Leasing Division
Sand and Gravel Unit

Studies Development Plan
FY 2004 – 2005

March 2003

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SECTION 1. Programmatic Overview

1.1 Introduction to the MMS Sand and Gravel Program

Many of the submerged shoals and surficial sand sheets located on the Federal OCS under the jurisdiction of the MMS represent viable sources of sand borrow material for coastal erosion management and wetlands protection efforts due to:

- the general diminishing supply of sand within State waters,
- the renourishment cycles for beaches or coastal areas requiring quantities of sand not currently available from State sources,
- immediate/emergency repair of beach and coastal damage from severe coastal storms,
- the potential for environmental damage/problems as a result of continued use of nearshore sand deposits.

These resources must be wisely managed to ensure that environmental damage to the marine and coastal environments will not occur. Many of these areas represent long-term sources of compatible, beach-quality material which may be used on a continual, prolonged basis.

The MMS Leasing Division's Sand and Gravel Unit, has been focusing on integrating geologic and environmental information, developed through partnerships with coastal States and contracted or cooperative study efforts, to identify suitable OCS sand deposits and to provide needed environmental information in regards to environmental management of these resources. This comprehensive analysis provides the basis for decisions regarding the use of Federal sand for future beach nourishment activities. Public Law 103-426, enacted October 31, 1994, allows the MMS to convey, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for shore protection, beach or wetlands restoration projects, or for use in construction projects funded in whole or part or authorized by the Federal Government.

1.2 Map of State/Federal Cooperative Sand Investigations

A key strategy to ensure environmental protection, safe operations, and issue resolution for decisions on access to OCS marine mineral activities is the closely coordinated partnerships between the Federal Government, coastal States and local communities. The MMS presently has, or in the past has had, cooperative projects with Alabama, Delaware, Florida, Maryland, New Jersey, North Carolina, South Carolina, Texas, Virginia, and Louisiana to identify OCS sources of beach nourishment sand for potential use in shore protection projects.

MMS encourages continuing dialogue with coastal states regarding new sand investigation projects; MMS is currently in discussions with the State of California regarding possible cooperative sand investigation efforts in light of a severe sand shortage for beach projects in portions of southern California. These partnerships rely primarily on State Geological Surveys-in cooperation with other State and Federal agencies-to identify the State's needs and propose suitable offshore areas for study. Figure 1 shows the location of past and current State/Federal sand investigations.

Figure 1. Location of MMS State/Federal Sand Investigations

1.3 Projected OCS Activities

The sand and gravel program is clearly in an operational phase, as opposed to what was once purely a research phase. Since Public Law 103-426 was enacted, MMS, as of February 6, 2002, has conveyed over 19 million cubic yards of sand to State, local, and Federal entities. A number of negotiated leases are either in-progress or anticipated in the near-term. Table 1 lists the negotiated agreements completed, in-progress as of January 15, 2003, and anticipated in the very near-term. Table 2 lists anticipated requests for sand within the next 3 to 5 years. In FY 2003 – 2005, MMS expects to convey in the range of 16 to 30 million cubic yards of sand. Requests come in throughout the year that are not anticipated and they need to be addressed when they are received.

1.4 Identification of Information Needs/Environmental Studies

1.4.1 Conduct of Sand and Gravel Environmental Studies

Since 1992, MMS has expended over $8.0 million of Environmental Studies Program funds for marine mineral environmental studies (Table 3). Site-specific, interdisciplinary studies have been conducted in identified sand borrow areas to provide basic information

Table 1. MMS Negotiated Leases for Sand and Gravel
Leases Completed/Requested/Anticipated
As of January 15, 2002
◆ =Leases in Progress/Pending Leases

Area	Borrow Area	Lease Completed	Amount (cubic yards)	Project Start/Completion Dates	Lease Requests Submitted/Anticipated (Amount in cubic yards/Expected Project Start)/Comments
Maryland					
Assategue Island (NPS)	Great Gull Bank	July 30, 1998	134,000	Project completed September 22, 1998	
Assategue Island (State)	Great Gull Bank	September 17, 2001	100,000	Project completed October 30,2002	Sand used for dune building
Assategue Island (NPS)	Great Gull Bank	September 28, 2001	1,800,000	Project began mid-October 2002/ongoing	
Virginia					
Dam Neck Naval Facility	Sandbridge Shoal	May 1996	808,600	June 1996/September 1996	
Sandbridge Beach	Sandbridge Shoal	June 1998	1,100,000	May 1998/June 1998	
Sandbridge Beach	Sandbridge Shoal	August 26, 2002	2,000,000	Mid-December 2002/January-February 2003	
Virginia Beach ◆	Cape Henry				1,000,000/ Project start unknown at this time: possible maintenance project in future year
Florida					
Duval County	Jacksonville Borrow Area	9/20/95	1,240,000	May 17, 1995/September 20, 1995	
Brevard County (North Reach)	Canaveral Shoals-Borrow Area II	7/11/02	4,500,000	October 1, 2000/April 9, 2001 (2.8 million cubic yards placed)	
Brevard County (South Reach) ◆	Canaveral Shoals		2,800,000		Request submitted August 30, 2001/Project start expected Spring 2003 pending funding
Patrick Air Force Base	Canaveral Shoal	MOA December 8, 2000	560,000	October 2, 2000/April 16, 2001	
South Carolina					
Surfside Beach/Garden City	Surfside Borrow Area	November 19, 1997	150,000	Project completed December 29, 1997	
Louisiana					
Holly Beach	Peveto Channel	May 3, 2002	4,200,000	June 2002/ongoing: expected completion mid-December 2002	Coastal/wetlands protection

Table 1, continued.

Louisiana continued					
Whiskey Island (rebuilding of the west flank)	Ship Shoal Block 88 (crest of Ship Shoal)				2,000,000/Project start expected Spring/Summer 2003/Barrier island restoration
South Pelto Block 12 Dredge Test to Evaluate Loading Characteristics of Sand on Eastern End of Ship Shoal	South Pelto Block 12 (eastern end of Ship Shoal)	12/20/02	3,000	Test completed 12/26/02	
New Cut	South Pelto Block 12/13 (see above)				1,000,000/ Coastal restoration: Project start expected Spring 2003
Morganza to the Gulf Hurricane Protection Project	South Pelto Block 12/13 (see above)				10,000,000/72-mile levee system around Houma, Louisiana: construction expected to commence in 2004

Table 2. Possible Conveyances of Sand Within the Next Three to Five Years

State	Locality	Cubic Yards Which Might Be Conveyed
NEW JERSEY	Corsons Inlet	1,200,000
LOUISIANA	Ship Shoal for LA Barrier Island projects	20 – 30,000,000
VIRGINIA	Virginia Beach resort strip	?
VIRGINIA	Dam Neck Naval Facility	1,000,000-2,000,000
NEW JERSEY	Harvey Cedars	7,400,000
NEW JERSEY	Avalon-Stone Harbor	?
NEW JERSEY	Monmouth-Sea Bright	?
NEW JERSEY	Brigantine Beach	?
NEW JERSEY	Manasquan-Barnegat Inlet	?
NORTH CAROLINA	Dare County	?
FLORIDA	East Coast	?

on the biological characterization of resident benthic communities, as well as the evaluation of potential dredging effects on the local wave and current regime.

The primary purpose of MMS sand and gravel biological studies is to address biological concerns raised by the potential for adverse environmental impacts on marine life as a consequence of dredging sand on the OCS. In order to provide an initial characterization of benthic ecological conditions at offshore borrow sites prior to any dredging activity, the MMS studies focus on the compilation and synthesis of existing oceanographic literature and available data sets which exist within identified offshore borrow areas, as

well as biological field sampling surveys. Biological sampling surveys include collecting traditional benthic grab samples, sediment profile camera images, and video sled footage. As a result, the MMS has been able to characterize and evaluate present benthic and pelagic communities within offshore borrow sites and address the potential effects of offshore sand dredging, including interpretations as to the potential rate and success of recolonization following cessation of dredging. In addition, the development of a time schedule of environmental windows that best protects benthic and pelagic species from adverse environmental effects has been examined.

Prior to dredging activity at an offshore borrow site, the potential for adverse changes in local wave and current patterns created by alterations in local bathymetry resulting from dredging operations must be assessed. Increased wave action after dredging offshore shoal areas may result in localized changes in erosional patterns and longshore coastal transport. A thorough evaluation of physical process changes must take into account the local current regime and the historical wind and wave climate. Numerical wave modeling studies are initiated to examine potential alterations in the local wave field following dredging and the excavation of sand within identified borrow sites. In addition, modeling studies examine the potential for increased wave action after dredging and any resultant adverse localized changes in erosional patterns and longshore transport which might result in significant losses of beach sand after nourishment. These efforts provide information to further explore the potential for changes in local sediment transport rates, as well as the cumulative physical effects of multiple dredging events.

