarity of substrates. To promote recolonization, some of the pre-mining substrate should be left at the mine site.

Removal of sand and gravel deposits may expose boulders, lower the seabed, and create pits or trenches. Fishermen have claimed that these occurrences pose problems for bottom trawlers. The French have experimented with abutting dredging tracks to obtain a lower, level seafloor. Large excavations of the seafloor in this manner can also result in alteration of bottom currents, longshore currents and wave patterns, which potentially can affect local sediment supply (see section 4.4).

4.3 Multiple Use Conflicts

OCS mining may conflict with other seafloor uses, such as commercial pipeline and cable routes, marine shipping traffic lanes, military/defense activities, archaeological sites, oil and gas activities, as well as recreation and fishing activities. Most conflicts can be anticipated and minimized or resolved by regulation and negotiation during the planning process--prior to leasing and development. Some conflicts, such as space use conflicts with fishing operations, can be alleviated through coordination and/or notification. However, it should be recognized that, for some areas of the OCS, mining would have to be closely monitored, restricted or precluded for reasons related to protection of the environment, conservation of resources, military activities, or fisheries concerns. Conflicts with fishing and military interests may be notable problems that require particular attention (National Research Council, 1989). A process will be needed to ensure that multiple ocean use conflicts can be identified and resolved.

Potential losses to fishing gear (pots, gillnets, long lines) can result from increased boat traffic in the commercial fishing areas--from supply boat, tug boat and barge traffic. These effects should be minimal, geographically-limited, and able to be mitigated.

Coastal areas of the country are an important recreational and economic asset, both to the Nation and to coastal residents and tourists. Marine mining could be perceived to affect recreation because of impairment of views, increased vessel traffic and loss of recreational area due to construction of onshore facilities. All OCS mining would occur at least 3 miles from shore, thus impacts on enjoyment of view should be minimal. Other potential impacts related to vessel traffic and onshore impacts would be thoroughly assessed during planning, though most such activities

would likely occur in existing commercial marine areas. Marine sand mining for source material for beach replenishment purposes should have a positive impact on recreation and tourism.

The National Marine Sanctuary Program, administered by the National Oceanic and Atmospheric Administration, has designated 13 sanctuaries (11 in the lower-48 States; see maps in Appendix A) to manage nationally significant marine areas. Specific areas are selected based on the need to preserve or restore their conservational, recreational, historical, cultural, ecological, and/or aesthetic values. Marine sanctuaries provide for multiple uses when consistent with the long-term protection of the sanctuary. Each sanctuary management plan establishes the necessary and reasonable regulations to control activities within its boundaries. In existing sanctuaries, exploration or development of sand and gravel is effectively prohibited due to a combination of seabed and discharge restrictions (NOAA).

4.4 Coastal Erosion

The issue of potential coastal erosion generally relates to effects from dredging in nearshore or shallow water areas. Thus, recovery of sand and gravel resources from the seabed in Federal waters, beyond the zone where removal of sediment supply could affect the coastline, may be an environmentally preferable alternative.

Physical oceanographic changes (currents, waves, erosion, and accretion) resulting from alteration of the seabed are some of the physical factors which must be considered during review of a proposed sand and gravel dredging operation. In nearshore areas, the removal of large amounts of sand and gravel may adversely affect sediment supplies for adjacent beaches and could change local wave and current patterns,[24] resulting in a disruption of longshore sediment transport and potentially contributing to erosion. The lowering of the seabed in nearshore areas could possibly cause increased wave energy particularly during storms that could lead to increased coastal erosion. Some countries with marine mining activities are sensitive to the potential coastal erosion problems and have taken precautionary measures. In Denmark, dredging for aggregates is not permitted within 300 meters of the coast. In the U.K., policy precludes licensing within 3 miles of the coastline or in water shallower than 18 meters, but this policy is not absolute.

The likelihood of increased erosion from dredging operations is a site-specific issue dependent on the natural dynamics of the area in question. In unusual conditions, it is possible that the uncontrolled removal of sand and gravel from the seabed in Federal waters could contribute to coastal erosion problems. Thus, potential physical effects from sediment removal must be carefully evaluated before and during dredging to prevent erosion effects on local coastlines resulting from the mining operation.

4.5 Onshore Impacts

Resulting From Mining

While some nearshore dredging can result in deterioration of the shoreline due to sand drawdown, removal of shore-bound sediments, removal of shore-protecting offshore banks, effects from changes in wave refraction, and water turbidity; such impacts would be largely eliminated by

[24] In Federal waters, it is unlikely that dredging would result in any changes in wave and current patterns because the distance (beyond 3 miles of State waters) is usually well beyond the wave base (i.e. the bottom area affected by wave action).

dredging in federal waters (see Section 4.4). Typically, any dredging in Federal waters (beyond the States' seaward boundaries) will be in deeper waters, likely beyond areas where dredging would affect sediment movement and wave action. With effective controls, marine mining for sand and gravel may prove to be an environmentally preferable alternative to shallow-water dredging and/or development of large quarries onshore.

Caused By Processing and Transportation

For marine sand and gravel production, it is unlikely that any processing of material will be done on board the marine dredging vessel because of the need for large volumes of fresh water to wash the material[25] and potential problems associated with disposal of the water and silt from the sand dewatering process. Thus, any processing is likely to occur onshore. Because onshore transportation costs are high, marine sand and gravel must be unloaded and processed near markets where transportation networks are adequate (likely to be major metropolitan areas). Yet, these areas have high land values and are increasingly experiencing land-use conflicts which can make finding an appropriate onshore processing site a problem. Locating an onshore terminal will be critical to the successful supply of marine aggregates to markets.

Onshore processing of marine aggregates may effectively make use of under-utilized port facilities and associated infrastructure. In many areas, ports have large numbers of abandoned and decaying water-side facilities. The location of a sand and gravel processing area in the port could be considered an economic improvement and contribute to port revitalization.

As with land-based mining and processing, the key environmental issues for onshore processing of marine aggregate relate to the operation of the terminal and distribution of the sand to markets. Onshore impacts will be associated with onshore processing,[26] storage, and transportation of material. The operation of a port terminal involves stockpiling of the raw material, washing to remove chlorides,[27] and stockpiling a washed product for outloading. Local impacts can cause community criticism associated with concerns about wash water disposal, noise, dust, and traffic. Such environmental impacts are regulated and usually require permits. By obtaining and complying with permits, the impacts are expected to be mitigated to some degree.

The processed sand and gravel product will be loaded on trucks, rail, or barge for transportation to market. Truck transportation is the most commonly used means to bring aggregates to market.

---

[25] Although sand and gravel for beach replenishment and fill material usually needs no processing, most U.S. production for aggregate is processed in some way. Dredged marine sand and gravel must be washed to remove excess fine sand, salts, and clay, as well as excess chlorides, in order to meet specifications for use as aggregate material.

[26] Users of aggregates for purposes such as concrete, will have certain minimum requirements or specifications to which aggregates are expected to conform. The sand and gravel must be processed (washed, crushed, screened, and blended) in plants, to correct sizes and portions. Associated with the processing plant are stockpiles of material and in some cases waste sand deposits and settling basins. The average area required for processing equipment, stockpiles, and transportation circulation is about 10 to 20 acres (Johnson, 1966). However, in congested or high-rent areas, land-based processing facilities could be squeezed down to a 5 to 10 acre area.

[27] The washing of materials for chlorides, unlike for silt or clay, will require discharge. While silt and clay can be separated from the wash water and the water used again, that is not so for chlorides. Thus, there is an impact of increased fresh water consumption and the discharge of brackish water.

Due to high costs, producers will prefer to haul less than 20 miles to deliver their aggregates. However, aggregate producers are reporting that the number of truck trips to markets is increasing due to imposition of restrictive weight limits on trucks, leading to smaller amounts of aggregate delivered per truck. Rail and barge transport of aggregates is on the increase in many metropolitan areas where highways and streets are often congested. Possible impacts from truck transportation include increased noise, traffic, and road damage. Such concerns can be mitigated with appropriate controls.

Some social, environmental, and economic benefit may be gained from supplying coastal markets with nearby marine aggregates thereby reducing heavy truck traffic deliveries by road across metropolitan areas from alternative land-based supplies.

5. Issue Identification and Conflict Resolution

5.1 Public Perceptions of Offshore Mining and Related Development

Much of the negative opinion attached to onshore mining may be applied to marine sand and gravel mining unless appropriate steps are taken. The mention of onshore mining activities to the average person conjures up images of strip-mining operations that destroy forests and animal habitats, leaving a scarred landscape (even though government regulations and industry practices are attempting to address these problems). In general, word and event associations with mining of any kind are negative. Given the relatively bad connotation the public associates with onshore mining and the growing concern for the environment, it is likely that marine mining will be viewed as inherently incompatible with the marine environment. For this reason, the public perception of this issue must be addressed early, for it very well may be the deciding factor in a proposed offshore marine mining project.

Social scientists commonly define perception as being more transitory than an attitude or a belief that is dependent on the individual's immediate past experience with the issue. Hence, perceptions are easier to change. For this reason, the undertaking of any marine sand and gravel mining activity should be conducted with an open, informative, highly interactive process. Many issues will have to be addressed. First, the public need for this public resource will have to be made very clear. The public should also be made aware of the many problems facing the continued mining of onshore sand and gravel deposits. These include restrictive zoning regulations, increased land values, building on deposit sites, and prohibitive transportation costs. Current experience with sand dredging (e.g., channel maintenance and beach nourishment projects) should be stressed as examples of the public benefits derived from marine sand and gravel mining.

The growing need for sand and gravel for use as construction aggregate is a prime example of why marine mineral mining is necessary. Many urban coastal areas are rapidly expanding while their onshore sand and gravel reserves are being depleted. Offshore deposits could be a cost efficient source to fill this need. The public needs to be aware of these various aspects of marine mining. Conveying this information through various means (e.g., newspaper articles, the "Rotary Club Circuit", etc.) will help increase public awareness of the issues. An upfront, "nothing-to-hide" approach furthered by the Federal Government or other appropriate marine mining regulators should make the public more willing to listen to a specific project proposal. If we have learned anything from the proposal to incinerate hazardous wastes at sea, it is that the intended purpose and need for the process or product be effectively communicated to the public and government decisionmakers before a specific project is proposed. There should be a concerted effort to inform all interested parties at the earliest stage possible on all anticipated impacts associated with

offshore marine mining and on what is to be done to mitigate them. For impacts that cannot be mitigated, the public should be provided a clear cost-benefit analysis to determine whether the need for the project outweighs the anticipated impacts.

Once the general need for the product is understood, the public will next want to know how the industry will be regulated. The current debate over the applicability of OCSLA Section 8(k) to marine mining needs to be resolved. If it is not, continued industry discontent over the current legal regime, for reasons stated in Section 6.3, Legal Framework, will make resource development even more uncertain and unpredictable.

With regard to marine mining, there must be a true partnership with the public in the decisionmaking process. If the perception is that it is a unilateral Federal Government decision, this perception will foster opposition based on the process as well as on proposed impacts. Under a democratic system of government, the public has a right to participate and be involved in decisions that affect them. If true public involvement does not occur in the decision and planning process it will assuredly occur in the public hearing process, where more time may be spent defending decisions ex post than would be required to incorporate public viewpoints before management decisions are made. Participation of diverse public interests in the process will provide a mechanism for incorporating a range of social values as well as a forum for debate and compromise (Hanna, 1992).

At the very least, the public will demand a decisionmaking process that attempts to take all factors, especially environmental, into consideration. A holistic approach to marine sand and gravel mining management utilizing the best management practices is needed. The best management practices entail a process which takes into consideration all possible situations and attempts to mitigate against any detrimental effects. A narrowly focused or limited process will be seen as environmentally dangerous and will invite public opposition. Top priority should be given to environmental concerns because of the public's interest in ensuring environmental integrity. The public and those affected by the mining project must be provided with a meaningful role in the project decisionmaking process, or they will be apt to oppose it, even though the project is well planned, mitigated, and necessary.

An additional aspect of marine mining and public perception is that the industry has to be seen as environmentally conscious by pursuing environmentally safe management and production practices.

Recommendations

The Committee recommends the following for dealing with public perception regarding nearshore mining of sand and gravel:

- A number of various public forums should be used (i.e., workshops, town meetings, media round tables, and public hearings) to avail the public of any issues, especially in the context of the need for sand and gravel before a specific project is proposed, but after one or more industry members have expressed serious interest in developing an offshore mining operation. State and local officials should be involved in these public forums.

- Full disclosure of the project's associated impacts from exploration, processing, and site restoration, and the plans being considered to mitigate negative impacts. Predictions of impacts must be very solidly-based, not speculative.

- Public participation needs to be internalized in the administration and management of the MMS program. Decisionmaking should include affected public and governmental entities, including local and regional authorities, as partners.

- Periodic monitoring and progress reporting to the public and responsible government agencies should be required.

- Prior to project approval, consideration should be given to which mining method(s) and environmental protection approaches will provide the greatest likelihood for acceptable recovery of the mined area. A comprehensive mitigation plan could include an impact assistance or revenue sharing mechanism.

6. Legal Framework: General Considerations in Hard Mineral Leasing and Development

6.1 Current Legal Regime and Regulations

The OCSLA, as amended in 1978 (OCSLA, 43 U.S.C. 1331 et seq [1982]) and associated regulations (30 CFR 250-270) were designed primarily to govern leasing, permitting, collecting of data, and operations for oil and gas on the OCS. However, Section 8 of the OCSLA does provide explicit authority for the Secretary of the Interior to grant leases for sulphur and other nonfuel minerals such as sand and gravel on the OCS on the basis of competitive bonus bidding and under such terms and conditions as he may prescribe at the time of offering the area for lease.[28] During the period from 1954 through 1988, 8 lease offerings were completed under OCSLA Section 8 authority.