Recognizing that the environmental effects of dredging operations in many instances are similar for most areas, generic-type studies have been initiated to examine the effects of particular types of dredging operations on various aspects of the physical, chemical, and biological environments, and to develop or recommend appropriate mitigation, computer modeling, monitoring techniques, or engineering alternatives to alleviate or prevent adverse environmental impacts. Studies have also been developed to examine current MMS practices in regards to archaeological and other seabed surveys, as well as looking at buffer zones to protect shipwrecks, pipelines, and oil and gas structures in areas where dredging is anticipated.

Because the OCS represents a future source of coarse sand and gravel for use as construction aggregate, MMS also has funded work in the United Kingdom to assess the potential for environmental damage associated with offshore aggregate mining in the event that such an endeavor is proposed for the U.S. OCS. These efforts have focused upon the extent and potential impacts associated with surface and benthic plumes generated during the aggregate operation, and the possible effects of these plumes on benthic organisms residing in the vicinity of dredging operations.

Environmental studies information is used by MMS analysts to evaluate the effects of specific proposed dredging operations, as required under current environmental laws and legislation. The results also are incorporated, as appropriate, in lease requirements and stipulations for the dredging of OCS sand.

1.4.2 Information Needs

The use of Federal OCS sand as a source of renourishment/restoration material will continue, especially given the growing scarcity of material in State waters and the adverse environmental impacts associated with the continual removal of nearshore sand material. Federal sand will serve as a primary and emergency source of material for beach nourishment and coastal restoration offshore both the Atlantic and Gulf of Mexico.

In the Gulf of Mexico, site-specific biological/physical information is urgently required on Ship Shoal, a submerged topographic feature located offshore the central coast of Louisiana. Geological and geophysical studies of Ship Shoal have determined that the shoal's sand is an ideal source of material to place on the rapidly eroding Louisiana barrier islands. MMS is currently negotiating leases with the State of Louisiana and several other Federal Agencies for planned barrier shoreline/barrier island restoration projects, as noted in Table 1. Many large-scale Louisiana coast projects are in the planning stages, some of which will require enormous amounts of nourishment material. Resource estimates for the volumes of sand comprising the Ship Shoal structure are 1.2 billion cubic meters (m^3) ranging from very fine to medium sand, 112 million m^3 in the shoal crest; 430 million m^3 in the shoal front; and 640 million m^3 within the shoal base. An additional 123 million m^3 of sand is estimated to be contained as distributary channel fill deposits under the shoal (Penland, et. al., 1990). Table 3 presents estimates in cubic meters (m^3) and cubic yards (yd^3) of sand of the fine and very fine mean grain size category by section of the shoal or depositional environment.

Table 3: Ship Shoal resource estimates of beach quality sand contained in Ship Shoal by depositional environment in cubic meters and cubic yards
(based on Penland, et. al. 1990 and Byrnes. 1991)

Shoal crest	112, 000,000 m^3	146,500,000 yd^3
Shoal front	430,000,000 m^3	562,440,000 yd^3
Shoal base	640,000,000 m^3	837.120,000 yd^3
Ship Shoal (entirety)	1,200,000,000 m^3	1,569,700,000 yd^3

As one can see from Table 3 above, the shoal contains an extremely large volume of sand. In addition, the sand, by virtue of its "overfill factor" is an absolutely ideal source of material for the planned and anticipated projects. To determine suitability of a specific sand source for beach nourishment, the mean grain size of the source material should be close to or slightly larger than that occurring at the in-situ or target beach. The term "beach quality" sand commonly infers a significant or a high degree of similarity between the sediment textural parameters of the sand source (shoal or deposit) and the sand target (coastal beach). However, estimates of beach quality are often considered by assessing an "overfill factor". The "overfill factor" concept and determination methodology were developed to describe a measure of the amount of source material that would be required to be placed on a target beach to compensate for the losses that occur from natural winnowing processes along the shoreface. The overfill factor, R_A, represents the number of m^3 of material required to create 1 m^3 of in-situ beach when the beach is in a condition compatible with the native material. Overfill factors are expressed as a ratio

of a unit volume of natural or in-situ beach to a volume of source material required; the factor is commonly listed as the unit of fill volume required. McBride et al., (1989) used an overfill factor formula to calculate an overfill factor for the Isles Dernieres shoreline using sand from Ship Shoal. The calculated overfill factor was determined to be 1:1.03 or 1.03. Based on that overfill factor, Ship Shoal sand constitutes an excellent long-term source of sand for Louisiana beach nourishment projects. One complicating factor is the magnitude of oil and gas structures, platforms and pipelines, which are located on the shoal. This necessitates that only limited areas serve as sand borrow areas. Thus, large volumes of material may ultimately be removed from only certain blocks or zones. The collection and assessment of biological information, as well as very site-specific numerical modeling in the areas most likely to be utilized is critical if MMS is to assess the potential consequences of long-term use of the shoal. During the preparation of previous environmental assessments for Ship Shoal, MMS analysts have found very little information relative to benthic biology for the shoal and have to use information from either closer to the coast or further out.

In Fiscal Year 2003, MMS, in cooperation with the Florida Geological Survey (FGS), began research in a virtually unexplored area to evaluate potential offshore sand resources for beach restoration along portions of Florida's northeast coast. This includes the offshore area along Nassau, Duval, St. Johns, Flagler and Volusia Counties. More than 30 percent of the 148 shoreline miles in this study area is classified as critical eroding. The primary focus is on the area extending from 3 to 8 miles offshore. Year one of this investigation will encompass the coastal and offshore portions of Nassau and Duval Counties to further understand processes affecting the study area to be characterized. Florida's eastern coastline is in a state of constant change. Natural forces impacting this coastline include waves, wind, and a probable rise in sea level. These forces are especially active in the winter months when nor'easters (wind coming in from the northeast) may sit offshore for days at a time. Together with high tides, this results in severe beach erosion. Florida has been, and will continue to be, a major user of Federal sand. In 1995, MMS negotiated a non-competitive lease with the City of Jacksonville to obtain the use of 1.24 million cubic yards of Federal sand to nourish seven miles of beach from Atlantic Beach to Jacksonville Beach. The probable use of material from the sites which will be identified as a result of the present MMS/FGS effort require that MMS undertake a biological characterization/numerical wave modeling effort similar to that already accomplished for other OCS areas in the Atlantic and Gulf of Mexico.

The continued, long-term use of sand shoals on the OCS as sand borrow sites in general presents numerous issues relative to possible negative impacts to local biology and the physical environment. Sand shoals tend to be focal points for various fisheries, both recreational and commercial. Altering the physical characteristics of these areas (e.g., grain size, bathymetry, etc.) could result in deleterious effects on various fish species or disruptions in commercial fisheries and/or fishing activity. With the passing of legislation such as the Magnuson-Stevens Act, agencies such as the MMS are mandated to consider the effects of offshore activities such as dredge operations on essential fish habitat (EFH). Areas on the OCS which are often selected as potential sand sites are in many cases used by fish as migration corridors, habitat for juvenile development, and

spawning grounds. Migratory corridors are essential for many species of fish as they play a distinctive role in their reproductive cycle. Activities that adversely influence these uses, through disturbances in migration patterns and changes in substrate, water quality or acoustic parameters can directly result in a decrease of both recreational and commercial fisheries. MMS has actively been conducting field studies within shoal areas offshore Maryland/Delaware and Louisiana/Texas to examine the various fish habitats in areas where potential sand borrow areas have been identified. The site-specific fish habitat information being collected will be used extensively for the required EFH consultations during the negotiated agreement NEPA process. Largely unknown, however, is the function that benthic communities play in the transfer of trophic energy to fish populations. As noted above, the areas targeted as potential sand sources have traditionally been submerged shoals; these areas also happen to be areas where large populations of fish tend to congregate. If the amount of energy being transferred to bottom feeding fish populations from marine benthos is adversely impacted, than the impacts to fish populations may be greater than previously believed, particularly if a borrow site is used on a long-term basis.

The MMS often receives requests for use of offshore areas for which the MMS had no prior notice or knowledge or has not yet conducted environmental study. In many instances, there may be little or limited biological information available regarding the area prior to the initiation of a lease or negotiated agreement. For these areas, generic studies which provide information relevant to OCS resource areas can prove invaluable in assisting the MMS analysts during the required consultation processes and NEPA assessment. In Fiscal Year 2003, MMS, in cooperation with the United States Geological Survey's Biological Resources Division, initiated a compilation and analysis of known and historic assemblages of offshore sand banks in the Gulf of Mexico and along the U.S. East coast. The information will be organized to provide a spatially-explicit depiction of known benthic community structure within or near identified OCS sand and gravel resources and attempt to identify any links benthic assemblages may have to particular sediment types or bathymetric microhabitats. Results from the synthesis will be organized into an easily searchable database. This information will more readily validate findings from site-specific benthic studies of potential sand sources and provide MMS with information to make an educated assessment of the types of benthic assemblages that may reside in unsurveyed areas. This effort will certainly provide much needed information for MMS biological analysts to use during the NEPA process and may also identify other data gaps and information needs.

Previous studies have resulted in inferences to potential recolonization rates and suggest that an ecological relationship between benthic communities and the unique habitats of ridge and shoal features may exist. Pre-dredge characterization studies and literature synthesis are only an initial step in evaluating these relationships and assessing recovery rates of benthic populations. Studies investigating the recovery of benthic communities following dredging (Blake et. al., 1996; Newell et al, 1998; Van Dolah et al., 1992) have indicated that communities of comparable total abundance and diversity can be expected to recolonize dredge sites within several years. However, even though these recolonized communities may be similar in terms of total abundance and species diversity, their taxonomic composition, in terms of dominant species and species abundance, is often very different from pre- to post-dredging. The environment in which these studies were

conducted are, in many cases, different than those that are currently being utilized by MMS for beach renourishment. In order to properly assess the impacts to benthic communities as a result of dredging, benthic repopulation post-dredge surveys and monitoring studies of sand resource areas are needed to adequately assess the impact and recovery of dredged areas. A more detailed and focused understanding of the ecological relationship between the unique habitats of ridge and shoal features and the resident biological communities that utilize those habitats would provide for an even more complete and in-depth analysis when evaluating the consequences associated with dredging.

Dredging activities also have the potential to disrupt or adversely affect ongoing commercial fishing operations. These effects may include loss of fishing habitat as dredging operations remove valuable substrate or organisms essential to fish survival or spatial use conflicts. It would be highly advantageous to survey the available worldwide literature/database to ascertain whether or not adverse impacts have actually been noted in areas where commercial fish activity coincides/co-exists with offshore dredging operations and if mitigation measures have been implemented to avoid impacts. An analysis of the success or failure of such mitigation measures would assist the MMS in implementing mitigation measures here in the U. S. Adverse effects from offshore dredging activities should qualitatively be determined in order to develop appropriate mitigation measures.

Numerical wave modeling has been an invaluable tool in examining the potential effects of dredging on offshore shoals. In some cases, modeling indicates that long-term excavation of shoals in some areas can result in a deleterious wave climate and sediment transport regime, particularly during storm events. Wave modeling and sediment transport potential computations performed to assess the significance of impacts that would result from dredging sand at proposed sites offshore the central eastern coast of Florida determined that extractions on the order of six to nine million cubic yards from within sites offshore St. Lucie Inlet, could have significant potential impacts on the adjacent shoreline. Therefore, these sites may need to be redesigned so that their impacts fall within acceptable limits, most likely by limiting the maximum depth of excavation at the sites. A similar situation exists for the complex of ridges and troughs that extend southeast and offshore from Cape Canaveral which cause significant increase in wave heights as waves propagate over this area. Model results indicate that the potential for negative impact to the physical regime exists in this area from cumulative, large-scale dredging.

The modeling conclusions noted above certainly indicate that MMS must continue to use numerical wave modeling to examine the effects of dredging in site-specific areas as it is an invaluable tool in assessing the potential impacts of seabed bathymetric changes induced by dredging on the local wave climate. Various models using different algorithms have been developed which attempt to simulate the wave conditions in a given area before and after dredging. All of the available models have inherent strengths and weaknesses; some appear to overstate resident site-specific wave climates, some appear to be more accurate. For the most part, MMS has been employing Ref Dif-S and, most recently, STWAVE, both of which are two-dimensional spectral wave models that

incorporate the effects of shoaling, refraction, energy dissipation, and diffraction. Developed by the U.S. Army Engineering Waterways Experiment Station (WES), STWAVE v2.0 is a computationally efficient, steady state, spectral wave transformation model that is able to simulate wave refraction and shoaling induced by changes in bathymetry and by wave interactions with currents and includes a wave breaking model based on water depth and wave steepness (Stone and Xu, 1996).

MMS has actively been pursuing, in cooperation with WES, continual improvement and refinement of the STWAVE model. However, other models do exist and are in the process of development which might prove more accurate and efficient in simulating resident wave fields and conditions than STWAVE; one such model actively being used is the SWAN model. SWAN was developed at Delft University of Technology, Delft, The Netherlands. Like STWAVE, the formulation of SWAN is based on the spectral wave action balance equation. This model currently has many well developed features, which give the user many options on how each model run is executed. These features range from purely convenient options that allow several different formats for input and output data, to options that allow control of fundamental physical processes in the model, like wave generation, dissipation, and interaction. SWAN and STWAVE have many similarities. Unlike STWAVE, however, in SWAN it is possible to define different spectral conditions at different points along the open boundary of a model domain. This feature is most useful when nested grid runs are executed. A nested grid uses output from a grid that includes a larger physical domain, but at the same time has a much coarser grid mesh. Using nested grids, more detailed computations are possible, without requiring the same degree of detail throughout the computational domain. This approach can decrease the total computational time, with little sacrifice in accuracy (Kelley et al. 2001).

Refinements in both STWAVE and SWAN continue and other models are also in various stages of development. Obviously, the more adept a model is at simulating the resident wave field and local conditions, the more reliable the model results are, and thus, the more useful the information. Given that MMS is likely to continue using numerical wave modeling as a tool for physical impact evaluation of proposed dredging activities, the Agency must initiate a thorough evaluation, field-test, and validation of existing numerical wave models, particularly in areas of complex bathymetry where STWAVE experiences some degree of difficulty.

SECTION 2. Proposed Study Profiles

2.1 Introduction

Profiles of ongoing Sand and Gravel studies administered by Headquarters can be found at: http://www.mms.gov/eppd/sciences/esp/profiles/nt-sg.htm

This website is up dated regularly and includes:

- An updated status of each study.
- Report due dates.
- Related publications.
- Affiliated websites.

For all completed ESP Studies go to:
http://mmspub.mms.gov:81/
This has the Environmental Studies Program Information System (ESPIS). ESPIS provides access to all completed study products. ESPIS is a searchable, web-based, full text retrieval system allowing users to view reports online or download their complete text.

2.2 Profiles of Studies Proposed for the FY 2004 NSL

Table 4. Sand and Gravel Proposed Studies and Ranking for FY 2004.

Page #	Topic **	Title	Rank ***
13	S&G	Environmental Investigation of the Long-Term Use of Ship Shoal Sand Resources for Large-Scale Beach and Coastal Restoration in Louisiana	1
15	S&G	Utilization of Benthic Communities by Fish Populations on Submerged Shoals Along the U.S. East Coast and Gulf of Mexico	2
17	S&G	Worldwide Survey of Dredging Impacts on Commercial and Recreational Fisheries and Analysis of Available Mitigation Measures to Protect and Preserve Resources	3

** PO = Physical Oceanography FE = Fate & Effect BIO = Biology
PS = Protected Species SE = Social & Economic OT = Other
*** Rank 1 = highest and rank n = lowest. S&G = Sand and Gravel

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2004-2006

Region: Headquarters

Planning Area(s): Central Gulf of Mexico

Title: Environmental Investigation of the Long-Term Use of Ship Shoal Sand Resources for Large-Scale Beach and Coastal Restoration in Louisiana

Cost Range: $480,000 - $720,000 **Period of Performance:** FY 2004 - 2006

Description:

Background Geological and geophysical studies of Ship Shoal, offshore the central coast of Louisiana, have determined that the shoal's sand is an ideal source of material to place on the rapidly eroding Louisiana barrier islands. MMS is currently negotiating leases with the State of Louisiana and several other Federal Agencies for planned barrier shoreline/barrier island restoration projects. Many large-scale Louisiana coast projects are in the planning stages, some of which will require enormous amounts of nourishment material. Resource estimates for the volumes of sand comprising the Ship Shoal structure are 1.2 billion cubic meters (m^3) ranging from very fine to medium sand. One complicating factor, however, is the magnitude of oil and gas structures, platforms and pipelines, which are located on the shoal. This necessitates that only areas free of pipelines and structures serve as sand borrow areas. Thus, large volumes of material may ultimately be removed from certain blocks or zones.

In addition to the existence of numerous oil and gas-related structures, site-specific biological information is scarce and sketchy at best. In a Southwest Research study conducted by Baker and others in 1981, samples from the Louisiana continental shelf (LCS), including Ship Shoal, were studied to determine the ecological effects of petroleum production platforms in the central Gulf of Mexico. The sampling stations for Ship Shoal, located in the vicinity of one platform, were located roughly 27km (17 miles) from the shore, in approximately six meters of water depth. Results from this study indicated that the benthic communities of the Ship Shoal varied from that found throughout the LCS. This data is not sufficient to properly assess impacts to the local biology given the probable long-term use of the shoal as a sand resource area.