In January 1989, MMS completed a second set of regulations specifically governing prospecting, leasing, and operations for OCS minerals other than oil, gas, and sulphur (30 CFR Parts 280, 281, and 282). These new regulations were in response to requests from industry for increased regulatory certainty concerning OCS hard minerals development and in recognition of the differences between OCS oil, gas, and sulphur activities and activities associated with the exploration and development of other OCS minerals. Because of the many different mineral commodities available on the OCS,[29] the regulations were designed so that each situation would be dealt with on a case-by-case basis in cooperation with adjacent States and with opportunities for public involvement at each step in the process. The case-by-case concept was selected in order to provide a practical approach in dealing with the variety of mineral resources found on the

---

[28] The OCS hard minerals (other than sulphur) leasing and development is authorized by Section 8(k) of the OCSLA which states:

> *[t]he Secretary [of the Interior] is authorized to grant to the qualified persons offering the highest cash bonuses on a basis of competitive bidding leases of any mineral other than oil, gas and sulphur in any area of the outer Continental Shelf not then under lease for such mineral upon such royalty, rental, and other terms and conditions as the Secretary may prescribe at the time of offering the area for lease.*

[29] Hard minerals in the OCS include over 80 different commodities. OCS mineral deposits having near-term economic potential include heavy mineral placers containing gold, chromium, platinum-group minerals and titanium; possibly phosphorite resources; and sand, gravel, and shell for construction material, fill, and coastal restoration.

OCS, different environmental settings, and the changes in technology that might be used for exploration and mineral development.

6.2 Comparisons with Oil and Gas

As with OCS oil and gas regulations, the hard minerals regulations are based on the lease sale framework, required by the OCSLA, to convey mineral development rights. Presale mineral prospecting and exploration for commercial purposes can only occur under a permit issued by the MMS, and resulting information must be made available to the MMS (but will be kept confidential for a specified period of time). Mineral development and production can only occur under a lease that has been obtained through the competitive bidding process. Once the mineral rights are obtained, operations on the lease can only begin after a delineation, testing, and/or mining plan has been submitted to, and approved by, the MMS.

The OCS oil and gas program is guided by a schedule of sales and policy provisions from the Comprehensive OCS Natural Gas and Oil Resource Management Program document (as required by OCSLA Section 18). There is no such sale schedule for OCS hard minerals. Therefore, the new regulations provide that upon request for a mineral lease sale, the MMS may begin a lease sale process. The regulations provide for a State/Federal task force approach as a mechanism for identifying, and possibly resolving, issues early in the process. This task force functions as a forum for comments from State and interested parties at various stages in the lease sale process. The focus of the task force typically will be to assess economic feasibility, to coordinate on environmental matters, and to resolve issues of mutual interest. The task forces do not make leasing decisions.

The regulations also specify various terms and conditions for hard minerals leasing under the competitive bidding system. A sand and gravel lease can be issued to the high cash-bonus bidder for an initial term of 10 years (up to 20 years for other minerals), and can continue as long as there is production. Appropriate rentals and royalty rates are determined at the time of sale as are lease stipulations and any mitigating measures adopted as a result of presale environmental analyses.

The planning process for the 1989 hard minerals (gold) lease sale offshore Nome, Alaska, was conducted under the new regulations. The regulatory regime appeared to be sufficiently broad and flexible to respond to circumstances as they arose in planning for this sale; however, criticism of this sale process stemmed from the often stated view that the OCSLA is not the appropriate legal regime to govern OCS hard minerals and the resulting regulations based on the required competitive cash-bonus bid leasing system such as for oil and gas lease sales, were also perceived to be inappropriate for governing this sale planning process.

6.3 OCSLA Provisions for Hard Minerals Development: Viewpoints on Their Adequacy

The DOI has taken the position that the OCSLA provides an adequate framework for management of hard mineral resources: Section 8(k) provides specific legal authority and responsibility for the leasing of minerals other than oil, gas, and sulphur on the OCS. This authority and responsibility, exercised in conjunction with the 20 other sections of the OCSLA which are applicable in whole or in part, and other laws (e.g., the National Environmental Policy Act, the Coastal Zone Management Act, the Endangered Species Act, etc.), provide the Secretary with adequate flexibility and guidance to establish and administer an OCS minerals leasing and mining program.

However, people within industry, coastal State and local governments, and the environmental community have stated that the OCSLA is not the appropriate enabling legislation for marine mining in the EEZ.[30] They contend that the OCSLA Section 8(k) authority is not sufficient in scope or depth to govern OCS hard minerals development and leaves far too much discretion to the Secretary in the development of a sound program with appropriate environmental safeguards. Further, they believe the OCSLA is deficient with respect to providing clear statutory authority regarding jurisdiction over the minerals of the EEZ when located beyond the geologic continental shelf.[31] Authority to lease offshore minerals is limited to the 50 U.S. States. Therefore, there currently is no legal authority for mineral leasing in the EEZ's of the U.S. overseas possessions, trust territories or islands not having the status of States of the Union. This limitation is important when considering the mineral potential in areas like offshore Johnston Island where there is some limited industry interest in future development of cobalt-rich manganese crusts.

Some coastal States and environmental groups contend that environmental safeguards and public participation provided in the 1978 amendments to OCSLA apply to oil and gas activities and do not automatically extend to hard minerals mining. There is a concern that public input, meaningful consultation with affected States, and environmental and other important considerations will not be adequately addressed for OCS hard minerals development under existing applicable OCSLA authority. Further, there is no provision within the OCSLA for revenue sharing to help coastal States offset costs and impacts from offshore mining.

The mining industry's view is that OCSLA Section 8(k) language is a disincentive to pioneering investment. Specifically, they believe that unpredictable access tailored to oil and gas practice--and in particular the competitive bidding with upfront cash-bonus bid requirement--should not be imposed on a fledgling industry dealing with minerals of unpredictable value. Such an approach stifles exploration and industry interest because there is no assurance that prospecting efforts will be rewarded: despite exploration costs incurred to delineate a commercial deposit, the explorer may have to bid against others who may have invested nothing.

The aggregate industry agrees that the OCSLA provision for competitive lease sales limits interest in the OCS as a potential alternative source to land-based sand and gravel resources. Given that the sand and gravel resources of the OCS are not adequately explored, industry would have to expend substantial risk capital to delineate commercial deposits and, under requirements of the OCSLA, must nominate these resources for competitive sale with no guarantees of obtaining the mining rights once the resource is identified. Without a provision for priority rights to any mineral

---

[30] In 1983, President Reagan proclaimed a 200-mile EEZ for the U.S. Within the EEZ, the U.S. has sovereign rights for the purpose of exploring, developing, conserving, and managing the mineral and other natural resources of the seabed.

[31] The DOI Solicitor has concluded that OCSLA leasing authority is applicable to the EEZ and beyond whenever the continental shelf extends beyond 200 miles. (This decision is based in part on the OCSLA definition of "outer Continental Shelf" which refers to submerged lands "that appertain to the U.S. and are subject to U.S. jurisdiction and control." The Solicitor interprets this definition to mean that Congress intended for the extent of the OCS [and OCSLA authority] to expand as U.S. jurisdiction and control expands, consistent with changes in international law.) Others, however, challenge this opinion and contend that OCSLA leasing authority extends only to the limits of the geologically defined continental shelf. This issue of OCSLA leasing jurisdiction within the full extent of the EEZ will not likely impact OCS sand and gravel development because economic and technological considerations will limit resource development to relatively nearshore resources within about 100-meters water depth.

discovered, the aggregates industry has indicated an unwillingness to invest exploration funds for OCS resources.

Another problem with the existing legal authority concerns the potential use of OCS sand and gravel resources for public works/coastal restoration projects. For such projects, the focus of the mineral rights conveyance is to provide sand and gravel for a single-purpose, limited end-use market--with no profit motive. The required competitive, high-cash bonus bid approach for conveying sand and gravel mineral rights creates an unworkable situation because there are no means to ensure that the State or local government entity sponsoring a coastal restoration project and requesting OCS mineral rights will win the lease in a competitive sale, nor can the Federal Government dictate how the mined sand is ultimately marketed and used by the lessee. Under a *competitive leasing system, sales should be designed to encourage competitive interest, and* include the possibility of sand and gravel demand for various market uses.

Important distinctions in mineral commodities and in the end use for commercial markets or public works projects are recognized in laws governing onshore Federal minerals. Certain hard minerals like coal, potash, lead, and zinc are considered to be "leasable" minerals which can be conveyed through competitive lease sales under the 1920 Mineral Leasing Act. Alternatively, "locatable" minerals like gold and silver can be prospected for under the Mining Law of 1872, with fee title granted upon proof of a commercial discovery. The "common variety" materials onshore such as sand, gravel, pumice, and clay are conveyed under the Materials Act of 1947, as amended in 1955 (30 U.S.C. 601). Under this law, sand and gravel on Federal onshore lands can be disposed of through non-competitive sales contracts or through competitive sales for large volumes when more than one company is interested. State and local governments are granted free use permits for Federal sand and gravel, mainly for materials used in road construction. For OCS sand and gravel, there is no comparable mechanism for noncompetitive contracts or free use permits to government organizations provided for under the OCSLA.

6.4 Alternative Legal Frameworks--Previous Recommendations

Strong support for new, stand-alone legislation has come from components of industry, environmental organizations, and State interests, each of which has expressed to the Congress dissatisfaction with the provisions of the OCSLA as it pertains to hard minerals. Representatives of these groups formed a coalition in 1985--the EEZ Hard Minerals Working Group--to assess the statutory and regulatory framework needed for U.S. EEZ hard minerals. This Working Group established a set of consensus principles for developing new hard minerals legislation (see Appendix C). From 1985 to 1989, Congress considered the need to legislate the conveyance of development rights to ocean hard minerals on the seabed. H.R. 1260 was introduced by Representative Mike Lowry (then Chairman of the Oceanography Subcommittee of the Merchant Marine and Fisheries Committee) in 1987 and 1988 and H.R. 2440 was introduced in 1989 by Representative Walter Jones. These legislative proposals, both known as the "National Seabed Hard Minerals Act," would repeal nonfuel mineral disposal authority of the OCSLA and substitute a new legal regime in its place. The draft bills incorporated provisions similar to those of the Deep

Seabed Hard Minerals Resource Act,[32] and concepts and principles developed by the EEZ Working Group.

The basic approach to conveying mineral rights under these proposed bills is through a non-competitive system--exclusive rights to explore for nonfuel minerals in an area could be obtained under a license with a priority right for the licensee to apply for a commercial recovery permit. The rights to a license would be allocated on a "first-come, first-served" basis to eligible and qualified applicants. Consultation with governors of affected States would be required before a license or permit was issued. The task force approach would be the forum for consultation and advice for coastal State concerns on license or permit approval.

Each bill requires a comprehensive program of research including environmental assessment, resource evaluation, mapping, and charting. License or permit issuance would be tied to the completion of sufficient research.

Both bills provide for a fee schedule and royalty payments; the bills include revenue sharing with affected coastal States to help provide for planning, and the mitigation of effects of exploration, development, and related purposes. Jurisdiction is specified over minerals in the EEZ offshore U.S. States, commonwealths, territories, and possessions. The Jones bill also includes a provision for competitive bidding for licenses or permits when sufficient resource information exists. The bills do not contain any separate provisions to govern disposal of sand and gravel for public works or beach nourishment projects.

Legislative hearings were held on the bills, and representatives of industry, coastal States, and environmental groups supported both bills. The DOI testified against the bills in favor of existing authority of the OCSLA. H.R. 1260, as amended, was approved and reported by the House Merchant Marine and Fisheries Committee (February 24, 1988--House Committee Report 100-1103, Part 1). Neither bill was ever taken up by the full House of Representatives (and a similar bill was never considered by the Senate). There are no seabed hard minerals bills currently under consideration by Congress.

Interest from industry and other groups to improve the current legal regime for hard minerals mining by furthering new, stand-alone legislation for seabed hard minerals has apparently waned due to competing marine priorities, and possibly because of current unfavorable perceptions regarding the economic development potential of hard minerals on the OCS. Unfortunately, failure to address and resolve legitimate concerns now would mean that a legal/regulatory framework conducive to and appropriate for seabed hard minerals may not be in place when interest in marine minerals, such as OCS sand and gravel, becomes a reality.

---

[32] The Deep Seabed Hard Mineral Resources Act (DSHMRA--30 U.S.C. 1401 et seq. [1982]) established a system for U.S. companies to explore for and recover manganese nodules on the seabed beyond the area claimed by any National jurisdiction. The DSHMRA was viewed as an interim legal regime under which technology could be developed and exploration and development of hard minerals of the deep seabed could occur until such time as a Law of the Sea Treaty enters into force. In general, the first acceptable application receives exclusive prospecting rights for 10 years, and can be extended for 5 more years. A license is obtained on the basis of a plan submitted to and approved by NOAA. Upon discovery of minerals, the licensee has a priority right to apply for a commercial recovery permit.

Recommendations

The subcommittee is firm in its conclusion that the present law (OCSLA) is not a suitable legal regime to govern development of OCS sand and gravel resources. It is clear that without significant modifications to the OCSLA or the development of new, stand-alone legislation for hard minerals, industry will not develop these resources.

If the OCSLA and current MMS operating procedures cannot be formally modified to incorporate these elements, new legislation dealing specifically with hard minerals should be developed and should include these elements (not in order of priority):

- A separate means for conveyance of sand to be used for public works projects, notably beach nourishment that should include a waiver of royalty.
- A mineral rights conveyance procedure more appropriate for hard minerals than the competitive process used for oil and gas.
- An effective Federal/State/local partnership in the decisionmaking process.
- Competitive bidding should be considered ONLY if information about the distribution, quantity, and quality of the resource is sufficiently complete to provide an acceptable level of risk to the industry. This will involve a major resource assessment program by MMS, USGS, and the States.

7. MMS Marine Minerals Program

7.1 Present Structure and Resources

The Marine Minerals Program is implemented by the Office of International Activities and Marine Minerals (INTERMAR) within MMS. INTERMAR functions as a liaison for agency involvement in international activities and provides policy direction for management of marine resources on the OCS. INTERMAR consists of three divisions: the Marine Minerals Activities Division, the Policy Development and Planning Division, and the International Activities Division.

7.2 State and Local Government Interactions

The INTERMAR program emphasizes effective public outreach and communication to affected governments, institutions, and organizations. Technical working groups or task forces have been established in geographic areas where State and individual interests in marine resources have been identified. These task forces help ensure State involvement in marine mineral issues and provide a focus for local input. Currently, 9 technical working groups or task forces have been established involving the participation of 16 East Coast and Gulf Coast States. Six of these working groups are focused on OCS sand for coastal restoration (see Section 3 and Appendix B for details).