Physical field and numerical modeling studies conducted on Ship Shoal indicate that it exerts a significant influence on regional hydrodynamics, reducing wave energy and modulating current velocity, particularly during storm events (Stone and Xu, 1996; Stone et al, 2001). Although wave modeling results show favorable results relative to potential effects of sand extraction on the local wave climate, Stone (2001) recommends site-specific numerical modeling, using state-of-the-art models such as SWAN when the precise volumes and dimensions of borrow sites are finalized, particularly for large-scale, cumulative events.

Objectives The objectives of the study are to provide biological, physical, and other pertinent information which can be used by MMS analysts during the evaluation of impacts associated with large-scale, cumulative extraction of sand from blocks which located on Ship Shoal.

Methods The study will involve the collection of site-specific biological information (infauna and epifauna) from within blocks identified as the most likely areas to be used as a source of sand on a long-term basis. Site-specific numerical wave modeling, using fine-mesh sub-grids, will also be performed using a state-of-the-art model such as SWAN or the enhanced version of STWAVE to evaluate the cumulative effects of large-scale sand extraction from within the most likely targets. An evaluation of the potential areas which can be exploited give the complexity of oil and gas structures (pipelines, platforms, etc.) will also be accomplished, given the geology of the shoal and usable sand thicknesses in site-specific areas.

Products Technical reports, numerical wave modeling outputs, maps showing zones of possible targets for sand extraction relative to the location of oil and gas infrastructure; refereed journal articles.

Importance to MMS The collection and assessment of biological information, as well as very site-specific numerical modeling in the areas most likely to be utilized is critical if MMS is to assess the potential consequences of long-term use of the shoal. During the preparation of previous environmental assessments for Ship Shoal, MMS analysts have found very little information relative to benthic biology for the shoal and have used information from either closer to shore or offshore of the shoal proper. Numerical modeling has also only been performed on a regional, shoal-wide basis.

Date Information Required: Several negotiated agreements are already being considered for the use of Ship Shoal as a source of sand for nourishment activities. Ship Shoal is the only viable, compatible, large-scale source of sand for planned Louisiana barrier island/barrier shoreline restoration and nourishment. Future requests for negotiated agreements will continue to be submitted, some of which may require enormous amounts of sand. The information collected from this analysis is needed as soon as possible and will be used for environmental analyses required under the National Environmental Policy Act.

Revised date: 01/24/03

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2004-2006

Region: Headquarters

Planning Area(s): To Be Determined

Title: Utilization of Benthic Communities by Fish Populations on Shoals along the U.S. East Coast and Gulf of Mexico

Cost Range: $360,000-540,000 **Period of Performance:** FY 2004-2006

Description:

Background The MMS/State Geological Task Forces continue to find viable sources of sand for coastal restoration activities. Requests for negotiated agreements along the Eastern and Gulf coasts of the United States for the use of identified OCS sand resources offshore are expected for the indefinite future. In response to these requests the MMS funds biological studies to assess the potential impacts of sand mining on biological communities of offshore borrow areas. Although short-term loss and changes in benthic community structure have been documented to occur following sand dredging, studies of the recovery of soft substrate benthic communities following dredging have indicated short-term loss and changes to the benthic communities. Communities of comparable total abundance and diversity can be expected to re-colonize dredge sites within several years. However, even though these re-colonized communities may be similar in terms of total abundance and species diversity, their taxonomic composition, in terms of dominant species and species abundance, is often very different from pre- to post-dredging. The ecological significance of these changes to the benthic community is uncertain, given the current scientific knowledge.

The potential effects to fisheries from sand dredging are unknown, having been identified in most of the environmental impact assessments prepared for OCS sand dredging to be minimal or non-existent. This assessment has been based on the determination that most of the fish inhabiting the potential dredge areas were characterized as wide-foraging or migratory, spending only part of their life cycle in the dredge borrow area. In addition, the ridge/shoal and shelf features identified as potential sand borrow areas are very large in geographic extent, extending over kilometers of seafloor and the potential borrow area for each dredging event is relatively small. Therefore the lost or altered habitat area, overall, would probably be minimal.

Excluding the potential effects of lost essential habitat as a result of dredging, the greatest potential effect to the fish community utilizing a dredge borrow area is alteration in trophic energy transfer from the benthos to the fish population, more commonly known as changes in the food-web. If the amount of energy being transferred to the fish population from the benthos is less than what is currently being provided by the area before dredging, then the potential long-term and cumulative ecological impacts of sand dredging may be far greater than predicted to date, a condition that may be unacceptable as more sites along the coast are dredged and others are dredged on a regular basis.

Stable isotope ratios of organisms provide valuable clues to the carbon sources of their diets. Carbon stable isotope ratios change only slightly with transfer between trophic levels, so changes in primary producers that fix carbon could be detected. Nitrogen isotopes show larger changes with each trophic transfer, and they have been used to establish trophic level. Because stable isotopes from food items are incorporated into the bodies of consumers with only small changes, the isotopic signatures of consumers reflect the food they have consumed. This allows stable isotope data to be used to describe trophic pathways (Cabana and Rasmussen, 1996; Fry, 1999; Hansson et al., 1997; Peterson, 1999; Pinnegar and Polunin, 2000). The ultimate focus of this proposed effort is to assess the trophic transfer of energy to the resident fish population, rather than to assess changes in the resident fish community.

Objectives The purpose of this study is to:
1) Determine if the relationship of carbon and nitrogen stable isotopes and trophic level improve the scientific knowledge of how the alteration of organic matter and benthic invertebrate communities affect the population of bottom feeding fish in an anthropogenically disturbed and recovering area of the ocean.

2) Evaluate the trophic transfer of energy from benthic communities to bottom feeding fish populations that utilize offshore shoal and ridge features.

3) Evaluate the likelihood of adverse impacts to fish populations from offshore dredge operations given potential impacts to the trophic transfer of energy to bottom feeding fish populations.

Methods Grab samples and trawls will be used during field collection of data. Analysis of stomach content, stable isotopes, biomass, and secondary production will be used in evaluating trophic energy transfer.

Products A final report, final technical report, non-technical report, matrices and a refereed scientific journal article.

Importance to MMS The MMS recognizes that currently available information is insufficient to fully understand the impacts of dredge operations on fish populations that utilize offshore borrow areas. A better understanding of how dredge operations affect fish populations is needed to ensure that dredge operations are accomplished in a manner that is environmentally responsible, especially for borrow areas are expected to be used on a continual basis. Information generated from this study will aid MMS in better understanding the impacts of sand mining on fish populations and assist MMS in meeting the requirements of NEPA and the Magnuson-Stevens Fishery Conservation Act.

Date Information Required: Requests for multiple negotiated agreements along the Eastern and Gulf coasts of the United States have already occurred. NEPA documents will need to be prepared to support negotiated agreements in FY2003 and beyond, as the Geological Task forces identify potential new sources of sand for beach and coastal restoration.

Revised date: 01/23/03

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2004-2006

Region: Headquarters

Planning Area(s): Generic - Applicable to All Planing Areas

Title: Worldwide Survey of Dredging Impacts on Commercial and Recreational Fisheries and Analysis of Available Mitigation Measures to Protect and Preserve Resources.

Cost Range: $120,000 – $180,000 **Period of Performance:** FY 2004

Description:

Background One of the primary uses of the OCS is fishing. Sand shoals that are desirable as potential sand borrow areas for beach nourishment frequently are also focal points for various fisheries, both commercial and recreational. Areas identified as potential sources of offshore construction aggregate are also, in many cases, important commercial or recreational fishery zones. As the MMS sand and gravel program expands in scope, the necessity of managing offshore resources to support and sustain these multiple types of use is increasing.

Due to the fact that there are large variations in fisheries at any given location, the physical settings in which dredging might occur, and the kinds of gear and methods used for fishing, analysis of a large cross-section of past studies is needed to aid the prediction of impacts and how those impacts may be mitigated. In addition, it is important to know how effective past mitigation measures have been in order to apply the most effective measures in projects regulated by MMS.

Objectives The purpose of this study is to establish a background that can facilitate in assessing the environmental impacts of beach nourishment activities on commercial and recreational fisheries. In addition, the study will provide a comprehensive list of detailed migration measures that can be applied to avoid adverse impacts to fisheries that may be present in sand resource areas, regardless of geographic location.

Methods A world-wide literature survey will be conducted that will entail analysis and review of the current literature base and other material from private, academic and governmental sources by qualified fisheries scientists and various marine experts.

Products Final technical report with associated charts, matrices, maps, tables, etc.