7.3 Options for Dealing With Program Elements

Budget and Personnel

The Marine Minerals Activities Division is staffed by the Deputy Program Director, 3 professionals, and a secretary. The Policy Development and Planning Division is staffed by the Deputy Program

Director, 3 professionals, and a secretary. The other INTERMAR employees work on MMS international activities. The budgetary history of the entire INTERMAR Program, containing 3 separate divisions and a total of 14 positions, has been relatively static:

YEAR	TOTAL EXPENDITURES
1989	$1.441 million
1990	$1.304 million
1991	$1.575 million
1992	$1.553 million

A staff of 8 professionals in 2 Divisions is responsible for the marine minerals program for the entire OCS. Moreover, most of the appropriations are expended on salaries and benefits and leaves only $500,000 to $600,000 for study contracts. Although a large resource base is undoubtedly present on the OCS, very little in the way of characterization and definition of these resources has been accomplished.

Environmental Studies Program

In addition to resource characterization, a major increase in environmental studies tied to marine mining effects will be necessary to make the minerals program viable. The Environmental Studies Program (ESP) has been developed almost exclusively to support the needs of the OCS oil and gas exploration and leasing program. The ESP budget is about $20 million per year, and much of the budget is already committed to long-term studies related only to oil and gas activities. The ranking criteria used to select study projects is based on criteria unfavorable to programs with no lease sale scheduled.

Two environmental studies related to marine minerals are currently underway:

- **Marine Minerals Literature Search Study**--A 15-month effort by Continental Shelf Associates. Scope is worldwide. (Final Report dated March 1993). The Executive Summary for this study accompanies the subcommittee's Final Report. Study contents include:
  - impacts analysis (on fisheries, benthos, etc.)
  - identification of data gaps
  - mitigation techniques available
  - availability and analysis of numerical models

- **Benthic Repopulation Study**--A cooperative agreement with the Florida Institute of Oceanography/University of South Florida. Signed April 27, 1992, the study will last 44 months. Study sites are off the Tampa/St. Petersburg, Florida area. Three dredge sites are to be studied regarding benthic organism repopulation over a 2-year period after cessation of dredging. Equipment includes a video/side-scan towed sled, box cores, and otter trawls.

Although some of the generic environmental data developed through the oil-and-gas-related efforts of ESP are certainly applicable to marine minerals, it is also true that development of marine minerals has its own set of potential environmental problems which must be studied.

Because of the differences in the maturity of the oil and gas leasing program as compared to the marine minerals program, it is suggested that requests for funding under ESP in marine minerals area should originate from INTERMAR directly. Moreover, selection criteria should not be based on

the ranking criteria used for studies in oil and gas leasing thereby eliminating direct competition with oil and gas environmental studies.

Recommendations

- Both the MMS and the DOI should re-evaluate the Marine Minerals Activities Division and provide adequate resources to carry out its mission. One very small program office is not adequate to design an OCS-wide program to develop marine minerals. The presence of significant mineral resources on the OCS makes it imperative that MMS have a strong, effective program with an adequate budget supported by the Department.

- Funds should be provided to the Marine Minerals Activities Division to carry out resource characterization studies starting in those areas where the need for minerals is greatest. These studies could be accomplished through mechanisms similar to the cooperative efforts presently in place. Initiatives should also be developed to interest private industry in resource exploration and development.

- The ESP should be restructured so that marine minerals related activities would not be in direct competition with oil and gas related activities. Environmental studies will be crucial to the development of marine minerals and both generic and site-specific studies should not be subordinated to oil and gas studies.

- The MMS should develop a viable community outreach program to educate the public about offshore minerals. Such a program should have strong State and local government input. Demonstration offshore mining projects could be used to show that marine resource extraction is feasible and environmentally sound.

8. Findings, Conclusions, and Key Recommendations

Based upon a 10-month effort by its Subcommittee on OCS Sand and Gravel Resources, the OCS Policy Committee submits the following findings, conclusions, and key recommendations related to OCS sand and gravel resources and to the MMS's role in managing them to the Secretary of the Department of the Interior:

Findings and Conclusions

- Offshore sand is presently being used for beach nourishment, and the demand will increase significantly in the near term. New sources of aggregate material for certain coastal population centers will be required in the near future, and within the next 10 years for other coastal areas--the OCS can provide a practical source for much of the needed supply. Therefore, it is advisable to plan now (by addressing pertinent environmental, technological, and legal issues) so that an appropriate program is in place when the demand for sand and gravel aggregate extends to resources located on the OCS.

- Offshore supplies of beach nourishment sand and aggregate are sufficient to meet specific market demands and could provide sources environmentally preferable to onshore alternatives.

- The general distribution of offshore resources is understood, but there is a lack of sufficient site-specific detailed information to support development and proper decisionmaking.

- Existing national policy and legislative intent are inadequate for guiding OCS hard minerals development. There is widespread dissatisfaction with the present legal framework. Industry's perspective is that the current legal framework is not suitable for developing offshore resources.

- Most of the existing information (environmental impacts, costs, technology) on offshore sand and gravel development is concentrated overseas. For example, in Japan and the United Kingdom, marine mining for sand and gravel is a long-established industry. The technology developed and experience gained by these countries in dealing with economic and environmental considerations could prove useful for future development of U.S. offshore sand and gravel resources.

- Information on environmental effects of ocean dredging is broad, but site-specific studies for the U.S. OCS are needed. The framework for the Environmental Studies Program (ESP) in the MMS is not adequate to provide needed information in a timely manner. The ESP is improperly structured and funded to provide the kinds of information necessary to support proper decisionmaking regarding the development of offshore sand and aggregate resources.

- Public perception of offshore resource development is negative and is likely to be a dominant influence on the future of the program. It is a primary concern that must be addressed. The Subcommittee finds that public involvement and support are necessary to the future of the program because the present system for dealing with these concerns is inadequate.

Key Recommendations

- The need for more detailed assessment and characterization studies of OCS sand and gravel resources should be met by expanded efforts in cooperation with the U.S. Geological Survey (USGS), U.S. Army Corps of Engineers (ACOE), and coastal States. A greater role for private industry in hard minerals resource assessment (e.g., through working groups, cooperative arrangements, changes in regulation to provide incentive measures, etc.) needs to be encouraged.

- The MMS, congressional representatives, coastal States, industry, and interest groups should work together in the development of new legislation that will provide a workable policy and appropriate procedures for managing offshore hard minerals development. The resulting regime should support the development of high-volume/low-value commodities. This effort could begin through the initiative of the OCS Policy Committee.

- Information to support OCS hard minerals development should be developed through a modified Environmental Studies Program at MMS and from information already gained from foreign offshore mining experiences.

- There needs to be an effective information transfer mechanism to accurately convey real issues to the public. Such a mechanism must be tailored to specific communities in order to educate them about offshore mineral issues. A programmatic assessment must be made to determine who is the most effective messenger. The continued use of State/Federal task force mechanisms is important.

- In 1988, a Policy Committee report on Improving the Process for Developing the 5-Year OCS *Oil and Gas Leasing Program* (the "*Shirley Report*"[33]) provided the Secretary with recommendations related to outreach and public perception. These concepts should be extended to the marine hard minerals program as well.

- Demonstration projects should be pursued to build public confidence in technology and increase public understanding of potential impacts and mitigation techniques. In the development of program documents, public concern needs to be equally addressed with science and technology.

- The MMS must forge linkages with producers and users of mineral materials to foster cooperation in the development of these emerging resources. The MMS should work with major industry groups (e.g., industry associations, ad-hoc working groups, marine mining companies, etc.) and institute a forum to involve them in program development.

- The presence of significant sand and gravel resources on the OCS and potential near-term demand for these resources makes it imperative that MMS have a strong, effective and adequately funded marine minerals program. The Department should give this program a high priority in its budgeting process.

[33] OCS Policy Committee task group report entitled, "Improving the Process for Developing the 5-Year OCS Oil and Gas leasing Program" (O.J. Shirley, Task Group Chairman), September 1988. At the request of the Secretary of the Interior, the task group reviewed the process that the DOI used to develop the 1987 5-year program and made recommendations for improving the process for developing future programs. A major finding of the task group was that program decisionmaking was often handicapped by a lack of information on the attitudes of the public toward proposed actions and the lack of consensus viewpoints among parties participating in the process. Recommendations from the task group focused on establishment of mechanisms that would help to identify potentially contentious issues, accurately gauge public attitudes, and promote public outreach efforts early in the process.

References

Amato, R. V. 1992. Sand and Gravel Resources of the Atlantic Continental Shelf: A New Look. In Proceedings, *Offshore Technology Conference* (OTC 6803).

Amato, R. V. 1991. *Sand and Gravel Maps of the Atlantic Continental Shelf with Explanatory Text*. U.S. Department of the Interior, Minerals Management Service, Draft Report.

Byrnes, M. R. and C. G. Groat. 1991. *Characterization of the Development Potential of Ship Shoal Sand for Beach Replenishment of Isles Dernieres*, Louisiana Geological Survey.

Congress of the United States, Office of Technology Assessment. 1987. *Marine Minerals: Exploring Our New Ocean Frontier*.

Courtney, K., J. DeHais, and W. A. Wallace. 1979. *The Demand for Construction Minerals in the Greater New York Metropolitan Area*. New York State Sea Grant Program.

Cruickshank, M., J. P. Flanagan, B. Holt, and J. W. Padan. 1987. *Marine Mining on the Outer Continental Shelf: Environmental Effects Overview*. U.S. Department of the Interior, Minerals Management Service, OCS Report 87-0035.

Dixon, K., and O. Pilkey. 1989. Beach Replenishment Along the U.S. Coast of the Gulf of Mexico. In *Proceedings, Coastal Zone '89*.

Drucker, B. 1992. The Minerals Management Service's Offshore Hard Minerals Program on the United States Outer Continental Shelf: Status of Projects and Activities. *CRC Handbook of Geophysical Exploration at Sea*, 2nd edition Hard Minerals, ed. Richard A. Geyer, Texas A&M University, by CRC Press, Inc.

Drucker, B., and J. Rowland. 1991. *Environmental Implications of Sand and Gravel, Shell and Placer Mining in the U.S. Offshore*, U.S. Department of the Interior, Minerals Management Service, April 1991.

Drucker, Barry. 1992. *Draft workplan: Benthic Repopulation Study*. U.S. Department of the Interior, Minerals Management Service, in progress.

Duane, D. B., and W. L. Stubblefield. 1988. Sand and Gravel Resources: U.S. Atlantic Continental Shelf. In *The Geology of North America*, Volume I-2, Sheridan, R.E., and Grow, J.A., eds., The Atlantic Continental Margin, U.S.: Geological Society of America.

Earney, F. 1990. *Marine Mineral Resources*. Ocean Management and Policy Series, Routledge-London and New York.

Garvin, P. C., and C. E. Sweeney. 1991. Evaluation of Effluent Mixing Zone Size with Permit Performance Standards for an Offshore Mining Vessel, In *Proceedings, Offshore Technology Conference*, May 1991 (OTC 6552).

Grover, D. 1990. Jones Act Barriers to U.S. Dredging Advances. In *Sea Technology*, January 1990.

Hammer, R., B. Balcom, M. Cruickshank, C. Morgan. 1993. *Synthesis and Analysis of Existing Information Regarding Environmental Effects of Marine Mining.* Prepared by Continental Shelf Associates, Inc. for the Minerals Management Service (MMS 93-0005).

Hanna, S. 1992. *A Model for Ocean Management.* Oregon State University Sea Grant College Program, Grant No. NA855AA-D-SG095.

International Council for the Exploration of the Sea. 1991. *Report of the Working Group on Effects on Fisheries of Marine Sand and Gravel Extraction.* Stromness, Orkney.

Johnson, C. 1966. *Practical Operating Procedures for Progressive Rehabilitation of Sand and Gravel Sites.* For National Sand and Gravel Association.

John, C.J. and C.G. Groat, et al. 1989. *Preliminary Assessment of Non-fuel Mineral Resources in the Outer Continental Shelf Exclusive Economic Zone of the Gulf of Mexico,* Louisiana Geological Survey.

Minerals Management Service. 1986. Bottom Sediments and Geologic and Geromorphic Feature Maps. In *Proposed Oil and Gas Lease Sales Nos. 113, 115, 116, Gulf of Mexico Region. MMS OCS EIS Series 87-0019.* (visuals no. 4, 4E, 5, 5E).

Minerals Management Service. 1988. *Environmental Assessment: Proposed Final Rulemaking for 30 CFR Part 282, Operations for Minerals Other than Oil, Gas, and Sulphur in the Outer Continental Shelf.*

Minerals Management Service. 1991. *OCS Mining Program Norton Sound Lease Sale. Final Environmental Impact Statement.* OCS EIS/EA MMS 90-0009, Alaska OCS Region, March 1991.

Moore, G. W., and M. D. Luken. 1979. *Offshore Sand and Gravel Resources of the Pacific Northwest.* U.S. Geological Survey, Menlo Park, California.

Mugler, M. W. 1981. *Beach Nourishment with Dredged Material: A Study of the Institutional Constraints of the Use of Dredged Material for Beach Nourishment Purposes on the Seacoasts and Great Lakes Shorelines.* U.S. Army Corps of Engineers, Policy Study 81-0110.

National Oceanic and Atmospheric Administration, "*National Marine Sanctuary Program,*" brochure not dated.

National Stone Association. 1991. *The Aggregate Handbook.*

National Research Council. 1989. *Our Seabed Frontier: Challenges and Choices,* Report of the Committee on Seabed Utilization in the EEZ. Marine Board Commission on Engineering and Technical Systems.

National Research Council, Committee on Coastal Erosion Zone Management, Water Science and Technology Board, Marine Board, Commission on Engineering and technical Systems. 1990. *Managing Coastal Erosion.*

New England Governors' Conference. 1992. *Construction Aggregates Demand in the New England States.* Contract with Minerals Management Service #16-35-0001-30542.

Packer, T. 1987. *Survey of Environmental Effects of Mineral Mining*. Special Project for the Ocean Mining Division, Resource Strategy and Information Mineral Policy Sector, Energy, Mines and Resources Canada.

Pasho, D. W. 1986. *The United Kingdom Offshore Aggregate Industry: A Review of Management Practices and Issues*. Canada Oil and Gas Lands Administration, Canada.