Importance to MMS The results will enable MMS, in its role of environmental manager and steward, to identify and minimize potential adverse impacts to commercial and recreational fisheries as a result of nourishment activities. This has been a major issue for many of the shoal areas which have been identified as sources of sand for nearby beach restoration projects. The results will assist MMS decision-makers in developing appropriate lease stipulations to mitigate potential adverse impacts to fishery resources.

Date Information Required: Numerous negotiated agreements are already being considered for the use of offshore shoal areas as a source of sand for nourishment activities. Future requests for such agreements will continue to be submitted. The information collected from this analysis will be used for environmental analyses required under the National Environmental Policy Act.

Revised date: 01/21/03

2.3 Profiles of Studies Proposed for the FY 2005 NSL

Table 5. Sand and Gravel Proposed Studies and Ranking for FY 2005.

Page #	Topic **	Title	Rank ***
21	S&G	Biological Characterization/Numerical Wave Model Analysis within Identified Borrow Sites Offshore the Northeast Coast of Florida	1
25	S&G	Investigation of Benthic Assemblages on Offshore Ridge and Shoal Features	2
27	S&G	Numerical Wave Modeling Analysis and Enhancement	3

** PO = Physical Oceanography FE = Fate & Effect BIO = Biology
PS = Protected Species SE = Social & Economic OT = Other
*** Rank 1 = highest and rank n = lowest. S&G = Sand and Gravel

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2004-2006

Region: Headquarters

Planning Area(s): South Atlantic

Title: Biological Characterization/Numerical Wave Model Analysis within Identified Borrow Sites Offshore the Northeast Coast of Florida

Cost Range: $400,000 - $600,000 **Period of Performance:** FY 2005 - 2007

Description:

Background In Fiscal Year 2003, the Florida Geological Survey, in cooperation with MMS, began conducting research to evaluate potential offshore sand resources for beach restoration along portions of Florida's northeast coast. This includes the offshore area along Nassau, Duval, St. Johns, Flagler and Volusia Counties. More than 30 percent of the 148 shoreline miles in this study area is classified as Critical Eroding. The primary focus is on the area extending from 3 to 8 miles offshore.

Florida's eastern coastline is in a state of constant change. Natural forces which impact this coastline include waves, wind, and a probable rise in sea level. These forces are especially active in the winter months when nor'easters commonly sit offshore for days at a time which, together with high tides, results in severe beach erosion. The presence of numerous inlets, structures, and complex topography in certain areas certainly influences local wave, current, and sediment transport patterns. Wave modeling and sediment transport potential computations performed for MMS to assess the significance of impacts that would result from dredging sand at proposed sites offshore the central eastern coast of Florida determined that certain volumes of extractions from within sites offshore St. Lucie Inlet and offshore from Cape Canaveral could result in significant increases in wave heights as waves propagate over these areas. (Kelly et al, 2001). The same conditions may exist for areas along the northeast coast of Florida. In addition, for previous NEPA assessments offshore Florida, little or no site-specific biological information has been available to use during the required environmental evaluations.

Objectives The purpose of the study is to address environmental concerns, prior to actual dredging of the identified sand resource areas, the likelihood of adverse environmental impacts on resident biological organisms and on the local wave climate and sediment transport regime from sand dredging for the purposes of beach renourishment. The information provided from this study will be used to prepare environmental analyses to meet the requirements of current environmental laws and legislation and incorporate results, as appropriate in lease requirements for the dredging of OCS sand.

Biological Objectives:

- Compile and synthesize existing oceanographic literature and data sets to develop an understanding of the baseline benthic ecological conditions on and around potential sand borrow areas.
- Conduct biological field data collection efforts to supplement those existing resources.

- Analyze the biological field data in conjunction with existing literature to characterize and evaluate the present infauna, epifauna, demersal fishes and sediment grain size in proposed borrow areas.
- Address the potential effects of offshore sand dredging on benthic communities including an analysis of the potential rate and success of recolonization following cessation of dredging.
- Develop a time schedule of environmental windows that best protects benthic and pelagic species from adverse environmental effects.
- Develop a document summarizing the above information to assist decision-makers in preparing an environmental analysis that meets the requirements of the National Environmental Policy Act.

Physical Objectives:

- Examine the potential for alteration in the local wave field following dredging and the excavation of sand from within the identified sand borrow sites offshore the northeast coast of Florida.
- Explore the potential for increased wave action after dredging within identified borrow sites and any resultant adverse localized changes in erosional patterns and longshore coastal transport which could result in significant losses of beach sand after renourishment.
- Examine the potential for changes in local sediment transport rates as a result of altering the local bathymetry, particularly in light of the recent studies which indicate that bathymetry does influence the manner in which waves approach the shoreline during storm events.
- Examine the cumulative physical effects of multiple dredging events within the identified borrow sites.

Methods

Biological: To evaluate the possible biological impacts associated with dredging, the present condition of benthic and fish assemblages will be characterized and interpretations will be developed to assess those impacts. The characterization of benthic communities will be done using existing literature, collection of field data and laboratory analysis. Grab samples, trawls, sediment profiling cameras, water column profiles and other current sampling techniques will be used to characterize the benthic biology in the field. The structure of benthic communities and fish assemblages will be analyzed for diversity, evenness, species richness, biomass, taxonomic composition, gut content, and secondary production, etc. Community cluster analysis will be performed as well. An evaluation of the potential environmental impacts to the biological community will be conducted by making inferences and interpretations based on the field data, laboratory analysis, historical information, past studies and the most recent scientifically accept theories and models.

Physical: To evaluate the possible physical impacts associated with dredging of identified borrow sites, wave transformation modeling and sediment transport potential calculations will be performed for 1) present existing conditions, and 2) present conditions with the proposed excavations sand from the identified borrow sites. Comparison of computations for existing and post-dredging conditions illustrate the relative impact of borrow site excavation on wave-induced

coastal processes. Nearshore wave heights and directions along the shoreline landward of the proposed borrow site will be estimated using a state-of-the-art spectral wave model (STWAVE or SWAN), which will be used to simulate the propagation of offshore waves to the shoreline. Offshore wave data, available from offshore wave buoys maintained by the National Data Buoy Center (NDBC) will be used to derive input wave conditions for the model used.

Products Cruise and field reports, final technical and non-technical report, refereed scientific journal article upon project completion, GIS data, metadata, habitat maps of benthic biological communities and fish resources, pre- and post-dredging numerical wave model outputs

Importance to MMS The State of Florida and local jurisdictions will certainly be requesting negotiated agreements from the MMS for the use of OCS sand resources offshore the northeast coast for beach nourishment, especially as resources in State waters run dry. One such area in Federal waters has already been used to renourish Jacksonville Beach. The information gathered from this study is crucial in properly undertaking the required environmental assessments for proposed site-specific beach nourishment projects and will be used in developing/incorporating environmental stipulations in negotiated leases to protect the environment.

Date Information Required: Requests from the State and local jurisdictions to use these sites is expected within 5 to 6 years; a NEPA analysis will need to be completed in advance of any negotiated agreements.

Revised date: 01/24/03

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2004-2006

Region: Headquarters

Planning Area(s): Generic - Applicable to All Planning Areas

Title: Investigation of Benthic Assemblages on Offshore Ridge and Shoal Features

Cost Range: $280,000 – $420,000 **Period of Performance:** FY 2005 - FY2007

Description:

Background In Fiscal Year 2003, MMS, in cooperation with the United States Geological Survey's Biological Resources Division (USGS-BRD), initiated a compilation and analysis of known and historic assemblages of offshore sand banks in the Gulf of Mexico and along the U.S. East coast. The objectives of the study are as follows:

- Conduct a comprehensive and intensive search of the existing literature base and data sets relative to benthic communities that utilize offshore ridge and shoal features along the Gulf of Mexico and the U.S Eastern coast.

- Characterize and develop, as information allows, an understanding of the benthic communities which utilize offshore ridge and shoal features, particularly in regards to small-scale relief that exists within the topographic features.

- Investigate and depict the spatial and temporal patterns of benthic communities that inhabit and utilize these topographic features.

- Identify any relationship(s) between benthic community structure and ridge/shoal features.

- Identify data gaps in the current understanding of benthic assemblages on natural sand bank areas and the relative impact of dredge operations on benthic communities that utilize ridge and shoal features.

Information will be gathered regarding benthos abundance, community structure, and/or biomass. Information related to the mapping of micro-relief, bathymetry, and habitat heterogeneity in the identified areas will also be gathered. The acquired information will be organized to provide a spatial depiction of the unknown benthos in identified sand borrow areas. Furthermore, all information pertaining to the above objectives will be entered into an easily searchable database providing MMS analysts with access to information needed to make informed management decisions.