Ransom, P. D. 1987. A General Overview of the Marine Aggregate Industry, in *Dredging + Port Construction*, August 1987.

Rock Products. 1989. *Offshore Mining in Japan*. January 1989.

Rock Products. 1992. *Public Works, Homebuilding to Lead 1993 Construction Growth*, December 1992.

Thompson, J. 1973. *Ecological Effects of Offshore Dredging and Beach Nourishment: A Review*. U.S. Army Corps of Engineers, Coastal Engineering Research Center, Miscellaneous Paper No. 1-73.

Tsurusaki, K. 1988. Seabed Sand Mining in Japan. In *Marine Mining*, Volume 7, No. 1.

U.S. Army Corps of Engineers. 1989. *Digest of Water Resources Policies and Authorities*. EP 1165-2-1, February 15, 1989.

U.S. Army Corps of Engineers. 1990. *Beach and Nearshore Placement of Material Dredged from Federally Authorized Navigation Projects*. IWR-Policy Study-90-PS-1.

U.S. Bureau of Mines. 1987. *An Economic Reconnaissance of Selected Sand and Gravel Deposits in the U.S. Exclusive Economic Zone*. Open File Report 3-87.

U.S. Bureau of Mines. 1990a. *Construction Sand and Gravel*, Annual Report. Valentine Tepordei.

U.S. Bureau of Mines. 1990b. *Minerals Today*. January 1990.

U.S. Bureau of Mines. 1992. *Minerals Today*. April 1992.

U.S. Bureau of Mines. 1993. *Mineral Commodity Summaries*.

U.S. Department of Transportation. *A Primer on U.S. Coastwise Laws*. Maritime Administration.

Uren, J. M. 1988. The Marine Sand and Gravel Dredging Industry of the United Kingdom. In *Marine Mining*, Volume 7, Number 1.

Welday, E. E., and J. W. Williams. 1975. *Offshore Surficial Geologic Map of California: Map Sheet No. 26*. California Division of Mines and Geology.

Williams, S. J. 1986. Sand and Gravel Deposits Within the United States Exclusive Economic Zone: Resource Assessment and Uses, U.S. Geological Survey, In *Proceedings, Offshore Technology Conference*, OTC 5197.

Williams, S. J., K. Dodd, and K. K. Gohn. 1990. *Coasts in Crisis*. U.S. Geological Survey Circular 1075.

Windom, H. L. 1976. Environmental Aspects of Dredging in the Coastal Zone, *CRC Critical Reviews in Environmental Control*, March 1976, pp 91-109.

Appendices

Appendix A. OCS Sand and Gravel Resources Descriptions and Maps

Appendix B. Minerals Management Service, Marine Minerals Activities

Appendix C. The EEZ Working Group on Hard Minerals

Appendix D. Federal Agency Roles on The OCS

Appendix E. Sand, Gravel, and Shell Extraction in State Coastal Waters

Appendix A: OCS Sand and Gravel Resources Descriptions and Maps

Atlantic Continental Shelf

In assessing sand and gravel resources, most researchers divide the U.S. Atlantic shelf into three broad geologic regions: (1) The North Atlantic region extending from Maine to the southern tip of Long Island, which consists of mostly glacial fill and glaciofluvial outwash--sand and gravel intermixed in some areas with silts and clays; (2) the Mid-Atlantic region dominated by Pleistocene fluvial channels and deltas along with Holocene offshore bars or shoals; and (3) the South Atlantic region, having a northern boundary in the vicinity of Cape Fear, North Carolina. The South Atlantic region changes gradually from quartzitic fluvial sands in the north to predominantly carbonate sands along the Florida shelf.

Duane and Stubblefield (1988) estimated volumes of minable quality sand on the Atlantic Continental Shelf between the present shoreline and a water depth of about 40 meters (the approximate maximum mining depth with current U.S. technology) as follows:

North Atlantic:	0.77 billion m^3
Mid-Atlantic:	13.00 billion m^3
South Atlantic:	1.60 billion m^3
Total:	15.37 billion m^3

Amato (1992), compiling sand and gravel maps of the U.S. Atlantic Continental Shelf at a scale of 1:1,000,000, cited inferred[1] sand and gravel resources to the 200-meter water depth contour at 750 billion cubic meters, and estimated that the total resources (including areas seaward of the 200-meter depth) at 2,400 billion cubic meters.

Figures A-1 through A-3, developed by the MMS, show areas of indicated and inferred sand and gravel resources for the Atlantic shelf within both the 40-meter and the 100-meter water depth contours. The cutoff at 100 meters reflects the maximum minable depth with emerging technology. A more practical or economically feasible maximum water depth for the near term, with currently available U.S. technology, is probably about 40 meters (Williams, 1986).

Gulf of Mexico Continental Shelf

Depositional environments in the Gulf of Mexico Continental Shelf vary from a fine-grained carbonate platform along the southwest Florida coast to deltas and migrating quartzose sand bars along the northern Gulf of Mexico coast. Williams (1986) estimated 220 billion cubic meters of sand and gravel in the Gulf of Mexico inside the 40-meter water depth contour.

Under a cooperative agreement with the MMS, State Geological Surveys in Alabama, Louisiana, Mississippi, and Texas conducted a preliminary assessment of sand and gravel (and other nonfuel mineral resources) in the northern Gulf of Mexico OCS (John, 1989). For specific prospect areas, they reported estimates of about 35 billion cubic meters of sand within 40 meters water depth

[1] Inferred resources represent quantitative estimates supported by geologic relationships and relatively few samples and measurements (as opposed to indicated resources which represent quantitative estimates based primarily on samples and measurements).

offshore Alabama, and about 5.5 billion cubic meters and 3 billion cubic meters offshore Louisiana and Texas, respectively.

Figures A-4 through A-6 show areas of indicated and inferred sand and gravel resources for the Gulf of Mexico coast within both the 40-meter and the 100-meter water depth contours.

Pacific Continental Shelf

Except for Alaska, sand and gravel seabottom deposits along the Pacific Continental Shelf are limited by the relative narrowness of the shelf. For much of the Pacific shelf, the 40 meter and 100 meter water depth contours are within the 3-mile State water boundary. Relatively little is known about the volume of usable resources. Williams (1986) cites studies offshore Southern California indicating about 1 billion cubic meters of sand and gravel within the 30-meter contour, some of which he states may be too fine-grained for construction or beach nourishment needs. Moore and Luken (1979) estimate that the total resource of gravel on the Oregon and Washington OCS, to a depth of 100 meters, is 3.3 billion cubic meters. Deposits with nearer term potential are those off Washington adjacent to Grays Harbor, about 200 kilometers from Portland.

Figures A-7 through A-10 show areas of indicated and inferred sand and gravel resources for the Pacific coast within both the 40-meter and the 100-meter water depth contours.

Examples of Detailed Studies

In response to a request from the MMS, BOM (1987) performed an economic reconnaissance of sand and gravel offshore New York, Boston, San Juan (Puerto Rico), Houston, Los Angeles, San Francisco, and Honolulu. The reconnaissance provides cost comparisons for onshore and offshore mining of construction aggregates; includes environmental considerations; and for most of the study areas, presents offshore surficial grain-size distribution information in sufficient detail to identify target areas for more detailed exploration.

The MMS and the Louisiana Geological Survey (LGS) (1991) conducted extensive studies of offshore sand resources for possible use in restoration of the Isles Dernieres barrier island system. These studies serve as excellent examples of detailed geologic characterization, as well as providing exceptional environmental, engineering, and economic studies needed for offshore sand-development decisions.

In addition to these more detailed resource studies, work is underway offshore New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Alabama, Mississippi, Louisiana, and Texas to identify sand resources for use primarily in beach nourishment and coastal restoration. These studies are being performed by the State geological surveys with MMS support and generally in cooperation with the ACOE and other Federal agencies. Though mostly in the early stages of shallow seismic surveys, these studies are expected to lead to detailed geologic characterization (sampling, grain size-analyses, etc.), and environmental, engineering, and economic analyses similar to the MMS/LGS Isles Dernieres model (see Appendix B).

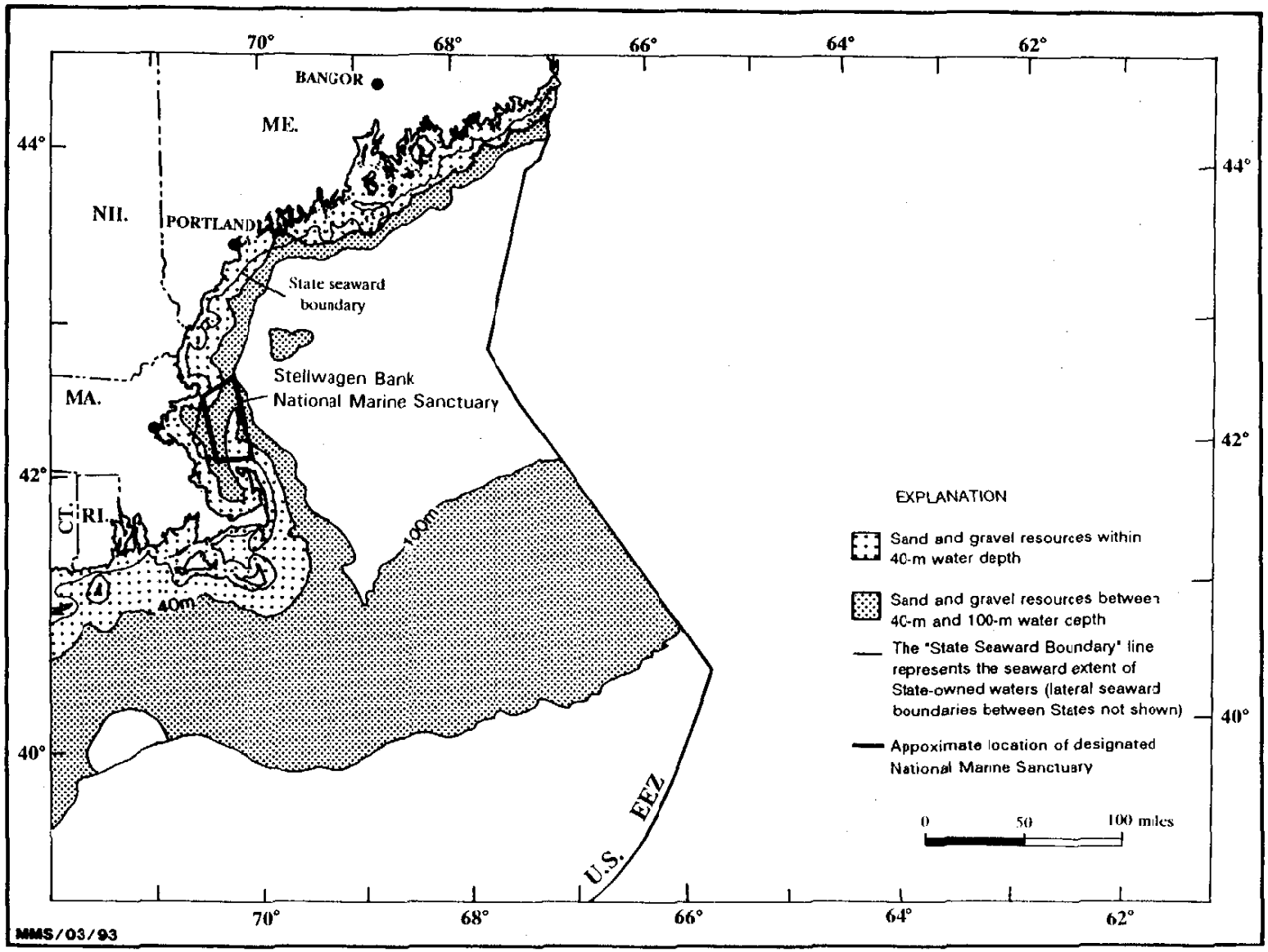


Figure A-1. Known Recoverable Sand and Gravel Resource Areas Offshore the North Atlantic States (Modified from Amato, 1992).

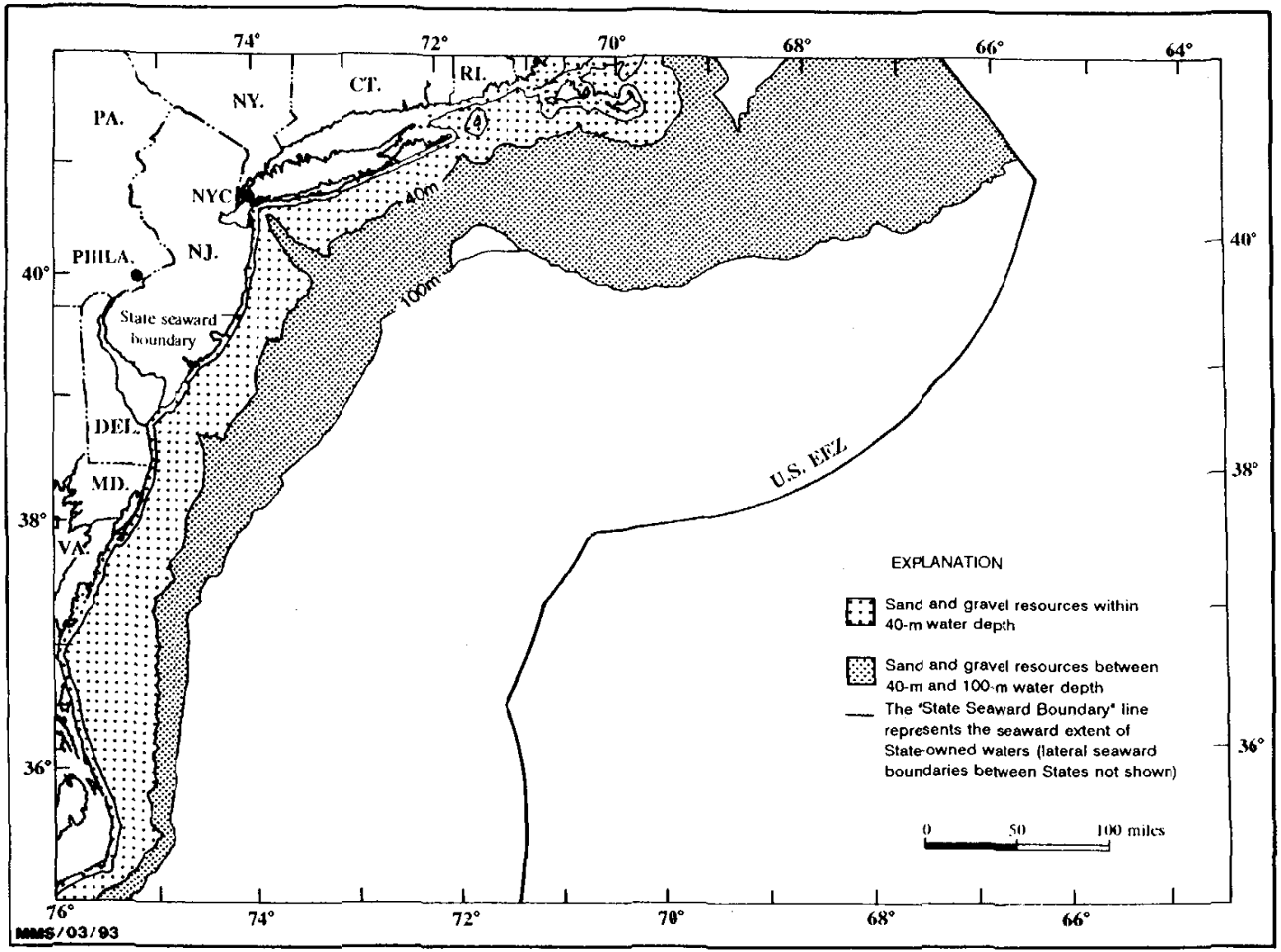


Figure A-2. Known Recoverable Sand and Gravel Resource Areas Offshore the Mid-Atlantic States (Modified from Amato, 1992).

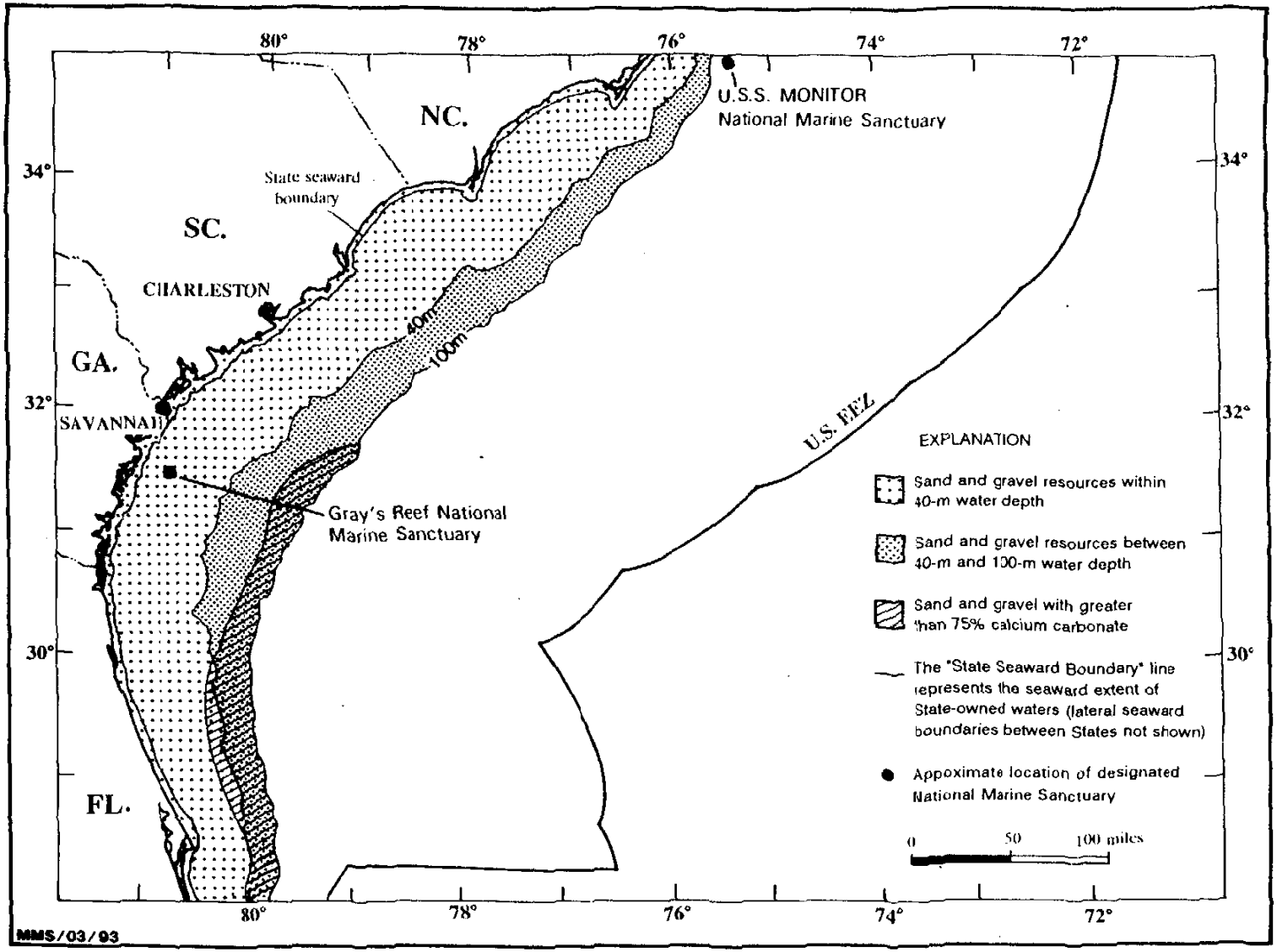


Figure A-3. Known Recoverable Sand and Gravel Resource Areas Offshore the South Atlantic States (Modified from Amato, 1992).

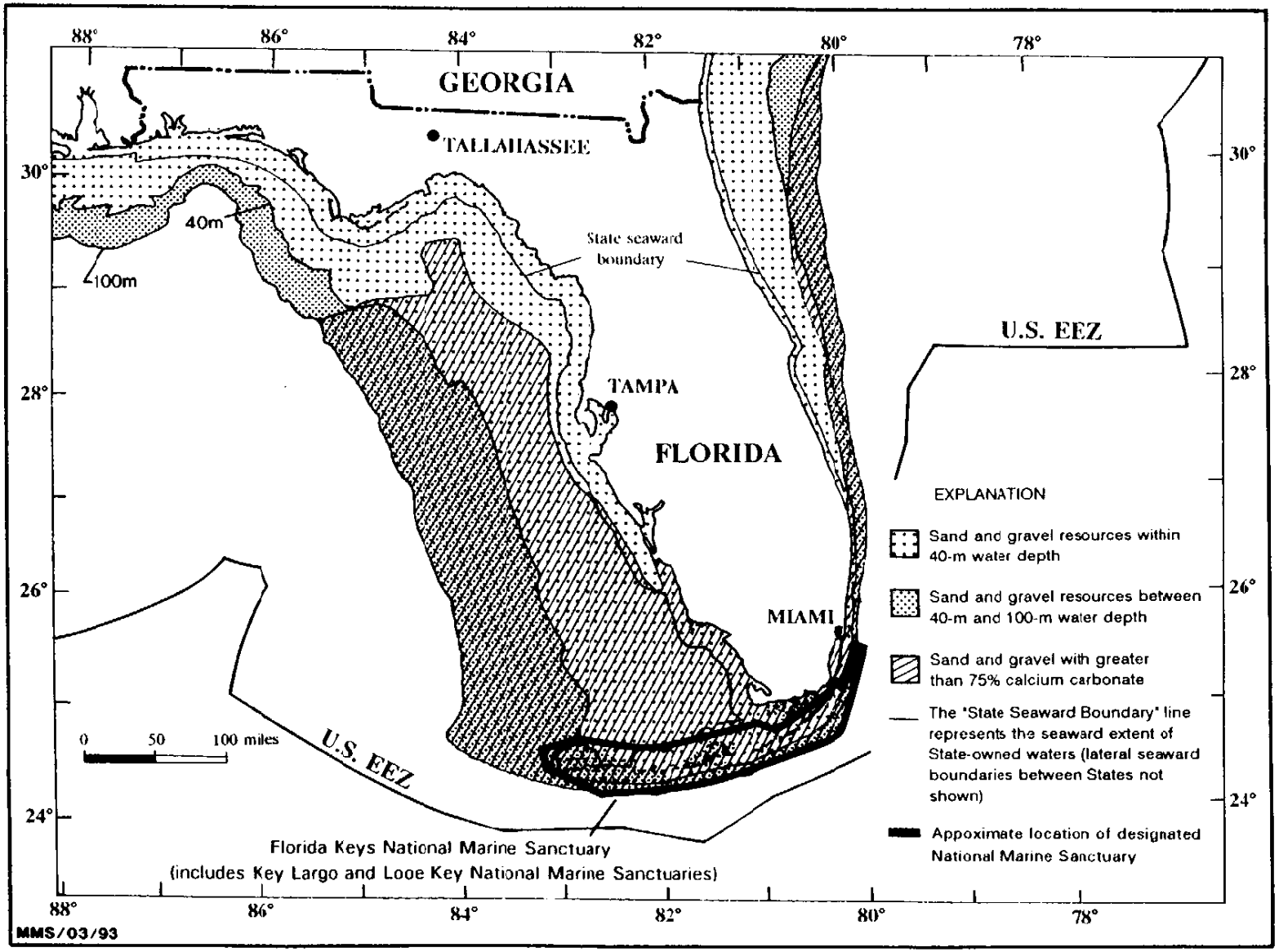


Figure A-4. Known Recoverable Sand and Gravel Resource Areas Offshore Florida (Modified from Amato, 1992; MMS, 1986).

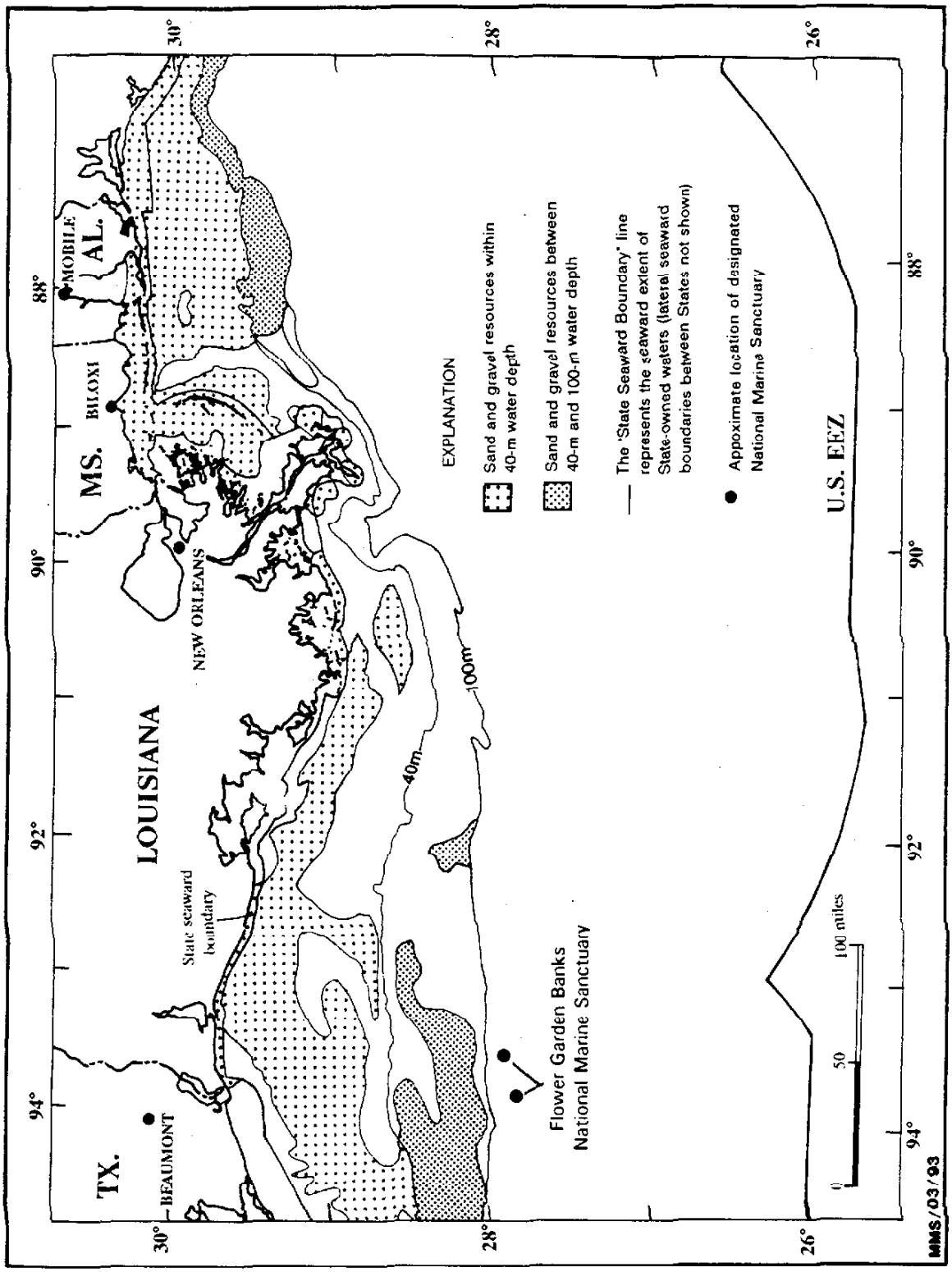


Figure A-5. Known Recoverable Sand and Gravel Resource Areas Offshore Louisiana, Mississippi, and Alabama (Modified from John, Penland, and Ramsey, 1989; MMS, 1986).