Objectives Results from the MMS/USGS-BRD study will inevitably identify data deficiencies and pose scientific questions that remain to be answered. In order to continue building and expanding the current scientific knowledge of the benthic ecology residing in potential offshore

sand banks, these questions will need to be investigated and data gaps filled. The MMS anticipates that, by conducting studies such as these, in conjunction with other relevant and site-specific studies, a more detailed understanding of the ecological relationship between ridge/shoal features and the resident benthic communities that utilize those habitats can be attained.

Methods Methods will be formulated following completion of the MMS/USGS-BRD study entitled, *"The benthic community of offshore sand banks: a literature synopsis of the benthic fauna resource in potential MMS OCS sand borrow areas*". Field surveys and data collection methods are likely to include grab sampling, still photographs, sediment profiling imagery, and benthic sled video.

Products Technical reports, biological field reports, field data, maps of benthic habitats, spatial data files, photos and video data and information.

Importance to MMS The MMS recognizes that currently available information is insufficient to fully understand the benthic ecology of offshore ridge and shoal features. A better understanding of how bathymetric features unique to offshore ridges and shoals influence benthic habitats is needed to ensure that dredging activities are accomplished in a manner that is environmentally responsible. This information will be used in conjunction with previous and ongoing MMS studies to develop a greater understanding of the importance of shoal ecosystems and the impacts of dredge operations on them.

Date Information Required: Information from this study will build upon currently ongoing studies and therefore should not be conducted until those studies are completed. However, requests for negotiated agreements to use OCS sand along the East and Gulf coasts of the United States are expected to continue. NEPA documents will be required to support negotiated agreements.

Revised date: 01/30/03

ENVIRONMENTAL STUDIES PROGRAM: Studies Development Plan FY 2004-2006

Region: Headquarters

Planning Area(s): Generic – Applicable to All Planning Areas

Title: Numerical Wave Modeling Analysis and Enhancement

Cost Range: $200,000 - $300,000 **Period of Performance:** FY 2005

Description:

Background MMS uses numerical wave modeling to examine the possible effects of dredging on the local wave climate in site-specific areas. Various models using different algorithms have been developed which attempt to simulate the wave conditions in a given area before and after dredging. All of the available models have inherent strengths and weaknesses; some appear to overstate resident site-specific wave climates, some appear to be more accurate. MMS initially relied on fairly simple monochromatic models which could only account for one wave approaching an area from one direction. Now that we have increased computational power, MMS has been employing Ref Dif-S and, most recently, STWAVE, both of which are two-dimensional spectral wave models that incorporate the effects of shoaling, refraction, energy dissipation, and diffraction and can account for the effects of multiple waves approaching from many directions. Developed by the U.S. Army Engineering Waterways Experiment Station (WES), STWAVE v2.0 is a computationally efficient, steady state, spectral wave transformation model that is able to simulate wave refraction and shoaling induced by changes in bathymetry and by wave interactions with currents and includes a wave breaking model based on water depth and wave steepness (Stone and Xu, 1996).

MMS has actively been pursuing, in cooperation with WES, continual improvement and refinement of the STWAVE model. However, other models do exist and are in the process of development which might prove more accurate and efficient in simulating resident wave fields and conditions than STWAVE; one such model actively being used is the SWAN model. SWAN was developed at Delft University of Technology, Delft, The Netherlands. Like STWAVE, the formulation of SWAN is based on the spectral wave action balance equation. This model currently has many well developed features, which give the user many options on how each model run is executed. These features range from purely convenient options that allow several different formats for input and output data, to options that allow control of fundamental physical processes in the model, like wave generation, dissipation, and interaction (Maa and Kim, 2000). SWAN and STWAVE have many similarities. Unlike STWAVE, however, in SWAN it is possible to define different spectral conditions at different points along the open boundary of a model domain. This feature is most useful when nested grid runs are executed. A nested grid uses output from a grid that includes a larger physical domain, but at the same time has a much coarser grid mesh. Using nested grids, more detailed computations are possible, without requiring the same degree of detail throughout the computational domain. This approach can decrease the total computational time, with little sacrifice in accuracy (Kelley et al. 1999).

Objectives The objectives of the study are to analyze available and developing numerical wave models in light of the MMS mission/impact assessment process and provide a thorough evaluation of each. The analysis should result in a recommendation as to the best model for MMS use, outline possible improvements to the selected model, and begin to implement those improvements.

Methods Several state-of-the-art numerical wave models will be obtained, configured and run for a selected OCS sand borrow sites where sufficient physical field information is available. The wave field predicted by the models will be compared against actual field conditions for validation.

Products Final technical and non-technical reports, refereed scientific journal article upon project completion, numerical wave model outputs

Importance to MMS The coastal states along the Atlantic and Gulf coasts will continue to look towards the OCS as a source of sand for beach nourishment, especially as resources in State waters run dry. The MMS/State cooperative efforts continue to conduct geological and geophysical efforts to define new borrow areas in Federal waters. Refinements in numerical wave models continue and other numerical models are also in various stages of development. Obviously, the more adept a model is at simulating the resident wave field and local conditions, the more reliable the model results are, and thus, the more useful the information. Given that MMS will continue using numerical wave modeling as a tool for physical impact evaluation of proposed dredging activities, the Agency must initiate a thorough evaluation, field-test, and validation of existing numerical wave models, particularly in areas of complex bathymetry where the currently used model, STWAVE, experiences some degree of difficulty. The information gathered from this study is crucial in properly undertaking the required physical environmental assessments for proposed site-specific beach nourishment projects and will be used in developing/incorporating environmental stipulations in negotiated leases to protect the environment.

Date Information Required: Requests from the State and local jurisdictions to use OCS sites as sand borrow areas will continue into the foreseeable future. The information is required to continue to incorporate the best available information and analysis into the required environmental assessments that need to be completed in advance of any negotiated agreements.

Revised date: 01/24/03

SECTION 3. MMS Sand and Gravel Program Topical Areas for FY 2006

3.1 Biological Characterization/Numerical Wave Modeling Within Potential OCS Sand Borrow Areas in Frontier OCS Areas

OCS sand will continue for many years to serve as a primary and emergency source of material for beach nourishment and coastal restoration along the Atlantic and Gulf of Mexico coasts. The MMS and the various coastal states, through the cooperative MMS/State Task Forces are continuing the collection of geological and geophysical data and information to identify new sources of clean, compatible sand. Identification of new sites will result in the need for site-specific environmental data to assist MMS analysts during assessment of the potential short and long-term impacts of dredging activities on local biological communities. Additional information needs include the effects of dredging on local wave and current patterns (particularly during intense storm events since studies indicate that shoal features may influence how waves approach the shore during storm events), and on nearshore sand supply/longshore transport processes. Without this information, specific requests for negotiated leases for specific nourishment/restoration projects cannot be adequately addressed. Likely areas needing site-specific environmental information include South Carolina, Offshore Folly Beach, North Carolina, Offshore Bogue Banks, and Southern California.

3.1.1 South Carolina, Offshore Folly Beach

Folly Beach is a rapidly eroding barrier island located just south of Charleston, South Carolina (Figure 2). This erosion is believed to be caused by the Charleston Harbour Jetties which block the longshore drift of sediment from northern coastal areas and river deltas. The City of Folly Beach, including Folly Beach County Park, was renourished in 1993 using sand from the Folly River. However, some researchers believe that dredging sand from the Folly River and Stono Inlet has upset the natural sediment/sand supply balance of the area.

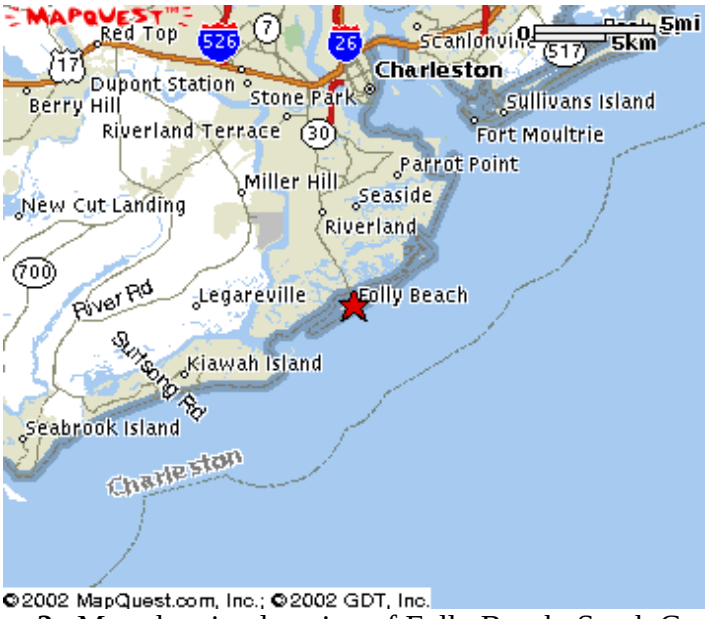

Figure 2. Map showing location of Folly Beach, South Carolina

While the 1993 project has performed fairly well outside of the county park area, erosion within the park has been extreme in recent years. Several small emergency renourishment projects have been constructed here, but a larger-scale solution is needed as soon as possible. Maintenance renourishment may also be needed for all of Folly Beach as well within the next 2-3 years, as the 1993 project reaches the end of its 8-year design life. Both the state and federal governments are committed to beach nourishment here and a long-term maintenance program exists which outlines sand requirements for the next 50-years. A substantial volume of sand may exist in Federal waters that may be suitable for use as beach nourishment material for Folly Beach. The MMS/State of South Carolina Cooperative Task Force is continuing to collect geological and geophysical data and information to better define potential borrow sites.