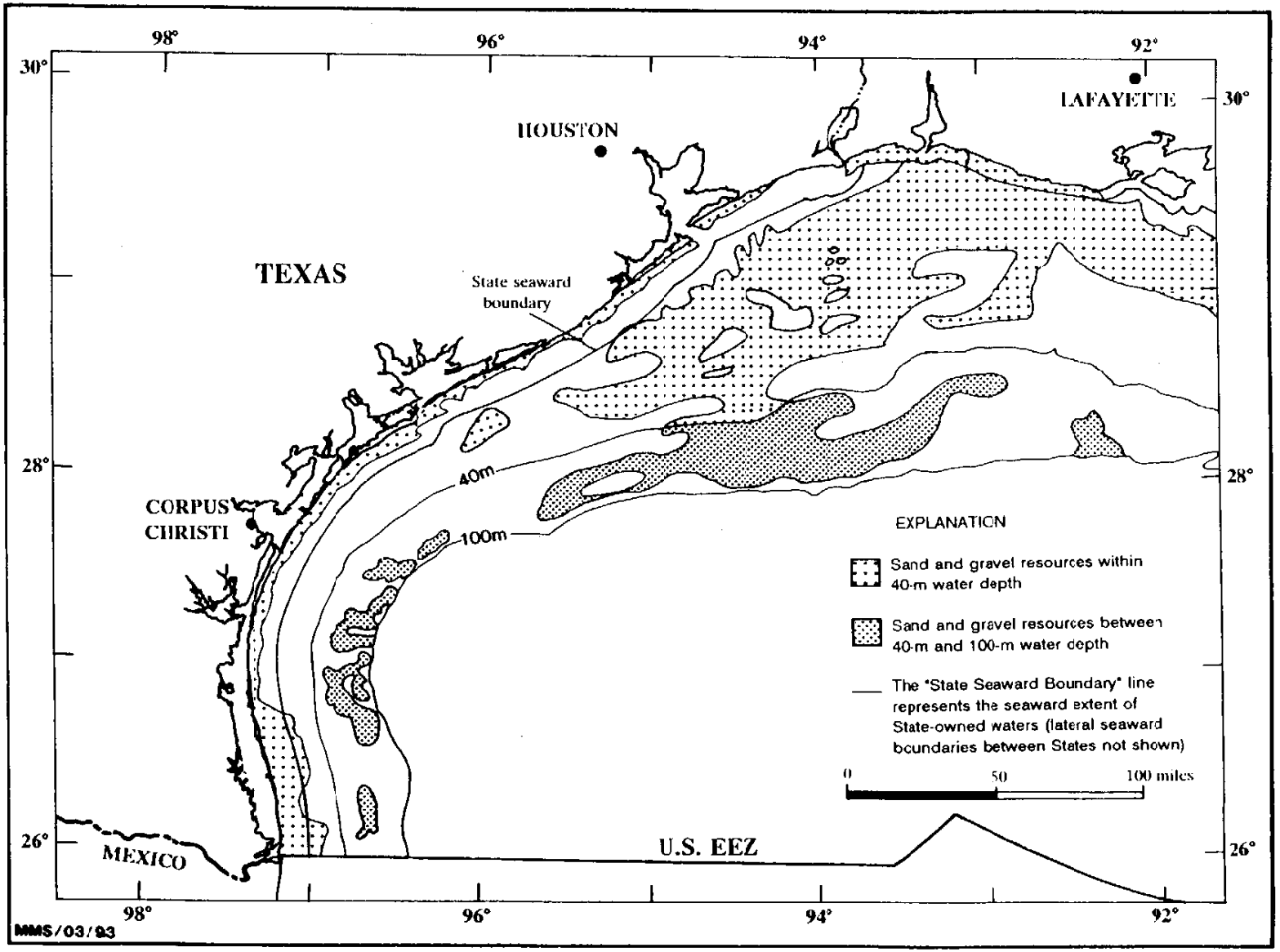


Figure A-6. Known Recoverable Sand and Gravel Resource Areas Offshore Texas (Modified from Paine, Morton, and White, 1988; MMS, 1986).

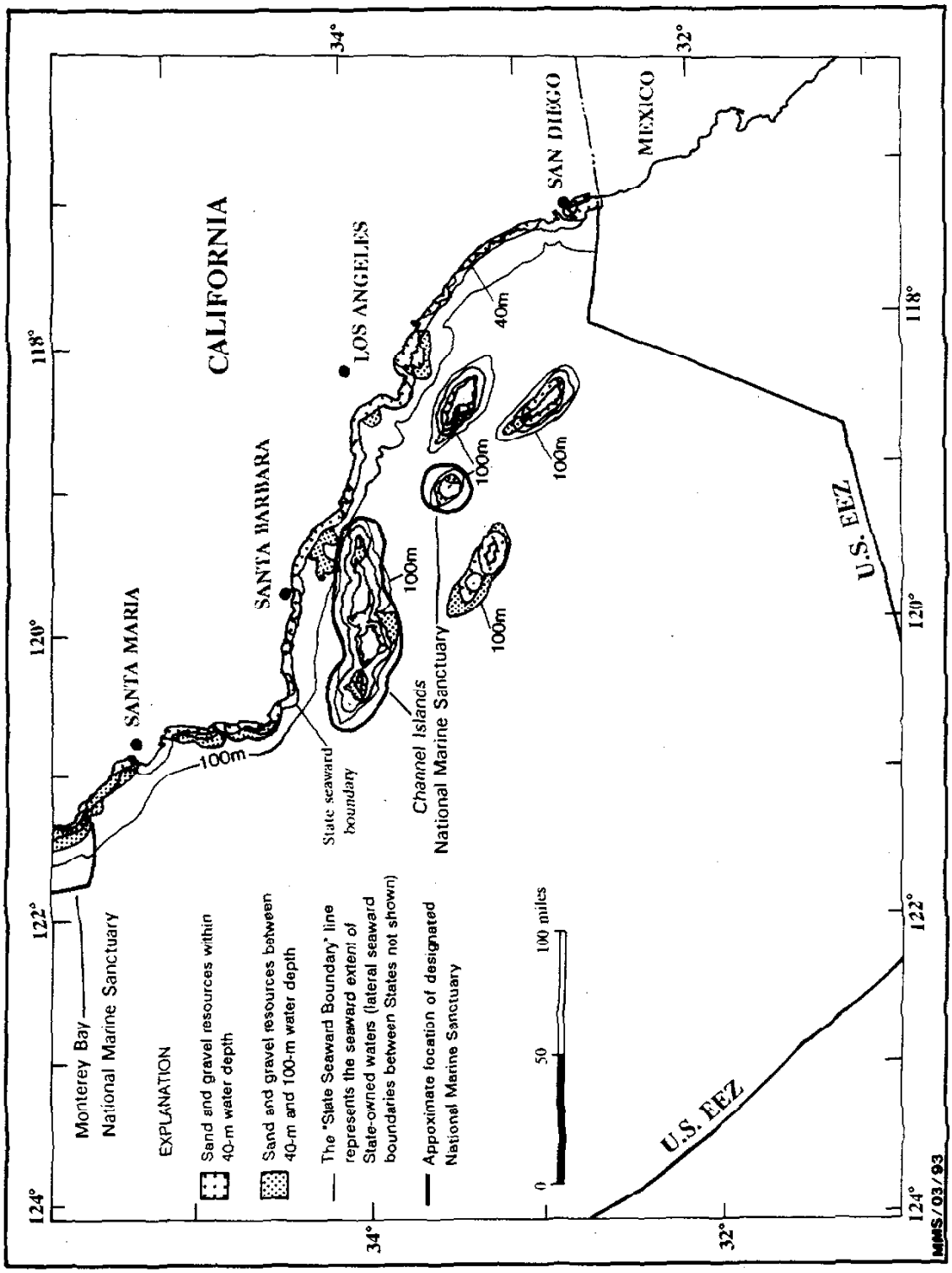


Figure A-7. Known Recoverable Sand and Gravel Resource Areas Offshore Southern California
(Modified from Welday and Williams, 1975).

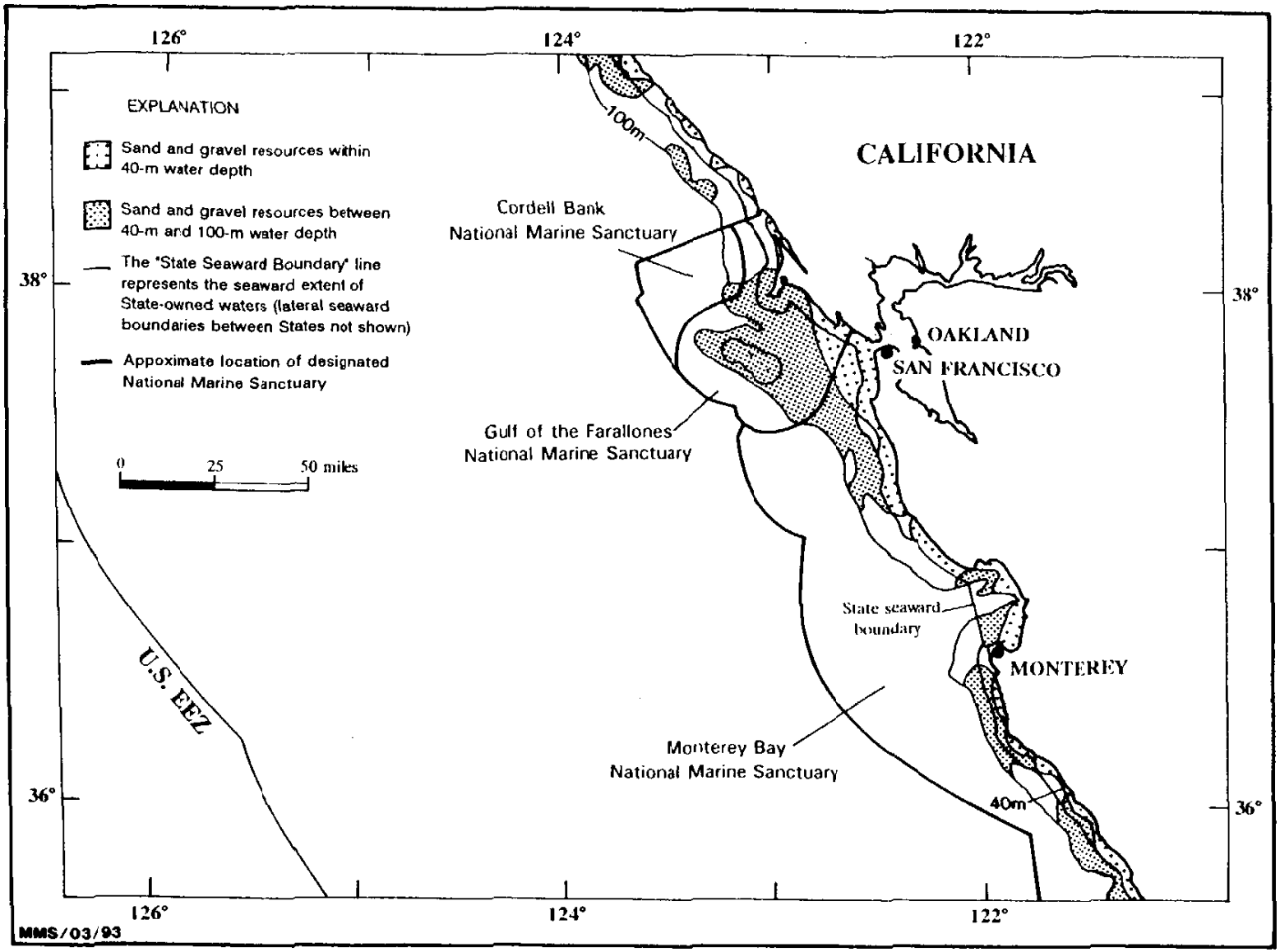


Figure A-8. Known Recoverable Sand and Gravel Resource Areas Offshore Central California (Modified from Welday and Williams, 1975).

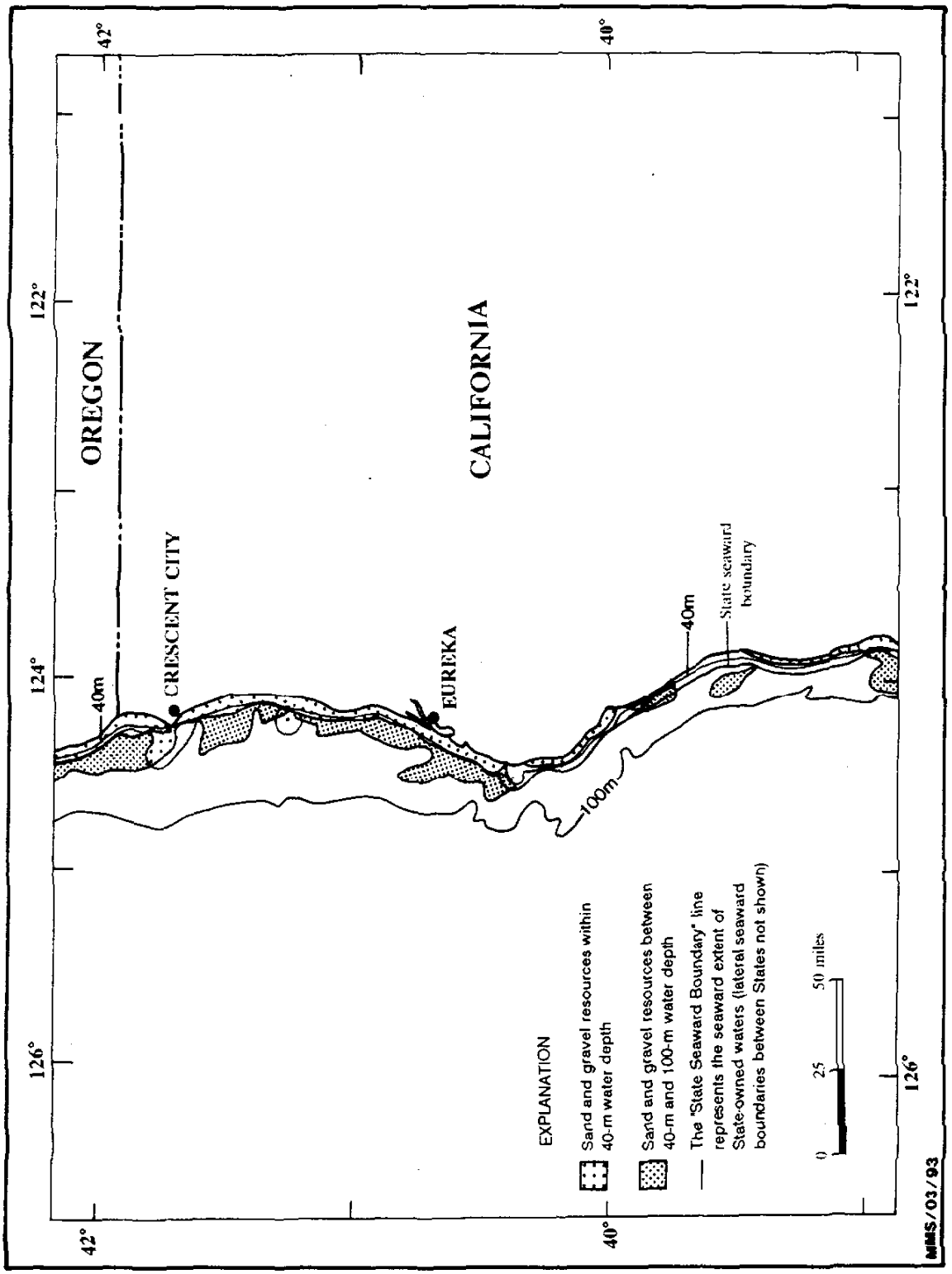


Figure A-9. Known Recoverable Sand and Gravel Resource Areas Offshore Northern California
(Modified from Welday and Williams, 1975).

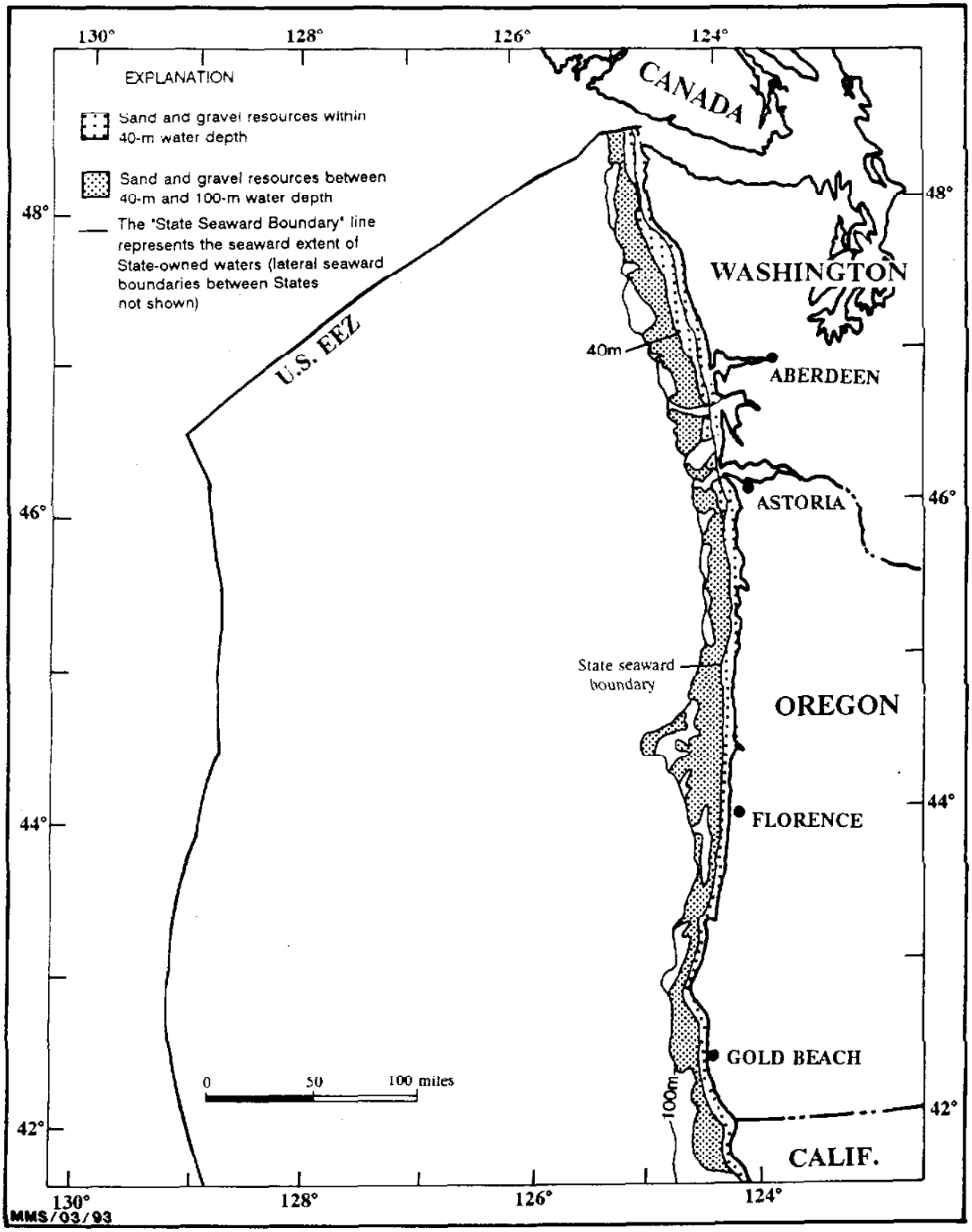


Figure A-10. Known Recoverable Sand and Gravel Resource Areas Offshore Oregon and Washington (Modified from Moore and Luken, 1979).

Appendix B: Minerals Management Service, Marine Minerals Activities

Background

The U.S. continental shelf constitutes a vast sand resource contained in numerous deposits including shoals. These deposits can be a major source of material for construction aggregate, coastal restoration, and shoreline protection. However, specific deposits must be located and determined to be geologically and environmentally appropriate, as well as economically feasible.

The near-term focus of activities now underway is focused on sand for coastal restoration. These cooperative projects are designed to provide a means for States to identify and assess suitable offshore sand resource deposits with potential to meet their coastal needs. The programmatic approach being taken allows for cooperative multifaceted assessments of specific marine deposits. Such collaborative efforts by coastal States and the MMS, in conjunction with other agencies, simultaneously address common concerns for both coastal and marine resources and environments.

Cooperative Approach

The MMS's basic approach is to work with the State Geological Survey or other agencies within individual States on the projects identified by them, while coordinating closely with other Federal, State and local agencies, academia, industry, and the public. Typically, each cooperative project involves: (1) identification by coastal States of high priority coastal restoration areas, (2) evaluation of suitable offshore sand deposits, and (3) analysis of technical, environmental and economic issues. Outreach and information transfer are also important components of each project. Through participation in professional conferences, public meetings, and various publishing media, the MMS and the States disseminate project and resource information to the public, other governmental agencies, academia, and industry.

For each cooperative project, co-funding and/or in-kind services are typically provided by the State. Additional support from other Federal agencies is also encouraged to facilitate respective decisions, reduce regulatory burdens, and maximize efficient use of resources.

New England States

A final report titled "Construction Aggregates Demand in the New England States" was completed in January 1992. The study is the first phase of a project designed to determine if adequate onshore sand and gravel resources exist in the region to supply future infrastructure needs. Projections of demand through the year 2010, examination of available transportation routes for hauling aggregates, and a survey of State and local statutes which regulate existing operations and the permitting of new aggregate mines and pits are discussed.

The second phase of the project, scheduled for completion in early 1993, is to conduct an assessment of construction aggregate supplies in each of the six New England States. Upon completion of the study, maps of the deposits and calculations of remaining resources will be presented in a report.

Phase three will use the results of both studies to draw conclusions on the regional outlook for construction aggregates and to forecast whether offshore supplies will be needed to meet future demand. A final report of the findings will be published with recommendations for future initiatives.

Atlantic Coastal States

In response to increasing coastal erosion and related land loss problems, an initiative has been implemented to establish cooperative projects with coastal States specifically designed to evaluate marine sand resources for beach restoration and shoreline protection. Each project provides for broad assessments of selected sand deposits in Federal waters emphasizing the geologic, environmental, engineering, and economic aspects of the potential recovery and placement of the resource. This strategy provides the flexibility needed to accommodate each State's objectives and concerns. Currently, cooperative work is underway with the States of New Jersey, Delaware, Maryland, Virginia, North Carolina, and South Carolina.

Gulf Coastal States

As a result of interest expressed in nonfuel marine mineral resources by the Gulf Coast Governors in late 1986, a cooperative agreement with the MMS was established in January 1987. The first accomplishment under the agreement was an assessment of the occurrence of marine minerals located off the coast of each individual State. Based on findings and recommendations from that early study, an effort to assess offshore sand resources for barrier island and beach restoration/wetlands enhancement was initiated.

Since 1989, the primary focus has been the assessment of the development potential of Ship Shoal, offshore Louisiana, as a near-term leasable sand deposit for restoration of the Isles Dernieres barrier islands. The methodology developed and utilized involves an integrated approach including geological, engineering, environmental, and economic analyses. Findings to date indicate that this sand resource is ideally suited and environmentally preferable for the restoration, and the economics are acceptable. A pilot project under the Coastal Wetlands Planning, Protection and Restoration Act is being considered for 1994. Alabama, Mississippi, and Texas are also conducting similar studies off their shorelines.

Appendix C: The EEZ Working Group on Hard Minerals

The EEZ Hard Minerals Working Group was an ad hoc group of private individuals with industry, environmental, and State perspectives which was formed in the fall of 1985 to examine the Department of the Interior's regulatory effort for EEZ hard minerals and to assess the statutory framework needed to foster the development of the fledgling EEZ mining industry. The Group developed 10 consensus points to serve as the foundation for their comments on proposed regulations and new legislation:

1. A new stand-alone EEZ Hard Minerals statute separate from the oil and gas regime of the Outer Continental Shelf Lands Act (OCSLA) must precede the issuance of any EEZ Hard Minerals regulation.

2. The new statute should govern all mineral deposits on or below the seabed of the EEZ other than oil, gas, and sulfur.

3. The new statute should apply to all geographic areas covered by the EEZ proclamation, as well as the Trust Territory of the Pacific Islands, to the extent such jurisdiction is consistent with U.S. obligations.

4. The mining and environmental provisions and practices contained in the Deep Seabed Hard Mineral Resources Act (DSHMRA) should be the point of departure for the new statute.

5. The Department of the Interior should carry out mineral reconnaissance and should regulate EEZ mining, sharing mapping activities with the National Oceanic and Atmospheric Administration (NOAA). NOAA should have the lead role on other research and environmental studies, working closely with the U.S. Geological Survey.

6. The Federal Government should ensure the early preparation and implementation of a comprehensive and systematic research plan, including the preparation of general topographic maps, broad mineral reconnaissance reports, and environmental baseline data.

7. There should be the widest public dissemination of data, consistent with legitimate needs for confidential treatment of information compiled by industry.

8. The new statute should contain provisions to encourage private entities to contribute to the gathering of data in points 5, 6 and 7.

9. The new statute should provide an effective Federal/State/local consultation process, based on the consistency provisions of the Coastal Zone Management Act, that is well-matched with the resource, its location, and the potential impact of the activities.

10. The new statute should provide an equitable system of sharing EEZ Hard Mineral revenues with coastal States.

John Knebel	American Mining Congress
Myron Nordquist	Kelly Drye & Warren
Clifton Curtis	The Oceanic Society
Gary Magnuson	Coastal States Organization
Richard Greenwald	Ocean Mining Associates
Vincent Ahearn	National Aggregates Association

Appendix D: Federal Agency Roles on The OCS

U.S. Army Corps of Engineers (ACOE)

The public harbors, rivers, and waterways of the Nation are developed and maintained for navigation by the ACOE. In addition, the ACOE has responsibilities to protect the quality of the human and natural environments, and to protect life and property from natural hazards. Although the principal purpose of dredging is for navigation, it is often required for flood control, shore protection and other Federal purposes. The ACOE responsibilities include: regulatory activities over waters, flood control, shore and beach erosion protection, hurricane protection, water quality, wetlands development, etc. ACOE projects can be specifically authorized by Congress or occur under the continuing Authorities Program, also referred to as the Small Projects Program (for navigation, flood control, beach erosion control and shore protection). The ACOE also has discretionary authority to use dredged material for beach nourishment purposes--a State must request the work, it must be in the public interest, and the non-Federal interests must pay the added costs for beach placement. The ACOE is involved in virtually every dredging operation performed in the U.S. through direct project involvement or in the exercise of its regulatory responsibilities. An ACOE authorized project then is one alternative for States and local governments to pursue for beach erosion control (either through placement of dredged material from navigation projects or through a special project for protection of shores). When appropriate, offshore sand, gravel, and shell operations would be required to obtain ACOE permits. The Rivers and Harbors Act requires a Section 10 permit for essentially all structures and/or work in or affecting navigable waters of the U.S. This includes seismic surveys, dredging, placement of an oil platform, etc. Under section 404 of the Clean Water Act, the ACOE retains primary responsibility for permits to discharge dredged or fill material into waters of the United States.

U.S. Geological Survey (USGS)

As the primary Federal agency for conducting research and information gathering on all earth-science topics, the USGS is engaged in studies focused on improving scientific understanding of the physical processes affecting coastal environments. The USGS is the dominant Federal agency that collects marine geological and geophysical data. The USGS is conducting research to provide the basic information needed to gain an improved understanding of the geologic processes causing coastal erosion and deterioration of wetlands' environments. The information derived from these investigations is providing important technical knowledge and data bases that can be used by the appropriate Federal, State, and local agencies to make strategic decisions and for designing and implementing measures to lessen the rates of land loss and mitigate the effects of erosion.

National Oceanic and Atmospheric Administration (NOAA)

The NOAA conducts studies of wetlands and coastal habitats that support marine resources; prepares nautical charts and geodetic surveys of coastal areas; monitors storm activities; operates an environmental satellite system; and administers a grants program for marine research. NOAA also manages the Deep Seabed Hard Minerals Resources Act. The Office of Coastal Resource Management in NOAA administers the Coastal Zone Management Act and the Federal funds granted to the States for research under and administration of their federally approved coastal zone management plans. NOAA also administers the marine sanctuary program under section 302 of the Marine Protection, Research and Sanctuaries Act (MPRSA), establishing the use regulations for each sanctuary. Designation of an area as a marine sanctuary does not mean that the area is closed to all development. Rather, the limitations on use are established on a case-by-case basis, with considerable weight being given to the wishes of the State containing or adjacent to the sanctuary. The National Marine Fisheries Service (NMFS), a branch of NOAA, serves as the lead Federal agency for ocean fishery management. NMFS also has jurisdiction under the Marine Mammal Protection Act, and shares jurisdiction under the Endangered Species Act with the U.S. Fish and Wildlife Service.