3.1.2 North Carolina, Offshore Bogue Banks

The State of North Carolina/MMS Task Force and the U.S. Army Corps of Engineers have been discussing the need for identifying new OCS sources of material for beach and coastal restoration offshore the central and southern coasts of North Carolina. The beaches of Bogue Banks in North Carolina have suffered considerable damage over the past several years from storm-related erosion. Bogue Banks is a moderately developed barrier island located along the central North Carolina coast in the northern portion of Onslow Bay between Cape Lookout and Cape Fear (Figure 3).

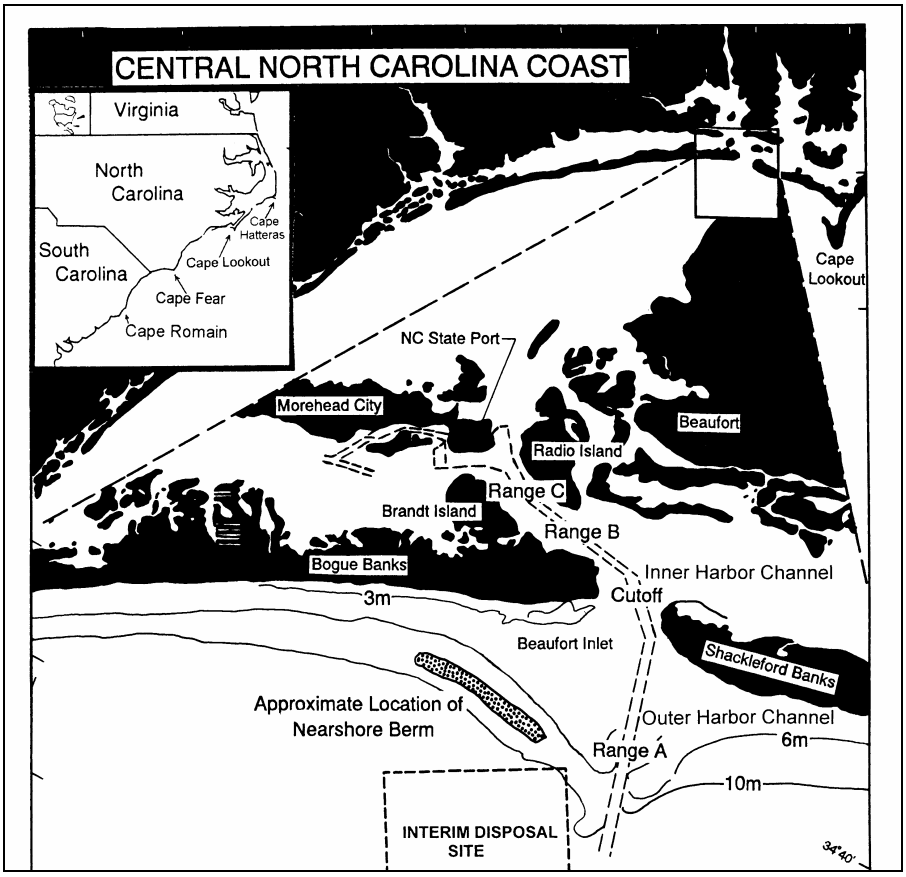

Figure 3. Map showing location of Bogue Banks, North Carolina

A recently completed study concluded that the Bogue Banks area has now returned to an erosional stage, most likely from reductions in sediment supply. This erosion will be exacerbated should another major storm hit the area. The same study concluded that offshore bathymetry significantly impacts nearshore wave height, wave angle, and the forcing of nearshore currents, particularly during storm events (Roessler and Wells, 2001). The State of North Carolina/MMS Task Force, in consultation with Carteret County, North Carolina has begun collecting geological/geophysical data and information offshore the southern coast of the State in order to identify potential sources of beach quality sand in Federal waters. The county is committed to recovering from the storm damage and mitigating future degradation of the local beaches through an extensive beach nourishment program, but will need new sources of sand to undertake planned projects.

3.1.3 Southern California

The Chief of the MMS Leasing Division and a staff geologist met with representatives from agencies of the State of California and the USACE South Pacific Region, Los Angeles and San Francisco District in San Francisco, CA on January 14 2003 to discuss topics of mutual interest related to continental shelf sand resources and the need for beach quality sand for possible use in beach restoration public works projects along the California coast. According to the California Coastal Coalition, more than 85% of California's shoreline is actively eroding. Public beaches have been experiencing massive losses of sand due to intense coastal erosion and inland development during the past century. Dams and other flood control measures have decreased the natural sediment

supply to the coast, while jetties and breakwaters have blocked longshore sand movement. There are numerous severe beach erosion problems in California at several local and regional sites.

Discussions at the meeting (which included the Department of Boating and Waterways, the California Governmental agency with prime responsibility for public beaches) focused on identification of areas for possible cooperative efforts pertinent to California beach restoration public works projects planned in the future and it is likely that MMS and the State will soon develop a cooperative program to identify and to assess the potential sand sites or shelf sand bodies. Based on the consensus at the meeting, San Diego, Orange County, Ventura and Los Angeles Counties will be the likely areas of study. Beach conditions and the need for sand seem especially critical at Surfside and Sunset Beaches in Orange County (Figure 4) and most of the beaches in San Diego County (Figure 5).

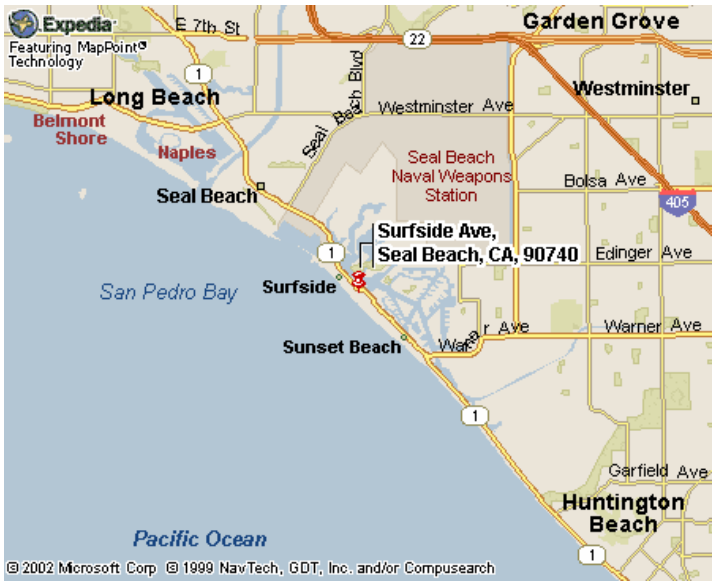

Figure 4. Location of Surfside and Sunset Beaches in Orange County, California

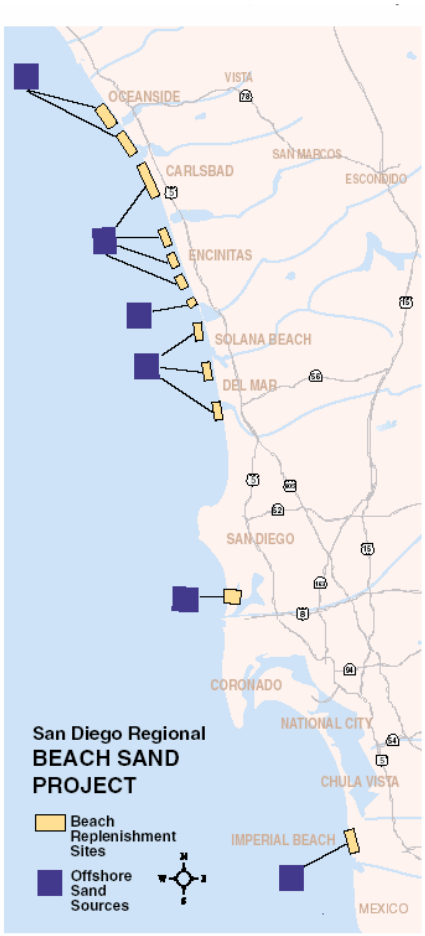

Figure 5. Map showing location of major beaches in San Diego County, California (Note: Offshore sand sources noted in figure are in State waters)

3.2 Non Site-Specific/Generic Issues/Studies

Generic studies which take an overview approach by focusing on collecting available information and literature and on the general nature of available technologies and mitigation have been invaluable in allowing the MMS to evaluate the environmental impacts associated with offshore dredging and the manner by which potential impacts can be avoided or minimized.