Bureau of Mines
The Bureau of Mines programs related to the EEZ include development of technologies that will permit recovery of mineral deposits from the ocean floor, studies of beneficiation and processing systems, economic analyses, and assessment of worldwide availability of mineral resources. At the request of MMS, the Bureau completed 2 studies that examined the economic feasibility of mining sand and gravel deposits and heavy mineral placers off the coasts of the U.S. Conclusions from the sand and gravel study indicated that deposits off the coast of Boston and New York City offered the most promising sites for commercial development.

U.S. Environmental Protection Agency (EPA)
The EPA funds and conducts contaminant studies and related coastal research; and regulates the discharge of coastal pollutants and the disposal of dredged sediments. When appropriate, sand, gravel, and shell operators would be required to obtain permits from the EPA: Clean Water Act Section 401, certification that issuance of Federal permit will not result in violation of applicable effluent limitations or water quality standards; Section 402, National Pollutant Discharge Elimination System point source discharge permits; MPRSA, Section 102, approval of ocean disposal sites and permits for transportation and dumping of non-dredged materials; Section 103, review of ACOE Section 103 dredged material transportation permits.

U.S. Fish and Wildlife Service (FWS)
The FWS manages extensive coastal lands and wildlife preserves; and conducts research on coastal wetlands, fish and wildlife populations, and changes in habitat. The FWS shares jurisdiction under the Endangered Species Act with NMFS. Under the Act, federal agencies must take measures (including consultation with FWS and NMFS to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize endangered or threatened species.

U.S. Coast Guard
The Coast Guard administers regulations covering marine safety and navigation matters such as aids to navigation, platforms and pipelines, and the International Regulations for Preventing Collisions at Sea.

U.S. Customs Service
The Customs Service, in conjunction with the Maritime Administration and the Coast Guard, exercises control over the use of foreign-built and foreign-flagged vessels in U.S. waters.

Source: modified from: (1) "Managing Oregon's Ocean Resources," The Oregon Ocean Resources Management Task Force Interim Report to the Joint Legislative Committee on Land Use, July 1, 1988, Appendix; and (2) Williams et al. 1990.

Appendix E: Sand, Gravel and Shell Extraction in State Coastal Waters

STATE STATUTE/REGULATIONS	SAND, GRAVEL, AND SHELL EXTRACTION IN COASTAL WATERS		
	AGGREGATE MINING	FEES	BEACH REPLENISHMENT PROJECTS
Alabama Alabama Code section 9-15-1 and 9-17-1 (et seq.) (1975).	Permit required for exploration. Mining leases granted by competitive sealed bidding only. No current marine mining activity. Oyster shell dredging occurred in coastal waters from 1960 to 1980.	Fee (unspecified) for exploration permit. Fee for lease determined by bidding (and minimum bid requirements.) Onshore (river) lessees pay the State about $.10 to $.35 per cubic yard.	No current activity. One past project to re-build 3/4 mile beach in Gulf Shores and one private project for 1/2 mile beach on Dauphin Island, both using marine sand. Potential for additional projects on Dauphin Island.
Alaska Ak. Statute section 38.05.110 and 115 and 810--State Timber and Materials.	Sand and gravel disposed through negotiated sales contracts (competitive if >25,000 yards). Application must have coastal zone review and State Best Interest Finding. No active contracts offshore Southcentral Region. In North Slope Region, only 2 contracts are for beach nourishment--past commercial applications rejected because of Corps and FWS concern for whale and anadromous fish passage.	$50 application fee. Royalty based on appraisal (typically about $.50-$1 per yard).	Two contracts using sand from about 3,000 feet off Wainwright and Barrow for beach nourishment. About 100,000 and 250,000 cubic yards. Uses both clamshell and hydraulic extraction.
California Cal. Public Resource Code sections 6371 and 6890-6900. Cal. Admin. Code title 2 sections 2200-2205.	Competitive lease sales for most sand & gravel disposal. No activity in coastal waters (2 applications denied), but 1 long-standing commercial sand and gravel operation and 1 oyster shell operation in San Francisco Bay. Possible upcoming competitive sand and gravel sale in San Francisco Bay. All California coastal waters protected from new oil and gas leasing by State sanctuaries designation--sand and gravel leasing will be decided on a case-by-case basis.	Fees set by statute--royalty at 10% of gross value (after deductions). Rentals @ $1/acre.	Numerous small-scale replenishment projects in southern California using sand dredged from channels by ACOE and local port districts. Sand placed on public use beaches.
Connecticut Connecticut General Statutes sections 22a-383 to 22a-390 (1987).	Permit by application required for taking material from tidal or coastal waters. Currently, two commercial tidal river sand and gravel operations. Some commercial use of material for fill from navigation dredging.	Fees set by statute--$1 per cubic yard for sand and gravel.	Some continuing small-scale beach replenishment projects using sand from nearshore.

STATE STATUTE/REGULATIONS	SAND, GRAVEL, AND SHELL EXTRACTION IN COASTAL WATERS		
	AGGREGATE MINING	FEES	BEACH REPLENISHMENT PROJECTS
Delaware Del. Code Ann. Title 7, chapter 61 (1983)	Mining lease requires competitive cash bonus bidding. No current commercial mining activity in State waters.	Lease rental is $.25 per acre and royalty is not less than 12.5% of gross production.	Current replenishment project using one offshore borrow site for Fenwick Island, S. Bethany, and Bethany Beaches. 538,000 cubic yards of sand will be dredged and placed on beach at a cost of $4.71 per cubic yard. In 1989, 2 local replenishment projects were privately funded.
Florida Florida Statutes, Public Lands and Property title 18, chapters 253.001 to 253.45, Energy Resources chapter 377 Part 1 (1987).	Statutes provide for mining leases on State lands by competitive bidding, however, any mining activity must be approved by the Board of Trustees. No mining activity has been approved in State waters.	Unspecified	Numerous beach restoration projects along east and west coasts. About 2 to 5 major projects per year. Sand sources typically are from offshore and ebb tidal shoals.
Georgia Georgia Code, section 50-16-43 (1985).	Mining leases issued by competitive bidding. No current commercial marine mining in State coastal waters.	Fees determined by State Properties Commission.	Three past replenishment projects using sand pumped from the nearshore: 1975-Tybee Island (1.1 mil. yds.); 1987-Tybee Island (1 mil. yds.) and 1990-Sea Island (2 mil. yds.). A planned 1993 Tybee Island project will use sand from ACOE channel dredging.
Hawaii Hawaii Revised Statutes, chapter 258 (1986) and chapters 26, 171, and 182, Act 375-88 (1988).	Mining of sand prohibited within 1,000 feet seaward of shoreline or in water depths less than 30 feet (except, sand for beach replenishment). No current offshore commercial sand mining. One small-scale sand operation in beach dunes in Kauai for construction materials.	Terms set at discretion of Board of Land and Natural Resources.	City of Honolulu studying erosion control methods for Kualoa Park. State Dept. of Transportation studying replenishment of Waikiki Beach to 75 feet wide, possibly using offshore sand.

STATE STATUTE/REGULATIONS	SAND, GRAVEL, AND SHELL EXTRACTION IN COASTAL WATERS AGGREGATE MINING	FEES	BEACH REPLENISHMENT PROJECTS
Louisiana Louisiana Statute, Title 56, Section 1; and Title 30, sections 121 to 179.14 (1984).	Mining leases issued by State Mineral Board. Leased by competitive sealed bidding. No sand and gravel leases in State coastal waters. One oyster shell lease (130,000 acres, 3 year term) in Atchafalaya Bay area.	Royalty set by statute at 1/8 of product value, but royalty can also be bid variable.	Several recent beach replenishment projects involving ACOE--used sand material pumped directly from foreshore areas or from navigation dredging (Grand Isle, Wine Island, Isle Dernieres.)
Maine Maine Revised Statutes Annotated title 12, chapter 201-A, subchapters III, and IV, subsections 558-A, 549 to 550 (1985).	Mining lease required to remove material by private sector. In 1992, Dept. of Environmental Protection issued comprehensive set of mining regulations governing State lands. No current commercial activities.	Fee would be set which represents fair market value for the rights conveyed.	No replenishment projects.
Maryland Title 9 Wetlands and Riparian Rights sections 9-101 to 9-503 (1987).	License required for any use in State waters. Board of Public Works determines if and under what conditions a license would be granted. No current marine mining activity, except for one ongoing fossil shell dredging operation which in part uses material to promote oyster propagation.	Set by Board of Public Works.	1988 1990 Ocean City project pumped about 6.5 mil. cubic yards of offshore sand onto 6 miles of beach. Other local community replenishment projects licensed and tightly controlled by Board of Public Works.
Massachusetts Mass. General Laws Annotated chapter 12, sections 54-56 (1981). Mass. Administrative Code title 310 (1983).	License required to explore followed by exclusive right to lease minerals discovered. Most coastal waters (about 80%) protected from mining by State's Ocean Sanctuaries law--only area potentially available is just outside Boston Harbor.	Fees set for licenses and permits.	Exempt from licensing requirements and from most ocean sanctuaries laws prohibitions. Several small private beach nourishment projects over the last 4 years.
Mississippi Mississippi Code Annotated section 49-27-1 through 69. Coastal Law, Mississippi Wetlands Act of 1973.	Depending on purposss of mining, a submerged land lease may be required from the Secretary of State's office. No current commercial activity. Some past dredging of shell.	Unknown	Numerous projects in Harrison and Hancock Counties to maintain beaches using offshore sand. In Jackson County, one project used dredged material to build island.

STATE STATUTE/REGULATIONS	SAND, GRAVEL, AND SHELL EXTRACTION IN COASTAL WATERS		
	AGGREGATE MINING	FEES	BEACH REPLENISHMENT PROJECTS
New Hampshire N.H. Rev. Stat. Ann ch. 12-E (1980) and 482-A	Mining permit would be required. No current activity.	Unknown	Numerous past small-scale replenishment projects using sand from State and ACOE dredging projects. One planned project for Hampton/Seabrook using sand from State harbor dredging.
New Jersey New Jersey Statutes Annotated Chapter 3, sections 21 to 22.	Ongoing extraction of sand and gravel from navigation channel in New York Harbor (400,000 to 800,000 cubic yards annually) under State mineral license.	Fees determined by Tidelands Resource Council. Current operator pays $.30 royalty per cubic yard.	Many beach replenishment projects undertaken jointly with ACOE using material from navigation dredging or offshore marine shoals. Current projects range from 3 to 19 million cubic yards of material placed on beaches.
New York New York Public Lands Law section 22 (1986).	Past extraction of sand and gravel from channel in New York Harbor under State license. DEIS covering mining in lower New York Harbor issued in 1992. Covers commercial sand and gravel mining under State licenses for 16 areas, for up to 150 million cubic yards of material. Term of licenses will be 1 or 2 years. New license fees set by Commissioner of General Services.	Operator paid $.25 per cubic yard to State for channel sand. Commissioner has indicated that royalty will be at least $1/yard for future licences.	Numerous beaches replenished using ACOE dredged material. Also, some smaller-scale local government beach replenishment projects using dredged material.
North Carolina North Carolina General Statutes subsections 74-46 to 74-68 and 146-8 (1987).	A permit to mine is required, terms set by negotiation. No current activity for sand and gravel mining. One non-producing phosphate lease on State submerged lands.	Fees determined by Division of Land Resources.	Two small-scale replenishment projects are currently planned.
Oregon Oregon Rev. Stat. 196-405-580 and Oregon Rev. Stat. 274-610.	Statutes governing offshore hard mineral leasing adopted in 1987 were rescinded in 1991. While sand and gravel mining was not expressly prohibited by statute, the intent of 1991 legislation was to preclude most offshore mineral development in State waters.	N/A	No beach replenishment projects.

STATE / STATUTE/REGULATIONS	SAND, GRAVEL, AND SHELL EXTRACTION IN COASTAL WATERS		
	AGGREGATE MINING	FEES	BEACH REPLENISHMENT PROJECTS
Rhode Island Rhode Island General Laws title 46, chapters 23 and 12, and title 42, chapter 17.1-17.35 as amended (1956).	Permits issued by Coastal Resources Management Council. Regulations for leasing minerals currently being developed. No commercial activity.	Fees determined by Council.	Some past and ongoing beach replenishment, but sand is trucked-in from onshore sources.
South Carolina South Carolina Code, South Carolina Mining Act title 48 chapter 20 (1990).	Mining permit required to remove material. No current commercial marine mining activities.	$500 application fee plus bond recl. fee. Royalty payments determined by State Budget Control Board.	Some past beach replenishment in Hilton Head area using material from ACOE navigation dredging project.
Texas Tex. Nat. Res. Code ch. 53 (1980). Tex. Admin. Code Tit. 31, sec. 13 (1979).	Mining lease or permit required. No current activity. Past offshore shell dredging during 1950's and 1960's depleted resources. Shell dredging now prohibited.	Unknown	Past project for S. Padre Island involved ACOE dredged sand placed as an offshore berm to supply beaches through current and wave action. Proposed beach replenishment project for Galveston beaches using material dredged from ACOE navigation channels or from shoreline areas containing accreted sand.
Virginia Virginia Code, Section 28.2-1203.	Permit required for removal of material. No commercial marine mining activity. State requires that suitable dredged materials be placed on beaches.	Royalty statutorily set at a minimum $.20 per cubic yard.	Ongoing annual replenishment projects for Virginia Beach using offshore pumped bypass sand (150,000 yards) and trucked-in sand (50,000-150,000 yards). Another project was replenishment of a small local beach using sand pumped directly from a small marine shoal.
Washington Washington Revised Code Annotated, subsection 79.01.616 to 79.01.651 (1985).	Although provided for in Statute, current regulatory policy may prohibit all mining in coastal waters. Some ongoing limited sand extraction from coastal dunes for local government use.	Royalty fees set by statute.	No coastal beach replenishment projects.

Sources: "Coastal State Mining Laws," U.S. Department of the Interior, Minerals Management Service, OCS Report MMS 89-0017; Fisher, David; "Survey of Coastal State Marine Nonenergy Mineral Activities," California State University, Long Beach, February 27, 1987; Congress, 1987; Personal communications with State Government representatives (September 1992).