3.2.1 Physical and Biological Implications of Using Buried Channel Deposits and Other Non-Topographic Offshore Features as Beach Nourishment Material

Geological and geophysical information has resulted in the identification of potential sand borrow areas in Federal waters which are not associated with topographic features such as the offshore shoals which are presently the primary target for local, Federal, and State authorities needing sand for beach nourishment projects. Significant quantities of sand suitable for beach nourishment have been found in surficial Holocene deposits on the inner continental shelf off the Delmarva coast. These deposits are highly variable in thickness, areal extent and grain size. Such characteristics can make sheets sands difficult to dredge. Sand may also be found as fill in paleochannels. The channels were formed by rivers and inlets, and have subsequently filled with sediment. However, channels are limited in size, and are usually buried under a significant thickness of overlying sediment. Like sheet sands, these qualities make channel deposits difficult to dredge. Nonetheless, these deposits do represent a viable source of sand for use in beach nourishment efforts. In fact, for the recent Holly Beach, Louisiana project, a buried channel deposit in Peveto Channel was used. An average of 6ft of fine silt and clay overlies the sand deposit and approximately 0.5 million cubic yards of fine sand and clay was dredged and side cast in order to dredge the underlying clean sand for the project. The overburden was side cast outside the borrow area limits. These types of deposits have very different resident biological communities than the shoal-type deposits which may be impacted quite differently during a typical dredging operation. In addition, the taking of the deposits could leave a sizable depression in the seafloor which could result in adverse changes in the local wave climate and sediment transport regime. These factors and the biological and physical impacts associated with the use of these deposits must be thoroughly investigated before negotiating leases for planned beach nourishment projects.

3.2.2 Physical Implications of Using Shore-face Attached Sand Ridges as a Source of Borrow Material for Beach Restoration Projects

The shore-face attached sand ridges at the False Cape area, offshore southeastern Virginia and off the southern shore of Long Island, New York are currently being investigated as a source of sand for nearby beach nourishment projects. These types of ridges exist elsewhere along the Atlantic and Gulf coasts. Studies indicate that these ridges are in many instances associated physically with the adjacent barrier island system and barrier inlets and will continue to form in the future providing there is enough sand available for ridge formation (Hayes and Nairn, in-press). Also, numerous studies have shown that wave-generated currents and storm-generated flows impact the ridges several times a year.

Several investigators have noted that there could be significant consequences associated with the extraction of sand from these ridges, including increased rates of coastal erosion landward. Many of the ridges are thought to be a major source of sediment for the beaches themselves. Preliminary wave modeling for the ridges offshore Long Island suggests that many of these sand ridges focus wave energy and thereby control patterns of sediment transport and erosion along the adjacent barrier-island system (Schwab et al., 2001).

From a physical impact perspective, the disappearance or deflation of these shoal features could have serious consequences. This outcome could result in dramatic change to wave patterns between the shoal and the shoreline. In turn, this could lead to a change in longshore and cross-shore sand transport patterns and changes in shoreline erosion and accretion rates.
The possibility that these ridges might deflate or disappear as a consequence of dredging, resulting in dramatic changes in wave conditions along the shore, is therefore, a major concern. The application of a spectral or phase-resolving wave model combined with two-dimensional hydrodynamic and sand transport models represents a viable method to evaluate this potential impact of dredging.

3.2.3 Analysis and Recommendations for the Use of Environmental Windows for Federal OCS Sand Borrow Areas

Environmental windows are periods in which the adverse impacts associated with dredging can be reduced below critical thresholds. For example, seasonal restrictions can be applied, and dredging activities prohibited, when the perceived increase in potential harm to aquatic resources is above critical thresholds. Windows are an intuitively simple means of reducing risk to biological resources from stressors generated during dredging activities, including entrainment of fish eggs and larvae, resuspension of buried contaminated sediments, habitat loss, and collisions with marine mammals. The use of windows as a management tool, however, can have significant cost implications. For example, windows can prolong completion of dredging projects, delay project deadlines, and increase risk to dredging personnel by shifting dredging to periods of potentially inclement weather and sea states.

Because both recommendations to impose environmental windows and the cumulative economic impact of their application are increasing, the USACE requested that the National Research Council's Transportation Research Board–Marine Board form a committee of experts to conduct a workshop to explore the decision-making process for establishing environmental windows and provide suggestions for improving the process. In 2001, the committee published a final report in which they outline a proposed process for setting, managing, and monitoring environmental windows (National Academy Press, 2001).

MMS has been funding the synthesis of information, as well as the collection of new biological and physical data in site-specific areas identified as potential sand borrow

areas. This information, plus other existing information, might be used effectively in the application of environmental windows for planned beach nourishment projects. A comprehensive analysis of the use of environmental windows and the Marine Board's proposed process during the MMS negotiated lease process should be initiated prior to application.

3.2.4 Analysis/Review of Contaminated Sediments in the United States: Protocols and Mitigation Measures

Over the past several decades the OCS has been used as a dumping ground for contaminated materials and subjected to intense industrial petroleum activity. As a result, some areas of potential sand sources are now contaminated or reside in the near vicinity of such materials or activity, particularly in the Gulf of Mexico and the Northeast Coast. The OCS is also an important commercial and recreational fishery zone for many coastal communities, not to mention its importance as a juvenile fish and feeding/breeding habitat. The disturbance of contaminated sites by offshore activities, and subsequent bathymetric changes, such as the lowering of sand ridges, could lead to the transport and diffusion of contaminates to the water column affecting marine life and coastal communities directly and indirectly. Therefore, a possible area of study would involve the development of proper protocols for pre-dredging surveys of contaminated sites and recommendations for mitigation measure during dredge operations.

3.2.5 Analysis of Dredging Impacts on Juvenile Fish and Fish Migration Patterns on the OCS

With the passing of revised legislation such as the Magnuson-Stevens Act, agencies such as the MMS are mandated to consider the effects of offshore activities such as dredge operations on fisheries. Areas on the OCS which are often selected as potential sand sites are in many cases used by fish as migration corridors, habitat for juvenile development, and spawning grounds. Migratory corridors are essential for many species of fish as they play a distinctive role in their reproductive cycle. Activities that adversely influence these uses, through disturbances in migration patterns and changes in substrate, water quality or acoustic parameters can directly result in a decrease of both recreational and commercial fisheries. Adverse effects from offshore dredging activities should qualitatively be determined in order to develop appropriate mitigation measures.

3.2.6 Examination of the Long-term Impacts of Multiple Dredging Events at Offshore Ridge and Shoal Features

By FY2006, several of the submerged shoal areas in Federal waters will have undergone repeated, multiple dredging events. In many cases, MMS will have conducted biological and physical studies prior to dredging those areas. Therefore, it would be invaluable to resample those areas and undertake additional wave modeling to evaluate what, if any, biological/physical effects the multiple dredging events have had. This would assist the MMS in regulating the future use of shoal areas along the East and Gulf of Mexico coasts and might indicate areas within the ridge and shoal system which should be off-limits to dredging.

3.2.7 Continued Analysis of the Relationship of Offshore Shoal Areas by Finfish and Other Mobile species

With the passing of the revised legislation such as the Magnuson-Stevens Act, agencies such as the Minerals Management Service are mandated to consider the effects of offshore activities such as dredging operations on fisheries. Areas on the OCS which are often selected as potential sand sites are in many cases known to have ample populations of finfish and other mobile species. The MMS awarded a contract in Spring 2002 to Versar, Inc. to examine how fisheries and other mobile species utilize the shoals offshore Maryland and Delaware. The objectives of the study are as follows:

Do shoals located on the mid-Atlantic seafloor:

1. serve as orientation features for finfish and mobile epi-benthos to orient to during migrations or other population movements.
2. serve as a staging ground for various species of finfish and mobile epi-benthos during migrations or other population movements.
3. provide needed physical habitat structure for a variety of marine species.
4. serve to maintain physical habitat diversity by contributing to maintenance of adjacent lows and seafloor flats.

A similar study is scheduled for initiation offshore the Texas/Louisiana coast; the United States Geological Survey's Biological Resources Division, in cooperation with MMS, will be examining fish habitats and habitat use on Heald and Sabine Banks, both of which represent potential sand borrow areas for coastal zones along the Texas/Louisiana border.

There is currently little information available relative to how dredging activities may impact the use of shoals by finfish and other mobile species. Information will be required that builds upon the results of the Versar and USGS finfish studies to examine any potential data gaps and to procure a more refined understanding of how offshore shoals are utilized by fisheries.